# 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 |

### Engine Control System/Fuel System Torque Specs

| Application | N.m | Lb Ft | Lb In |
|---|---|---|---|
| Crankshaft Position Sensor Mounting Bolt | 25 | 18 | — |
| EGR Control Pressure/BARO Sensor | 35 | — | 27 |
| Boost (BARO) Sensor Mounting Bolts | 3.5 | — | 27 |
| Fuel Manager/Filter to Intake Manifold Bolts | 25 | 18 | — |
| Water in Fuel Sensor Mounting Screws | 2 | — | 24 |
| Injection Lines to nozzle Fittings | 25 | 18 | — |
| Fuel Feed Pipe and Suction Pipe to Fuel Pump | 30 | 22 | — |
| Injection Pump Flange Nuts | 40 | 30 | — |
| Driven Gear to Injection Pump Bolts | 25 | 18 | — |
| Injection Nozzle | 70 | 50 | — |

**GM SPO Group Numbers**

| Parts Name | Group |
|---|---|
| Engine Control Modlue | 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 Assemblyl | 3.402 |
| Air Cleaner Filter | 3.410 |
| Fuel Filter | 3.890 |
| Fuel Tank | 3.001 |

## 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.

## Scan Tool Data

### Engine Data List

| Engine at Operating Temp/Closed Throttle/Park or Neutral/All Acc. OFF | | |
|---|---|---|
| **Scan Position** | **Units Displayed** | **Typical Data Value** |
| Engine Speed | RPM | 650 RPM |
| Desired Speed | RPM | 652 RPM |
| ECT | °C/°F | 93°C (200°F) |
| Startup ECT | °C/°F | Varies |
| ECT Sensor | Volts | 2.00 Volts |
| IAT Sensor | Volts | 1.46 Volts |
| IAT Sensor | °C/°F | 43°C (109°F) |
| ESO Solenoid | on/off | on |
| Boost Solenoid | % | 60-70% |
| Boost Pressure | kPa | 60-103 kPa |
| Actual EGR | kPa | 75-85 kPa |
| Desired EGR | kPa | 75-85 kPa |
| EGR Solenoid | % | 35-45% |
| EGR Vent Solenoid | on/off | on |
| Fuel Temperature | °C/°F | 70°C (159°F) |
| Fuel Rate | millimeters cubed | 7-12 mm3 |
| Glow Plug | Volts | 0 Volts |
| Glow Plug System | disabled/enabled | Disabled |
| Des. Inj Timing | Degrees | 4-7 Degrees |
| Act. Inj. Timing | Degrees | 4-7 Degrees |
| APP Angle | % | 0% |
| APP 1 | Volts | 0.44–0.95 Volts |
| APP 2 | Volts | 4.0–4.5 Volts |
| APP 3 | Volts | 3.6–4.0 Volts |
| Inj. Pump Closure Time | milliseconds | 1.70-1.90 ms |
| TDC Offset | Degrees | +0.75 to -1.75 |
| Ignition Volts | Volts | 12-14 Volts |
| MPH/KPH | MPH/KPH | 0 MPH/KPH |
| Cruise Switch | on/off | off |
| Cruise Active | on/off | off |
| Cruise Brake Switch | open/closed | closed |
| Brake Switch | open/closed | open |
| Set Switch | on/off | off |
| Resume Switch | on/off | off |
| TR Switch | Park-Neutral,Reverse,Drive 1, Drive 2, Drive 3 | Park |
| Crank Ref Missed | Counts | 0 |
| Inj. Pump Cam Reference Missed | Counts | 0 |
| Lift Pump | Volts | 12-15 Volts |
| Lift Pump System | disabled/enabled | enable |
| Engine Load | % | 4-6% |
| Engine Torque | ft lb | 7-10Ft lb |
| # of Curr. DTCs | Counts | 0 |

## Engine Data List (cont'd)

| Engine at Operating Temp/Closed Throttle/Park or Neutral/All Acc. OFF | | |
|---|---|---|
| **Scan Position** | **Units Displayed** | **Typical Data Value** |
| DTC Set This Ign. | Counts | 0 |
| TFT Sensor | Volts | 2.5-3.5 Volts |
| TFT | C°/F° | 70°C (158°F) |
| Calc. A/C Load | ft lb | 0Ft lb |
| A/C Request | on/off | off |
| A/C Compressor | engaged/disengaged | disengaged |
| A/C Relay | yes/no | no |
| MIL Lamp | on/off | off |
| STS Lamp | on/off | off |
| 4WDL Mode | enabled/disabled | disabled |
| Front Axle Switch | unlocked/locked | unlocked |
| A/B/C Range Switch | on on on/off off off | off off off |
| 1-2 Sol 2-3 Sol | on/off | on off |
| TCC Enable | on/off | off |
| PC Solenoid | on/off | off |
| Device Control | yes/no | no |
| Engine Run Time | seconds | 0 |

## 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.

**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 engine idling. Engine speed value is very accurate.

**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.

**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.

**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.

**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.

**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.

**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.

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

**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.

**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.

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

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

**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.

**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.

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

**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.

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

**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 .35–.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.

**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.

**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.

**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).

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

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

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

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

**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.

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

**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.

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

**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.

**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 weather 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.

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

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

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

**DTC Set This Ign.–Range #:** Indicates the total number of current DT'Cs set this ignition cycle.

**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 vehicle is running.

**TFT Sensor–Range 0–5 volts:** This value represents the input signal of the transmission fluid temperature sensor in voltage. Refer to section 10.

**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 Section 10.

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

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

**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.

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

**STS Lamp–Range ON/OFF:** Represents the commanded state of the Service Throttle Soon lamp.

**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.

**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 Section 10.

**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 section 10.

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

**PC Solenoid–On/Off:** This value is the commanded state of the pressure control solenoid. Refer to section 10.

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

**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.

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

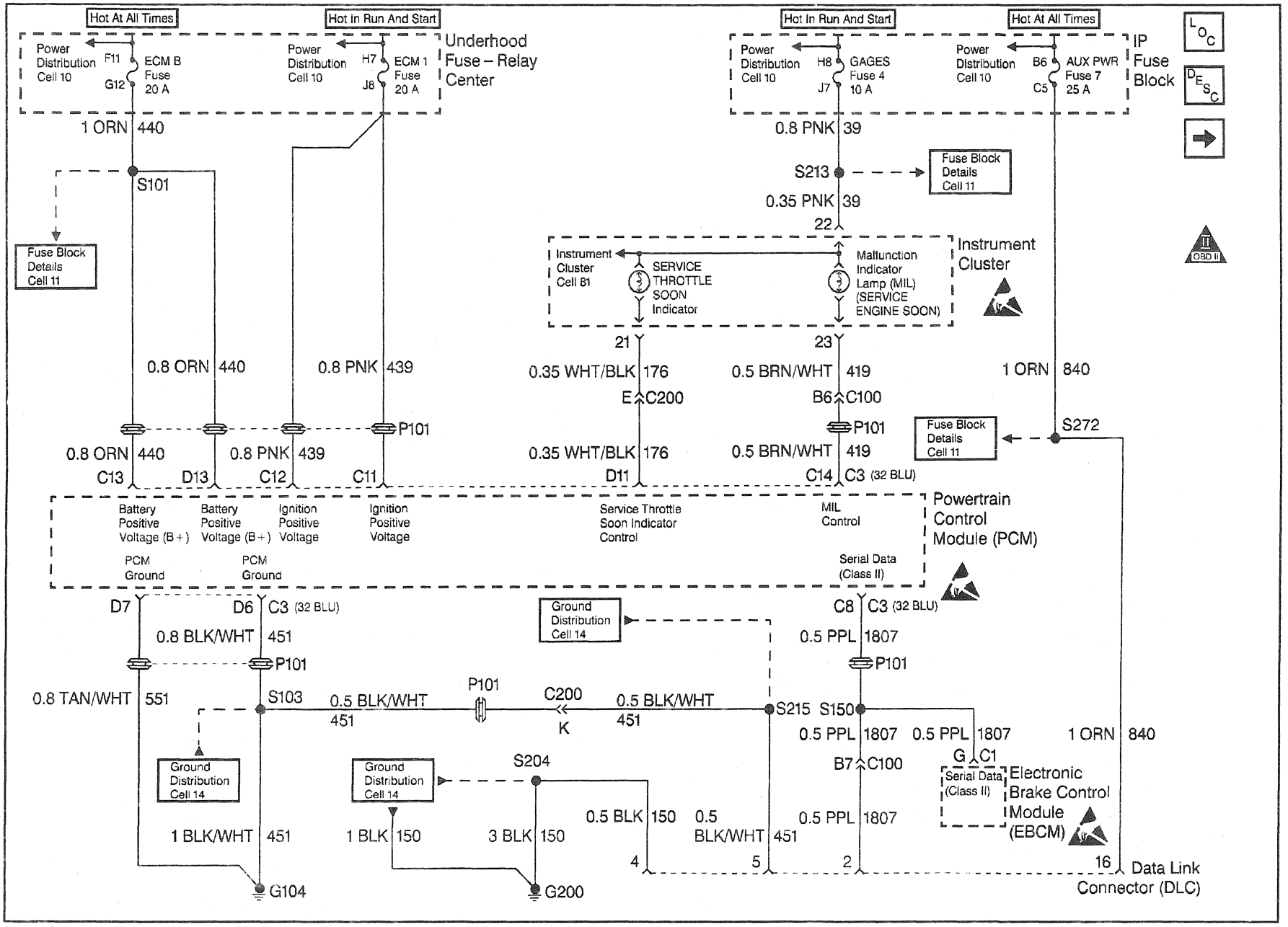
**First Odometer–Range miles (x16):** The amount of miles (in 16 mile increments) that the vehicle has traveled since the freeze frame or failure record has been stored.

**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).

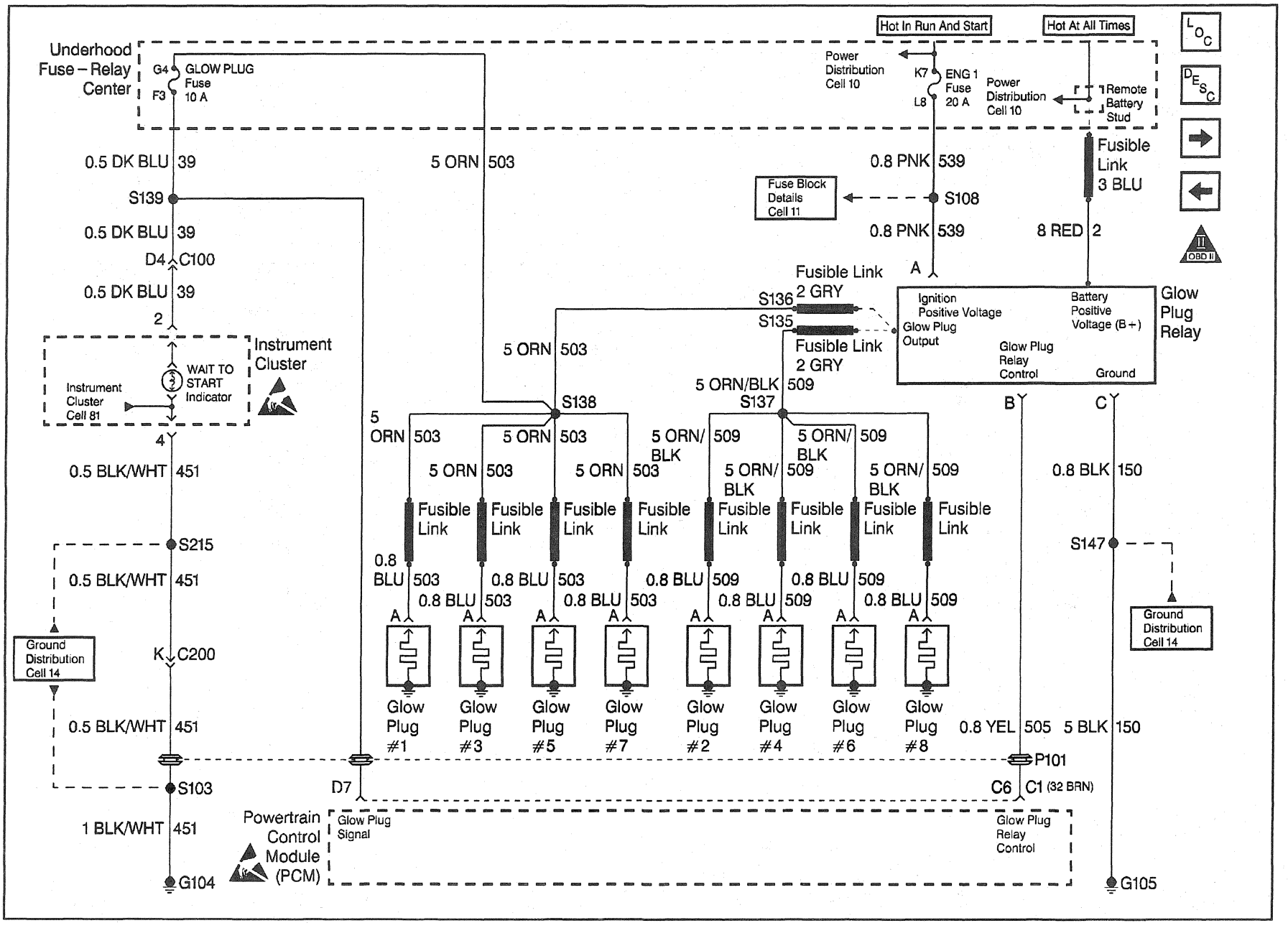
**Fail Counter–Range (decimal):** The number of ignition cycles that at test has ran and failed (at least once).

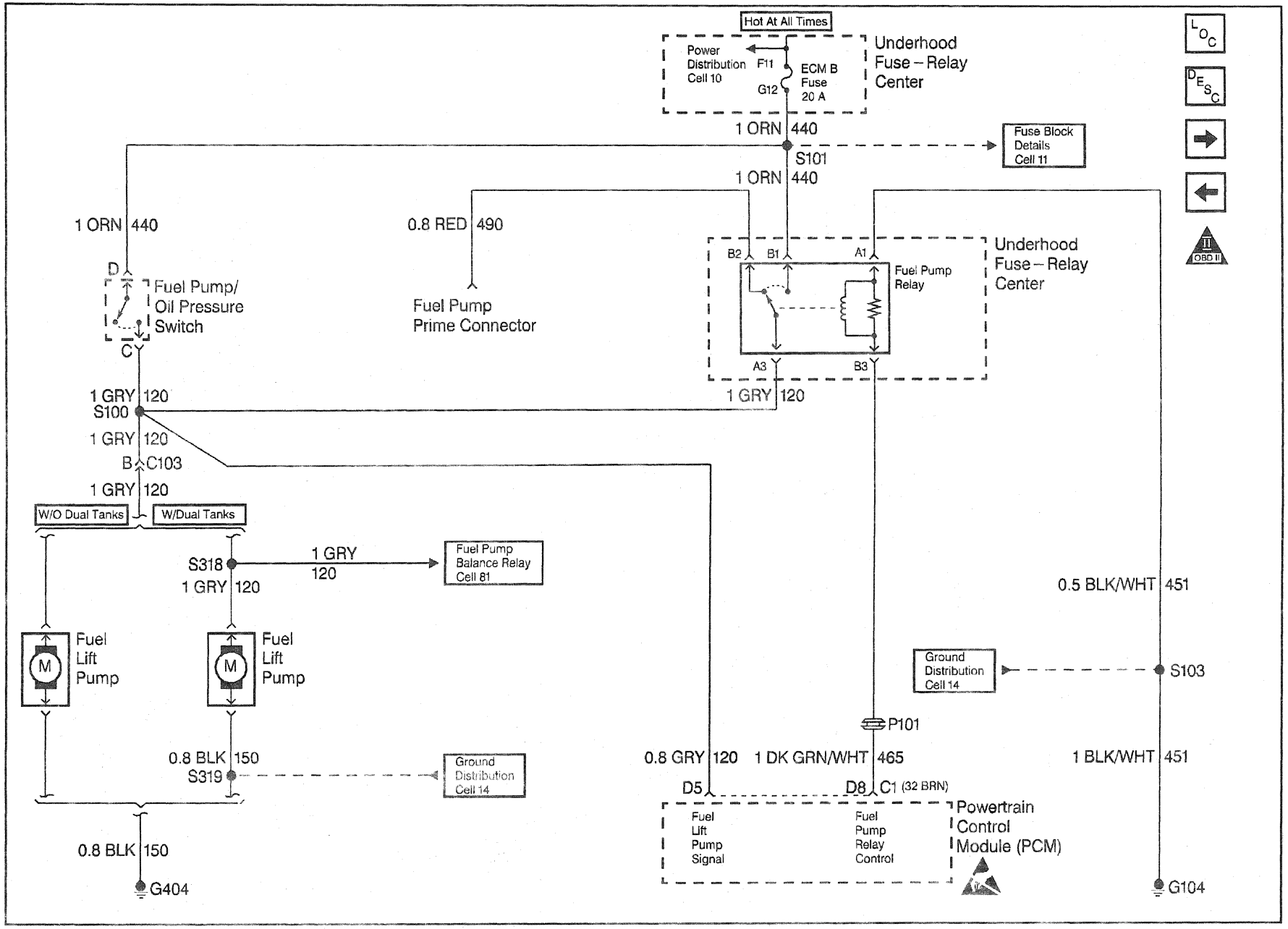
**Pass Counter–Range (decimal):** The number of ignition cycles that at test has ran and passed (at least once).

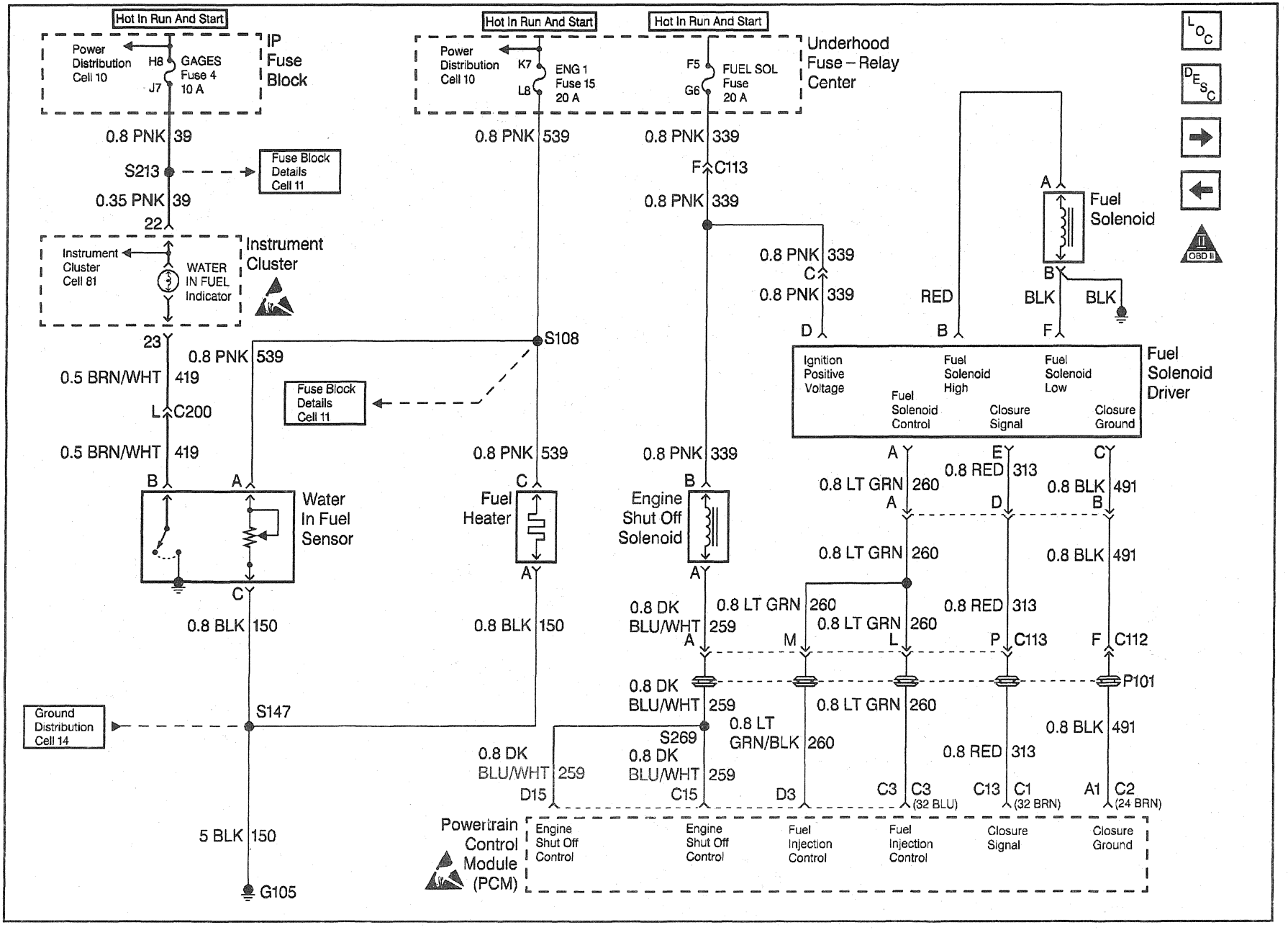
**No Results Counter:** The number of ignition cycles with out a result (pass or fail).


Hot At All Times
Hot In Run And Start
Underhood Fuse – Relay Center
Power Distribution Cell 10
F11
G12
ECM B Fuse 20 A
H7
J8
ECM 1 Fuse 20 A
1 ORN 440
S101
Fuse Block Details Cell 11
0.8 ORN 440
0.8 PNK 439
P101
C13
D13
C12
C11
Hot In Run And Start
Hot At All Times
IP Fuse Block
H8
J7
GAGES Fuse 4 10 A
B6
C5
AUX PWR Fuse 7 25 A
0.8 PNK 39
S213
0.35 PNK 39
22
Instrument Cluster Cell 81
SERVICE THROTTLE SOON Indicator
Malfunction Indicator Lamp (MIL) (SERVICE ENGINE SOON)
Instrument Cluster
21
23
0.35 WHT/BLK 176
0.5 BRN/WHT 419
1 ORN 840
E C200
B6 C100
P101
S272
D11
C14
C3 (32 BLU)
Battery Positive Voltage (B+)
Battery Positive Voltage (B+)
Ignition Positive Voltage
Ignition Positive Voltage
Service Throttle Soon Indicator Control
MIL Control
PCM Ground
PCM Ground
Serial Data (Class II)
Powertrain Control Module (PCM)
D7
D6
C3 (32 BLU)
0.8 BLK/WHT 451
0.8 TAN/WHT 551
S103
0.5 BLK/WHT 451
P101
C200
K
0.5 BLK/WHT 451
Ground Distribution Cell 14
C8
0.5 PPL 1807
S215
S150
0.5 PPL 1807
0.5 PPL 1807
1 ORN 840
G C1
B7 C100
Serial Data (Class II)
Electronic Brake Control Module (EBCM)
S204
1 BLK/WHT 451
1 BLK 150
3 BLK 150
0.5 BLK 150
0.5 BLK/WHT 451
0.5 PPL 1807
4
5
2
16
Data Link Connector (DLC)
G104
G200

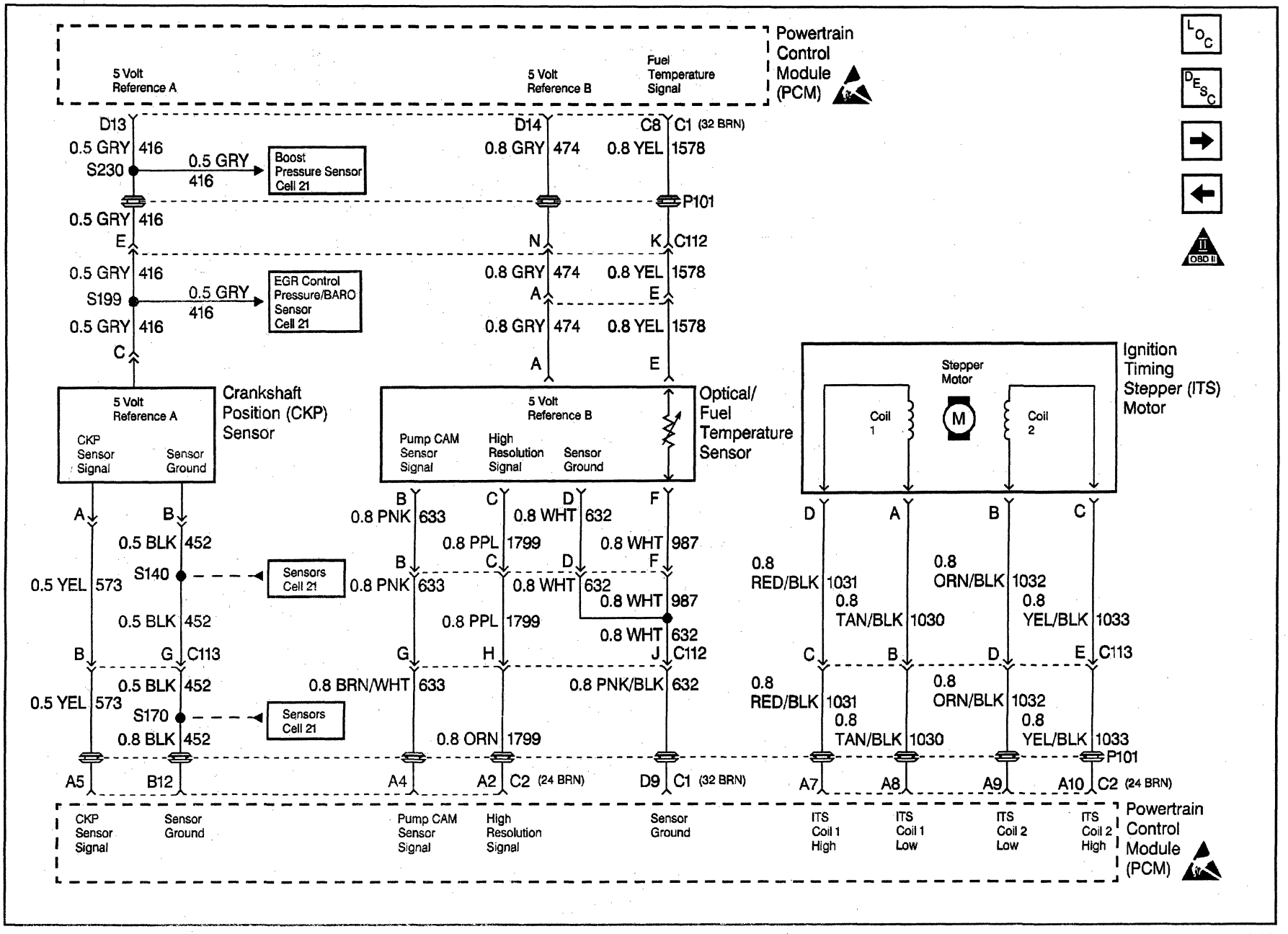
30912

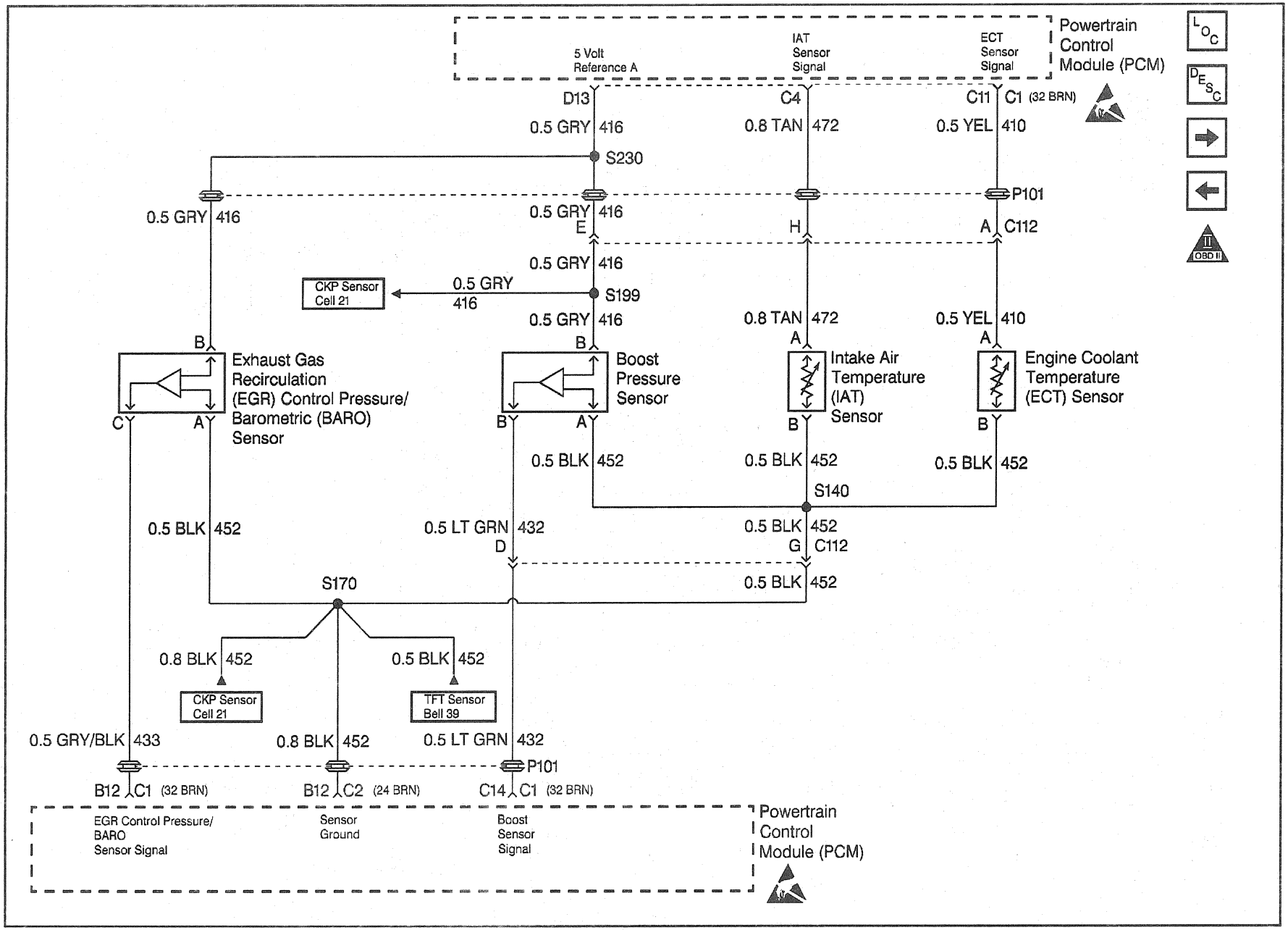

Hot In Run And Start
Hot At All Times
Underhood Fuse – Relay Center
G4
F3
GLOW PLUG Fuse 10 A
Power Distribution Cell 10
K7
L8
ENG 1 Fuse 20 A
Power Distribution Cell 10
Remote Battery Stud
0.5 DK BLU 39
5 ORN 503
0.8 PNK 539
Fusible Link 3 BLU
Fuse Block Details Cell 11
S139
S108
0.5 DK BLU 39
0.8 PNK 539
8 RED 2
D4
C100
0.5 DK BLU 39
A
Fusible Link 2 GRY
S136
S135
Ignition Positive Voltage
Glow Plug Output
Battery Positive Voltage (B+)
Glow Plug Relay Control
Ground
Glow Plug Relay
2
Instrument Cluster
WAIT TO START Indicator
Instrument Cluster Cell 81
5 ORN 503
Fusible Link 2 GRY
5 ORN/BLK 509
S138
S137
B
C
4
0.5 BLK/WHT 451
5 ORN 503
5 ORN/BLK 509
0.8 BLK 150
Fusible Link
S215
S147
0.5 BLK/WHT 451
0.8 BLU 503
0.8 BLU 509
Ground Distribution Cell 14
Ground Distribution Cell 14
K
C200
0.5 BLK/WHT 451
Glow Plug #1
Glow Plug #3
Glow Plug #5
Glow Plug #7
Glow Plug #2
Glow Plug #4
Glow Plug #6
Glow Plug #8
0.8 YEL 505
5 BLK 150
P101
S103
D7
C6
C1 (32 BRN)
1 BLK/WHT 451
Powertrain Control Module (PCM)
Glow Plug Signal
Glow Plug Relay Control
G104
G105
30918

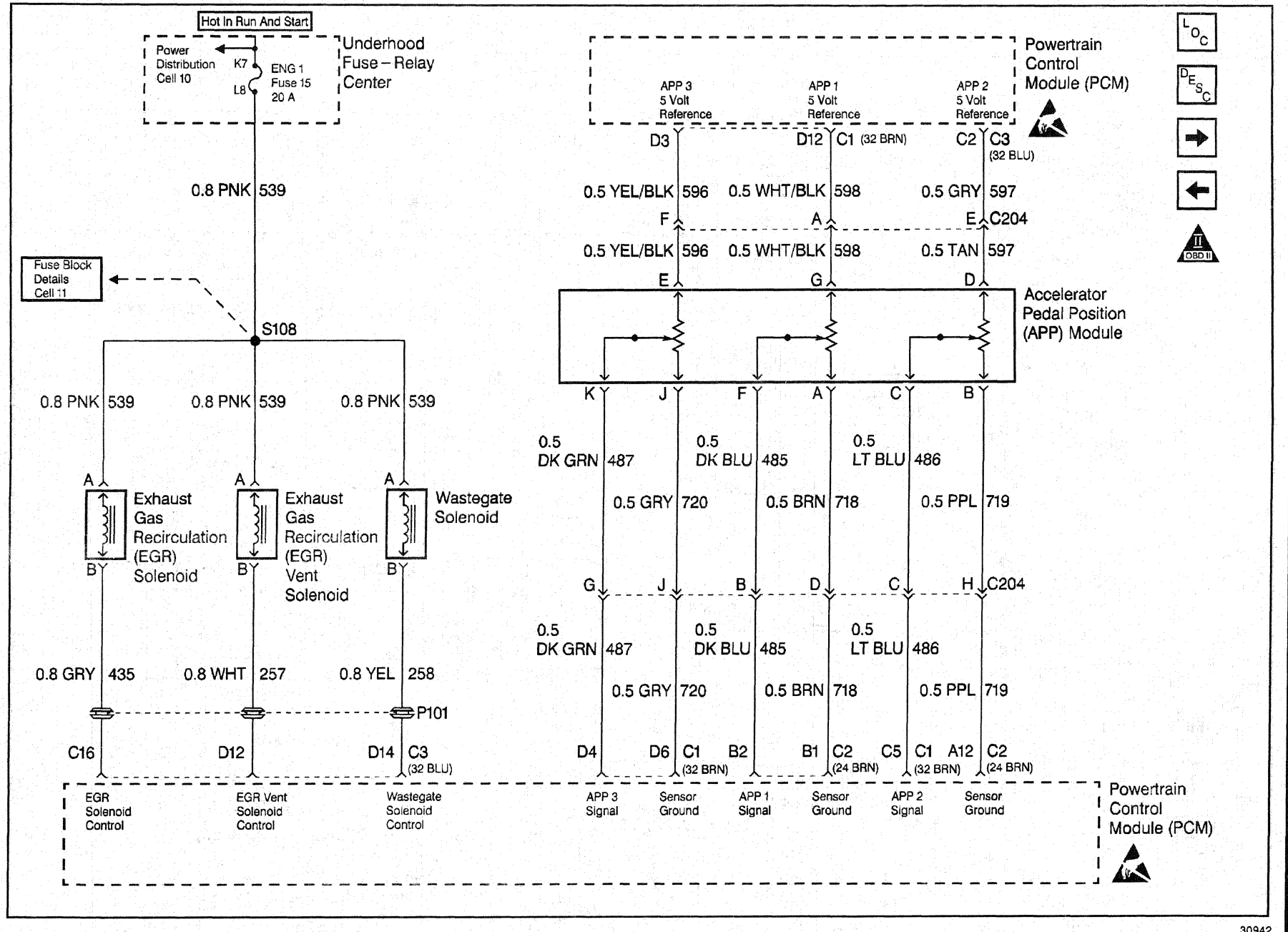

Hot At All Times
Power Distribution Cell 10
F11
G12
ECM B Fuse 20 A
Underhood Fuse – Relay Center
1 ORN 440
S101
Fuse Block Details Cell 11
1 ORN 440
1 ORN 440
0.8 RED 490
D
Fuel Pump/ Oil Pressure Switch
C
Fuel Pump Prime Connector
B2
B1
A1
Fuel Pump Relay
Underhood Fuse – Relay Center
A3
B3
1 GRY 120
1 GRY 120
S100
1 GRY 120
B C103
1 GRY 120
W/O Dual Tanks
W/Dual Tanks
S318
1 GRY 120
1 GRY 120
Fuel Pump Balance Relay Cell 81
0.5 BLK/WHT 451
Fuel Lift Pump
Fuel Lift Pump
Ground Distribution Cell 14
S103
P101
0.8 BLK 150
S319
Ground Distribution Cell 14
0.8 GRY 120
1 DK GRN/WHT 465
1 BLK/WHT 451
D5
D8
C1 (32 BRN)
Fuel Lift Pump Signal
Fuel Pump Relay Control
Powertrain Control Module (PCM)
0.8 BLK 150
G404
G104
OBD II
30922

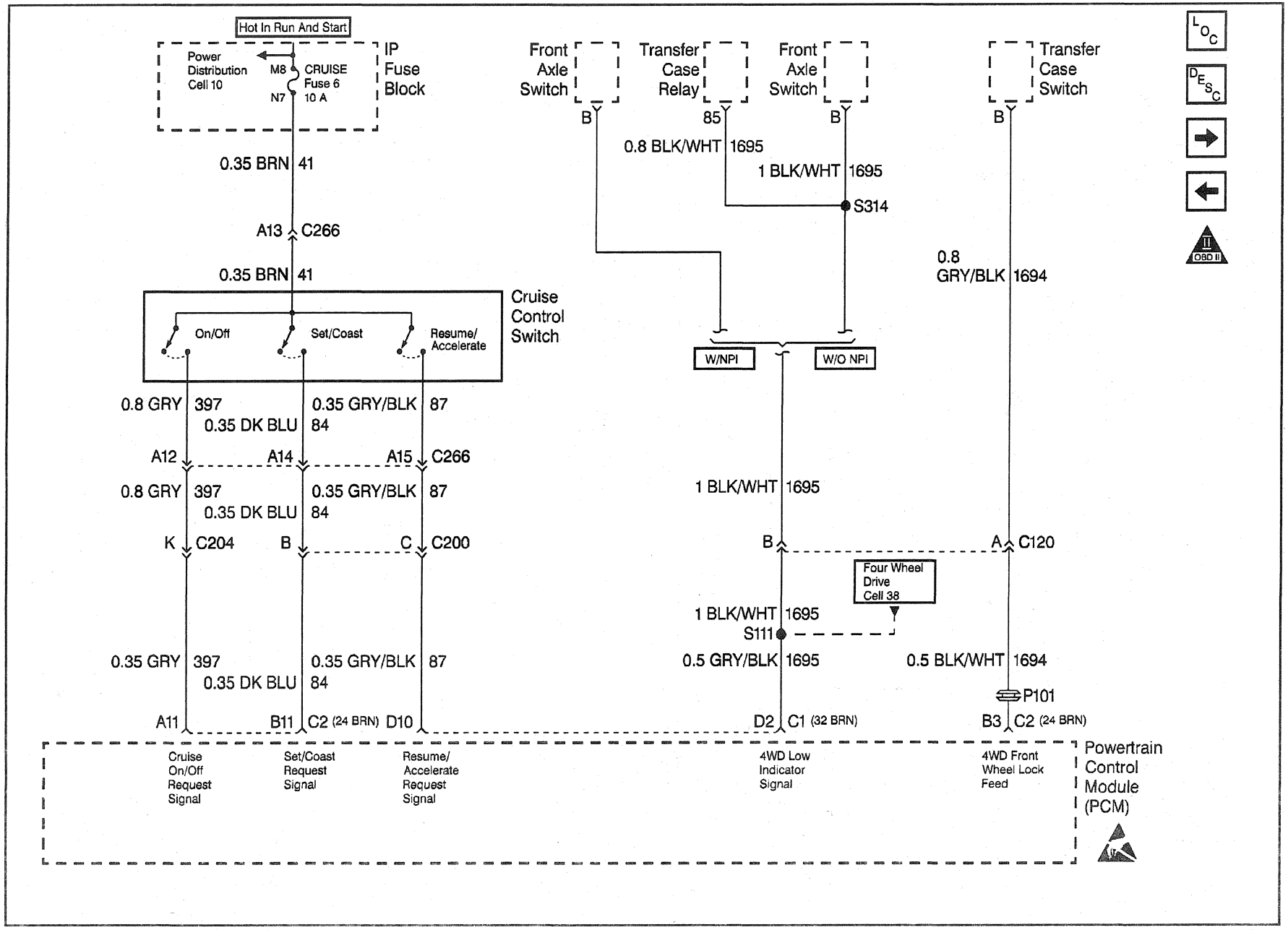

Hot In Run And Start
Power Distribution Cell 10
H8
J7
GAGES Fuse 4 10 A
IP Fuse Block
0.8 PNK 39
S213
Fuse Block Details Cell 11
0.35 PNK 39
22
Instrument Cluster Cell 81
WATER IN FUEL Indicator
Instrument Cluster
23
0.5 BRN/WHT 419
L C200
0.5 BRN/WHT 419
B
A
Water In Fuel Sensor
C
0.8 BLK 150
Ground Distribution Cell 14
S147
5 BLK 150
G105
Hot In Run And Start
Power Distribution Cell 10
K7
L8
ENG 1 Fuse 15 20 A
0.8 PNK 539
S108
Fuse Block Details Cell 11
0.8 PNK 539
C
Fuel Heater
A
0.8 BLK 150
Hot In Run And Start
F5
G6
FUEL SOL Fuse 20 A
Underhood Fuse – Relay Center
0.8 PNK 339
F C113
0.8 PNK 339
0.8 PNK 339
C
0.8 PNK 339
D
B
Engine Shut Off Solenoid
A
0.8 DK BLU/WHT 259
A
S269
0.8 DK BLU/WHT 259
D15
0.8 DK BLU/WHT 259
C15
0.8 LT GRN/BLK 260
D3
A
Fuel Solenoid
B
RED
BLK
BLK
F
Ignition Positive Voltage
Fuel Solenoid Control
Fuel Solenoid High
Closure Signal
Fuel Solenoid Low
Closure Ground
Fuel Solenoid Driver
A
0.8 LT GRN 260
A
0.8 LT GRN 260
0.8 LT GRN 260
M
0.8 LT GRN 260
L
0.8 LT GRN 260
E
0.8 RED 313
D
0.8 RED 313
0.8 RED 313
P C113
C
0.8 BLK 491
B
0.8 BLK 491
0.8 BLK 491
F C112
P101
0.8 BLK 491
0.8 RED 313
C3
C3 (32 BLU)
C13
C1 (32 BRN)
A1
C2 (24 BRN)
Powertrain Control Module (PCM)
Engine Shut Off Control
Engine Shut Off Control
Fuel Injection Control
Fuel Injection Control
Closure Signal
Closure Ground
LOC
DESC
OBD II

30923

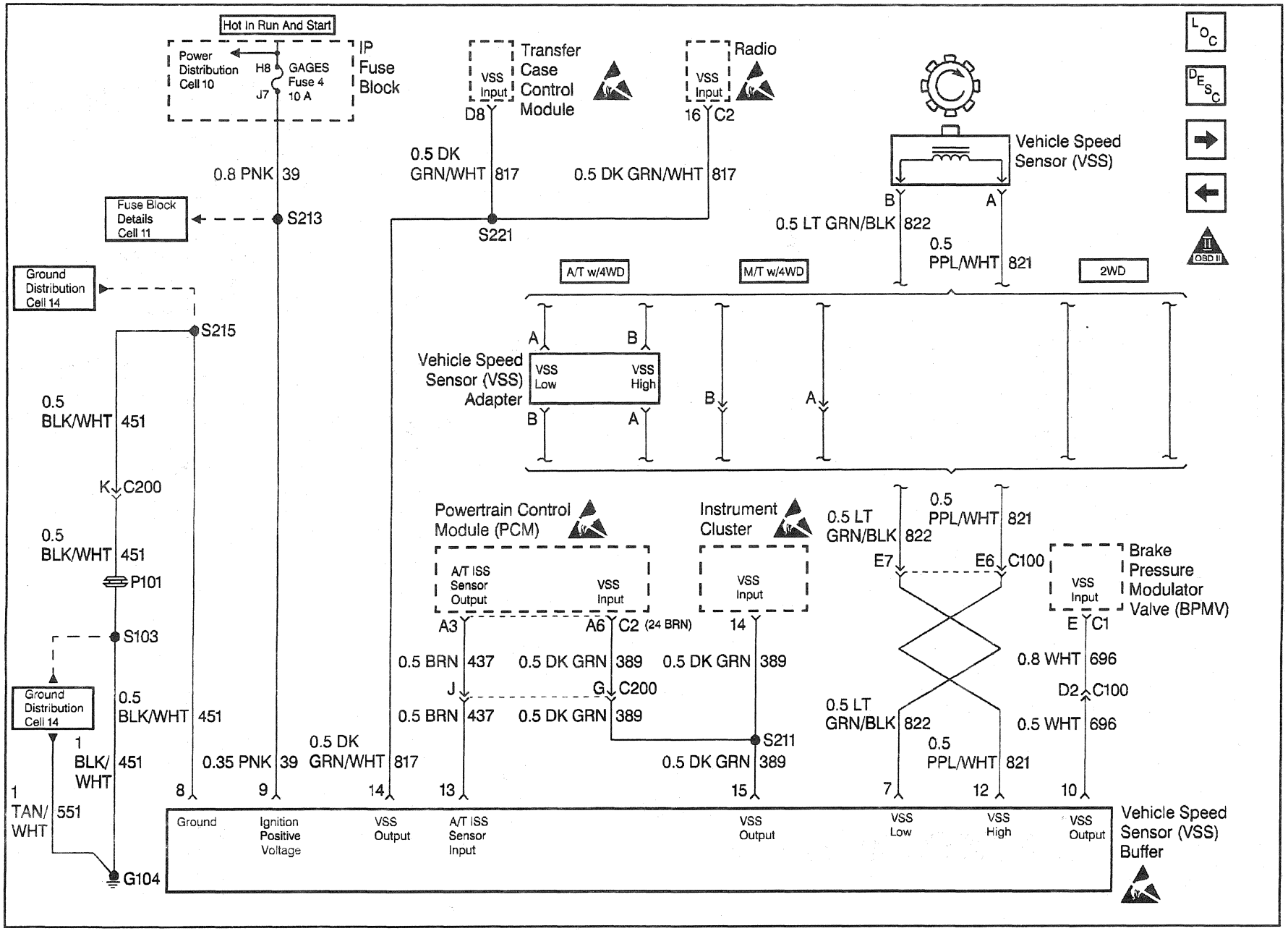

Powertrain Control Module (PCM)
5 Volt Reference A
5 Volt Reference B
Fuel Temperature Signal
D13
0.5 GRY 416
S230
0.5 GRY 416
Boost Pressure Sensor Cell 21
D14
0.8 GRY 474
C8
0.8 YEL 1578
C1 (32 BRN)
P101
E
N
K C112
S199
EGR Control Pressure/BARO Sensor Cell 21
A
E
C
Crankshaft Position (CKP) Sensor
CKP Sensor Signal
Sensor Ground
Optical/ Fuel Temperature Sensor
Pump CAM Sensor Signal
High Resolution Signal
Sensor Ground
Ignition Timing Stepper (ITS) Motor
Stepper Motor
Coil 1
Coil 2
M
0.5 BLK 452
S140
Sensors Cell 21
0.5 YEL 573
S170
0.8 PNK 633
0.8 WHT 632
0.8 PPL 1799
0.8 WHT 987
0.8 WHT 632
0.8 BRN/WHT 633
0.8 PNK/BLK 632
0.8 ORN 1799
0.8 RED/BLK 1031
0.8 TAN/BLK 1030
0.8 ORN/BLK 1032
0.8 YEL/BLK 1033
A5
B12
A4
A2
C2 (24 BRN)
D9
C1 (32 BRN)
A7
A8
A9
A10
C2 (24 BRN)
CKP Sensor Signal
Sensor Ground
Pump CAM Sensor Signal
High Resolution Signal
Sensor Ground
ITS Coil 1 High
ITS Coil 1 Low
ITS Coil 2 Low
ITS Coil 2 High
Powertrain Control Module (PCM)
30925


Powertrain Control Module (PCM)
5 Volt Reference A
IAT Sensor Signal
ECT Sensor Signal
D13
C4
C11
C1 (32 BRN)
0.5 GRY 416
0.8 TAN 472
0.5 YEL 410
S230
P101
E
H
A
C112
CKP Sensor Cell 21
S199
B
A
Exhaust Gas Recirculation (EGR) Control Pressure/ Barometric (BARO) Sensor
Boost Pressure Sensor
Intake Air Temperature (IAT) Sensor
Engine Coolant Temperature (ECT) Sensor
C
0.5 BLK 452
S140
0.5 LT GRN 432
D
G
S170
0.8 BLK 452
0.5 BLK 452
CKP Sensor Cell 21
TFT Sensor Bell 39
0.5 GRY/BLK 433
0.8 BLK 452
0.5 LT GRN 432
B12
C1 (32 BRN)
C2 (24 BRN)
C14
EGR Control Pressure/ BARO Sensor Signal
Sensor Ground
Boost Sensor Signal
Powertrain Control Module (PCM)
OBD II
30933

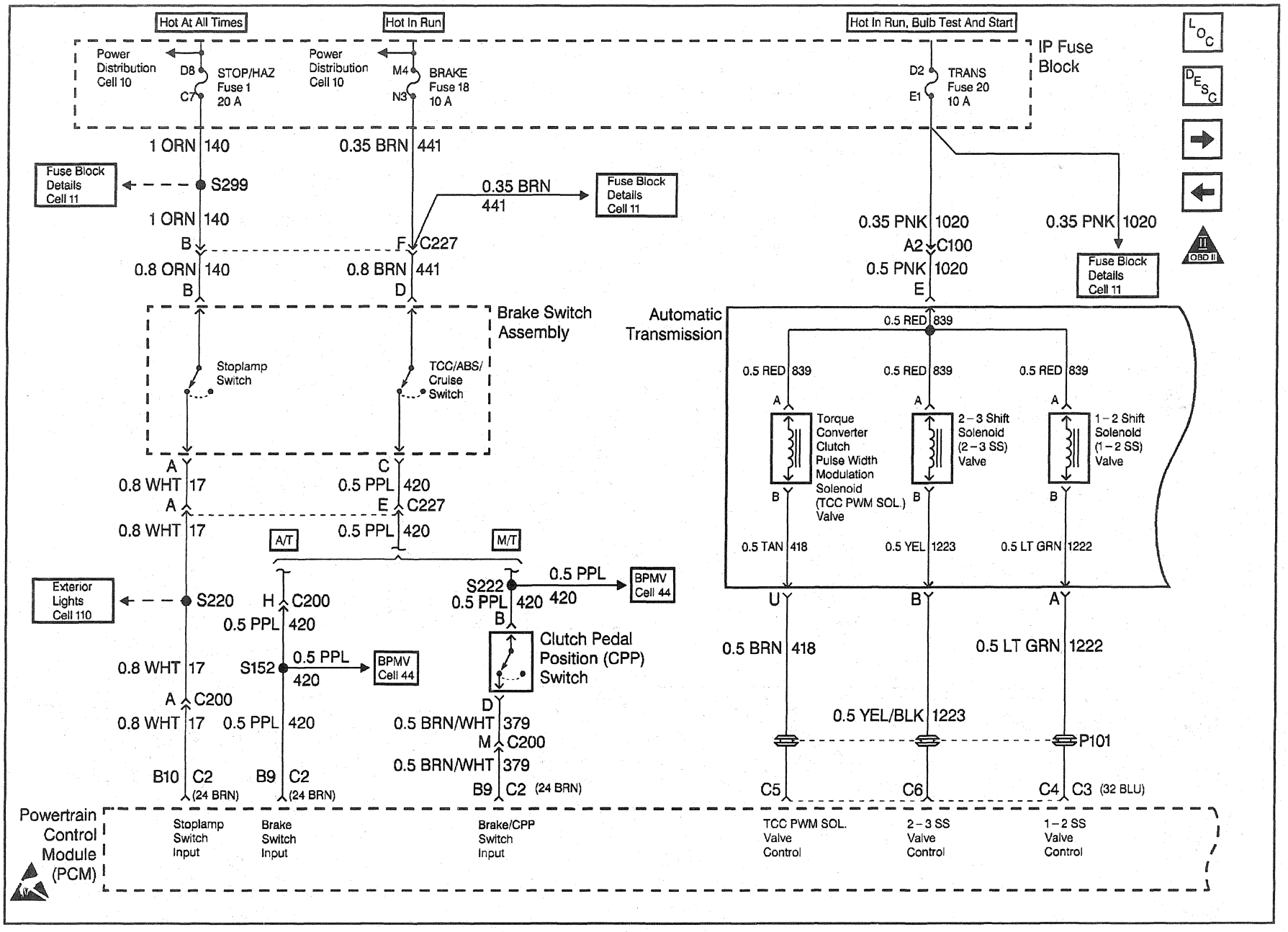

Hot In Run And Start
Power Distribution Cell 10
K7
L8
ENG 1 Fuse 15 20 A
Underhood Fuse – Relay Center
0.8 PNK 539
Fuse Block Details Cell 11
S108
0.8 PNK 539
0.8 PNK 539
0.8 PNK 539
A
B
Exhaust Gas Recirculation (EGR) Solenoid
Exhaust Gas Recirculation (EGR) Vent Solenoid
Wastegate Solenoid
0.8 GRY 435
0.8 WHT 257
0.8 YEL 258
P101
C16
D12
D14 C3 (32 BLU)
EGR Solenoid Control
EGR Vent Solenoid Control
Wastegate Solenoid Control
Powertrain Control Module (PCM)
APP 3 5 Volt Reference
APP 1 5 Volt Reference
APP 2 5 Volt Reference
D3
D12 C1 (32 BRN)
C2 C3 (32 BLU)
0.5 YEL/BLK 596
0.5 WHT/BLK 598
0.5 GRY 597
F
A
E C204
0.5 YEL/BLK 596
0.5 WHT/BLK 598
0.5 TAN 597
E
G
D
Accelerator Pedal Position (APP) Module
K
J
F
A
C
B
0.5 DK GRN 487
0.5 DK BLU 485
0.5 LT BLU 486
0.5 GRY 720
0.5 BRN 718
0.5 PPL 719
G
J
B
D
C
H C204
0.5 DK GRN 487
0.5 DK BLU 485
0.5 LT BLU 486
0.5 GRY 720
0.5 BRN 718
0.5 PPL 719
D4
D6 C1 (32 BRN)
B2
B1 C2 (24 BRN)
C5
C1 (32 BRN)
A12 C2 (24 BRN)
APP 3 Signal
Sensor Ground
APP 1 Signal
Sensor Ground
APP 2 Signal
Sensor Ground
Powertrain Control Module (PCM)
LOC
DESC
OBD II
30942

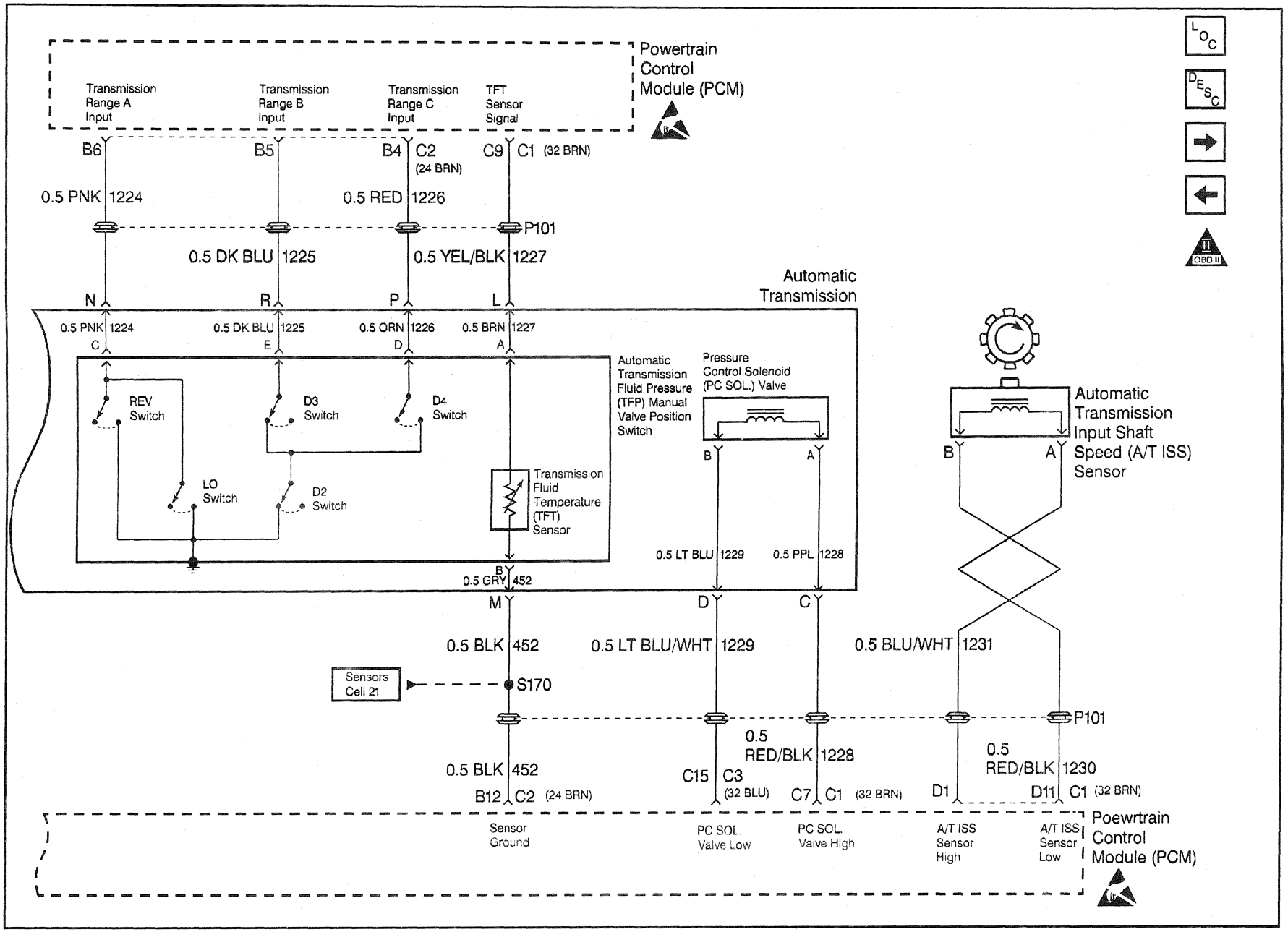

Hot In Run And Start
Power Distribution Cell 10
M8
N7
CRUISE Fuse 6 10 A
IP Fuse Block
0.35 BRN 41
A13 C266
0.35 BRN 41
Cruise Control Switch
On/Off
Set/Coast
Resume/ Accelerate
0.8 GRY 397
0.35 DK BLU 84
0.35 GRY/BLK 87
A12 A14 A15 C266
0.8 GRY 397
0.35 DK BLU 84
0.35 GRY/BLK 87
K C204 B C C200
0.35 GRY 397
0.35 DK BLU 84
0.35 GRY/BLK 87
A11 B11 C2 (24 BRN) D10
Front Axle Switch
Transfer Case Relay
Front Axle Switch
Transfer Case Switch
B
85
B
B
0.8 BLK/WHT 1695
1 BLK/WHT 1695
S314
0.8 GRY/BLK 1694
W/NPI
W/O NPI
1 BLK/WHT 1695
B A C120
Four Wheel Drive Cell 38
1 BLK/WHT 1695
S111
0.5 GRY/BLK 1695
0.5 BLK/WHT 1694
P101
D2 C1 (32 BRN)
B3 C2 (24 BRN)
Cruise On/Off Request Signal
Set/Coast Request Signal
Resume/ Accelerate Request Signal
4WD Low Indicator Signal
4WD Front Wheel Lock Feed
Powertrain Control Module (PCM)
LOC
DESC
OBD II

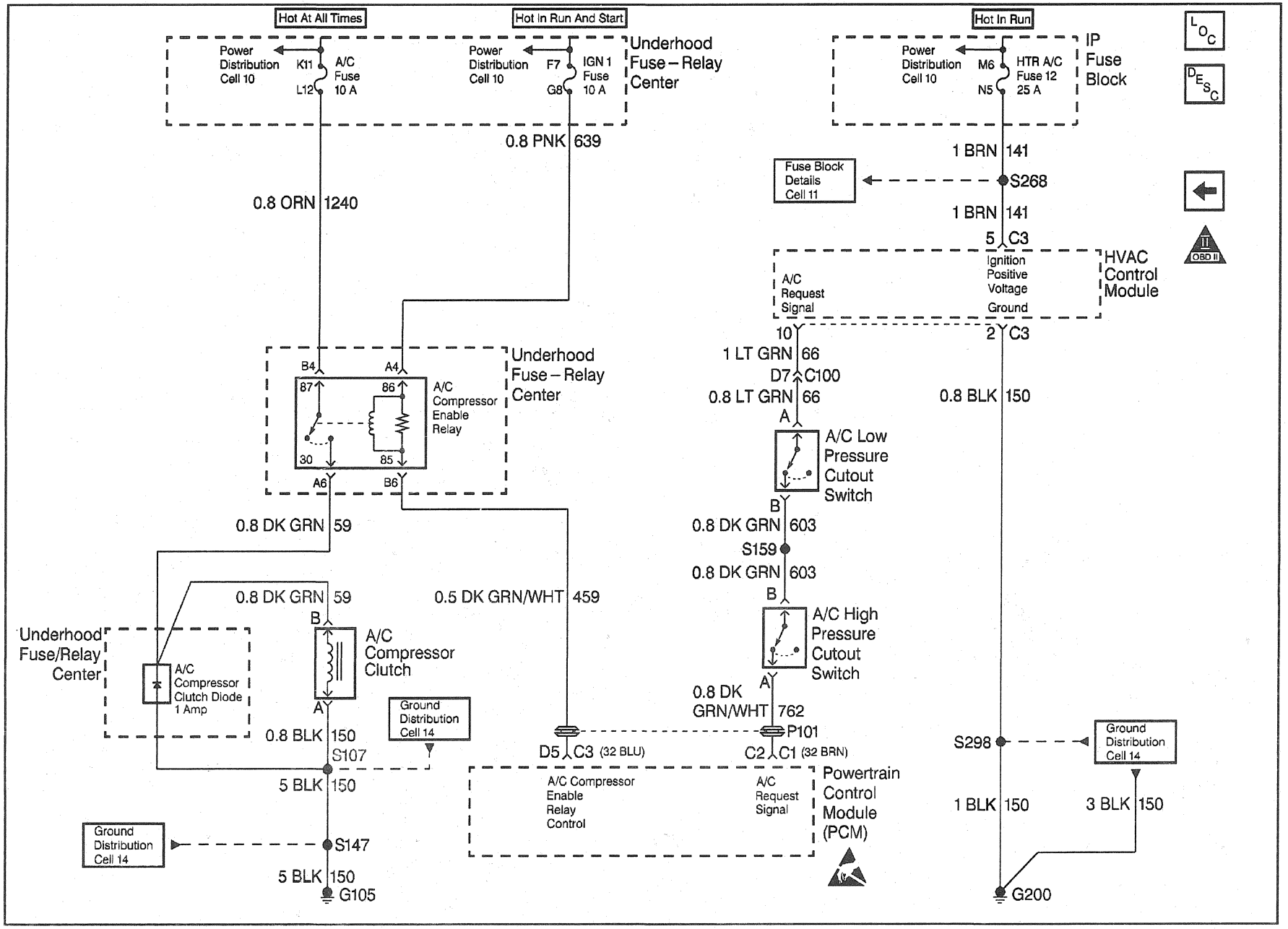
30946


Hot In Run And Start
Power Distribution Cell 10
H8
J7
GAGES Fuse 4 10 A
IP Fuse Block
0.8 PNK 39
Fuse Block Details Cell 11
S213
Ground Distribution Cell 14
S215
0.5 BLK/WHT 451
K C200
0.5 BLK/WHT 451
P101
S103
Ground Distribution Cell 14
0.5 BLK/WHT 451
1 BLK/WHT 451
1 TAN/WHT 551
G104
VSS Input
D8
Transfer Case Control Module
0.5 DK GRN/WHT 817
S221
VSS Input
16 C2
Radio
0.5 DK GRN/WHT 817
Vehicle Speed Sensor (VSS)
B
A
0.5 LT GRN/BLK 822
0.5 PPL/WHT 821
A/T w/4WD
M/T w/4WD
2WD
OBD II
Vehicle Speed Sensor (VSS) Adapter
VSS Low
VSS High
Powertrain Control Module (PCM)
A/T ISS Sensor Output
VSS Input
A3
A6 C2 (24 BRN)
0.5 BRN 437
0.5 DK GRN 389
J
G C200
0.5 BRN 437
0.5 DK GRN 389
Instrument Cluster
VSS Input
14
0.5 DK GRN 389
S211
0.5 DK GRN 389
0.5 LT GRN/BLK 822
0.5 PPL/WHT 821
E7
E6 C100
VSS Input
E C1
Brake Pressure Modulator Valve (BPMV)
0.8 WHT 696
D2 C100
0.5 WHT 696
0.5 LT GRN/BLK 822
0.5 PPL/WHT 821
8
9
14
13
15
7
12
10
Ground
Ignition Positive Voltage
VSS Output
A/T ISS Sensor Input
VSS Output
VSS Low
VSS High
VSS Output
Vehicle Speed Sensor (VSS) Buffer

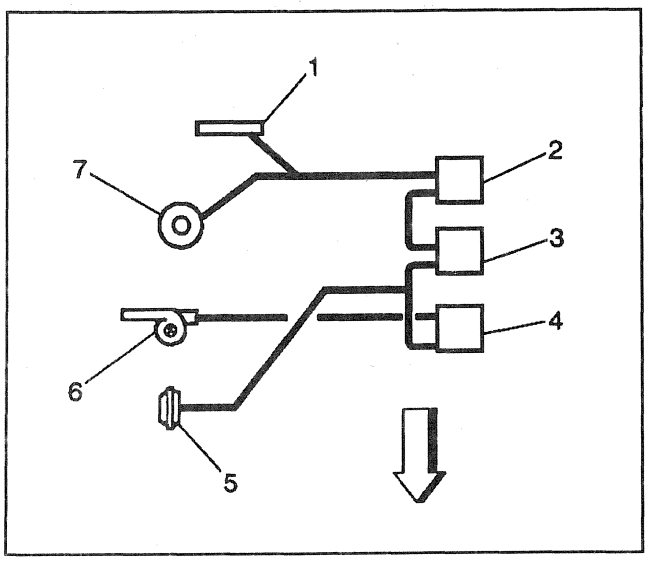
30953


Hot At All Times
Hot In Run
Hot In Run, Bulb Test And Start
IP Fuse Block
Power Distribution Cell 10
D8
C7
STOP/HAZ Fuse 1 20 A
Power Distribution Cell 10
M4
N3
BRAKE Fuse 18 10 A
D2
E1
TRANS Fuse 20 10 A
1 ORN 140
0.35 BRN 441
Fuse Block Details Cell 11
S299
0.35 BRN 441
Fuse Block Details Cell 11
1 ORN 140
B
F C227
0.8 ORN 140
B
0.8 BRN 441
D
0.35 PNK 1020
A2 C100
0.5 PNK 1020
E
0.35 PNK 1020
Fuse Block Details Cell 11
Brake Switch Assembly
Stoplamp Switch
TCC/ABS/ Cruise Switch
Automatic Transmission
0.5 RED 839
0.5 RED 839
0.5 RED 839
0.5 RED 839
A
A
A
Torque Converter Clutch Pulse Width Modulation Solenoid (TCC PWM SOL.) Valve
2 – 3 Shift Solenoid (2 – 3 SS) Valve
1 – 2 Shift Solenoid (1 – 2 SS) Valve
B
B
B
A
0.8 WHT 17
C
0.5 PPL 420
A
E C227
0.8 WHT 17
0.5 PPL 420
0.5 TAN 418
0.5 YEL 1223
0.5 LT GRN 1222
A/T
M/T
Exterior Lights Cell 110
S220
H C200
0.5 PPL 420
S222
0.5 PPL 420
0.5 PPL 420
BPMV Cell 44
B
U
B
A
0.8 WHT 17
S152
0.5 PPL 420
BPMV Cell 44
Clutch Pedal Position (CPP) Switch
0.5 BRN 418
0.5 LT GRN 1222
A C200
0.8 WHT 17
0.5 PPL 420
D
0.5 BRN/WHT 379
M C200
0.5 BRN/WHT 379
0.5 YEL/BLK 1223
P101
B10 C2 (24 BRN)
B9 C2 (24 BRN)
B9 C2 (24 BRN)
C5
C6
C4 C3 (32 BLU)
Powertrain Control Module (PCM)
Stoplamp Switch Input
Brake Switch Input
Brake/CPP Switch Input
TCC PWM SOL. Valve Control
2 – 3 SS Valve Control
1 – 2 SS Valve Control
OBD II
30960


Powertrain Control Module (PCM)
Transmission Range A Input
Transmission Range B Input
Transmission Range C Input
TFT Sensor Signal
B6
B5
B4
C2 (24 BRN)
C9
C1 (32 BRN)
0.5 PNK 1224
0.5 RED 1226
P101
0.5 DK BLU 1225
0.5 YEL/BLK 1227
Automatic Transmission
N
R
P
L
0.5 PNK 1224
0.5 DK BLU 1225
0.5 ORN 1226
0.5 BRN 1227
C
E
D
A
REV Switch
D3 Switch
D4 Switch
LO Switch
D2 Switch
Transmission Fluid Temperature (TFT) Sensor
Automatic Transmission Fluid Pressure (TFP) Manual Valve Position Switch
Pressure Control Solenoid (PC SOL.) Valve
B
A
Automatic Transmission Input Shaft Speed (A/T ISS) Sensor
B
0.5 GRY 452
0.5 LT BLU 1229
0.5 PPL 1228
M
D
C
0.5 BLK 452
0.5 LT BLU/WHT 1229
0.5 BLU/WHT 1231
Sensors Cell 21
S170
P101
0.5 RED/BLK 1228
0.5 RED/BLK 1230
0.5 BLK 452
C15
C3 (32 BLU)
C7
C1 (32 BRN)
D1
D11
C1 (32 BRN)
B12
C2 (24 BRN)
Sensor Ground
PC SOL. Valve Low
PC SOL. Valve High
A/T ISS Sensor High
A/T ISS Sensor Low
Poewrtrain Control Module (PCM)
30963


Hot At All Times
Hot In Run And Start
Hot In Run
Power Distribution Cell 10
K11
A/C Fuse 10 A
L12
Power Distribution Cell 10
F7
IGN 1 Fuse 10 A
G8
Underhood Fuse – Relay Center
Power Distribution Cell 10
M6
HTR A/C Fuse 12 25 A
N5
IP Fuse Block
0.8 PNK 639
1 BRN 141
Fuse Block Details Cell 11
S268
1 BRN 141
5 C3
Ignition Positive Voltage
Ground
HVAC Control Module
A/C Request Signal
10
2 C3
0.8 ORN 1240
B4
A4
87
86
30
85
A/C Compressor Enable Relay
Underhood Fuse – Relay Center
1 LT GRN 66
D7 C100
0.8 LT GRN 66
A
0.8 BLK 150
A/C Low Pressure Cutout Switch
A6
B6
B
0.8 DK GRN 603
S159
0.8 DK GRN 603
B
0.8 DK GRN 59
0.5 DK GRN/WHT 459
A/C High Pressure Cutout Switch
A
0.8 DK GRN/WHT 762
Underhood Fuse/Relay Center
A/C Compressor Clutch Diode 1 Amp
B
A/C Compressor Clutch
A
Ground Distribution Cell 14
0.8 BLK 150
S107
P101
D5 C3 (32 BLU)
C2 C1 (32 BRN)
S298
Ground Distribution Cell 14
5 BLK 150
A/C Compressor Enable Relay Control
A/C Request Signal
Powertrain Control Module (PCM)
1 BLK 150
3 BLK 150
Ground Distribution Cell 14
S147
5 BLK 150
G105
G200
30969

## Emission Hose Routing Diagram




47227

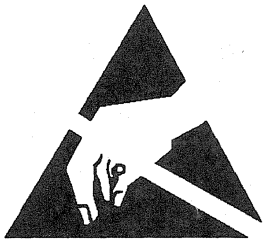
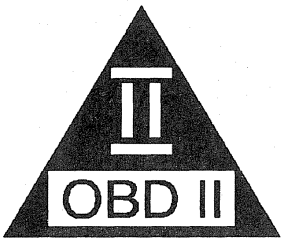
**Legend**

(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

## Engine Controls Schematic Reference

| Reference on Schematic | |
|---|---|
| Antilock Brakes - Cell 44 | |
| Automatic Transmission Controls - Cell 39 | |
| Cruise Control - Cell 34 | |
| Data Link Connector (DLC) - Cell 50 | |
| Fuse Block Details - Cell 11 | |
| Power Distribution - Cell 10 | |
| Ground Distribution - Cell 14 | |
| Sensors - Cell 25 | |
| Instrument Panel - Cell 81 | |

## Engine Controls Schematic Icon

| Icon | Icon Definition |
|---|---|
|  | Refer to Electrostatic Discharge (ESD) Sensitive Devices in Section 8A-3 Symbols |
|   | Refer to On-Board Diagnostics II (OBD II) Circuits in Section 8A-5 Repair Procedures |

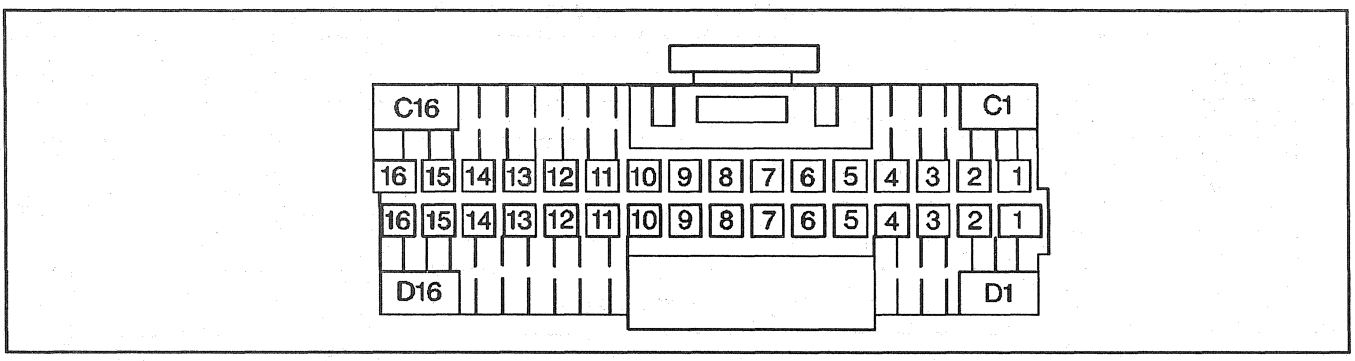
## Component Locator

### Engine Controls Component Location

| Name | Location | Locator View | Connector End View | Group No. |
|---|---|---|---|---|
| Balance Fuel Pump | On Inside LH Framrail near front of rear Tank | — | — | — |
| Balance Fuel Pump Relay | On Fuel Pump Balance Module | — | — | — |
| Connector, PCM C1, Brn | RH side of the engine compartment | 01-24, Fig. 38 | 202-101 | 3.670 |
| Connector, PCM C2, Brn | RH side of the engine compartment | 01-24, Fig. 38 | 202-102 | 3.670 |
| Connector, PCM C3, Blu | RH side of the engine compartment | 201-24, Fig. 38 | 202-103 | 3.670 |
| Crankshaft Position Sensor | LH lower, front engine cover | — | — | — |
| Electronic Accelerator Pedal Module | Includes Accelerator Pedal | — | — | — |
| Electronic Fuel Injection Pump | Top of engine | — | — | — |
| EGR Control Pressure/Baro Sensor | On bulkhead, RH of steering Column | — | — | — |
| Engine Coolant Temperature (ECT) Sensor | Top front of the engine on the thermostat crossover housing | — | — | — |
| Exhaust Gas Recirculation Pulse Width modulated Solenoid Valve | Left rear top of engine | 201-16, Fig. 22 | — | — |
| Exhaust Gas Recirculation Valve | Top of engine | 201-16, Fig. 22 | — | — |
| Fuel Pump Oil Pressure Switch and Sender | Under intake manifold center of engine | — | — | — |
| Fuel Pump Prime Connector | I/P Harness, aprox. 20 cm into Fuse-Relay Center Breakout | — | — | — |
| Fuel Pump Relay | In relay center | — | — | — |
| Glow Plug Relay | LH rear of engine | — | — | — |
| Intake Air Temperature Sensor | In air intake duct | — | — | — |
| Powertrain Control Module (PCM) | Under RH end of I/P, above blower motor | 201-24, Fig. 38 | 202-103 | 3.670 |
| Optical/Fuel Temperature Sensor | Inside fuel injection pump | — | — | — |
| Underhood Fuse-Relay Center | LH rear of engine Compartment, on fender | 201-4, Fig. 8 | — | — |
| Wastegate Solenoid | Left rear top of engine | 201-16, Fig. 22 | — | — |
| Refer to 8A-200 Master Component Section for connector, ground, pass through grommet, and splice location references. | | | | |

## Engine Controls Connector End Views

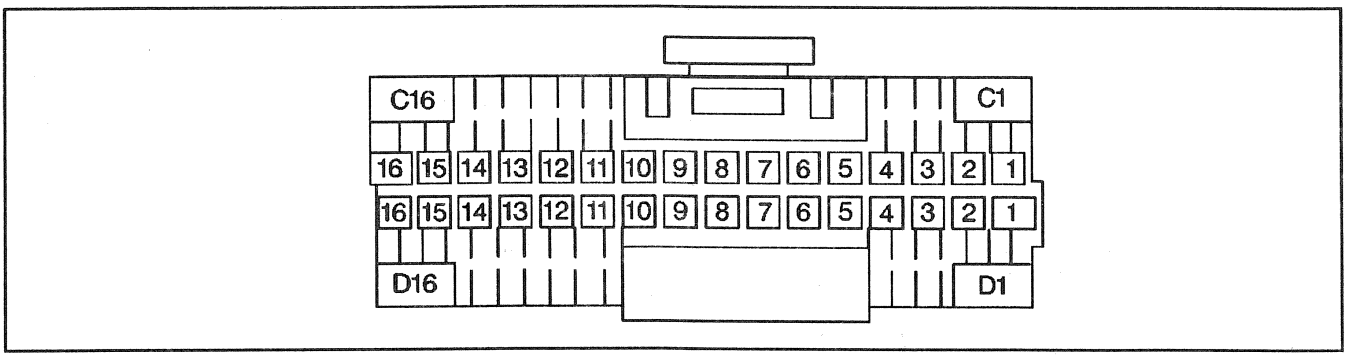
### PCM 32 Way Brown (C1) Connector




31454

| Connector Part Information | • 12110245<br>• PCM 32 Way Brown (C1) Connector | | | | | |
|---|---|---|---|---|---|---|
| **Pin** | **Wire Color** | **Circuit No.** | **Function** | **Component Connector Cavity** | **DTC(s) Affected** | **Possible Symptoms From a Faulty Circuit** |
| C1 | — | — | Not Used | — | — | — |
| C2 | DK GRN/WHT | 762 | A/C Request | A | — | No A/C |
| C3 | — | — | Not Used | — | — | — |
| C4 | TAN | 472 | IAT Signal | A | P0113 | — |
| C5 | LT BLU | 486 | APP (2) Signal | C | P0222 | — |
| C6 | YEL | 505 | Glow Plug Relay Ccontrol | B | P0380 | NO/Hard Start |
| C7 | RED/BLK | 1228 | Pressure Control Solenoid Valve (Hi) | C | — | — |
| C8 | YEL | 1578 | Fuel Temperature | E | P0183 | — |
| C9 | YEL/BLK | 1227 | TFT Temperature | L | — | — |
| C10 | — | — | Not Used | — | — | — |
| C11 | YEL | 410 | ECT Signal | A | P0118 | Long Crank Times and Poor Shift Quality |
| C12 | GRY/BLK | 433 | EGR Control Pressure/Baro Signal | B | P0406 | No EGR, Black Smoke On Hard Acceleration |
| C13 | RED | 313 | Closure Signal | E | P1217 | Poor Performance |
| C14 | LT GRN | 432 | Boost Sensor Signal | B | P0238 | Poor Performance |
| C15 | LT BLU/WHT | 1229 | Pressure Control Solenoid Valve (Lo) | D | — | — |
| C16 | — | — | Not Used | — | — | — |

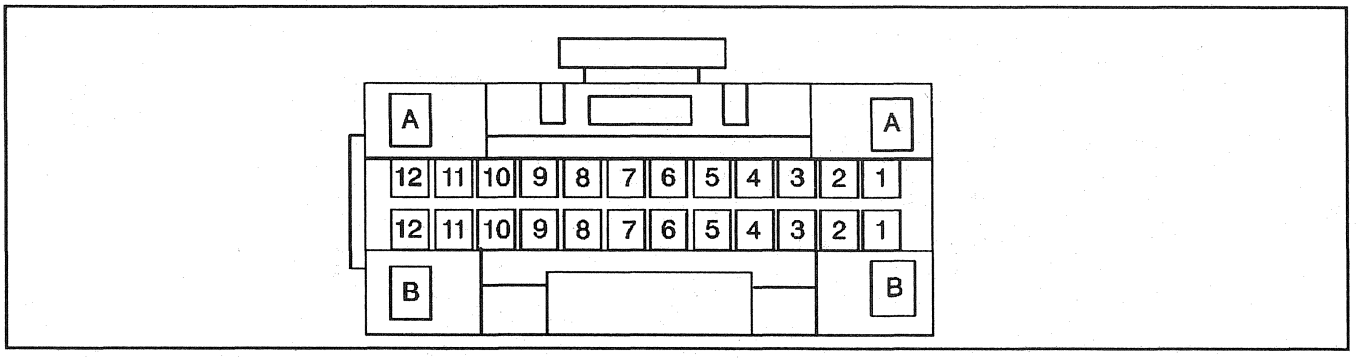
## PCM 32 Way Brown (C1) Connector




31454

| Connector Part Information | • 12110245<br>• PCM 32 Way Brown (C1) Connector | | | | | |
|---|---|---|---|---|---|---|
| **Pin** | **Wire Color** | **Circuit No.** | **Function** | **Component Connector Cavity** | **DTC(s) Affected** | **Possible Symptoms From a Faulty Circuit** |
| D1 | BLU/WHT | 1231 | Transmission Input Speed Signal | B | — | — |
| D2 | GRY/BLK | 1694 | 4WD Low Indicator Signal | B | — | — |
| D3 | YEL/BLK | 596 | APP (3) 5 Volt Ref. | E | P0228 | — |
| D4 | DK GRN | 487 | APP (3) Signal | K | P0227 | — |
| D5 | GRY | 120 | Fuel Lift Pump Signal | B | P0231 | Poor Performance during Heavy Acceleration or Pulling Heavy Loads |
| D6 | GRY | 720 | APP (3) Ground | J | P0228 | — |
| D7 | DK BLU | —<br>507 | Glow Plug Signal | 2 | P0380 | — |
| D8 | GRN/WHT | 465 | Fuel Lift Pump Control | B3 | P0231 | Poor Performance during Heavy Acceleration or Pulling Heavy Loads |
| D9 | PNK/BLK | 632 | Pump Cam, HIGH Res. and Fuel Temperature GroundP | D | — | No Start, Multible DTC's |
| D10 | —<br>GRY/BLK | 87 | Cruise Resume/Accel Reques | A15 | P0567 | No Resume/Accel Request |
| D11 | RED/BLK | 1230 | Transmission Input Speed Signal (Lo) | A | — | — |
| D12 | WHT/BLK | 598 | APP (1) 5 Volt Ref. | G | P123 | — |
| D13 | GRY | 416 | Boost, Crank and EGR 5 Volt Ref. | C | — | Multible DTC's |
| D14 | GRY | 464 | Pump Cam and High Res. 5 Volt Ref. | A | — | No Start, Multible DTC's |
| D15 | — | — | Not Used | — | — | — |
| D16 | — | — | Not Used | — | — | — |

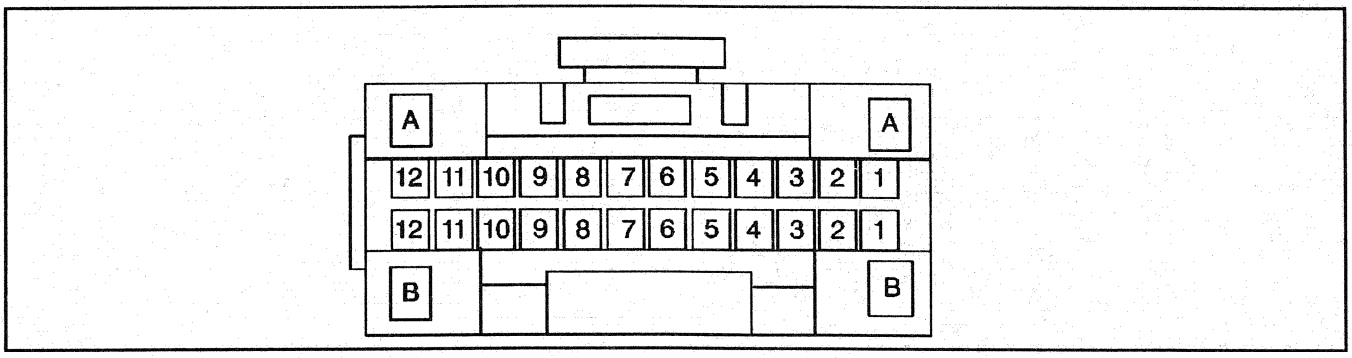
## PCM 24 Way Brown (C2) Connector




31460

| Connector Part Information | • 12110244<br>• PCM 24 Way Brown (C2) Connector | | | | | |
|---|---|---|---|---|---|---|
| **Pin** | **Wire Color** | **Circuit No.** | **Function** | **Component Connector Cavity** | **DTC(s) Affected** | **Possible Symptoms From a Faulty Circuit** |
| A1 | BLK | 491 | Closure Ground | C | — | Back up Fuel |
| A2 | ORN | 1799 | High Res. Signal | C | P0370, P0335 | Back up Fuel |
| A3 | BRN | 437 | Transmission Input Speed Signal | 13 | — | — |
| A4 | BRN/WHT | 633 | IPump Cam Sensor Signal | B | P0251, P0370 | Back up Fuel |
| A5 | YEL | 573 | Crankshaft Position Sensor Signal | A | P0335 | Back up Fuel |
| A6 | DK GRN | 389 | VSS Signal | — | P0501 | — |
| A7 | RED/BLK | 1031 | Injection Injection Stepper Motor (HI) | D | P0216 | Combustion Noise |
| A8 | TAN/BLK | 1030 | Injection Timing Stepper Motor (LO) | A | P0216 | Combustion Noise |
| A9 | ORN/BLK | 1032 | Injection Timing Stepper Motor (LO) | B | P0216 | Combustion Noise |
| A10 | YEL/BLK | 1033 | Injection Timing Stepper Motor (HI) | C | P0216 | Combustion Noise |
| A11 | GRY | 397 | Cruise ON/OFF Signal | A12 | — | No Cruise Control |
| A12 | PPL | 719 | APP (2) Ground | B | P0222, 1125 | Poor Performance |

## PCM 24 Way Brown (C2) Connector

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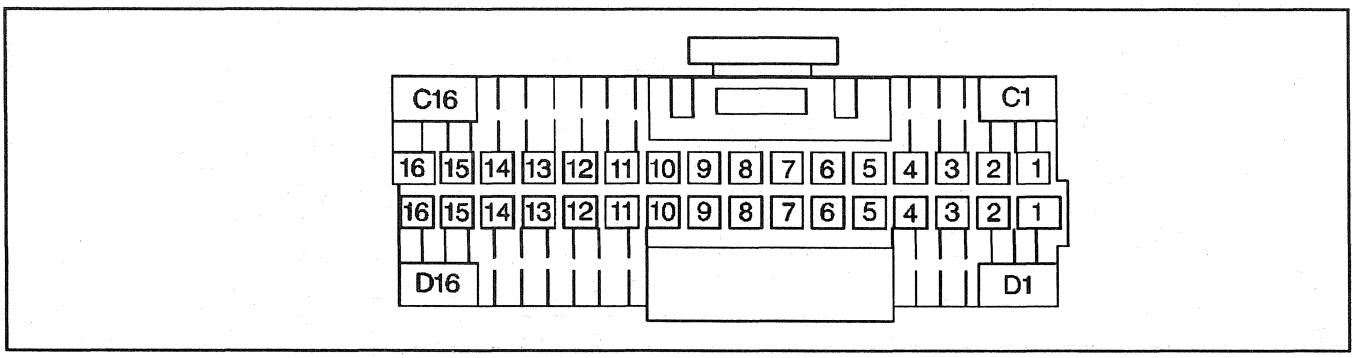
| Connector Part Information | • 12110244<br>• PCM 24 Way Brown (C2) Connector | | | | | |
|---|---|---|---|---|---|---|
| **Pin** | **Wire Color** | **Circuit No.** | **Function** | **Component Connector Cavity** | **DTC(s) Affected** | **Possible Symptoms From a Faulty Circuit** |
| B1 | BRN | 718 | APP (1) Ground | A | P0122, P1125 | — |
| B2 | BK BLU | —<br>485 | APP (1) Signal | F | P0122 | — |
| B3 | BLK/WHT | 1695 | Front Axle Switch Signal | — | — | — |
| B4 | RED | 1226 | TR Switch A | N | — | — |
| B5 | DK BLU | 1225 | TR Switch B | R | — | — |
| B6 | PNK | 1224 | TR Switch C | P | — | — |
| B7 | — | — | PTO (1360 RPM) | — | — | — |
| B8 | — | — | PTO (1070 0 RPM) | — | — | — |
| B9 | PPL | 420 | Cruise Control Brake Switch | E | P0571 | No Cruise |
| B10 | WHT | 17 | Brake Switch | A | P0571 | No Cruise |
| B11 | DK BLU | 84 | Cruise Set/Coast Signal | A14 | P0568 | No Cruise |
| B12 | BLK | 452 | Sensor Ground (Boost, EGR, ECT, IAT, Fuel Temp., Trans Temp and Crank Sensor) | — | — | Multible DTC |

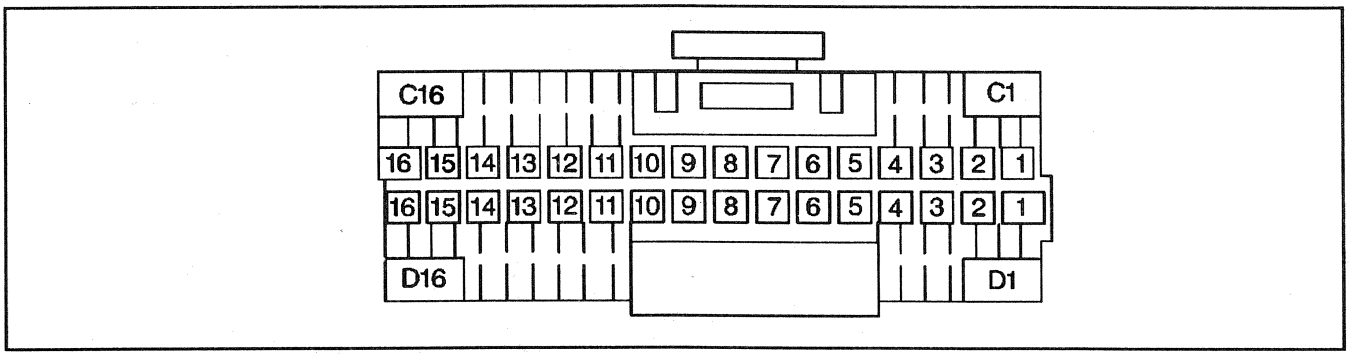
## PCM 32 Way Blue (C3) Connector




31454

| Connector Part Information | • 12110207<br>• PCM 32 Way Blue (C3) Connector | | | | | |
|---|---|---|---|---|---|---|
| **Pin** | **Wire Color** | **Circuit No.** | **Function** | **Component Connector Cavity** | **DTC(s) Affected** | **Possible Symptoms From a Faulty Circuit** |
| C1 | — | — | Not Used | — | — | — |
| C2 | GRY | 597 | APP (2) 5 Volt Ref. | D | P0222, P1125 | Poor Performance |
| C3 | LT GRN | 260 | Fuel Inject Signal | A | — | — |
| C4 | LT GRN | 1222 | Shift Solenoid (1-2) | A | — | No 1-2 Shift |
| C5 | BRN | 418 | TCC PWM | U | — | Poor Fuel Economy |
| C6 | YEL/BLK | 1223 | Shift Solenoid (2-3) | B | — | No 2-3 Shift |
| C7 | — | — | Not Used | — | — | — |
| C8 | PPL | 1807 | Class 2 Communication | 2 | — | No Scan Tool Communications |
| C9 | — | — | Not Used | — | — | — |
| C10 | — | — | Not Used | — | — | — |
| C11 | PNK | 439 | Ignition | — | — | — |
| C12 | PNK | 439 | Ignition | — | — | — |
| C13 | ORN | 440 | Battery | — | — | — |
| C14 | BRN/WHT | 419 | MIL Control Control | 23 | P1641 | No MIL |
| C15 | DK BLU/WHT | 259 | ESO Control | A | P0215 | No Start |
| C16 | GRY | 435 | EGR Solenoid Control | B | P1655, P0404 | No EGR, Black Smoke On Hard Acceleration |

## PCM 32 Way Blue (C3) Connector

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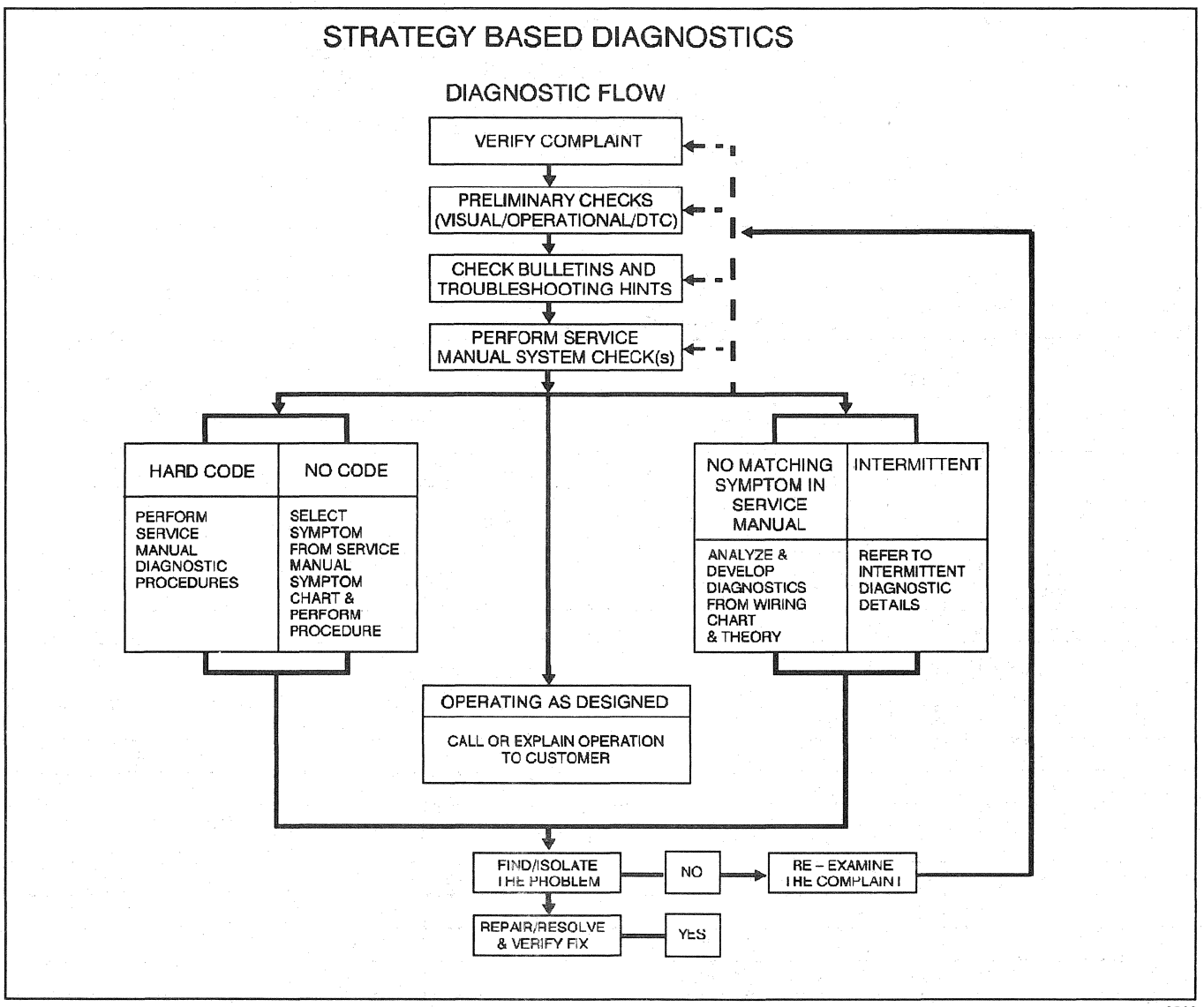
| Connector Part Information | • 12110207<br>• PCM 32 Way Blue (C3) Connector | | | | | |
|---|---|---|---|---|---|---|
| **Pin** | **Wire Color** | **Circuit No.** | **Function** | **Component Connector Cavaity** | **DTC(s) Affected** | **Possible Symptoms From a Faulty Cirtuit** |
| D1 | — | — | Not Used | — | — | — |
| D2 | — | — | Not Used | — | — | — |
| D3 | LT GRN | 260 | Fuel Inject Control | A | — | — |
| D4 | — | — | Not Used | — | — | — |
| D5 | DK GRN/WHT | 459 | A/C Enable | — | — | No A/C |
| D6 | BLK/WHT | 451 | Ground | — | — | — |
| — D7 | TAN/WHT | 551 | Ground | — | — | — |
| D8 | — | — | Not Used | — | — | — |
| D9 | — | — | Not Used | — | — | — |
| D10 | — | — | Not Used | — | — | — |
| D11 | WHT/BLK | 176 | Service Throttle Soon Lamp Control | 21 | P1654 | No Service Throttle Soon Lamp |
| D12 | WHT | 257 | EGR Vent Control | B | P1653 | No EGR |
| D13 | ORN | 440 | Battery | — | — | — |
| D14 | YEL | 258 | Wastegate Solenoid Control | B | P1656 | Poor Performance |
| D15 | DK BLU/WHT | 259 | ESO Solenoid Control | A | P0215 | No Start |
| D6 | — | — | Not Used | — | — | — |

# Diagnostic Information and Procedures

## Strategy Based Diagnostic Flow

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The strategy based diagnostic is a uniform approach to repair all Electrical and Electronic (E/E) systems. Resolve an E/E system problem using the diagnostic flow. The diagnostic flow is also a starting point when repairs are necessary. The steps below are defined in order to instruct the technician how to proceed with a diagnosis.

**Verify the Customer Complaint**
In order to verify the customer complaint the technician should know the normal operation of the system.

**Preliminary Checks**
Perform the following steps:

1. Conduct a thorough visual inspection
2. Review the service history
3. Detect unusual sounds or odors
4. Gather diagnostic trouble code information in order to achieve an effective repair

**Check Bulletins and Other Service Information**
This should include videos, newsletters, and Pulsat programs.

**Service Information System Checks**
A system may not be supported by one or more DTCs. System checks verify the proper operation of the system. This will lead the technician in an organized approach to diagnostics.

**Service Diagnostics (Paper and Electronic)**

1. DTC Stored - Follow the designated DTC Table exactly to make an effective repair.

2. No DTC - Select the symptom from the symptom tables and follow the diagnostic paths or suggestions to complete the repair, or refer to the applicable component/system check.
3. No Matching Symptom - Analyze the complaint. Develop a plan for diagnostics. Utilize the wiring diagrams and theory of operation.
4. Intermittents - Conditions that are not always present are intermittent. In order to resolve Intermittents, perform the following steps:
   4.1. Observe the history DTCs, the DTC modes and, the freeze frame data.
   Call technical assistance for similar cases where repair history may be available. Combine the technician knowledge with efficient use of the available service information.
   4.2. Evaluate the symptoms and conditions described by the customer.
   4.3. Use a check sheet or other method in order to identify the circuit or electrical system component.
   4.4. Follow the suggestions for intermittent diagnosis found in the service documentation.
   4.5. The Tech 1, Tech 2 and Fluke 87 scan tools have data capturing capabilities that can assist in detection of Intermittents.
5. Vehicle operates as designed/No trouble found
6. Call technical assistance for similar cases where repair history may be available. Combine technician knowledge with efficient use of the available service information.
   6.1. This condition exists when the vehicle is found to operate normally.
   6.2. The condition described by the customer may be normal. Verify against another vehicle that is operating normally.
   6.3. The condition may be intermittent. Verify the complaint under the conditions described by the customer before releasing the vehicle.

**Re-Examine the Complaint**
When the complaint cannot be successfully found or isolated, a reevaluation is necessary. The complaint should be re-verified and could be intermittent or normal.

**Repair and Verification Tests**
After isolating the cause, the repairs should be made. Then validate for proper operation and verify that the symptom has been corrected. This may involve road testing the vehicle in order to verify that the complaint has been resolved.

## Powertrain OBD System Check

Refer to *Power Feeds and Grounds*.

### 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. When the ignition is turned on, the MIL will momentarily flash ON and OFF and then remain on until the engine is running if no Diagnostic Trouble Codes (DTCs) are stored.
2. The diagnostic tables in this section are designed for use with a properly functioning scan tool. Before beginning any other diagnostic procedures, correct the serial data communications. The Class II Serial Data will not transmit if the system voltage measures below 9.0 volts or above 16.0 volts.
4. 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 faulty part
   4. System level DTCs (DTCs that indicate a system fault)
5. By storing the Freeze Frame Data and the Failure records selection in the scan tool, an electronic copy of the freeze frame data and the failure records taken when the fault occurred is stored which can be referred to later.

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 following sensors for proper operation:

   - 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.

**Powertrain OBD System Check**

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| *1* | 1. Turn ON the ignition leaving the engine OFF.<br>2. Observe the Malfunction Indicator Lamp (MIL).<br>Is the MIL ON? | — | *Go to Step 2* | Go to |
| *2* | 1. Turn OFF the ignition.<br>2. Install the scan tool.<br>3. Turn ON the ignition.<br>Does the scan tool display PCM data? | — | *Go to Step 3* | Go to |
| 3 | Using the scan tool command the MIL to turn OFF.<br>Does the MIL turn OFF? | — | *Go to Step 4* | Go to |
| *4* | Check for DTCs using the scan tool.<br>Were any current, history, or MIL request DTCs set? | — | *Go to Step 5* | *Go to Step 6* |
| *5* | Using the scan tool, store the Freeze Frame Data and the Failure Records Data.<br>Is the action complete? | — | Go to the Applicable DTC Table | — |
| 6 | Does the engine start and continue to run? | — | *Go to Step 7* | Go to |
| *7* | 1. Turn ON the ignition leaving the engine OFF.<br>2. Check the ECT.<br>3. Start the engine.<br>4. Allow the engine temperature to reach the specified value.<br>5. While the engine is reaching the operating temperature, check the ECT.<br>6. Compare the scan tool values of the sensors with the typical values shown in the Scan Tool Values.<br>Are the displayed values normal or within typical ranges? | 90°C–95°C | Go to the Driveability Symptoms Tables | Go to the Applicable DTC Table |

## No Malfunction Indicator Lamp

Refer to *Power Feeds and Grounds.*

### Circuit Description

There should always be a steady Malfunction Indicator Lamp (MIL) when the ignition is ON and engine 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.

### Test Description

Number(s) below refer to 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 faulty.
8. Refer to PCM terminal end view in this section 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 | Was the Powertrain On–Borad Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | Attempt to start the engine.<br>Does the engine start? | — | *Go to Step 3* | *Go to Step 6* |
| 3 | Check the fuse number 4.<br>Is the fuse OK? | — | *Go to Step 4* | *Go to Step 14* |
| 4 | Turn the ignition ON, probe the ignition feed circuit at the cluster connector with a test light to ground.<br>Is the test light ON? | — | *Go to Step 5* | *Go to Step 11* |
| *5* | 1. Turn the Ignition OFF.<br>2. Disconnect the blue PCM connector.<br>3. Turn the ignition ON.<br>4. With a fused jumper wire connected to ground,probe the MIL control circuit at the PCM connector.<br>5. Observe the MIL.<br>Is the MIL ON? | — | *Go to Step 9* | *Go to Step 10* |
| *6* | Check the PCM Ignition Feed and Battery Feed fuses.<br>Are both of the fuses OK? | — | *Go to Step 7* | *Go to Step 13* |
| 7 | 1. Turn the ignition OFF.<br>2. Disconnect the PCM connectors.<br>3. Turn the ignition ON.<br>4. Probe the PCM harness ignition and battery feed circuits with a test light to ground.<br>Is the test light ON both circuit? | — | *Go to Step 8* | *Go to Step 12* |
| *8* | 1. Check for a faulty PCM ground or a poor PCM ground connection.<br>2. If a problem is found, repair as necessary.<br>Was a problem found? | — | *Go to Step 20* | *Go to Step 9* |
| 9 | 1. Check for a poor connection at the PCM.<br>2. If a poor connection is found, repair as necessary.<br>Was a problem found? | — | *Go to Step 20* | *Go to Step 15* |

## No Malfunction Indicator Lamp (cont'd)

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 10 | 1. Check the MIL control circuit for an open.<br>2. If the MIL control circuit is open, repair as necessary.<br>Was a problem found? | — | *Go to Step 20* | *Go to Step 16* |
| 11 | Repair open in the ignition feed circuit to the cluster connector.<br>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<br>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.<br>Is the action complete? | — | *Go to Step 20* | — |
| 14 | Locate and repair short to ground in the instrument cluster Ignition Feed circuit.<br>Is the action complete? | — | *Go to Step 20* | — |
| 15 | Replace the PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Go to *PCM Replacement/Programming.*<br>Is the action complete? | — | *Go to Step 20* | — |
| 16 | 1. Check the MIL control circuit for a poor connection at the instrument cluster connector.<br>2. If a problem is found, repair as necessary.<br>Was a problem found? | — | *Go to Step 20* | *Go to Step 17* |
| 17 | 1. Remove the instrument cluster.<br>2. Inspect the MIL bulb.<br>Is the bulb OK? | — | *Go to Step 19* | *Go to Step 18* |
| 18 | Replace the MIL bulb.<br>Is the action complete? | — | *Go to Step 20* | — |
| 19 | Replace the instrument cluster.<br>Is the action complete? | — | *Go to Step 20* | — |
| 20 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Attempt to start the engine.<br>Does the engine start and continue to run? | — | *Go to Step 21* | *Go to Step 2* |
| 21 | 1. Allow engine to idle until normal operating temperature is reached.<br>2. Select DTC, Failed This Ign.<br>Are any DTCs displayed? | — | Go to the Applicable DTC Table | *Go to Step 22* |
| 22 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed ? | — | Go to the Applicable DTC Table. | System OK |

## No Scan Tool Data

Refer to *Power Feeds and Grounds.*

### Circuit Description

There should always be a steady Malfunction Indicator Lamp (MIL) when the ignition is ON and engine 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.

3. Check that the Scan Tool is functioning properly on another vehicle. If the scan is functioning properly, and CKT the serial data cirucit is OK, the PCM may be at fault for the NO DLC symptom.
5. If the light goes OFF when the PCM connector is disconnected, then the control circuit is not shorted to ground.

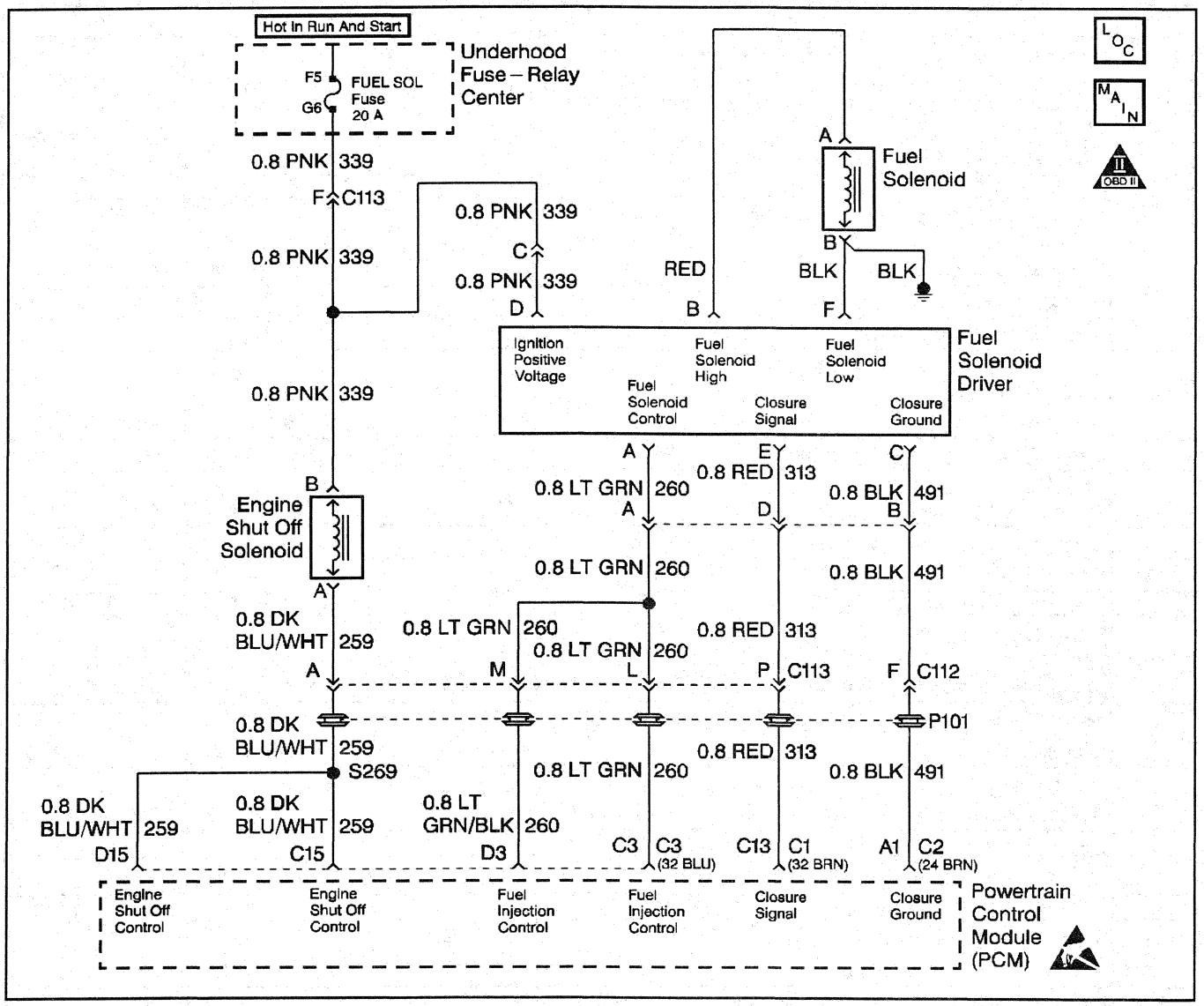
**No Scan Tool Data**

| 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.<br>Was the Powertrain On–Borad Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Ignition OFF for 30 seconds.<br>2. Ignition ON, Engine OFF.<br>Is the MIL ON? | — | *Go to Step 3* | Go to *No Malfunction Indicator Lamp* |
| *3* | Can the Scan Tool communicate with the PCM? | — | *Go to Step 4* | *Go to Step 7* |
| 4 | With the Scan Tool, command the MIL ON and OFF.<br>Does the MIL change states when commanded? | — | *Go to Step 17* | *Go to Step 5* |
| *5* | 1. Ignition OFF.<br>2. Disconnect the PCM connectors.<br>3. Ignition ON.<br>Is the MIL OFF? | — | *Go to Step 6* | *Go to Step 18* |
| 6 | With the Scan Tool, check Engine CAL ID.<br>Is the proper CAL ID present? | — | *Go to Step 28* | *Go to Step 19* |
| 7 | With a test light to ground, probe the DLC connector (pin 16.)<br>Is the test light ON? | — | *Go to Step 8* | *Go to Step 20* |
| 8 | With a test light to B+, probe the DLC connector (pins 4 and 5.)<br>Is the test light ON for both circuits? | — | *Go to Step 9* | *Go to Step 21* |
| 9 | Check for proper operation of the cigar lighter.<br>Does the cigar lighter operate properly? | — | *Go to Step 10* | *Go to Step 22* |
| 10 | Verify proper operation of the Scan Tool with a known good vehicle with the same equipment\controller.<br>Does the Scan Tool communicate with known good vehicle? | — | *Go to Step 11* | *Go to Step 23* |
| 11 | 1. Disconnect the Scan Tool.<br>2. With the *J 39200* connected to ground, check the PCM serial data line at the DLC connector (pin 2).<br>Is voltage on the serial data line less than the specified value? | 7 V | *Go to Step 12* | *Go to Step 15* |
| 12 | With the *J 39200* connected to ground, again check the PCM serial data line at the DLC connector (pin 2).<br>Is voltage on the serial data line less than the specified value? | 1 V | *Go to Step 13* | *Go to Step 16* |

## No Scan Tool Data (cont'd)

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 13 | 1. Ignition OFF.<br>2. With the *J 39200* connected to ground, check resistance of the serial data line at the DLC connector (pin 2).<br>Is resistance less than the specified value? | 10 Ohms | *Go to Step 14* | *Go to Step 27* |
| 14 | 1. Disconnect the PCM connectors.<br>2. With the *J 39200* connected to ground, check resistance of the serial data line at the DLC connector (pin 2).<br>Is resistance less than the specified value? | 10 Ohms | *Go to Step 24* | *Go to Step 28* |
| 15 | 1. Ignition OFF.<br>2. Disconnect the PCM connectors.<br>3. Ignition ON<br>4. Check voltage on the DLC connector (pin 2).<br>Is voltage at the specified value? | 0 V | *Go to Step 28* | *Go to Step 25* |
| 16 | Reprogram the EEPROM and retest. Refer to *PCM Replacement/Programming*<br>Is serial data present? | — | *Go to Step 26* | *Go to Step 28* |
| 17 | System OK. | — | — | — |
| 18 | Repair short to ground in the MIL control circuit.<br>Is action complete? | — | *Go to Step 26* | — |
| 19 | Reprogram the EEPROM and retest. Refer to *PCM Replacement/Programming* | — | — | — |
| 20 | 1. Check fuse number 7.<br>2. If fuse is blown, repair short to ground in the battery feed circuit to the DLC connector (pin 16.)<br>3. If the fuse is OK, repair open in the battery feed circuit to the DLC connector (pin 16.) | — | — | — |
| 21 | Repair open in circuit that did not light the test light.<br>Refer to Electrical Diagnosis for ground distribution. | — | — | — |
| 22 | Refer to Electrical Diagnosis for cigar lighter repair. | — | — | — |
| 23 | Faulty Scan Tool and/or cable. | — | — | — |
| 24 | Repair short to ground in the serial data line. | — | — | — |
| 25 | Repair short to voltage in the serial data line. | — | — | — |
| 26 | System OK. | — | — | — |
| 27 | 1. Check serial data line for an open.<br>2. If OK, check PCM and DLC connections.<br>3. If OK, replace the PCM.<br>If the PCM is faulty, the new PCM must be programmed. Refer to *PCM Replacement/Programming*<br>Is the action complete? | — | Go to *Powertrain OBD System Check* | — |
| 28 | Replace the faulty PCM. If the PCM is faulty, the new PCM must be programmed. Refer to *PCM Replacement/Programming*<br>Is the action complete? | — | Go to *Powertrain OBD System Check* | — |

## Engine Cranks but Does Not Run

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### Circuit Description

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

### Diagnostic Aids

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

- 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 are disconnected or faulty at the same time, a 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.

## 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.<br>Was the Powertrain On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | Check for proper condition of batteries. Refer to Engine Electrical.<br>Is condition of batteries OK? | — | *Go to Step 3* | *Go to Step 23* |
| 3 | Check for adequate fuel in tank.<br>Is fuel at a adequate level? | — | *Go to Step 4* | *Go to Step 23* |
| 4 | Check the quality of fuel. Refer to Fuel System Contamination.<br>Is fuel quality OK? | — | *Go to Step 5* | *Go to Step 23* |
| 5 | Check glow plug system operation. Refer to Glow Plug System.<br>Are glow plugs operating OK? | — | *Go to Step 6* | *Go to Step 23* |
| *6* | Check for proper cranking speed. Refer to Engine Electrical.<br>Is cranking speed OK? | — | *Go to Step 7* | *Go to Step 23* |
| 7 | Check for a restriction in the fuel return system. Refer to Fuel System.<br>Does the fuel return system operate properly? | — | *Go to Step 8* | *Go to Step 23* |
| *8* | Check injection pump ground wire.<br>Is ground OK? | — | *Go to Step 9* | *Go to Step 23* |
| 9 | Ignition ON.<br>Does MIL come ON? | — | *Go to Step 10* | Go to Table A–1 |
| 10 | Install scan tool.<br>Does scan tool display data? | — | *Go to Step 11* | Go to Table A–2 |
| 11 | 1. Loosen injector line at injector.<br>2. Crank engine.<br>Is there fuel at injection line? | — | *Go to Step 17* | *Go to Step 12* |
| *12* | Disconnect Optical/Fuel temperature sensor.<br>Does vehicle start? | — | *Go to Step 16* | *Go to Step 13* |
| 13 | 1. Reconnect Optical/Fuel temperature sensor.<br>2. Disconnect fuel solenoid driver at the driver.<br>3. With *J 39200* connected to ground, probe fuel inject control circuit at harness terminal.<br>4. Crank engine.<br>Is voltage greater than or equal to specified value? | 1.2 V | *Go to Step 14* | *Go to Step 18* |
| 14 | 1. Fuel solenoid driver still disconnected.<br>2. Probe fuel solenoid closure ground circuit with a test light connected to B+ at the harness terminal.<br>Is test light ON? | — | *Go to Step 15* | *Go to Step 19* |
| 15 | 1. Ignition ON, engine OFF.<br>2. Probe ignition feed circuit at the fuel solenoid harness connector with a test light connected to ground.<br>Is test light ON? | — | *Go to Step 16* | *Go to Step 21* |

## Engine Cranks but Does Not Run (cont'd)

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 16 | Replace fuel injection pump. Refer to *Fuel Injection Pump*<br>Is the action complete? | — | *Go to Step 25* | — |
| 17 | Injection system OK. Refer to Diesel Driveability. | — | — | — |
| 18 | Check the fuel inject control circuit for an open or ground between the fuel solenoid driver and the PCM.<br>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.<br>Was a problem found? | — | *Go to Step 22* | *Go to Step 20* |
| 20 | Inspect the fuel solenoid driver connector and PCM connector for proper connection.<br>Was a problem found? | — | *Go to Step 22* | *Go to Step 24* |
| 21 | Repair the open in the ignition feed circuit.<br>Is the action complete? | — | *Go to Step 25* | — |
| 22 | Repair the circuit as necessary.<br>Is the action complete? | — | *Go to Step 25* | — |
| 23 | Make appropriate repairs.<br>Is the action complete? | — | *Go to Step 25* | — |
| 24 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Refer to *PCM Replacement/Programming*<br>Is the action complete? | — | *Go to Step 25* | — |
| 25 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Attempt to start engine.<br>Does the engine start and continue to run? | — | *Go to Step 26* | *Go to Step 2* |
| 26 | 1. Allow engine to idle until normal operating temperature is reached.<br>2. Select DTC, Fail This Ign.<br>Are any DTCs displayed? | — | *Go to Step 27* | — |
| 27 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## Fuel Pump Circuit Diagnosis

Refer to *Fuel Pump System*

### Circuit Description

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 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 ( 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 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 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Turn the ignition OFF for 10 seconds.<br>2. Turn the ignition ON.<br>Does fuel pump operate during 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.<br>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.<br>2. Turn the ignition OFF for 10 seconds.<br>3. Turn the ignition ON.<br>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.<br>2. Turn the ignition ON, engine OFF.<br>3. Probe the fuel pump relay battery feed terminal at the fuel pump relay harness connector with a test light to ground.<br>Is the test light ON? | — | *Go to Step 6* | *Go to Step 14* |
| 6 | Connect a test light between the fuel pump relay battery feed circuit harness connector and ground.<br>Is the test light ON? | — | *Go to Step 7* | *Go to Step 15* |
| 7 | 1. Connect a test light between the fuel pump relay control circuit and ground.<br>2. Turn the ignition OFF for 20 seconds.<br>3. Turn the ignition ON.<br>Is the test light ON during glow plug cycle and then OFF? | — | *Go to Step 8* | *Go to Step 16* |
| 8 | Check for a faulty connection at the fuel pump relay control connector terminal.<br>Was a problem found? | — | *Go to Step 11* | *Go to Step 9* |

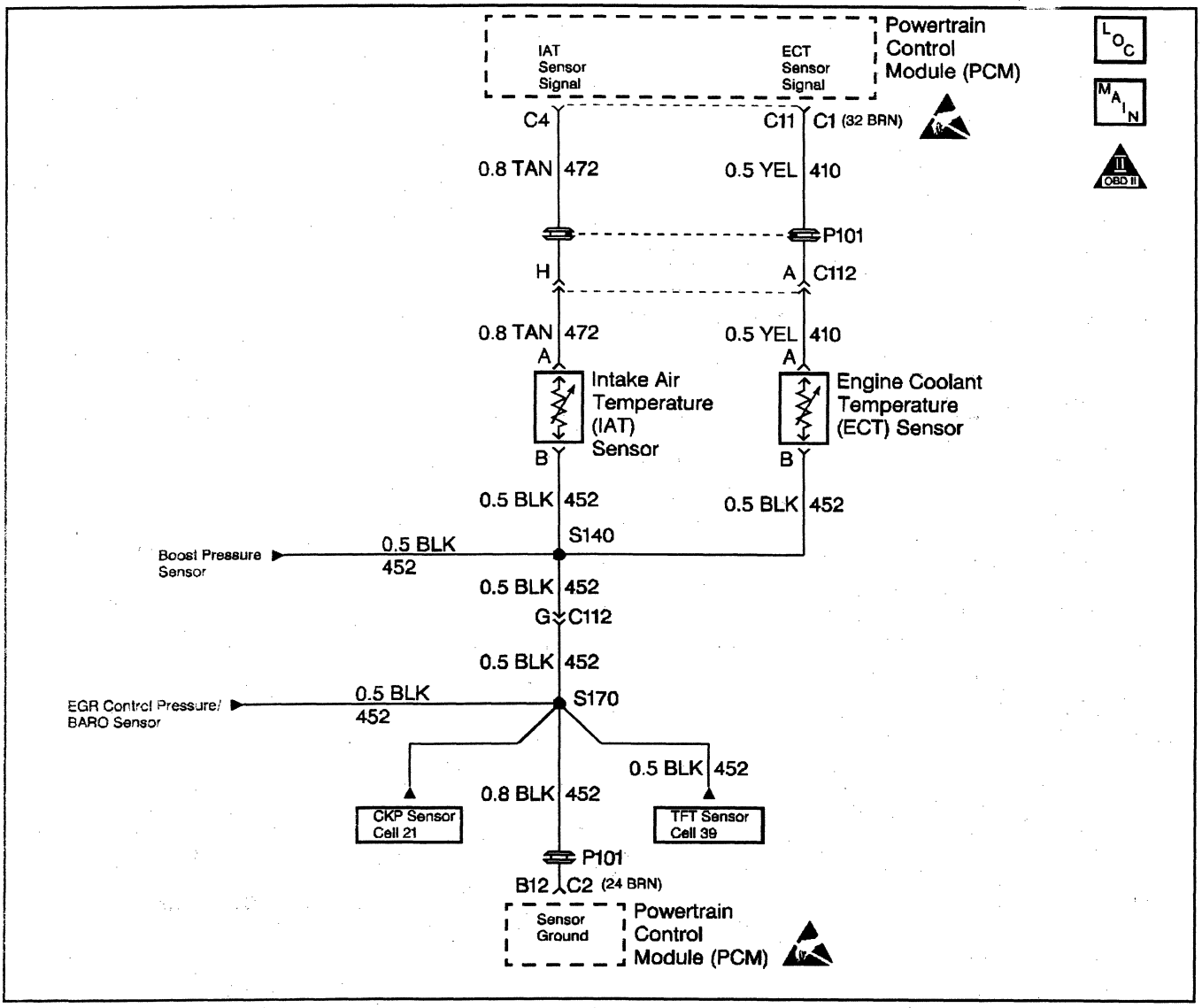
## Fuel Pump Circuit Diagnosis (cont'd)

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 9 | Replace the fuel pump relay. Refer to *Fuel Pump Relay*<br>Is the action complete? | — | *Go to Step 25* | *Go to Step 10* |
| *10* | 1. Start the engine and idle until normal operating temperature is reached.<br>2. Oil pressure within normal range.<br>3. Disconnect the fuel pump relay.<br>Does the engine continue to run? | — | *Go to Step 11* | *Go to Step 17* |
| 11 | 1. Reinstall the fuel pump relay.<br>2. Turn the ignition OFF.<br>3. Probe the fuel pump test connector with a test light to ground.<br>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.<br>2. Apply a 12 volt fused jumper to the fuel pump test terminal.<br>3. Probe the fuel pump feed circuit with a test light to ground.<br>Is the test light ON? | — | *Go to Step 13* | *Go to Step 20* |
| 13 | With a test light connected to B+ probe the fuel pump *ground terminal (vehicle side) of the chassis harness fuel* pump connector.<br>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.<br>Is the action complete? | — | *Go to Step 25* | — |
| 15 | Repair the open in the fuel pump relay ground circuit.<br>Is the action complete? | — | *Go to Step 25* | — |
| 16 | 1. Check for a faulty connection at the VCM fuel pump relay control circuit.<br>2. Check for open or short to ground in the harness between the fuel pump relay control connector terminal and the fuel pump relay control circuit.<br>Was a problem found? | — | *Go to Step 22* | *Go to Step 24* |
| 17 | Check the oil pressure switch harness connector terminals for a faulty connection.<br>Was a problem found? | — | *Go to Step 22* | *Go to Step 18* |
| 18 | Replace the oil pressure switch. Refer to *Oil Pressure Switch*<br>Is the action complete? | — | *Go to Step 25* | — |
| 19 | Replace the fuel pump. Refer to *Fuel Lift Pump*<br>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.<br>Is the action complete? | — | *Go to Step 25* | — |
| 21 | Repair the open in the fuel pump harness ground circuit.<br>Is the action complete? | — | *Go to Step 25* | — |
| 22 | Repair the circuit as necessary.<br>Is the action complete? | — | *Go to Step 25* | — |

## Fuel Pump Circuit Diagnosis (cont'd)

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 23 | Repair the connection as necessary.<br>Is the action complete? | — | *Go to Step 25* | — |
| 24 | Replace the PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Refer to *PCM Replacement/Programming*<br>Is the action complete? | — | *Go to Step 25* | — |
| 25 | 1. Using the scan tool, select DTC, Clear Info.<br>2. Attempt to start the engine.<br>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.<br>2. Select DTC, Failed This Ign.<br>Are any additional DTCs displayed? | — | Go to Applicable DTC Table | *Go to Step 27* |
| 27 | Using the scan tool, select Capture Info, Review Info.<br>Are any additional DTCs displayed that have not been diagnosed? | — | Go to Applicable DTC Table | System OK |

## DTC P0112 IAT Sensor Circuit Low Voltage




29578

### Circuit Description

The Intake Air Temperature (IAT) sensor is a thermister 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. This is a type B DTC.

### Conditions for Setting the DTC

- Engine coolant temperature less than 42.5 °C (109 °F).
- Intake air temperature greater than or equal to 151 °C (304 °F).
- Conditions met for 2 seconds.

### Action Taken When the DTC Sets

A possible poor performance problem may exist during cold weather operation.

### 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 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

Check harness routing for a potential short to ground in the signal circuit. Scan Tool displays intake air temperature in degrees centigrade. Refer to *Intermittents*. A skewed sensor could result in poor driveability complaints.

## Test Description

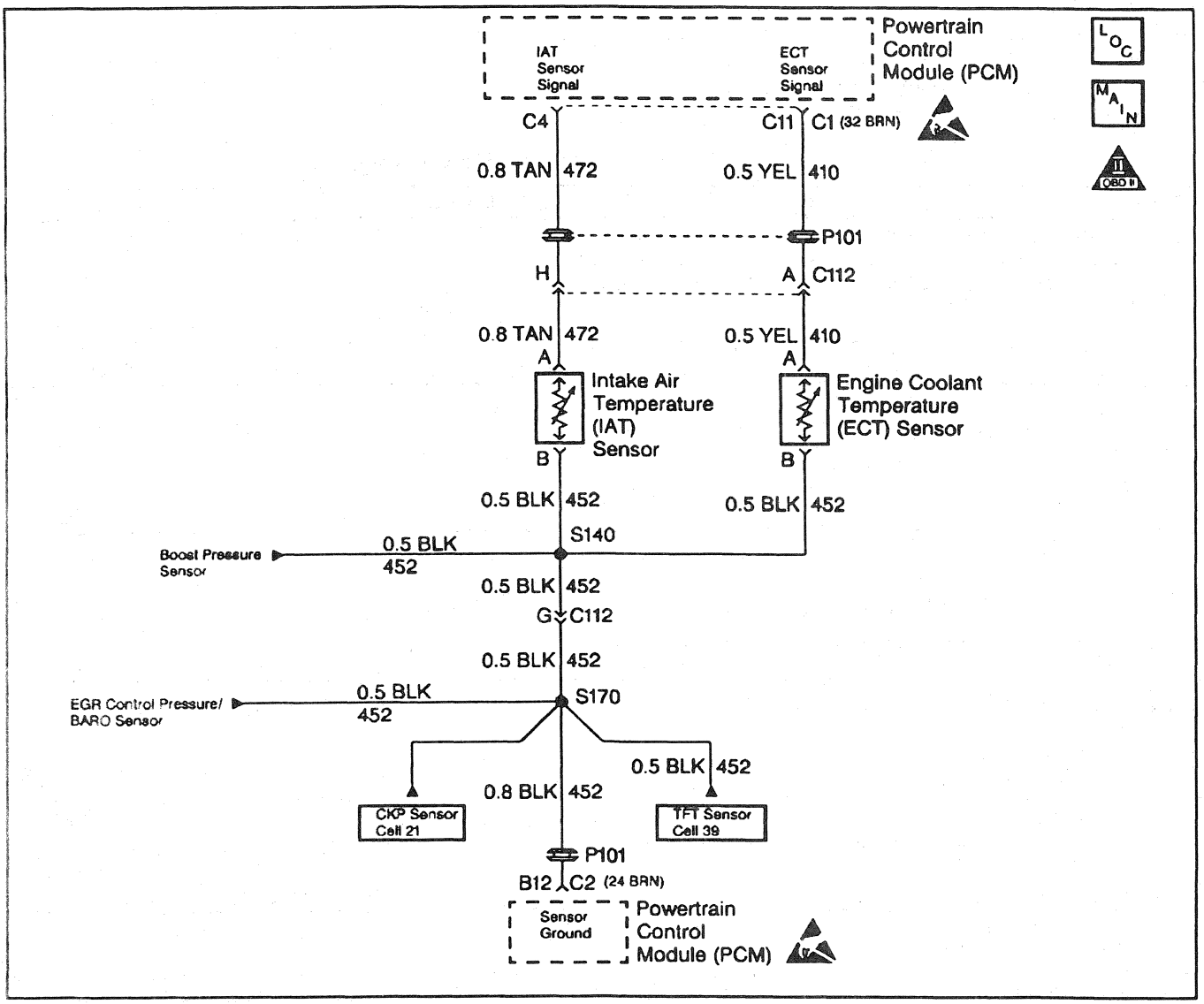
Number(s) below refer to the Step number(s) on the Diagnostic Table.

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.

### DTC P0112 IAT Sensor Circuit Low Voltage

| 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.<br>Was the Powertrain On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Scan tool connected.<br>2. Start the engine.<br>3. Monitor the IAT display on Scan Tool.<br>Is the IAT display greater than or equal to the specified value? | 151 °C (304 °F) | *Go to Step 3* | *Go to Step 5* |
| 3 | 1. Turn the engine OFF.<br>2. Turn the ignition ON.<br>3. Disconnect the IAT sensor connector.<br>Is the IAT display less than or equal to the specified value? | –40 °C (–40 °F) | *Go to Step 7* | *Go to Step 4* |
| 4 | 1. Turn the ignition OFF.<br>2. Using the *J 39200*, measure the resistance across the IAT sensor harness connector.<br>Is the resistance at the specified value? | Infinite | *Go to Step 8* | *Go to Step 6* |
| 5 | DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored, refer to those table(s).<br>Are additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 6 | Repair the short to ground in the IAT signal circuit.<br>Is the action complete? | — | *Go to Step 9* | — |
| 7 | Replace the IAT sensor. Refer to *IAT Sensor.*<br>Is the action complete? | — | *Go to Step 9* | — |
| 8 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Go to *PCM Replacement/Programming.*<br>Is the action complete? | — | *Go to Step 9* | — |
| 9 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 10* | *Go to Step 2* |
| 10 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0113 IAT Sensor Circuit High Voltage




29578

### Circuit Description

The Intake Air Temperature (IAT) sensor is a thermister 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. This is a type B DTC.

### Conditions for Setting the DTC

- Engine operating for 8 minutes.
- IAT less than or equal to –40°C (–40°F).
- Conditions met for 2 seconds.

### Action Taken When the DTC Sets

A possible poor performance problem may exist during cold weather operation.

### 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 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

The scan tool displays intake air temperature in degrees centigrade. Refer to *Intermittent Symptoms*. A skewed sensor could result in poor driveability complaints.

### 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 faulty PCM.

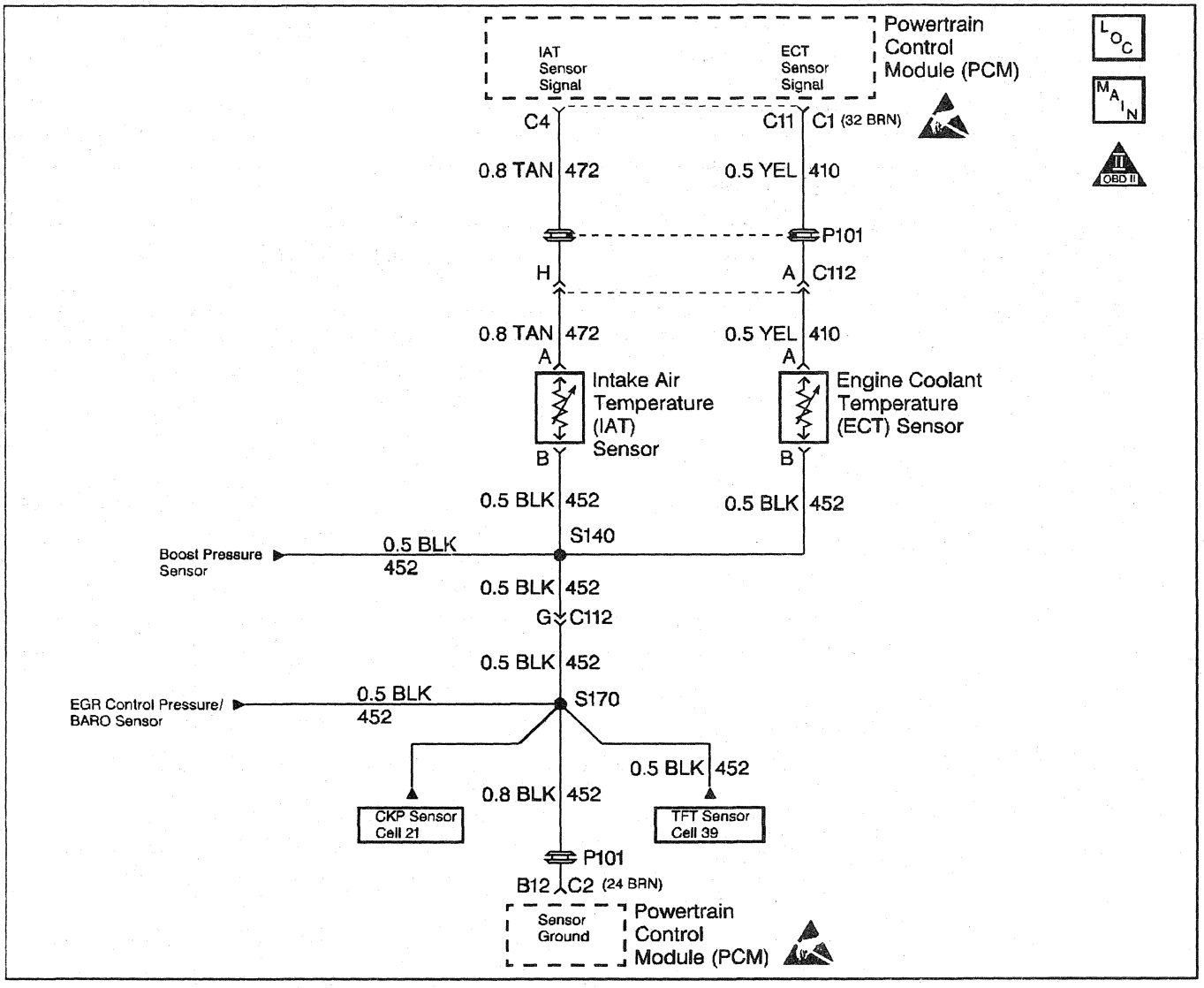
## DTC P0113 IAT Sensor Circuit High Voltage

| 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Scan tool connected.<br>2. Start the engine.<br>3. Monitor the IAT display on scan tool.<br>Does the IAT display less than or equal to the specified value? | –40°C (–40°F) | *Go to Step 3* | *Go to Step 5* |
| 3 | 1. Turn the engine OFF.<br>2. Turn the ignition ON.<br>3. Disconnect the IAT sensor connector.<br>4. Jumper the IAT harness terminals together.<br>Does the scan tool display IAT greater than or equal to the specified value? | 151°C (304°F) | *Go to Step 6* | *Go to Step 4* |
| 4 | Jumper the IAT sensor signal circuit to a known good ground.<br>Does the scan tool display a IAT greater than or equal to the specified value? | 151°C (304°F) | *Go to Step 7* | *Go to Step 8* |
| 5 | DTC is intermittent. If no other DTCs are stored, refer to Diagnostic Aids.<br>Are than any other DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 6 | Inspect the sensor connector and PCM connector for a proper connection.<br>Was a problem found? | — | *Go to Step 9* | *Go to Step 10* |
| 7 | Check the IAT sensor ground circuit for an open between the IAT sensor and the PCM.<br>Was a problem found? | — | *Go to Step 9* | *Go to Step 11* |
| 8 | Check the IAT sensor signal circuit for an open between the IAT sensor and the PCM.<br>Was a problem found? | — | *Go to Step 9* | *Go to Step 11* |
| 9 | Repair the circuit as necessary.<br>Is the action complete? | — | *Go to Step 12* | — |
| 10 | Replace the faulty IAT sensor. Refer to *IAT Sensor*<br>Is the action complete? | — | *Go to Step 12* | — |
| 11 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Refer to *PCM Replacement/Programming*<br>Is the action complete? | — | *Go to Step 12* | — |

## DTC P0113 IAT Sensor Circuit High Voltage (cont'd)

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 12 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 13* | — |
| 13 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0117 ECT Sensor Circuit Low Voltage




29578

### 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 thermister is interpreted as a temperature. This is a type B DTC.

### Conditions for Setting the DTC

Engine coolant temperature greater than or equal to 151 °C (304 °F) for 2 seconds.

### Action Taken When the DTC Sets

- High idle
- No TCC
- Shift schedules will be affected.

### 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 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 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. This diagnostic checks for a skewed sensor.

## 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 (304 °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.

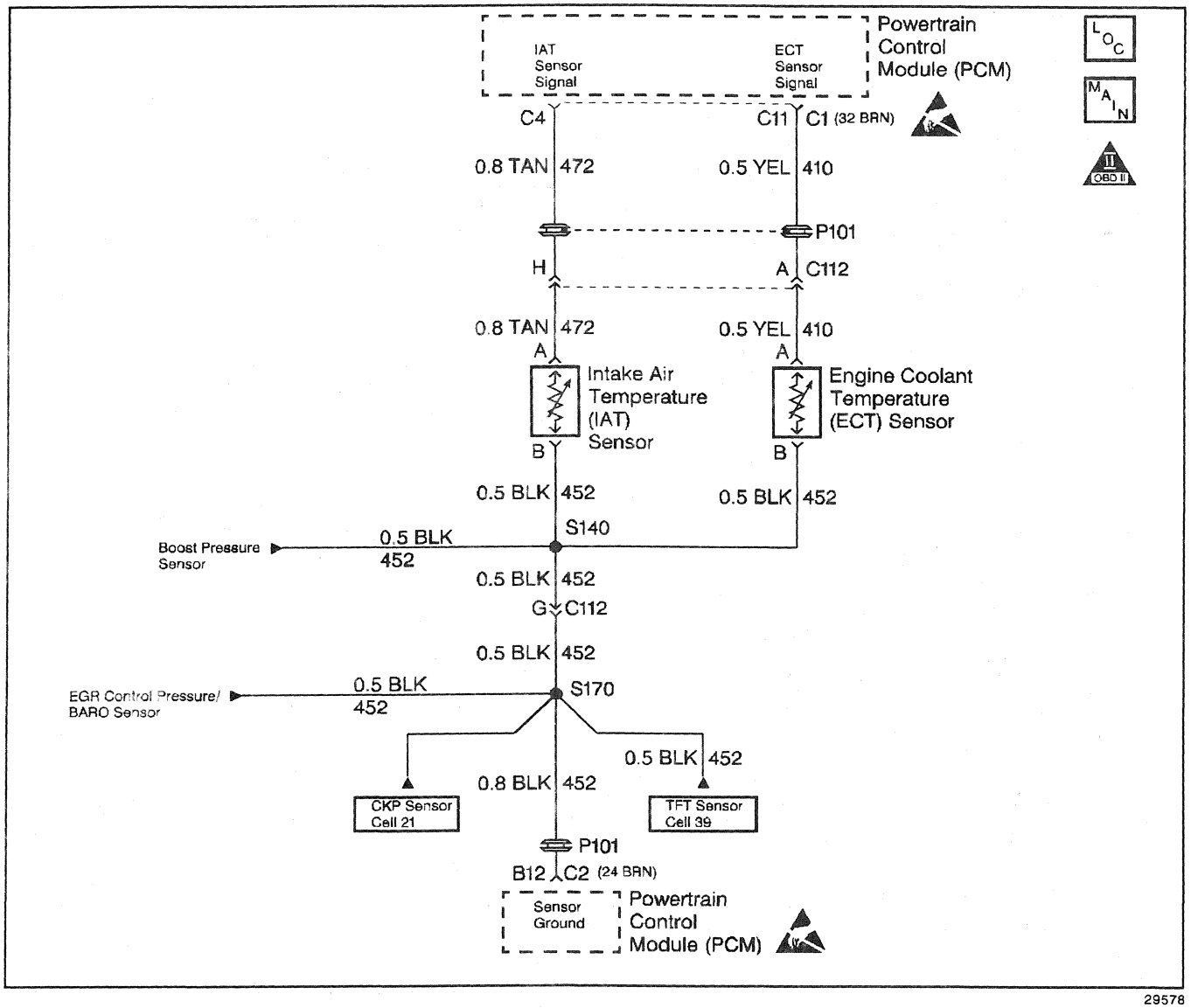
## DTC P0117 ECT Sensor Circuit Low Voltage

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 1 | **Important:** Before clearing the DTCs, use the scan tool to record the Freeze Frame and the Failure Records for reference. This data will be lost when the Clear Info function is used.<br>Was the Powertrain On-Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Connect the scan tool.<br>2. Start the engine.<br>3. Monitor the Engine Coolant Temperature (ECT) display on scan tool.<br>Does the scan tool display an ECT greater than the specified value? | 151 °C (304 °F) | *Go to Step 3* | *Go to Step 5* |
| 3 | 1. Turn off the engine.<br>2. Turn ON the ignition.<br>3. Disconnect the ECT sensor connector.<br>Does the scan tool display an ECT less than or equal to the specified value? | -40 °C (-40 °F) | *Go to Step 7* | *Go to Step 4* |
| 4 | 1. Turn off the ignition.<br>2. Using the *J 39200*, check the resistance across the ECT sensor harness connector.<br>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. | — | Go to The Applicable DTC Table | *Go to Step 6* |
| 6 | Repair the short to the ground in the ECT signal circuit. Refer to *Wiring Repairs* in Engine Electrical.<br>Is the action complete? | — | *Go to Step 9* | — |
| 7 | Replace the ECT sensor. Refer to *ECT Sensor.*<br>Is the replacement complete? | — | *Go to Step 9* | — |
| 8 | Replace the PCM.<br>**Important:** If the PCM is faulty, reprogram the PCM. Refer to *PCM Replacement/Programming.*<br>Is the replacement complete? | — | *Go to Step 9* | — |

## DTC P0117 ECT Sensor Circuit Low Voltage (cont'd)

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 9 | 1. Using the scan tool, select the DTC and the Clear Info.<br>2. Start the Engine.<br>3. Idle the Engine at the normal operating temperature.<br>4. Select the DTC and the Specific.<br>5. Enter the DTC number which was set.<br>6. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the scan tool indicate that this diagnostic ran and passed? | — | *Go to Step 10* | *Go to Step 2* |
| 10 | Using the scan tool, select the Capture Info and the Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to The Applicable DTC Table | System OK |

## DTC P0118 ECT Sensor Circuit High Voltage




29578

### 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 thermister is interpreted as a temperature. This is a type B DTC.

### Conditions for Setting the DTC

- Engine running for at least 8 minutes.
- ECT less than –40 °C (–40 °F).
- Conditions met for 2 seconds.

### Action Taken When the DTC Sets

Idle increase.

### 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 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

Check harness routing for a potential short to ground. After engine is started, the ECT temperature should rise steady to about 85 °C (185 °F). A mis–scaled sensor could result in poor driveability complaints.

## Test Description

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

2. This test determines if P0118 is an intermittent condition.
3. This test will determine if signal circuit is open, or a faulty PCM.

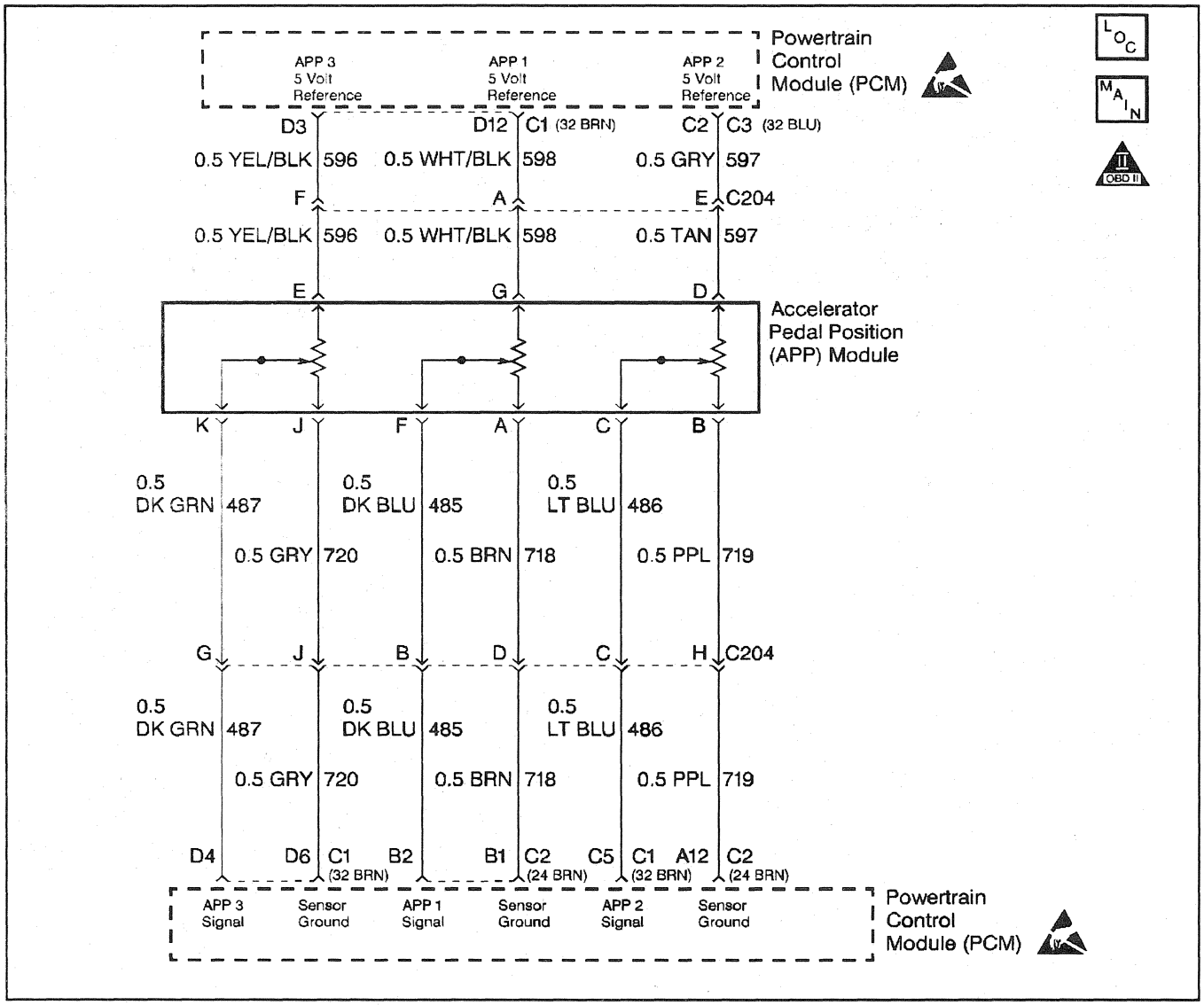
### DTC P0118 ECT Sensor Circuit High Voltage

| 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Scan tool connected.<br>2. Start the engine.<br>3. Monitor the ECT display on scan tool.<br>Is the ECT display less than or equal to the specified value? | –40°C (–40°F) | *Go to Step 3* | *Go to Step 5* |
| 3 | 1. Turn the engine OFF.<br>2. Turn the ignition ON.<br>3. Disconnect the ECT sensor connector.<br>4. Jumper the ECT harness terminals together.<br>Does the scan tool display ECT greater than or equal to the specified value? | 151°C (304°F) | *Go to Step 6* | *Go to Step 4* |
| 4 | Jumper the ECT sensor signal circuit to a known good ground.<br>Does the scan tool display a ECT greater than the specified value? | 151°C (304°F) | *Go to Step 7* | *Go to Step 8* |
| 5 | DTC is intermittent. If no other DTC(s) are stored, refer to Diagnostic Aids.<br>Are there any other DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 6 | Inspect the sensor connector and PCM connector for a proper connection.<br>Was a problem found? | — | *Go to Step 9* | *Go to Step 10* |
| 7 | Check the ECT sensor ground circuit for an open between the ECT sensor and the PCM.<br>Was a problem found? | — | *Go to Step 9* | *Go to Step 11* |
| 8 | Check the ECT sensor signal circuit for an open between the ECT sensor and the PCM.<br>Was a problem found? | — | *Go to Step 9* | *Go to Step 11* |
| 9 | Repair the circuit as necessary.<br>Is the action complete? | — | *Go to Step 12* | — |
| 10 | Replace the faulty ECT sensor. Refer to *ECT Sensor*<br>Is the action complete? | — | *Go to Step 12* | — |
| 11 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Refer to *PCM Replacement/Programming*<br>Is the action complete? | — | *Go to Step 12* | — |

## DTC P0118 ECT Sensor Circuit High Voltage (cont'd)

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 12 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 13* | — |
| 13 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTC[prime ]s displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0121 APP Sensor1 Circuit Performance




29555

### 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. This is a type D DTC.

### Conditions for Setting the DTC

- Ignition voltage greater than 6.4 volts.
- Engine speed greater than 300 RPM.
- The difference between APP 1 and APP 2 is greater than .23 volts (PCM compares pre–scaled voltage (internal to PCM)).
- The difference between APP 1 and APP 3 is greater than .50 volts (PCM compares pre–scaled voltage (internal to PCM)).
- No in range faults for APP 2 or APP 3 (PCM checks for high and low voltage faults).
- Conditions met for 2 seconds.

### Action Taken When the DTC Sets

- The input from APP 1 sensor is ignored.
- A current and history DTC will set but it will not turn on the Service Throttle Soon lamp.
- Throttle will operate normally as long as there is only one malfunction present. If there are two APP malfunctions present, the PCM will 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 only allow the engine to operate at idle.

### 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 scan tool reads APP 1 position in volts. It should read about .45 to .95 volt with throttle closed and ignition ON or at idle. Voltage should increase at a steady rate as 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 engine stopped and ignition ON. Display should vary from about .74 volt when throttle was closed to over about 3.7 volts when throttle is held at Wide Open Throttle (WOT) position. 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 can[prime ]t read). The scan tool reads only output voltages.

### 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.

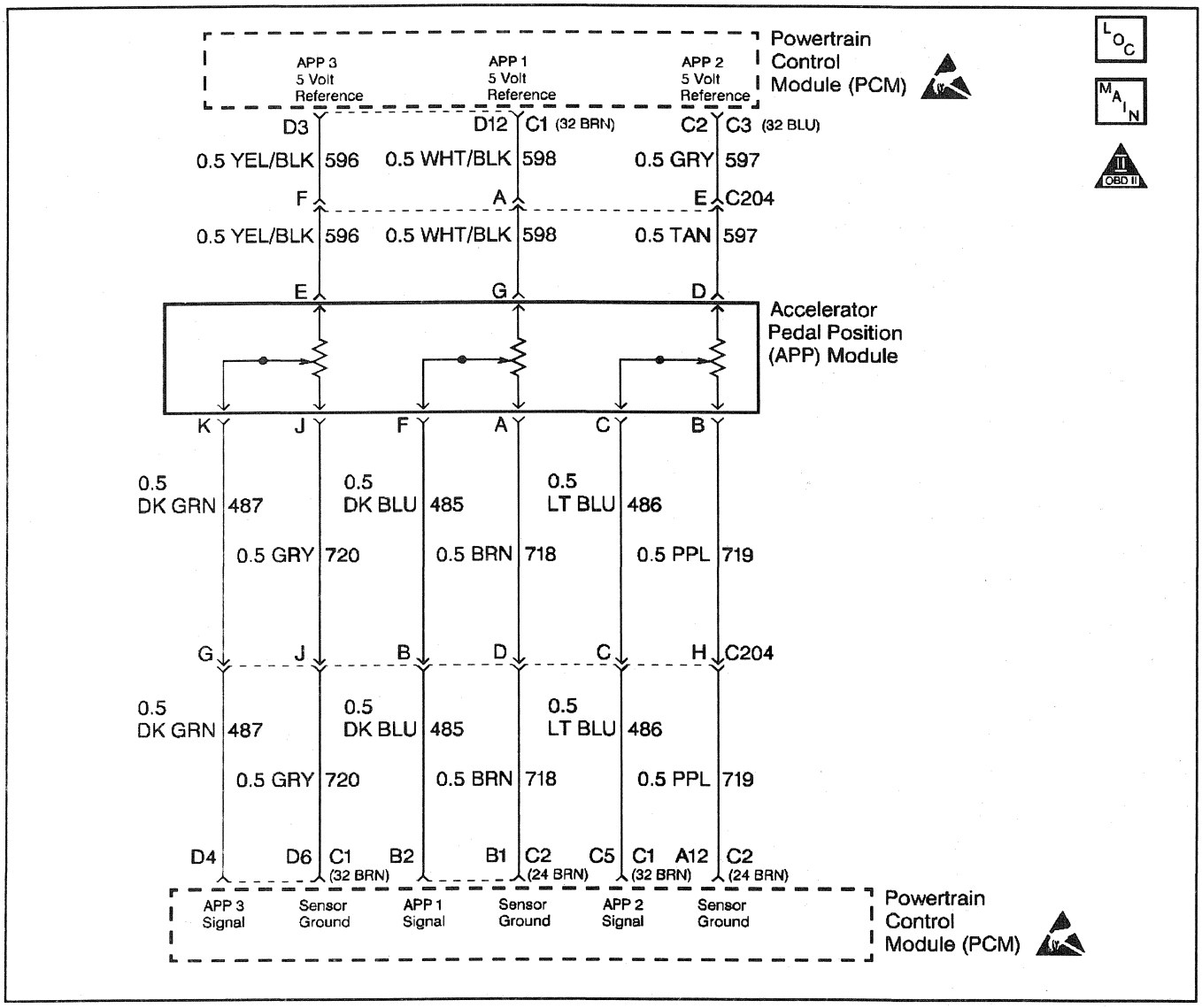
### DTC P0121 APP Sensor1 Circuit Performance

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 1 | **Important:** Before clearing 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Ignition ON, engine OFF.<br>2. With the throttle closed, observe APP voltages on the scan tool.<br>Are APP voltages at specified values? | .45–.95 V<br>4.0–4.5 V<br>3.6–4.0 V | *Go to Step 3* | *Go to Step 4* |
| 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 additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| *4* | 1. Disconnect the APP sensor electrical connector.<br>2. Ignition ON, engine OFF.<br>3. With *J 39200* connected to ground, probe APP sensor 5 volt reference circuits at APP harness terminals G, D, and E.<br>Is voltage at the specified value on all circuits? | 4.75 V | *Go to Step 5* | *Go to Step 6* |
| *5* | 1. Ignition ON, engine OFF.<br>2. With a test light connected to B+, probe APP sensor ground circuits at the APP sensor harness terminals A, B, and J.<br>Is Test light ON (all circuits)? | — | *Go to Step 9* | *Go to Step 8* |
| 6 | 1. Ignition OFF.<br>2. Disconnect the PCM and check the 5 volt reference circuit for an open or short to ground.<br>3. If the 5 volt reference circuit is open or shorted to ground, repair it as necessary.<br>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 poor connection at the PCM and replace terminal if necessary.<br>Did the terminal require replacement? | — | *Go to Step 11* | *Go to Step 10* |

## DTC P0121 APP Sensor1 Circuit Performance (cont'd)

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 8 | 1. Ignition OFF.<br>2. Disconnect the PCM and check for an open sensor ground circuit to the PCM.<br>3. If problem is found, repair as necessary.<br>Was APP sensor ground circuit open? | — | *Go to Step 11* | *Go to Step 10.* |
| 9 | Replace the APP module. Refer to *APP Module*<br>Is the action complete? | — | *Go to Step 11* | — |
| 10 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Refer to *PCM Replacement/Programming*<br>Is the action complete? | — | *Go to Step 11* | — |
| 11 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 12* | *Go to Step 2* |
| 12 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0122 APP Sensor1 Circuit Low Voltage




29555

### 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. This is a type D DTC.

### Conditions for Setting the DTC

- Voltage is less than .25 volts on APP 1.
- Conditions met for 2 seconds.

### Action Taken When the DTC Sets

- The input from APP 1 sensor is ignored.
- A current and history DTC will set but it will not turn on the Service Throttle Soon lamp.
- Throttle will operate normally as long as there is only one malfunction present. If there are two APP malfunctions present, the PCM will 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 only allow the engine to operate at idle.

### 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 scan tool reads APP 1 position in volts. Should read about .45 to .95 volt with throttle closed and ignition ON or at idle. Voltage should increase at a steady rate as throttle is moved toward Wide Open Throttle (WOT).Also, 90% pedal travel is acceptable for correct APP operation. Scan APP sensor while depressing accelerator pedal with engine stopped and ignition ON. Display should vary from about .74 volt when throttle is closed to about 3.7 volts when throttle is held at Wide Open Throttle (WOT) position. A DTC P0122 will result if the signal or reference circuit are open.

### 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.

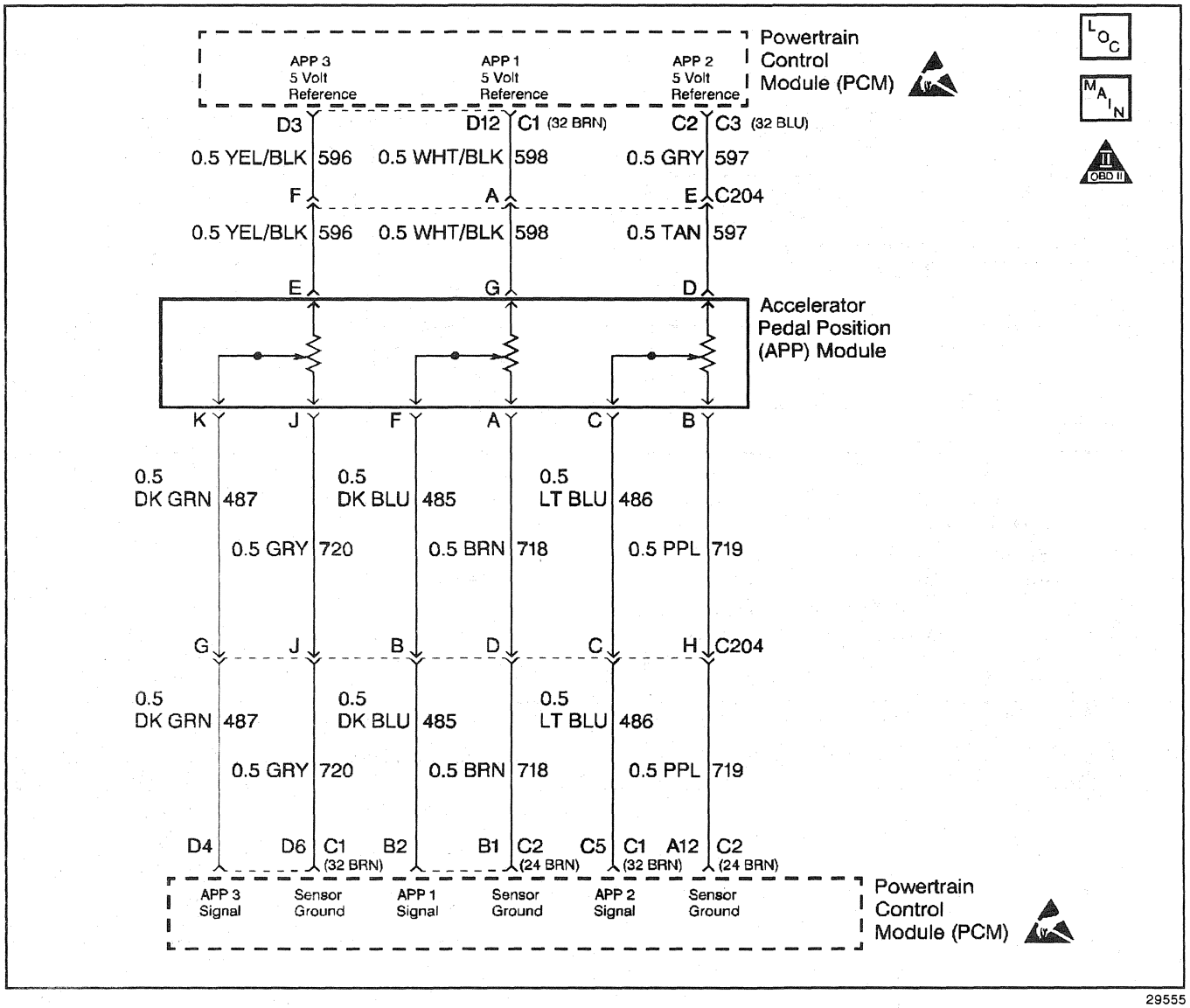
## DTC P0122 APP Sensor1 Circuit Low Voltage

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 1 | **Important:** Before clearing 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| *2* | 1. Ignition ON, engine OFF.<br>2. With the throttle closed, observe the APP 1 voltage on the Scan Tool.<br>Is APP 1 voltage less than or equal to the specified value? | .25 V | *Go to Step 3* | *Go to Step 4* |
| 3 | DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored, refer to those tables(s) first.<br>Are additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| *4* | 1. Disconnect the APP sensor electrical connector.<br>2. Jumper APP 1 5 volt reference circuit and the APP 1 signal together at the APP sensor harness connector.<br>3. Observe the APP 1 voltage on the Scan Tool.<br>Is APP 1 voltage greater than the specified value? | 4.75 V | *Go to Step 10* | *Go to Step 5* |
| 5 | 1. Connect a test light between B+ and the APP 1 sensor signal circuit at the APP sensor harness connector.<br>2. Observe the APP 1 voltage on the Scan Tool.<br>Is APP 1 voltage greater than the specified value? | 4.75 V | *Go to Step 6* | *Go to Step 8* |
| 6 | 1. Ignition OFF.<br>2. Disconnect the PCM and check the 5 volt reference circuit for an open or short to ground.<br>3. If the 5 volt reference circuit is open or shorted to ground, repair it as necessary.<br>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 poor connection at the PCM and replace terminal if necessary.<br>Did the terminal require replacement? | — | *Go to Step 12* | *Go to Step 11* |

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

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 8 | 1. Ignition OFF.<br>2. Disconnect the PCM, and check the APP 1 signal circuit for an open, short to ground.<br>3. If the APP 1 sensor signal circuit is open or shorted to ground, repair it as necessary.<br>Was the APP 1 signal circuit open or shorted to ground? | — | *Go to Step 12* | *Go to Step 9* |
| 9 | Check the APP 1 sensor signal circuit for a poor connection at the PCM and replace terminal if necessary.<br>Did the terminal require replacement? | — | *Go to Step 12* | *Go to Step 11* |
| 10 | Replace the APP module. Refer to *APP Module*<br>Is the action complete? | — | *Go to Step 12* | — |
| 11 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Refer to *PCM Replacement/Programming*<br>Is the action complete? | — | *Go to Step 12* | — |
| 12 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 13* | *Go to Step 2* |
| 13 | Using the Scan Tool, select Capture Info, Review Info.<br>Are there any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0123 App Sensor1 Circuit High Voltage




29555

### 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. This is a type D DTC.

### Conditions for Setting the DTC

- Voltage is greater than 4.75 volts on APP 1 sensor.
- Condition met for 2 seconds.

### Action Taken When the DTC Sets

- The input from APP 1 sensor is ignored.
- A current and history DTC will set but it will not turn on the Service Throttle Soon lamp.
- Throttle will operate normally as long as there is only one malfunction present. If there are two APP malfunctions present, the PCM will 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 only allow the engine to operate at idle.

### 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 scan tool reads APP 1 position in volts. Should read about .45 to .95 volt with throttle closed and ignition ON or at idle. Voltage should increase at a steady rate as throttle is moved toward Wide Open Throttle (WOT). Also, 90% pedal travel is acceptable for correct 0 APP operation. Scan APP 1 sensor while depressing accelerator pedal with engine stopped and ignition ON. Display should vary from about .74 volt when throttle was closed to about 3.7 volt when throttle is held at Wide Open Throttle (WOT) position. A P0123 will result if the ground circuit is open or the signal circuit is shorted to voltage. Refer to *Intermittents Symptoms*.

### 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.
3. This Step checks the PCM and wiring.

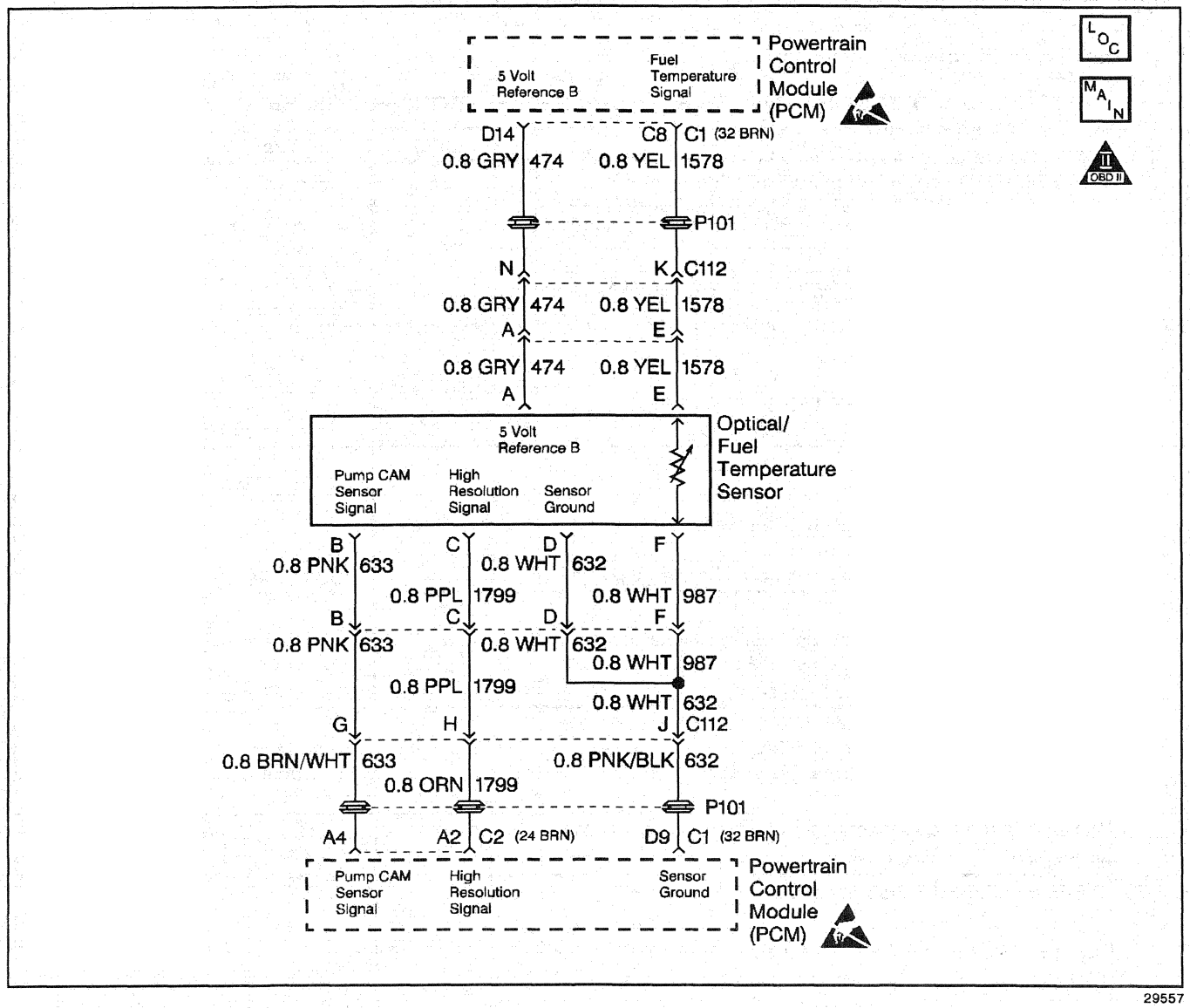
## DTC P0123 App Sensor1 Circuit High Voltage

| 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Ignition ON, engine OFF.<br>2. With the throttle closed, observe the APP 1 display on the scan tool.<br>Is APP 1 above the specified value? | 4.75 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 additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 4 | 1. Disconnect the APP sensor electrical connector.<br>2. Observe the APP 1 display on the scan tool.<br>Is APP 1 less than the specified value? | .25 V | *Go to Step 5* | *Go to Step 6* |
| 5 | Probe APP 1 sensor ground circuit at the APP sensor harness connector with a test light connected to B+.<br>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.<br>2. If the APP 1 sensor signal circuit is shorted, repair it as necessary.<br>Was the APP 1 sensor signal circuit shorted? | — | *Go to Step 11* | *Go to Step 10* |
| 7 | Check for poor electrical connections at the APP sensor and replace terminals if necessary.<br>Did any terminals require replacement? | — | *Go to Step 11* | *Go to Step 10.* |
| 8 | 1. Check for an open sensor ground circuit.<br>2. If a problem is found, repair it as necessary.<br>Was APP 1 sensor ground circuit open? | — | *Go to Step 11* | *Go to Step 10* |
| 9 | Replace the APP module. Refer to *APP Module*<br>Is the action complete? | — | *Go to Step 11* | — |
| 10 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Refer to *PCM Replacement/Programming*<br>Is the action complete? | — | *Go to Step 10* | — |

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

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 11 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 12* | *Go to Step 2* |
| 12 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0182 Fuel Temperature Sensor CKT Low Voltage




29557

### 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. This is a type B DTC.

### Conditions for Setting the DTC

- Fuel temperature greater than 102°C (215°F).
- Conditions met for 2 seconds.

### Action Taken When the DTC Sets

Poor idle quality during hot conditions.

### 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 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 scan tool reads fuel temperature in degrees centigrade. After engine is started, the fuel temperature should rise steadily.

## 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.

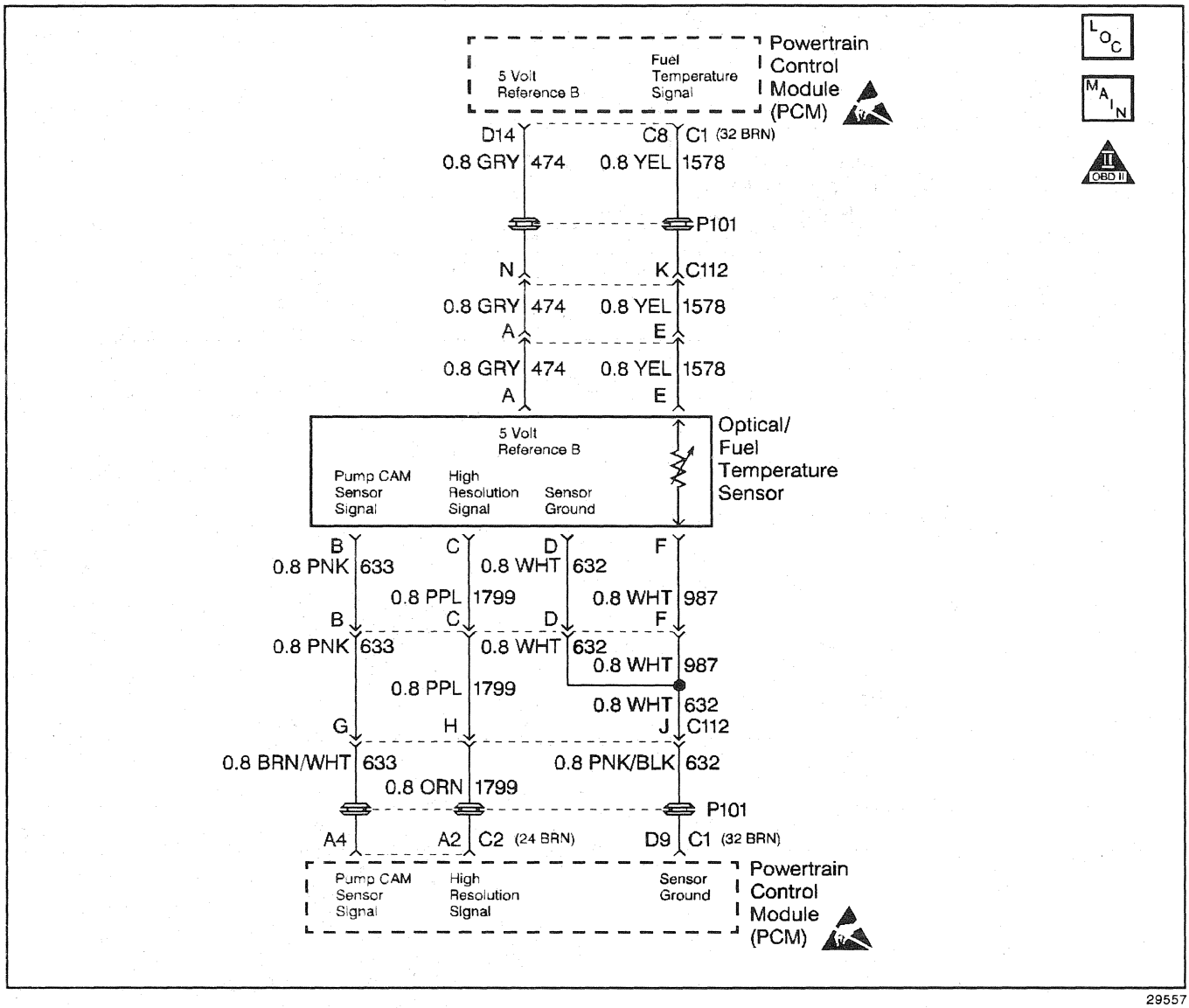
### DTC P0182 Fuel Temperature Sensor CKT Low Voltage

| 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| *2* | 1. Scan tool connected.<br>2. Start the engine.<br>3. Monitor the Fuel Temp display on scan tool.<br>Is Fuel Temp greater than the specified value? | 102°C (215°F) | *Go to Step 3* | *Go to Step 5* |
| *3* | 1. Engine OFF.<br>2. Ignition ON.<br>3. Disconnect the Optical/Fuel Temperature sensor connector.<br>Is Fuel Temp less than or equal to the specified value? | 17°C ( 63°F) | *Go to Step 7* | *Go to Step 4* |
| 4 | 1. Ignition OFF.<br>2. Using the *J 39200* measure the resistance across the Fuel Temperature sensor harness connector.<br>Is the resistance at the specified value? | Infinite | *Go to Step 8* | *Go to Step 6* |
| 5 | 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.<br>Is the action complete? | — | *Go to Step 9* | — |
| 7 | Replace the fuel injection pump.<br>**Important:** If fuel injection pump is faulty, the new injection pump must be timed. Go to Checking or Adjusting injection timing.<br>Is the action complete? | — | *Go to Step 9* | — |
| 8 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Go to *PCM Replacement/Programming*<br>Is the action complete? | — | *Go to Step 9* | — |

## DTC P0182 Fuel Temperature Sensor CKT Low Voltage (cont'd)

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 9 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 10* | *Go to Step 2* |
| 10 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTC[prime ]s displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0183 Fuel Temperature Sensor CKT High Voltage




29557

### 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. This is a type B DTC.

### Conditions for Setting the DTC

- Engine operating for 8 minutes.
- Fuel temperature less than or equal to 17 °C (63 °F).
- Conditions met for 2 seconds.

### Action Taken When the DTC Sets

Poor idle quality during hot conditions.

### 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 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 scan tool reads fuel temperature in degrees centigrade. After engine is started, the temperature should rise steadily. A faulty connection, or an open in the signal circuit.

### 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 sensor connector if measured with J 39200–DVM. This will determine if there is a wiring problem or a faulty PCM.

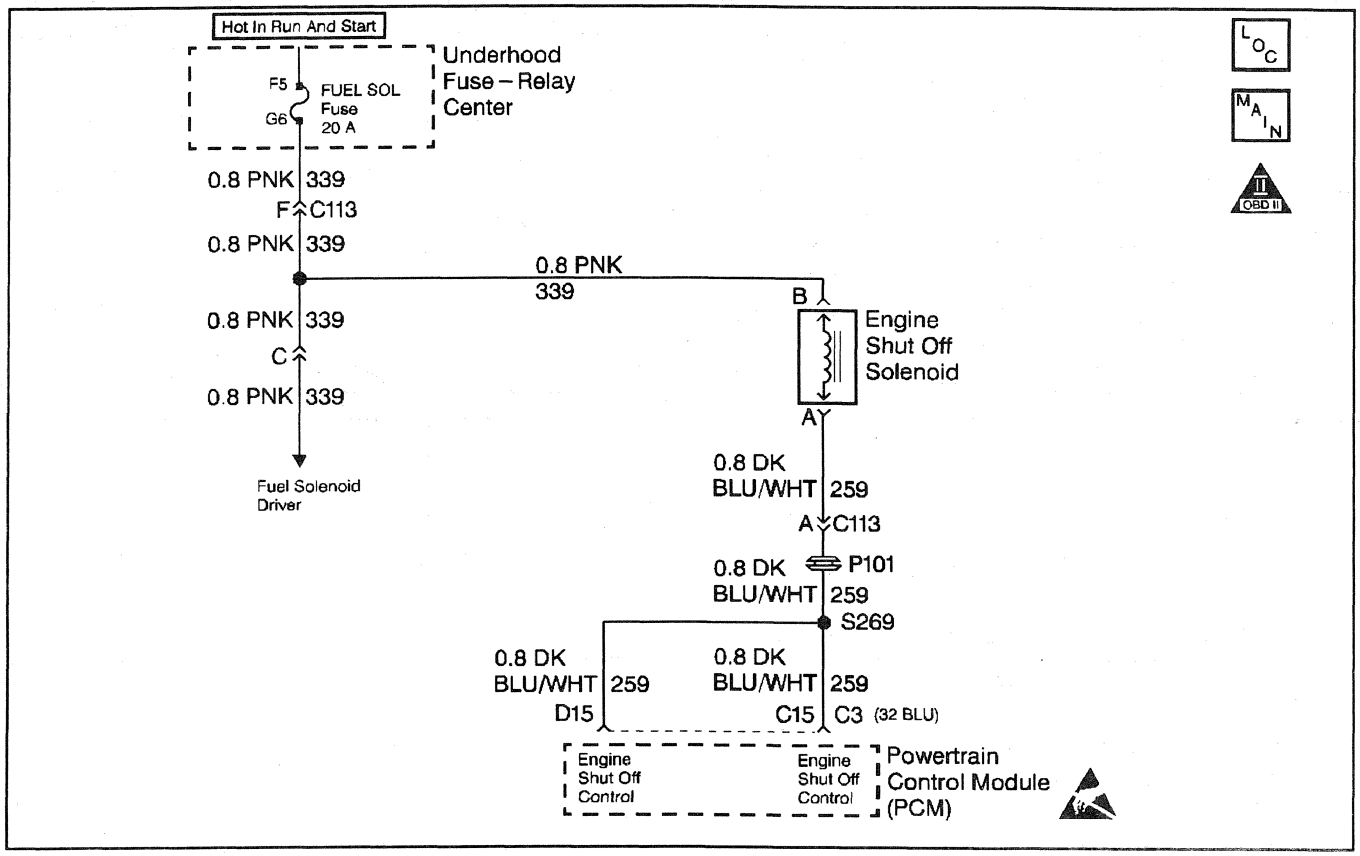
### DTC P0183 Fuel Temperature Sensor CKT High Voltage

| 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.<br>Was the Powertrain On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Scan Tool connected.<br>2. Start and idle engine.<br>3. Monitor the Fuel Temp display on Scan Tool.<br>Is Fuel Temp less than or equal to the specified value? | 17°C (63°F) | *Go to Step 3* | *Go to Step 5* |
| 3 | 1. Engine OFF.<br>2. Ignition ON.<br>3. Disconnect the Optical/Fuel Temperature sensor connector.<br>4. Jumper the Fuel Temperature harness terminals together.<br>Does the Scan Tool display 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.<br>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 | 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.<br>Are any other DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 6 | Inspect the sensor connector and PCM connector for proper connection.<br>Was a problem found? | — | *Go to Step 9* | *Go to Step 10* |
| 7 | Check the Fuel Temperature sensor ground circuit for an open between the Fuel Temp sensor and the PCM.<br>Was a problem found? | — | *Go to Step 9* | *Go to Step 11* |
| 8 | Check the Fuel Sensor signal circuit for an open between the Fuel Temp sensor and the PCM.<br>Was a problem found? | — | *Go to Step 9* | *Go to Step 11* |
| 9 | Repair the circuit as necessary.<br>Is the action complete? | — | *Go to Step 12* | — |
| 10 | Replace the injection pump. Refer to *Fuel Injection Pump*<br>Is the action complete? | — | *Go to Step 12* | — |
| 11 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Refer to *PCM Replacement/Programming*<br>Is the action complete? | — | *Go to Step 12* | — |

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

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 12 | 1. Using the Scan Tool select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 13* | *Go to Step 2* |
| 13 | Using the Scan Tool, select Capture Info, Review Info.<br>Are there any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0215 Engine Shutoff Control Circuit




### 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. This is a type D DTC.

### Conditions for Setting the DTC

- PCM requested ESO ON.
- Control circuit voltage at the PCM is greater than 8 volts.
- Conditions met for 2 seconds.

or

- PCM requested ESO OFF.
- Control circuit voltage at the PCM is less than 8 volts.
- Conditions met for 2 seconds.

### Action Taken When the DTC Sets

P0215 will not turn ON the MIL.

### 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

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.

### Test Description

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

3. This Step will check the control circuit for an open.

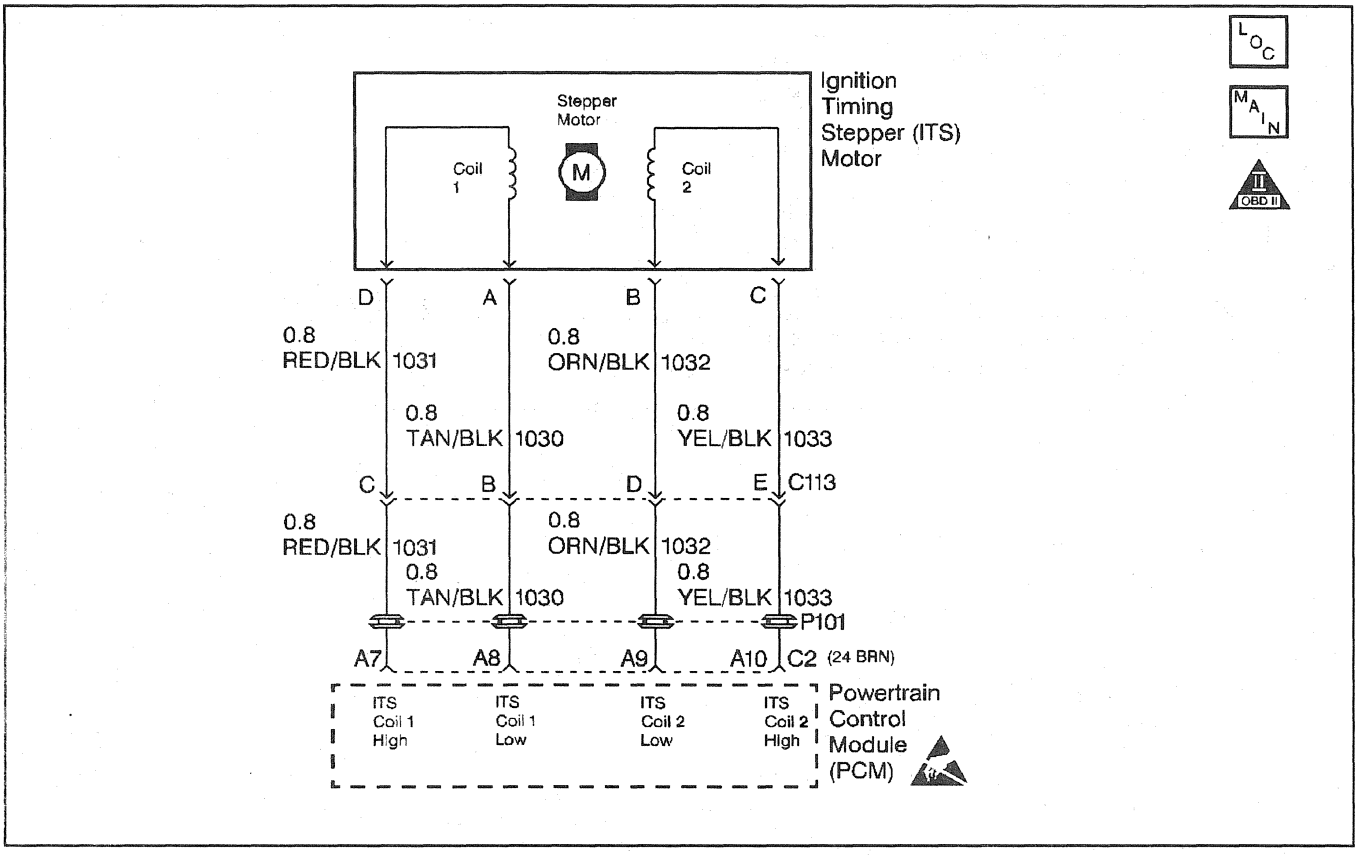
## DTC P0215 Engine Shutoff Control Circuit

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 1 | **Important:** Before clearing DTC(s) use the scan tool to record freeze frame and failure records for reference, as data will be lost when Clear Info function is used.<br>Was the Powertrain On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Ignition OFF.<br>2. Disconnect the ESO harness electrical connector.<br>3. Ignition ON, engine OFF.<br>4. With a test light connected to chassis ground, probe the ESO ignition feed circuit at harness connector.<br>Is test light ON? | — | *Go to Step 3* | *Go to Step 5* |
| *3* | 1. Ignition OFF<br>2. With a test light, jumper the ESO harness terminals together.<br>3. Ignition ON, engine OFF.<br>Is test light ON? | — | *Go to Step 4* | *Go to Step 6* |
| 4 | Check the ESO harness for a poor connection and replace terminals if necessary.<br>Did the terminal require replacement? | — | *Go to Step 9* | *Go to Step 7* |
| 5 | 1. Check the ESO ignition feed circuit for:<br>• an open<br>• faulty fuse.<br>2. If the ESO ignition feed circuit was faulty, repair it as necessary.<br>Was a repair performed? | — | *Go to Step 9* | — |
| 6 | 1. Check the ESO control circuit for the following conditions:<br>• an open.<br>• poor connection at PCM.<br>• circuit shorted to ground.<br>2. If the ESO control circuit was faulty, repair it as necessary.<br>Was a repair performed? | — | *Go to Step 09* | *Go to Step 8* |
| 7 | Replace the injection pump. Refer to *Fuel Injection Pump*<br>**Important:** If the injection pump is faulty, the new injection pump must be timed. Refer to *Checking/Adjust Injection Timing*<br>Is the action complete? | — | *Go to Step 9* | — |
| 8 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Refer to *PCM Replacement/Programming*<br>Is the action complete? | — | *Go to Step 9* | — |

## DTC P0215 Engine Shutoff Control Circuit (cont'd)

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 9 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 10* | *Go to Step 2* |
| 10 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DT'Cs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0216 Injection Timing Control Circuit




29541

### Circuit Description

Timing of the combustion event is accomplished by delivering a pulse of fuel into the combustion chamber at a desired degree of cylinder travel. This desired degree (desired timing), defines the current position of the cylinder 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 Setting the DTC

- Engine speed has not changed more than 56 rpm for 20.8 seconds.
- A 5 degree deference between Act. Inj. Time and Des. Inj. Time

### Action Taken When the DTC Sets

Possible combustion noise.

### 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 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 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 Checking and Adjusting Injection Timing 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.

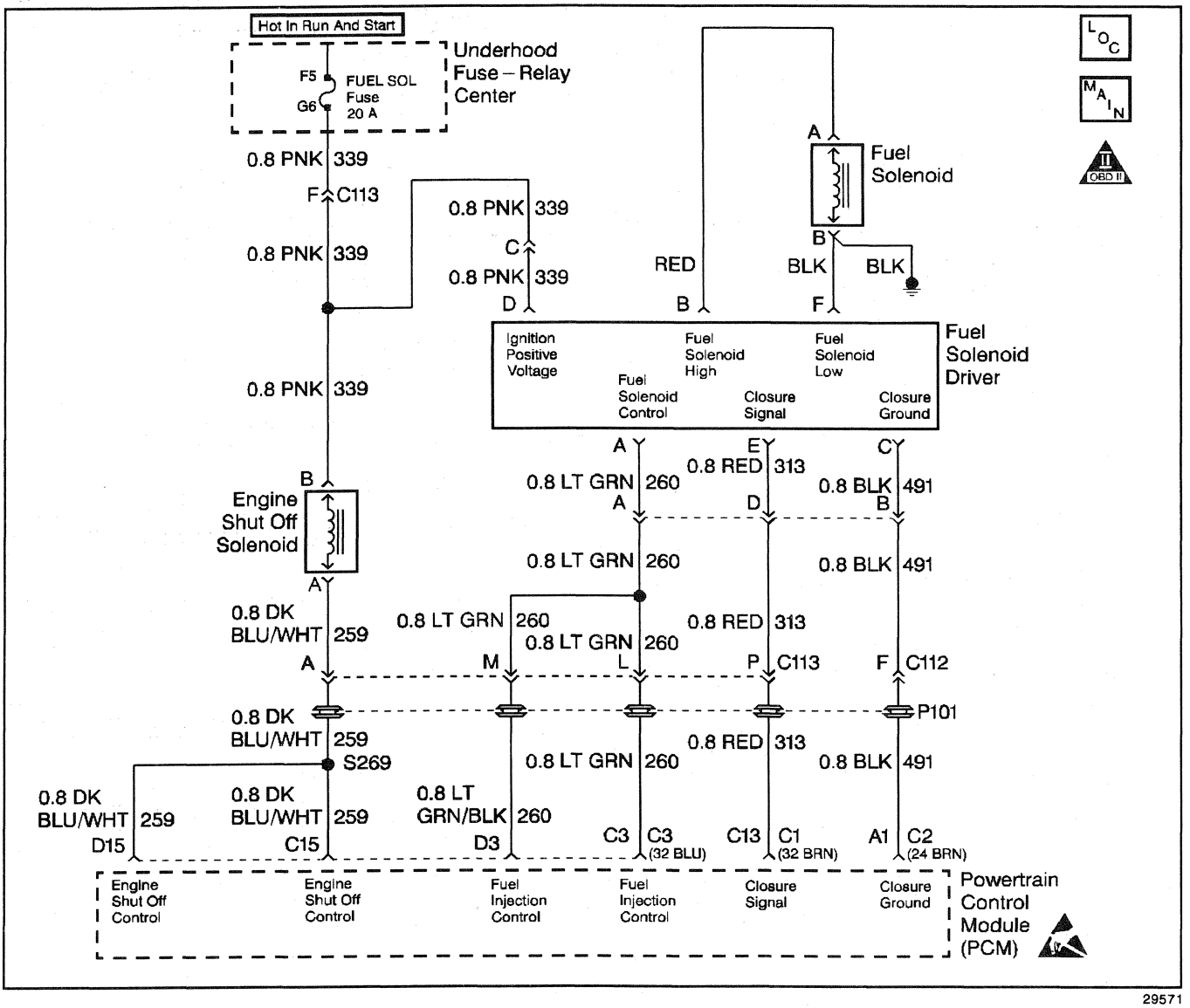
### DTC P0216 Injection Timing Control Circuit

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 1 | 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to OBD System Check |
| 2 | 1. Engine at operating temperature.<br>2. Scan injection timing at idle and at 1500 rpm.<br>Does scan tool display a the difference of the specified value between Actual Inj Time and Desired Inj Time at idle or at 1500 RPMs? | 5° | *Go to Step 3* | *Go to Step 4* |
| 3 | 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 DTCs stored? | — | Go to thepplicable DTC Table | Go to Diagnostic Aids |
| 4 | 1. Ignition OFF.<br>2. Disconnect PCM.<br>3. Measure resistance between coil 1 low and coil 1 high at PCM harness.<br>Is resistance between specified value? | 10 – 60 Ohms | *Go to Step 5* | *Go to Step 9* |
| 5 | Measure resistance between coil 2 low and coil 2 high at PCM harness.<br>Is resistance between specified value? | 10 – 60 Ohms | *Go to Step 6* | *Go to Step 10* |
| 6 | 1. Reconnect PCM.<br>2. Disconnect Injection Timing Stepper motor.<br>3. Start and idle engine.<br>4. Using scan tool, command Time Set ON.<br>5. With J 39200 connected to ground, check for a varying voltage on all terminals at injection timing Stepper motor electrical harness.<br>Does voltage vary? | — | *Go to Step 7* | *Go to Step 12* |
| 7 | 1. Disconnect crankshaft position sensor.<br>2. Measure resistance between crankshaft position sensor signal and 5 volt reference circuit at sensor pigtail.<br>Is resistance between specified value? | 950 –1050 Ohms | *Go to Step 8* | *Go to Step 15* |
| 8 | Check for one of the following:<br>• Injection timing set correctly<br>• Sheared camshaft driven key<br>Was a repair performed? | — | *Go to Step 18* | *Go to Step 16* |

## DTC P0216 Injection Timing Control Circuit (cont'd)

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 9 | 1. Ignition OFF.<br>2. Disconnect PCM and check for an open in one of the following:<br>• Coil 1 low circuit.<br>• Coil 1 high circuit.<br>• If a problem is found, repair it as necessary.<br>Was a repair performed? | — | *Go to Step 18* | *Go to Step 16* |
| 10 | 1. Ignition OFF.<br>2. Disconnect PCM and check for an open in one of the following:<br>• Coil 2 low circuit.<br>• Coil 2 high circuit.<br>• If a problem is found, repair it as necessary.<br>Was a repair performed? | — | *Go to Step 18* | *Go to Step 16* |
| 11 | Check for poor electrical connection at the injection timing Stepper motor.<br>Did any terminals require replacement? | — | *Go to Step 12* | *Go to Step 17* |
| 12 | Check the circuit for a short to ground or a poor connection at the PCM.<br>Was a repair performed? | — | *Go to Step 18* | *Go to Step 17* |
| 13 | 1. Check crankshaft sensor pigtail for a short to ground.<br>2. If the circuit is shorted to ground, repair it as necessary.<br>Was the circuit shorted to ground? | — | *Go to Step 18* | *Go to Step 14* |
| 14 | Check the circuit for a poor connection and replace terminal if necessary.<br>Did the terminal require replacement? | — | *Go to Step 18* | *Go to Step 17* |
| 15 | Replace crankshaft position sensor. Refer to *Crankshaft Position Sensor*<br>Is the action complete? | — | *Go to Step 18* | — |
| 16 | Replace Injection pump. Refer to *Fuel Injection Pump*<br>**Important:** If injection pump is faulty, the new injection pump must be timed. Refer to *Checking/Adjust Injection Timing*<br>Is the action complete? | — | *Go to Step 18* | — |
| 17 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Refer to *PCM Replacement/Programming*<br>Is the action complete? | — | *Go to Step 18* | — |
| 18 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 19* | *Go to Step 2* |
| 19 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0219 Engine Overspeed Condition




29571

### Circuit Description

The PCM has the ability to put the vehicle in a ESO controlled idle if an engine overspeed condition has been detected. This is a type D DTC.

### Conditions for Setting the DTC

5 ESO cycles with an RPM drop.

### 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).

### 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

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

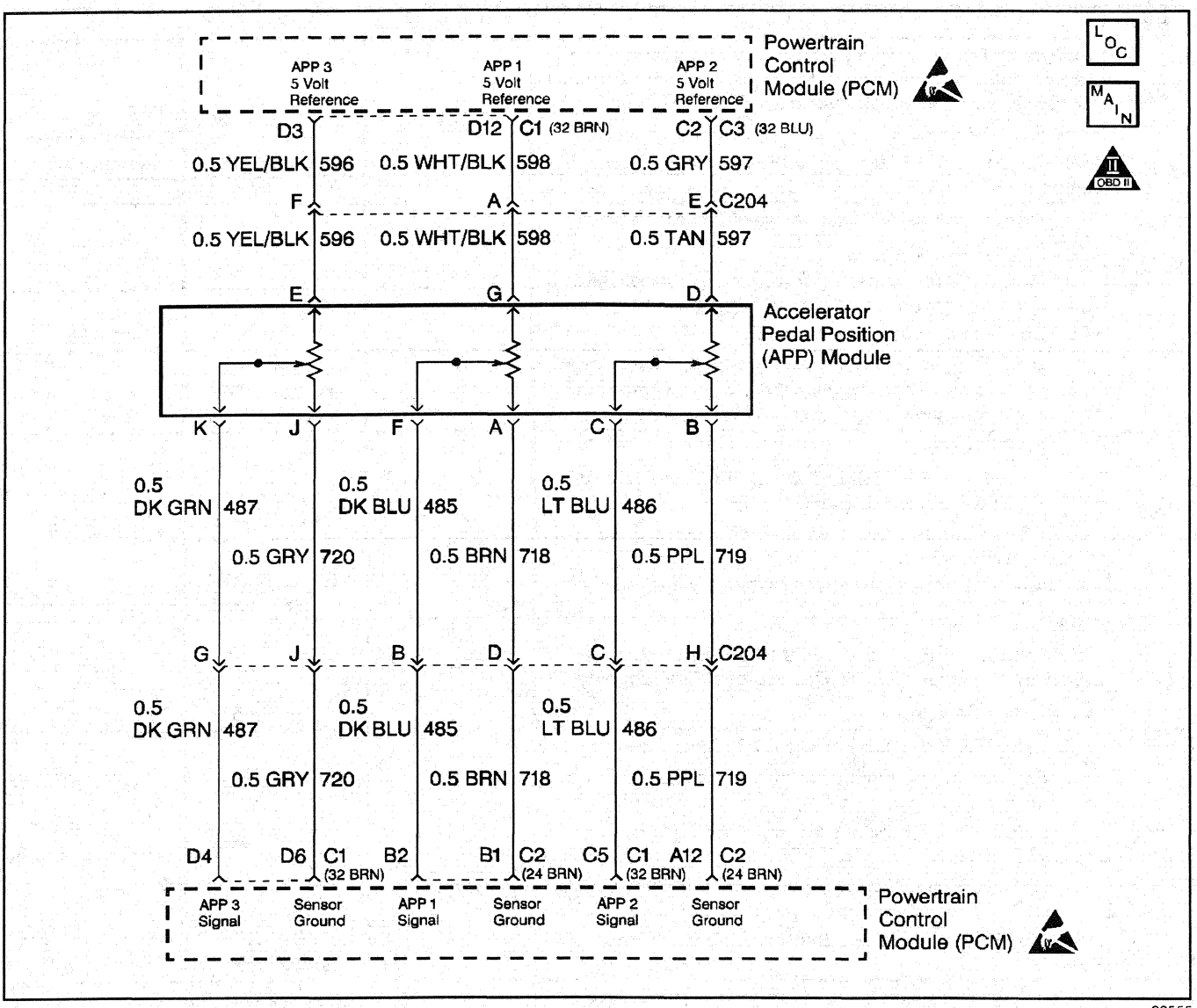
Number(s) below refer to the Step number(s) on the Diagnostic Table.

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

## DTC P0219 Engine Overspeed Condition

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 1 | 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to OBD System Check |
| 2 | Replace Injection pump. If injection pump is faulty, the new injection pump must be timed. Refer to Checking and Adjusting Injection Timing.<br>Is the action complete? | — | *Go to Step 3* | — |
| 3 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 4* | *Go to Step 2* |
| 4 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0220 APP Sensor2 Circuit




29555

### 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. This is a type D DTC.

### Conditions for Setting the DTC

- Reference voltage on APP 2 less than 4.8 volts.
- Condition met for 2 seconds.

### Action Taken When the DTC Sets

If DTC P0220 is stored, the PCM will turn ON the Service Throttle Soon lamp and limit power.

### 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

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

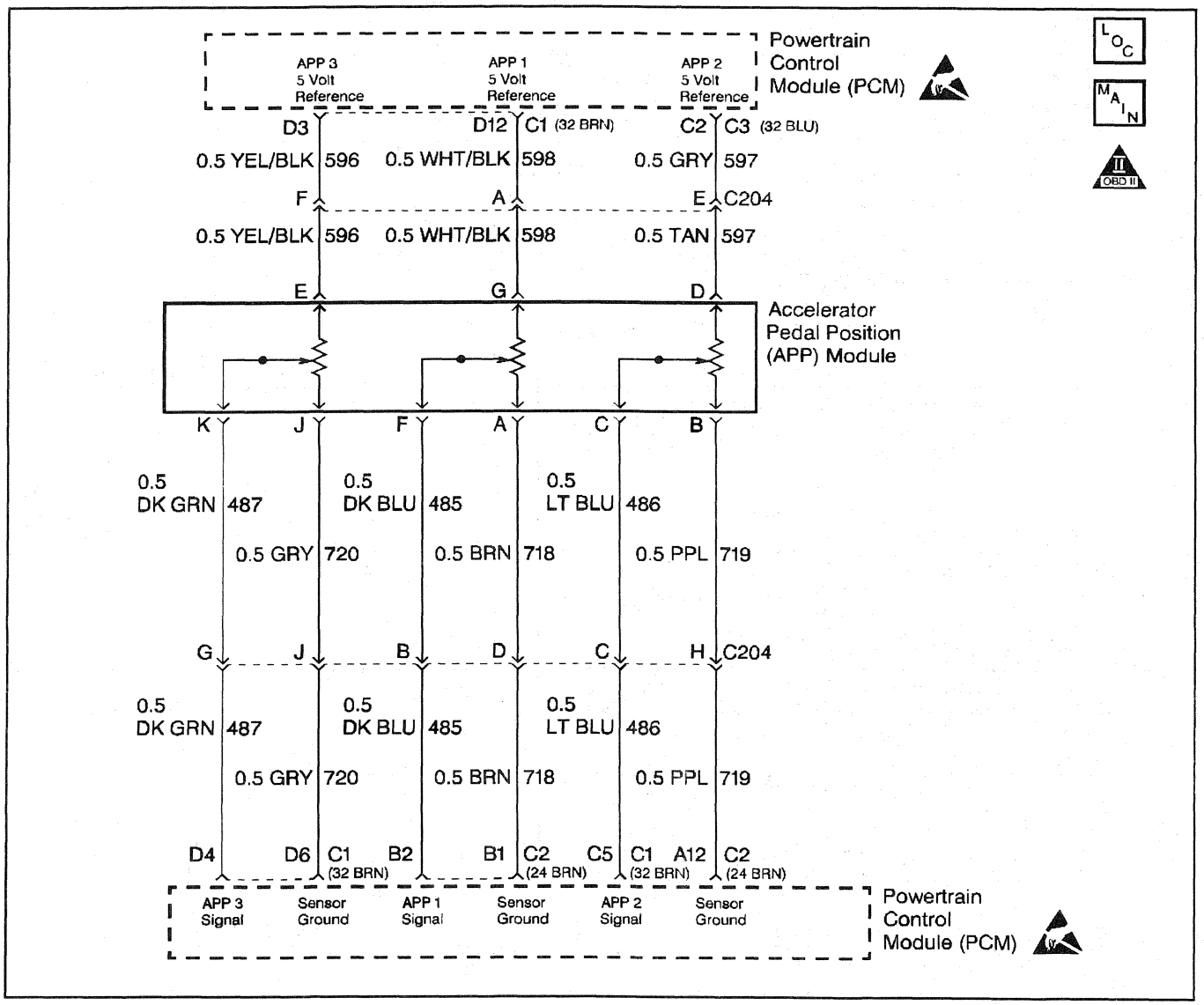
Number(s) below refer to the Step number(s) on the Diagnostic Table.

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 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| *2* | 1. Disconnect the APP sensor electrical connector.<br>2. Ignition ON, engine OFF.<br>3. With *J 39200* connected to ground, check all APP 5 volt reference circuits at APP harness.<br>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 those table(s) first. Are additional DTC(s) stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 4 | 1. Ignition OFF.<br>2. Disconnect the PCM and check the 5 volt reference circuit for a short to ground.<br>3. If the 5 volt reference circuit is shorted to ground, repair it as necessary.<br>Was the 5 volt reference circuit shorted to ground? | — | *Go to Step 6* | *Go to Step 5* |
| 5 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Refer to *PCM Replacement/Programming*<br>Is the action complete? | — | *Go to Step 6* | — |
| 6 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 7* | *Go to Step 2* |
| 7 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTC[prime ]s displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0221 APP Sensor2 Circuit Performance




29555

### 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. This is a type C DTC.

### Conditions for Setting the DTC

- Ignition voltage greater than 6.4 volts.
- Engine speed greater than 300 RPM.
- The difference between APP 2 and APP 1 is greater than .23 volts (PCM compares pre–scaled voltage (internal to PCM)).
- The difference between APP 2 and APP 3 is greater than .50 volts (PCM compares pre–scaled voltage(internal to PCM)).
- No in range faults for APP 1 or APP 3 (PCM checks for high and low voltage faults).
- Conditions met for 2 seconds.

### Action Taken When the DTC Sets

- The input from APP 2 sensor is ignored.
- A current and history DTC will set but it will not turn on the Service Throttle Soon lamp.
- 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 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 scan tool reads APP 2 position in volts and should read about 4.5 volts with throttle closed and ignition ON or at idle. Voltage should decrease at a steady rate as throttle is moved toward WOT. Also, 90% pedal travel is acceptable for correct APP operation. Scan APP 2 sensor while depressing accelerator pedal with engine stopped and ignition ON. Display should vary from about 4.5 volts when throttle was closed to about 1.5 volts when throttle is held at Wide Open Throttle (WOT) position.

### 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.

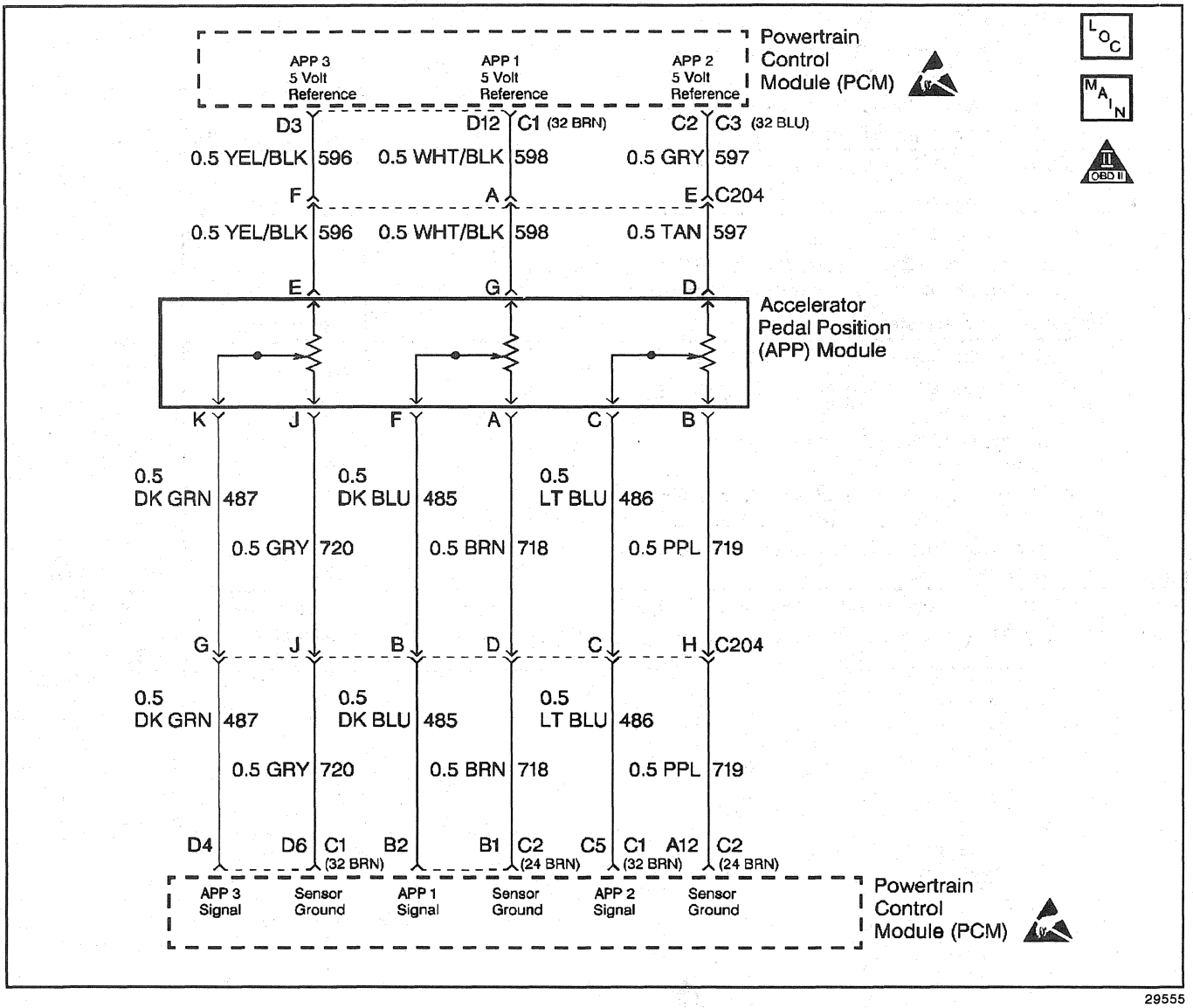
### DTC P0221 APP Sensor2 Circuit Performance

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 1 | **Important:** Before clearing 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Ignition ON, engine OFF.<br>2. With the throttle closed, observe APP voltages on the scan tool.<br>Are APP voltages at specified values? | 0.45–0.95 V<br>4.0–4.5 V<br>3.6–4.0 V | *Go to Step 3* | *Go to Step 4* |
| 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 additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| *4* | 1. Disconnect the APP sensor electrical connector.<br>2. Ignition ON, engine OFF.<br>3. With *J 39200* connected to ground, probe APP sensor 5 volt reference circuits at APP harness terminals G, D, and E.<br>Is voltage at the specified value on all circuits? | 4.75 V | *Go to Step 5* | *Go to Step 6* |
| *5* | 1. Ignition ON, engine OFF.<br>2. With a test light connected to B+, probe APP sensor ground circuits at the APP sensor harness terminals A, B, and J.<br>Is Test light ON (all circuits)? | — | *Go to Step 9* | *Go to Step 8* |
| 6 | 1. Ignition OFF.<br>2. Disconnect the PCM and check the 5 volt reference circuit for an open or short to ground.<br>3. If the 5 volt reference circuit is open or shorted to ground, repair it as necessary.<br>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 poor connection at the PCM and replace terminal if necessary.<br>Did the terminal require replacement? | — | *Go to Step 11* | *Go to Step 10* |

## DTC P0221 APP Sensor2 Circuit Performance (cont'd)

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 8 | 1. Ignition OFF.<br>2. Disconnect the PCM and check for an open sensor ground circuit to the PCM.<br>3. If problem is found, repair as necessary.<br>Was APP sensor ground circuit open? | — | *Go to Step 11* | *Go to Step 10* |
| 9 | Replace the APP module. Refer to *APP Module.*<br>Is the action complete? | — | *Go to Step 11* | — |
| 10 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Refer to *PCM Replacement/Programming.*<br>Is the action complete? | — | *Go to Step 11* | — |
| 11 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 12* | *Go to Step 2* |
| 12 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0222 APP Sensor2 Circuit Low Voltage




29555

### 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. This is a type D DTC.

### Conditions for Setting the DTC

- Voltage is less than .25 volt on APP 2 sensor.
- Condition met for 2 seconds

### Action Taken When the DTC Sets

- The input from APP 2 sensor is ignored.
- A current and history DTC will set but it will not turn on the Service Throttle Soon lamp.
- 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 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 scan tool reads APP 2 position in volts and should read about 4.5 volts with throttle closed and ignition ON or at idle. Voltage should decrease at a steady rate as throttle is moved toward WOT. Also, 90% pedal travel is acceptable for correct APP operation. Scan APP 2 sensor while depressing accelerator pedal with engine stopped and ignition ON. Display should vary from about 4.5 volts when throttle was closed to about 1.5 volts when throttle is held at Wide Open Throttle (WOT) position.

## 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.

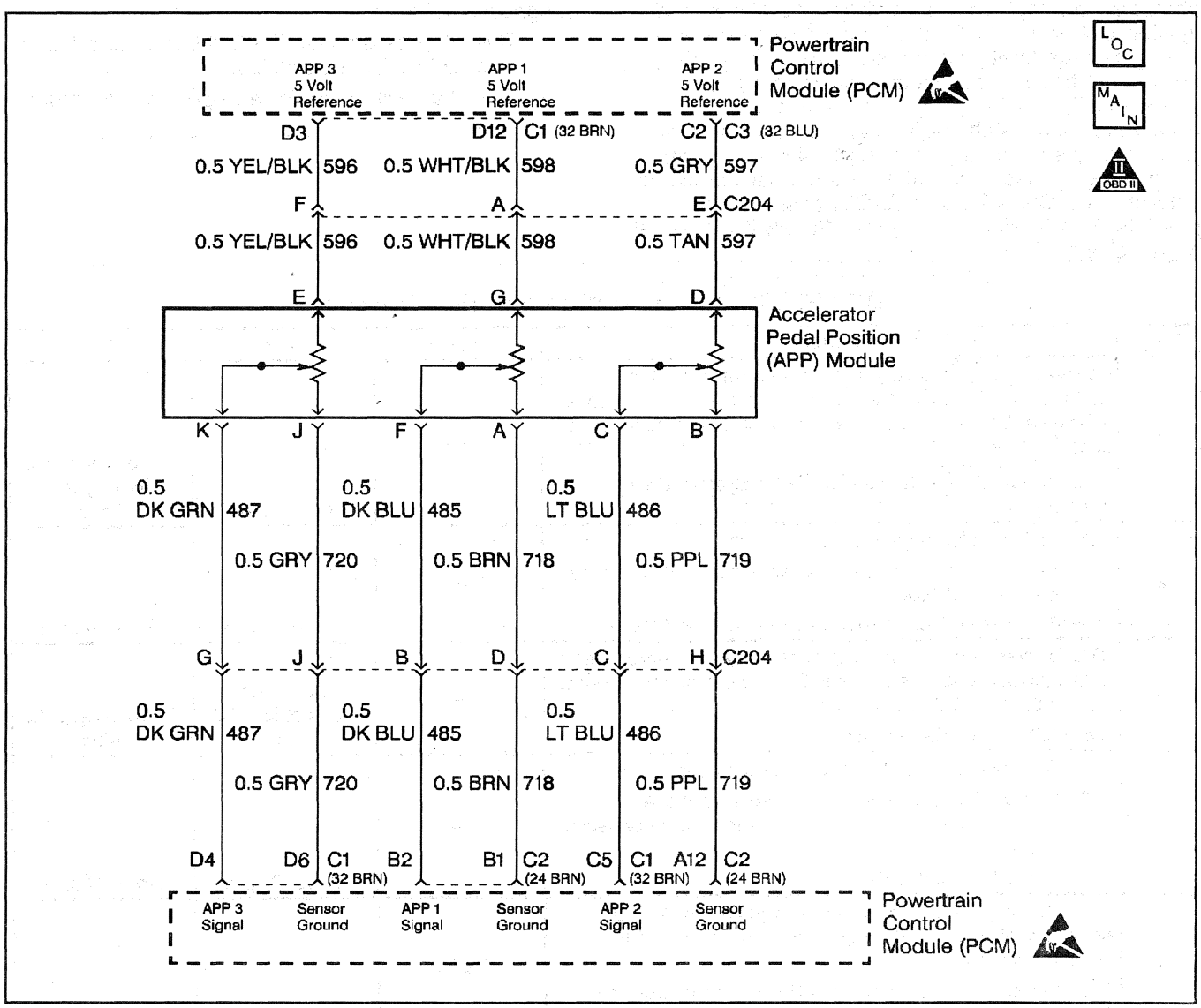
## DTC P0222 APP Sensor2 Circuit Low Voltage

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 1 | **Important:** Before clearing 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| *2* | 1. Ignition ON, engine OFF.<br>2. With the throttle closed, observe the APP 2 voltage on the Scan Tool.<br>Is APP 2 voltage less than or equal to the specified value? | 0.25 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 those tables(s) first.<br>Are additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 4 | 1. Disconnect the APP sensor electrical connector.<br>2. Use the *J 39200* in order to probe the APP 2, 5 volt reference circuit at APP harness.<br>Is 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.<br>Is APP 2 voltage greater than the specified value? | 5 V | *Go to Step 10* | *Go to Step 8* |
| 6 | 1. Ignition OFF.<br>2. Disconnect the PCM and check the 5 volt reference circuit for an open or short to ground.<br>3. If the 5 volt reference circuit is open or shorted to ground, repair it as necessary.<br>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 poor connection at the PCM and replace the terminal if necessary.<br>Did the terminal require replacement? | — | *Go to Step 13* | *Go to Step 12* |
| 8 | 1. Ignition OFF.<br>2. Disconnect the PCM, and check the APP 2 signal circuit for an open, or a short to ground.<br>3. If the APP 2 sensor signal circuit is open or shorted to ground, repair it as necessary.<br>Was the APP 2 signal circuit open or shorted to ground? | — | *Go to Step 13* | *Go to Step 9* |
| 9 | Check the APP 2 sensor signal circuit for a poor connection at the PCM and replace terminal if necessary.<br>Did the terminal require replacement? | — | *Go to Step 13* | *Go to Step 12* |

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

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 10 | Check for a poor electrical connection at the APP sensor.<br>Was a repair performed? | — | *Go to Step 13* | *Go to Step 11* |
| 11 | Replace the APP module. Refer to *APP Module*.<br>Is the action complete? | — | *Go to Step 13* | — |
| 12 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Refer to *PCM Replacement/Programming*.<br>Is the action complete? | — | *Go to Step 13* | — |
| 13 | 1. Use the Scan Tool in order to select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 14* | *Go to Step 2* |
| 14 | Using the Scan Tool, select Capture Info, Review Info.<br>Are there any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0223 APP Sensor2 Circuit High Voltage




29555

### 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. This is a type D DTC.

### Conditions for Setting the DTC

- Voltage is greater than 4.75 volts on APP 2.
- Condition met for 2 seconds.

### Action Taken When the DTC Sets

- The input from APP 2 sensor is ignored.
- A current and history DTC will set but it will not turn on the Service Throttle Soon lamp.
- 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 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 Scan tool reads APP 2 position in volts and should read about 4.5 volts with throttle closed and ignition ON or at idle. Voltage should decrease at a steady rate as throttle is moved toward WOT. Also, 90% pedal travel is acceptable for correct APP operation. Scan APP 2 signal while depressing accelerator pedal with engine stopped and ignition ON. Display should vary from about 4.5 volts when throttle was closed to about 1.5 volts when throttle is held at Wide Open Throttle (WOT) position. Its 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.

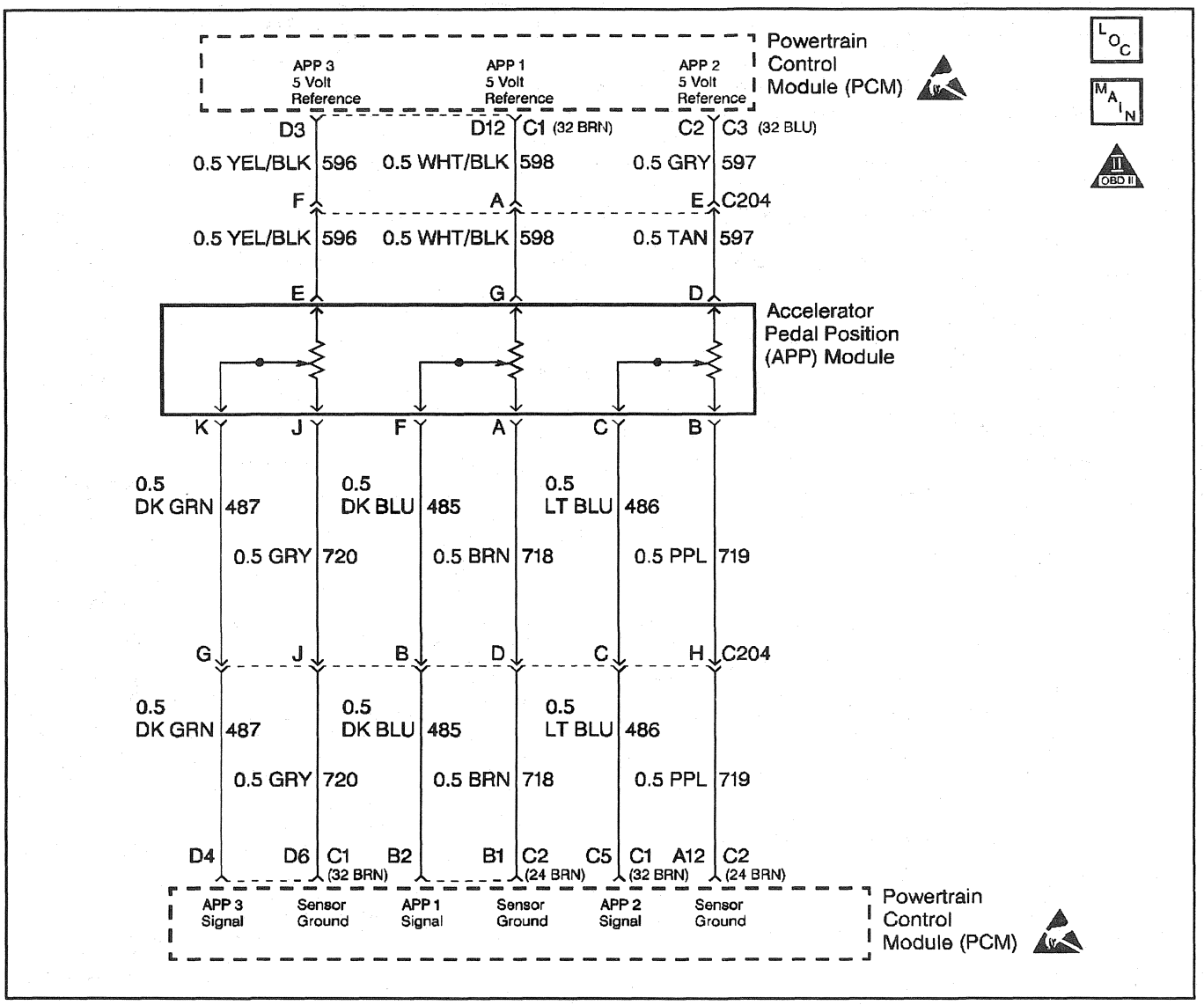
### DTC P0223 APP Sensor2 Circuit High Voltage

| 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| *2* | 1. Ignition ON, engine OFF.<br>2. With the throttle closed, observe the APP 2 display on the scan tool.<br>Is APP 2 greater than or equal to the specified value? | 4.75 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.<br>Are additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 4 | 1. Disconnect the APP sensor harness connector.<br>2. Probe APP 2 sensor ground circuit at the APP sensor harness connector with a test light connected to B+.<br>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.<br>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.<br>2. If the APP 2 sensor signal circuit is open, repair it as necessary.<br>Was the APP 2 sensor signal circuit open? | — | *Go to Step 11* | *Go to Step 10* |
| 7 | 1. Check for an open sensor ground circuit.<br>2. If a problem is found, repair it as necessary.<br>Was the APP 2 sensor ground circuit open? | — | *Go to Step 11* | *Go to Step 10* |
| 8 | Check for a poor electrical connection at the APP sensor.<br>Was the repair performed? | — | *Go to Step 11* | *Go to Step 9* |
| 9 | Replace the APP module. Refer to *APP Module*.<br>Is the action complete? | — | *Go to Step 11* | — |

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

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 10 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Refer to *PCM Replacement/Programming.*<br>Is the action complete? | — | *Go to Step 11* | — |
| 11 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 12* | *Go to Step 2* |
| 12 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0225 APP Sensor3 Circuit




29555

### 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. This is a type D DTC.

### Conditions for Setting the DTC

- Reference voltage on APP 3 below 4.8 volts.
- Condition met for 2 seconds.

### Action Taken When the DTC Sets

If DTC P0225 is present, the PCM will turn ON the Service Throttle Soon lamp and limit power.

### 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

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

### Test Description

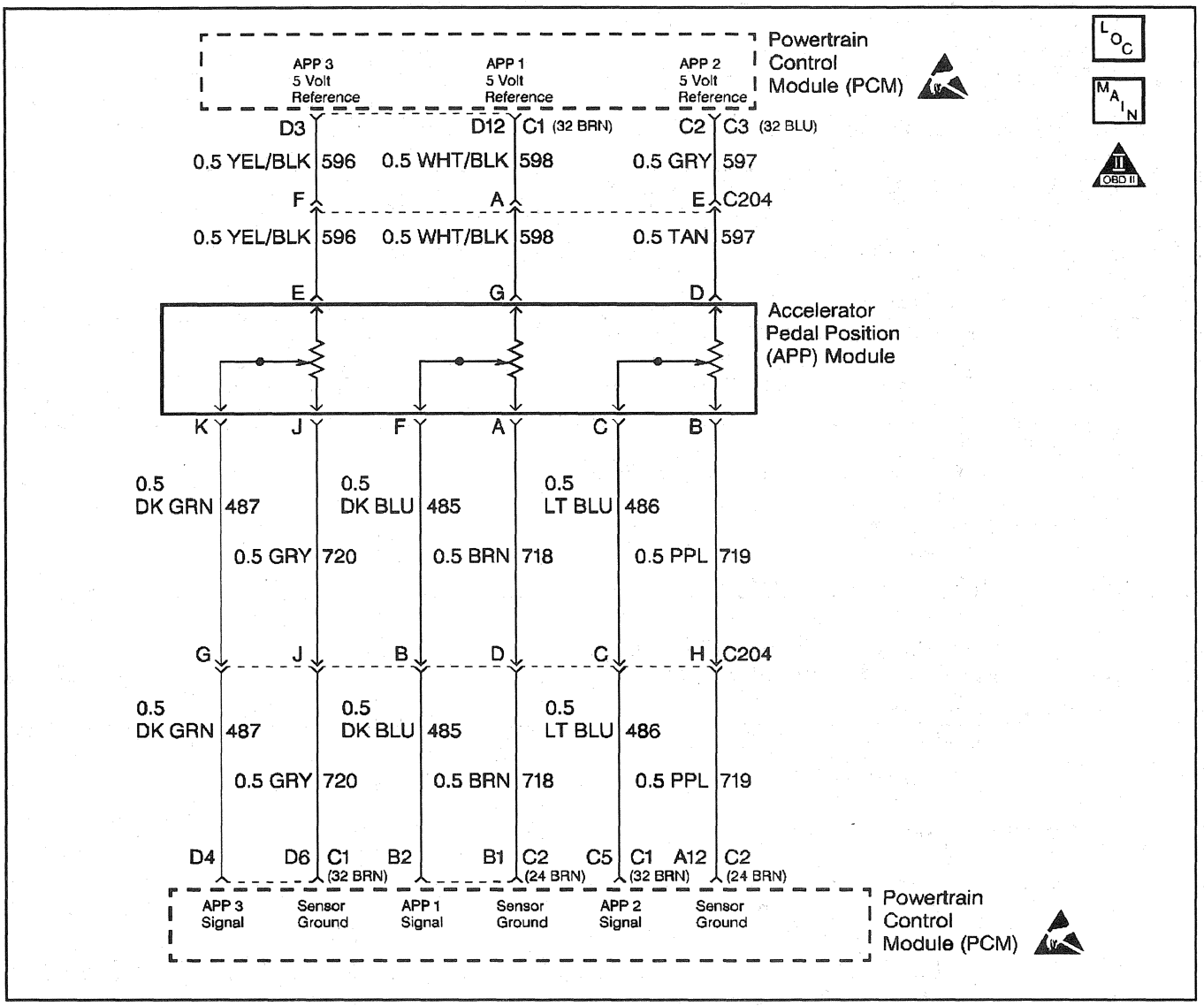
Number(s) below refer to the Step number(s) on the Diagnostic Table.

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 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| *2* | 1. Disconnect the APP sensor electrical connector.<br>2. Ignition ON, engine OFF.<br>3. With *J 39200* connected to ground, check all APP 5 volt reference circuits at APP harness.<br>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 additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 4 | 1. Ignition OFF.<br>2. Disconnect the PCM and check the 5 volt reference circuit for a short to ground.<br>3. If the 5 volt reference circuit is shorted to ground, repair it as necessary.<br>Was the 5 volt reference circuit shorted to ground? | — | *Go to Step 6* | *Go to Step 5* |
| 5 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Refer to *PCM Replacement/Programming.*<br>Is the action complete? | — | *Go to Step 6* | — |
| 6 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 7* | *Go to Step 2* |
| 7 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0226 APP Sensor3 Circuit Performance




29555

### 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. This is a type D DTC.

### Conditions for Setting the DTC

- Ignition voltage greater than 6.4 volts.
- Engine speed greater than 300 RPM.
- The difference between APP 3 and APP 1 is greater than .23 volts (PCM compares pre–scaled voltage (internal to PCM)).
- The difference between APP 3 and APP 2 is greater than .50 volts (PCM compares pre–scaled voltage(internal to PCM)).
- No in range faults for APP 1 or APP 2 (PCM checks for high and low voltage faults).
- Conditions met for 2 seconds.

### Action Taken When the DTC Sets

- The input from APP 2 sensor is ignored.
- A current and history DTC will set but it will not turn on the Service Throttle Soon lamp.
- 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 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 scan tool reads APP 3 position in volts. Should read about 4.0 volts with throttle closed and ignition ON or at idle. Voltage should decrease at a steady rate as throttle is moved toward Wide Open Throttle (WOT). Also, 90% pedal travel is acceptable for correct APP operation. Scan APP 3 sensor while depressing accelerator pedal with engine stopped and ignition ON. Display should vary from about 4.0 volts when throttle was closed to about 2.0 volts when throttle is held at Wide Open Throttle (WOT) position.

### 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.

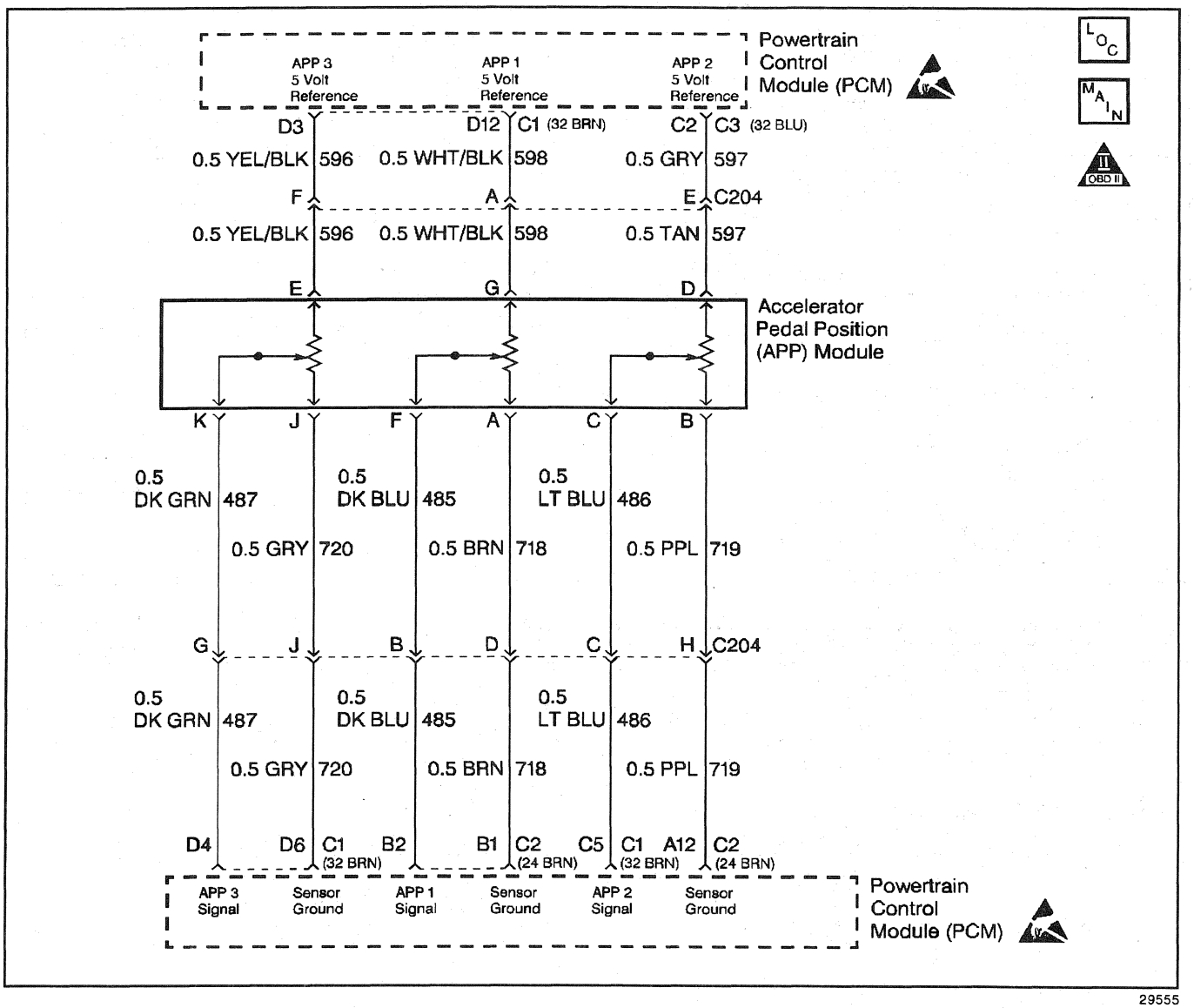
### DTC P0226 APP Sensor3 Circuit Performance

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 1 | **Important:** Before clearing 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| *2* | 1. Ignition ON, engine OFF.<br>2. With the throttle closed, observe APP voltages on the scan tool.<br>Are APP voltages at specified values? | 0.45–0.95 V<br>4.0–4.5 V<br>3.6–4.0 V | *Go to Step 3* | *Go to Step 4* |
| 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 additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 4 | 1. Disconnect the APP sensor electrical connector.<br>2. Ignition ON, engine OFF.<br>3. With *J 39200* connected to ground, probe APP sensor 5 volt reference circuits at APP harness terminals G, D, and E.<br>Is voltage at the specified value on all circuits? | 4.75 V | *Go to Step 5* | *Go to Step 6* |
| 5 | 1. Ignition ON, engine OFF.<br>2. With a test light connected to B+, probe APP sensor ground circuits at the APP sensor harness terminals A, B, and J.<br>Is Test light ON (all circuits)? | — | *Go to Step 9* | *Go to Step 8* |
| 6 | 1. Ignition OFF.<br>2. Disconnect the PCM and check the 5 volt reference circuit for an open or short to ground.<br>3. If the 5 volt reference circuit is open or shorted to ground, repair it as necessary.<br>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 poor connection at the PCM and replace terminal if necessary.<br>Did the terminal require replacement? | — | *Go to Step 11* | *Go to Step 10* |

## DTC P0226 APP Sensor3 Circuit Performance (cont'd)

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 8 | 1. Ignition OFF.<br>2. Disconnect the PCM and check for an open sensor ground circuit to the PCM.<br>3. If problem is found, repair as necessary.<br>Was APP sensor ground circuit open? | — | *Go to Step 11* | *Go to Step 10* |
| 9 | Replace the APP module. Refer to *APP Module.*<br>Is the action complete? | — | *Go to Step 11* | — |
| 10 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, 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, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 12* | *Go to Step 2* |
| 12 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0227 APP Sensor3 Circuit Low Voltage




29555

### 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. This is a type D DTC.

### Conditions for Setting the DTC

- Voltage is less than .25 volts on APP 3 sensor.
- Conditions met for 2 seconds.

### Action Taken When the DTC Sets

- The input from APP 3 sensor is ignored.
- A current and history DTC will set but it will not turn ON the Service Throttle Soon lamp.
- 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 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 scan tool reads APP 3 position in volts. Should read about 4.0 volts with throttle closed and ignition ON or at idle. Voltage should decrease at a steady rate as throttle is moved toward Wide Open Throttle (WOT). Also, 90% pedal travel is acceptable for correct APP operation. Scan APP 3 sensor while depressing accelerator pedal with engine stopped and ignition ON. Display should vary from about 4.0 volts when throttle was closed to about 2.0 volts when throttle is held at Wide Open Throttle (WOT) position.

### 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.
3. This Step checks the PCM and wiring.

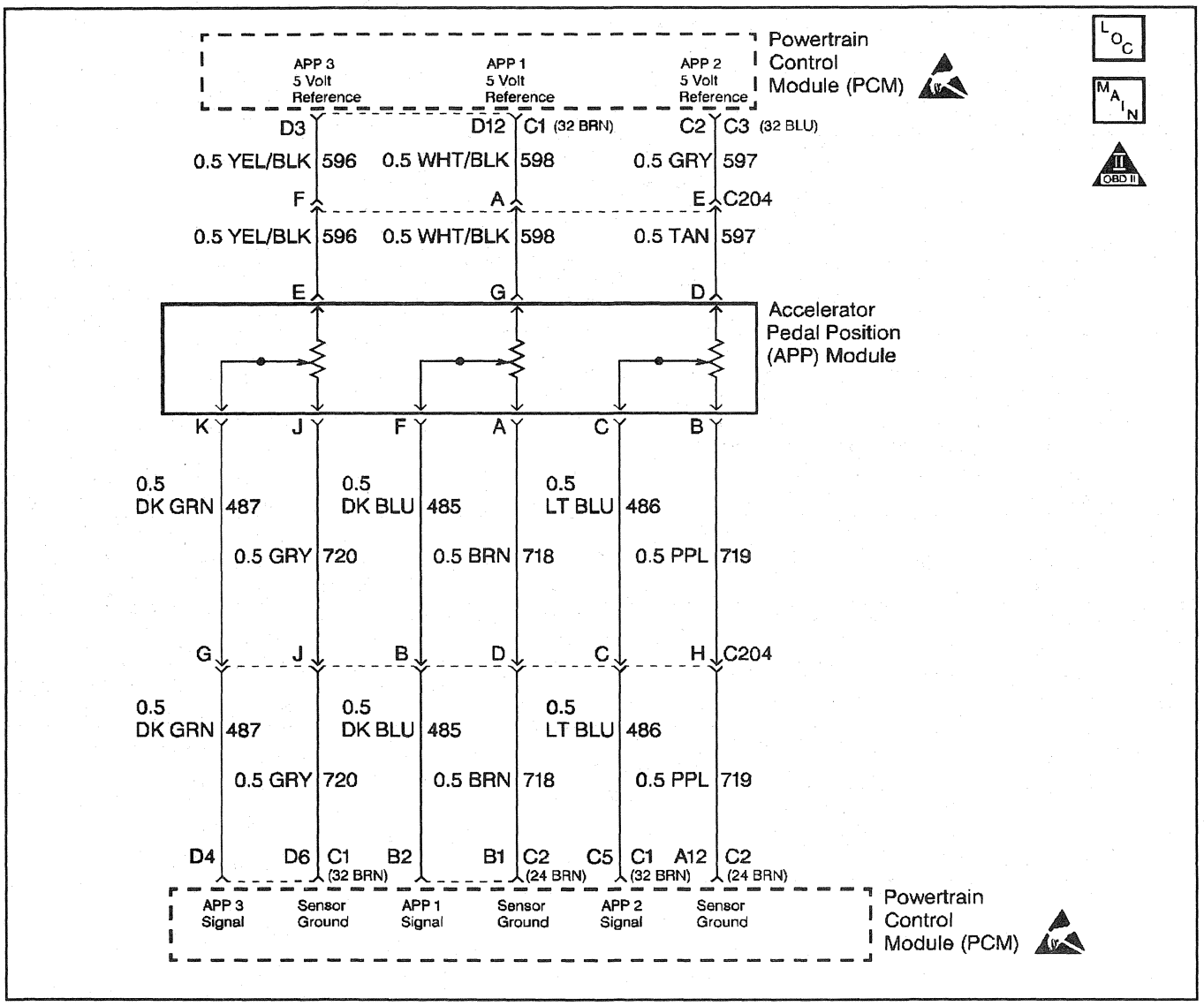
## DTC P0227 APP Sensor3 Circuit Low Voltage

| 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| *2* | 1. Ignition ON, engine OFF.<br>2. With the throttle closed, observe the APP 3 voltage on the Scan Tool.<br>Is APP 3 voltage less than or equal to the specified value? | 0.25 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 those tables(s) first.<br>Are additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 4 | 1. Disconnect the APP sensor electrical connector.<br>2. Use the *J 39200* in order to probe the APP 3, 5 volt reference circuit at the APP harness.<br>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.<br>Is the voltage at the specified value? | 5 V | *Go to Step 10* | *Go to Step 8* |
| 6 | 1. Ignition OFF.<br>2. Disconnect the PCM and check the 5 volt reference circuit for an open or short to ground.<br>3. If the 5 volt reference circuit is open or shorted to ground, repair it as necessary.<br>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 poor connection at the PCM and replace terminal if necessary.<br>Did the terminal require replacement? | — | *Go to Step 13* | *Go to Step 12* |
| 8 | 1. Ignition OFF.<br>2. Disconnect the PCM, and check the APP 3 signal circuit for an open, short to ground.<br>3. If the APP 3 sensor signal circuit is open or shorted to ground, repair it as necessary.<br>Was the APP 3 signal circuit open or shorted to ground? | — | *Go to Step 13* | *Go to Step 9* |
| 9 | Check the APP 3 sensor signal circuit for a poor connection at the PCM and replace terminal if necessary.<br>Did the terminal require replacement? | — | *Go to Step 13* | *Go to Step 12* |

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

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 10 | Check for a poor electrical connection at the APP sensor.<br>Was a repair performed? | — | *Go to Step 13* | *Go to Step 11* |
| 11 | Replace the APP module. Refer to *APP Module.*<br>Is the action complete? | — | *Go to Step 13* | — |
| 12 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Refer to *PCM Replacement/Programming.*<br>Is the action complete? | — | *Go to Step 13* | — |
| 13 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 14* | *Go to Step 2* |
| 14 | Using the Scan Tool, select Capture Info, Review Info.<br>Are there any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0228 APP Sensor3 Circuit High Voltage




29555

### 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. This is a type D DTC.

### Conditions for Setting the DTC

- Voltage is greater than 4.75 volts for 2 seconds on APP 3 sensor.
- Conditions met for 2 seconds.

### Action Taken When the DTC Sets

- The input from APP 3 sensor is ignored.
- A current and history DTC will set but it will not turn ON the Service Throttle Soon lamp.
- 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 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 scan tool reads APP 3 position in volts. Should read about 4.0 volts with throttle closed and ignition ON or at idle. Voltage should decrease at a steady rate as throttle is moved toward Wide Open Throttle (WOT). Also, 90% pedal travel is acceptable for correct APP operation. Scan APP 3 sensor while depressing accelerator pedal with engine stopped and ignition ON. Display should vary from about 4.0 volts when throttle was closed to about 2.0 volts when throttle is held at Wide Open Throttle (WOT) position.

## Test Description

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

2. This Step will determine if DTC P0228 is the result of a hard failure or an intermittent condition.
3. This Step checks the PCM and wiring.

### DTC P0228 APP Sensor3 Circuit High Voltage

| 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| *2* | 1. Ignition ON, engine OFF.<br>2. With the throttle closed, observe the APP 3 display on the scan tool.<br>Is APP 3 greater than or equal to the specified value? | 4.75 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.<br>Are additional DTCs stored ? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 4 | 1. Disconnect the APP sensor harness connector.<br>2. .Probe the APP 3 sensor ground circuit at the APP sensor harness connector with a test light connected to B+.<br>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.<br>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.<br>2. If the APP 3 sensor signal is open, repair it as necessary.<br>Was the APP 3 sensor signal circuit open? | — | *Go to Step 11* | *Go to Step 10* |
| 7 | 1. Check for an open sensor ground circuit.<br>2. If a problem is found, repair it as necessary.<br>Was APP 3 sensor ground circuit open? | — | *Go to Step 11* | *Go to Step 10* |
| 8 | Check for a poor elecrtical connection at the APP sensor.<br>Was a repair performed? | — | *Go to Step 11* | *Go to Step 9* |
| 9 | Replace the APP module. Refer to *APP Module.*<br>Is the action complete? | — | *Go to Step 11* | — |

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

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 10 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Refer to *PCM Replacement/Programming.*<br>Is the action complete? | — | *Go to Step 11* | — |
| 11 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 12* | *Go to Step 2* |
| 12 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0231 Fuel Pump Feedback Circuit Low Voltage

Refer to *Fuel Pump System*

### 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. This is a type B DTC.

### Conditions for Setting the DTC

- Fuel lift pump commanded ON.
- Ignition voltage minus 4 volts.
- Fuel lift pump voltage less than ignition voltage value.
- Condition met for 2 seconds.

### Action Taken When the DTC Sets

No action taken.

### 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 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 DTC P0231 will result in a poor performance problem under heavy loads or grades.

### Test Description

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

2. This fuel pump can also be felt for a pulsing, this will also determine if the fuel pump is working.
3. This Step checks the fuel lift pump circuit.
13. This Step checks if the PCM is sending a signal to turn ON the fuel pump. The scan tool display Lift Pump Voltage will tell you if feed back voltage is being sent back to the PCM.

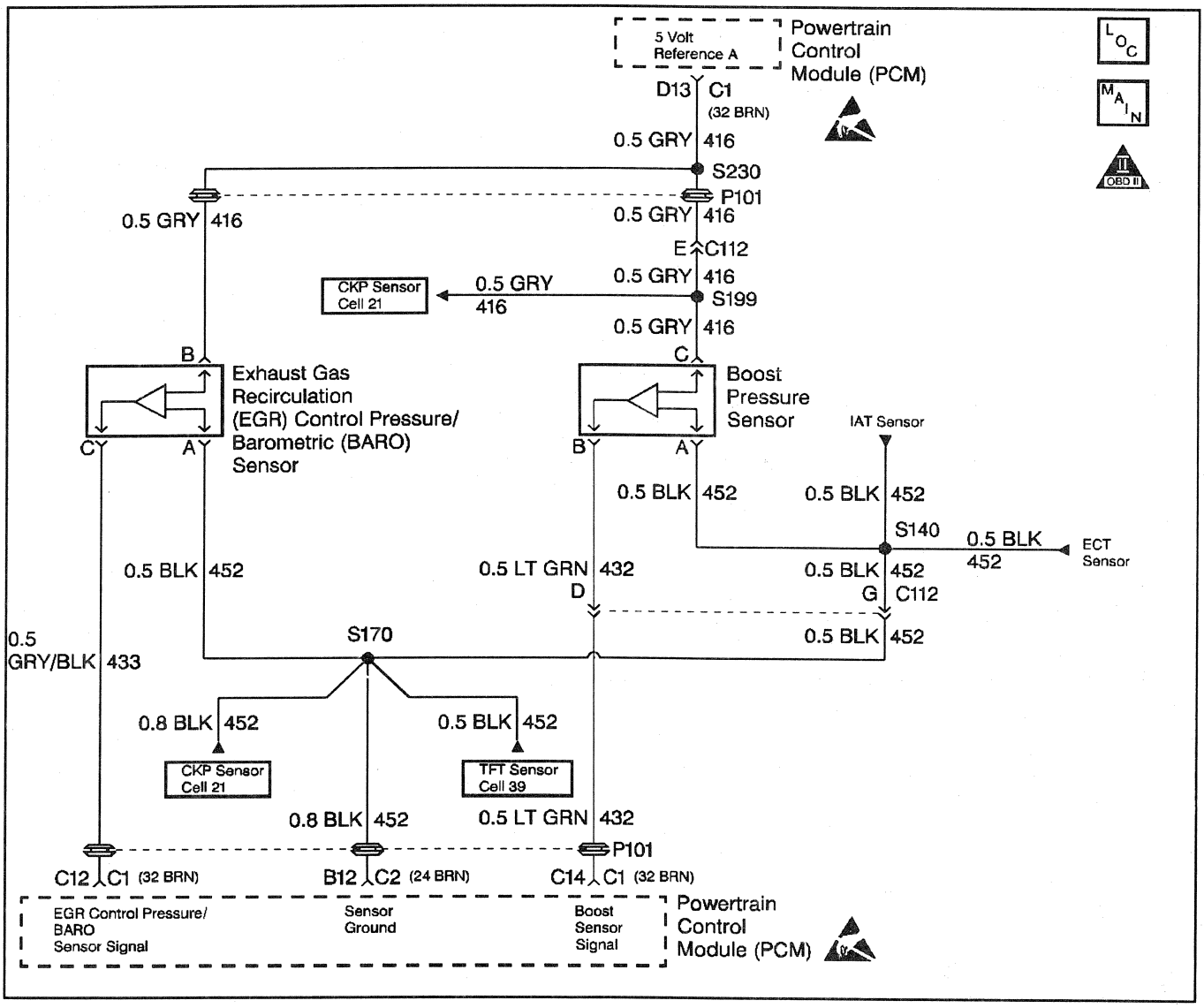
**DTC P0231 Fuel Pump Feedback Circuit Low Voltage**

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 1 | **Important:** Before clearing DTCs use the scan tool to record Freeze Frame and failure Records for reference, as data will be lost when Clear Info function is used. Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Scan tool installed.<br>2. With the scan tool command the fuel pump ON.<br>3. Listen for the fuel pump.<br>Does the fuel pump operate? | — | Go to Diagnostic Aids | *Go to Step 3* |
| 3 | 1. Turn the ignition OFF.<br>2. Probe the fuel pump test terminal with a fused jumper to B+.<br>3. Listen for the fuel pump.<br>Does the fuel pump operate? | — | *Go to Step 9* | *Go to Step 4* |
| 4 | 1. Remove the fuel pump relay.<br>2. From underneath the U/H relay center, probe the A3 terminal with a fused jumper to B+.<br>3. Listen for the fuel pump.<br>Does the fuel pump operate? | — | *Go to Step 5* | *Go to Step 6* |
| 5 | Replace the faulty fuel pump relay. Refer to *Fuel Pump Relay.*<br>Is the action complete? | — | *Go to Step 20* | — |
| 6 | Check for an open fuel pump signal circuit.<br>Was a problem found? | — | *Go to Step 7* | *Go to Step 8* |
| 7 | Check for a ground on the fuel pump signal circuit.<br>Is the action complete? | — | *Go to Step 20* | *Go to Step 16* |
| 8 | Replace the faulty fuel pump. Refer to *Fuel Lift Pump.*<br>Is the action complete? | — | *Go to Step 20* | — |

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

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 9 | 1. Turn the ignition OFF.<br>2. Remove the fuel pump relay.<br>3. Connect a test light to ground.<br>4. Probe the fuel pump relay harness connector terminal number B1.<br>Is the test light ON? | — | *Go to Step 11* | *Go to Step 10* |
| 10 | Repair the open in the battery feed circuit to the fuel pump relay.<br>Is the action complete? | — | *Go to Step 20* | — |
| 11 | Connect a test light between terminal number B1 and terminal number A1 of the fuel pump relay harness connector.<br>Is the test light ON? | — | *Go to Step 13* | *Go to Step 12* |
| 12 | Repair the open fuel pump relay ground circuit.<br>Is the action complete? | — | *Go to Step 20* | — |
| *13* | 1. Turn the ignition OFF.<br>2. Connect a test light between terminal number B3 of the fuel pump relay harness connector and ground.<br>3. Monitor the test light.<br>4. Turn the ignition ON.<br>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 17* | *Go to Step 14* |
| 14 | Check for an open in circuit from fuel pump relay harness connector terminal number B3 and PCM.<br>Was a problem found? | — | *Go to Step 15* | *Go to Step 16* |
| 15 | Repair the open in the fuel pump relay control circuit.<br>Is the action complete? | — | *Go to Step 20* | — |
| 16 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Refer to *PCM Replacement/Programming.*<br>Is the action complete? | — | *Go to Step 20* | — |
| 17 | Check for a faulty connection at fuel pump relay connector terminal number B3.<br>Was a problem found? | — | *Go to Step 18* | *Go to Step 19* |
| 18 | Repair the faulty connection at the fuel pump relay connector terminal number B3.<br>Is the action complete? | — | *Go to Step 20* | — |
| 19 | Replace the faulty fuel pump relay. Refer to *Fuel Pump Relay.*<br>Is the action complete? | — | *Go to Step 20* | — |
| 20 | After Repair, use the scan tool Clear Info function and road test vehicle. check for DTCs, Current or history. Review test status information. If status is test(s) Failed or DTCs are present begin diagnosis again, on that DTCs. If last test Failed is not present and no DTCs are present repair is complete.<br>Are the repairs complete? | — | *Go to Step 21* | — |
| 21 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0236 TC Boost System




### 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. This is a type B DTC.

### Conditions for Setting the DTC

- Engine speed greater than 2400 RPM.
- Fuel rate greater than 20 mm.
- Boost pressure less than or equal to 20 kPa from desired (internal to PCM).
- Conditions met for 10 seconds.

or

- Engine speed greater than 1800 but less than 2400 RPM.
- Fuel rate greater than 20 mm.
- Boost pressure less than or equal to (110 kPa) – ((100 kPa – BARO)/2) (internal to PCM).
- Conditions met for 2 seconds.

### Action Taken When the DTC Sets

- Poor performance
- Reduce maximum fuel.
- No 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 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 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. This diagnostic checks for a skewed sensor.

### Test Description

Number(s) below the Step number(s) on the Diagnostic Table.

3. This will check the Boost sensor scaling. One Step will check the scaling with vacuum applied and one without.

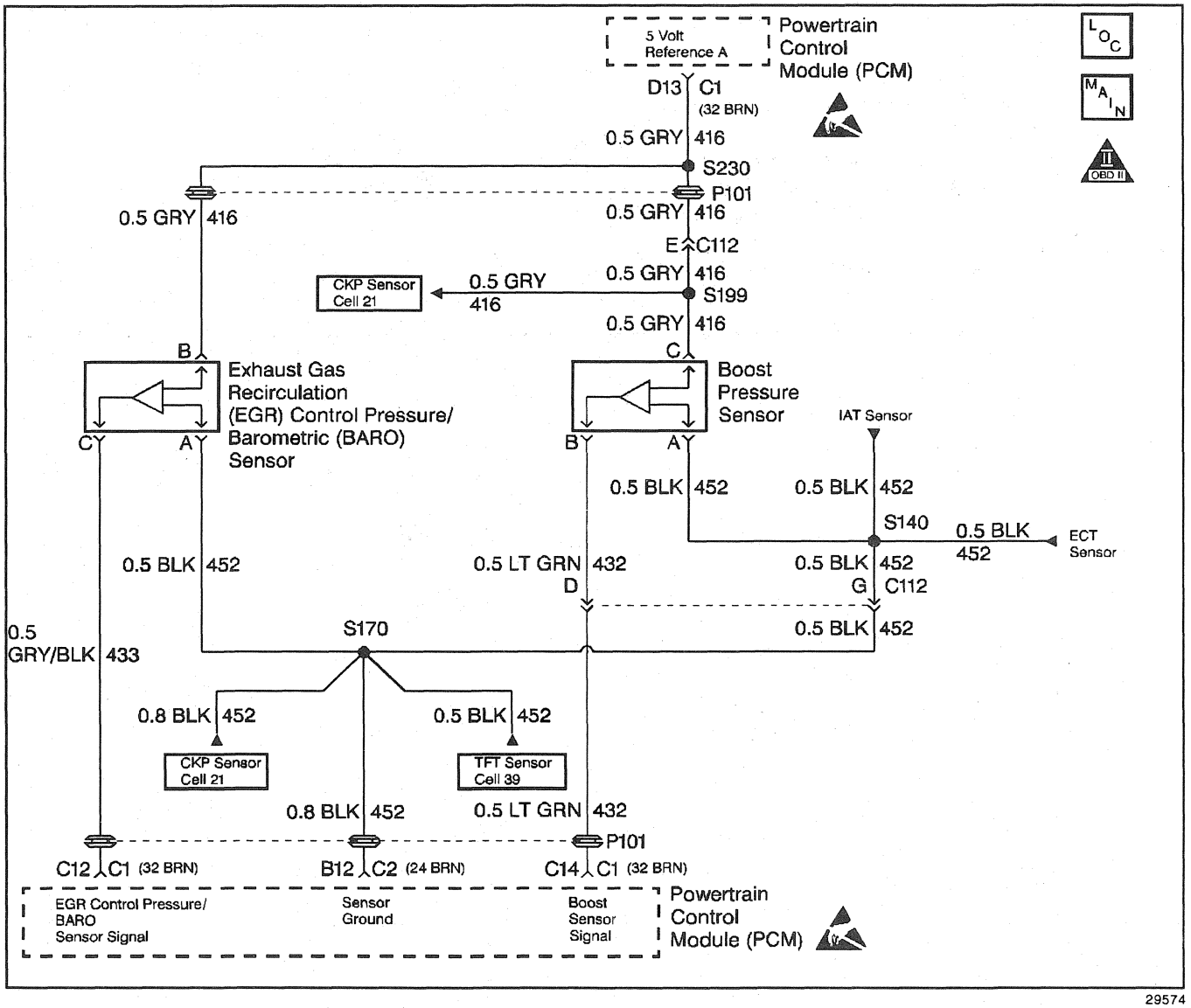
### DTC P0236 TC Boost System

| 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Install the scan tool.<br>2. Turn the ignition ON, engine OFF.<br>3. Observe scan tool displays for Boost Pressure and BARO.<br>Is the Boost Pressure and BARO within the specified value of each other? | 5 kPa | *Go to Step 3* | *Go to Step 7* |
| *3* | 1. Disconnect and plug the Boost sensor source.<br>2. Connect a vacuum pump to the Boost sensor.<br>3. Start the engine.<br>4. With *J 39200* connected to ground, probe PCM harness connector Boost signal circuit.<br>5. Note the Boost Pressure voltage.<br>6. Apply 34 kPa (10" Hg) of vacuum and note the Boost sensor voltage.<br>Subtract the second reading from the first, is the difference greater than the specified value? | 1.5 V | *Go to Step 4* | *Go to Step 5* |
| 4 | DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored, refer to those table(s).<br>Are additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 5 | Check the Boost sensor connection(s).<br>Was a problem found? | — | *Go to Step 6* | *Go to Step 7* |
| 6 | Repair the connection(s) as necessary.<br>Is the action complete? | — | *Go to Step 8* | — |
| 7 | Replace the faulty Boost sensor. Refer to *Boost Sensor (Diesel)*.<br>Is the action complete? | — | *Go to Step 8* | — |

## DTC P0236 TC Boost System (cont'd)

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 8 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 9* | *Go to Step 2* |
| 9 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0237 TC Boost Sensor Circuit Low Voltage




29574

### 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. This is a type D DTC.

### Conditions for Setting the DTC

- Boost Pressure less than 40 kPa.
- Condition met for 2 seconds.

### Action Taken When the DTC Sets

No turbo boost.

### 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 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

With the ignition ON and the engine stopped, boost pressure is equal to atmospheric pressure. Comparison of this reading with a known good vehicle using the same sensor is a good way to check accuracy of a suspect sensor. Readings should be the same + .4 volt. Very little boost can be attained by revving the engine in neutral. If the Boost sensor signal circuit is open or shorted to ground, Boost solenoid will show a zero duty cycle. A J 39200 can be used to measure (actual) signal voltage at the PCM harness connector.

## 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.

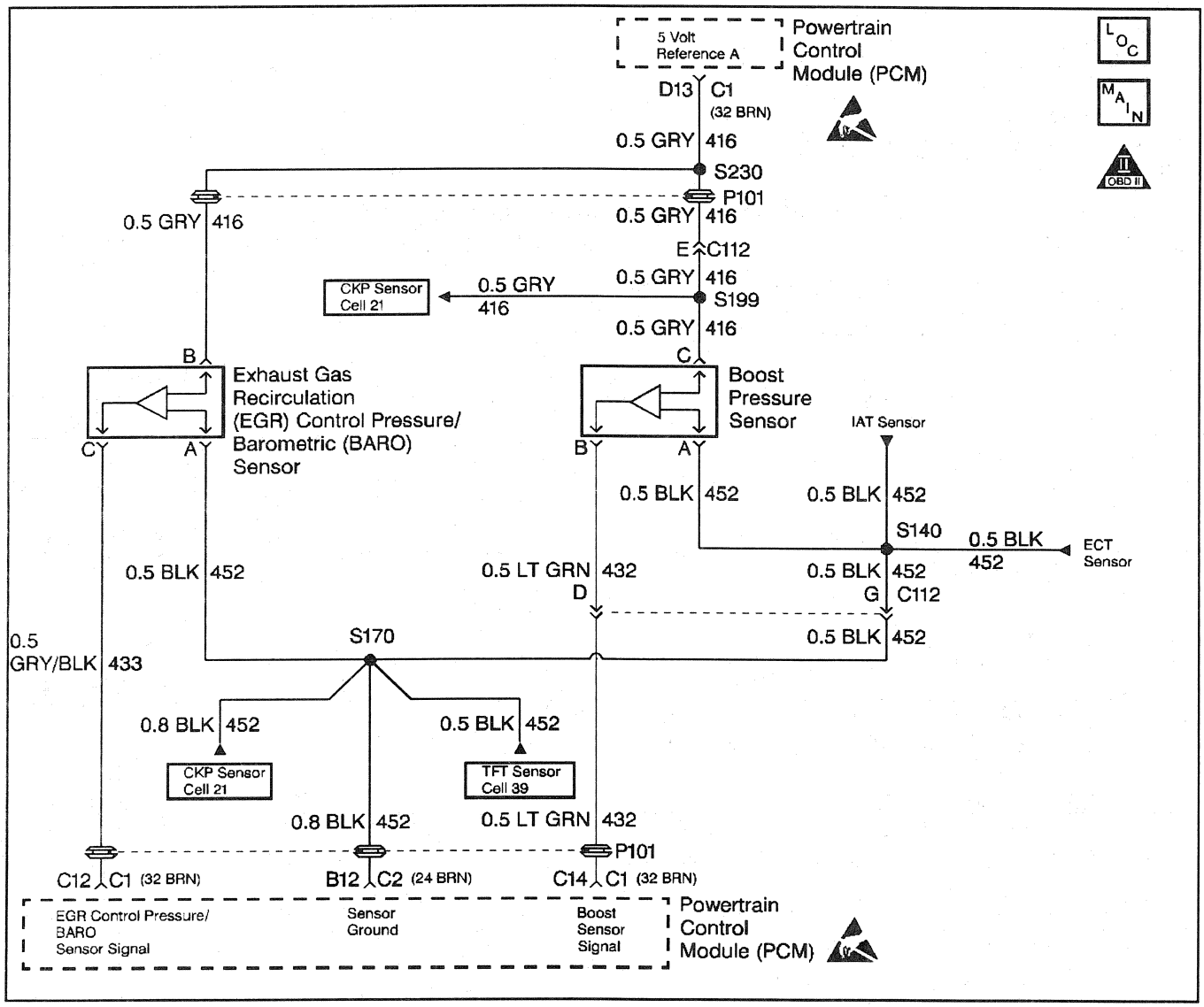
## DTC P0237 TC Boost Sensor Circuit Low Voltage

| 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.<br>Was the On–Board Diagnostic (OBD) system check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| *2* | 1. Scan tool connected.<br>2. Engine idling.<br>3. With *J 39200* connected to ground, probe PCM harness connector Boost signal circuit.<br>Does the *J 39200* display a voltage less than the specified value? | 1 V (40 kPa) | *Go to Step 3* | *Go to Step 5* |
| *3* | 1. Turn the ignition OFF.<br>2. Disconnect the Boost sensor electrical connector.<br>3. Jumper the Boost sensor 5 volt reference to the Boost sensor signal circuit at the harness.<br>4. Turn the ignition ON.<br>Does the scan tool display a Boost Pressure greater than the specified value? | 202 kPa | *Go to Step 6* | *Go to Step 4* |
| 4 | 1. Turn the ignition OFF.<br>2. Boost sensor still disconnected.<br>3. Remove the jumper wire.<br>4. Jumper the Boost sensor signal circuit at the harness with a test light connected to B+.<br>5. Turn the ignition ON.<br>Does the scan tool display a Boost Pressure greater than the specified value? | 202 kPa (4.0 V) | *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 chart(s) first. Are additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 6 | Check for a faulty connection at the Boost sensor.<br>Was a problem found? | — | *Go to Step 11* | *Go to Step 10* |
| 7 | Check for an open or a short to ground in Boost sensor signal circuit.<br>Was a problem found? | — | *Go to Step 11* | *Go to Step 12* |
| 8 | Check for an open in the Boost sensor 5 volt reference circuit.<br>Was a problem found? | — | *Go to Step 11* | *Go to Step 9* |

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

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 9 | Check for a short to ground in the Boost sensor 5 volt reference circuit.<br>Was a problem found? | — | *Go to Step 11* | *Go to Step 12* |
| 10 | Replace the faulty Boost sensor. Refer to *Boost Sensor (Diesel)*.<br>Is the action complete? | — | *Go to Step 13* | — |
| 11 | Repair the circuit as necessary.<br>Is the action complete? | — | *Go to Step 13* | — |
| 12 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Refer to *PCM Replacement/Programming*.<br>Is the action complete? | — | *Go to Step 13* | — |
| 13 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 14* | *Go to Step 2* |
| 14 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0238 TC Boost Sensor Circuit High Voltage




29574

### 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. This is a type D DTC.

### Conditions for Setting the DTC

- Boost Pressure greater than or equal 4.8 volts (202 kPa).
- Engine Speed less than 3506 RPM.

### Action Taken When the DTC Sets

No turbo boost.

### 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 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

With the ignition ON and the engine stopped, boost pressure is approximately equal to Baro. Comparison of this reading with a known good vehicle using the same sensor is a good way to check accuracy of a suspec' sensor. Readings should be the same + .4 volt. Very little boost can be attained by revving the engine in neutral. A J 39200 can be used to measure (actual) signal voltage at the PCM harness connector.

## Test Description

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

2. This Step simulates conditions for a DTC P0237 If the PCM recognizes the change, the PCM and the signal circuit are OK.
3. This Step will make sure the PCM is responding to a low signal voltage. This will indicate that the PCM is OK.

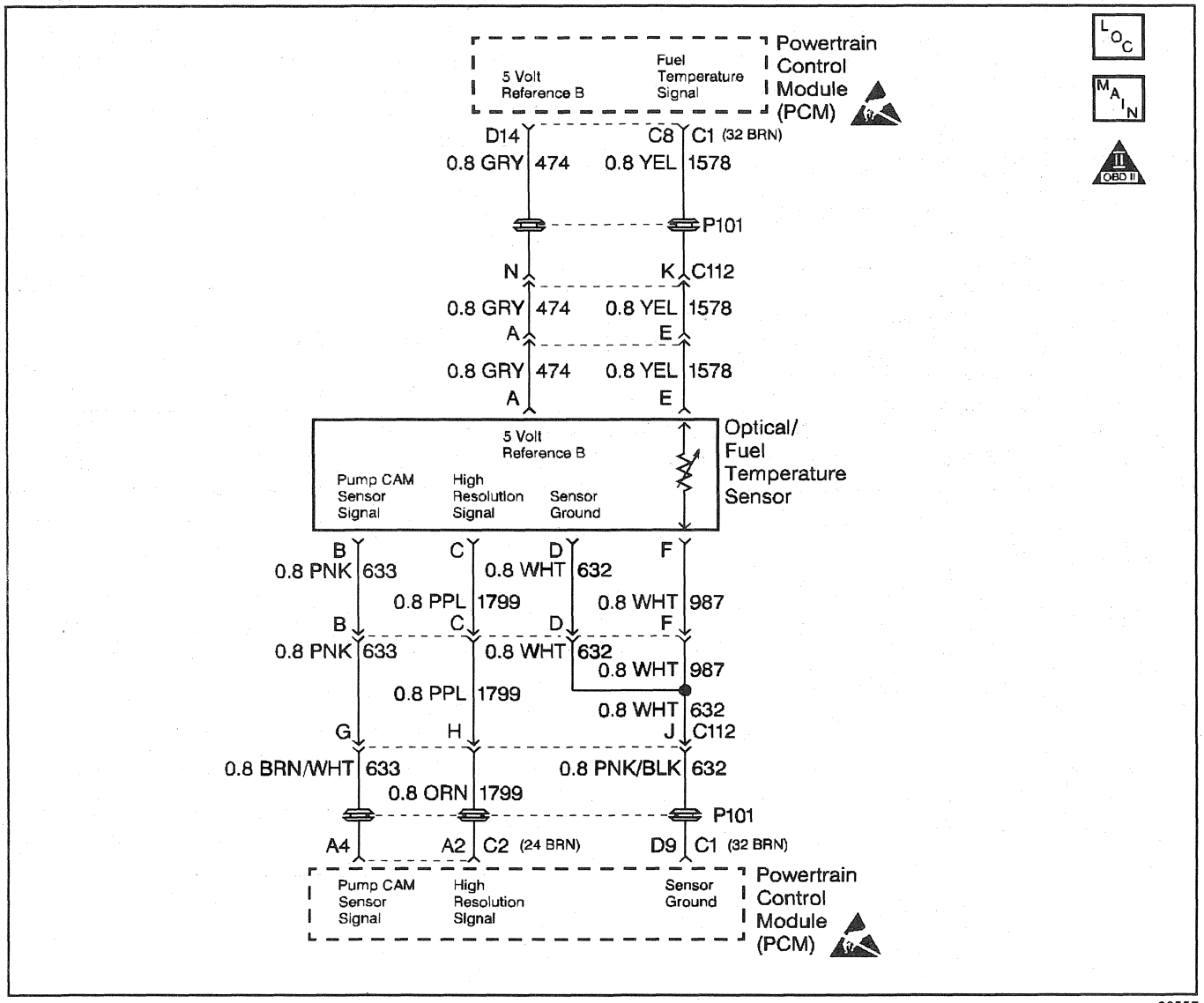
## DTC P0238 TC Boost Sensor Circuit High Voltage

| 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| *2* | 1. Scan tool connected.<br>2. Engine idling.<br>Does the scan tool display a Boost Pressure greater than or equal to the specified value? | 202 kPa (4.8 V) | *Go to Step 3* | *Go to Step 4* |
| *3* | 1. Turn the ignition OFF.<br>2. Disconnect the Boost sensor electrical connector.<br>3. Turn the ignition ON.<br>Does the scan tool display a Boost Pressure less than or equal to the specified value? | 9 kPa | *Go to Step 5* | *Go to Step 9* |
| 4 | DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs are stored, refer to those chart(s) first.<br>Are additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 5 | 1. Ignition ON, engine OFF<br>2. With a J 39200 connected to ground, probe the 5 volt reference circuit at the boost sensor harness.<br>Is voltage greater than the specified value? | 5.2V | *Go to Step 10* | *Go to Step 6* |
| 6 | 1. Boost sensor disconnected.<br>2. Jumper the Boost sensor ground circuit at the harness with a test light connected to B+.<br>Is the test light ON? | — | *Go to Step 7* | *Go to Step 11* |
| 7 | Check the Boost sensor for a restriction.<br>Was a problem found? | — | *Go to Step 12* | *Go to Step 8* |
| 8 | Replace the faulty Boost sensor. Refer to *Boost Sensor (Diesel).*<br>Is the action complete? | — | *Go to Step 14* | — |
| 9 | Check for a short to voltage in the Boost sensor signal circuit.<br>Was a problem found? | — | *Go to Step 12* | *Go to Step 13* |
| 10 | Check for a short to voltage in the Boost sensor 5 volt reference circuit.<br>Was a problem found? | — | *Go to Step 12* | *Go to Step 13* |
| 11 | Repair the Boost sensor ground circuit.<br>Is the action complete? | — | *Go to Step 14* | — |
| 12 | Repair as necessary.<br>Is the action complete? | — | *Go to Step 14* | — |

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

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 13 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Refer to *PCM Replacement/Programming*.<br>Is the action complete? | — | *Go to Step 14* | — |
| 14 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 15* | *Go to Step 2* |
| 15 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0251 Injection Pump Cam System




29557

### 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. This is a type A DTC.

### Conditions for Setting the DTC

- RPM less than 300.
- 8 consecutive cam pulses missing for 8 #1 cylinder events.

or

- RPM greater than or equal to 300.
- 8 consecutive cam pulses missing for 32 #1 cylinder events.

### Action Taken When the DTC Sets

Backup 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 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

When PCM is in backup fuel, fast idle and poor performance problems will exist. If P0251 is also stored, there is a possible problem with signal circuit. P0251 and P0370 will set if vehicle has run out of fuel.

### Test Description

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

2. This Step will determine if this is a hard or intermittent DTC.
4. This Step will determine if there is a 5 volt reference.
6. This Step will check to see if the sensor is sending a signal back to the PCM.

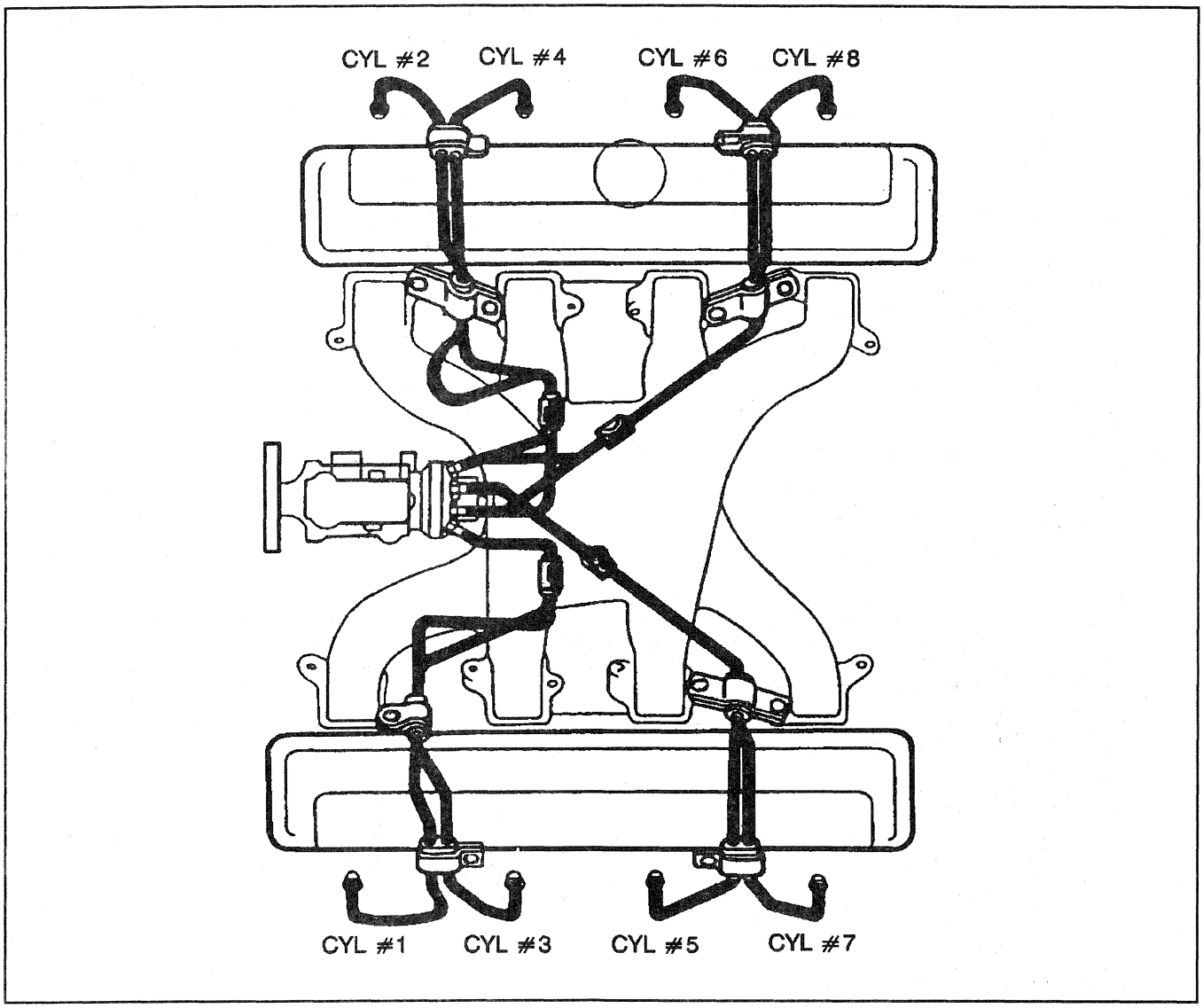
### DTC P0251 Injection Pump Cam System

| 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Start and idle engine.<br>2. With the throttle closed, observe the Cam Ref Missed display on scan tool.<br>Does scan tool display specified value? | 8 | *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 additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 4 | 1. Ignition OFF.<br>2. Disconnect the Optical/Fuel temperature sensor electrical connector.<br>3. Ignition ON engine OFF.<br>4. Using a *J 39200*, measure voltage between the Optical/Fuel Temperature 5 volt reference circuit and chassis ground at harness connector.<br>Is voltage at specified value? | 5 V | *Go to Step 5* | *Go to Step 7* |
| 5 | Probe the sensor ground circuit with a test light connected to B+ at the harness connector.<br>Is test light ON? | — | *Go to Step 6* | *Go to Step 8* |
| 6 | 1. Reconnect Optical/Fuel temperature sensor.<br>2. Start and idle engine.<br>3. With scan tool, command 900 rpm.<br>4. With *J 39200* on Hertz (Hz) scale, back probe Cam signal circuit at PCM.<br>Is Hertz reading at specified value? | 60 Hz<br>(± 3 Hz) | *Go to Step 12* | *Go to Step 11* |
| 7 | 1. Removed electrical harness filter from vehicle.<br>2. Check resistance on the electrical harness filter 5 volt reference circuit (terminal A).<br>Is resistance greater than specified value? | 2.0 Ohms | *Go to Step 15* | *Go to Step 8* |

## DTC P0251 Injection Pump Cam System (cont'd)

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 8 | 1. Ignition OFF.<br>2. Electrical harness filter removed from vehicle.<br>3. Disconnect the PCM, and check the Optical/Fuel temperature 5 volts reference circuit for an open, short to ground, or short to the sensor ground circuit.<br>4. If the Optical/Fuel temperature 5 volt reference circuit is open or shorted to ground, repair it as necessary.<br>Was the Optical/Fuel temperature 5 volt reference circuit open or shorted to ground? | — | *Go to Step 16* | *Go to Step 10* |
| 9 | 1. Check for an open or a poor sensor ground terminal connection at the PCM.<br>2. If a problem is found, repair as necessary.<br>Was a repair performed? | — | *Go to Step 16* | *Go to Step 14* |
| 10 | Check the Optical/Fuel temperature 5 volt reference circuit for a poor connection at the PCM and replace terminal if necessary.<br>Did the terminal require replacement? | — | *Go to Step 16* | *Go to Step 14* |
| 11 | 1. Ignition OFF.<br>2. Check the Cam signal circuit for an open or short to ground.<br>3. If the Cam signal circuit is open or shorted to ground, repair it as necessary.<br>Was the Cam signal circuit open or shorted to ground? | — | *Go to Step 16* | *Go to Step 13* |
| 12 | Check for a poor connection at the PCM harness terminal and replace if necessary.<br>Did the terminal require replacement? | — | *Go to Step 16* | *Go to Step 14* |
| 13 | Replace injection pump. Refer to *Fuel Injection Pump*.<br>Is the action complete? | — | *Go to Step 16* | — |
| 14 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Refer to *PCM Replacement/Programming*.<br>Is the action complete? | — | *Go to Step 16* | — |
| 15 | Replace electrical harness filter.<br>Is the action complete? | — | *Go to Step 16* | — |
| 16 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 10* | *Go to Step 2* |
| 17 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0263 Cylinder 8 Balance System




29653

### 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 fuel correction amount exceeds define limits, DTC P0263 will set. This is a type D DTC.

### Conditions for Setting the DTC

- Engine at idle.
- Engine coolant at normal temperatures.
- Cylinder fault must be constant.
- Fuel correction amount exceeds limits (internal to PCM).
- Conditions met for 2 seconds.

### Action Taken When the DTC Sets

Possible rough idle

### 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

Injector balance test on scan tool should be used to confirm faulty cylinder. Scan tool will cutout specific cylinder requested. If original complaint was multiple cylinder balance DTCs and vehicle has a manual transmission, dual mass flywheel could be at fault. Its possible that if a cylinder balance fault has been detected and 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 which will cause multiple cylinder balance DTCs to set. The

scan tool snap shot mode can be used to properly identify the suspected cylinder. The must likely cause of cylinder balance DTCs are faulty nozzles or engine mechanical (low compression) problems.

### Test Description

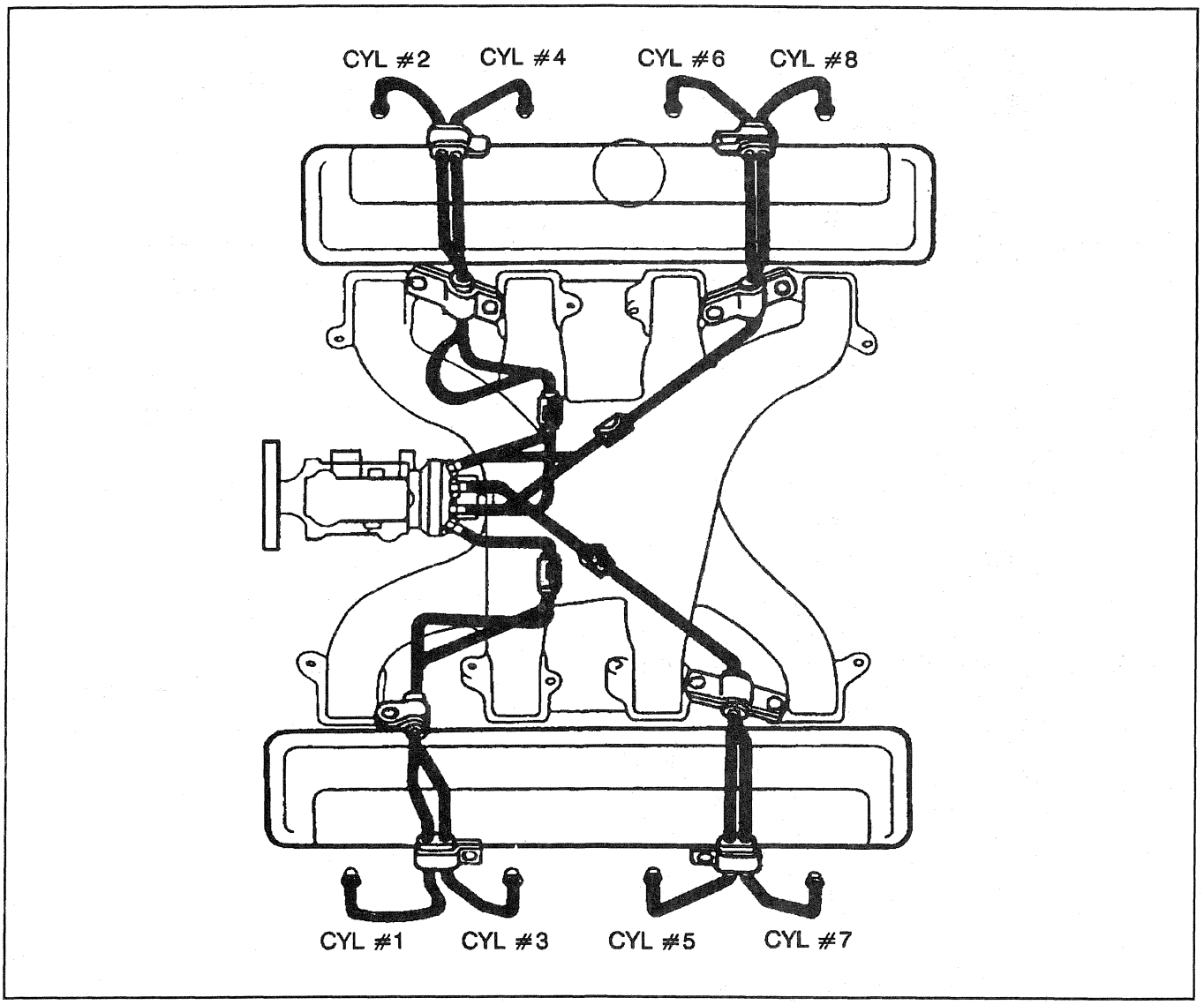
Number(s) below refer to the Step number(s) on the Diagnostic Table.

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 8 Balance System

| 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Scan tool connected.<br>2. Start and idle engine.<br>3. Engine at operating temperature.<br>4. Make sure all DTCs are cleared.<br>5. Using the scan tool, cutout (Inj. Balance) the suspected cylinder.<br>Is there an RPM drop in the suspected cylinder? | — | *Go to Step 3* | *Go to Step 4* |
| 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 additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 4 | Check for the follwoing basic engine mechanical or fuel delivery problems in that cylinder.<br>• Low compression (refer to Engine Mechanical)<br>• Faulty injection nozzle (refer to Fuel Systems)<br>Was a repair performed? | — | *Go to Step 5* | — |
| 5 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 6* | *Go to Step 2* |
| 6 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0266 Cylinder 7 Balance System




29653

### 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 fuel correction amount exceeds define limits, DTC P0266 will set. This is a type D DTC.

### Conditions for Setting the DTC

- Engine at idle.
- Engine coolant at normal temperatures.
- Cylinder fault must be constant.
- Fuel correction amount exceeds limits (internal to PCM).
- Conditions met for 2 seconds.

### Action Taken When the DTC Sets

Possible rough idle

### 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

Injector balance test on scan tool should be used to confirm faulty cylinder. Scan tool will cutout specific cylinder requested. If original complaint was multiple cylinder balance DTCs and vehicle has a manual transmission, dual mass flywheel could be at fault. Its possible that if a cylinder balance fault has been detected and 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 which will cause multiple cylinder balance DTCs to set. The scan tool snap shot mode can be used to properly identify the suspected cylinder. The must likely cause of cylinder balance DTCs are faulty nozzles or engine mechanical (low compression) problems.

### Test Description

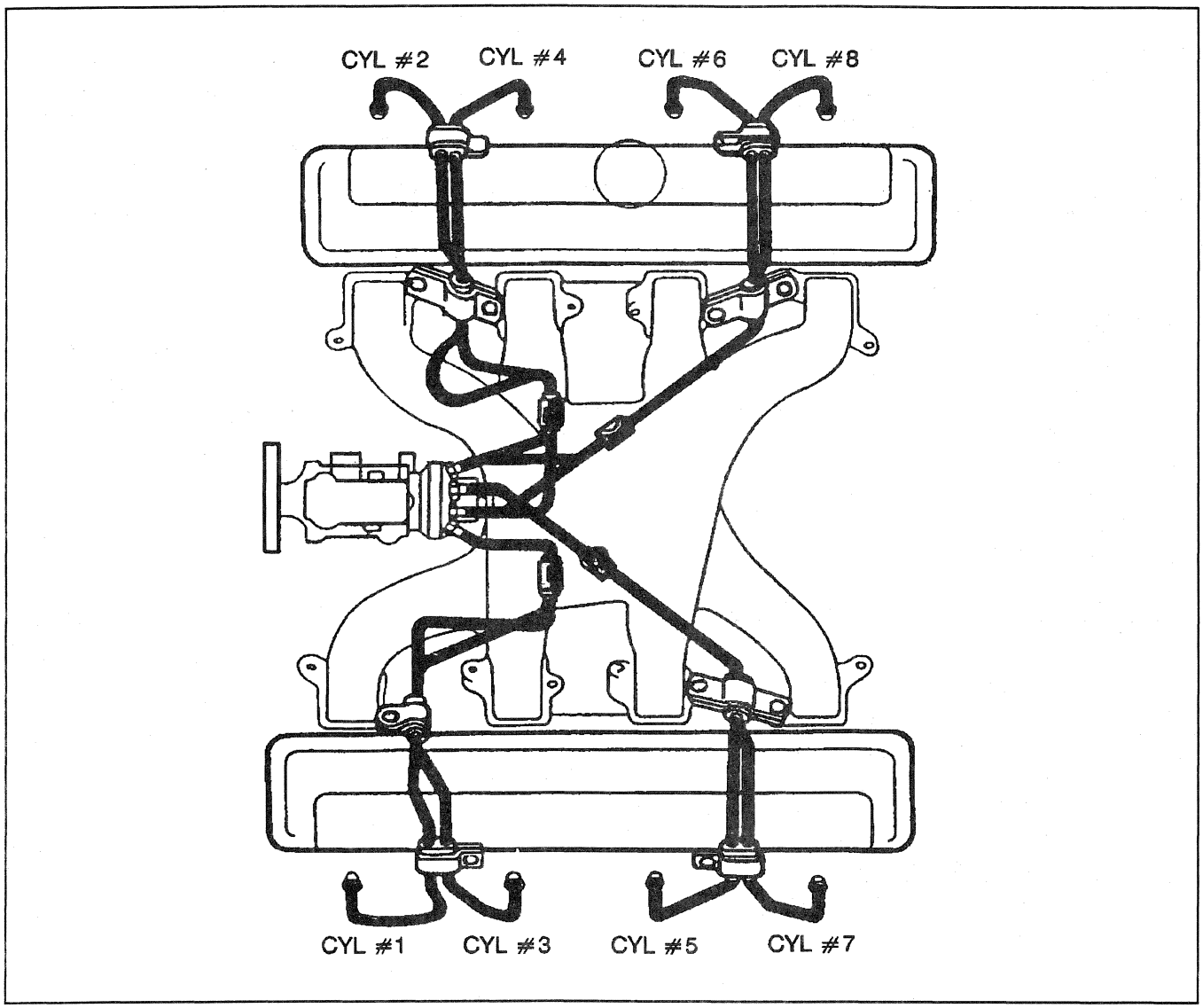
Number(s) below refer to the Step number(s) on the Diagnostic Table.

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 7 Balance System

| 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Scan tool connected.<br>2. Start and idle engine.<br>3. Engine at operating temperature.<br>4. Make sure all DTCs are cleared.<br>5. Using the scan tool, cutout (Inj. Balance) the suspected cylinder.<br>Is there an RPM drop in the suspected cylinder? | — | *Go to Step 3* | *Go to Step 4* |
| 3 | DTC is intermittent. If no additional DTCs are stored refer to Diagnostic Aids. If additional DTCs were stored refer tothe applicable DTC table(s) first.<br>Are additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 4 | Check for the follwoing basic engine mechanical or fuel delivery problems in that cylinder.<br>• Low compression (refer to Engine Mechanical)<br>• Faulty injection nozzle (refer to Fuel Systems)<br>Was a repair performed? | — | *Go to Step 5* | — |
| 5 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 6* | *Go to Step 2* |
| 6 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0269 Cylinder 2 Balance System




29653

### 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 fuel correction amount exceeds define limits, DTC P0269 will set. This is a type D DTC.

### Conditions for Setting the DTC

- Engine at idle.
- Engine coolant at normal temperatures.
- Cylinder fault must be constant.
- Fuel correction amount exceeds limits (internal to PCM).
- Conditions met for 2 seconds.

### Action Taken When the DTC Sets

Possible rough idle

### 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

Injector balance test on scan tool should be used to confirm faulty cylinder. Scan tool will cutout specific cylinder requested. If original complaint was multiple cylinder balance DTCs and vehicle has a manual transmission, dual mass flywheel could be at fault. Its possible that if a cylinder balance fault has been detected and 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 which will cause multiple cylinder balance DTCs to set. The scan tool snap shot mode can be used to properly identify the suspected cylinder. The must likely cause of cylinder balance DTCs are faulty nozzles or engine mechanical (low compression) problems.

### Test Description

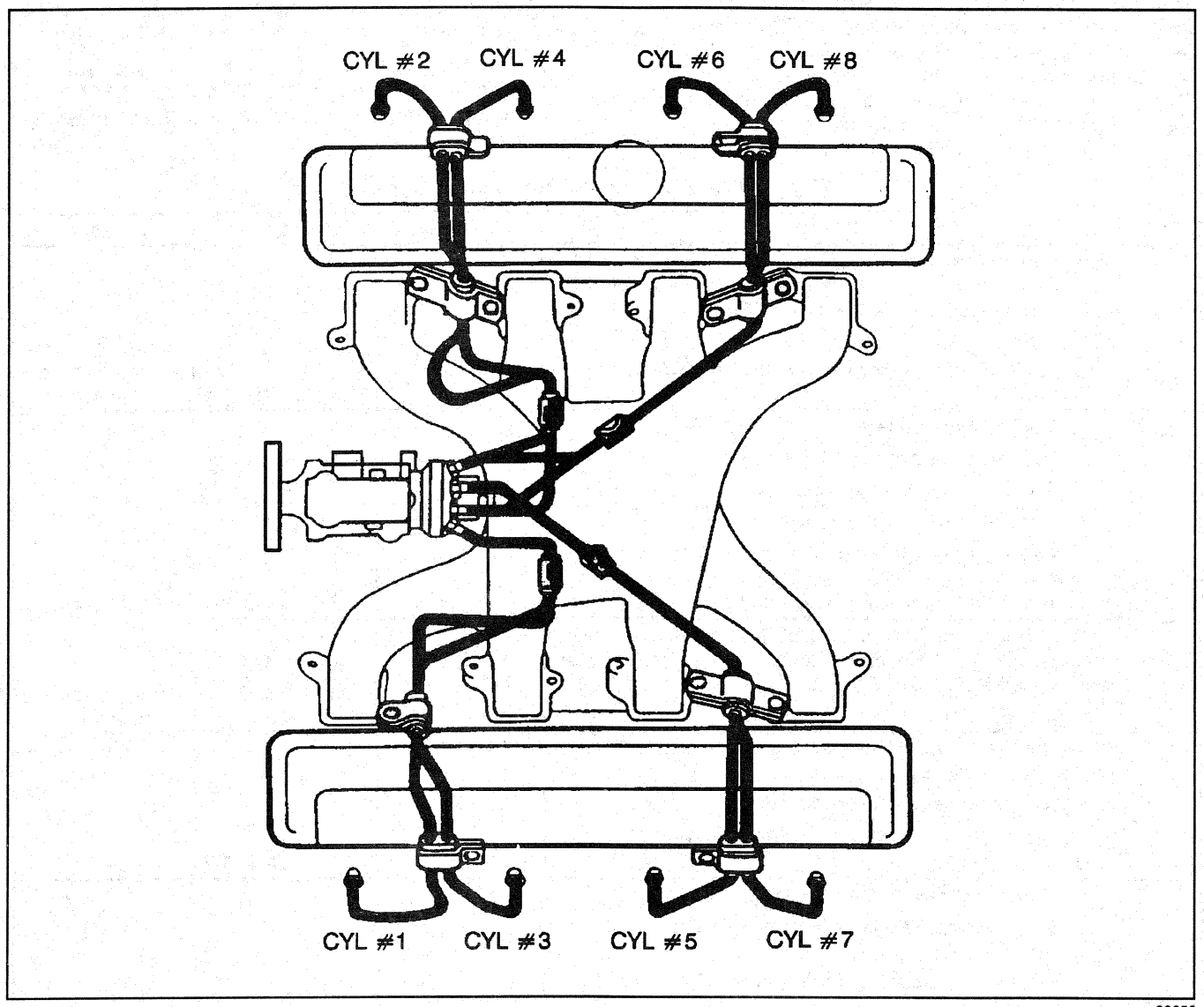
Number(s) below refer to the Step number(s) on the Diagnostic Table.

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 2 Balance System

| 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Scan tool connected.<br>2. Start and idle engine.<br>3. Engine at operating temperature.<br>4. Make sure all DTCs are cleared.<br>5. Using the scan tool, cutout (Inj. Balance) the suspected cylinder.<br>Is there an RPM drop in the suspected cylinder? | — | *Go to Step 3* | *Go to Step 4* |
| 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.<br>Are additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 4 | Check for the follwoing basic engine mechanical or fuel delivery problems in that cylinder.<br>• Low compression (refer to Engine Mechanical)<br>• Faulty injection nozzle (refer to Fuel Systems)<br>Was a repair performed? | — | *Go to Step 5* | — |
| 5 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 6* | *Go to Step 2* |
| 6 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0272 Cylinder 6 Balance System




29653

### 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 fuel correction amount exceeds define limits, DTC P0272 will set. This is a type D DTC.

### Conditions for Setting the DTC

- Engine at idle.
- Engine coolant at normal temperatures.
- Cylinder fault must be constant.
- Fuel correction amount exceeds limits (internal to PCM).
- Conditions met for 2 seconds.

### Action Taken When the DTC Sets

Possible rough idle

### 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

Injector balance test on scan tool should be used to confirm faulty cylinder. Scan tool will cutout specific cylinder requested. If original complaint was multiple cylinder balance DTCs and vehicle has a manual transmission, dual mass flywheel could be at fault. Its possible that if a cylinder balance fault has been detected and 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 which will cause multiple cylinder balance DTCs to set. The scan tool snap shot mode can be used to properly identify the suspected cylinder. The must likely cause of cylinder balance DTCs are faulty nozzles or engine mechanical (low compression) problems.

### Test Description

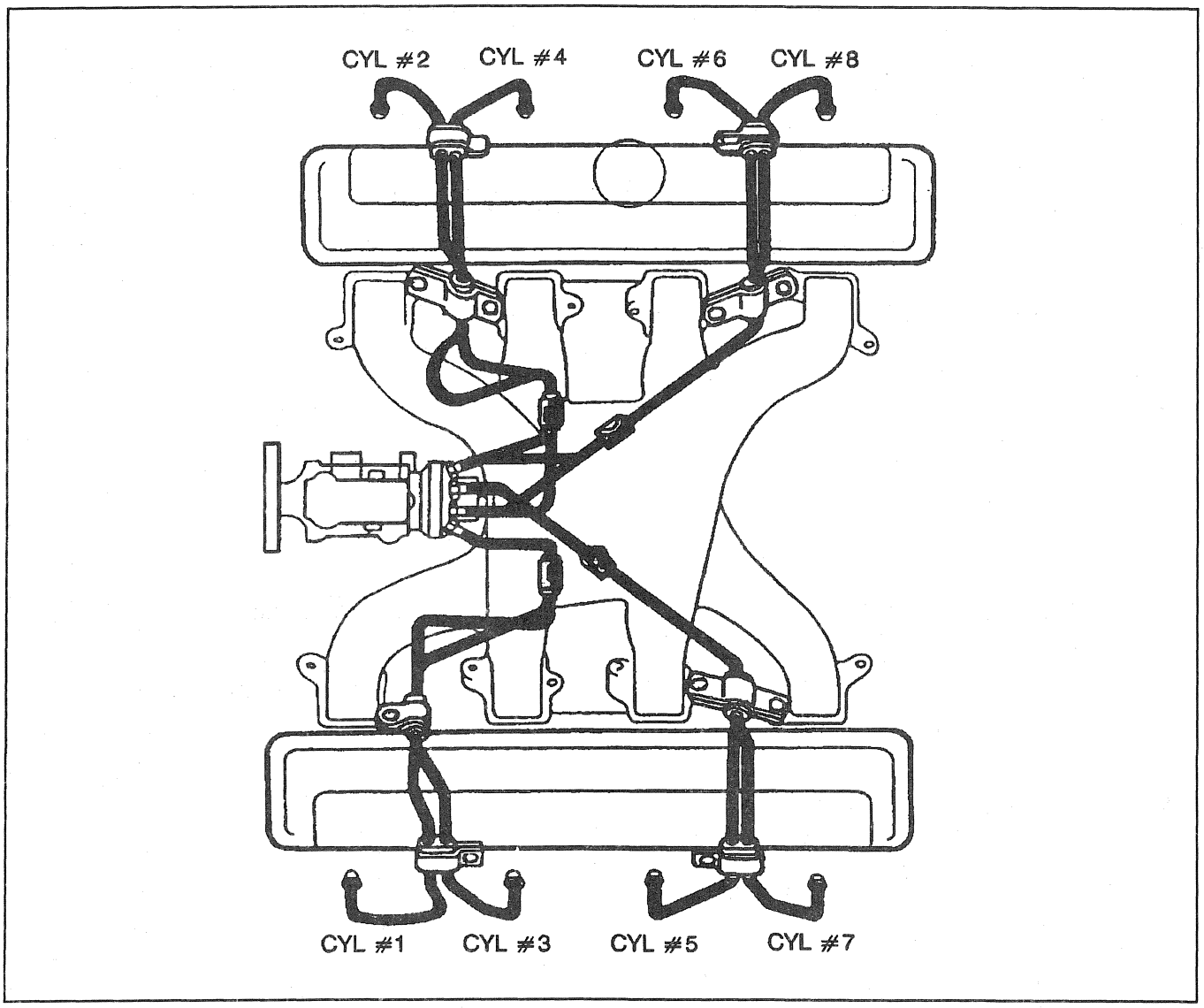
Number(s) below refer to the Step number(s) on the Diagnostic Table.

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 6 Balance System

| 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Scan tool connected.<br>2. Start and idle engine.<br>3. Engine at operating temperature.<br>4. Make sure all DTCs are cleared.<br>5. Using the scan tool, cutout (Inj. Balance) the suspected cylinder.<br>Is there an RPM drop in the suspected cylinder? | — | *Go to Step 3* | *Go to Step 4* |
| 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.<br>Are additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 4 | Check for the follwoing basic engine mechanical or fuel delivery problems in that cylinder.<br>• Low compression (refer to Engine Mechanical)<br>• Faulty injection nozzle (refer to Fuel Systems)<br>Was a repair performed? | — | *Go to Step 5* | — |
| 5 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 6* | *Go to Step 2* |
| 6 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0275 Cylinder 5 Balance System




29653

### 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 fuel correction amount exceeds define limits, DTC P0275 will set. This is a type D DTC.

### Conditions for Setting the DTC

- Engine at idle.
- Engine coolant at normal temperatures.
- Cylinder fault must be constant.
- Fuel correction amount exceeds limits (internal to PCM).
- Conditions met for 2 seconds.

### Action Taken When the DTC Sets

Possible rough idle

### 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

Injector balance test on scan tool should be used to confirm faulty cylinder. Scan tool will cutout specific cylinder requested. If original complaint was multiple cylinder balance DTCs and vehicle has a manual transmission, dual mass flywheel could be at fault. Its possible that if a cylinder balance fault has been detected and 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 which will cause multiple cylinder balance DTCs to set. The scan tool snap shot mode can be used to properly identify the suspected cylinder. The must likely cause of cylinder balance DTCs are faulty nozzles or engine mechanical (low compression) problems.

### Test Description

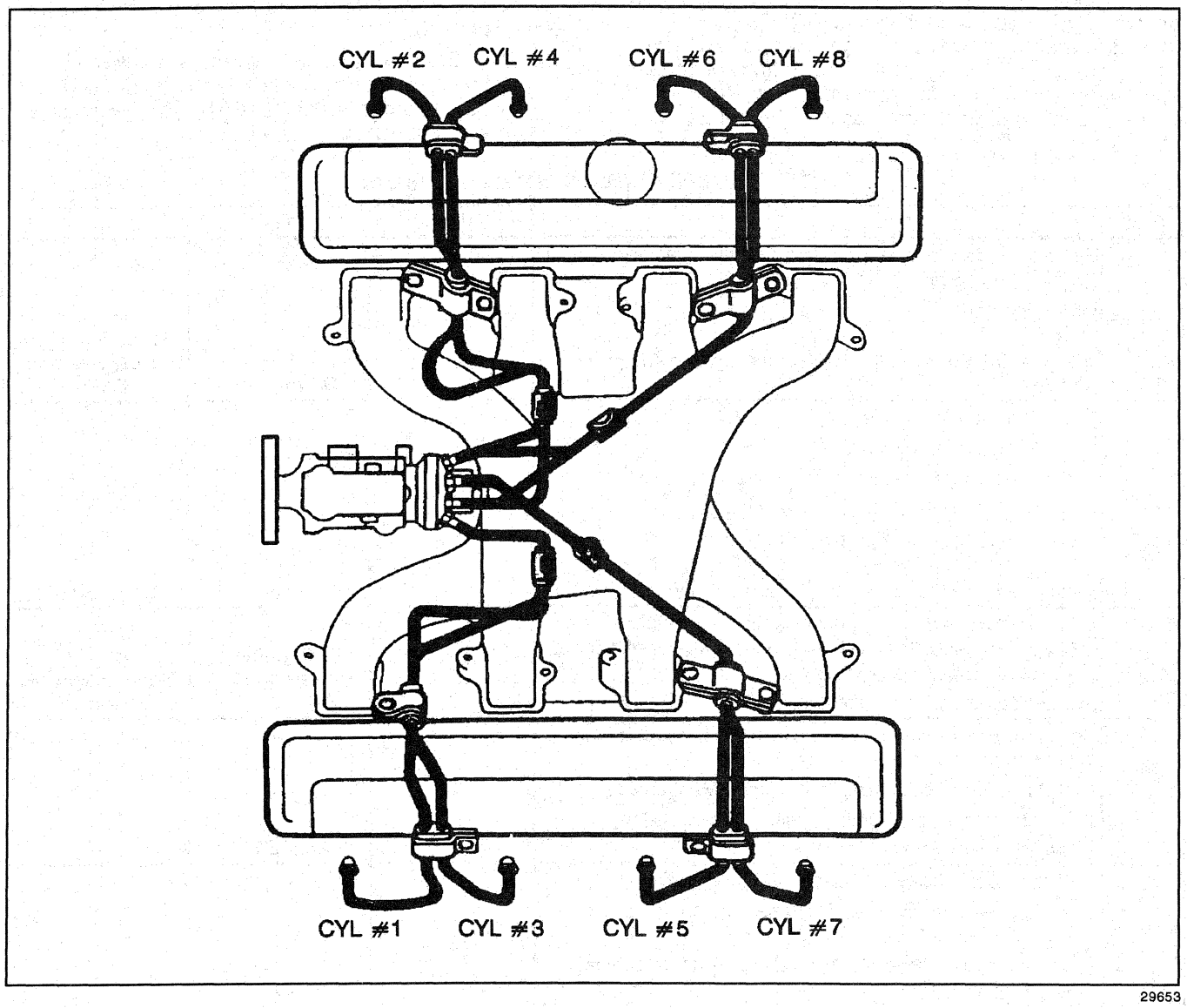
Number(s) below refer to the Step number(s) on the Diagnostic Table.

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 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Scan tool connected.<br>2. Start and idle engine.<br>3. Engine at operating temperature.<br>4. Make sure all DTCs are cleared.<br>5. Using the scan tool, cutout (Inj. Balance) the suspected cylinder.<br>Is there an RPM drop in the suspected cylinder? | — | *Go to Step 3* | *Go to Step 4* |
| 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.<br>Are additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 4 | Check for the follwoing basic engine mechanical or fuel delivery problems in that cylinder.<br>• Low compression (refer to Engine Mechanical)<br>• Faulty injection nozzle (refer to Fuel Systems)<br>Was a repair performed? | — | *Go to Step 5* | — |
| 5 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 6* | *Go to Step 2* |
| 6 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0278 Cylinder 4 Balance System




29653

### 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 fuel correction amount exceeds define limits, DTC P0278 will set. This is a type D DTC.

### Conditions for Setting the DTC

- Engine at idle.
- Engine coolant at normal temperatures.
- Cylinder fault must be constant.
- Fuel correction amount exceeds limits (internal to PCM).
- Conditions met for 2 seconds.

### Action Taken When the DTC Sets

Possible rough idle

### 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

Injector balance test on scan tool should be used to confirm faulty cylinder. Scan tool will cutout specific cylinder requested. If original complaint was multiple cylinder balance DTCs and vehicle has a manual transmission, dual mass flywheel could be at fault. Its possible that if a cylinder balance fault has been detected and 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 which will cause multiple cylinder balance DTCs to set. The scan tool snap shot mode can be used to properly identify the suspected cylinder. The must likely cause of cylinder balance DTCs are faulty nozzles or engine mechanical (low compression) problems.

### Test Description

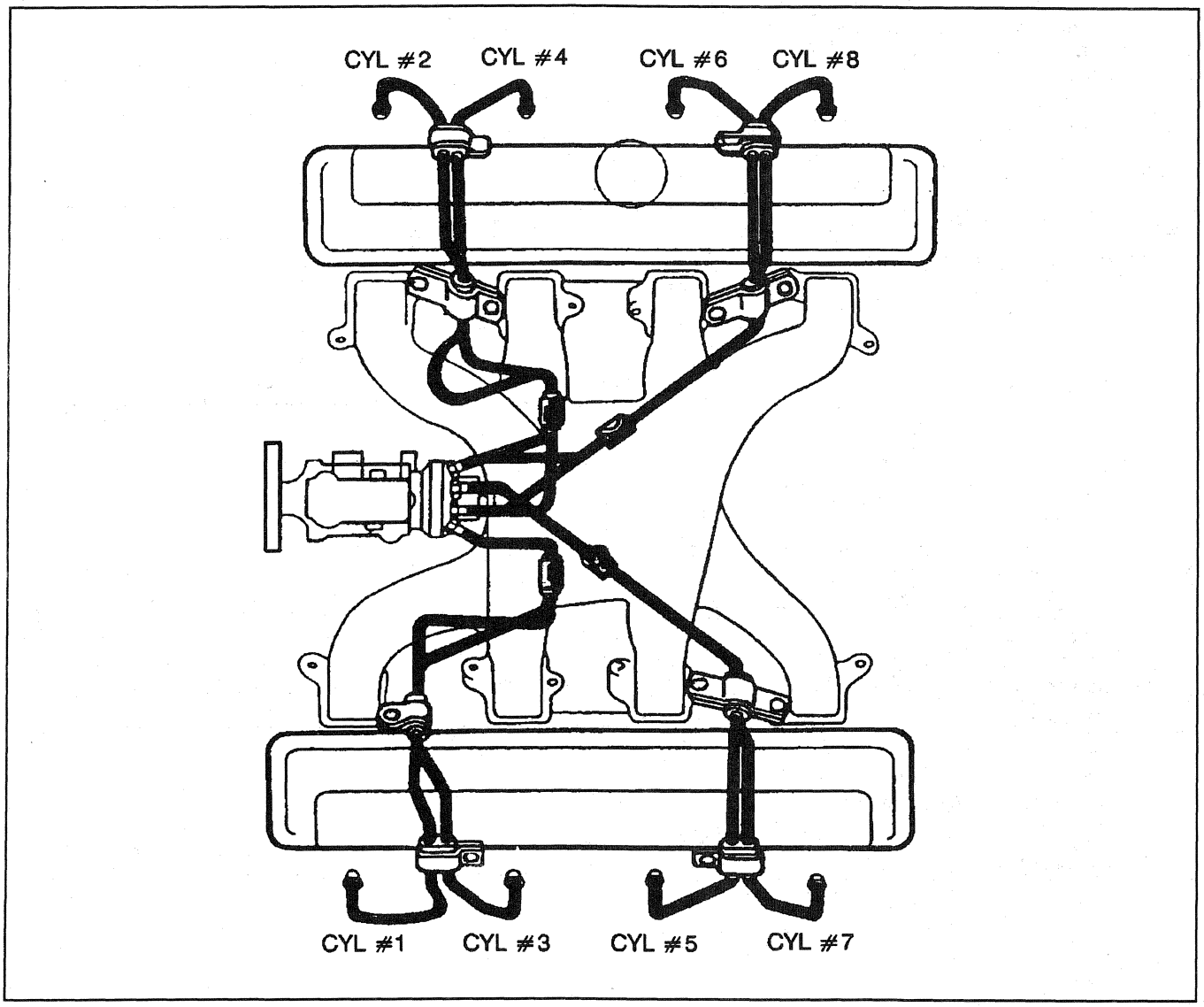
Number(s) below refer to the Step number(s) on the Diagnostic Table.

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 4 Balance System

| 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Scan tool connected.<br>2. Start and idle engine.<br>3. Engine at operating temperature.<br>4. Make sure all DTCs are cleared.<br>5. Using the scan tool, cutout (Inj. Balance) the suspected cylinder.<br>Is there an RPM drop in the suspected cylinder?. | — | *Go to Step 3* | *Go to Step 4* |
| 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.<br>Are additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 4 | Check for the follwoing basic engine mechanical or fuel delivery problems in that cylinder.<br>• Low compression (refer to Engine Mechanical)<br>• Faulty injection nozzle (refer to Fuel Systems)<br>Was a repair performed? | — | *Go to Step 5* | — |
| 5 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 6* | *Go to Step 2* |
| 6 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0281 Cylinder 3 Balance System




29653

### 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 fuel correction amount exceeds define limits, DTC P0281 will set. This is a type D DTC.

### Conditions for Setting the DTC

- Engine at idle.
- Engine coolant at normal temperatures.
- Cylinder fault must be constant.
- Fuel correction amount exceeds limits (internal to PCM).
- Conditions met for 2 seconds.

### Action Taken When the DTC Sets

Possible rough idle

### 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

Injector balance test on scan tool should be used to confirm faulty cylinder. Scan tool will cutout specific cylinder requested. If original complaint was multiple cylinder balance DTCs and vehicle has a manual transmission, dual mass flywheel could be at fault. Its possible that if a cylinder balance fault has been detected and 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 which will cause multiple cylinder balance DTCs to set. The scan tool snap shot mode can be used to properly identify the suspected cylinder. The must likely cause of cylinder balance DTCs are faulty nozzles or engine mechanical (low compression) problems.

### Test Description

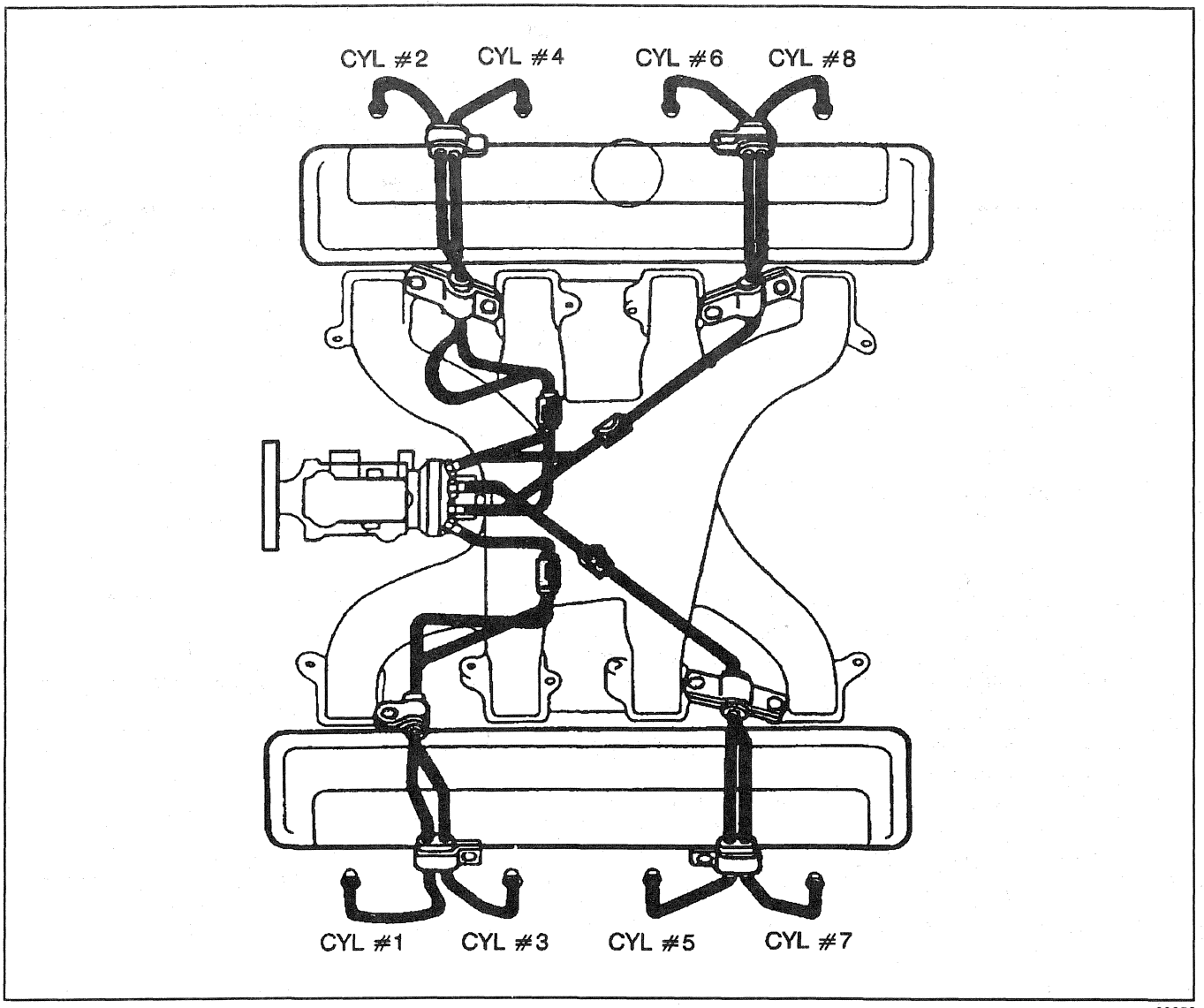
Number(s) below refer to the Step number(s) on the Diagnostic Table.

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 3 Balance System

| 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Scan tool connected.<br>2. Start and idle engine.<br>3. Engine at operating temperature.<br>4. Make sure all DTCs are cleared.<br>5. Using the scan tool, cutout (Inj. Balance) the suspected cylinder.<br>Is there an RPM drop in the suspected cylinder? | — | *Go to Step 3* | *Go to Step 4* |
| 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.<br>Are additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 4 | Check for the follwoing basic engine mechanical or fuel delivery problems in that cylinder.<br>• Low compression (refer to Engine Mechanical)<br>• Faulty injection nozzle (refer to Fuel Systems)<br>Was a repair performed? | — | *Go to Step 5* | — |
| 5 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 6* | *Go to Step 2* |
| 6 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0284 Cylinder 1 Balance System




29653

### 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 fuel correction amount exceeds define limits, DTC P0284 will set. This is a type D DTC.

### Conditions for Setting the DTC

- Engine at idle.
- Engine coolant at normal temperatures.
- Cylinder fault must be constant.
- Fuel correction amount exceeds limits (internal to PCM).
- Conditions met for 2 seconds.

### Action Taken When the DTC Sets

Possible rough idle

### 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

Injector balance test on scan tool should be used to confirm faulty cylinder. Scan tool will cutout specific cylinder requested. If original complaint was multiple cylinder balance DTCs and vehicle has a manual transmission, dual mass flywheel could be at fault. Its possible that if a cylinder balance fault has been detected and 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 which will cause multiple cylinder balance DTCs to set. The scan tool snap shot mode can be used to properly identify the suspected cylinder. The must likely cause of cylinder balance DTCs are faulty nozzles or engine mechanical (low compression) problems.

### Test Description

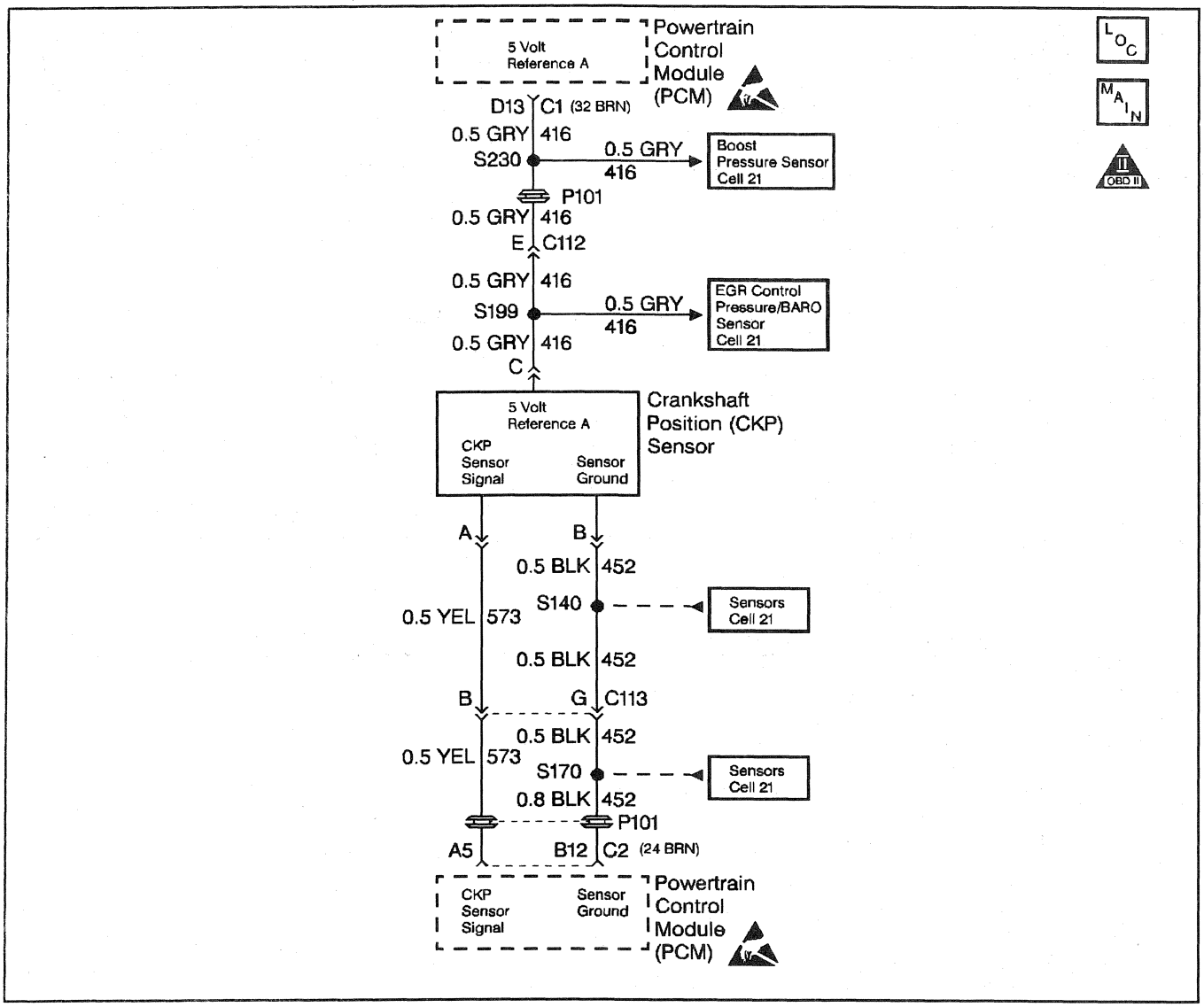
Number(s) below refer to the Step number(s) on the Diagnostic Table.

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 1 Balance System

| 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Scan tool connected.<br>2. Start and idle engine.<br>3. Engine at operating temperature.<br>4. Make sure all DTCs are cleared.<br>5. Using the scan tool, cutout (Inj. Balance) the suspected cylinder.<br>Is there an RPM drop in the suspected cylinder? | — | *Go to Step 3* | *Go to Step 4* |
| 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.<br>Are additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 4 | Check for the follwoing basic engine mechanical or fuel delivery problems in that cylinder.<br>• Low compression (refer to Engine Mechanical)<br>• Faulty injection nozzle (refer to Fuel Systems)<br>Was a repair performed? | — | *Go to Step 5* | — |
| 5 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 6* | *Go to Step 2* |
| 6 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0335 Crankshaft Position (CKP) Sensor CKT




29554

### Circuit Description

The crankshaft position sensor is a 'Hall–effect' type sensor that monitors crankshaft position and speed. There are four teeth 90° 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. This is a type A DTC.

### Conditions for Setting the DTC

- RPM less than 300.
- 8 consecutive cam pulses missing for 8 #1 cylinder events.

or

- RPM greater than or equal to 300.
- 8 consecutive cam pulses missing for 32 #1 cylinder events.

### Action Taken When the DTC Sets

Backup 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 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

When PCM is in backup fuel, long crank times, fast idle and poor performance conditions will exist. Check for good connection at crankshaft position sensor and at PCM. Many intermittent problems are caused by faulty electrical connections or wiring. When attempting to diagnoses 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 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.

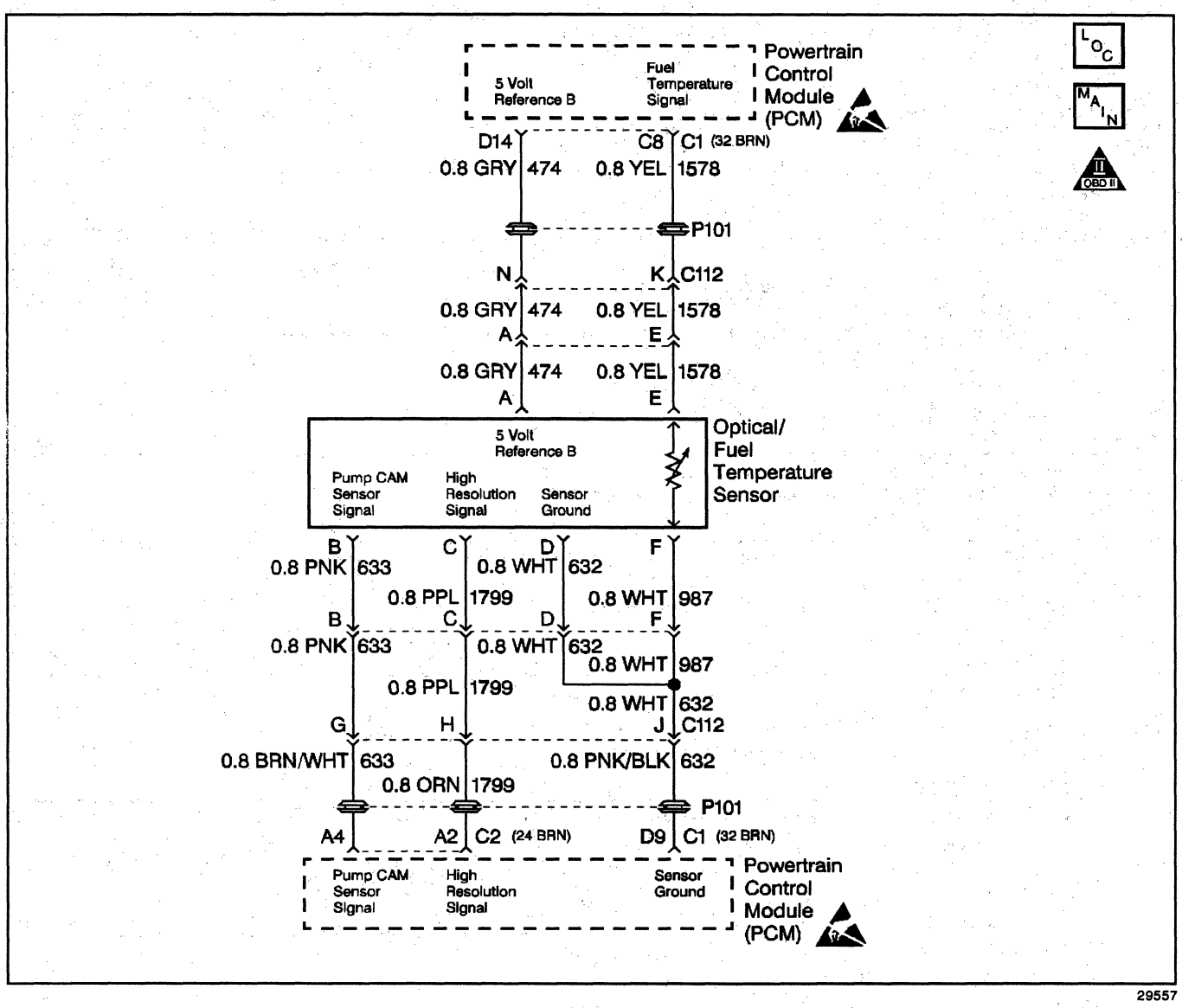
### DTC P0335 Crankshaft Position (CKP) Sensor CKT

| 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Start and idle engine.<br>2. With the throttle closed, observe the 'Crank Ref. Missed' display on scan tool.<br>Does scan tool display specified value? | 8 | *Go to Step 4* | *Go to Step 3* |
| 3 | DTC is intermittent. If no additional DTCs are stored, refer to the Applicable DTC Table(s) first.<br>Are additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 4 | 1. Ignition OFF.<br>2. Disconnect the Optical/Fuel temperature sensor electrical connector.<br>3. Ignition ON engine OFF.<br>4. With a DVM *J 39200*, measure voltage between the Optical/Fuel Temperature 5 volt reference circuit and chassis ground.<br>Is voltage at specified value? | 5 V | *Go to Step 5* | *Go to Step 7* |
| 5 | Probe the sensor ground circuit with a test light connected to B+.<br>Is test light ON? | — | *Go to Step 6* | *Go to Step 8* |
| 6 | 1. Reconnect Optical/Fuel temperature sensor.<br>2. Back probe Optical/Fuel temperature signal circuit at the PCM with a DVM *J 39200* connected to ground.<br>3. Crank engine.<br>Is voltage at the specified value? | 4 V | *Go to Step 11* | *Go to Step 10* |
| 7 | 1. Ignition OFF.<br>2. Disconnect the PCM, and check the Optical/Fuel temperature 5 volts reference circuit for an open, short to ground, or short to the sensor ground circuit.<br>3. If the Optical/Fuel temperature 5 volt reference circuit is open or shorted to ground, repair it as necessary.<br>Was the Optical/Fuel temperature 5 volt reference circuit open or shorted to ground? | — | *Go to Step 14* | *Go to Step 9* |

## DTC P0335 Crankshaft Position (CKP) Sensor CKT (cont'd)

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 8 | 1. Check for an open or a poor sensor ground terminal connection at the PCM.<br>2. If a problem is found, repair as necessary.<br>Was a repair performed? | — | *Go to Step 14* | *Go to Step 13* |
| 9 | Check the Optical/Fuel temperature 5 volt reference circuit for a poor connection at the PCM and replace terminal if necessary.<br>Did the terminal require replacement? | — | *Go to Step 14* | *Go to Step 13.* |
| 10 | 1. Ignition OFF.<br>2. Disconnect the PCM, and check the Optical/Fuel temperature signal circuit for an open, short to ground, or short to the sensor ground circuit.<br>3. If the Optical/Fuel temperature signal circuit is open or shorted to ground, repair it as necessary.<br>Was the Optical/Fuel temperature signal circuit open or shorted to ground? | — | *Go to Step 14* | *Go to Step 11* |
| 11 | Check the Optical/Fuel temperature signal circuit for a poor connection at the PCM and replace terminal if necessary.<br>Did the terminal require replacement? | — | *Go to Step 14* | *Go to Step 12* |
| 12 | Replace the Crankshaft position sensor. Refer to *Crankshaft Position Sensor.* If the Crankshaft Position Sensor is faulty, the PCM must be programmed with a new TDC Offset. Refer to *TDC Offset.*<br>Is the action complete? | — | *Go to Step 14* | — |
| 13 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Refer to *PCM Replacement/Programming.*<br>Is the action complete? | — | *Go to Step 14* | — |
| 14 | 1. Using the scan tool, select DTC, Clear Info.<br>2. Start the engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate the vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the scan tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 15* | *Go to Step 2* |
| 15 | Using the scan tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0370 Timing Reference High Resolution




29557

### 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. This is a type A DTC.

### Conditions for Setting the DTC

A number of High Resolution pulses (internal to PCM) per every 8 cam reference pulses.

### Action Taken When the DTC Sets

Backup 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 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

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 fault. It is possible P0370 may set if the vehicle runs out of fuel.

### Test Description

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

2. This Step will determine if there is a 5 volt reference.
3. This Step checks the ground circuit.
4. This Step will check to see if the sensor is sending a signal back to the PCM.

### DTC P0370 Timing Reference High Resolution

| 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| *2* | 1. Ignition OFF.<br>2. Disconnect the Optical/Fuel temperature sensor electrical connector.<br>3. Ignition ON engine OFF.<br>4. Using a *J 39200*, measure voltage between the Optical/Fuel Temperature 5 volt reference circuit and chassis ground at harness connector.<br>Is voltage at specified value? | 5 V | *Go to Step 3* | *Go to Step 5* |
| *3* | Probe the sensor ground circuit with a test light connected to B+ at the harness connector.<br>Is test light ON? | — | *Go to Step 4* | *Go to Step 7* |
| *4* | 1. Reconnect Optical/Fuel temperature sensor.<br>2. Start and idle engine.<br>3. With scan tool, command 900 rpm.<br>4. With J 39200 on Hertz (Hz) scale, back probe high resolution signal circuit at PCM.<br>Is Hertz reading at specified value? | 3840 Hz (± 100) | *Go to Step 10* | *Go to Step 9* |
| 5 | 1. Removed electrical harness filter from vehicle.<br>2. Check resistance on the electrical harness filter 5 volt reference circuit (terminal A).<br>Is resistance greater than specified value? | 2.0 Ohms | *Go to Step 13* | *Go to Step 6* |
| 6 | 1. Ignition OFF.<br>2. Electrical harness filter removed from vehicle.<br>3. Disconnect the PCM, and check the Optical/Fuel temperature 5 volts reference circuit for an open, short to ground, or short to the sensor ground circuit.<br>4. If the Optical/Fuel temperature 5 volt reference circuit is open or shorted to ground, repair it as necessary.<br>Was the Optical/Fuel temperature 5 volt reference circuit open or shorted to ground? | — | *Go to Step 14* | *Go to Step 8* |
| 7 | 1. Check for an open or a poor sensor ground terminal connection at the PCM.<br>2. If a problem is found, repair as necessary.<br>Was a repair performed? | — | *Go to Step 14* | *Go to Step 12* |
| 8 | Check the Optical/Fuel temperature 5 volt reference circuit for a poor connection at the PCM and replace terminal if necessary.<br>Did the terminal require replacement? | — | *Go to Step 14* | *Go to Step 14* |

## DTC P0370 Timing Reference High Resolution (cont'd)

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 9 | 1. Ignition OFF.<br>2. Disconnect the PCM, and check the high resolution signal circuit for an open, short to ground, or short to the sensor ground circuit.<br>3. If the high resolution signal circuit is open or shorted to ground, repair it as necessary.<br>Was the high resolution signal circuit open or shorted to ground? | — | *Go to Step 14* | *Go to Step 11* |
| 10 | Check the high resolution signal circuit for a poor connection at the PCM and replace terminal if necessary.<br>Did the terminal require replacement? | — | *Go to Step 14* | *Go to Step 12* |
| 11 | Replace Injection pump. If injection pump is faulty, the new injection pump must be timed. Refer to *Checking and Adjusting Injection Timing* in Section 4.<br>Is the action complete? | — | *Go to Step 14* | — |
| 12 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Go to *PCM Replacement/Programming.*<br>Is the action complete? | — | *Go to Step 14* | — |
| 13 | Replace electrical harness filter.<br>Is the action complete? | — | *Go to Step 14* | — |
| 14 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 10* | *Go to Step 2* |
| 15 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0380 Glow Plug Circuit Performance

Refer to *Glow Plug System*

### 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 initial engine operation. The PCM controls the glow plug ON times by monitoring coolant temperatures and glow plug voltage. This is a type B code.

### Conditions for Setting the DTC

- PCM has commanded glow plugs ON and voltage at the glow plugs is less than .8 volts.

or

- PCM has commanded glow plugs OFF and voltage at the glow plugs is greater than .8 volts.

or

- 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

Hard start or no start and possible white smoke.

### 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 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

If glow plug relay is stuck in the ON position, check for proper operation of glow plugs, refer to *Section 7.* 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.

### Test Description

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 PCM is requesting the glow plug system ON.
7. This Step will determine if the glow plug relay has been activated, and out put voltage has been seen by the PCM.

**DTC P0380 Glow Plug Circuit Performance**

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 1 | 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Scan tool installed<br>2. Ignition ON, engine OFF.<br>3. With scan tool command glow plugs ON.<br>4. Observe Glow Plug System on scan tool display.<br>Does scan tool display Glow Plug System enabled? | — | *Go to Step 3* | *Go to Step 7* |
| 3 | 1. Ignition ON, engine OFF.<br>2. With scan tool command glow plugs ON.<br>3. Observe Glow Plugs display on scan tool.<br>Does scan tool display Glow Plugs at specified value? | B+ | *Go to Step 4* | *Go to Step 5* |
| 4 | DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids If additional DTCs were stored refer to those table(s).<br>Were additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 5 | 1. Disconnect glow plug relay connector.<br>2. Ignition ON, engine OFF.<br>3. With test light connected to ground, probe glow plug relay harness ignition feed circuit.<br>Is test light ON? | — | *Go to Step 6* | *Go to Step 10* |

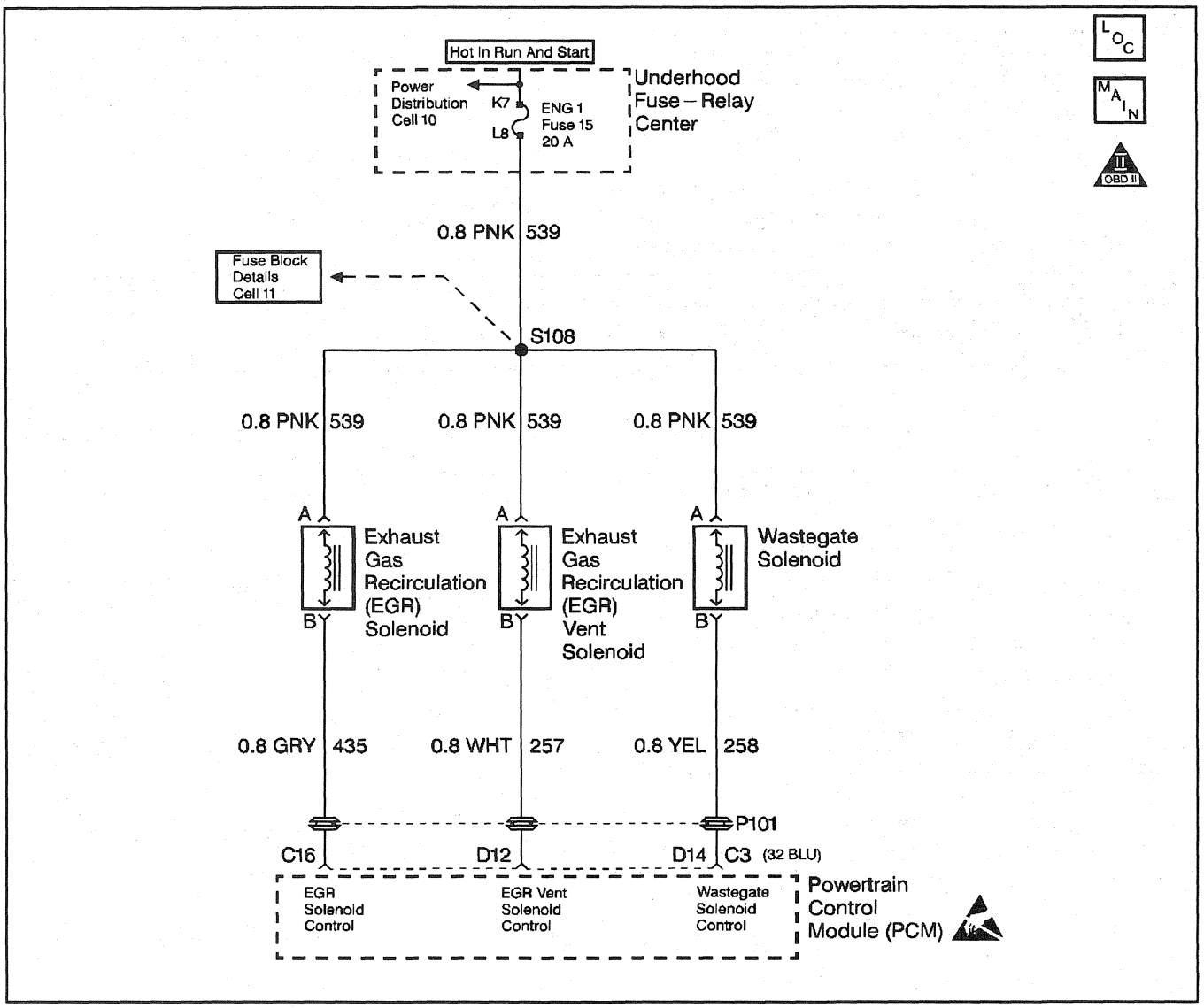
## DTC P0380 Glow Plug Circuit Performance (cont'd)

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 6 | 1. Ignition ON, engine OFF.<br>2. Connect test light between glow plug harness ignition feed circuit and the harness ground circuit.<br>Is test light ON? | — | *Go to Step 7* | *Go to Step 11* |
| 7 | 1. Ignition ON, engine OFF.<br>2. Glow plug harness still disconnected.<br>3. With a *J 39200* connected to ground, probe glow plug relay control circuit at the glow plug harness connector.<br>4. With scan tool, command glow plugs ON.<br>Is voltage at the specified value? | B+ | *Go to Step 8* | *Go to Step 12* |
| 8 | 1. Reconnect glow plug relay.<br>2. Ignition ON, engine OFF.<br>3. With test light connected to ground, probe glow plug side of relay.<br>4. With scan tool, command glow plugs ON.<br>Is test light ON when scan tool commands glow plugs ON? | — | *Go to Step 14* | *Go to Step 16* |
| 9 | Check glow plug relay control circuit for a poor connection at the PCM and replace terminal if necessary.<br>Did any terminals require replacement? | — | *Go to Step 18* | *Go to Step 17* |
| 10 | Repair open or short to ground in glow plug relay ignition feed circuit.<br>Is the action complete? | — | *Go to Step 18* | — |
| 11 | Repair open or poor connections in glow plug relay ground circuit.<br>Is the action complete? | — | *Go to Step 18* | — |
| 12 | 1. Check glow plug relay control circuit for an open or short to ground.<br>2. If the glow plug relay control circuit is open or shorted to ground, repair it as necessary.<br>Was a problem found? | — | *Go to Step 18* | *Go to Step 13* |
| 13 | Check glow plug relay control circuit for a poor connection at the PCM and replace terminal if necessary.<br>Was a problem found? | — | *Go to Step 18* | *Go to Step 17* |
| 14 | 1. Check glow plug relay signal control circuit for an open or short to ground.<br>2. If the glow plug relay signal circuit is open or shorted to ground, repair it as necessary.<br>Was a problem found? | — | *Go to Step 18* | *Go to Step 15* |
| 15 | Check glow plug relay signal circuit for a poor connection at the PCM and replace terminal if necessary.<br>Was a problem found? | — | *Go to Step 18* | *Go to Step 17* |
| 16 | Replace glow plug relay. Refer to *Glow Plug Relay.*<br>Is the action complete? | — | *Go to Step 18* | |
| 17 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Refer to *PCM Replacement/Programming.*<br>Is the action complete? | — | *Go to Step 18* | — |

## DTC P0380 Glow Plug Circuit Performance (cont'd)

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 18 | 1. Using the scan tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the scan tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 19* | *Go to Step 2* |
| 19 | Using the scan tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the *Applicable DTC Table* | System OK |

## DTC P0404 EGR System




29560

### 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. 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 Setting the DTC

- DTCs P0405 or P0406 are not stored.
- ENGINE SPEED greater than 506 rpm.
- (Desired EGR pressure) – (Measured EGR pressure) > 50 kPa.
- Above conditions persist for at least 25.5 seconds.

### Action Taken When the DTC Sets

The PCM will shut down the EGR.

### 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 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 vacuum leak or a pinched vacuum will cause a DTC P0404. Check all vacuum lines and components connected to the hoses for leaks or sharp bends or deformities. Check vacuum source to EGR solenoid assembly. Also check for small leak in EGR valve, and proper vacuum line routing.

## Test Description

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

3. This step checks vacuum to the EGR valve.
4. This step checks for a faulty EGR vent solenoid.
5. This step checks for a good vacuum source. The vacuum gauge will fluctuate at the approximate specified value.

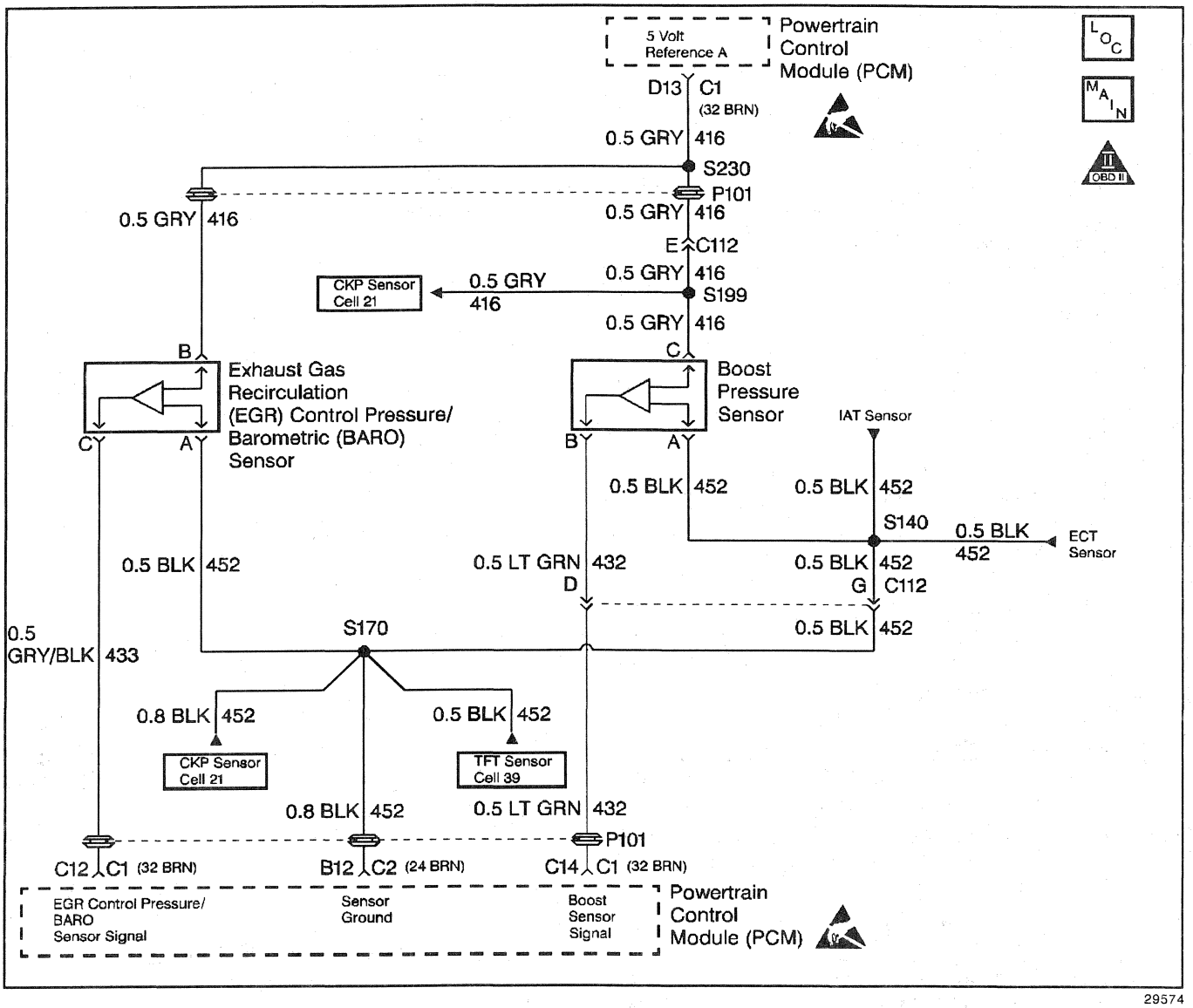
### DTC P0404 EGR System

| 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Install vacuum gage in place of EGR valve.<br>2. Start engine.<br>3. At idle observe vacuum.<br>Is vacuum at the specified value? | 5 –7 Hg | *Go to Step 3* | *Go to Step 5* |
| *3* | 1. Disconnect EGR vent solenoid electrical connector.<br>2. Vacuum gage still in place.<br>3. Start engine.<br>4. Observe vacuum gage at idle.<br>Is there any vacuum present? | — | *Go to Step 10* | *Go to Step 6* |
| *4* | DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids.<br>If additional DTCs were stored refer to those table(s).<br>Were additional DTCs stored? Are additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| *5* | Check vacuum source at solenoid assembly.<br>Is vacuum greater than the specified value? | 15 Hg | *Go to Step 7* | *Go to Step 8* |
| 6 | 1. Ignition OFF.<br>2. Install vacuum pump on EGR valve.<br>3. Pump up to 15 Hg of vacuum.<br>4. Observe EGR valve for movement.<br>Does EGR valve move? | — | *Go to Step 7* | *Go to Step 11* |
| 7 | Check for plugged or leaking vacuum hoses.<br>Is the action complete? | — | *Go to Step 12* | — |
| 8 | Check for plugged or leaking vacuum hose to the vacuum pump.<br>Is the action complete? | — | *Go to Step 12* | *Go to Step 9* |
| 9 | Check for a faulty vacuum pump.<br>Is the action complete? | — | *Go to Step 12* | — |
| 10 | Replace EGR vent solenoid. Refer to *EGR Vent Solenoid.*<br>Is the action complete? | — | *Go to Step 12* | — |
| 11 | Replace EGR valve. Refer to *EGR Valve.*<br>Is the action complete? | — | *Go to Step 12* | — |

## DTC P0404 EGR System (cont'd)

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 12 | After Repairs use the scan tool Clear Info function and road test vehicle. Check for DTCs Current or History. Review test status information. If status is test Failed or DTCs are present begin diagnosis again on that DTCs. If last test Failed is not present and no DTCs are present repair is complete.<br>Are the repairs complete? | — | Go to *Powertrain OBD System Check* | — |
| 13 | Using the scan tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0405 EGR Sensor Circuit Low Voltage




29574

### 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 Setting the DTC

- Actual EGR less than or equal to .24 volts (15 kPa).
- Condition met for 2 seconds.

### Action Taken When the DTC Sets

The PCM will shut down the EGR.

### 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 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

With the ignition ON and the engine stopped, the EGR pressure is equal to atmospheric pressure with the signal voltage being high. The information is used by the PCM as an indication of vehicle altitude. Comparison of this reading with a known good vehicle with the same sensor is a good way to check accuracy of a 'suspect' sensor. Readings should be the same + .4 volt. An intermittent open in signal circuit or the 5 volt reference circuit will result in a DTC P0405.

### 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.

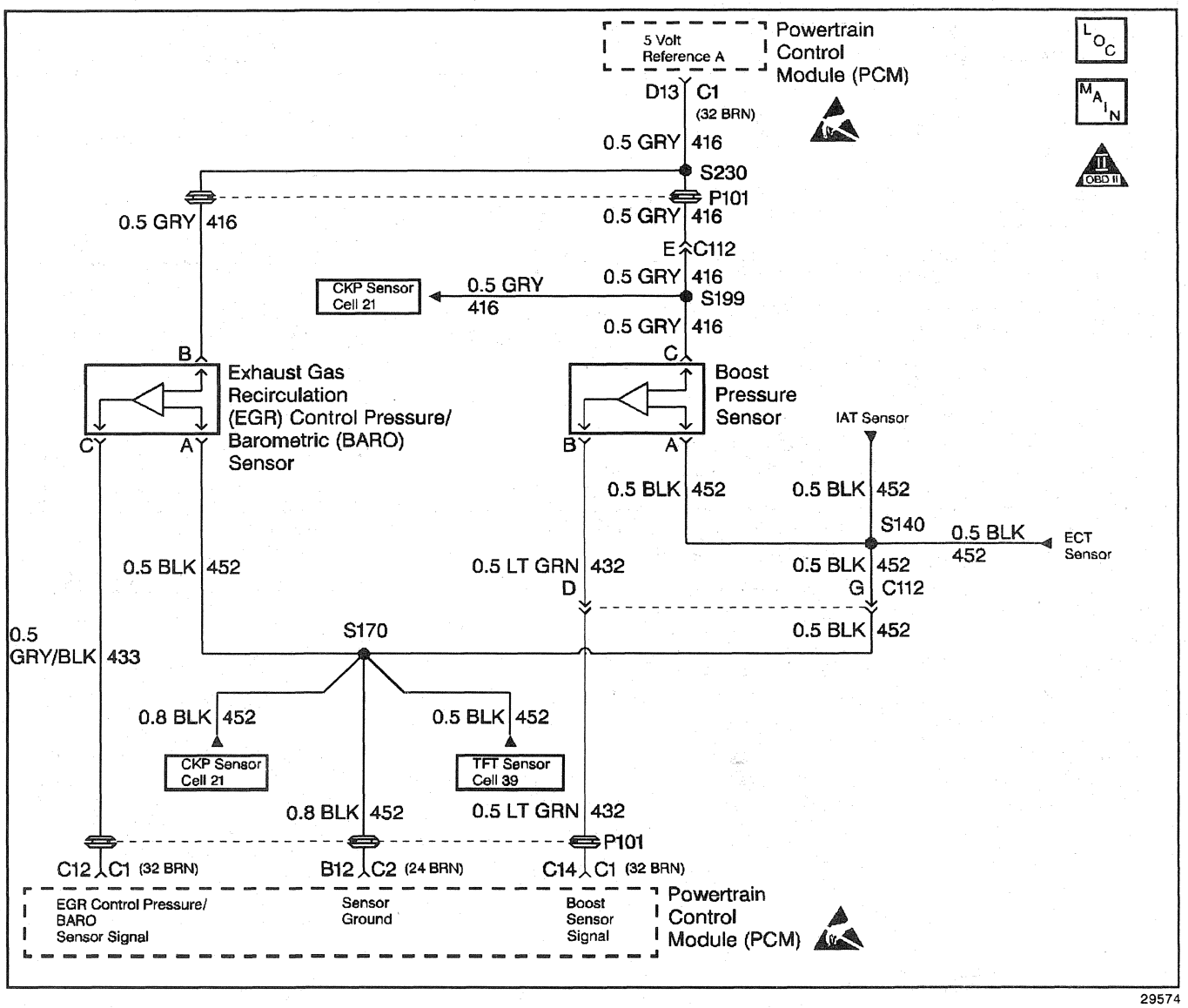
## DTC P0405 EGR Sensor Circuit Low Voltage

| 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.<br>Was the On–Board Diagnostic (OBD) system check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Install Scan tool.<br>2. Engine idling.<br>3. Observe EGR Sensor display on scan tool.<br>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.<br>2. Disconnect the EGR Control Pressure/Baro sensor electrical connector.<br>3. Jumper the sensor 5 volt reference circuit to the sensor signal circuit at the harness connector.<br>4. Turn the Ignition ON.<br>Does the scan tool display 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.<br>2. Remove the jumper wire.<br>3. Probe the sensor signal circuit at the harness connertor with a test light connected to B+<br>4. Turn the Ignition ON.<br>Does the scan tool display 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 chart(s) first.<br>Are additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 6 | Check for a faulty connection at the EGR sensor.<br>Was a problem found? | — | *Go to Step 12* | *Go to Step 11* |
| 7 | Check for an open EGR sensor signal circuit.<br>Was a problem found? | — | *Go to Step 12* | *Go to Step 8* |
| 8 | Check the EGR sensor signal circuit for a short to ground.<br>Was a problem found? | — | *Go to Step 12* | *Go to Step 13* |
| 9 | Check for an open in the EGR sensor 5 volt reference circuit.<br>Was a problem found? | — | *Go to Step 12* | *Go to Step 10* |
| 10 | Check for a short to ground in the EGR sensor 5 volt reference circuit.<br>Was a problem found? | — | *Go to Step 12* | *Go to Step 13* |

## DTC P0405 EGR Sensor Circuit Low Voltage (cont'd)

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 11 | Replace the faulty EGR sensor. Refer to *EGR Valve*.<br>Is the action complete? | — | *Go to Step 14* | — |
| 12 | Repair the circuit as necessary.<br>Is the action complete? | — | *Go to Step 14* | — |
| 13 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Go to *PCM Replacement/Programming*.<br>Is the action complete? | — | *Go to Step 14* | — |
| 14 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 15* | *Go to Step 2* |
| 15 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0406 EGR Sensor Circuit High Voltage




29574

### 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 Setting the DTC

- Actual EGR greater than or equal to 3.96 volts (85 kPa).
- Desired EGR is less than or equal to 60 kPa.
- EGR vent is closed.
- Conditions met for 2 seconds.

### Action Taken When the DTC Sets

PCM will shut off EGR system.

### 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 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

With the ignition ON and the engine stopped, 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. Comparison of the reading with a known good vehicle with the same sensor is a good way to

check accuracy of a 'suspect' sensor. Readings should be the same + .4 volt. A DTC P0406 will result if the ground circuit is open. If DTC P0406 is intermittent, refer to *Symptoms*.

### 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 EGR Sensor Circuit High Voltage

| 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.<br>Was the On-Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | Is DTC P1653 set? | — | Go to the Applicable DTC Table | *Go to Step 3* |
| 3 | 1. Connect the scan tool.<br>2. Engine idling.<br>Does the scan tool display EGR Sensor voltage greater than the specified value? | 4.0 V | *Go to Step 4* | *Go to Step 5* |
| 4 | 1. Turn the ignition OFF.<br>2. Disconnect the EGR Control Pressure/Baro sensor electrical connector.<br>3. Turn the ignition ON.<br>Does the scan tool display a EGR Sensor voltage less than the specified value? | 1.0 V | *Go to Step 6* | *Go to Step 10* |
| 5 | DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs are stored refer to those chart(s) first.<br>Are additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 6 | 1. Ignition ON, engine Off.<br>2. With a *J 39200* connected to ground, probe the 5 volt reference circuit at the EGR Control Pressure/Baro Sensor harness connector.<br>Is 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+.<br>Is the test light ON? | — | *Go to Step 8* | *Go to Step 12* |
| 8 | Check the EGR vacuum source for a restriction.<br>Was a problem found? | — | *Go to Step 13* | *Go to Step 9* |
| 9 | Replace the faulty EGR Control Pressure/Baro sensor. Refer to *EGR Control Pressure Sensor*.<br>Is the action complete? | — | *Go to Step 15* | — |
| 10 | Check for a short to voltage in the sensor signal circuit.<br>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<br>2. If a problem is found, repair as necessary.<br>Was a repair performed? | — | *Go to Step 15* | *Go to Step 14* |

## DTC P0406 EGR Sensor Circuit High Voltage (cont'd)

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 12 | Repair the open in the sensor ground circuit.<br>Is the action complete? | — | *Go to Step 15* | — |
| 13 | Repair as necessary.<br>Is the action complete? | — | *Go to Step 15* | — |
| 14 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Go to *PCM Replacement/Programming.*<br>Is the action complete? | — | *Go to Step 15* | — |
| 15 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 16* | *Go to Step 2* |
| 16 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0501 Vehicle Speed Sensor Circuit

Refer to *Transmission - Vehicle Speed Sensor and Buffer*.

### 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. This is a type D DTC.

### Conditions for Setting the DTC

- Vehicle speed greater than 20 mph.
- Four wheel low not selected.
- VSS buffer calculated speed is less than half the transmission calculated speed.

or

- VSS buffer calculated speed is greater than transmission calculated speed by 20 mph.
- All conditions must be met for 2 seconds.

### Action Taken When the DTC Sets

No cruise control.

### 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

Check connections at VSS buffer and PCM. Refer to 4L80E Diagnostic Diagnostic Trouble Codes in *Section 10* 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.

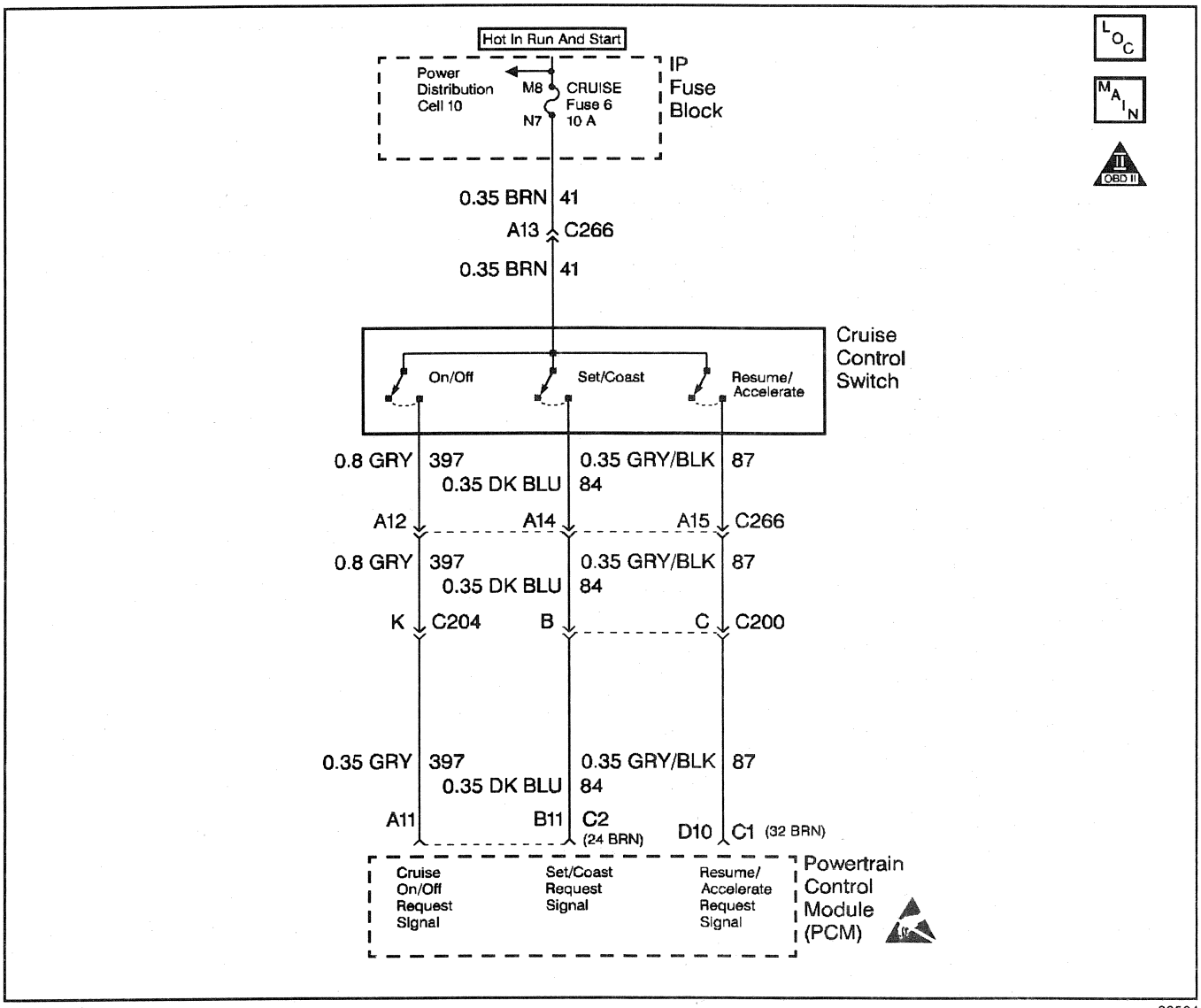
### DTC P0501 Vehicle Speed Sensor Circuit

| 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Install scan tool.<br>2. Raise drive wheels.<br>3. Engine operating.<br>4. Transmission in any drive range.<br>With drive wheels rotating, does vehicle speed increase with drive wheel speed increase? | — | *Go to Step 7* | *Go to Step 3* |
| 3 | 1. Transmission in park.<br>2. Back probe VSS buffer module ignition feed circuit with a test light connected to ground.<br>Is test light ON? | — | *Go to Step 4* | *Go to Step 8* |
| 4 | Back probe VSS buffer module ignition feed circuit to the ground circuit with a test light.<br>Is the test light ON? | — | *Go to Step 5* | *Go to Step 9* |
| 5 | 1. Back probe VSS buffer module at VSS input circuit (C7) to the other VSS input circuit (C12) with a *J 39200* on the AC scale.<br>2. Transmission in any drive range with drive wheels rotating.<br>Does voltage increase on *J 39200* with drive wheel increase? | — | *Go to Step 6* | *Go to Step 10* |
| 6 | Does scan tool display a trans output speed (MPH) increase with drive wheel increase? | — | *Go to Step 11* | *Go to Step 13* |

## DTC P0501 Vehicle Speed Sensor Circuit (cont'd)

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 7 | DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs are stored refer to those chart(s) first.<br>Are additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 8 | Repair the open in the ignition feed circuit.<br>Is the action complete? | — | *Go to Step 15* | — |
| 9 | Repair the open in the ground circuit.<br>Is the action complete? | — | *Go to Step 15* | — |
| 10 | Check the complete VSS input circuit for an open or short to ground.<br>Was a repair performed? | — | *Go to Step 15* | — |
| 11 | Check VSS output circuit for an open or short to ground.<br>Was a repair performed? | — | *Go to Step 15* | *Go to Step 12* |
| 12 | Check VSS output circuit for a poor connections at buffer module and PCM.<br>Was a repair performed? | — | *Go to Step 15* | *Go to Step 14* |
| 13 | Replace VSS Buffer module. Refer to *Vehicle Speed Signal Buffer.*<br>Is the action complete? | — | *Go to Step 15* | — |
| 14 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Refer to *PCM Replacement/Programming.*<br>Is the action complete? | — | *Go to Step 15* | — |
| 15 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 16* | *Go to Step 2* |
| 16 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0567 Cruise Resume Circuit




29564

### 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. Cruise Resume/Accel switch sends ignition voltage to the PCM when the switch is switch is closed (ON). This is a type D DTC.

### Conditions for Setting the DTC

- Cruise switch OFF.
- Ignition voltage on Resume switch signal circuit.

or

- Cruise switch ON.
- Resume switch ON for longer than 25.5 seconds.

### Action Taken When the DTC Sets

- Will not turn on the MIL.
- The PCM will disallow all cruise inputs.
- TCC shift schedules may be affected.

### 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

Check for a resume/accel switch stuck in the engage position or the signal circuit is shorted to voltage.

## Test Description

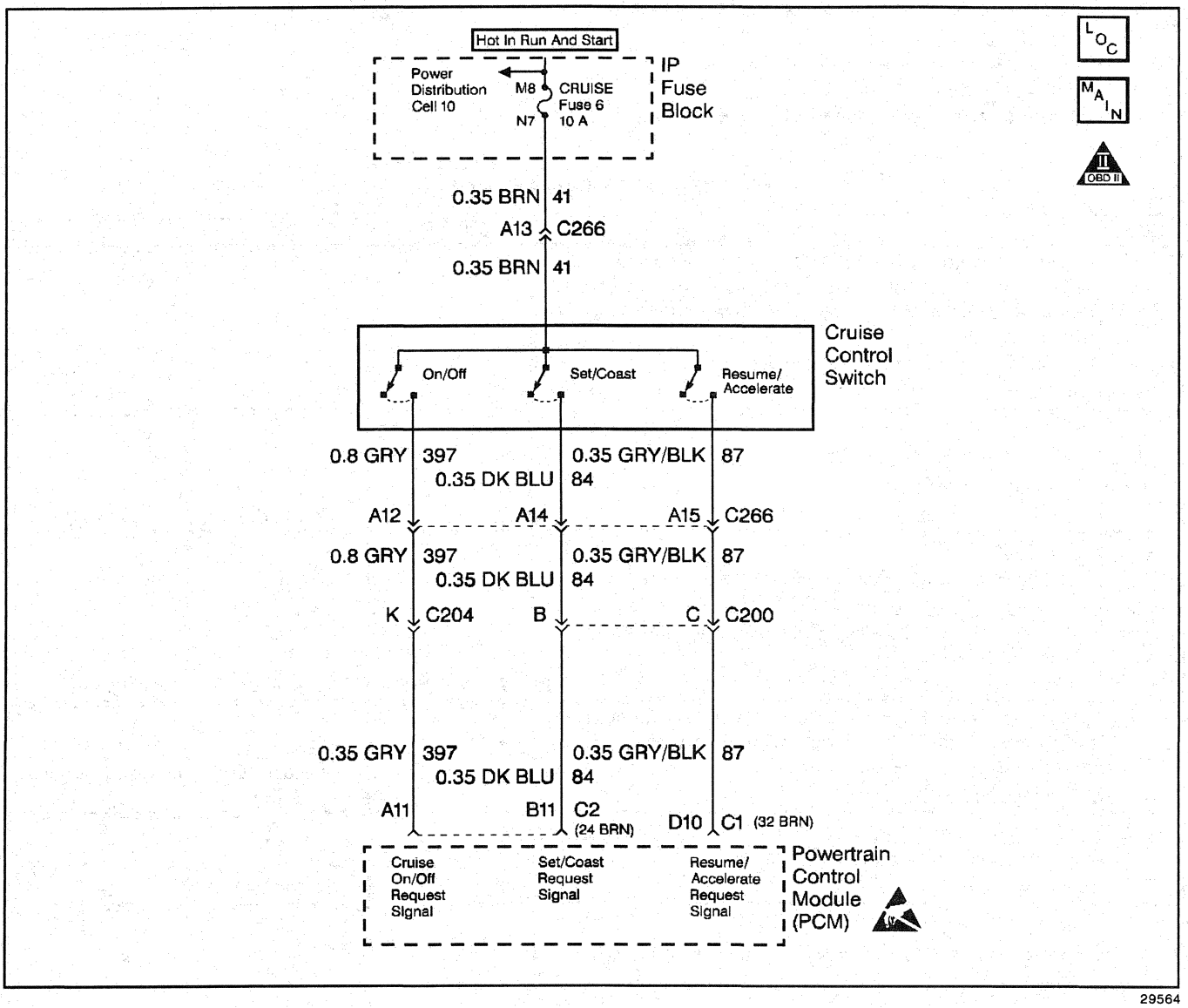
Number(s) below refer to the Step number(s) on the Diagnostic Table.

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 Resume 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| *2* | 1. Scan tool connected.<br>2. Ignition ON, engine OFF.<br>3. Cruise switch OFF.<br>Does scan tool display Resume Switch ON? | — | *Go to Step 3* | *Go to Step 4* |
| *3* | 1. Ignition ON.<br>2. Disconnect the PCM brown 32 way connector.<br>3. Probe the Resume switch signal circuit at the PCM harness with a test light connected to chassis ground.<br>Is the test light ON? | — | *Go to Step 5* | *Go to Step 7* |
| 4 | 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.<br>Are additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 5 | 1. Resume switch signal circuit is shorted to voltage.<br>2. Repair as necessary.<br>Is the action complete? | — | *Go to Step 8.* | — |
| 6 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Go to *PCM Replacement/Programming.*<br>Is the action complete? | — | *Go to Step 7* | — |
| 7 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 8* | *Go to Step 2* |
| 8 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0568 Cruise Set Circuit




29564

### 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. Cruise Set/Coast switch sends a ignition voltage signal to the PCM when the Set/Coast switch is ON. This is a type D DTC.

### Conditions for Setting the DTC

- Cruise switch OFF.
- Ignition voltage on Resume switch signal circuit.

or

- Cruise switch ON.
- Resume switch ON for longer than 25.5 seconds.

### Action Taken When the DTC Sets

- The PCM will disallow all cruise inputs.
- TCC shift schedules may be affected.

### 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

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

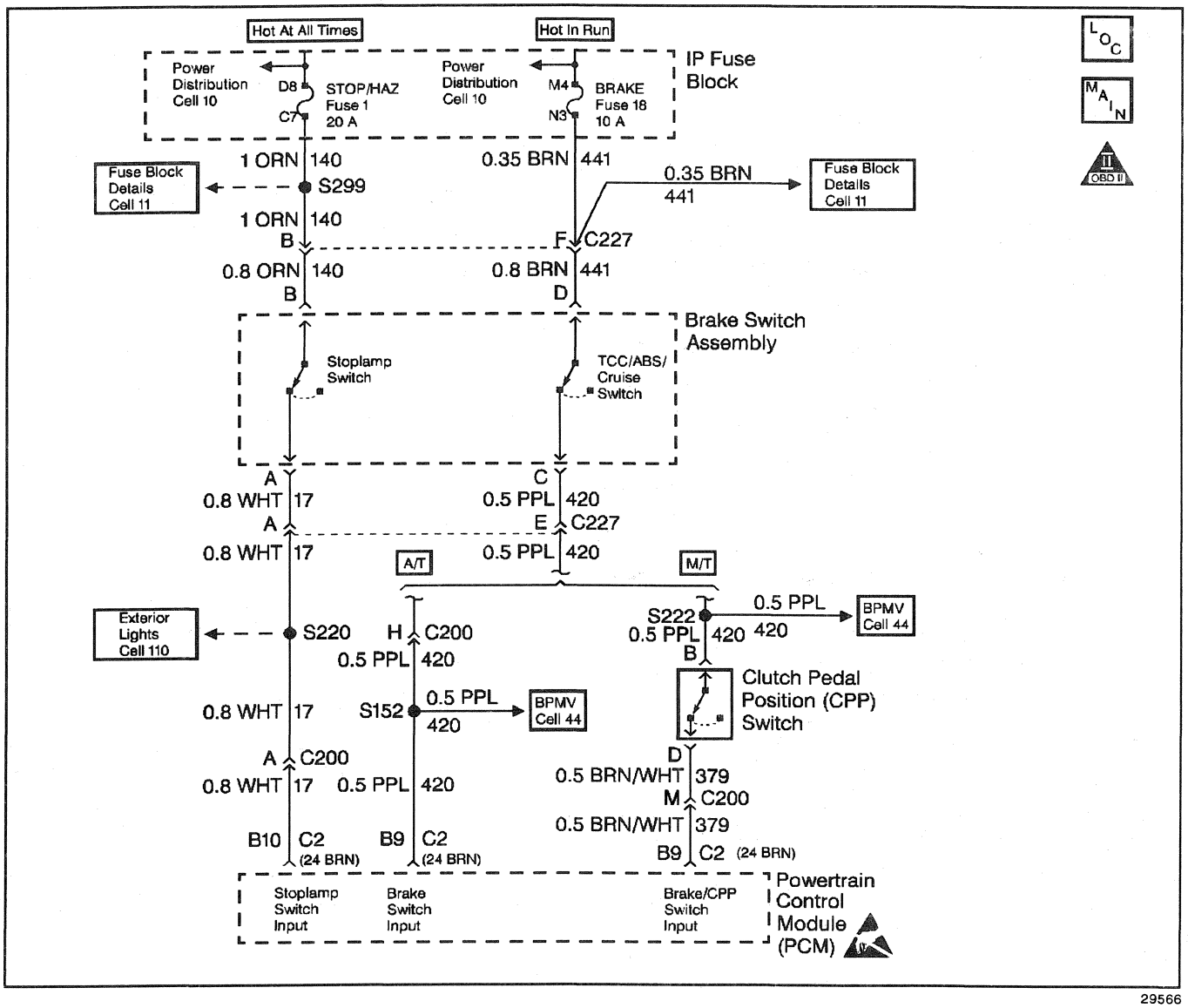
Number(s) below refer to the Step number(s) on the Diagnostic Table.

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 Set 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Scan tool connected.<br>2. Ignition ON, engine OFF.<br>3. Cruise switch OFF.<br>Does scan tool display Set switch ON? | — | *Go to Step 3* | *Go to Step 4* |
| 3 | 1. Ignition ON.<br>2. Disconnect the PCM brown 24 way connector.<br>3. Probe the Set switch signal circuit at the PCM harness with a test light connected to chassis ground.<br>Is the test light ON? | — | *Go to Step 5* | *Go to Step 7* |
| 4 | 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.<br>Are additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 5 | 1. Resume switch signal circuit is shorted to voltage.<br>2. Repair as necessary.<br>Is the action complete? | — | *Go to Step 8* | — |
| 6 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Go to *PCM Replacement/Programming.*<br>Is the action complete? | — | *Go to Step 7* | — |
| 7 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 8* | *Go to Step 2* |
| 8 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0571 Cruise Brake Switch Circuit




29566

### Circuit Description

The TCC normally closed brake switch supplies a B+ signal on CKT 420 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 CKT 820 to the PCM when the brake is applied. This is a type D DTC.

### Conditions for Setting the DTC

- Switches disagree for 10 consecutive minutes.

or

- TCC and cruise control brake switches are not toggling open and closed, during 6 brake applications on same ignition cycle.

### Action Taken When the DTC Sets

Fourth gear operation in hot mode, and cruise control operation.

### 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

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.

2. This test simulates brake switch closed or brakes OFF.
3. This test checks the feed circuit.

### DTC P0571 Cruise Brake Switch 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| *2* | 1. Scan tool installed.<br>2. Ignition ON, engine OFF?<br>3. Apply brakes.<br>Does scan tool display Cruise Brake switch Closed and then Open when brake is released? | — | *Go to Step 3* | *Go to Step 4* |
| *3* | Apply brakes again.<br>Does scan tool display Brake switch Open and then Closed when brake is released? | — | *Go to Step 8* | *Go to Step 6* |
| 4 | 1. Ignition ON, engine OFF.<br>2. Stop lamp switch disconnected.<br>3. With a test light connected to ground, probe normally open feed circuit (terminal B).<br>Is test light ON? | — | *Go to Step 5* | *Go to Step 9* |
| 5 | 1. Disconnect stop lamp switch.<br>2. Jumper normally open (terminal A) feed circuit and the normally open signal circuits (terminal B) together.<br>Does scan tool display Cruise Brake switch Closed? | — | *Go to Step 6* | *Go to Step 10* |
| 6 | 1. Ignition ON, engine OFF.<br>2. Stop lamp switch disconnected.<br>3. With a test light connected to ground, probe normally closed feed circuit (terminal F).<br>Is test light ON? | — | *Go to Step 7* | *Go to Step 12* |
| 7 | 1. Stop lamp switch disconnected.<br>2. Jumper normally closed (terminal F) feed circuit and the normally closed signal circuits (terminal E) together.<br>Does scan tool display Cruise Brake switch Closed? | — | *Go to Step 6* | *Go to Step 14* |
| 8 | 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.<br>Are additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 9 | Check normally open feed circuit (terminal B) for and open or short to ground.<br>Is the action complete? | — | *Go to Step 17* | — |
| 10 | Check normally open Cruise Brake switch signal circuit for and open or short to ground.<br>Was a repair performed? | — | *Go to Step 17* | *Go to Step 11* |

## DTC P0571 Cruise Brake Switch Circuit (cont'd)

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 11 | Check the normally open Cruise Brake switch signal circuit for a poor connection at PCM?<br>Was a repair performed? | — | *Go to Step 17* | *Go to Step 16* |
| 12 | Check normally closed feed circuit (terminal F) for and open or short to ground.<br>Is the action complete? | — | *Go to Step 17* | — |
| 13 | Check normally closed Brake switch signal circuit for and open or short to ground.<br>Was a repair performed? | — | *Go to Step 17* | *Go to Step 14* |
| 14 | Check the normally closed Brake switch signal circuit for a poor connection at PCM?<br>Was a repair performed? | — | *Go to Step 17* | *Go to Step 16* |
| 15 | Replace stop lamp switch.<br>Is the action complete? | — | *Go to Step 17* | — |
| 16 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Go to *PCM Replacement/Programming.*<br>Is the action complete? | — | *Go to Step 17* | — |
| 17 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 18* | *Go to Step 2* |
| 18 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0601 Internal Control Module Memory Check Sum

| 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | Replace the faulty PC<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Go to *PCM Replacement/Programming.*<br>Is the action complete? | — | *Go to Step 3* | — |
| 3 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 4* | *Go to Step 2* |
| 4 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

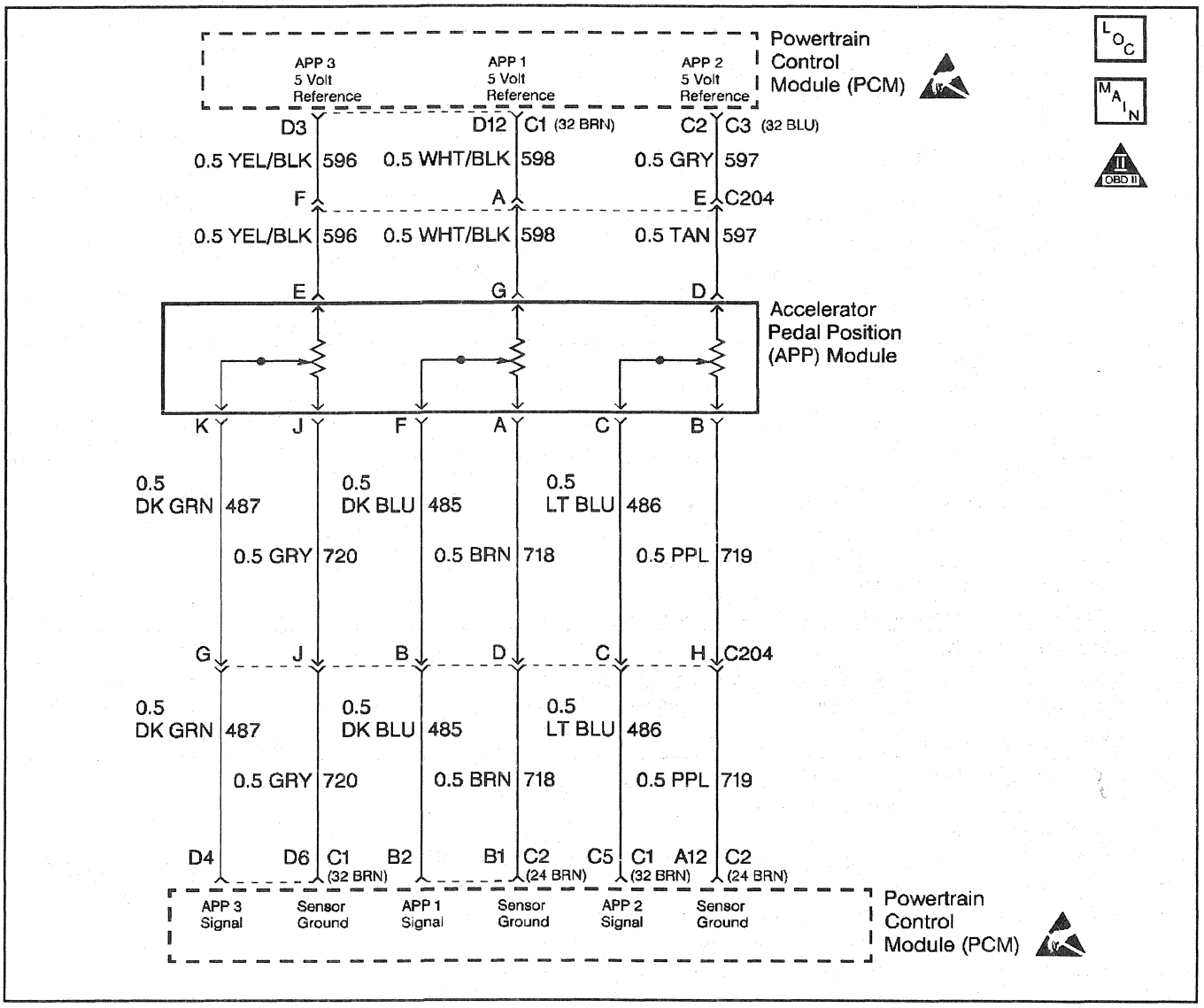
## DTC P0602 Control Module Programming

| 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | Check all PCM connections.<br>Was a problem found? | — | *Go to Step 4* | *Go to Step 3* |
| 3 | Check Techline terminal/equipment for latest software.<br>Was a problem found? | — | *Go to Step 4* | *Go to Step 5* |
| 4 | Try again to reprogram.<br>Is programming complete? | — | *Go to Step 6* | *Go to Step 5* |
| 5 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Go to *PCM Replacement/Programming.*<br>Is the action complete? | — | *Go to Step 6* | — |
| 6 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 7* | *Go to Step 2* |
| 7 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P0606 PCM Internal Communication Interrupted

| 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | Is DTC P0370 set? | — | Refer to the Applicable DTC Table | *Go to Step 3* |
| 3 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Go to *PCM Replacement/Programming.*<br>Is the action complete? | — | *Go to Step 4* | — |
| 4 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 5* | *Go to Step 2* |
| 5 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P1125 APP System




29555

### 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. This is a type D DTC.

### Conditions for Setting the DTC

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.

### 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 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.

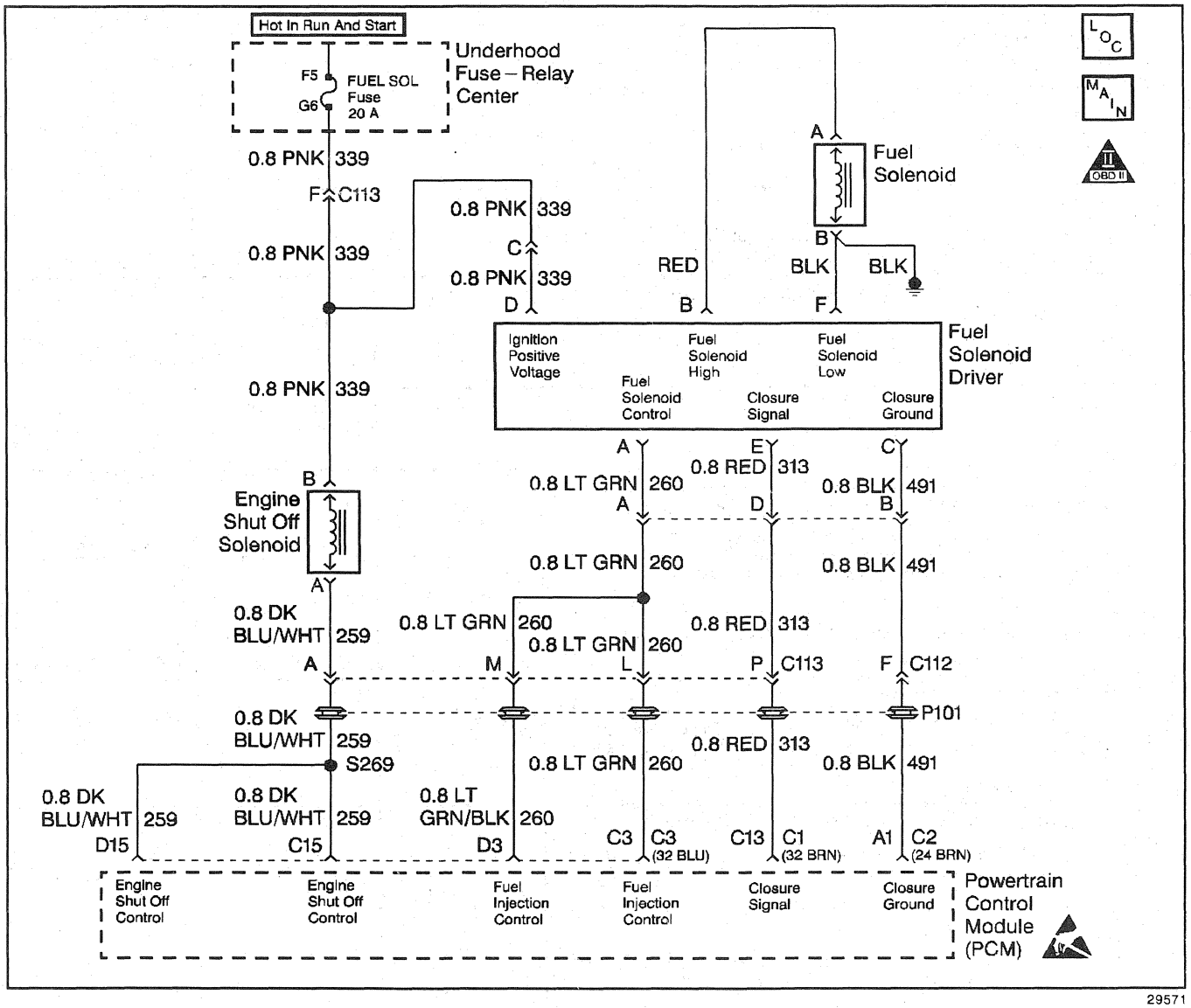
## DTC P1125 APP System

| 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| *2* | 1. Disconnect the APP sensor electrical connector.<br>2. Ignition ON, engine OFF.<br>3. With *J 39200* connected to ground, check all APP 5 volt reference circuits at APP harness.<br>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.<br>Are additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 4 | 1. Ignition OFF.<br>2. Disconnect the PCM and check the 5 volt reference circuit for a short to ground.<br>3. If the 5 volt reference circuit is shorted to ground, repair it as necessary.<br>Was the 5 volt reference circuit shorted to ground? | — | *Go to Step 6* | *Go to Step 5* |
| 5 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Go to *PCM Replacement/Programming.*<br>Is the action complete? | — | *Go to Step 6* | — |
| 6 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 7* | *Go to Step 2* |
| 7 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P1214 Injection Pump Timing Offset

| 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | Install scan tool.<br>Does scan tool display a DTC Offset greeter than or less than the specified values? | +2.5 or –2.5 | *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 rthe applicable table(s) first.<br>Are additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 4 | Are there any other DTCs set? | — | Go to the Applicable DTC Table | *Go to Step 5* |
| 5 | Clear all codes and reset injection timing until TDC Offset is between specified values. Refer to *TDC Offset.*<br>Is timing within specified value? | –.25 to –.75 | *Go to Step 8* | *Go to Step 6* |
| 6 | Check the crankshaft position sensor for the following.<br>• Proper installation.<br>• Loose or broken sensor mounting tab.<br>Was a repair performed? | — | *Go to Step 8* | *Go to Step 7* |
| 7 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Refer to *PCM Replacement/Programming.*<br>Is the action complete? | — | *Go to Step 8* | — |
| 8 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 9* | *Go to Step 2* |
| 9 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P1216 Fuel Solenoid Response Time Too Short




29571

### 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. This is a type D DTC.

### Conditions for Setting the DTC

- Battery voltage greater than 10 volts and less than 16 volts.
- Engine coolant temperature greater than –1 °C (34 °F).
- ENGINE SPEED greater than 506 rpm.
- Requested fuel rate is greater than 0.0 mm
- Inj. Pump Closure Time less than .75 ms.

### Action Taken When the DTC Sets

Possible poor performance or no start.

### 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

If DTC P1216 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.

### 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.

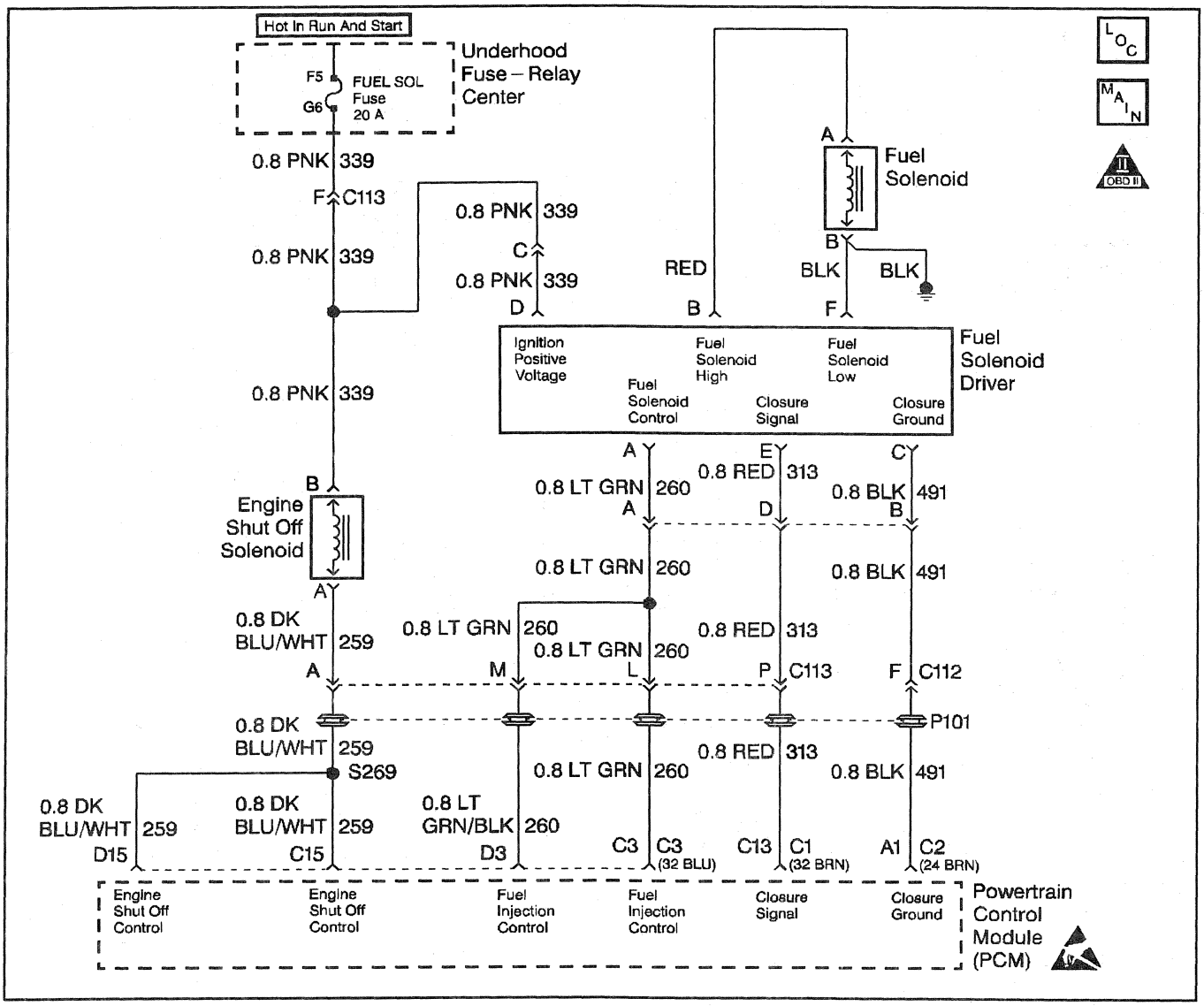
## DTC P1216 Fuel Solenoid Response Time Too Short

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 1 | **Important:** Before clearing 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| *2* | Is DTC P0219 set? | — | Go to *DTC P0219 Engine Overspeed Condition* | *Go to Step 3* |
| *3* | Will engine start? | — | *Go to Step 4* | *Go to Step 7* |
| 4 | 1. Engine at operating temperature.<br>2. Observe Inj. Pump Closure Time on scan tool.<br>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. Engine running.<br>2. Again, observe Inj. Pump Closure Time on scan tool.<br>Does Inj. Pump Closure Time display the specified value? | 0.0 ms | *Go to Step 8* | *Go to Step 10* |
| 6 | 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.<br>Are additional DTCs stored? | — | Go to the Applicable DTC Table | — |
| 7 | 1. Check the Closure ground circuit for an open.<br>2. If the Closure ground circuit is open, repair as necessary.<br>Was a repair performed? | — | *Go to Step 12* | — |
| 8 | 1. Check the Closure signal circuit for an open or short to ground.<br>2. If the Closure signal circuit is open or shorted to ground, repair as necessary.<br>Was a repair performed? | — | *Go to Step 12* | *Go to Step 9* |
| 9 | Check the Closure signal circuit for a poor connection at the PCM and replace terminal if necessary.<br>Did the terminal require replacement? | — | *Go to Step 12* | *Go to Step 10* |
| 10 | Replace the Injection pump. Refer to *Fuel Injection Pump.*<br>**Important:** If the injection pump is faulty, the new injection pump must be timed. Refer to *Checking/Adjust Injection Timing.*<br>Is the action complete? | — | *Go to Step 11* | — |
| 11 | Replace the faulty PCM. If the PCM is faulty, the new PCM must be programmed. Go to *PCM Replacement/Programming*<br>Is the action complete? | — | *Go to Step 12* | — |

## DTC P1216 Fuel Solenoid Response Time Too Short (cont'd)

| | | | | |
|---|---|---|---|---|
| 12 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 13* | *Go to Step 2* |
| 13 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P1217 Fuel Solenoid Response Time Too Long




29571

### 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. This is a type D DTC.

### Conditions for Setting the DTC

- Battery voltage greater than 10 volts and less than 16 volts.
- Engine coolant temperature greater than –1 °C (34 °F).
- ENGINE SPEED greater than 506 rpm.
- Requested fuel rate is greater than 0.0 mm
- Closure Time less than 2.5 ms.

### Action Taken When the DTC Sets

Possible poor performance

### 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.

## Test Description

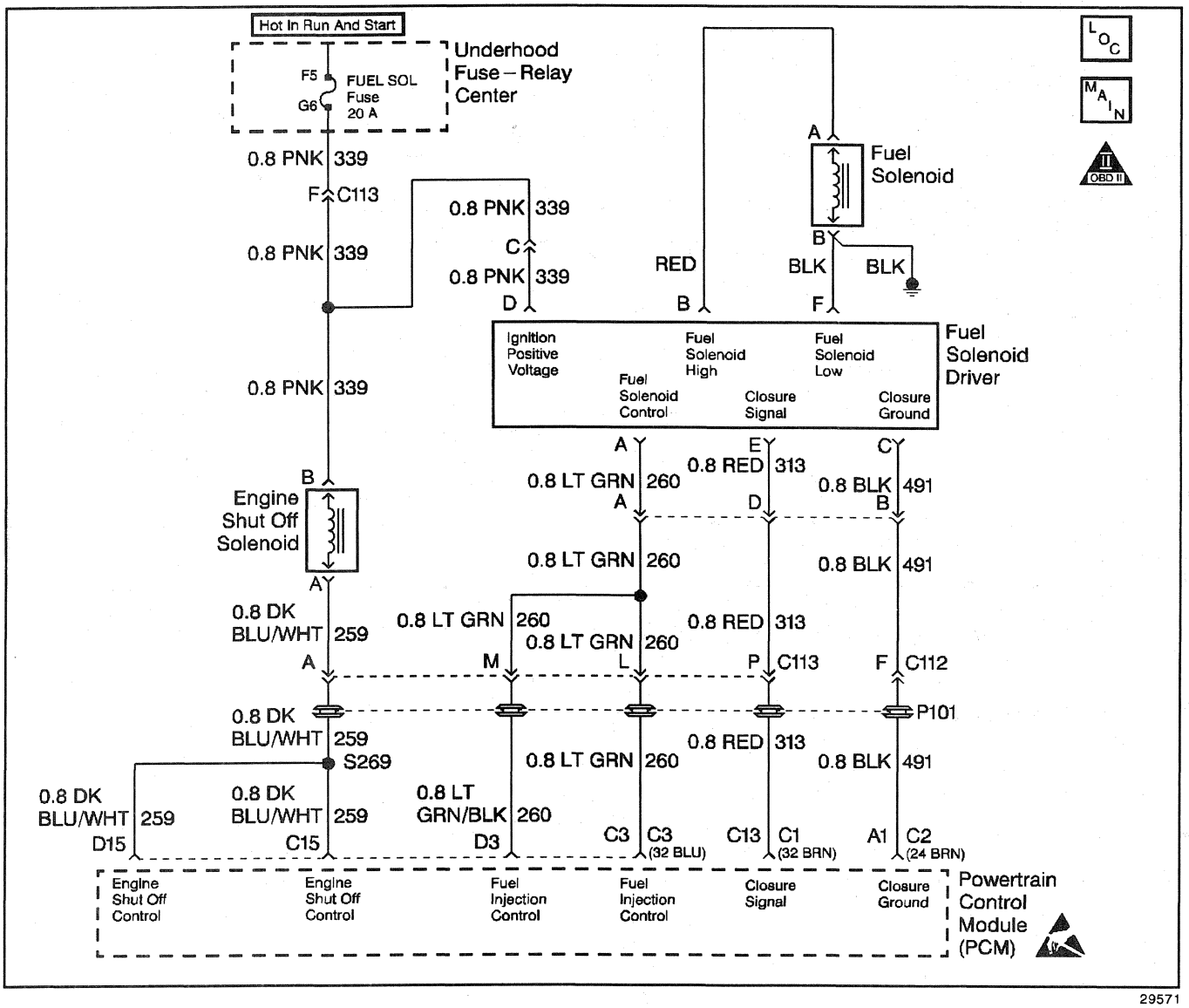
Number(s) below refer to the Step number(s) on the Diagnostic Table.

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 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | Is DTC P0370 set? | — | Go to *DTC P0370 Timing Reference High Resolution* | *Go to Step 3* |
| *3* | 1. Start and idle engine.<br>2. Observe Inj. Pump Closure Time display on scan tool.<br>Is the scan tool display greater than the specified value? | 2.4 ms | *Go to Step 4* | *Go to Step 5* |
| 4 | 1. All accessories on (includes aftermarket add-ons).<br>2. Engine idling.<br>3. All post glow plug cycles completed<br>4. With a *J 39200* connected to ground, measure voltage at the FUEL SOL fuse (fuel solenoid driver ignition feed circuit) in the U/H relay center.<br>Is voltage between specified value? | 11 - 16V | *Go to Step 7* | *Go to Step 6* |
| 5 | 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 additional DTCs stored? | — | Go to the Applicable DTC Table | — |
| *6* | Check the fuel solenoid driver ignition feed circuit for poor connections or aftermarket add-ons *Connect Add-On Electrical Operated Equipment to Battery.*<br>Was a repair performed? | — | *Go to Step 8* | — |
| 7 | Replace the Injection pump. Refer to *Fuel Injection Pump.*<br>**Important:** If injection pump is faulty, the new injection pump must be timed. Refer to *Checking/Adjust Injection Timing.*<br>Is the action complete? | — | *Go to Step8* | — |
| 8 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 9* | *Go to Step 2* |
| 9 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P1218 Injection Pump Calibration Circuit




29571

### 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. This is a type B DTC.

### Conditions for Setting the DTC

- PCM currently does not have a valid resistor valve.
- PCM is unable to read a resistor value

### Action Taken When the DTC Sets

The lowest fuel table. Possible poor performance problem.

### 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 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

Check connection at 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 faulty injection pump.

### DTC P1218 Injection Pump Calibration 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | Are than any other DTCs set? | — | Refer to Applicable DTC Table | *Go to Step 3* |
| *3* | 1. Check connection at Fuel Solenoid Driver.<br>2. Clear DTC, and cycle ignition.<br>Does the DTC clear? | — | *Go to Step 5* | *Go to Step 4* |
| 4 | Replace injection pump. Refer to *Fuel Injection Pump.*<br>Is the action complete? | — | *Go to Step 5* | — |
| 5 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 6* | *Go to Step 2* |
| 6 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

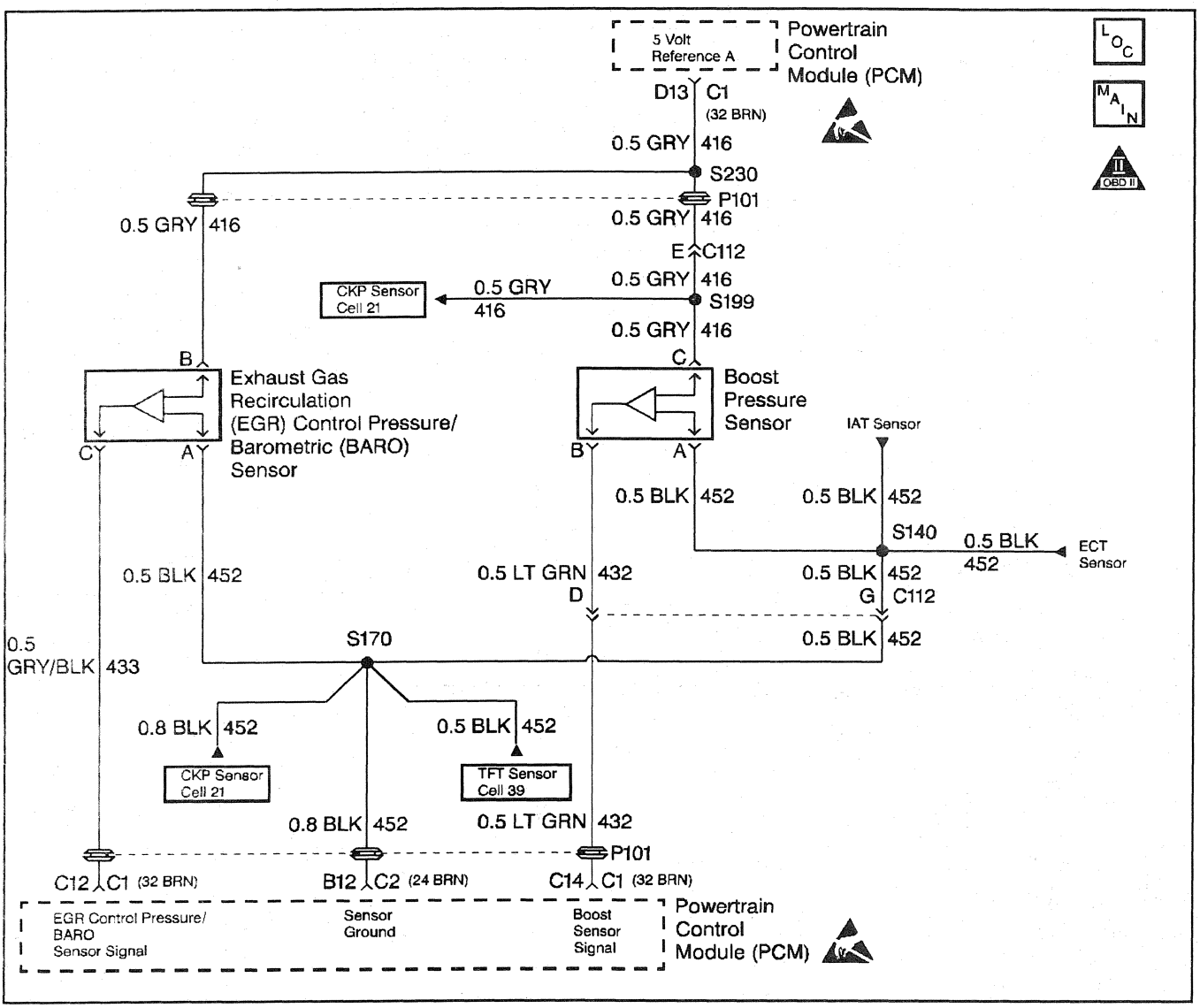
## DTC P1621 PCM Memory Performance

| 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<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Refer to *PCM Replacement/Programming.*<br>Is the action complete? | — | *Go to Step 3* | — |
| 3 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 4* | *Go to Step 2* |
| 4 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P1627 A/D Performance

| 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<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed. Refer to *PCM Replacement/Programming.*<br>Is the action complete? | — | *Go to Step 3* | — |
| 3 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 4* | *Go to Step 2* |
| 4 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P1635 5 Volt Reference Low




29574

### 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/HI.Res). This is a type D DTC.

### Conditions for Setting the DTC

5 volt reference is less than 1 volt.

### Action Taken When the DTC Sets

- Backup fuel
- No EGR.
- No turbo boost.

### 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

During the time the failure is present, the setting of additional DTCs that share a 5 volt reference may also set.

### Test Description

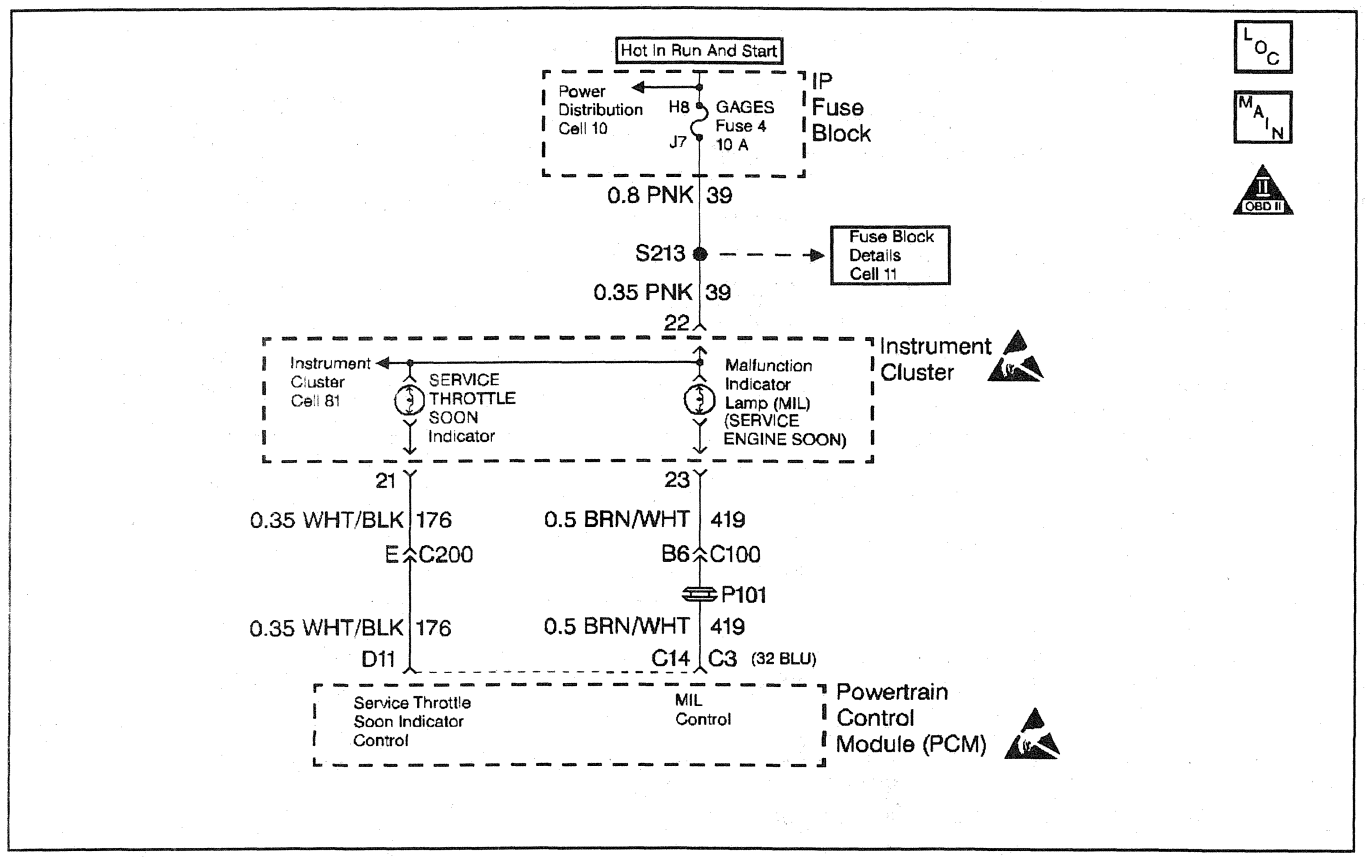
Number(s) below refer to the Step number(s) on the Diagnostic Table.

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.

## DTC P1635 5 Volt Reference Low

| 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Scan Tool installed.<br>2. Crank engine for 15 seconds or start up.<br>Does DTC reset? | — | *Go to Step 3* | *Go to Step 5* |
| 3 | 1. Ignition ON, engine OFF.<br>2. Disconnect EGR Control Pressure/BARO sensor.<br>3. With *J 39200* DVM, probe 5 volt reference circuit at harness connector.<br>Is voltage less than the specified value? | 4.0 V | *Go to Step 4* | *Go to Step 6* |
| 4 | 1. Disconnect PCM connector with EGR sensor 5 volt reference circuit.<br>2. With test light connected to B+, probe 5 volt reference circuit at PCM harness.<br>Is test light ON? | — | *Go to Step 7* | *Go to Step 8* |
| 5 | DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to those table(s).<br>Are additional DTCs stored? | — | Go to the applicable DTC table | Go to Diagnostic Aids |
| 6 | Replace EGR Control Pressure/BARO sensor. Refer to *EGR Control Pressure Sensor.*<br>Is the action complete? | — | *Go to Step 8* | — |
| 7 | Repair short to ground in 5 volt reference circuit.<br>Is the action complete? | — | *Go to Step 8* | — |
| 8 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed.<br>Refer to *PCM Replacement/Programming.*<br>Is the action complete? | — | *Go to Step 9* | — |
| 9 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 10* | *Go to Step 2* |
| 10 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC table | System OK |

## DTC P1641 MIL Control Circuit




29548

### 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 volts). The primary function of the PCM is to supply the ground for the MIL circuit. This is a type D DTC

### Conditions for Setting the DTC

- MIL requested ON.
- Voltage on MIL control circuit high (near battery volts).

or

- MIL requested OFF.
- Voltage on MIL control circuit low (near 0 volts).

### Action Taken When the DTC Sets

Will not turn ON the MIL.

### 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 faulty bulb or the control circuit shorted to ground will cause a P1641 to set.

### Test Description

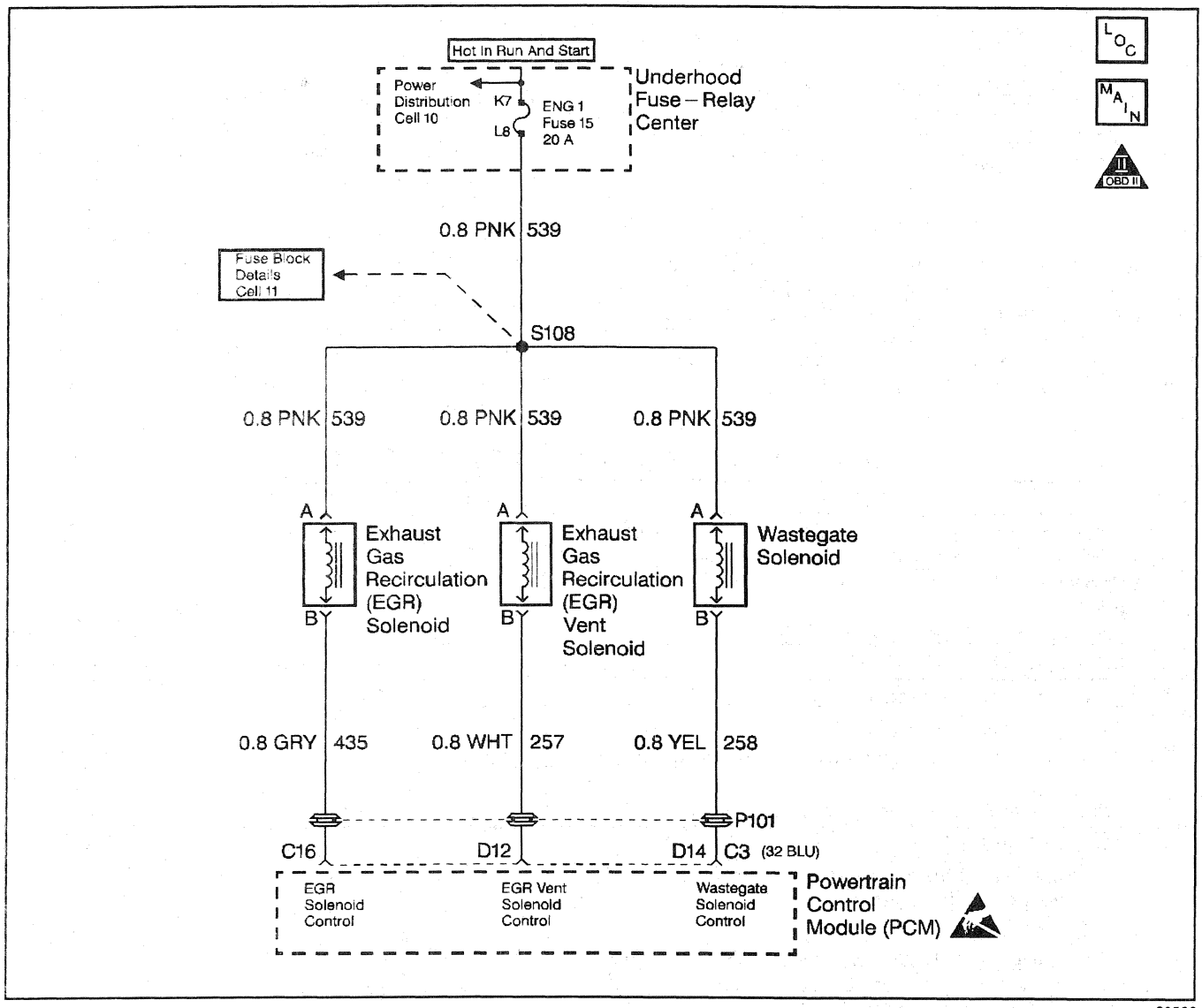
Number(s) below refer to the Step number(s) on the Diagnostic Table.

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 connection at the PCM, the PCM maybe faulty, however, this is an extremely unlikely failure.

## DTC P1641 MIL Control Circuit

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 1 | **Important:** Before clearing DTCs use the scan tool to record freeze frame and failure records for reference, as data will be lost when Clear Info function is used.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Ignition ON, engine OFF.<br>2. Using a scan tool, command the lamp ON and OFF.<br>Does the lamp turn ON and OFF with each command? | — | *Go to Step 3* | *Go to Step 4* |
| 3 | DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to those table(s).<br>Are additional DTCs stored? | — | Go to the applicable DTC table | Go to Diagnostic Aids |
| 4 | 1. Ignition OFF.<br>2. Disconnect the PCM connector containing the lamp control circuit.<br>3. Ignition ON, engine OFF.<br>Is the lamp OFF? | — | *Go to Step 5* | *Go to Step 7* |
| 5 | 1. Ignition ON, engine OFF.<br>2. With a fused jumper wire connected to ground, probe the lamp control circuit in the PCM harness connector.<br>Is the lamp ON? | — | *Go to Step 6* | *Go to Step 8* |
| 6 | 1. Check for poor connections at PCM.<br>2. If a problem was found, repair as necessary.<br>Was a repair performed? | — | *Go to Step 10* | *Go to Step 9* |
| 7 | MIL control circuit is shorted to ground, repair as necessary.<br>Is the action complete? | — | *Go to Step 10* | — |
| 8 | Check the MIL circuit for the following:<br>• Open ignition feed to the bulb.<br>• Faulty bulb.<br>• Control circuit open or shorted to B+.<br>Is the repair complete? | — | *Go to Step 10* | — |
| 9 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed.<br>Refer to *PCM Replacement/Programming*.<br>Is the action complete? | — | *Go to Step 10* | — |
| 10 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 11* | *Go to Step 2* |
| 11 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go the Applicable DTC Table | System OK |

## DTC P1653 EGR Vent Solenoid Control Circuit




29560

### 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 volts). The primary function of the PCM in this circuit is to supply the ground for the EGR vent solenoid. This is a type B code.

### Conditions for Setting the DTC

- PCM requested EGR vent ON.
- Voltage on EGR vent control circuit high (near battery volts).
- Conditions met for 2 seconds.

or

- PCM requested EGR vent solenoid OFF.
- Voltage on EGR vent control circuit low (near 0 volts).
- Conditions met for 2 seconds.

### Action Taken When the DTC Sets

- No EGR.
- Possible black smoke on acceleration.

### 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 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

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.

### 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 engerized 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.

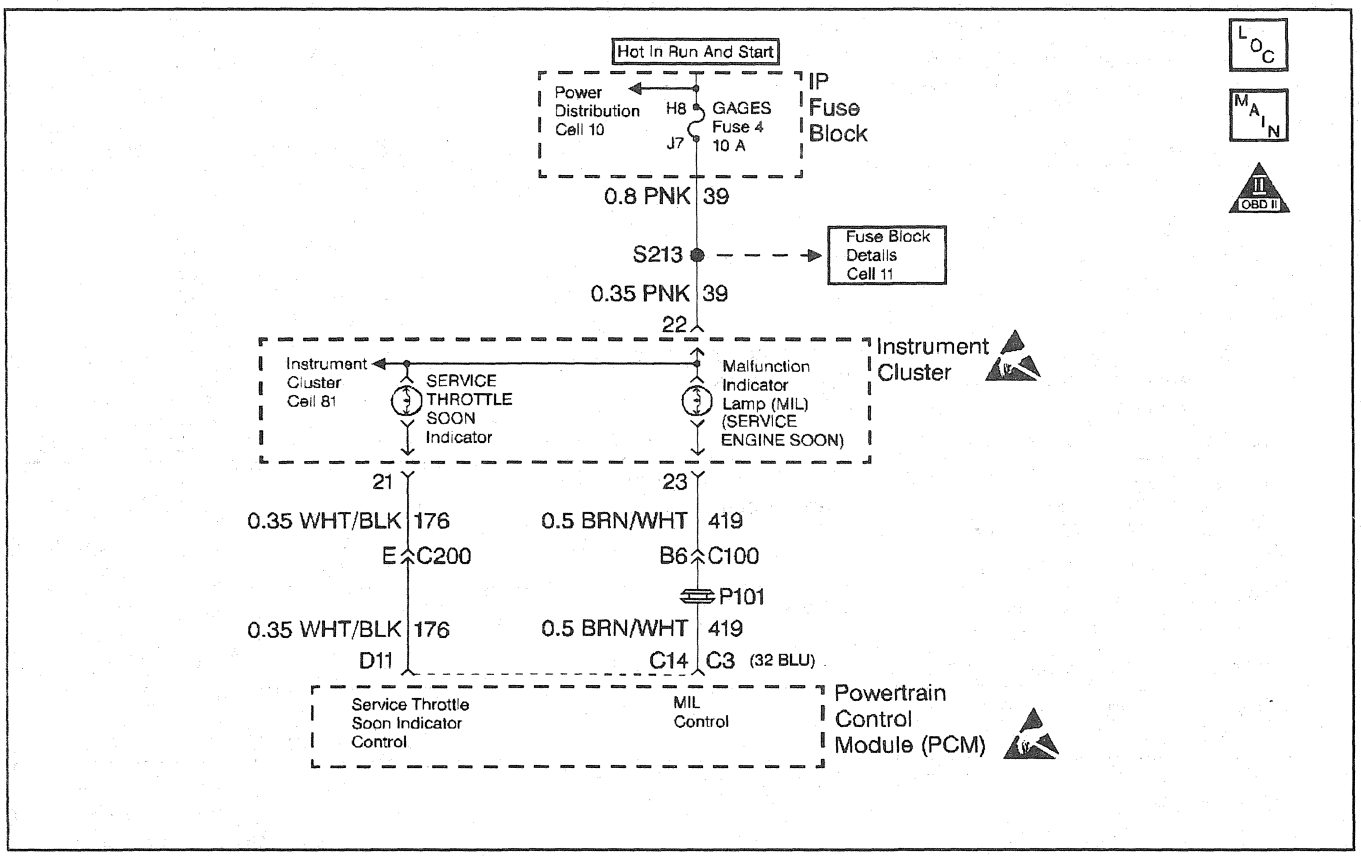
### DTC P1653 EGR Vent Solenoid Control Circuit

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 1 | **Important:** Before clearing 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<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| *2* | 1. Scan tool connected.<br>2. Start and idle engine.<br>3. With scan tool, command EGR vent solenoid ON and OFF.<br>Does Actual EGR respond to scan tool commands? | — | *Go to Step 3* | *Go to Step 5* |
| *3* | 1. Ignition OFF.<br>2. Disconnect the PCM connector containing the EGR vent solenoid control circuit.<br>3. Ignition ON.<br>4. Using DVM *J 39200* on 10 Amp scale, measure current from the solenoid control circuit in the PCM harness connector to ground for 2 minutes.<br>Is current draw less then the specified value, but not zero? | 0.75 A | *Go to Step 8* | *Go to Step 4* |
| 4 | 1. Ignition OFF.<br>2. PCM connector still disconnected.<br>3. Disconnect EGR vent solenoid.<br>4. Using DVM *J 39200*, measure resistance from the solenoid control circuit in the PCM harness connector to ground.<br>Does DVM display infinite resistance? | — | *Go to Step 13* | *Go to Step 10* |
| 5 | 1. Disconnect EGR vent solenoid<br>2. Ignition ON, engine OFF.<br>3. Connect a test light between the EGR vent solenoid control circuit and the ignition feed circuit at the harness connector.<br>4. Using a scan tool, command the solenoid ON and OFF.<br>Does test light turn ON and OFF with each command? | — | *Go to Step 9* | *Go to Step 6* |

## DTC P1653 EGR Vent Solenoid Control Circuit (cont'd)

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 6 | 1. Ignition ON engine OFF.<br>2. With a test light connected to ground, probe the ignition feed circuit at the EGR vent solenoid harness connector.<br>Is the test light ON? | — | *Go to Step 7* | *Go to Step 12* |
| 7 | 1. Ignition OFF.<br>2. Reconnect solenoid.<br>3. Disconnect the PCM harness containing the solenoid control circuit.<br>4. Ignition ON.<br>5. With a fused jumper wire connected to ground, probe the solenoid control circuit in the PCM harness connector.<br>Does the solenoid operate? | — | *Go to Step 11* | *Go to Step 10* |
| 8 | DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored referto the applicable DTC table(s) first.<br>Are any additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 9 | Check for a poor connection at the EGR vent solenoid and replace terminals as necessary.<br>Did the terminal require replacement? | — | *Go to Step 15* | *Go to Step 13* |
| 10 | Repair EGR vent solenoid control circuit.<br>Is the action complete? | — | *Go to Step 15* | — |
| 11 | Check for a poor connection at the PCM, EGR vent control circuit.<br>Was a problem found? | — | *Go to Step 15* | *Go to Step 14* |
| 12 | Repair the open in the ignition feed circuit.<br>Is the action complete? | — | *Go to Step 15* | — |
| 13 | Replace the EGR vent solenoid.<br>Is the action complete? | — | *Go to Step 15* | — |
| 14 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed.<br>Go to *PCM Replacement/Programming.*<br>Is the action complete? | — | *Go to Step 15* | — |
| 15 | 1. Using the scan tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the scan tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 15* | *Go to Step 2* |
| 16 | Using the scan tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P1654 Service Throttle Soon Lamp Control CKT




29548

### 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 volts). The primary function of the PCM in this circuit is to supply the ground for the Service Throttle Soon Lamp. This is a type D DTC.

### Conditions for Setting the DTC

- Service Throttle Soon lamp requested ON.
- Voltage on the Service Throttle Soon control circuit high (near battery volts).

or

- Service Throttle Soon lamp requested OFF.
- Voltage on the Service Throttle Soon control circuit low (near 0 volts).

### Action Taken When the DTC Sets

Will not turn ON the MIL.

### 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 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 faulty bulb or the control circuit shorted to ground will cause a P1654 to set.

### Test Description

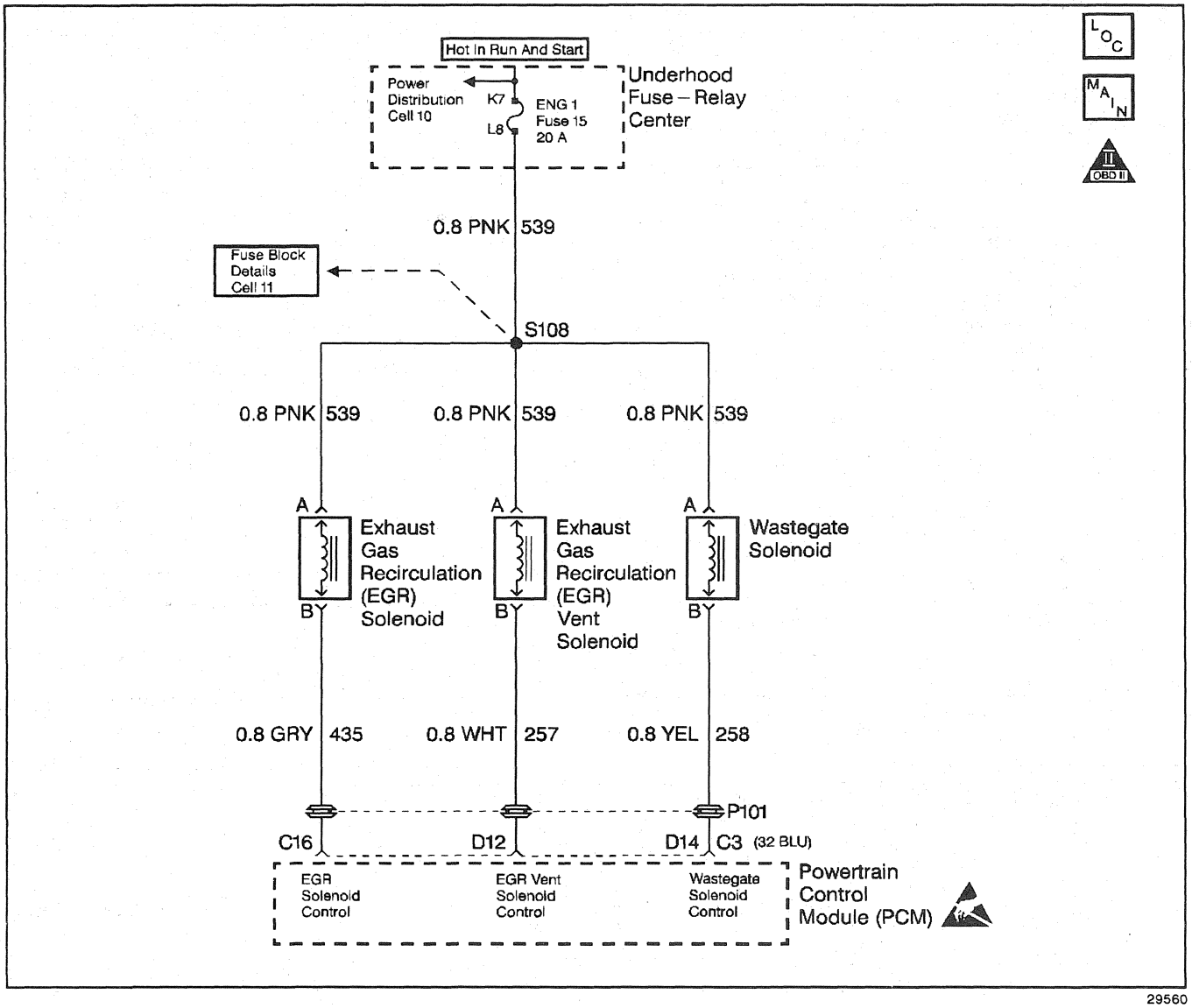
Number(s) below refer to the Step number(s) on the Diagnostic Table.

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 faulty, 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 DTCs use the scan tool to record freeze frame and failure records for reference, as data will be lost when Clear Info function is used.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Ignition ON, engine OFF.<br>2. Using a scan tool, command the lamp ON and OFF.<br>Does the lamp turn ON and OFF with each command? | — | *Go to Step 3* | *Go to Step 4* |
| 3 | DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to those table(s).<br>Are additional DTCs stored? | — | Go to the applicable DTC table | Go to Diagnostic Aids |
| 4 | 1. Ignition OFF.<br>2. Disconnect the PCM connector containing the lamp control circuit.<br>3. Ignition ON, engine OFF.<br>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.<br>Is the lamp ON?. | — | *Go to Step 6* | *Go to Step 8* |
| 6 | 1. Check for poor connections at PCM.<br>2. If a problem was found, repair as necessary.<br>Was a repair performed? | — | *Go to Step 10* | *Go to Step 9* |
| 7 | Service Throttle Soon lamp control circuit is shorted to ground, repair as necessary.<br>Is the action complete? | — | *Go to Step 10* | — |
| 8 | Check the Service Throttle Soon circuit for the following:<br>• Open ignition feed to the bulb.<br>• Faulty bulb.<br>Is the repair complete? | — | *Go to Step 10* | — |
| 9 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed.<br>Got to *PCM Replacement/Programming.*<br>Is the action complete? | — | *Go to Step 10* | — |
| 10 | 1. Using the Scan Tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the Scan Tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 11* | *Go to Step 2* |
| 11 | Using the Scan Tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P1655 EGR Solenoid Control Circuit




29560

### 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 volts). The primary function of the PCM in this circuit is to supply the ground for the EGR solenoid. This is a type B code.

### Conditions for Setting the DTC

- PCM requested EGR solenoid ON.
- Voltage on EGR solenoid control circuit high (near battery volts).
- 2 consecutive faults detected.
- Conditions met for 2 seconds.

or

- PCM requested EGR solenoid OFF.
- Voltage on EGR solenoid control circuit low (near 0 volts).
- 2 consecutive faults detected.
- Conditions met for 2 seconds.

### Action Taken When the DTC Sets

No EGR. Possible black smoke on acceleration.

### 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 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

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. Its 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 EGR solenoid is OFF. Full EGR will be achieved when EGR solenoid is commanded ON with the scan tool.

### 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. 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 engerized 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 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Scan tool connected.<br>2. Start and idle engine.<br>3. With scan tool, command EGR solenoid ON and OFF.<br>Does Actual EGR respond to scan tool commands? | — | *Go to Step 3* | *Go to Step 5* |
| 3 | 1. Ignition OFF.<br>2. Disconnect the PCM connector containing the EGR solenoid control circuit.<br>3. Ignition ON.<br>4. Using DVM *J 39200* on 10 Amp scale, measure current from the solenoid control circuit in the PCM harness connector to ground for 2 minutes.<br>Is current draw less then the specified value, but not zero? | 0.75 A | *Go to Step 8* | *Go to Step 4* |
| 4 | 1. Ignition OFF.<br>2. PCM connector still disconnected.<br>3. Disconnect EGR solenoid.<br>4. Using DVM, *J 39200* measure resistance from the solenoid control circuit in the PCM harness connector to ground.<br>Does DVM display infinite resistance? | — | *Go to Step 13* | *Go to Step 10* |

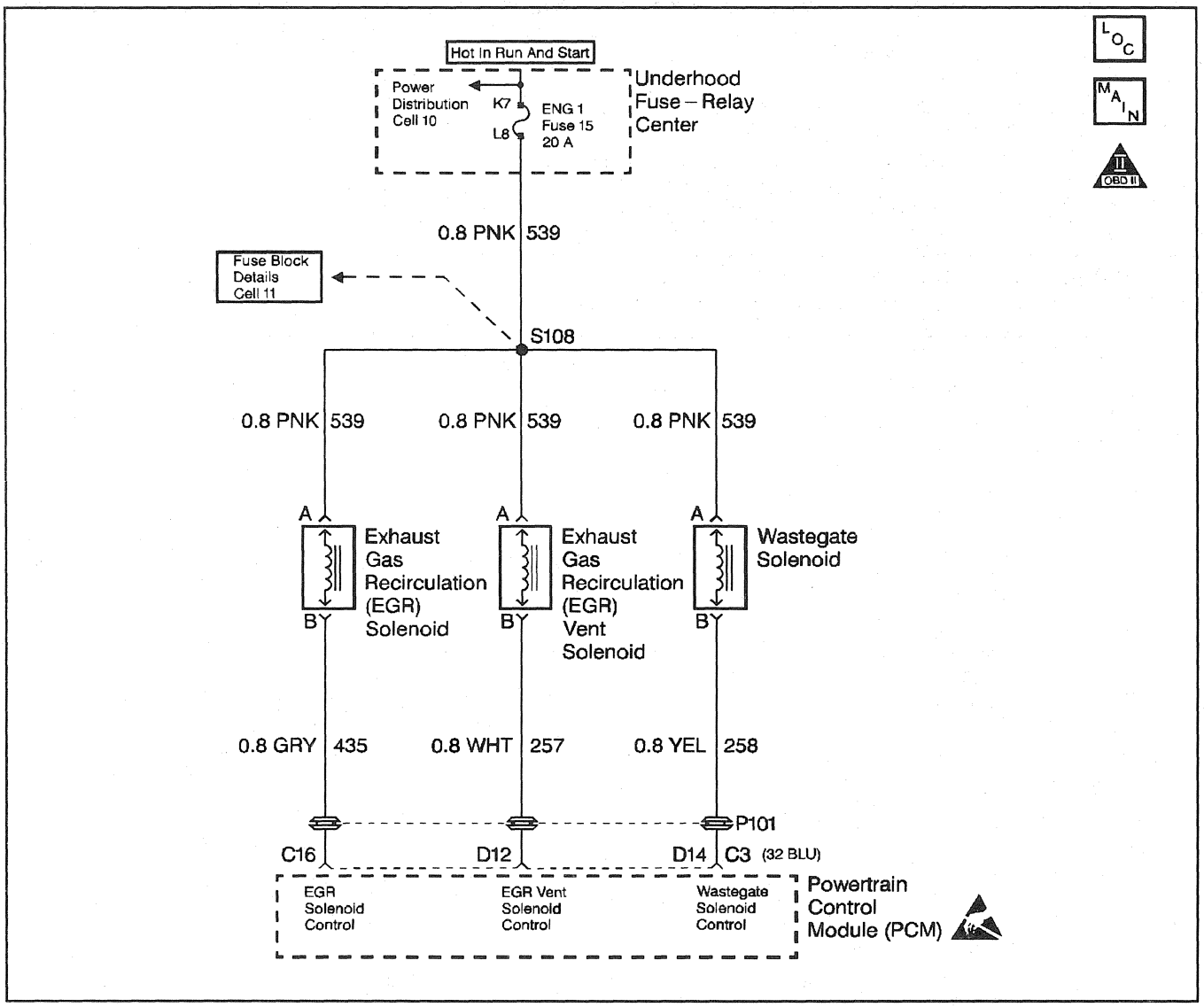
## DTC P1655 EGR Solenoid Control Circuit (cont'd)

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 5 | 1. Disconnect EGR solenoid<br>2. Ignition ON, engine OFF.<br>3. Connect a test light between the EGR solenoid control circuit and the ignition feed circuit at the harness connector.<br>4. Using a scan tool, command the solenoid ON and OFF.<br>Does test light turn ON and OFF with each command? | — | *Go to Step 9* | *Go to Step 6* |
| 6 | 1. Ignition ON engine OFF.<br>2. With a test light connected to ground, probe the ignition feed circuit at the EGR solenoid harness connector.<br>Is the test light ON? | — | *Go to Step 7* | *Go to Step 12* |
| 7 | 1. Ignition OFF.<br>2. Reconnect solenoid.<br>3. Disconnect the PCM harness containing the solenoid control circuit.<br>4. Ignition ON.<br>5. With a fused jumper wire connected to ground, probe the solenoid control circuit in the PCM harness connector.<br>Does the solenoid operate? | — | *Go to Step 11* | *Go to Step 10* |
| 8 | 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.<br>Are any additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 9 | Check for a poor connection at the EGR solenoid and replace terminals as necessary.<br>Did the terminal require replacement? | — | *Go to Step 15* | *Go to Step 13* |
| 10 | Repair EGR solenoid control circuit.<br>Is the action complete? | — | *Go to Step 15* | — |
| 11 | Check for a poor connection at the PCM, EGR control circuit.<br>Was a problem found? | — | *Go to Step 15* | *Go to Step 14* |
| 12 | Repair the open in the ignition feed circuit.<br>Is the action complete? | — | *Go to Step 15* | — |
| 13 | Replace the EGR solenoid. Refer to *EGR Solenoid.*<br>Is the action complete? | — | *Go to Step 15* | — |
| 14 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed.<br>Go to *PCM Replacement/Programming.*<br>Is the action complete ? | — | *Go to Step 15* | — |

## DTC P1655 EGR Solenoid Control Circuit (cont'd)

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 15 | 1. Using the scan tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the scan tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 15* | *Go to Step 2* |
| 16 | Using the scan tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## DTC P1656 Wastegate Solenoid Control Circuit




29560

### 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 volts). The primary function of the PCM in this circuit is to supply the ground for the wastegate solenoid. This is a type B code.

### Conditions for Setting the DTC

- PCM requested Wastegate solenoid ON.
- Voltage on Wastegate solenoid control circuit high (near battery volts).
- 2 consecutive faults detected.
- Conditions met for 2 seconds.

or

- PCM requested Wastegate solenoid OFF.
- Voltage on Wastegate solenoid control circuit low (near 0 volts).
- 2 consecutive faults detected.
- Conditions met for 2 seconds.

### Action Taken When the DTC Sets

Low power.

### 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 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

This diagnostic will set when 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. Its 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 abort to prevent engine damage).

### 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 mant 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 engerized 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 P1656 Wastegate Solenoid Control 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.<br>Was the On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | 1. Scan tool connected.<br>2. Ignition ON, engine OFF.<br>3. Observe Wastegate duty cycle on scan tool.<br>4. With scan tool, command Wastegate solenoid ON and OFF.<br>Does Wastegate duty cycle respond to scan tool commands? | — | *Go to Step 3* | *Go to Step 5* |
| 3 | 1. Ignition OFF.<br>2. Disconnect the PCM connector containing the wastegate solenoid control circuit.<br>3. Ignition ON.<br>4. Using DVM *J 39200* on 10 Amp scale, measure current from the solenoid control circuit in the PCM harness connector to ground for 2 minutes.<br>Is current draw less then the specified value, but not zero? | 0.75 A | *Go to Step 8* | *Go to Step 4* |
| 4 | 1. Ignition OFF.<br>2. PCM connector still disconnected.<br>3. Disconnect wastegate solenoid.<br>4. Using DVM *J 39200*, measure resistance from the solenoid control circuit in the PCM harness connector to ground.<br>Does DVM 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 wastegate solenoid<br>2. Ignition ON, engine OFF.<br>3. Connect a test light between the wastegate solenoid control circuit and the ignition feed circuit at the harness connector.<br>4. Using a scan tool, command the solenoid ON and OFF.<br>Does test light turn ON and OFF with each command? | — | *Go to Step 9* | *Go to Step 6* |
| 6 | 1. Ignition ON engine OFF.<br>2. With a test light connected to ground, probe the ignition feed circuit at the wastegate solenoid harness connector.<br>Is the test light ON? | — | *Go to Step 7* | *Go to Step 12* |
| 7 | 1. Ignition OFF.<br>2. Reconnect solenoid.<br>3. Disconnect the PCM harness containing the solenoid control circuit.<br>4. Ignition ON.<br>5. With a fused jumper wire connected to ground, probe the solenoid control circuit in the PCM harness connector.<br>Does the solenoid operate? | — | *Go to Step 11* | *Go to Step 10* |
| 8 | 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.<br>Are any additional DTCs stored? | — | Go to the Applicable DTC Table | Go to Diagnostic Aids |
| 9 | Check for a poor connection at the wastegate solenoid and replace terminals as necessary.<br>Did the terminal require replacement? | — | *Go to Step 15* | *Go to Step 13* |
| 10 | Repair wastegate solenoid control circuit.<br>Is the action complete? | — | *Go to Step 15* | — |
| 11 | Check for a poor connection at the PCM, wastegate control circuit.<br>Was a problem found? | — | *Go to Step 15* | *Go to Step 14* |
| 12 | Repair the open in the ignition feed circuit.<br>Is the action complete? | — | *Go to Step 15* | — |
| 13 | Replace the wastegate solenoid. Refer to *Wastegate Solenoid.*<br>Is the action complete? | — | *Go to Step 15* | — |
| 14 | Replace the faulty PCM.<br>**Important:** If the PCM is faulty, the new PCM must be programmed.<br>Refer to *PCM Replacement/Programming.*<br>Is the action complete ? | — | *Go to Step 15* | — |

## DTC P1656 Wastegate Solenoid Control Circuit (cont'd)

| Step | Action | Value(s) | Yes | No |
|---|---|---|---|---|
| 15 | 1. Using the scan tool, select DTC, Clear Info.<br>2. Start engine and idle at normal operating temperature.<br>3. Select DTC, Specific, then enter the DTC number which was set.<br>4. Operate vehicle within the conditions for setting this DTC as specified in the supporting text.<br>Does the scan tool indicate that this diagnostic Ran and Passed? | — | *Go to Step 15* | *Go to Step 2* |
| 16 | Using the scan tool, select Capture Info, Review Info.<br>Are any DTCs displayed that have not been diagnosed? | — | Go to the Applicable DTC Table | System OK |

## Important Preliminary Checks

| Checks | Action |
|---|---|
| Before Using This Section | Before using this section, you should have performed the On-Board Diagnostic System Check and determined that:<br>1. The Control Module and MIL (Malfunction Indicator Lamp) are operating correctly.<br>2. There are no Diagnostic Trouble Codes (DTCs) stored, or a DTC exists but without a MIL.<br>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 Control Module grounds for being clean, tight and in their proper location.<br>• Check the vacuum hoses for splits, kinks and proper connections, as shown on the Vehicle Emission Control Information label.<br>• Check thoroughly for any type of leak or restriction.<br>• Check for air leaks at all the mounting areas of the intake manifold sealing surfaces.<br>• Check the wiring for the following items:<br>  • Proper connections<br>  • Pinches<br>  • Cuts<br>• The following symptom tables contain groups of possible causes for each symptom and cover several engines. The following symptom tables cover several engines. 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 the Control Module Wiring Diagrams for an application. |
| Symptom | Verify the customer complaint.<br>Locate the correct symptom table.<br>Check the items indicated under that symptom. |

## Intermittents

| Checks | Action |
|---|---|
| Before Using This Section | Before using this section, you should have performed the On-Board Diagnostic System Check and determined that:<br>1. The Control Module and MIL (Malfunction Indicator Lamp) are operating correctly.<br>2. There are no Diagnostic Trouble Codes (DTCs) stored, or a DTC exists but without a MIL.<br>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. |

## Intermittents (cont'd)

| Checks | Action |
|---|---|
| Visual and Physical Checks | • Check the Control Module grounds for being clean, tight and in their proper location.<br>• Check the vacuum hoses for splits, kinks and proper connections, as shown on the Vehicle Emission Control Information label.<br>• Check thoroughly for any type of leak or restriction.<br>• Check for air leaks at all the mounting areas of the intake manifold sealing surfaces.<br>• Check the wiring for the following items:<br>– Proper connections<br>– Pinches<br>– Cuts<br>• The following symptom tables contain groups of possible causes for each symptom and cover several engines. The following symptom tables cover several engines. 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 the Control Module Wiring Diagrams for an application. |
| Symptom | Verify the customer complaint.<br>Locate the correct symptom table.<br>Check the items indicated under that symptom. |

## 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 Important Preliminary Checks.<br>• Make sure the driver is using the correct starting procedure. |
| Sensor Checks | • Check the Engine Coolant Temperature (ECT) sensor using the scan tool 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 Systems.<br>• Check for air in fuel system. Refer to Fuel Systems.<br>• Check the fuel return from injection pump. Refer to Fuel Systems.<br>• engine shut–off solenoid operation. Refer to Control Module Systems.<br>• Check the fuel injection nozzles. Refer to Fuel Systems.<br>• Check the fuel tank cap vent.<br>• Check for an internal injection pump problem. Refer to Fuel Systems. |
| Electrical System Checks | • Check glow plug operation. Refer to Section 7.<br>• Check for slow cranking speed. |
| Air Intake System Checks | • Check the air cleaner and air intake ducts for a restriction.<br>• Check for a restriction in turbo charger inlet duct.<br>• Check for a restriction in the intake manifold. |
| Exhaust System Check' | • Check the exhaust system for possible restriction. Refer to Control Module Systems. |

## Hard Start (cont'd)

| Checks | Action |
|---|---|
| Engine Mechanical Checks | • Check the engine for the following:<br>– Improper valve timing<br>– Low compression<br>– Bent pushrods<br>– Worn rocker arms<br>– Broken or weak valve springs<br>– Worn camshaft lobes |
| Additional Checks | • Check for no crank signal. Refer to Control Module Systems.<br>• 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 Important Preliminary Checks.<br>• Be sure the driver understands the Torque Converter Clutch (TCC) operation.<br>• Be sure the driver understands the A/C compressor operation.<br>• Use the scan tool to make sure the reading of VSS matches vehicle speedometer. This excludes vehicles with electronic transmissions where some variation between VSS and the speedometer is normal. Refer to DTC P0501 Diagnostic Aids. |
| Fuel System Checks | • Check the fuel pressure while condition exists. Refer to Fuel Systems. |
| Additional Checks | • Check the control module grounds for being clean, tight, and in their proper locations.<br>• Check generator output voltage. Repair if less than 9 or more than 16 volts.<br>• Check vacuum lines for kinks or leaks.<br>• Check 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 Important Preliminary Checks.<br>• Compare customers vehicle with a similar unit. Make sure the customer has an actual problem.<br>• Remove air filter and check for dirt, or for air ducts being plugged clean or, replace as necessary.<br>• Transmission shift pattern and down shift operation.<br>• Check fuel quality, refer to Fuel Specific Gravit Check.<br>• Check engine oil level and quality. |
| Fuel System Checks | • Check the fuel supply to injection pump and fuel return from injection pump. Refer to Fuel Systems.<br>• Check fuel pump operation. Refer to Fuel Systems.<br>• Check for faulty fuel injection nozzles. Refer to Fuel Systems. |
| Exhaust System Checks | • Check the exhaust system for a possible restriction. Refer to Control Module Systems.<br>• Inspect the exhaust system for damaged or collapsed pipes. |

## Lack of Power, Sluggishness, or Sponginess (cont'd)

| Checks | Action |
|---|---|
| Air Intake System Checks | • Check for an air leakage or restriction in air inlet ducks or intake manifold.<br>• Check for a worn or damaged turbo charger turbine wheel, shaft or compressor wheel. |
| Engine Mechanical Check | Check the engine for the following:<br>• Low compression<br>• Improper valve timing<br>• Improper or worn camshaft |
| Additional Checks | • Check the control module grounds for being clean, tight, and in their proper location. Refer to Component Locations.<br>• Check the torque Converter Clutch (TCC) operation.<br>• Check the A/C operation. Refer to Control Module Systems.<br>• Check the generator output voltage. Repair if less than 9 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 throttle opening. | |
| Preliminary Checks | • Refer to Important Preliminary Checks.<br>• Make sure the customer has an actual problem.<br>• Check the fuel quality. Refer to Specific Gravity Check in Fuel Systems. |
| Cooling System Checks | • Check for obvious overheating problems. Refer to the appropriate service manual.<br>• Check for a low engine coolant level.<br>• Check for a loose water pump belt.<br>• Check for restricted air flow through the radiator, or restricted coolant flow.<br>• Check for a faulty or incorrect thermostat.<br>• 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 using the scan tool 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 for air leaks in fuel supply to injection pump. Refer to Fuel System Diagnosis in Fuel Systems.<br>• Check the injection pump static timing. Refer to Fuel Systems.<br>• Check the injection nozzles. Refer to Fuel Systems. |
| Engine Mechanical Checks | • Check for incorrect basic engine parts such as cam, heads, pistons, etc.<br>• Check for excessive oil entering combustion chamber. |
| Additional Checks | Check the Service Bulletins for control module software updates. |

## Cuts Out, Misses Cuts Out and Misses

| Checks | Action |
|---|---|
| Definition: A steady or jerking that follows 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 *Important Preliminary Checks.* |
| Ignition System Checks | Check for a cylinder misfire:<br>1. Start the engine.<br>2. Allow the engine to stabilize.<br>3. Perform Injector balance test.<br>4. If there is a RPM drop on all cylinders , go to *Rough, Unstable, or Incorrect Idle, Stalling.*<br>5. If there is no RPM drop on one or more of the cylinders, or excessive variation in drop, refer to Engine Mechanical. |
| Engine Mechanical Checks | • Perform a cylinder compression check. Refer to Engine Mechanical.<br>• Check the engine for the following:<br>– Improper valve timing<br>– Bent pushrods,<br>– Worn rocker arms<br>– Worn camshaft lobes<br>– Broken or weak valve springs Refer to Engine Mechanical.<br>• Check the intake and exhaust manifold passages for casting flash. Refer to Engine Mechanical. |
| Fuel System Checks | • Check the fuel system - plugged fuel filter, low fuel pressure, etc. Refer to *Fuel System Diagnosis.*<br>• Check for water contamination in the fuel. |
| Additional Check | Check for Electromagnetic Interference (EMI).<br>The EMI on the reference circuit can cause a missing condition.<br>Monitoring the engine RPM with a scan tool can detect an EMI.<br>A sudden increase in the RPM with little change in the actual engine RPM, indicates EMI is present.<br>If the problem exists, check the routing of the secondary wires and the ground circuit. |

## Poor Fuel Economy

| Checks | Action |
|---|---|
| Definition: Fuel economy, as measured by an actual road test, is noticeably lower than expected. Also, the economy is noticeably lower than it was on this vehicle at one time, as previously shown by an actual road test. | |
| Preliminary Checks | • Refer to Important Preliminary Checks.<br>• Check air cleaner filter for dirt or being plugged.<br>• Visually (physically) check: Vacuum hoses for splits, kinks, and proper connections.<br>• Perform Powertrain On–Board Diagnostic System Check.<br>• Check owners driving habits.<br>• Is A/C ON full time (Defroster mode ON)?<br>• Are tires at correct pressure?<br>• Are excessively heavy loads being carried?<br>• Is acceleration too much, too often?<br>• Suggest owner fill fuel tank and recheck fuel economy.<br>• Suggest driver read 'Important Facts on Fuel Economyin Owners Manual. |

## Poor Fuel Economy (cont'd)

| Checks | Action |
|---|---|
| Fuel System Checks | • Check the fuel type, quality. Refer to Diagnosis in Fuel Systems.<br>• Check the fuel pressure. Refer to Table A–5in Control Modulel Systems. |
| Cooling System Checks | • Check the engine coolant level.<br>• Check the engine thermostat for always being open or for the wrong heat range. |
| Additional Checks | • Check the transmission shift pattern.<br>• Check the Torque Converter Clutch (TCC) operation. When the TCC is commanded ON, a scan tool should indicate an RPM drop.<br>• Check the Service Bulletins for control module software updates.<br>• Check for dragging brakes. Refer to the appropriate service manual. |

## 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, as from a stop sign. The condition may cause the engine to stall if it[prime ]s severe enough. | |
| Preliminary Check | Refer to Important Preliminary Checks. |
| Fuel System Checks | • Check the fuel pressure. Refer toTable A–5 in Control Module Systems.<br>• Check for water contamination in the fuel. Refer to Fuel Systems.<br>• Perform the Injector Balance Test. Refer to Fuel Systems.<br>• 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 faulty fuel pump or a restriction in the fuel system. Refer to Fuel Systems. |
| Additional Checks | • Check the Service Bulletins for control module software updates.<br>• Check the generator output voltage. |

## Excessive Smoke

| Checks | Action |
|---|---|
| Definition: White, black, gray or blue smoke under load, idle or start up hot or cold. | |
| Preliminary Check | • Refer to Important Preliminary Checks.<br>•<br>• Make sure the customer has an actual problem.<br>• Check fuel quality. Refer to Specific Gravity Check in Fuel Systems. |
| Fuel System Checks | • Injection pump. Refer to Fuel System Diagnosis in Fuel Systems.<br>• Check the injection pump timing. Refer to Fuel Systems.<br>• Check the injection nozzles. Refer to Fuel Systems. |
| Sensor Check | • Check the Engine Coolant Temperature (ECT) sensor using the scan tool 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.<br>• Check the glow plug system operation. |
| Air Intake System Check | • Check the air cleaner and air intake ducts for restriction.<br>• Check for a restriction in turbo charger inlet duct.<br>• Check for a restriction in intake manifold. |
| Engine Mechanical Check | • Check for incorrect basic engine parts such as cam, heads, pistons, Etc.<br>• Check for excessive oil entering 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 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 *Section 6F* of the appropriate service manual.

## Air Cleaner Element

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.

## Cruise Control Diagnosis

Refer to *HVAC System.*

### 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 anytime time by applying the brakes. This input is sent to the PCM by the Cruise Control Brake Switch. If the cruise is inoperative, and no Cruise Control or Brake Switch DTC(s) are stored, check for the following conditions:

- Faulty Cruise multi function switch/ wiring harness (opens or faulty connections).
- Clutch pedal switch stuck in the open position.

Other conditions that will not allow the Cruise Control to engage that are not the fault of the cruise system.

- Vehicle speed below 25 MPH (if cruise is already set, cruise will disengage at 20 MPH).
- Vehicle in 4 wheel drive low.
- Any DTC that puts 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 set.

## A/C Request Circuit Check

Refer to *HVAC System.*

### 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 anytime time by applying the brakes. This input is sent to the PCM by the Cruise Control Brake Switch. If the cruise is inoperative, and no Cruise Control or Brake Switch DTC(s) are stored, check for the following conditions:

- Faulty Cruise multi function switch/ wiring harness (opens or faulty connections).
- Clutch pedal switch stuck in the open position.

Other conditions that will not allow the Cruise Control to engage that are not the fault of the cruise system.

- Vehicle speed below 25 MPH (if cruise is already set, cruise will disengage at 20 MPH).
- Vehicle in 4 wheel drive low.
- Any DTC that puts 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 set.

## Fuel System Contamination

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: To avoid personal injury, do not come into physical contact with biocides.***

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.

## Contamination Testing

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 Fuel System.
- If gasoline is present, Go to Cleaning Gasoline from Fuel System.

**Cleaning Water from 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 Replacement).
5. Inspect the fuel tank and fuel sender for rust, fungi or bacteria.
6. Clean the inside of the fuel tank and fuel sender with hot water, then dry them with compressed air.
7. Disconnect the ends of the following lines.
   - Lift pump suction line.
   - Lift pump feed line.
   - Fuel filter outlet line.
   - Fuel filter drain line.
   - Fuel return line.
8. Inspect each of the pipes and replace any rusted pipes.
9. Clean the inside of the fuel filter housing and dry it with compressed air.
10. Dry the inside of each line with low pressure air.
11. Remove FUEL SOL fuse from fuse panel.
12. Install a new fuel filter element.
13. Install the fuel sender and fuel tank (add clean diesel fuel to 1/4 full).
14. Reconnect the following lines.
    - Lift pump suction (both ends) lines.
    - Lift pump feed (both ends) lines.
    - Fuel filter drain line.
    - Fuel return (at injection pump) line.
15. Connect the fuel filter outlet and the fuel return line at the fuel sender to hoses that flow to metal containers.
16. Connect the batteries, and use scan tool to command lift pump ON. Operate lift pump until clean fuel flows from the fuel filter outlet into a metal container.
17. Connect the hose from the fuel filter outlet to the injection pump inlet.
18. 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.

    **Important:** Use two wrenches when tightening the injection line fittings.
19. Tighten each injection line fitting at its nozzle.
20. Install FUEL SOL fuse in fuse panel.
21. Start and run the engine for 1 minutes while fuel flows from the fuel return line into a metal container.
22. Stop the engine.
23. Connect the fuel return hose to the fuel sender.
24. Clean the engine of fuel spillage.
25. Fill the fuel tank and add a biocide, if needed.

**Cleaning Gasoline from Fuel System**

1. Drain the fuel tank.
2. Fill the fuel tank.
3. Remove FUEL SOL fuse from fuse panel.
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 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 FUEL SOL fuse in fuse panel.
8. Atempt to start and run the engine for 15 minutes (If engine does not start, purge the injection system).
9. Stop the engine.
10. Clean the engine of fuel spillage.
11. Clear engine DTC(s).

## Fuel Quality

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.
4. 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 a approximate fuel oil specific gravity.
   - Refer to tool instructions on how to determine API Gravity.
   - Refer to Fuel Oil Specific Gravity Requirements table.
5. 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, fuel should be replaced.

## Fuel Tank

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.

## Fuel Tank Leak Check

***Caution: Before attempting Fuel Tank Leak Check, place a dry chemical (Class B) fire extinguisher near area. Before removing the fuel tank for a suspected leak, make sure fuel pipes or tubes are not leaking onto the tank. Once removed, make sure fuel is not leaking around fuel sender O-ring.***

1. This check requires the fuel sender and o-ring to be installed.
2. Disconnect battery cables.
3. Drain the fuel tank. Refer to *Draining Fuel Tank.*
4. Remove fuel tank. Refer to *Fuel Tank.*
5. Cap fuel feed tube and fuel return tube on fuel sender.
6. Connect a piece of hose to the filler tube nipple and plug opposite end.
7. Submerge tank in water or apply soap solution to outside of tank.
8. Apply 35 kPa (5 psi) air pressure to the vent hose of the fuel tank (a leak will show up as bubbles).

## Fuel Sender Assembly

The fuel sender should be checked for return restrictions. For diagnosis of the pickup tube, refer to Fuel Supply System Checks.

## 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 other 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 fuel connections from the fuel tank to the injection pump.
- Tighten any loose connections.
- With the engine running, check all hoses and lines for flattening or kinks that would restrict the flow of fuel.

### Fuel Lift Pump Flow Check

1. Remove FUEL SOL fuse.
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 to collect fuel.
4. Crank the engine and measure the amount of fuel.
   - If more than 0.24 liter (1/2 pint) in 15 seconds, refer to *Fuel Supply System Check*
   - If less than 0.24 liter (1/2 pint) in 15 seconds, refer to *Fuel Supply System Check*

### Fuel Lift Pump Suction Line Check

1. Remove the fuel tank cap and repeat the Lift Pump Flow Check.
   - If flow is more than 0.24 liter (1/2 pint) in 15 seconds, replace the defective fuel tank cap and refer to *Fuel Supply System Check*
   - If flow is less than 0.24 liter (1/2 pint) in 15 seconds, go to next step.
2. Separate the lift pump suction line from the fuel sender.
3. Connect the suction line to a source of clean fuel, using an additional hose.
4. Repeat the Lift Pump Flow Check.
   - If flow is more than 0.24 liter (1/2 pint) in 15 seconds, remove the fuel sender and check it for restriction.
   - If flow is less than 0.24 liter (1/2 pint) in 15 seconds, Refer to Step 5.
5. Check the lift pump suction line for restriction.
   - If restriction exists, repair it and recheck lift pump flow.
   - If no restriction exists, replace the lift pump and recheck lift pump flow. Refer to *Fuel Lift Pump*
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 dial indication of 0–103 kPa (0–15 psi) to the tee adapter.
3. Start engine and measure fuel pressure.
   - If fuel pressure is a least 4 psi (27 kPa) continue to step 4.
   - If pressure is less than 4 psi, refer to *Fuel Pump Circuit Diagnosis* before replacing lift pump.
4. Remove pressure gauge and tee adapter.
5. Connect inlet pipe.
6. Clean any fuel spillage
7. Operate engine and check for fuel leaks.

### Fuel System Air Leak Check

1. Install a transparent hose between the filter outlet and 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 6.
   - 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 and plug it.
   - Disconnect the fuel pipe from the lift pump, and install a hand held vacuum pump with gauge.
   - Apply vacuum to the fuel pipe and observe the gauge reading.
     - If vacuum does not drop, connect fuel pipe and Go to Step 4.
     - If vacuum drops, repair the air leak in the suction line and install the suction line pipe and hose.
4. Check the fuel sender for air leakage.
   - Remove the fuel tank.
   - Remove the fuel sender from the fuel tank, remove strainer and plug the bottom end of the pickup tube.
   - Apply a vacuum to the upper end of the pickup tube, and observe the gauge reading.
     - If vacuum does not drop (fuel inlet side of sender is OK), install the fuel sender and fuel tank.
     - If 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, observing 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 6.
6. Remove the transparent hose and connect the hose of the filter outlet to the injection pump inlet fitting.
7. Disconnect the return hose at the injection pump.
8. Install a transparent hose between the injection pump and the hose of the return line.
9. Start and run the engine, observing the fuel for air bubbles.

   **Important:** Its OK to see small amounts of bubbles during snap acceleration.
   - If air bubbles are present, replace the injection pump. Refer to *Fuel Injection Pump*
   - If air bubbles are not present, Go to Step 10.
10. Stop the engine.
11. Remove the transparent hose and attach the fuel return hose at the injection pump.
12. Clean any fuel spillage.
13. 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 back up 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 On Vehicle Service. For diagnosis of the lift pump electrical circuit, refer to *Fuel Pump Circuit Diagnosis*

## Fuel Manager/Filter

Diagnosis of the fuel filter can be found in the Contamination Testing Procedure. For diagnosis of the Water in Fuel lamp circuit, refer to the Water in Fuel Lamp Circuit Check.

Diagnosis of the fuel heater can be found in the Fuel Heater Functional Check.

## Fuel Lines/Hoses

The diagnosis of fuel odor may be a condition of a leaking fuel feed, or return pipe or hose. Fuel pipes that are pinched, plugged, or miss-routed may cause restricted fuel delivery.

## Fuel Injection System

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 chinking that causes restrictions or leakage could effect driveability or cause a DTC to set.

## Injection Nozzles

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 been 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 scan tool.
2. Start and idle engine.
3. Perform injector balance test on each cylinder (balance test refer to a specific cylinder).

   If a suspect nozzle has been located, it can be swapped with the adjacent cylinder and balance test can be repeated as a check to positively identify a faulty nozzle.
4. Locate and replace faulty nozzle and glow plug.

### Nozzle Opening Pressure 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 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 absorb the test fluid.
- Install two clear plastic hoses (1 inch 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 *Power Feeds and Grounds.*

### 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 initial 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 glow plug relay is stuck in the ON position, check for proper operation of glow plugs. 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. Most glow plug system failure are covered by DTC P0380. If no DTCs are stored, vehicle is hard to start and white smoke is present during cranking or after 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.<br>Was the Powertrain On–Board Diagnostic (OBD) System Check performed? | — | *Go to Step 2* | Go to *Powertrain OBD System Check* |
| 2 | Is DTC:<br>• P0117<br>• P0118<br>• P0380<br>stored as history or current codes? | — | Go to applicable DTC table | *Go to Step 3* |
| 3 | 1. Ignition OFF.<br>2. Disconnect all glow plugs.<br>3. With a test light connected to B+, probe the spade terminal on each glow plug.<br>Do all glow plugs turn test light ON? | — | *Go to Step 4* | *Go to Step 5* |
| 4 | 1. Ignition ON, engine OFF.<br>2. Glow plugs still disconnected.<br>3. With a test light, jumper each glow plug connector terminal to ground.<br>4. With a scan tool, command glow plugs ON.<br>Does each circuit turn the test light ON? | — | *Go to Step 7* | *Go to Step 6* |
| 5 | Replace all glow plugs that do not turn ON the test light. Refer to *Glow Plugs*.<br>Is action complete? | — | *Go to Step 7* | — |
| 6 | Repair open in each circuit that does not turn ON the test light?<br>Is action complete? | — | *Go to Step 7* | — |
| 7 | Operate vehicle within the conditions under which system was noted.<br>Does system operate properly? | — | System OK | *Go to Step 1* |

## CDR Valve Test

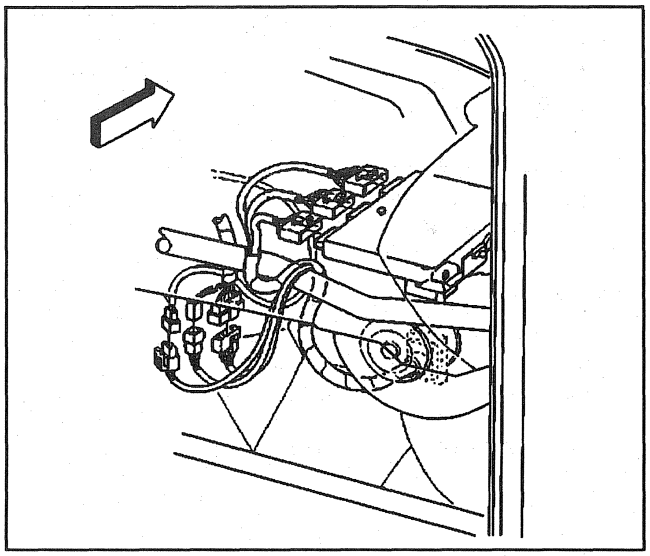
The purpose of the CDR valve is to maintain 0 to 4 inches of water vacuum in the crankcase at all engine speeds, assuming that piston/ring combustion blow by is not excessive (less than 4 cfm). Too little vacuum will tend to force oil leaks.

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 (0in. –1in.) 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.).

## Repair Instructions



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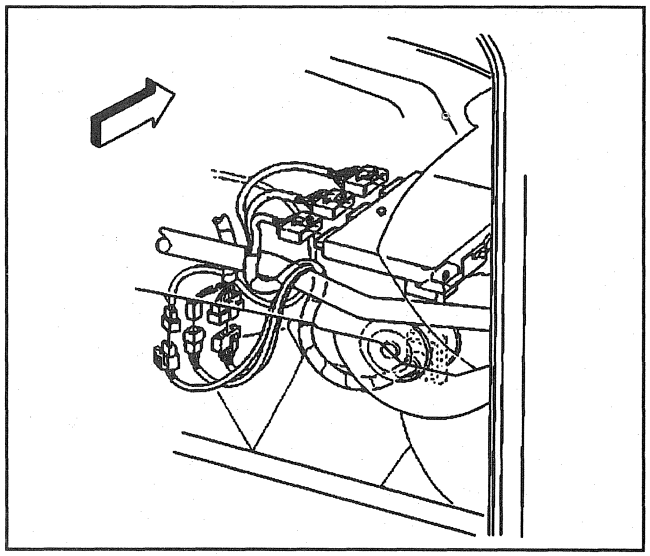


26961

### PCM Replacement/Programming

Service of the PCM should normally consist of replacement of the PCM.

If the diagnostic procedures call for the PCM to be replaced, it will be necessary to program the EEPROM in the PCM using the procedure in this section.

#### Removal Procedure

***Caution: Disconnect the negative battery cable under the following circumstances:***

- ***When installing an electrical unit.***
- ***When a tool or equipment could easily come into contact with "live" exposed electrical terminals.***

***Failure to disconnect the negative battery terminal may result in personal injury or damage to the vehicle's components. Turn OFF the vehicle ignition, unless instructed otherwise.***

1. Remove negative battery cables.
2. Remove PCM from passenger compartment.
3. Remove connectors from PCM.
4. Remove PCM mounting hardware.

   **Important:** To prevent possible electrostatic discharge to the PCM, do not touch the component leads, and do not remove integrated circuit from carrier.

#### Installation Procedure

1. Install PCM mounting hardware.
2. Install connectors to PCM.
3. Install PCM in passenger compartment behind glove box.
4. Install 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 be turned OFF and normal operation will occur.
5. Refer to PCM Programming.

#### PCM Programming

1. Perform set up.
   - Battery is charged.
   - Ignition is ON.
   - Battery/cig. Lighter connection secure.
   - Data Link Connector attached.
2. Perform programming. Refer to up to date Techline terminal/equipment for user instructions.
3. After vehicle has been programed, operate vehicle until coolant temperature is greater than 77°C(170°F). This will allow the TDC Offset to be programed (refer to PCM Programming (TDC Offset) if necessary).
4. Check Data list for a TDC Offset.

5. If PCM fails to reprogram, do the following.
   - Check all PCM connections.
   - Check Techline terminal/equipment for latest software version.
   - Try again to reprogram PCM. If it fails again, replace the PCM. Refer to PCM replacement.

### PCM Programming (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.

## ECT Sensor

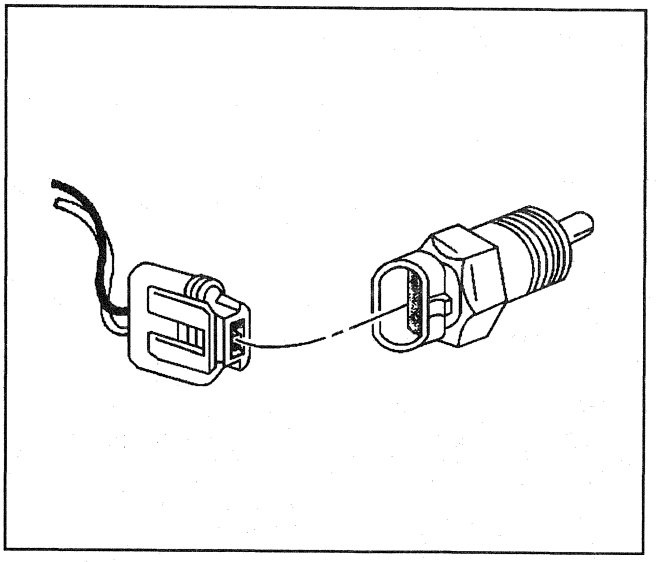
### Removal Procedure

***Caution: Disconnect the negative battery cable under the following circumstances:***

- ***When installing an electrical unit.***
- ***When a tool or equipment could easily come into contact with "live" exposed electrical terminals.***

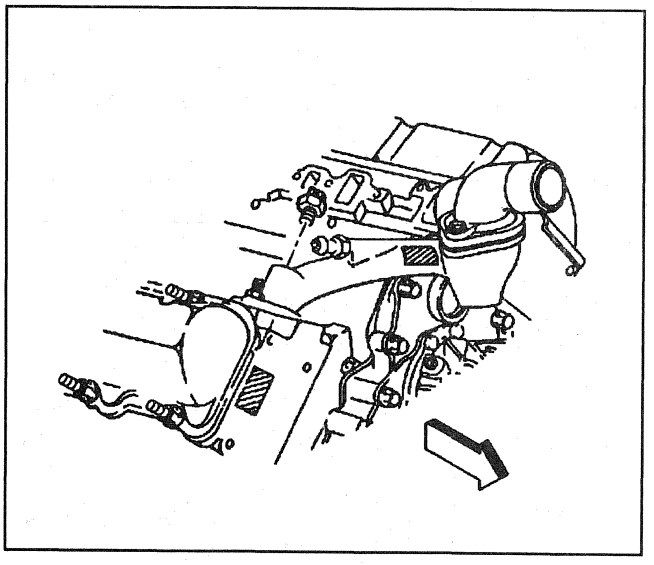
***Failure to disconnect the negative battery terminal may result in personal injury or damage to the vehicle's components. Turn OFF the vehicle ignition, unless instructed otherwise.***

1. Remove negative battery cable.
2. Drain cooling system below level of sensor.
3. Remove electrical connector releasing locking tab.



26963

4. Remove sensor.



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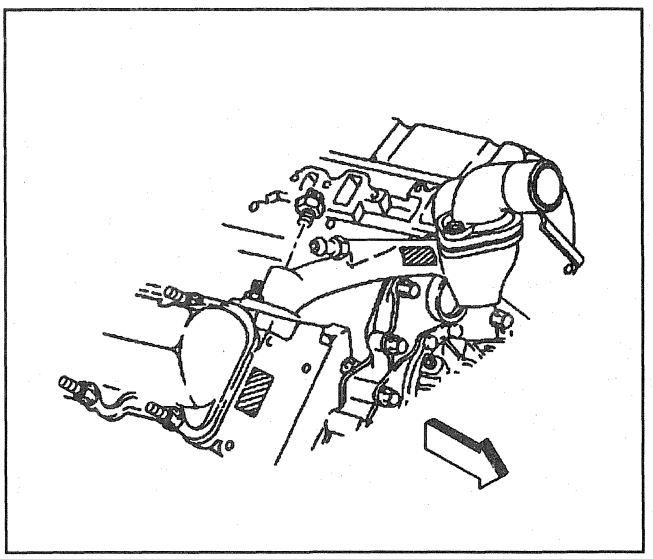

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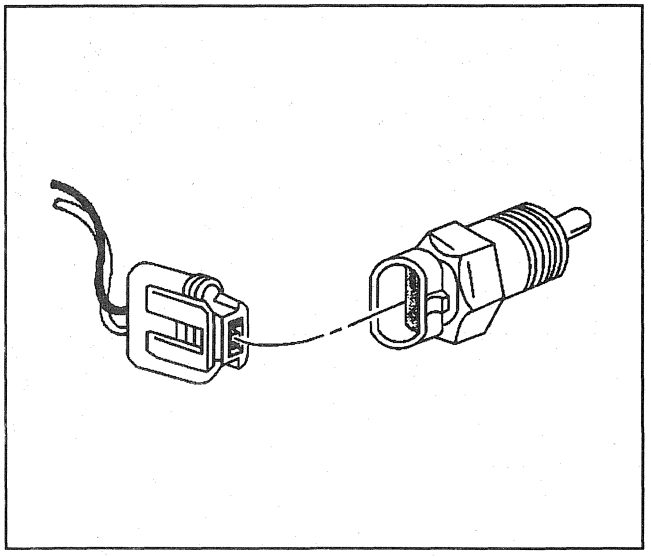
### Installation Procedure

1. Install sensor into engine.



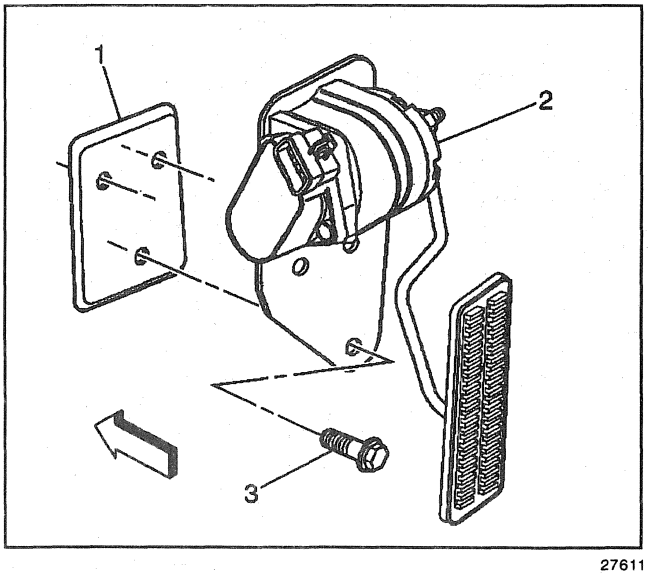
26963

2. Install electrical connector.
3. Refill coolant system.
4. Install negative battery cable.

## APP Module

### Removal Procedure

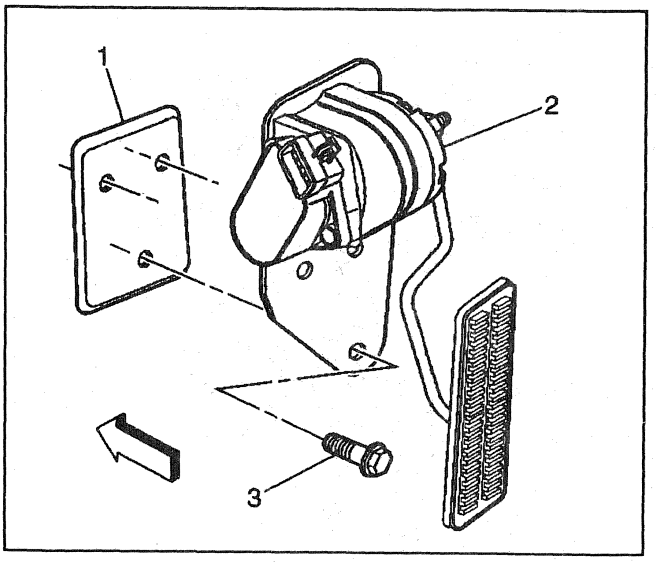
1. Remove negative battery cable.
2. Remove electrical connector.
3. Remove mounting bolts (3).
4. Remove sensor (2).




27611

### Installation Procedure

1. Install the sensor (2) and mounting bolts (3).
   **Tighten**
   Tighten the mounting bolts to 1 N·m (10 lb in)
   Refer to *Fastener Notice*
2. Install electrical connector.
3. Install negative battery cable.



27611

## Optical/Fuel Temperature Sensor

These sensors are only serviceable with electronic fuel injection pump.

## Crankshaft Position Sensor

### Removal Procedure

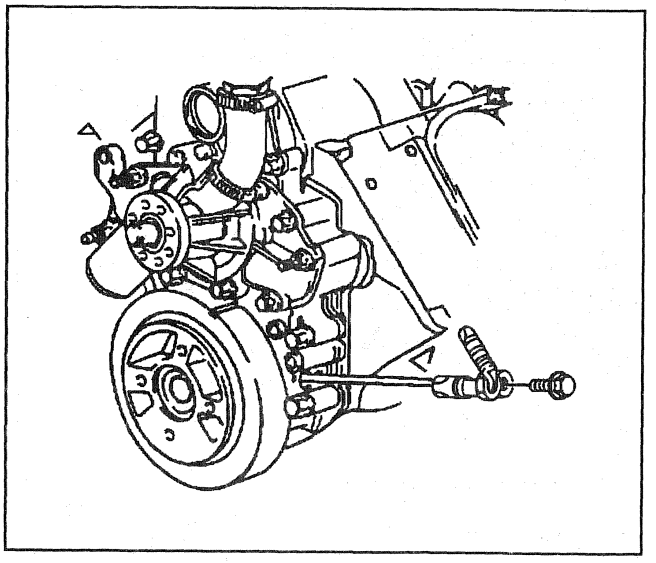
***Caution: Disconnect the negative battery cable under the following circumstances:***

- ***when installing an electrical unit.***
- ***when a tool or equipment could easily come into contact with "live" exposed electrical terminals.***

***Failure to disconnect the negative battery terminal may result in personal injury or damage to the vehicle's components. Turn OFF the vehicle ignition, unless instructed otherwise.***

1. Remove negative battery cable.
2. Remove sensor electrical connector.
3. Remove power steering pump. Refer to Power Steering Pump Removal.
4. Remove sensor mounting bolt.
5. Remove sensor from engine.

   **Important:** Care must be taken when handling the sensor. Damage to sensor will affect proper operation of the injection timing control system.
6. Inspect sensor O-ring for wear, cracks or leakage and replace if necessary.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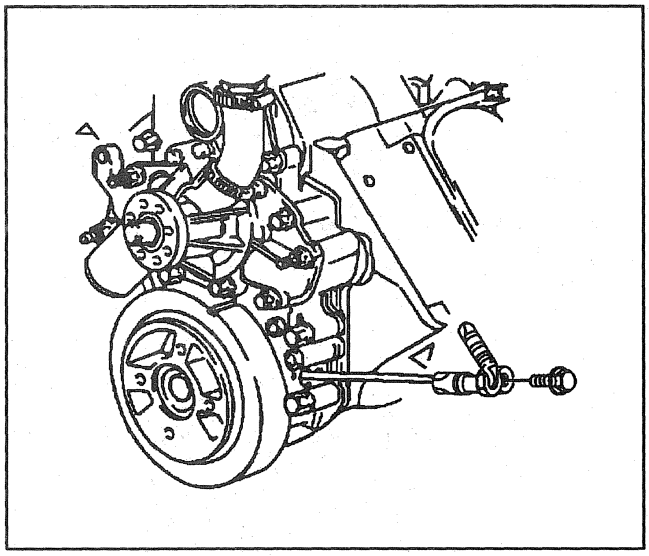
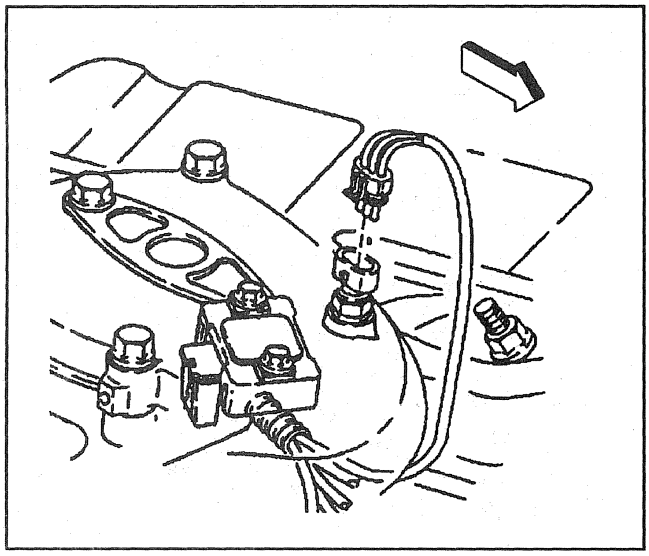


26945

### Installation Procedure

1. Lube new O–ring with engine oil.
2. Install sensor in engine.
3. Install sensor mounting bolt.
   **Tighten**
   Tighten mounting bolt to 25 N·m (17 lb ft).
   Refer to *Fastener Notice*
4. Install sensor electrical connector.
5. Install negative battery cables.
6. Refer to PCM Programming (TDC Offset). This procedure must be done when a crankshaft position sensor is replaced.



26952

## IAT Sensor

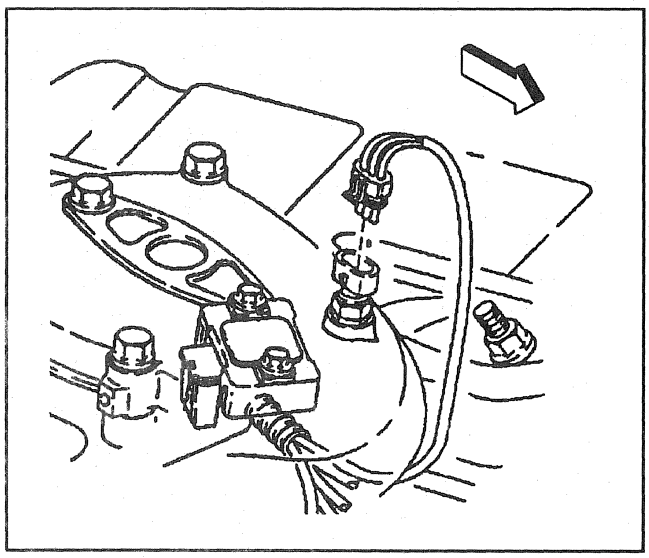
### Removal Procedure

***Caution: Disconnect the negative battery cable under the following circumstances:***

- ***When installing an electrical unit.***
- ***When a tool or equipment could easily come into contact with "live" exposed electrical terminals.***

***Failure to disconnect the negative battery terminal may result in personal injury or damage to the vehicle's components. Turn OFF the vehicle ignition, unless instructed otherwise.***

1. Remove negative battery cable.
2. Remove electrical connector..
3. Remove IAT sensor.



26952

### Installation Procedure

1. Install IAT sensor.
2. Install electrical connector.
3. Install negative battery cable.

## EGR Control Pressure Sensor

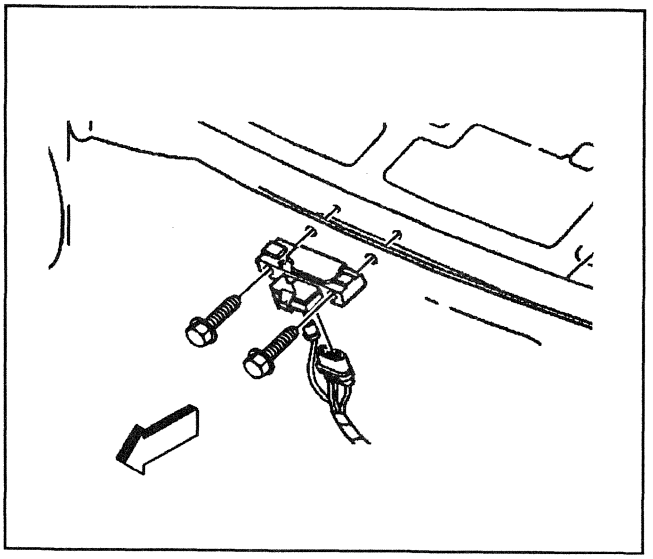
### Removal Procedure

***Caution: Disconnect the negative battery cable under the following circumstances:***

- ***When installing an electrical unit.***
- ***When a tool or equipment could easily come into contact with "live" exposed electrical terminals.***

***Failure to disconnect the negative battery terminal may result in personal injury or damage to the vehicle's components. Turn OFF the vehicle ignition, unless instructed otherwise.***

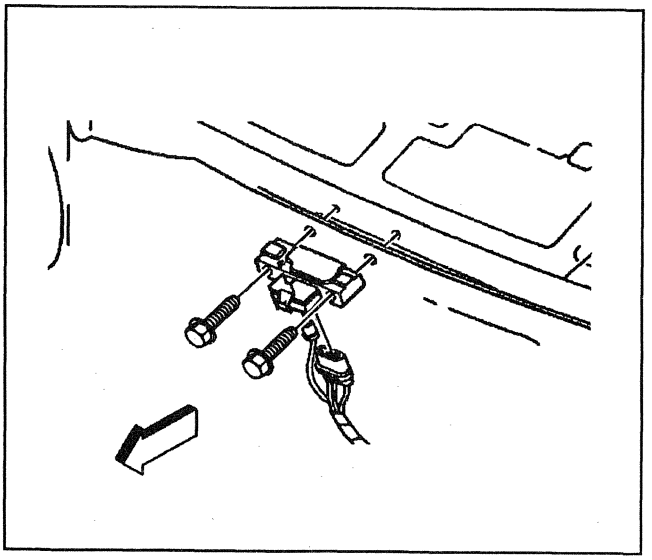
1. Remove negative battery cable.
2. Remove vacuum harness assembly.
3. Remove electrical connector.
4. Remove mounting bolts.
5. Remove sensor.



26954

### Installation Procedure

1. Install mounting bolts with sensor.
   **Tighten**
   Tighten mounting bolts to 3.5 N·m (27 lb in).
   Refer to *Fastener Notice*
2. Install electrical connector.
3. Install vacuum harness.
4. Install negative battery cable.



26954

## Boost Sensor (Diesel)

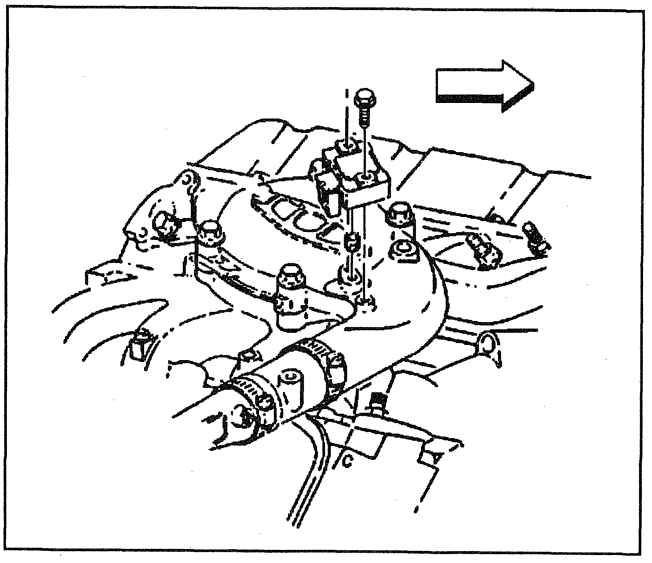
### Removal Procedure

***Caution: Disconnect the negative battery cable under the following circumstances:***

- ***When installing an electrical unit.***
- ***When a tool or equipment could easily come into contact with "live" exposed electrical terminals.***

***Failure to disconnect the negative battery terminal may result in personal injury or damage to the vehicle's components. Turn OFF the vehicle ignition, unless instructed otherwise.***

1. Remove negative battery cable.
2. Remove electrical connector.
3. Remove mounting bolts.
4. Remove sensor.



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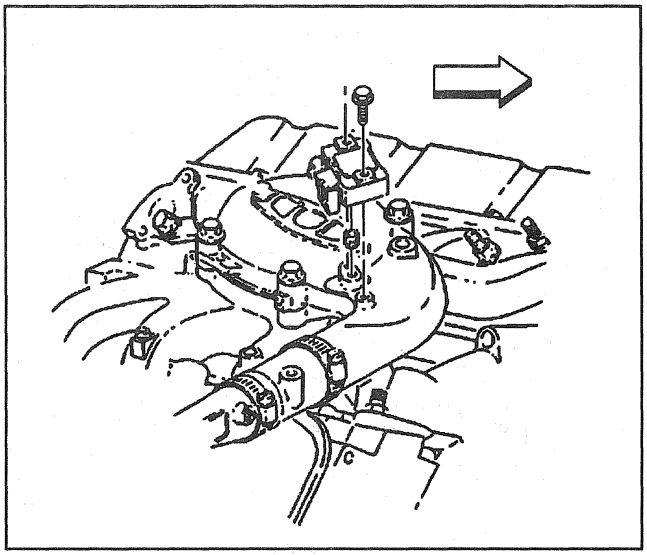
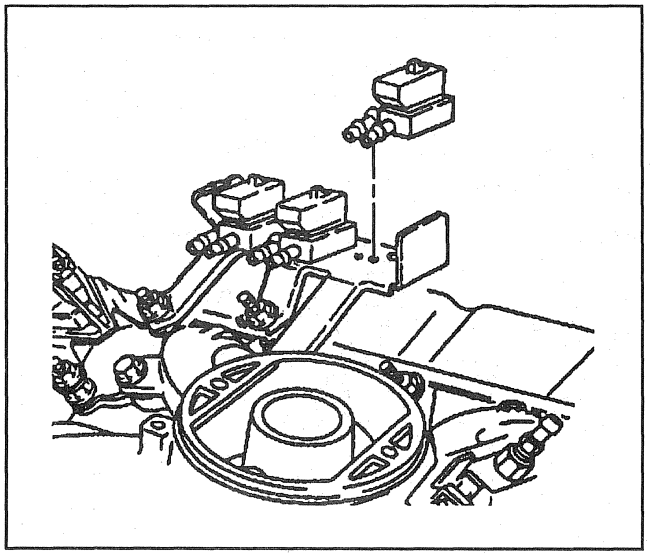


26957

### Installation Procedure

1. Install port gasket on sensor.
2. Install the sensor.
3. Install mounting bolts.
   **Tighten**
   Tighten mounting bolts to 3.5 N·m (27 lb in).
   Refer to *Fastener Notice*
4. Install electrical connector.
5. Install negative battery cable.



26958

## Wastegate Solenoid

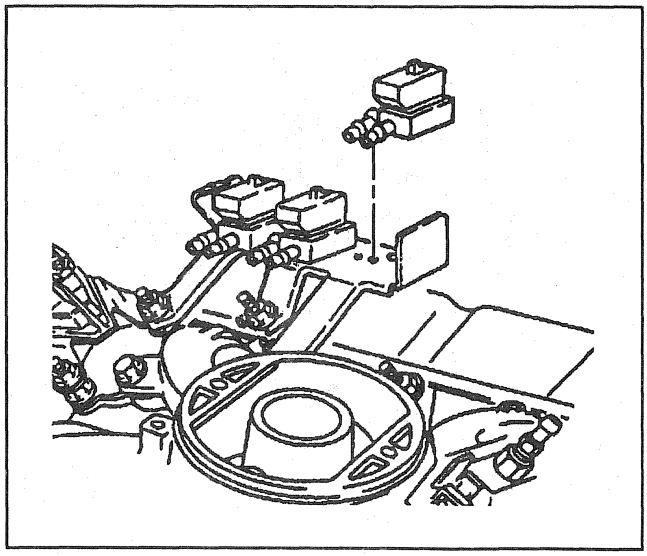
### Removal Procedure

***Caution: Disconnect the negative battery cable under the following circumstances:***

- ***When installing an electrical unit.***
- ***When a tool or equipment could easily come into contact with "live" exposed electrical terminals.***

***Failure to disconnect the negative battery terminal may result in personal injury or damage to the vehicle's components. Turn OFF the vehicle ignition, unless instructed otherwise.***

1. Remove negative battery cables.
2. Remove electrical connector from the solenoid.
3. Remove vacuum hoses.
4. Remove solenoid mounting bolt
5. Remove wastegate solenoid.



26958

### Installation Procedure

1. Install wastegate solenoid.
2. Install wastegate mounting bolt.
3. Install vacuum hoses.
4. Install electrical connector.
5. Install negative battery cables.

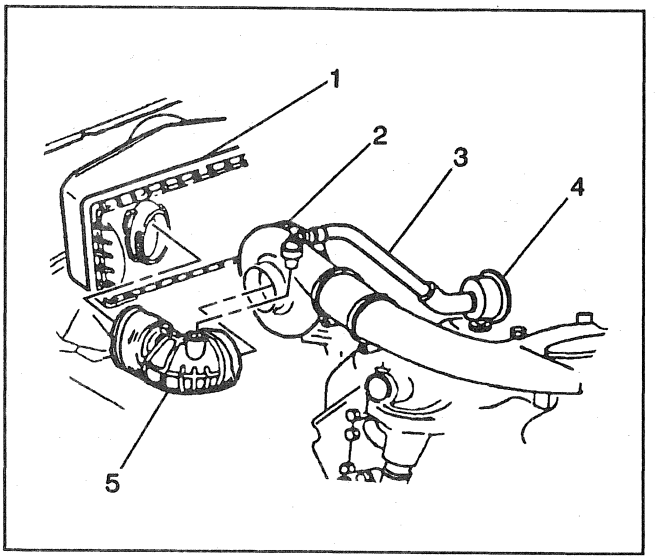
## Vehicle Speed Signal Buffer

The VSS buffer module is mounted in the instrument panel. Refer to Engine Electrical.

## Air Cleaner Element

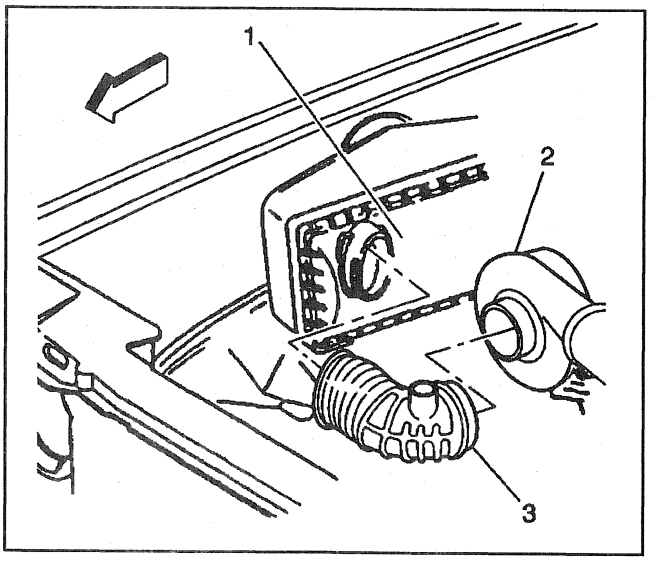
### Removal Procedure

1. Remove the Crankcase Depression Regulator CDR hose (3) from air inlet elbow (5).




25531

2. Remove the air inlet elbow (3) from turbocharger (2) and air cleaner (1).

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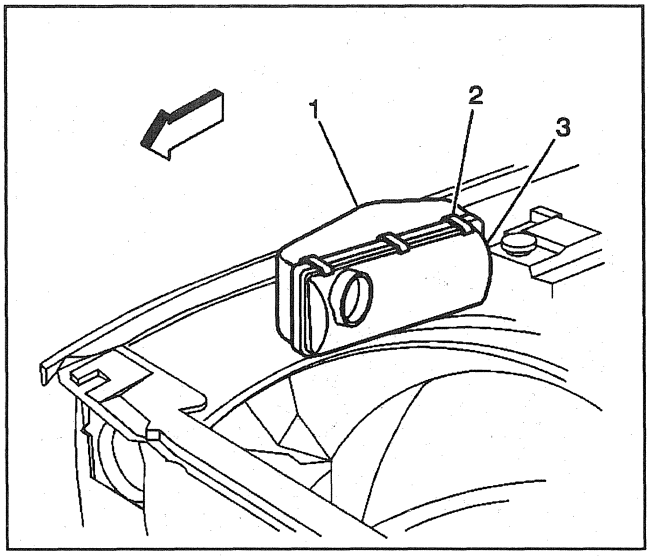


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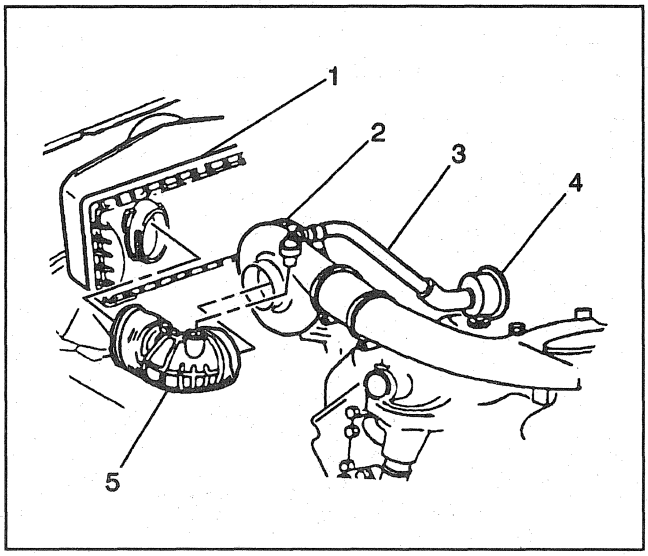
3. Release the clips (2) holding air cleaner cover (3) to the housing (1).
4. Remove the air cleaner filter.
5. Inspect air cleaner filter for damage or excessive dirt accumulation. Replace if necessary.

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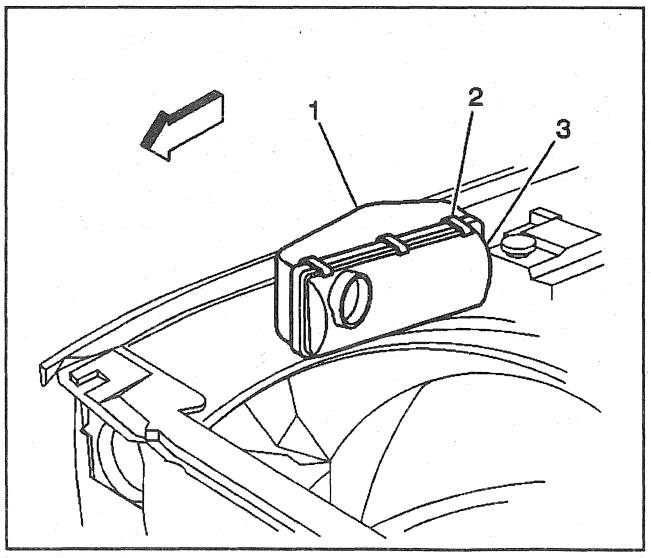
6. Inspect air inlet elbow (5) and CDR hose (3) for damage or cracks, replace if necessary.

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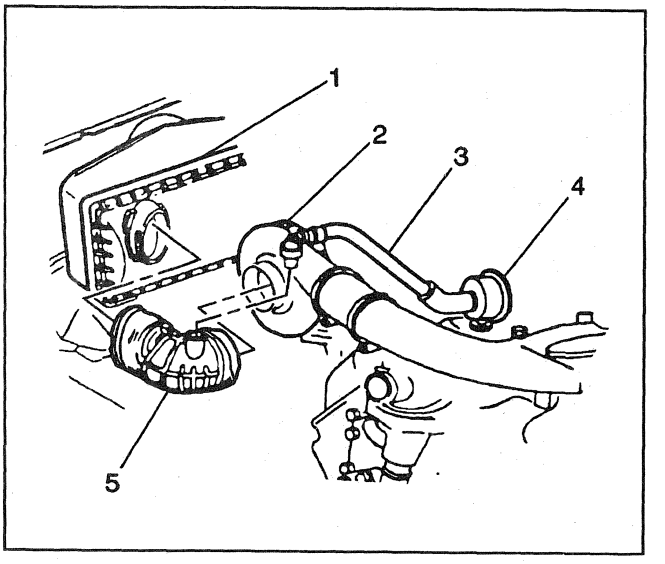
## Installation Procedure

1. Install air cleaner filer.
2. Install air cleaner cover (3) to housing (1) and clip the air cleaner cover (3) into place.

3. Install air inlet elbow (5) to air cleaner cover (1) and turbocharger (2).
   **Tighten**
   Tighten the inlet elbow clamps to 1.7 N·m (15 lb in).
   Refer to *Fastener Notice*.
4. Install CDR valve (4) into air inlet elbow (5).



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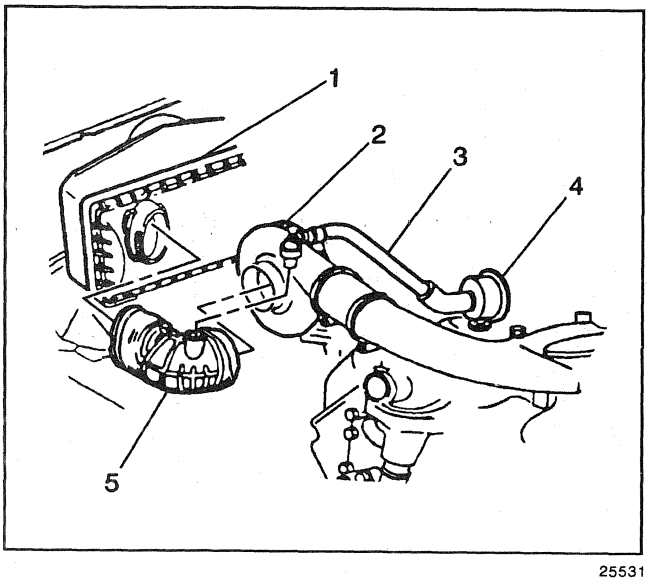
## Air Cleaner

### Removal Procedure

1. Remove the CDR hose (3).
2. Remove the inlet elbow (5).



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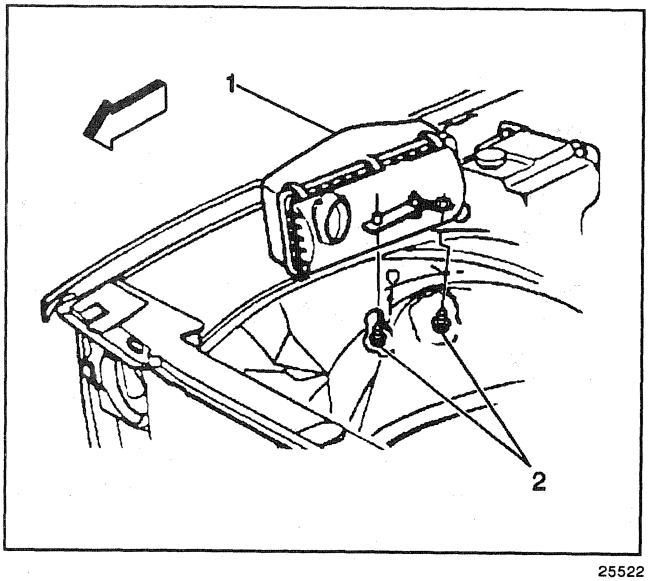
3. Remove the air cleaner mounting bolts (2).
4. Remove the air cleaner assembly (1).



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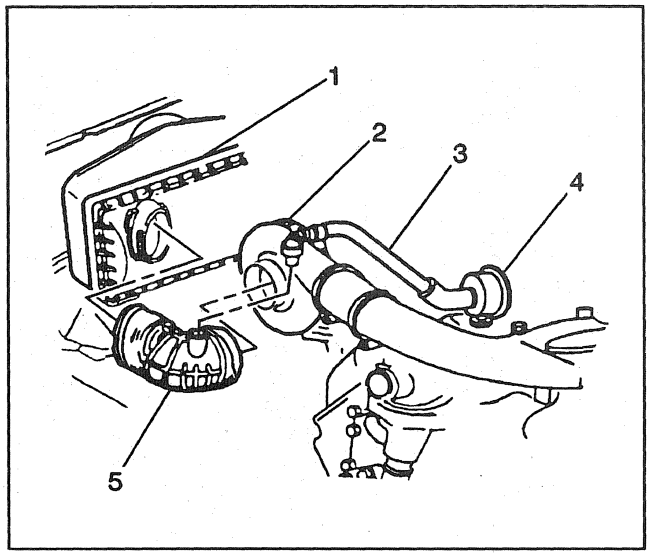


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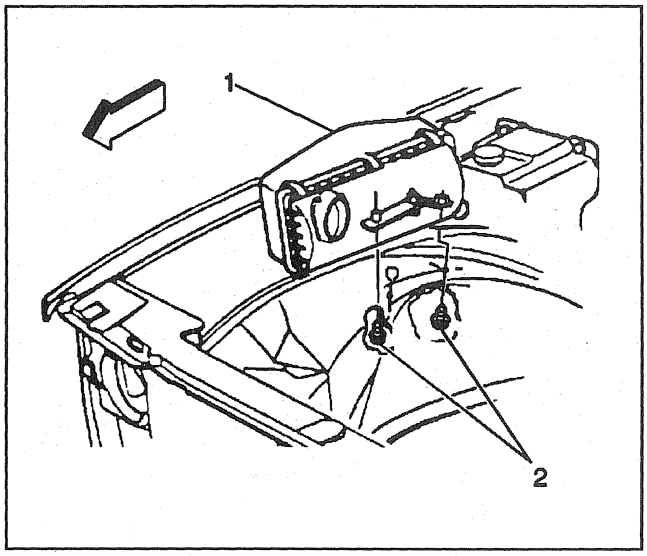
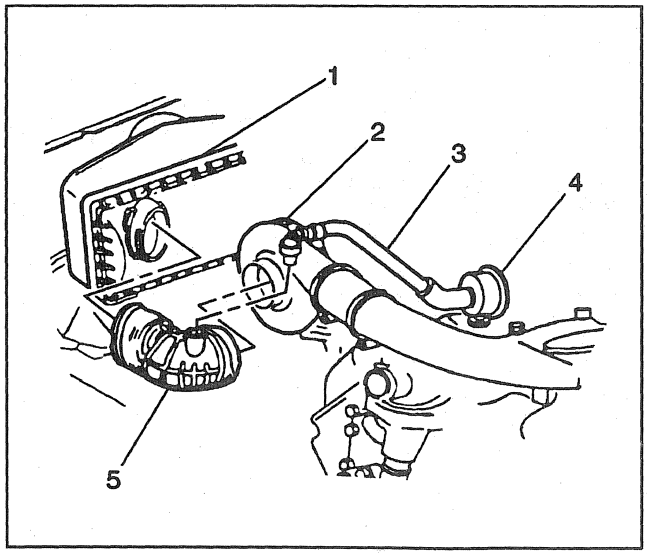
5. Inspect the CDR hose (3) for cracks or binds.
6. Inspect the air cleaner cover (1) seals for damage.
7. Inspect the air cleaner filter for damage or excessive dirt accumulation. Replace any part which shows any of the above conditions.




25522

## Installation Procedure

1. Install the air cleaner assembly (1).
2. Install the air cleaner mounting bolts (2).
   **Tighten**
   Tighten the bolts to 12N·m (96 lb in).
   Refer to *Fastener Notice*.

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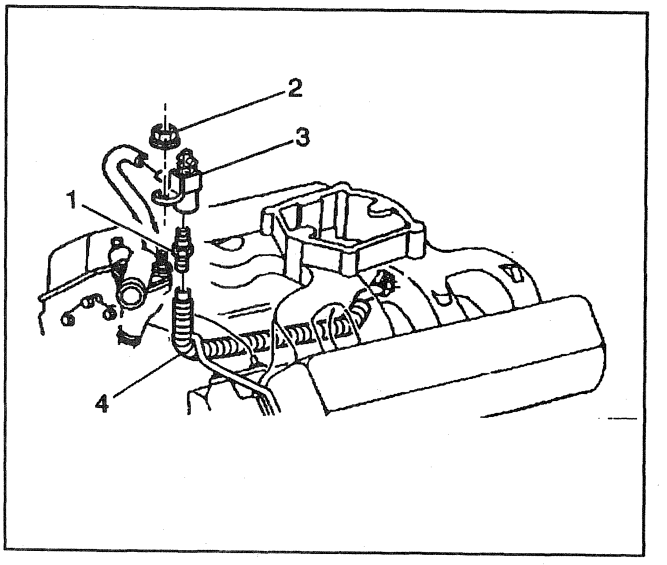
3. Install the CDR hose (3).
4. Install inlet elbow (5).

## Draining Water from Fuel Manager/Filter

1. Turn OFF the engine and apply the parking brake.
2. Place a suitable container under the filter drain hose.
3. Open the drain valve (3).
4. Start the engine and allow it to idle for one minutes or until clear fuel is observed.
5. Close the drain valve (3) and stop the engine.
6. Dispose of the drained mixture in a proper manner.

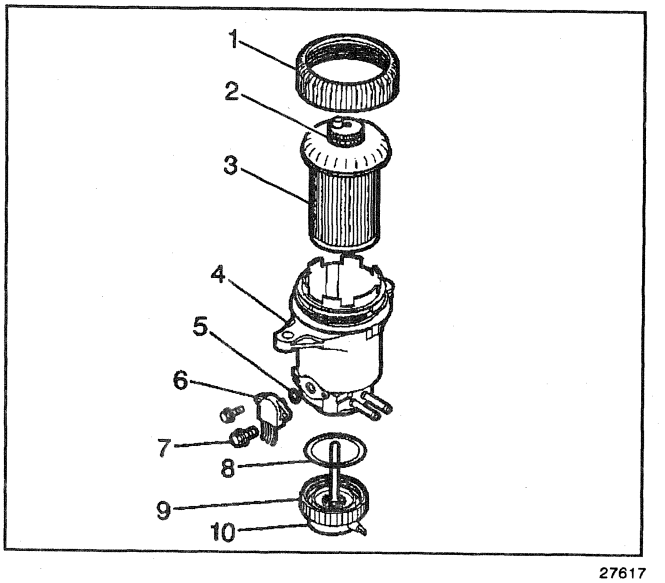


27616

## Fuel Filter Element Replacement

### Removal Procedure

1. Remove fuel tank filler cap.
2. Open air bleed valve (2) on top of the fuel manager/filter (3) to release any pressure in the fuel supply system.
3. Remove element nut (1) by turning it in a counterclockwise direction. If unable to turn by hand, a strap wrench (oil filter type) may be used to break loose the element nut.
4. Remove the filter (3) by lifting it straight up and out of the filter assembly (4). 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 (4) cavity.

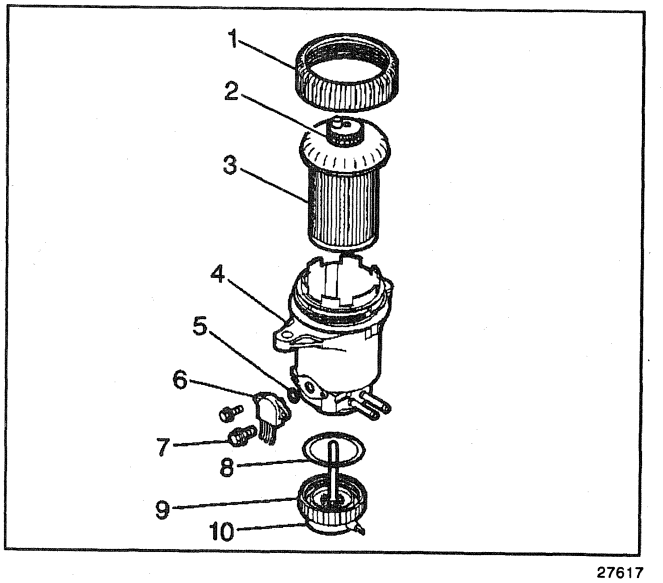


27617

### Installation Procedure

**Important:** Make sure the mating surface between the element assembly (3) and the filter assembly (4) is clean before installation.

1. Install the new filter (3) by aligning the widest key slot located under the element assembly cap with the widest key in the header assembly.
2. Push the element (3), in a downwards direction until the mating surfaces make contact.
3. Install the element nut (1).
   **Tighten**
   Tighten the element nut (1) securely by hand.
   Refer to *Fastener Notice*.
4. Bleed air from fuel manager/filter. Refer to *Bleeding Air from Fuel Supply System*.
5. Reinstall fuel tank filler cap.

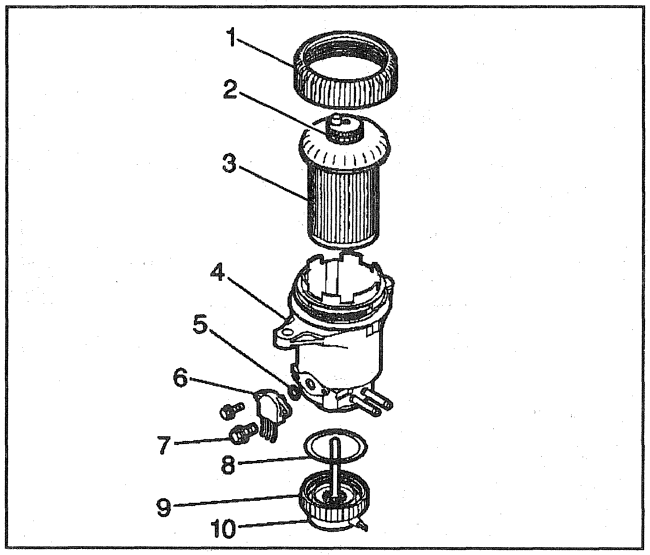


27617

## Bleeding Air from Fuel Supply System

***Caution: The Water/Diesel Fuel Mixture Is Flammable, And Could Be Hot. To Help Avoid Personal Injury and/or Property Damage, Do Not Touch The Fuel Coming From The Drain Hose, And 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 Risk Of Personal Injury and/or 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 FUEL SOL fuse.
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 FUEL SOL fuse.
7. Start the engine and allow to run for 5 minutes at idle.
8. Check for fuel leaks.
9. Clear all engine DTCs.




27617

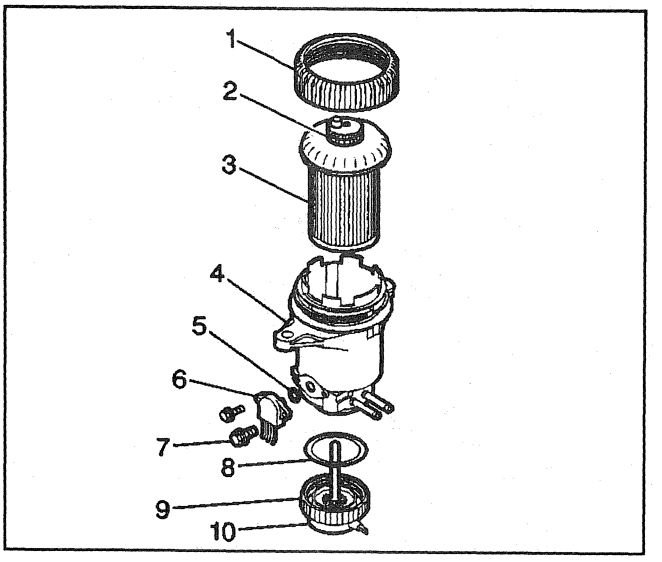
## Fuel Manager/Filter Replacement

### Removal Procedure

1. Remove the fuel tank filler cap.
2. Open air bleed valve (2) on top of the fuel manager/filter to release any pressure in the fuel supply system.
3. Remove the mounting bolts which attach the fuel manager/filter to the intake manifold.
4. Remove the wiring harnesses and fuel hoses.
5. Remove the fuel manager/filter (3).

### Installation Procedure

1. Install the fuel hoses and wiring harnesses.
2. Position fuel manager/filter to intake manifold.
3. Install the fuel manager/filter mounting bolts.
   **Tighten**
   Tighten the mounting bolts to 25 N·m (18 lb ft).
   Refer to *Fastener Notice*
4. Bleed air from fuel manager/filter. Refer to *Bleeding Air from Fuel Supply System.*
5. Reinstall fuel tank filler cap.

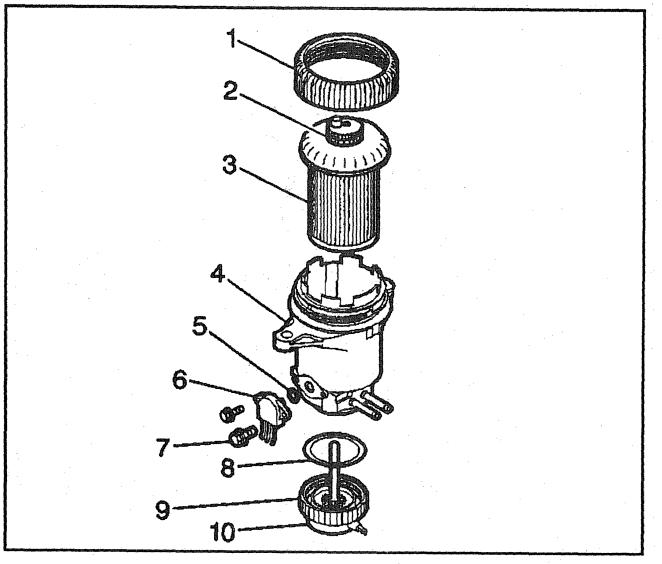


27617

## Water-in-Fuel Sensor

### Removal Procedure

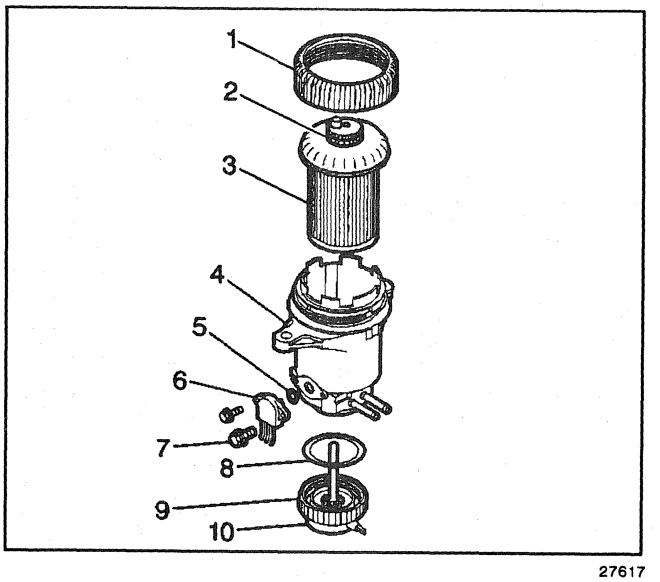
1. Open air bleed valve (2) on top of the fuel manager/filter to release any pressure in the fuel supply system.
2. Remove the mounting bolts that connect the fuel manager/filter to the intake manifold and move the fuel manager/filter to a position that enables access to the sensor mounting screws.
3. Remove the sensor wiring harness.
4. Remove the sensor mounting screws (7) .
5. Remove the sensor (6).



27617

### Installation Procedure

1. Install new water in fuel sensor (6) and a new water in fuel sensor seal (5).
2. Instal the mounting screws.
   **Tighten**
   Tighten the mounting screws to 2 N·m (13 lb in).
   Refer to *Fastener Notice.*
3. Install the fuel manager/filter to the intake manifold with mounting bolts.
   **Tighten**
   Tighten the mounting bolts to 25 N·m (18 lb ft).
4. Bleed air from fuel manager/filter if necessary Refer to *Bleeding Air from Fuel Supply System.*



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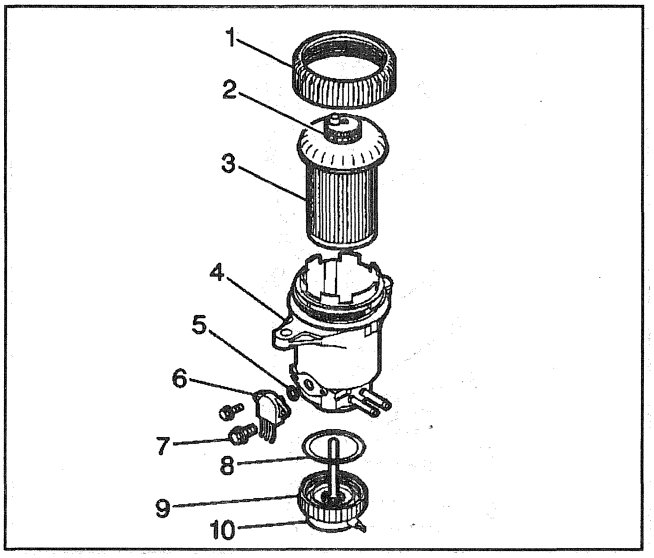


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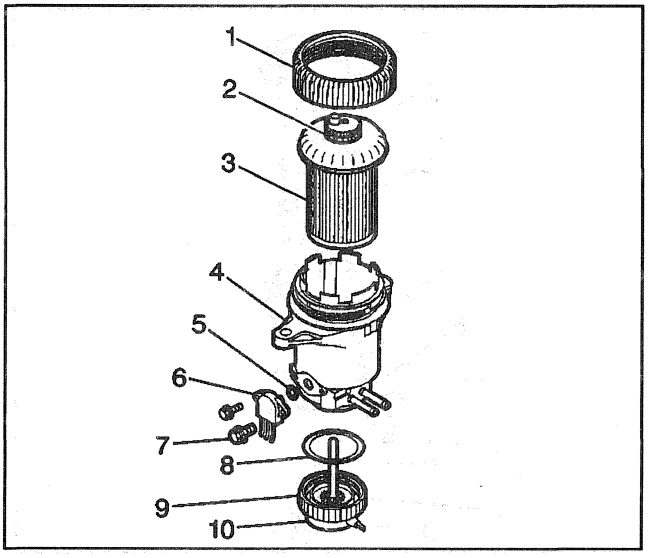


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## Fuel Heater (Diesel)

### Removal Procedure

1. Open air bleed valve (2) on top of the fuel manager/filter to release any pressure in the fuel supply system.
2. Remove fuel manager/filter Refer to *Fuel Manager/Filter Replacement.*
3. Remove fuel heater threaded nut (9), using hand pressure or a strap wrench.
4. Remove fuel heater (10) from the filter housing.
5. Clean fuel heater to housing sealing surfaces.

### Installation Procedure

1. Install the cap seal (8) into filter housing.
2. Install the fuel heater (10).
3. Install the cap nut (9).
   **Tighten**
   Tighten cap nut securely by hand.
   Refer to *Fastener Notice.*
4. Install fuel manager/filter Refer to *Fuel Manager/Filter Replacement.*
5. Bleed air from fuel manager/filter Refer to *Bleeding Air from Fuel Supply System.*

## Draining Fuel Tank

***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 fuel and reinstall filler cap.

## Fuel Tank (Suburban)

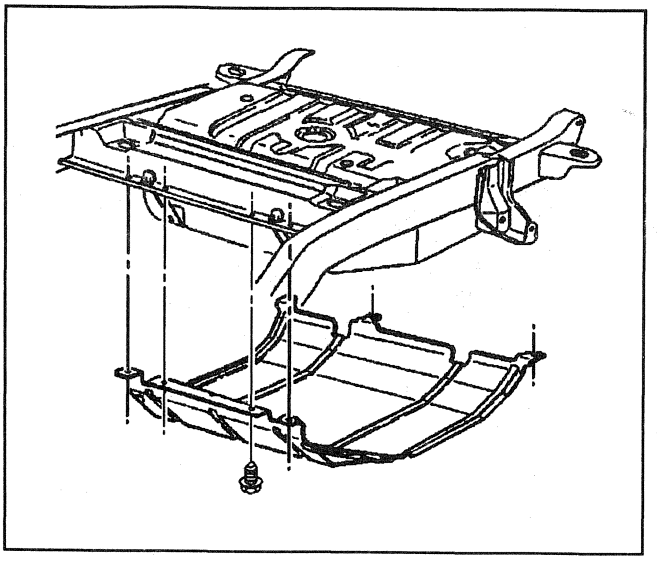
### Removal Procedure

***Caution: Disconnect the negative battery cable under the following circumstances:***

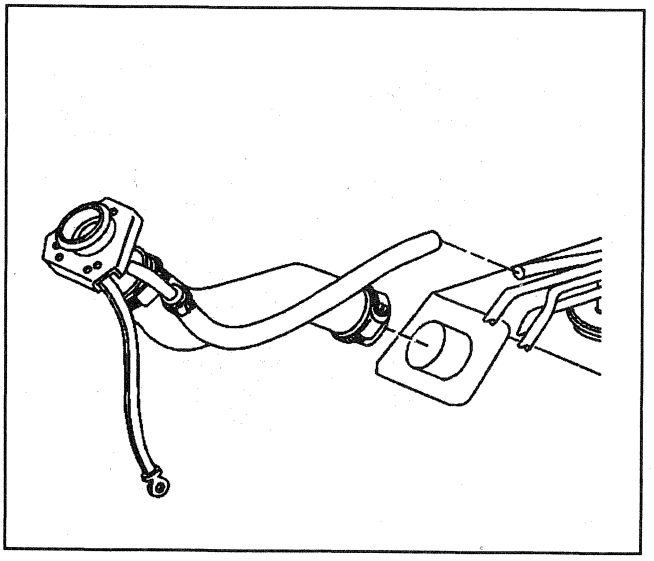
- ***When installing an electrical unit.***
- ***When a tool or equipment could easily come into contact with "live" exposed electrical terminals.***

***Failure to disconnect the negative battery terminal may result in personal injury or damage to the vehicle's components. Turn OFF the vehicle ignition, unless instructed otherwise.***

1. Disconnect negative battery cables.
2. Drain the fuel from the tank. Refer to *Draining Fuel Tank*.
3. Raise the vehicle.
4. Remove 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.

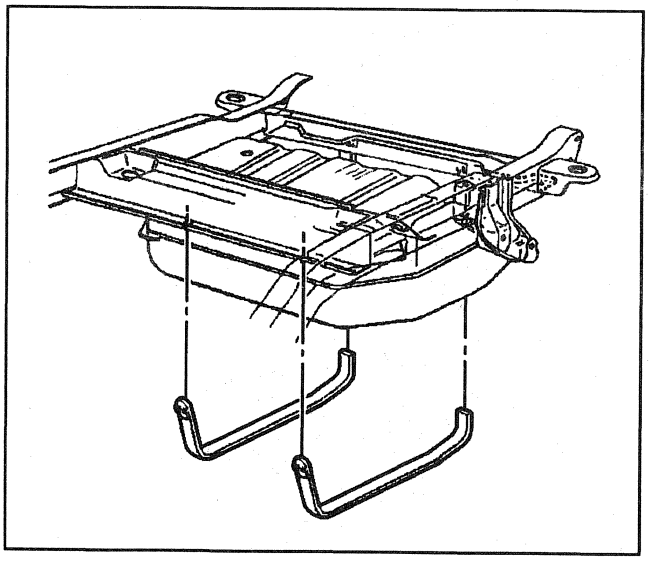


18322

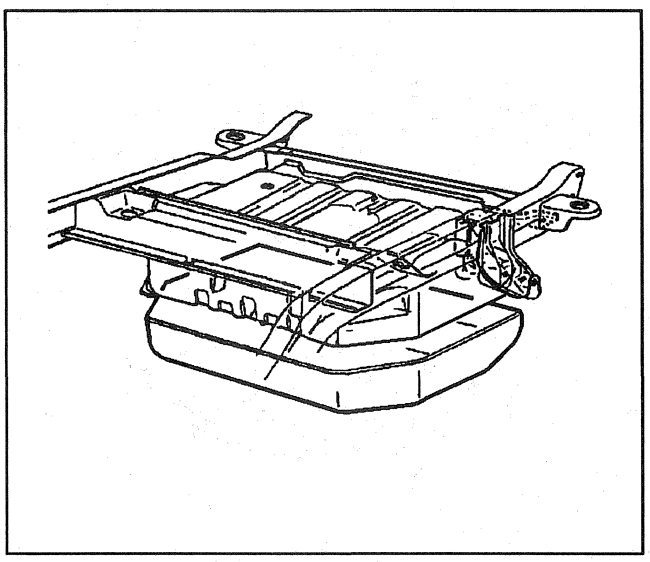


18442

6. Support the fuel tank and remove the tank straps and insulator strips, if equipped.

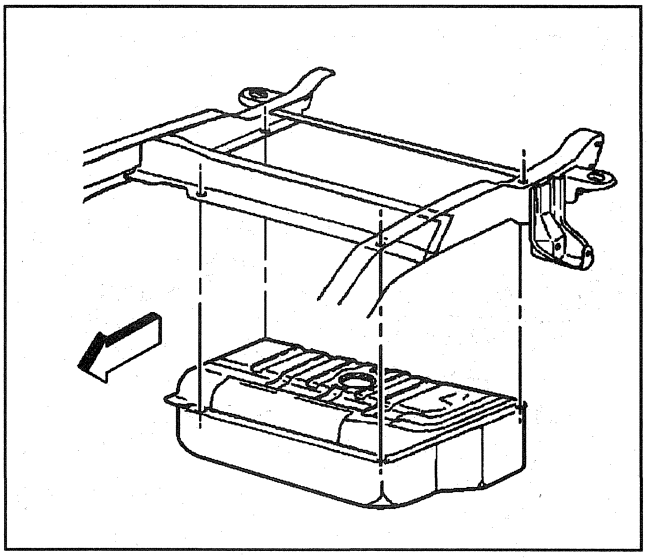


18311



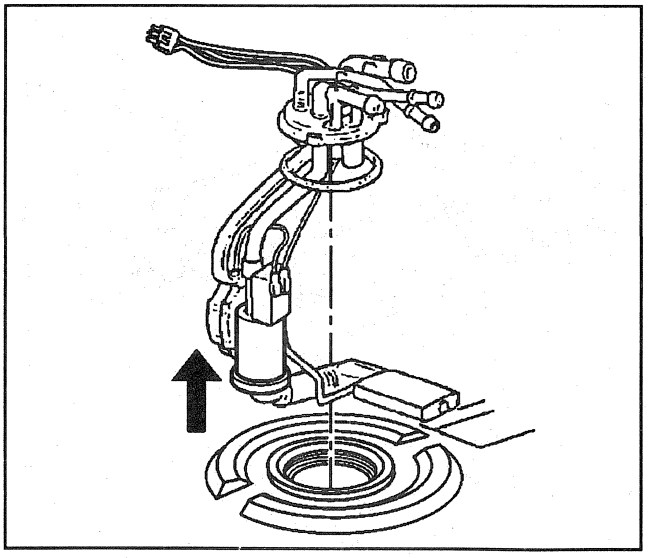
18313

7. Lower fuel tank shield.



18321

8. Lower the fuel tank. Disconnect the fuel feed and vapor hoses. Disconnect the electrical connections at the sender.

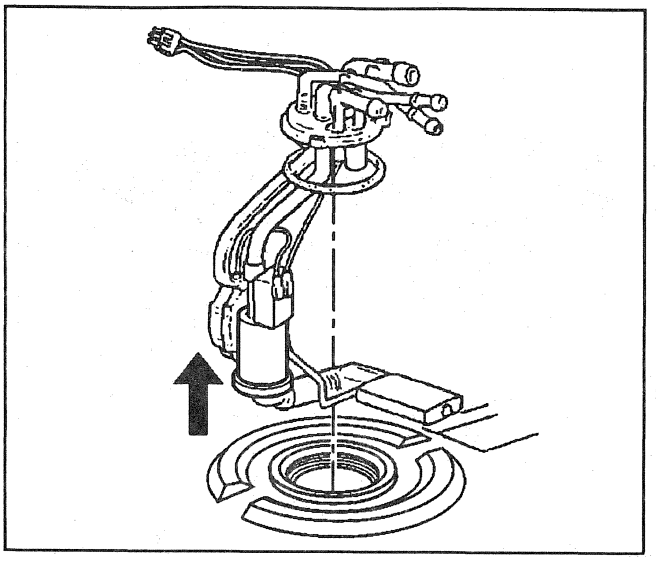


17407

9. Remove the fuel sender assembly and seal ring, using tool *J 39765*. Discard the old seal ring. Purge the tank, if the tank is being repaired.

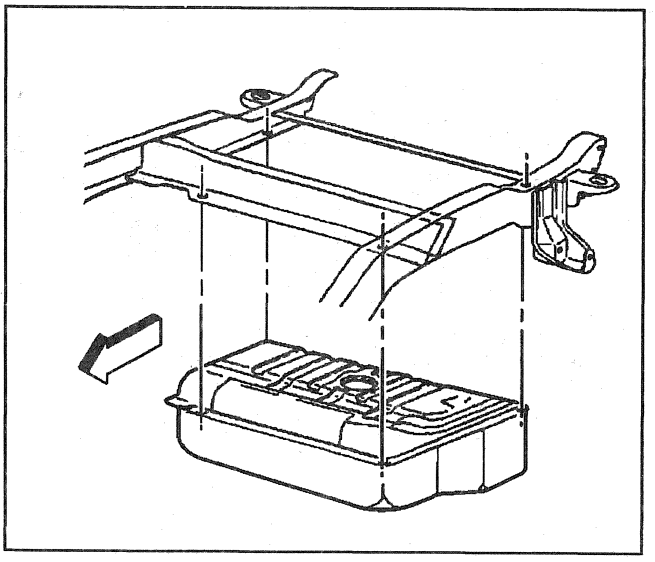
### Installation Procedure

1. Install the new seal ring and reinstall the sender using tool *J 39765*.
2. Raise the tank slightly and reconnect the fuel feed and vapor hoses and the electrical connections at the sender.



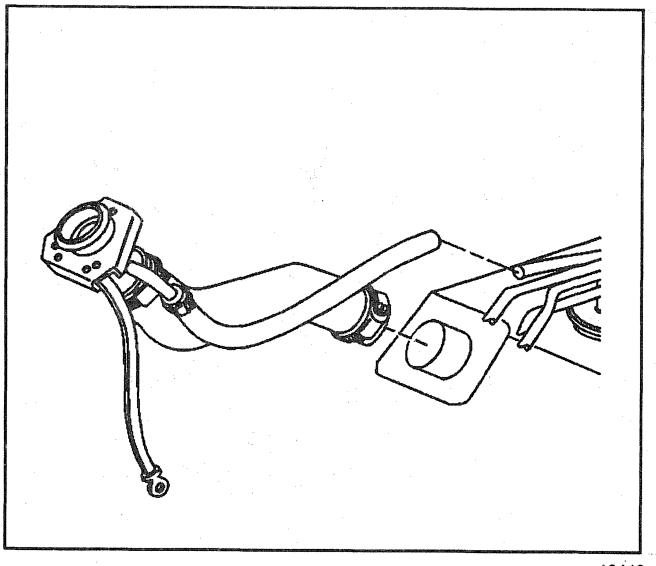
17407

3. Raise the tank fully.

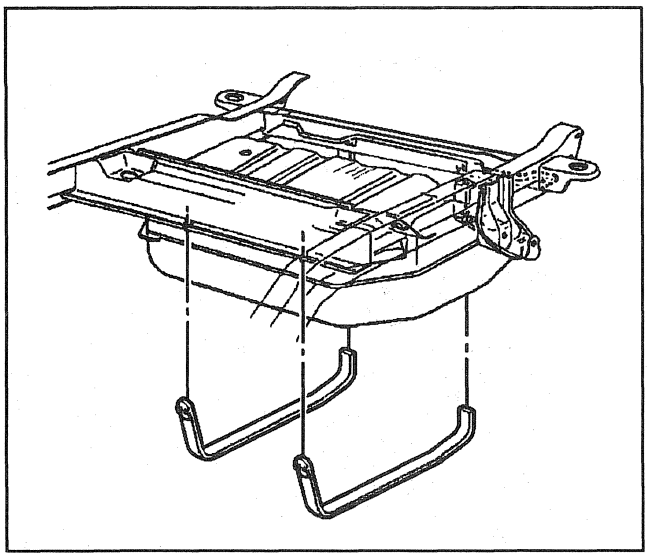


18321

4. Reinstall the fuel tank filler neck to the tank. Tighten the clamp.



18442



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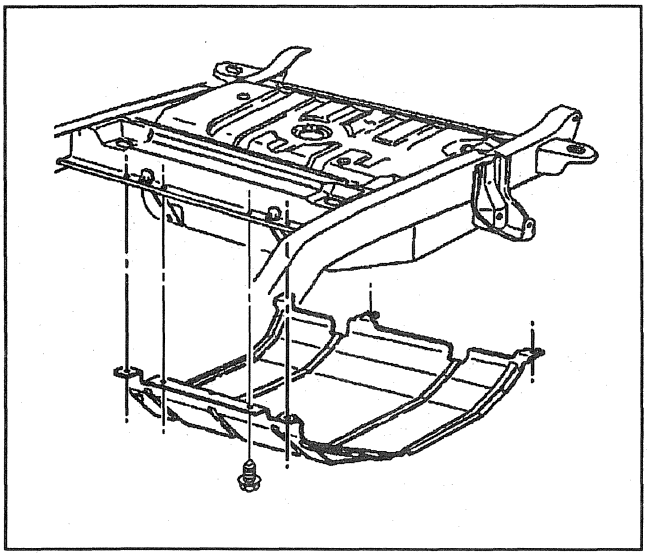
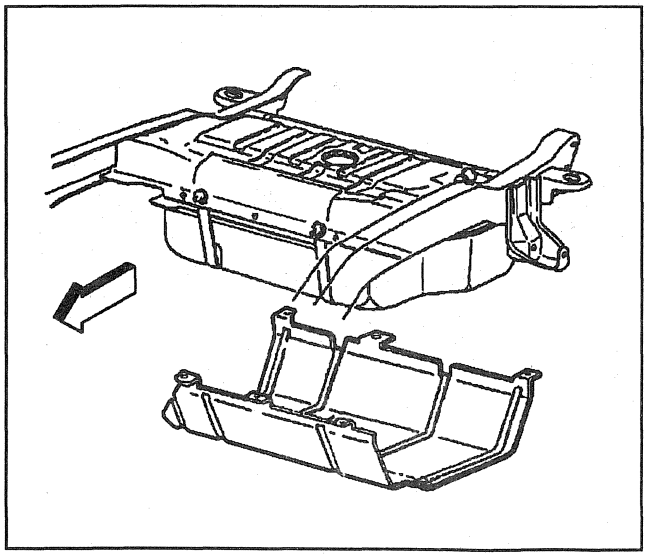


18322



18318

***Notice:*** The strap nuts must be tightened by steps, alternating between the four nuts until the specified torque is reached. Otherwise, the bottom of the tank will flex upward and the fuel gage will indicate fuel remaining in the tank when the tank runs dry.

5. Install the fuel tank brackets with insulator strips in place.
   **Tighten**
   Tighten the strap nuts to 45N.m (33 lb ft).
   Refer to *Fastener Notice*
6. Install the fuel tank off-road shield, if equipped.
7. Replenish the fuel in the tank. Reinstall the fuel tank filler cap.
8. 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.
9. Check for leaks.
   9.1. Turn ON the ignition switch for 2 seconds.
   9.2. Turn OFF the ignition switch for 10 seconds.
   9.3. Again, turn the ignition switch to the ON position.
   9.4. Check for fuel leaks.

## Fuel Tank (Tahoe/Yukon)

### Removal Procedure

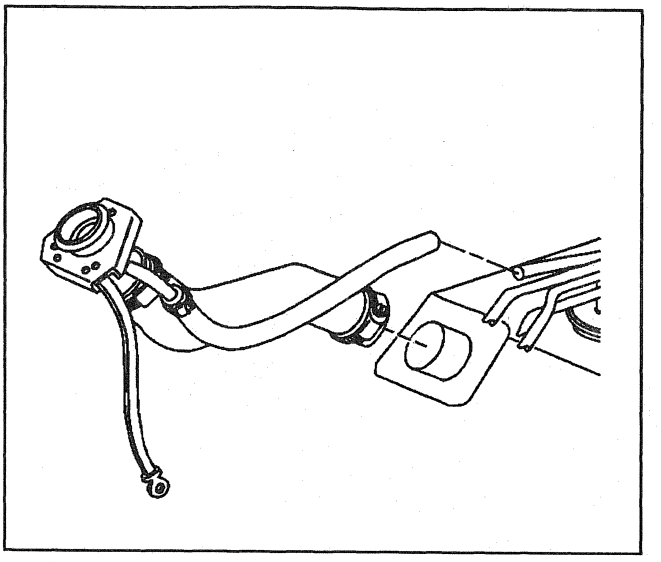
***Caution: Disconnect the negative battery cable under the following circumstances:***

- ***When installing an electrical unit.***
- ***When a tool or equipment could easily come into contact with "live" exposed electrical terminals.***

***Failure to disconnect the negative battery terminal may result in personal injury or damage to the vehicle's components. Turn OFF the vehicle ignition, unless instructed otherwise.***

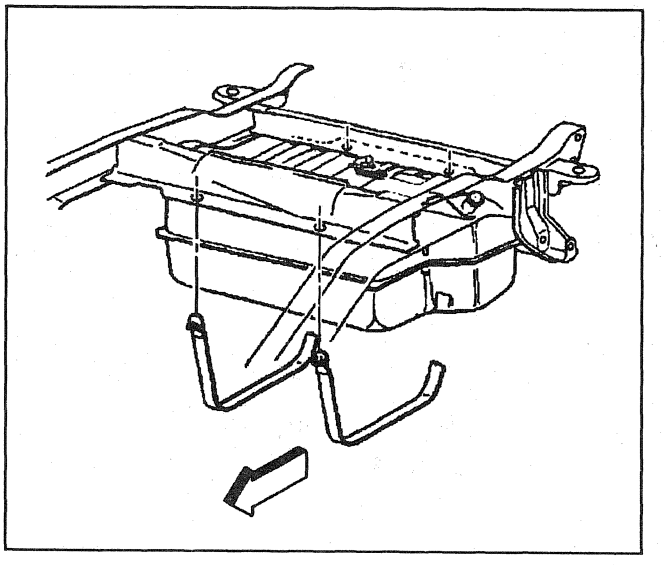
1. Remove negative battery cable.
2. Drain the fuel from the tank. Refer to *Draining Fuel Tank.*
3. Raise the vehicle.
4. Remove the fuel tank off-road shield, if equipped.

5. Loosen the filler neck hose clamp at the fuel tank.
6. Disconnect the fuel tank filler neck from the fuel tank.



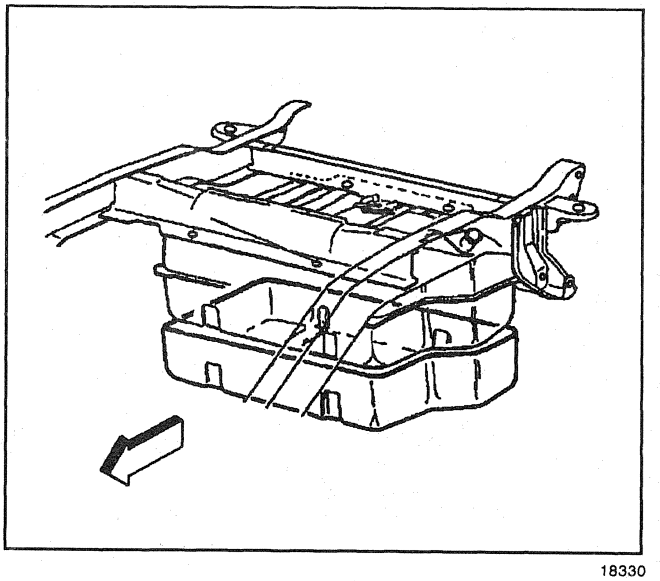
18442

7. Support the fuel tank and remove the tank straps and insulator strips, if equipped.

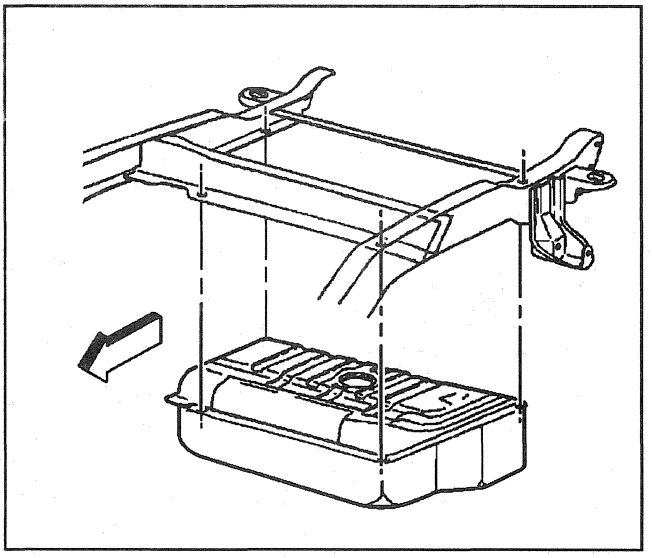


18329

8. Lower the fuel tank shield.

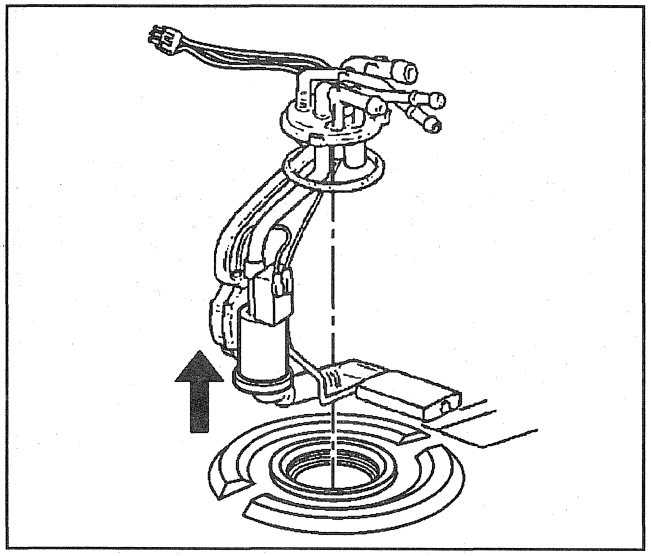


18330



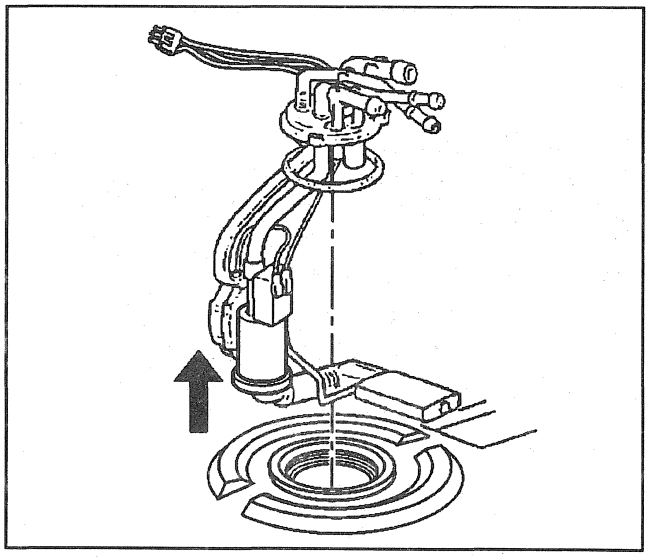
18321

9. Lower the fuel tank. Disconnect the fuel feed and vapor hoses.
10. Disconnect the electrical connections at the sender.



17407

11. Remove the fuel sender assembly and seal ring, using tool *J 39765*. Discard the old seal ring. Purge the tank, if the tank is being repaired.

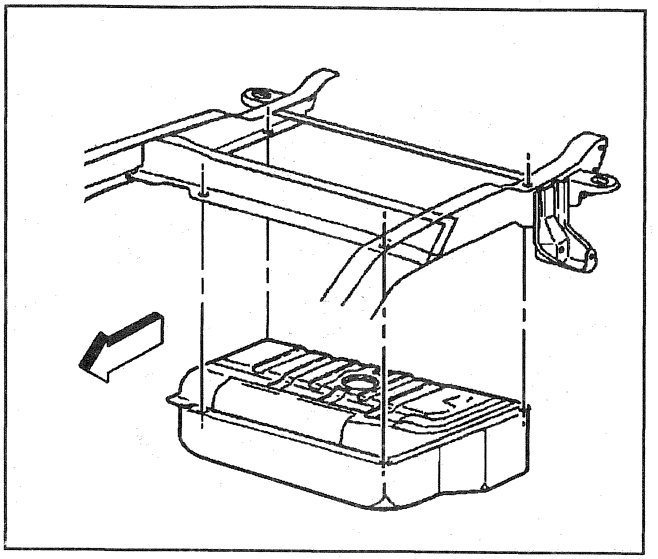


17407

## Installation Procedure

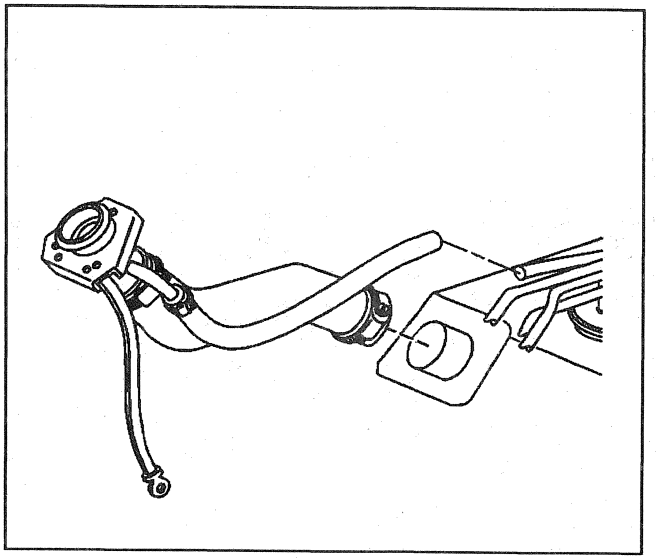
1. Install the new seal ring and reinstall the sender using tool *J 39765*.
2. Raise the tank slightly and reconnect the fuel feed and vapor hoses and the electrical connections at the sender.

3. Raise the tank fully.



18321

4. Reinstall the fuel tank filler neck to the tank. Tighten the clamp.



18442

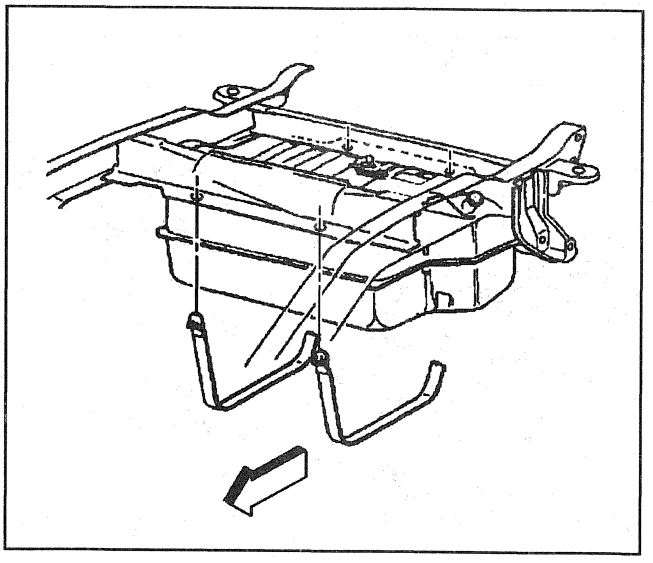
***Notice:*** The strap nuts must be tightened by steps, alternating between the four nuts until the specified torque is reached. Otherwise, the bottom of the tank will flex upward and the fuel gage will indicate fuel remaining in the tank when the tank runs dry.

5. Install the fuel tank brackets with insulator strips in place.

   **Tighten**

   Tighten the strap nuts to 45 N.m (33 lb ft).

   Refer to *Fastener Notice*



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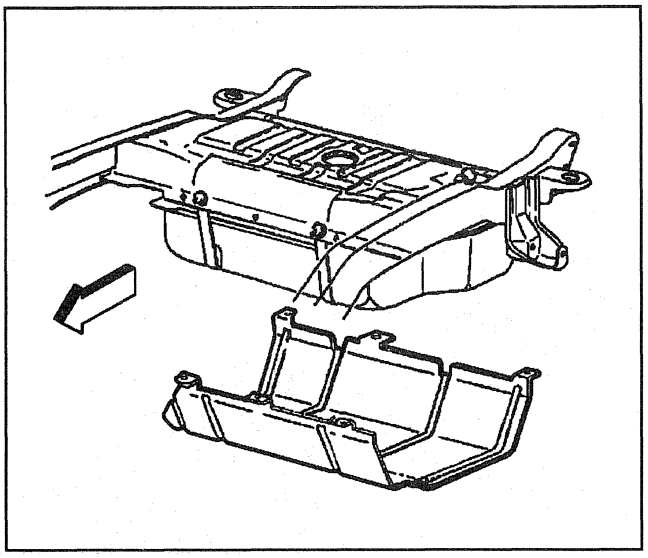

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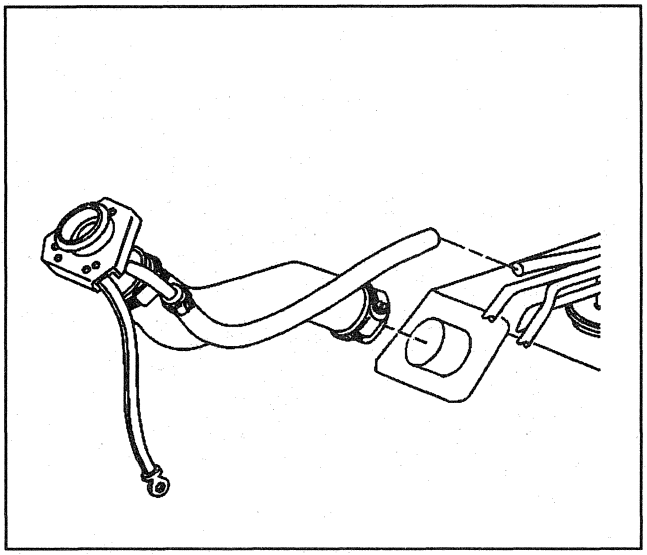

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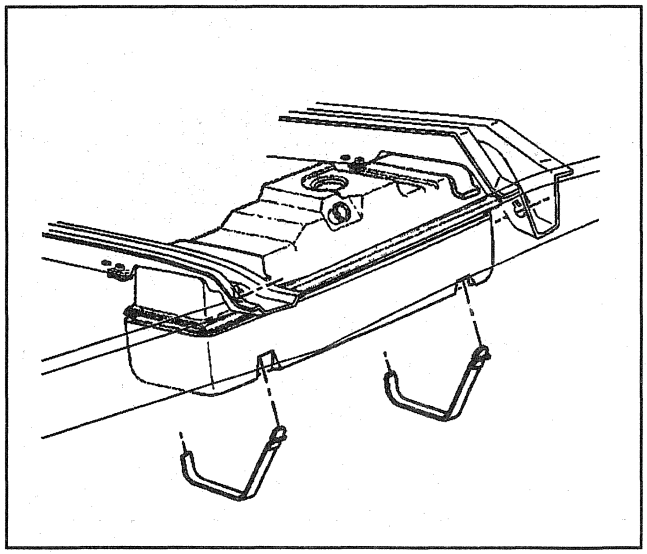


18413

6. Install the fuel tank off-road shield, if equipped.
7. Replenish the fuel in the tank. Reinstall the fuel tank filler cap.
8. 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.
9. Check for fuel leaks.
   9.1. Turn ON the ignition switch for 2 seconds.
   9.2. Turn OFF the ignition switch for 10 seconds.
   9.3. Again, turn the ignition switch to the ON position.
   9.4. Check for fuel leaks.

## Fuel Tank (Extended Cab Side Tank)

### Removal Procedure

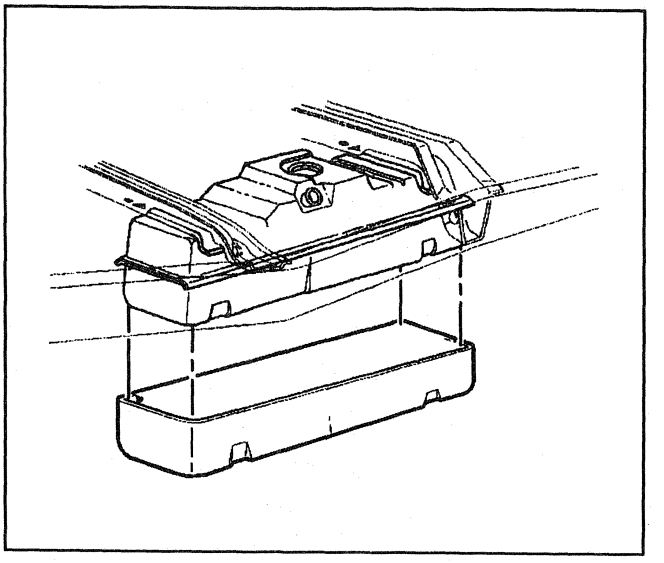
***Caution: Disconnect the negative battery cable under the following circumstances:***

- ***When installing an electrical unit.***
- ***When a tool or equipment could easily come into contact with "live" exposed electrical terminals.***

***Failure to disconnect the negative battery terminal may result in personal injury or damage to the vehicle's components. Turn OFF the vehicle ignition, unless instructed otherwise.***

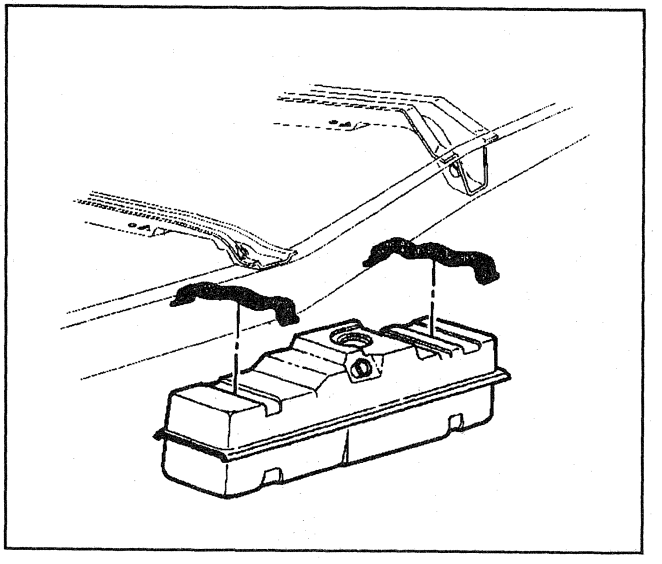
1. Disconnect negative battery cables.
2. Drain the fuel from the tank. Refer to *Draining Fuel Tank.*
3. Raise the vehicle.
4. Loosen the filler neck hose clamp at the fuel tank and disconnect the fuel tank filler neck from the fuel tank.
5. Support the fuel tank and remove the tank straps and insulator strips, if equipped.

6. Lower the fuel tank shield.



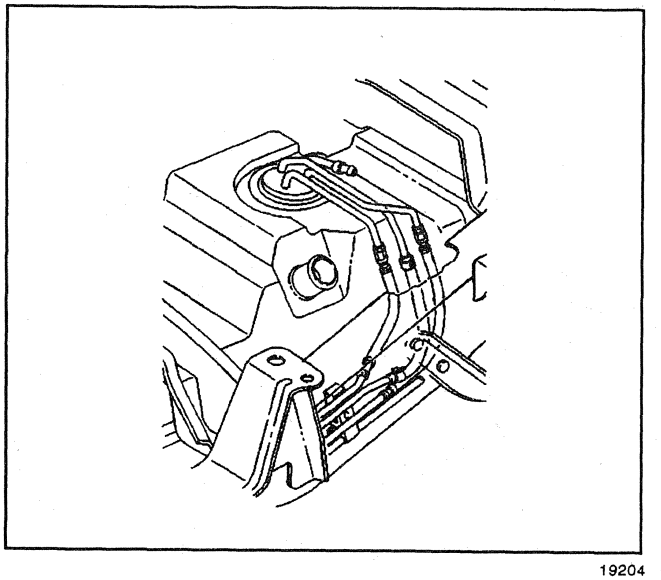
18414

7. Lower the fuel tank.

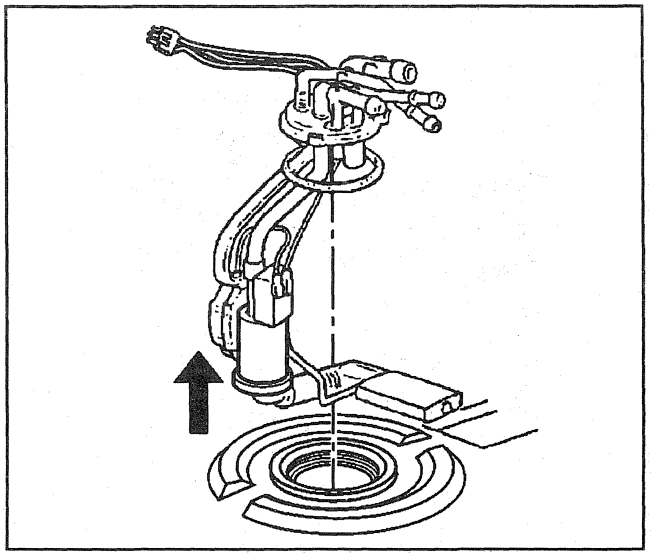


18415

8. Disconnect the fuel hoses and lines. Disconnect the electrical connections at the sender.

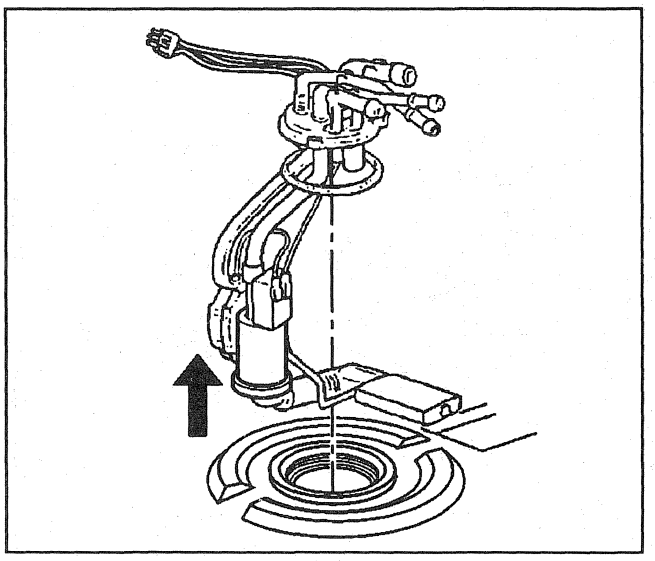


19204



17407

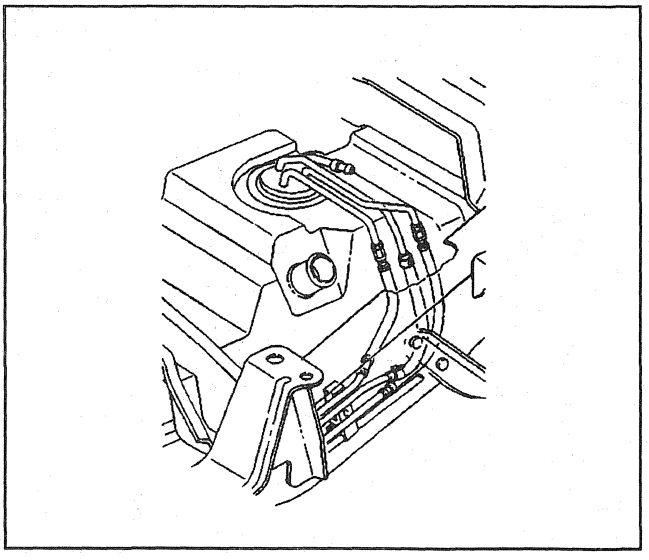
9. Remove the fuel sender assembly and seal ring, using tool *J 39765*. Discard the old seal ring. Purge the tank, if the tank is being repaired.



17407

### Installation Procedure

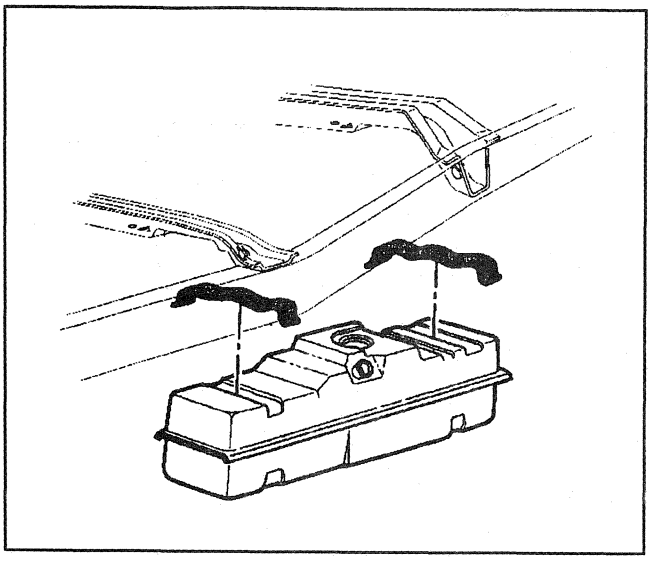
1. Install the new seal ring.
2. Use tool *J 39765* in order to reinstall the sender.



19204

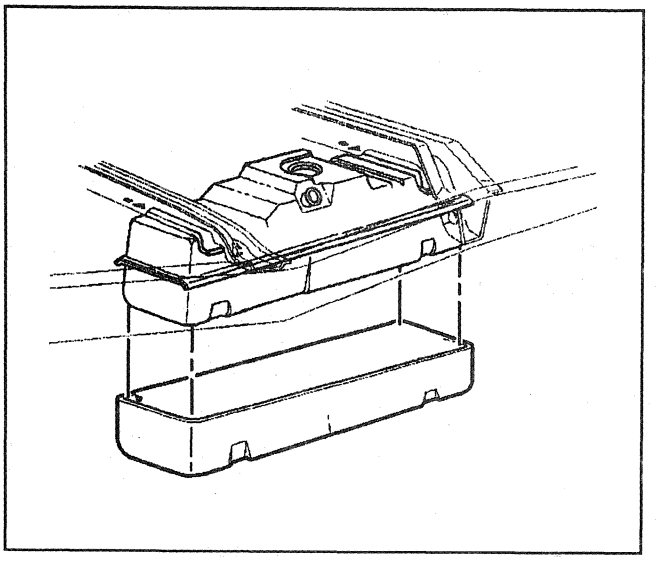
3. Raise the tank slightly and reconnect the fuel hoses, the lines, and the electrical connections at the sender.

4. Raise the tank fully.



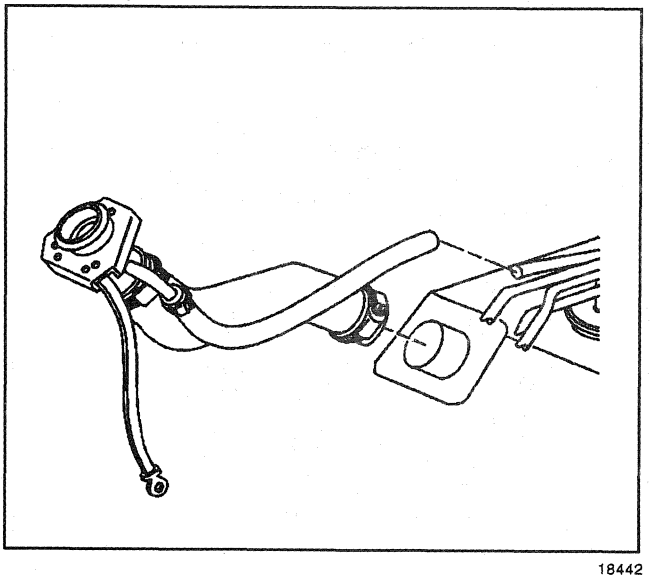
18415

5. Install the fuel tank shield.

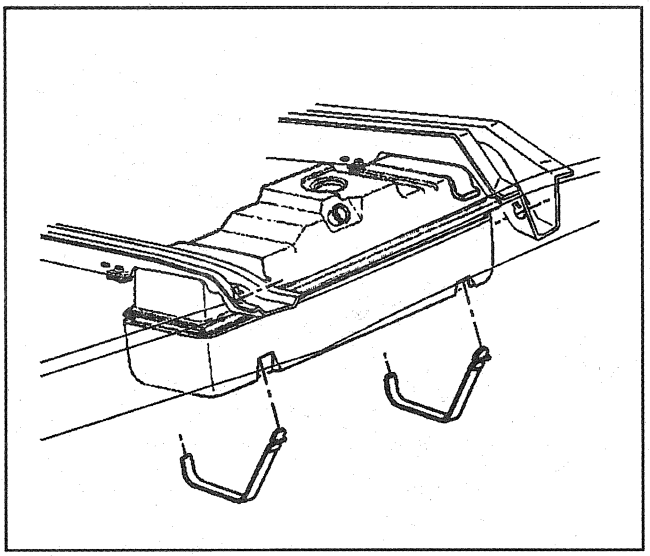


18414

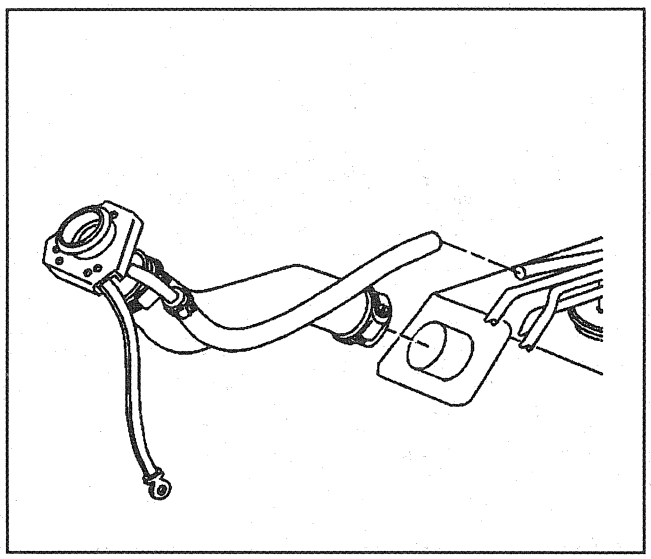
6. Reinstall the fuel tank filler neck to the tank.
7. Tighten the clamp.



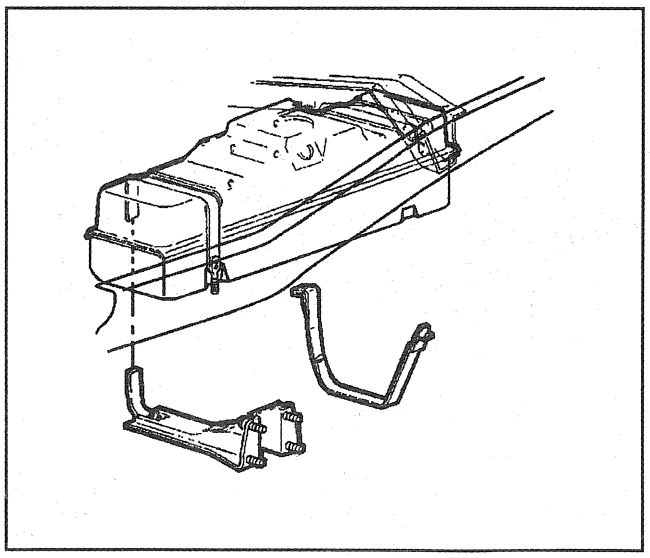
18442



18413



18442



18407

8. Install the fuel tank brackets with insulator strips in place.

   ***Notice:*** The strap nuts must be tightened by steps, alternating between the four nuts until the specified torque is reached. Otherwise, the bottom of the tank will flex upward and the fuel gage will indicate fuel remaining in the tank when the tank runs dry.
9. Tighten the strap nuts to 45 N.m (33 lb ft).

   Refer to *Fastener Notice*
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.

## Fuel Tank (Pickup Side Tank)

### Removal Procedure

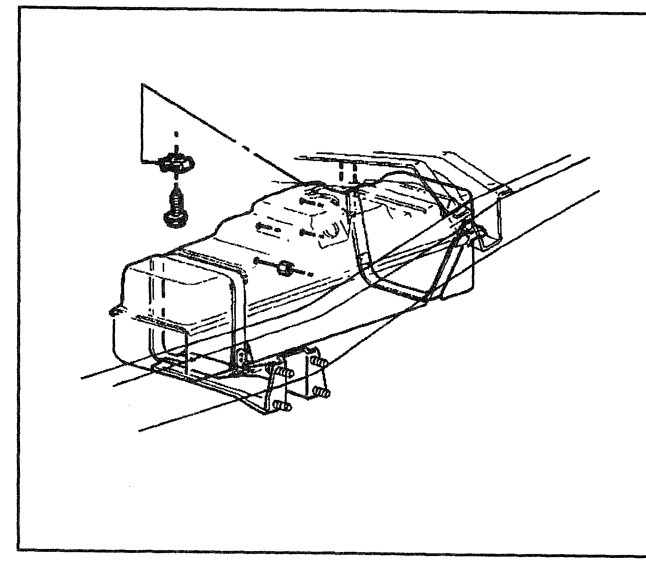
***Caution: Disconnect the negative battery cable under the following circumstances:***

- ***When installing an electrical unit.***
- ***When a tool or equipment could easily come into contact with "live" exposed electrical terminals.***

***Failure to disconnect the negative battery terminal may result in personal injury or damage to the vehicle's components. Turn OFF the vehicle ignition, unless instructed otherwise.***

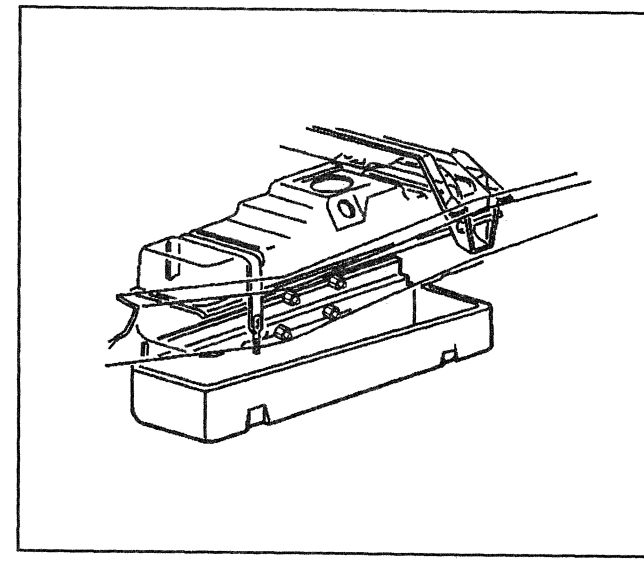
1. Remove negative battery cables.
2. Drain the fuel from the tank. Refer to *Draining Fuel Tank*.
3. Raise the vehicle.
4. Loosen the filler neck hose clamp at the fuel tank and disconnect the fuel tank filler neck from the fuel tank.
5. Support the fuel tank and remove the tank straps and insulator strips, if equipped.

6. Remove the frame mounted bracket.



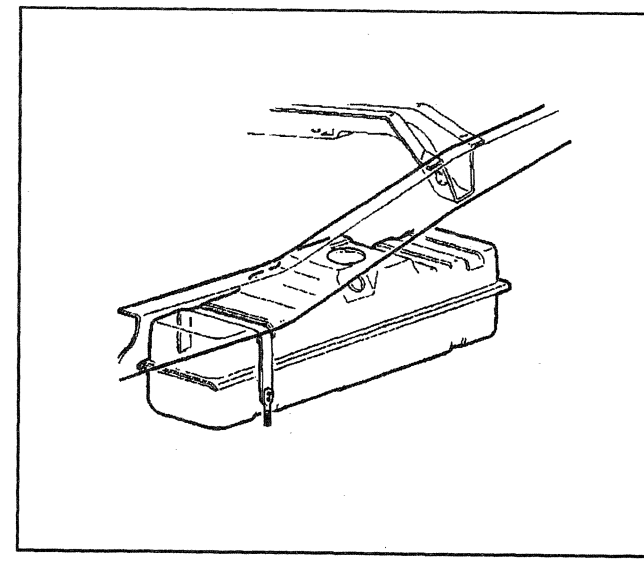
18406

7. Lower the fuel tank shield.

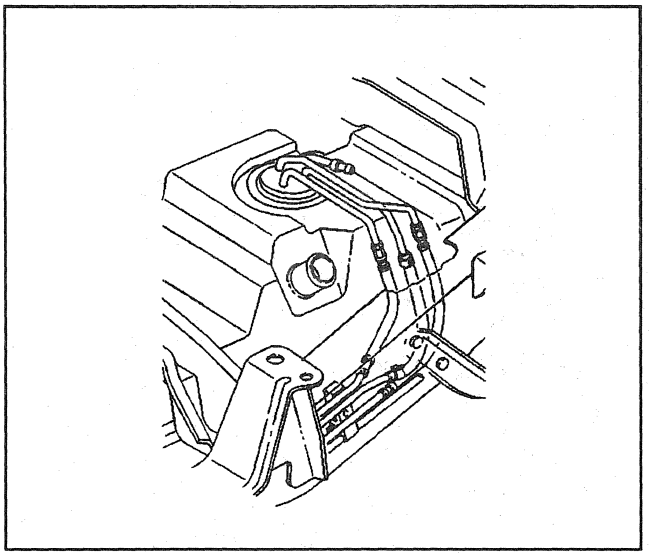


18408

8. Lower the fuel tank.

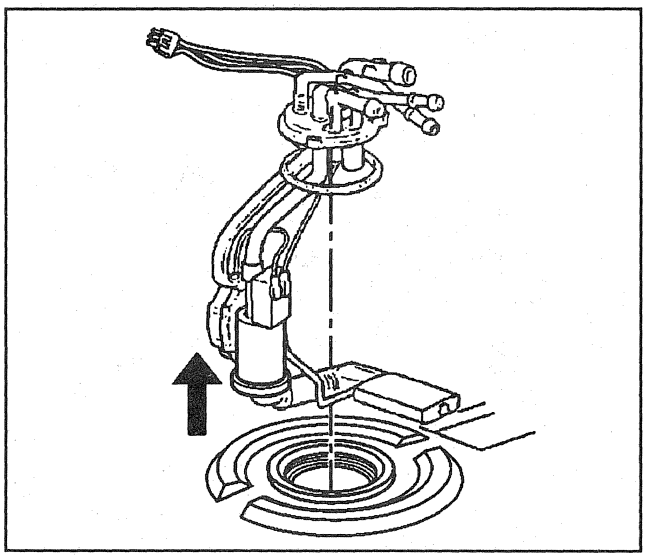


18409



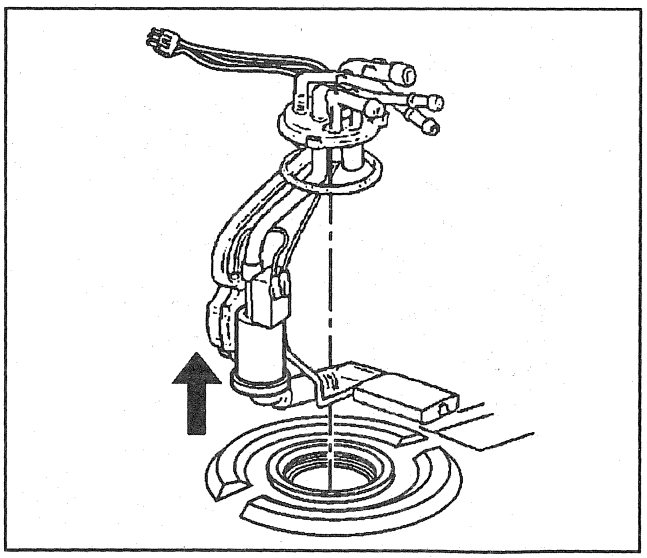
19204

9. Disconnect the fuel hoses and lines. Disconnect the electrical connections at the sender.



17407

10. Remove the fuel sender assembly and seal ring, using tool *J 39765*. Discard the old seal ring. Purge the tank, if the tank is being repaired.

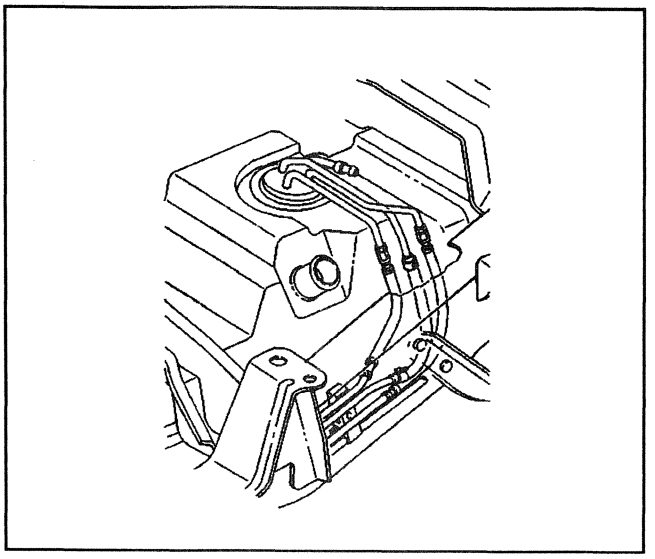


17407

### Installation Procedure

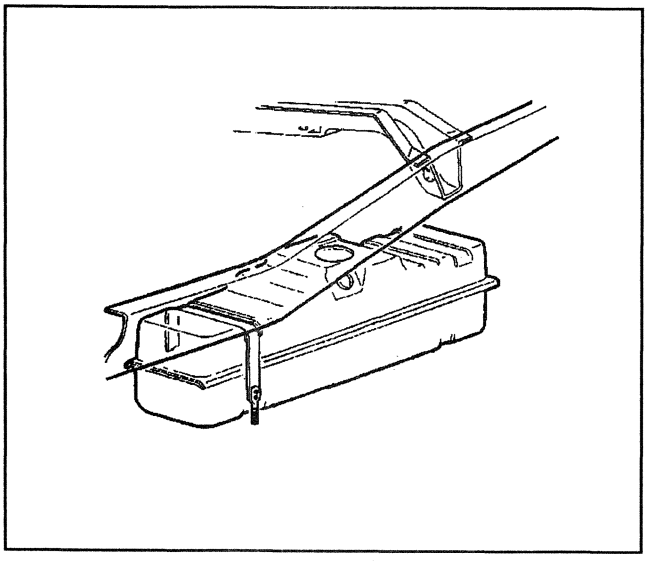
1. Install the new seal ring.
2. Use tool *J 39765* in order to reinstall the sender.

3. Raise the tank slightly and reconnect the fuel hoses, the lines, and the electrical connections at the sender.



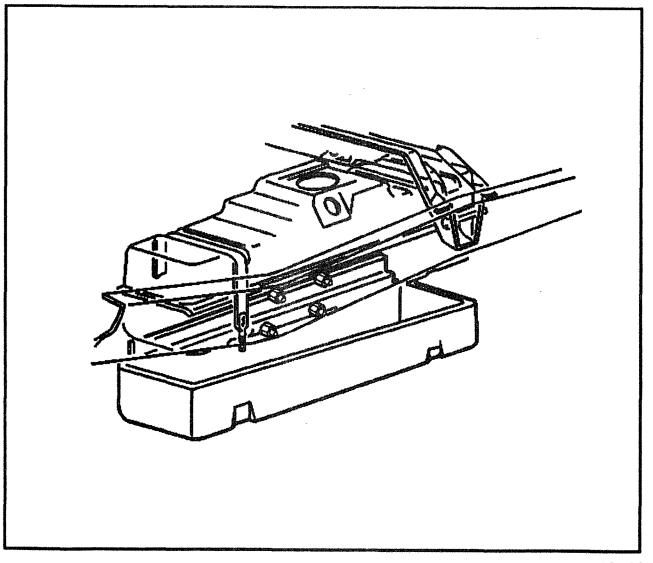
19204

4. Raise the tank fully.

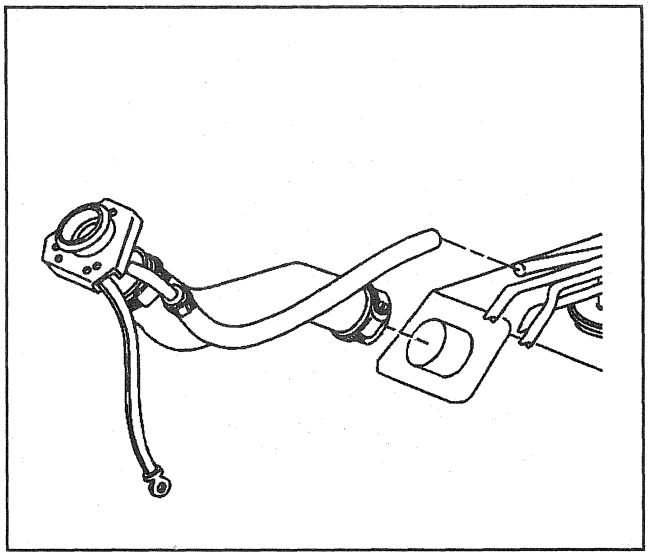


18409

5. Install the fuel tank shield.

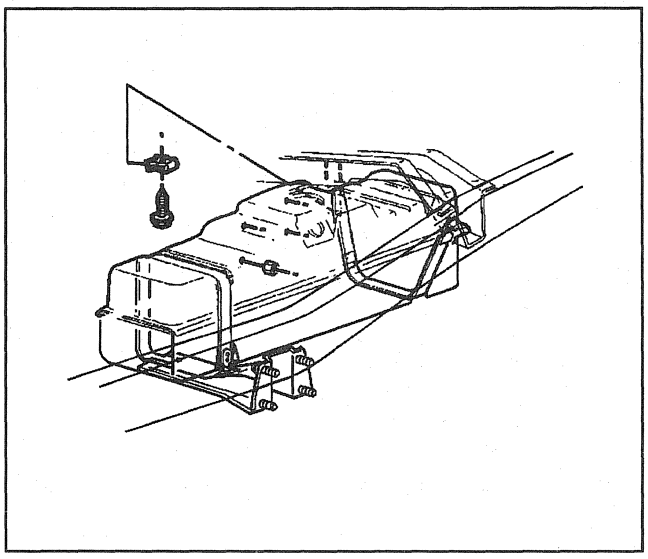


18408



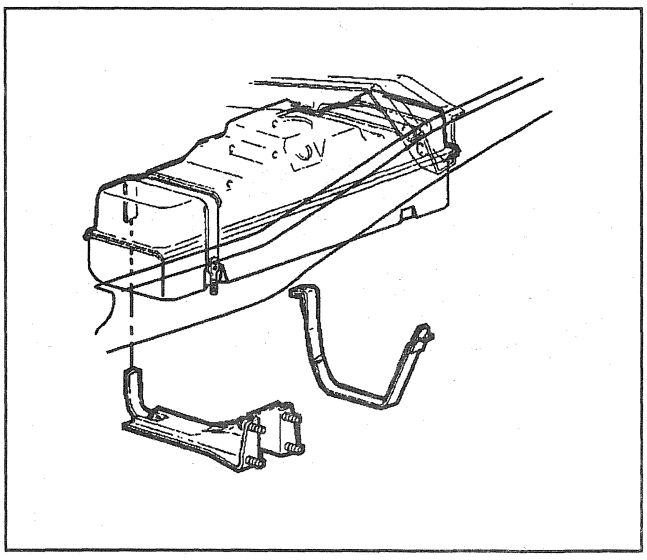
18442

6. Reinstall the fuel tank filler neck on to the tank.
7. Tighten the clamp.



18406

8. Install the frame mounted bracket.



18407

9. Install the fuel tank brackets with the insulator strips in place.

   ***Notice:*** The strap nuts must be tightened by steps, alternating between the four nuts until the specified torque is reached. Otherwise, the bottom of the tank will flex upward and the fuel gage will indicate fuel remaining in the tank when the tank runs dry.
10. Tighten the strap nuts to 45 N.m (33 lb ft).

    Refer to *Fastener Notice*
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 of the devices that lost their memory after the battery was disconnected.
14. Check for leaks.

## Fuel Tank (Cab and Chassis Side Tank)

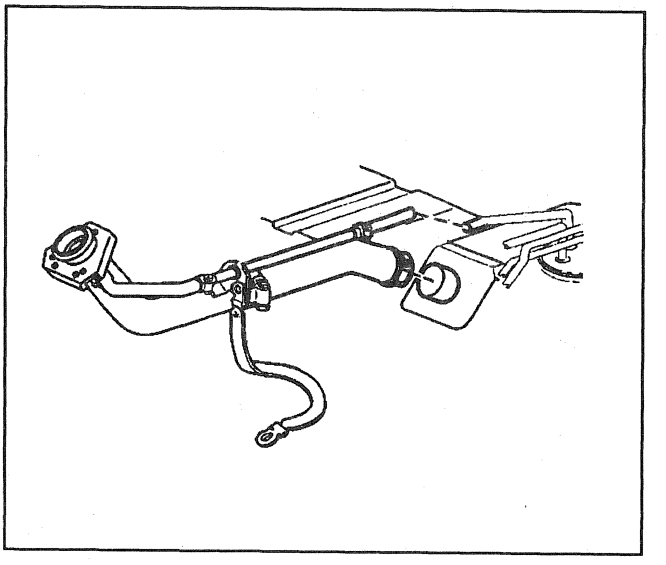
### Removal Procedure

***Caution: Disconnect the negative battery cable under the following circumstances:***

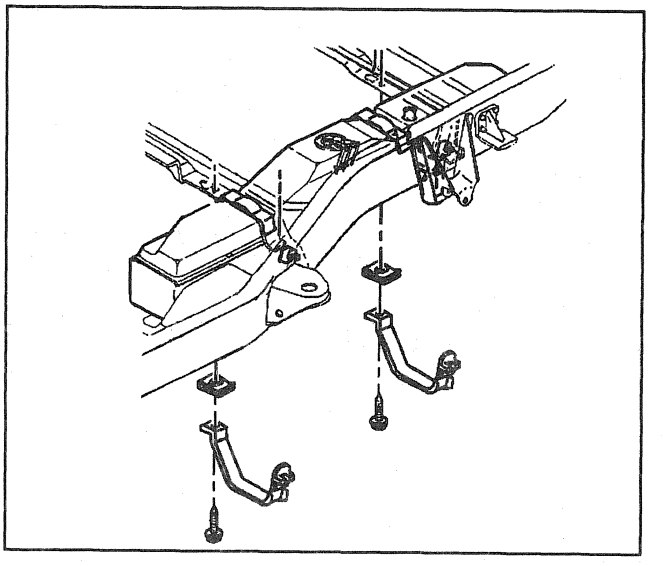
- ***When installing an electrical unit.***
- ***When a tool or equipment could easily come into contact with "live" exposed electrical terminals.***

***Failure to disconnect the negative battery terminal may result in personal injury or damage to the vehicle's components. Turn OFF the vehicle ignition, unless instructed otherwise.***

1. Disconnect negative battery cables.
2. Drain the fuel from the tank. Refer to *Draining Fuel Tank*.
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.

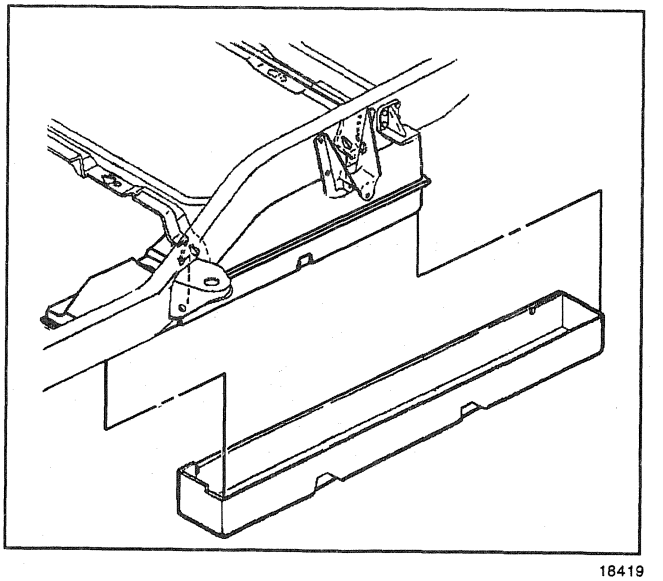


18440

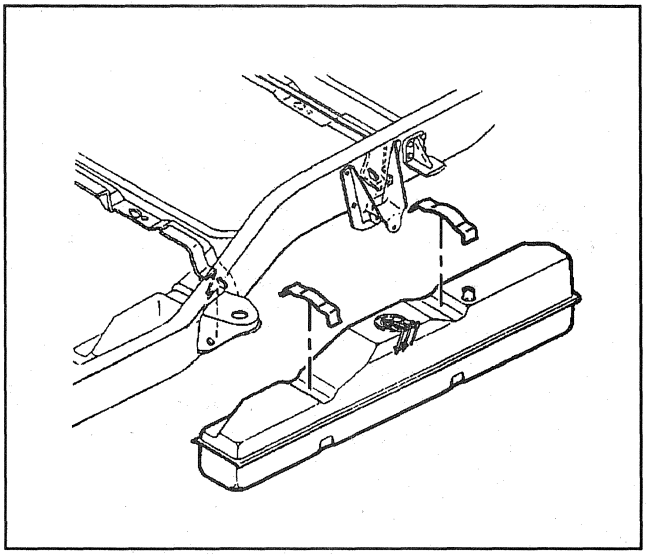


18418

6. Lower the fuel tank shield.

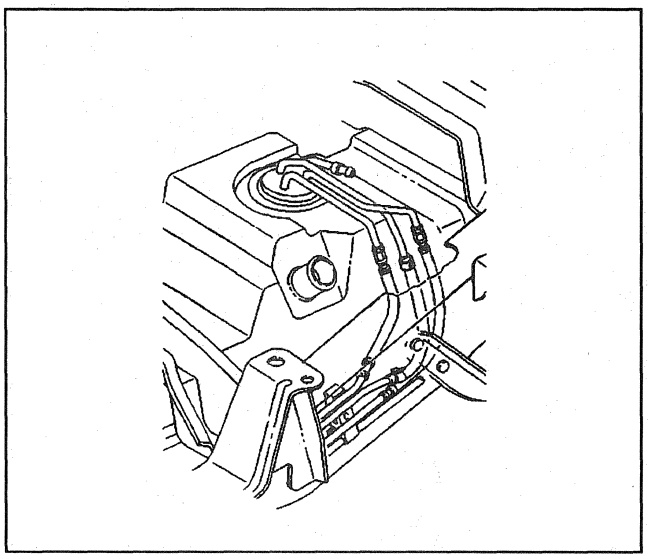


18419



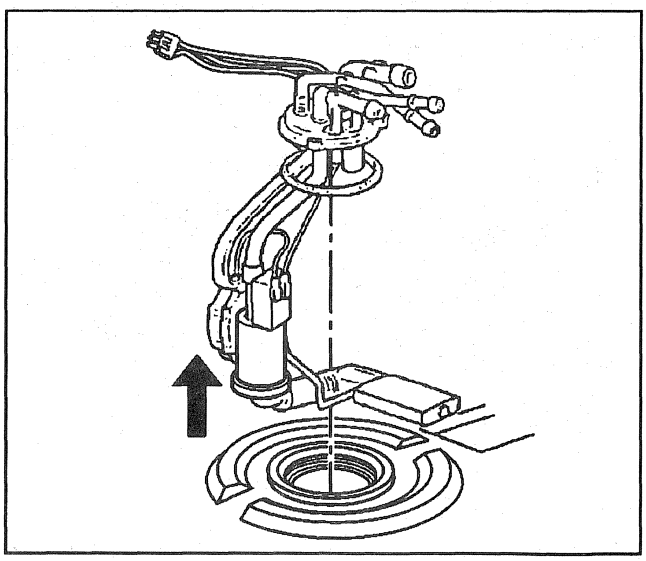
18420

7. Lower the fuel tank.



19204

8. Disconnect the fuel hoses and lines. Disconnect the electrical connections at the sender.

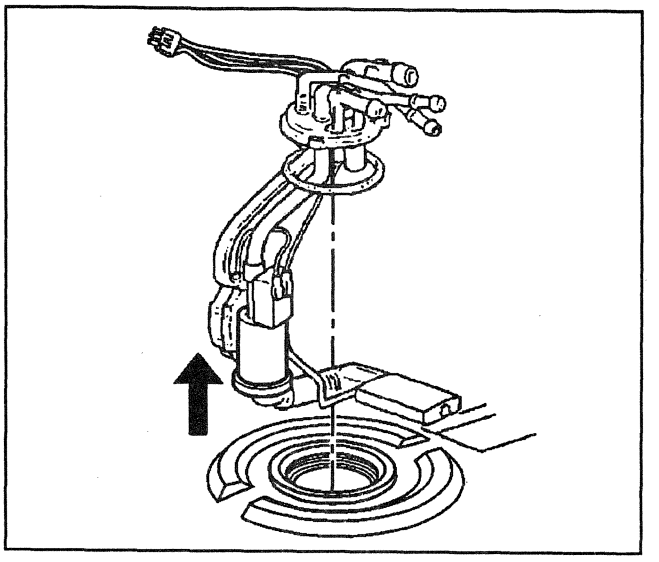


17407

9. Remove the fuel sender assembly and seal ring, using tool *J 39765*. Discard the old seal ring. Purge the tank, if the tank is being repaired.

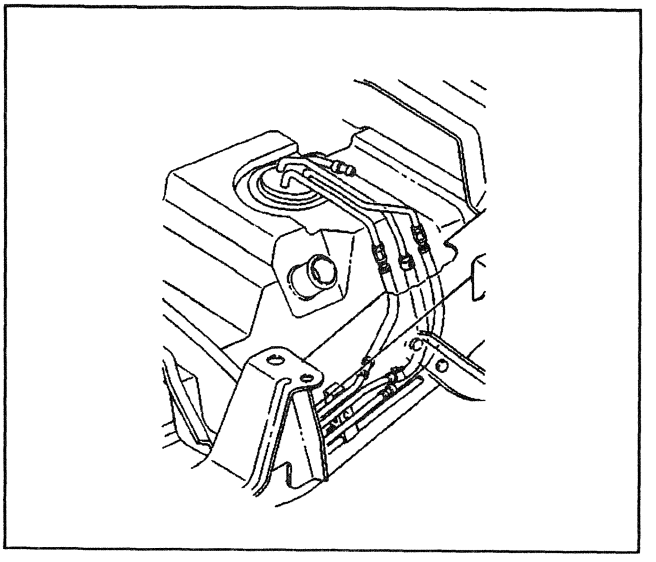
### Installation Procedure

1. Install the new seal ring.
2. Use tool *J 39765* in order to reinstall the sender.



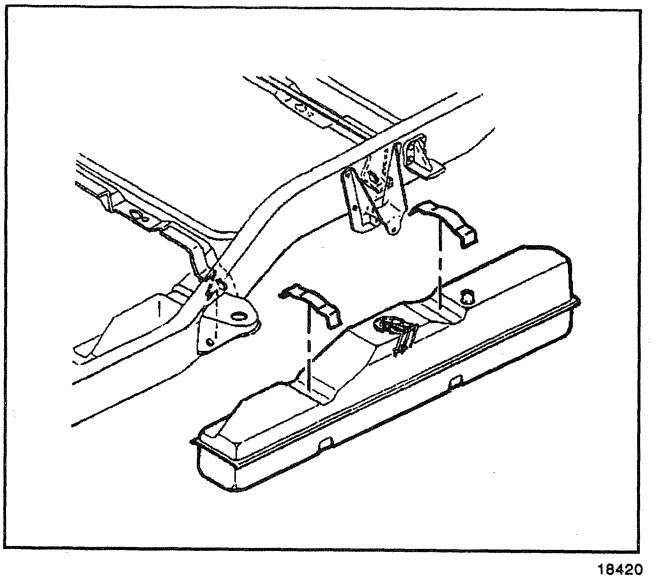
17407

3. Raise the tank slightly and reconnect the fuel hoses, the lines, and the electrical connections at the sender.

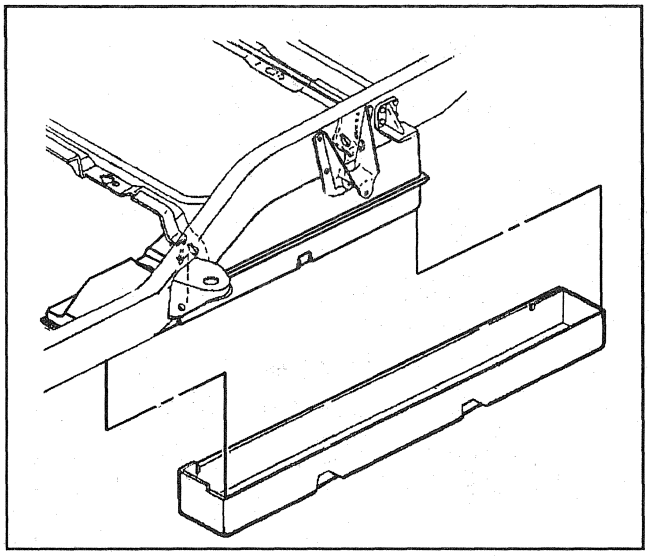


19204

4. Raise the tank fully.

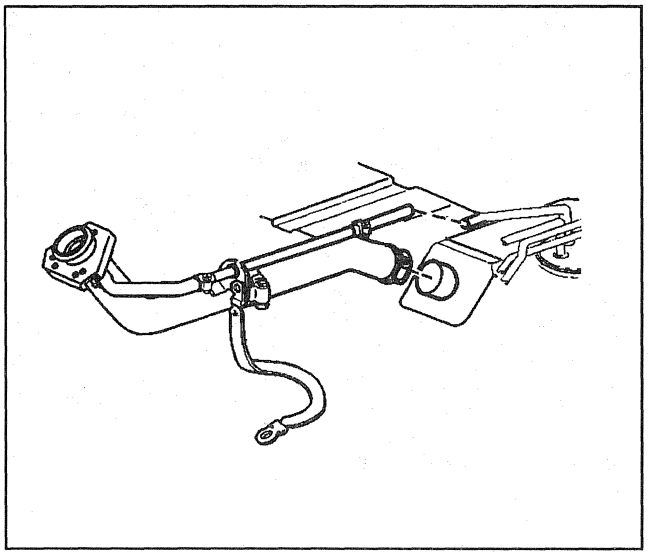


18420



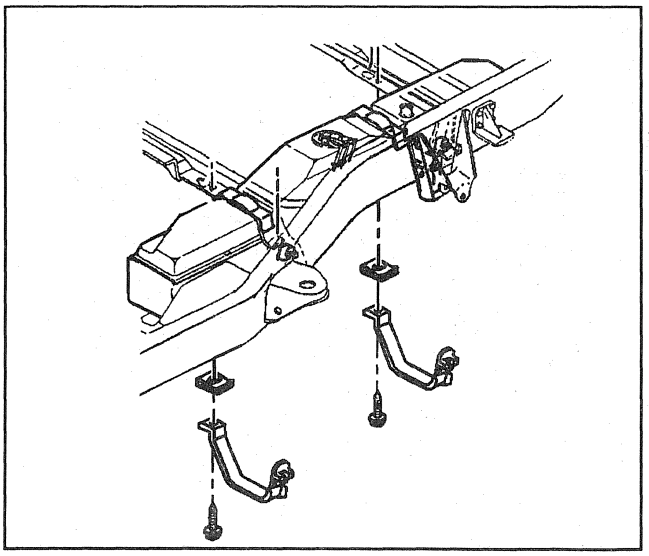
18419

5. Install the fuel tank shield.



18440

6. Reinstall the fuel tank filler neck to the tank.
7. Tighten the clamp.



18418

8. Install the fuel tank brackets with the insulator strips in place.

   ***Notice:*** The strap nuts must be tightened by steps, alternating between the four nuts until the specified torque is reached. Otherwise, the bottom of the tank will flex upward and the fuel gage will indicate fuel remaining in the tank when the tank runs dry.
9. Tighten the strap nuts to 45 N·m (33 lb ft).

   Refer to *Fastener Notice*
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, reset (to the extent possible) all devices that lost their memory after the battery was disconnected.
13. Check for leaks.

## Fuel Tank (Cab and Chassis Rear Tank)

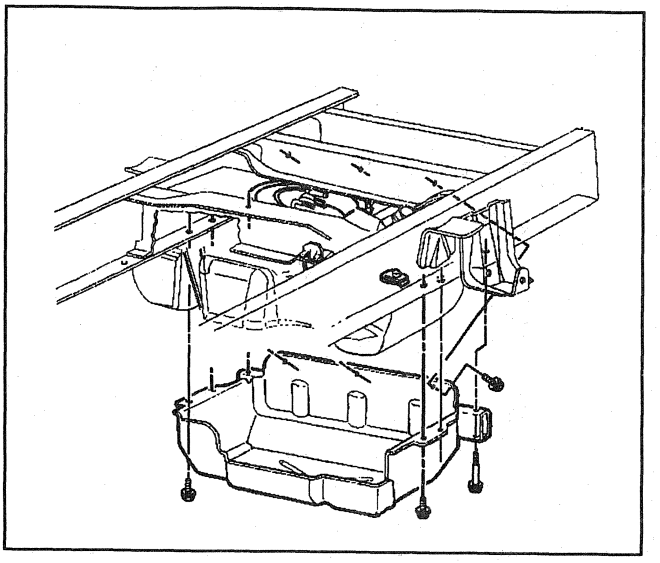
### Removal Procedure

***Caution: Disconnect the negative battery cable under the following circumstances:***

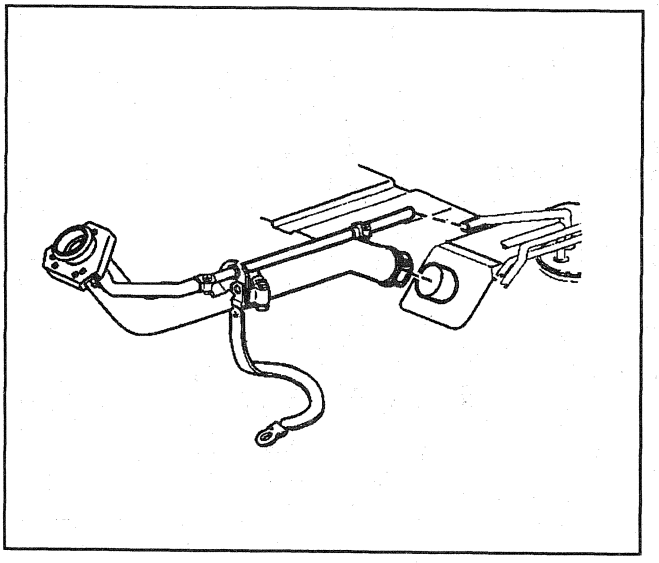
- ***When installing an electrical unit.***
- ***When a tool or equipment could easily come into contact with "live" exposed electrical terminals.***

***Failure to disconnect the negative battery terminal may result in personal injury or damage to the vehicle's components. Turn OFF the vehicle ignition, unless instructed otherwise.***

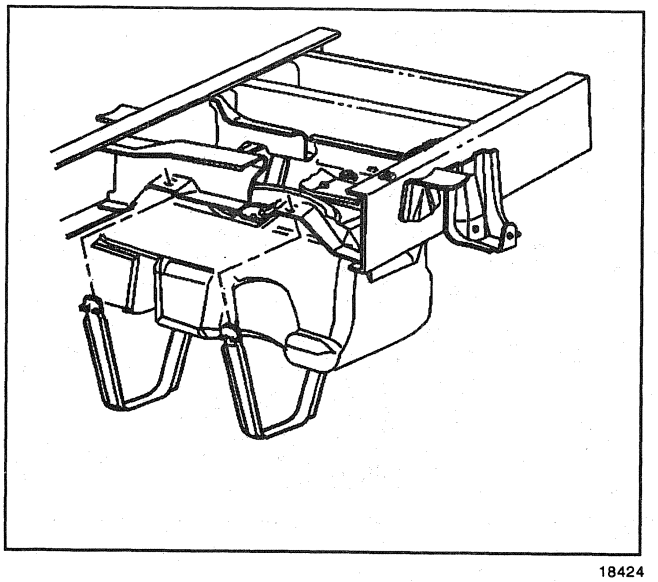
1. Disconnect negative battery cables.
2. Drain the fuel from the tank. Refer to *Draining Fuel Tank*.
3. Raise the vehicle.
4. Remove the fuel tank off-road shield, if equipped.
5. Loosen the filler neck hose clamp at the fuel tank and disconnect the fuel tank filler neck from the fuel tank.
6. Support the fuel tank and remove the tank straps and insulator strips, if equipped.



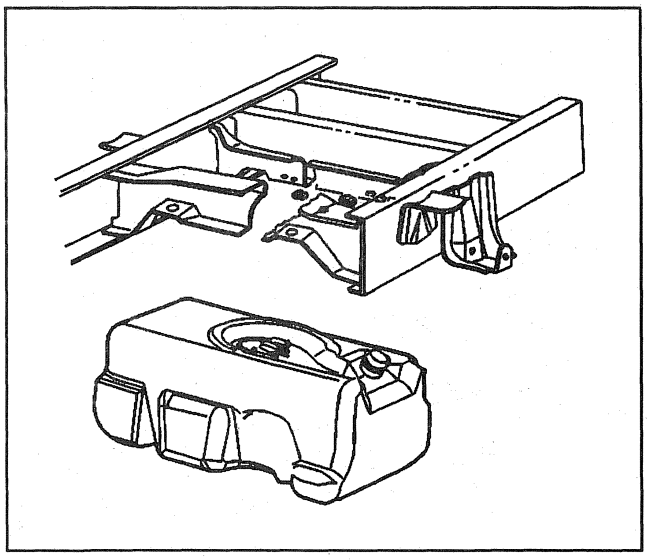
18426



18440

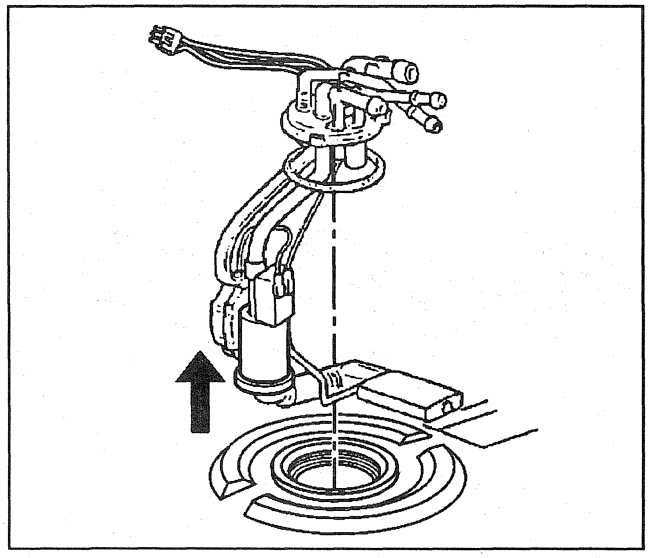


18424



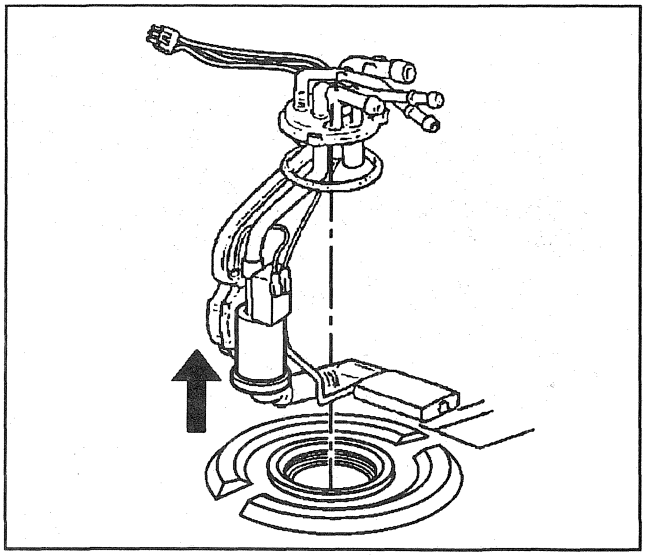
18425

7. Lower the fuel tank. Disconnect the fuel hoses and lines. Disconnect the electrical connections at the sender.



17407

8. Remove the fuel sender assembly and seal ring, using tool *J 39765*. Discard the old seal ring. Purge the tank, if the tank is being repaired.

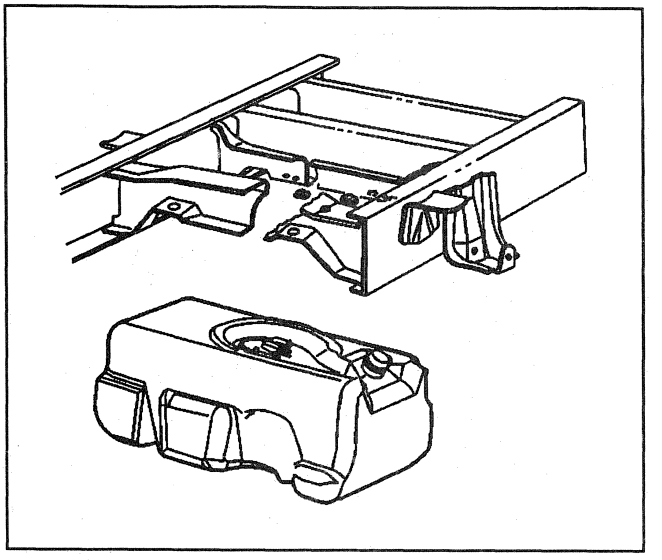


17407

### Installation Procedure

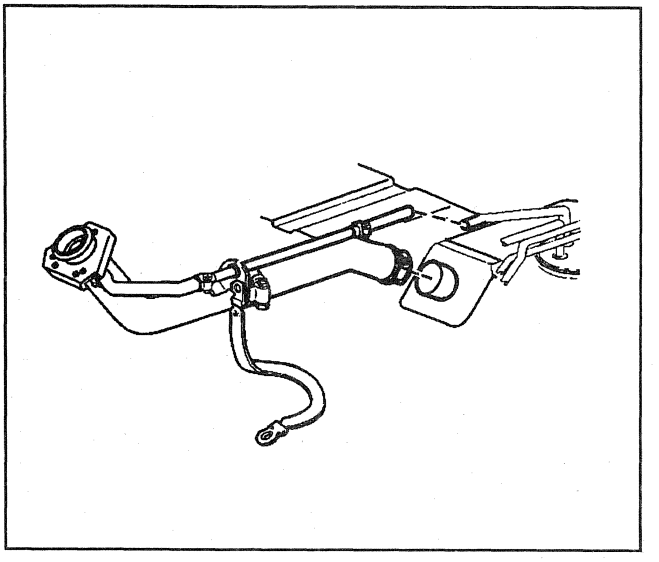
1. Install the new seal ring.
2. Use tool *J 39765* in order to reinstall the sender.
3. Raise the tank slightly and reconnect the fuel hoses, the lines, and the electrical connections at the sender.

4. Raise the tank fully.



18425

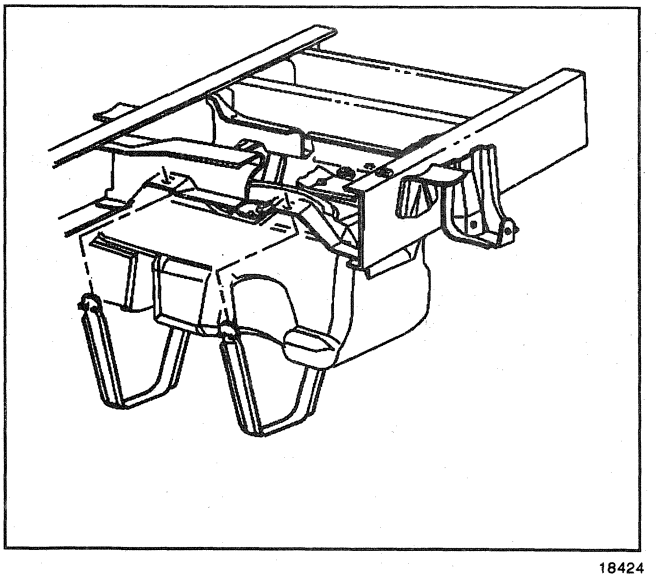
5. Reinstall the fuel tank filler neck to the tank.
6. Tighten the clamp.



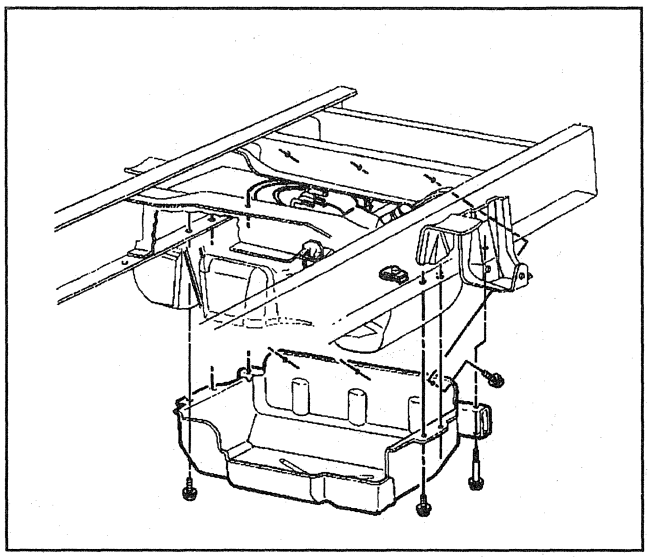
18440

7. Install the fuel tank brackets with the insulator strips in place.

   ***Notice:*** The strap nuts must be tightened by steps, alternating between the four nuts until the specified torque is reached. Otherwise, the bottom of the tank will flex upward and the fuel gage will indicate fuel remaining in the tank when the tank runs dry.
8. Tighten the strap nuts to 45 N.m (33 lb ft).
   Refer to *Fastener Notice*



18424



18426

9. Install the fuel tank off-road shield, if equipped.
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, reset (to the extent possible) all devices that lost their memory after the battery was disconnected.
13. Check for leaks.

## Fuel System Cleaning

### Removeal Procedure

1. Remove the negative battery cable(s). Refer to *Battery Disconnect Caution.*
2. Remove the fuel from the tank. Refer to *Draining Fuel Tank.*
3. Remove the fuel tank.
4. Remove the fuel sender. Refer to *Fuel Sender Assembly.*
5. Clean the fuel tank.

   **Important:** The fuel tank should be replaced if it is rusted internally.
6. Remove the fuel strainer or replace if necessary. Refer to *Fuel Strainer.*
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 FUEL SOL from fuse panel.
10. Remove the fuel filter. Refer to *Fuel Filter Element Replacement.*

### Installation Procedure

1. Install fuel sender. Refer to *Fuel Sender Assembly.*
2. Install fuel tank.
3. Install fuel feed pipes at fuel lift pump.
4. Install clean diesel fuel into the tank until it is 1/4 full.
5. Install fuel tank cap.
6. Install negative battery cable.
7. Crank the engine for 15 seconds with one minute cooling periods until clean fuel is pumped out.

   **Important:** Use a suitable container to catch the fuel.
8. Install 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 FUEL SOL fuse in fuse panel.
    - 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.

      **Tighten**

      Tighten the injection line to nozzle fitting to 25 N·m(18 lb ft).

      Refer to *Fastener Notice.*

      **Important:** Use two wrenches to prevent nozzle damage.
    - 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 engine DTCs.

### Gasoline in Fuel System

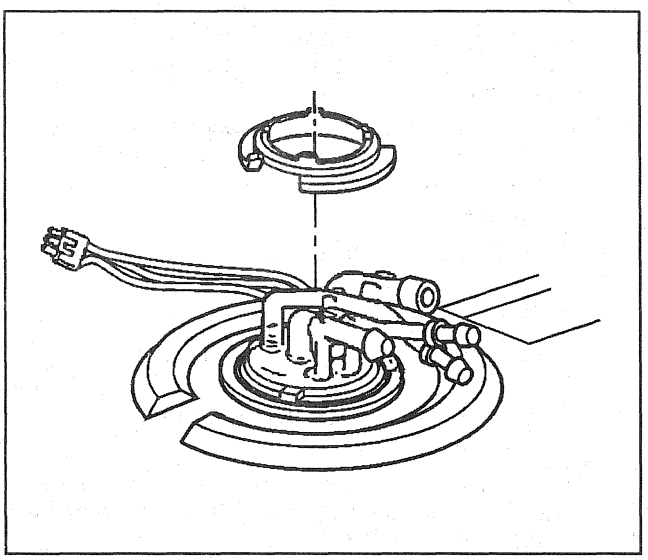
#### Engine Will Run or Start

1. Drain the fuel tank. Refer to *Draining Fuel Tank.*
2. Fill the fuel tank with diesel fuel.
3. Run the engine for 15 minutes.

#### Engine Will Not Run

1. Drain the fuel tank. Refer to *Draining Fuel Tank.*
2. Fill the fuel tank with diesel fuel.
3. Disconnect engine shutoff solenoid connector.
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 gasoline from the system.
7. Install the fuel hose between the fuel filter and the injection pump.
8. Connect the engine shutoff solenoid connector.
9. Start the engine.

   **Important:** Check for leaks.
10. Run the engine for 15 minutes.
11. Clear engine DTCs.



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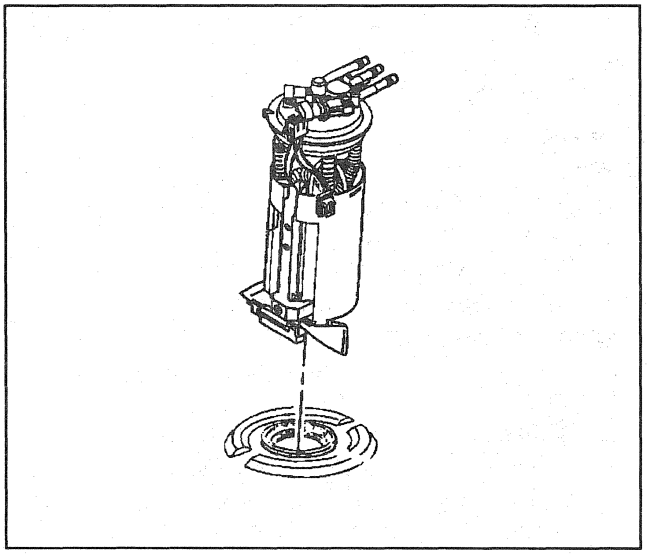

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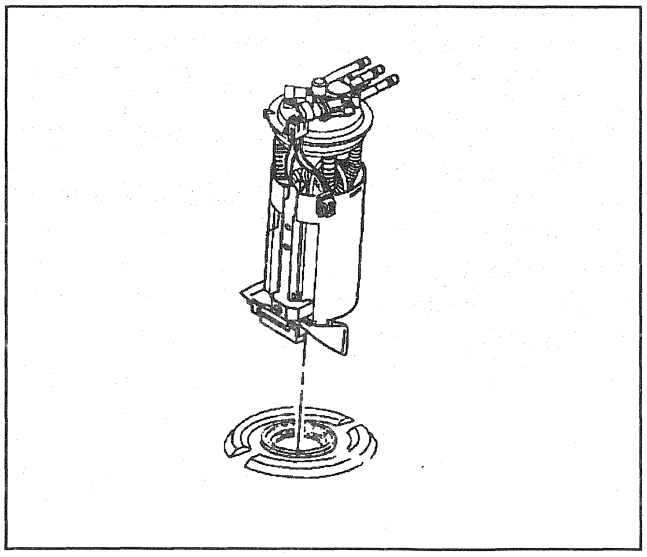


28226

## Fuel Sender Assembly

### Removal Procedure

1. Remove fuel tank filler cap.
2. Disconnect the negative battery cable(s). Refer to *Battery Disconnect Caution*
3. Raise the vehicle on a hoist.

   ***Notice:*** Extreme care must be used when lowering the fuel tank. The fuel sender is made of pastic and may be damaged when lowering the fuel tank.
4. Remove the fuel tank.
5. Remove the sender unit by turning the cam lock counterclockwise using tool *J36608*.

**Important:** Do not damage the rubber insulator or the strainer.

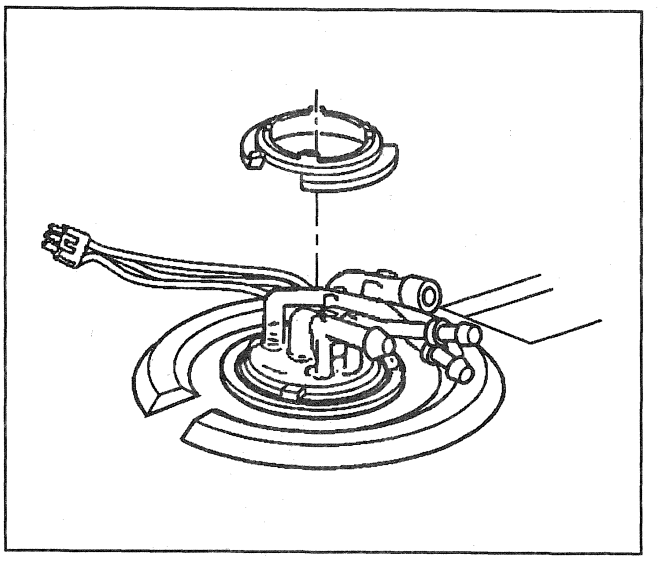
6. Remove the sending unit by pulling up.
7. Inspect the attaching hose for signs of deterioration.
8. Inspect the rubber sound insulation at the bottom of the pump.
9. Inspect the strainer.

### Installation Procedure

1. Install the sender assembly into the attaching hose.

   ***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. Insert a new O-ring seal.

4. Install the cam lock assembly.
5. Turn the cam lock clockwise in order to lock it.
6. Install the fuel tank.
7. Connect the negative battery cable.
8. Check the system for leaks.



17406

## Fuel Strainer

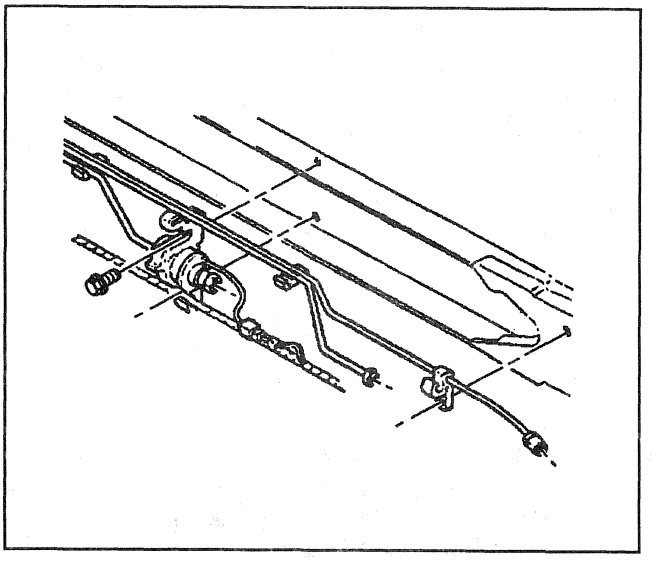
If the in-tank filter requires service, refer to *Fuel Sender Assembly.*

## Fuel Lift Pump

### 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.***

1. Remove negative battery cable(s). Refer to *Battery Disconnect Caution*
2. Loosen filler cap(s) to relieve tank pressure.
3. Remove electrical connector.
4. Clean both fuel pipe connections and surrounding areas at fuel pump before disconnecting to avoid possible contamination of the fuel system.
5. Remove both fuel pipes from fuel pump.
6. Slide fuel lift pump out of bracket.



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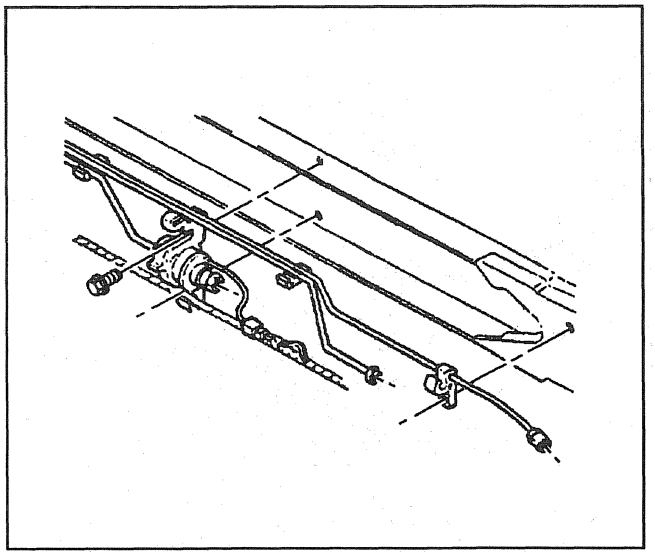

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### Installation Procedure

1. Install fuel pipes.
2. Position new pump in pump bracket.
3. Install fuel feed pipe and suction pipe to the fuel pump.
   **Tighten**
   Use backup wrench to prevent pump from turning. Tighten fittings to 30 N.m (22 lb ft).
   Refer to *Fastener Notice*
4. Harness connector.
5. Negative battery cables.
6. Tighten filler cap(s).
7. Bleed air from system.
8. Start engine and check for leaks.

## Fuel Pump Relay

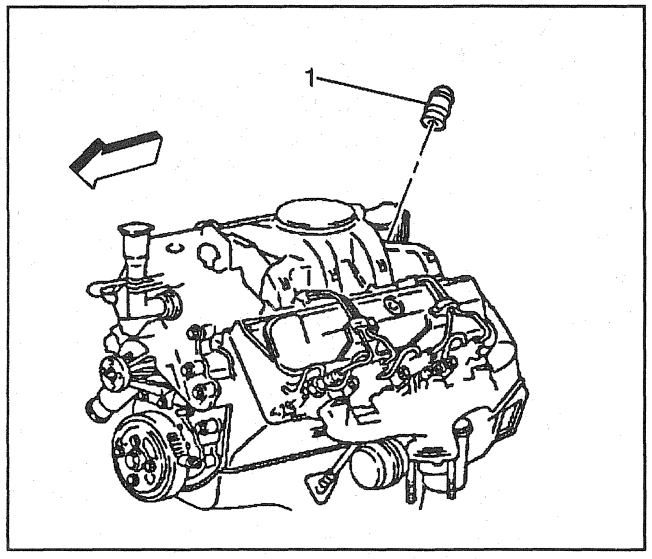
### Removal Procedure

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).

## Oil Pressure Switch



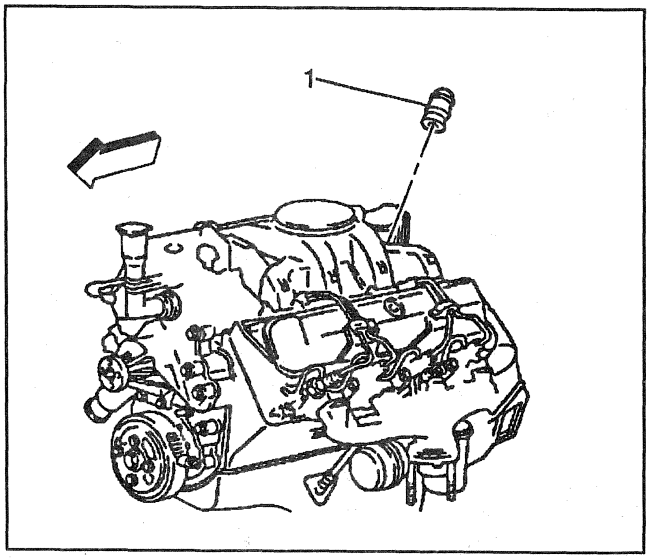

27615

### Removal Procedure

1. Remove the Fuel Filter/Manger. Refer to *Fuel Manager/Filter Replacement.*
2. Disconnect the electrical connector.
3. Remove the switch (1) using *J 35748.*

### Installation Procedure

1. Install the Fuel Filter/Manger. Refer to *Fuel Manager/Filter Replacement*.
2. Install the switch (1).
3. Connect the electrical connector.
4. Bleed fuel system. Refer to *Bleeding Air from Fuel Supply System*.

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## Engine and Chassis Pipes and Hoses

### 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″ (100 mm) of any part of the exhaust system, or within 10″ (254 mm) of the catalytic converter. The hose[prime ]s 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 fuel line to the frame.

## Fuel Injection Components

Removing the fuel injection pump and injection lines requires removing the intake manifold. Refer to Intake Manifold.

## Injection Lines (Diesel)

### Removal Procedure

**Important:** Clean all line fittings that will be loosened or removed.

1. Remove negative battery cables. Refer to *Battery Disconnect Caution*
2. Remove intake manifold. Refer to Intake Manifold Removal.

   **Important:** Before any further service work is to be done, cover the intake ports with J 29664-1.
3. Remove injection line clips at the loom brackets.
4. Remove injection lines at the nozzles.
   - Cap the lines and nozzles immediately.
   - Do not bend injection lines.
5. Remove injection lines at the pump. Refer to *Injector Line Routing.*
   - Cap the lines and the pump fittings immediately.
   - Tag the lines for installation.

### Installation Procedure

1. Install injection lines at the pump. Refer to *Injector Line Routing.*
   - Uncap the lines and pump fittings.
   - Refer to the tags for correct installation.
   - Install injection lines at the nozzles.
2. Uncap the lines and nozzles.

   **Tighten**

   Tighten fittings to 25 N·m(20 lb ft).

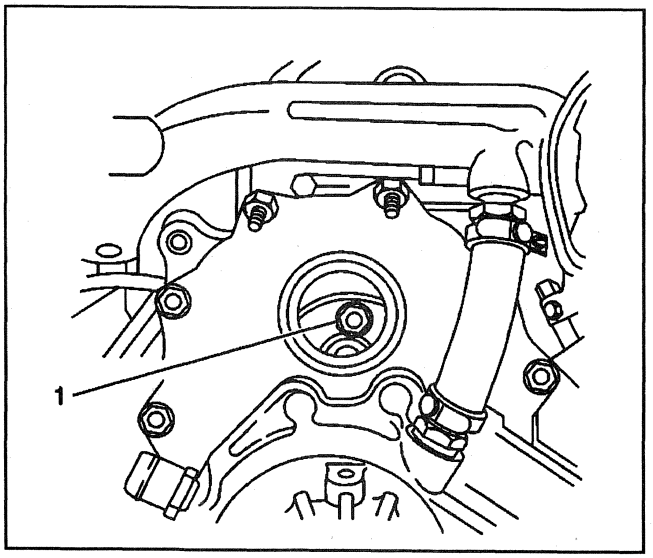
   Refer to *Fastener Notice*
3. Install injection line clips at the loom brackets.
4. Remove J 29664- 1.
5. Install intake manifold. Refer to Intake Manifold.
6. Install negative battery cables.

## Fuel Injection Pump

### Removal Procedure

1. Remove the negative battery cables. Refer to *Battery Disconnect Caution*
2. Remove the intake manifold. Refer to Intake Manifold Removal.
3. Remove the injection lines. Refer to *Injection Lines (Diesel)*.
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 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.

    **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 wrench J 41069.
12. Remove the injection pump.
13. Cap all open lines and nozzles.
14. Remove the flange gasket.

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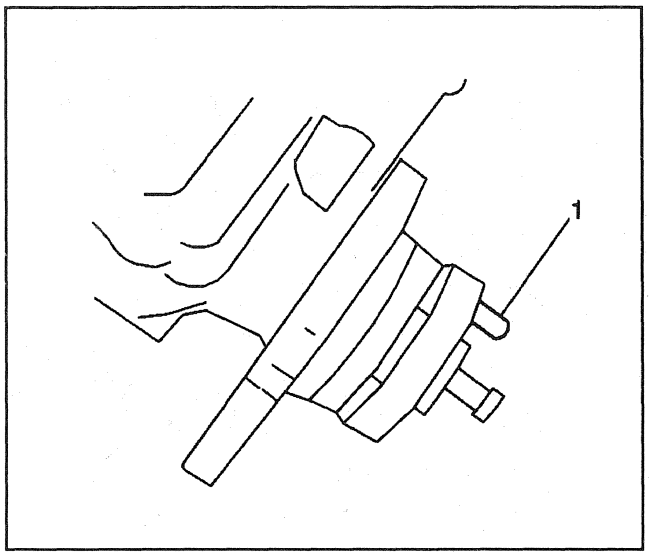


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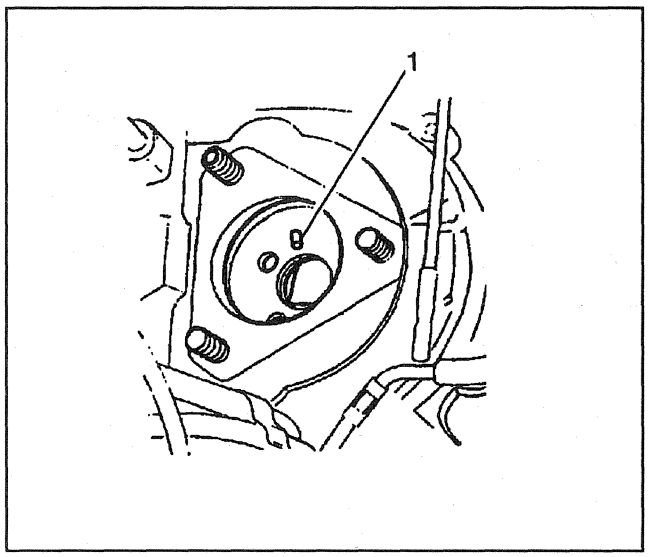



27613

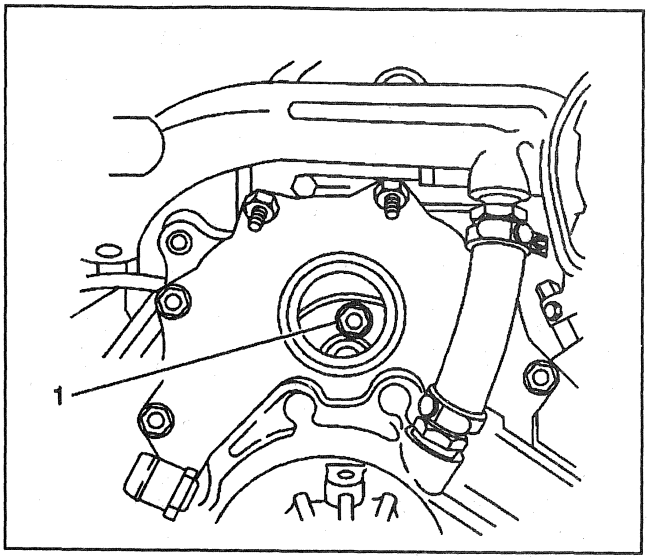
## Installation Procedure

1. Install the new flange gasket on the injection pump .
2. Adjust locating stud (1) to proper position to match with the slotted/elongated hole in driven gear.

   **Important:** Be sure the locating stud (1) on the injection pump hub goes into the slotted/elongated hole in the driven gear.

3. Install the injection pump making sure the locating stud is positioned within the slotted/elongated hole (3) in the driven gear.

4. Install the injection pump flange nuts.
   **Tighten**
   Tighten nuts to 40 N·m (30 lb ft).
   Refer to *Fastener Notice*
   **Important:** All driven gear bolts should not be torqued until all bolts are installed. This will allow for proper alignment of all 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 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 harness and connectors.
11. Install the injection lines. Refer to tags on lines. Refer to *Injection Lines (Diesel)*.
12. Install intake manifold. Refer to Intake Manifold Installation.
13. Install negative battery cables.
14. Adjust injection timing. Refer to *Checking/Adjust Injection Timing*.



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## Checking/Adjust Injection Timing

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

| Application | Inj. Pump Timing |
|---|---|
| All | 3.5° avg. |

**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 engine.
2. Engine at operating temperature.
3. Install scan tool.
4. Use scan tool to activate Time Set (if Time Set has been activated correctly, Des. Inj. Time on scan tool will read 0.0°).

   **Important:** The Act. Inj. Time value on the scan tool will fluctuate. The Average reading should be 3.5°.
5. Act. Inj. Time (scan tool display) should be approximately 3.5°. If not, continue to step 6.

   **Important:** If engine stalls during Time Set activation, slightly (1 mm equals 2°) 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.
7. Engine OFF, loosen injection pump flange nuts using J 41089.
8. Slightly rotate injection pump using J 29872.
9. Set Act. Inj. Time to 3.5°.

   **Important:** It is normal for Act. Inj. Time value on scan tool to fluctuate. Average fluctuation of Act. Inj. Time should be 3.5°.
10. Continue to repeat until average fluctuation of Act. Inj. time is 3.5°.
    - If Act. Inj Time is above 3.5° SLIGHTLY (1 mm equals 2°) ROTATE INJECTION PUMP TOWARDS THE PASSENGER SIDE OF VEHICLE.
    - If Act. Inj time is below 3.5°, SLIGHTLY (1 mm equals 2°) ROTATE INJECTION PUMP TOWARD DRIVERS SIDE OF VEHICLE.

## TDC Offset

This procedure should only be used when a DTC has directed you to or one of the following repairs has been performed:

- The engine has been replaced
- The front engine cover has been replaced.
- The PCM and the Injection pump have 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 Clear and Learn procedure has been performed.

### TDC Offset Specification

| Applicacation | TDC Offset |
|---|---|
| All | ± .25 to ± .75 |

#### Clearing and Learning TDC Offset

1. One of the above repairs has been performed. If not, do not continue. Refer to On Vehicle Service for repair that was performed.
2. Install Scan tool.
3. Start engine.
4. Operate vehicle until engine coolant temperature is greater than 77°C (170°F).
5. Clear all DTCs.
6. Turn the Ignition ON, engine OFF, hold the accelerator pedal in the wide open throttle position for a minium of 45 seconds.

   In this step the TDC Offset is being cleared from the PCM's memory.
7. Turn the ignition OFF for 30 seconds.

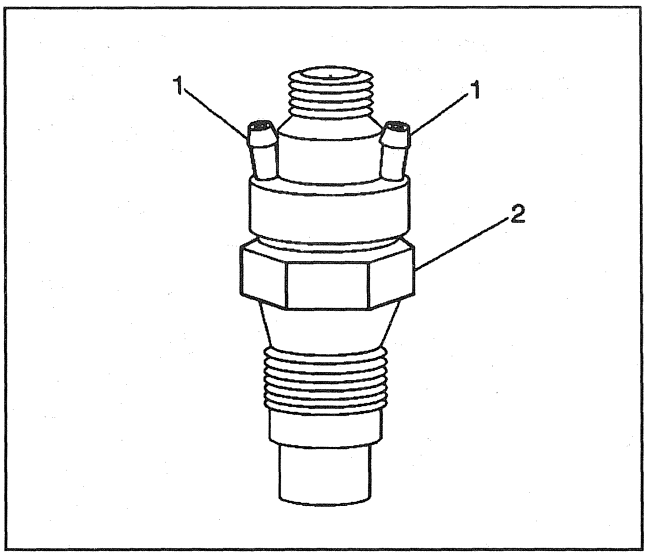
   In this step, the PCM is being powered down.
8. Turn the Ignition ON, engine OFF.
9. Verify in the scan tool that TDC Offset has been cleared to zero. If not, repeat steps 2 through 7.
10. Start the engine.
    - Verify in the scan tool that ECT is greater than 77°C (170°F). If not, operate vehicle until desired ECT is achieved (vehicle can be driven or throttle can be depressed until correct coolant temperature is achieved).
    - As soon as ECT is greater than 77°C (170°F) and engine speed is below 1500 RPMs, the PCM automatically learns a new offset.
11. TDC Offset should be between -.25 and -.75.

12. If not, turn engine OFF and loosen injection pump flange nuts using J 41089.

    **Important:** If the PCM fails to program the TDC Offset, do the following:

    - Check all PCM and injection timing stepper motor connections.
    - Check Techline terminal/equipment for latest software version.
    - Try again to program the PCM. If it fails again replace the PCM. Refer to *PCM Replacement/Programming*.

13. Slightly (1 mm equals 2°) rotate the injection pump (use tool J 29872 to rotate injection pump) and repeat steps 1 through 8 until correct TDC offset has been achieved. DTC P1214 will be stored if procedure has not been done or offset is out of range (see DTC P1214 for DTC setting criteria).
14. To achieve a negative a (-) number, rotate pump toward driver side; a positive (+) number, rotate toward passenger side (1 mm equals 2°).

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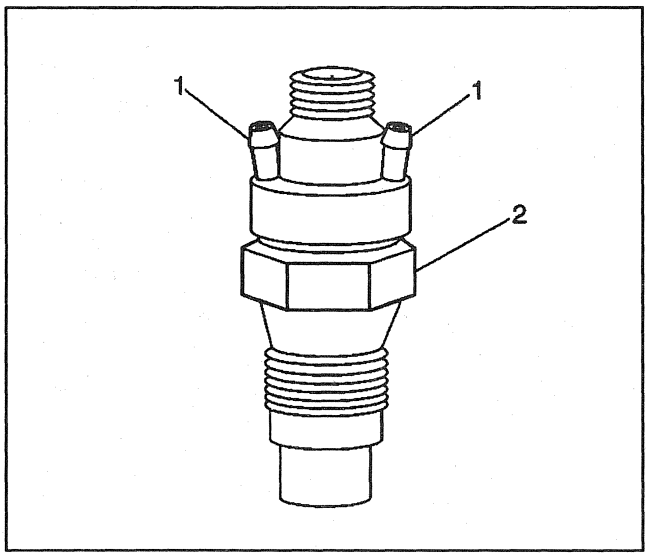


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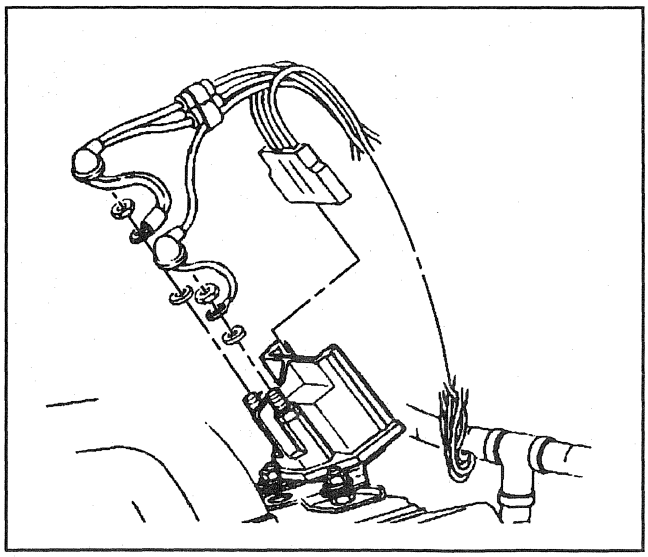

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## Injection Nozzles

### Removal Procedure

**Important:** When removing an injection nozzle, use J 29873. Remove the nozzle using the 30 mm hex portion. Failure to do so will result in damage to the injection nozzle.

1. Remove negative battery cable(s). Refer to *Battery Disconnect Caution*
2. Remove fuel line clip.
3. Remove fuel return hoses (1) from nozzle (2).
4. Remove fuel injection line.
5. Cap the nozzle and lines.
6. Remove injection nozzle (2) using J 29873.

### Installation Procedure

**Important:** When installing an injection nozzle, use J 29873. Install the nozzle using the 30 mm hex portion. Failure to do so will result in damage to the injection nozzle.

1. Install injection nozzle using J 29873 (apply anti seize compound to threads of nozzle that contact the cylinder).
2. **Tighten**

   Tighten nozzle to 70 N·m (50 lb. ft.).

   Refer to *Fastener Notice*
3. Fuel injection line.

   **Tighten**

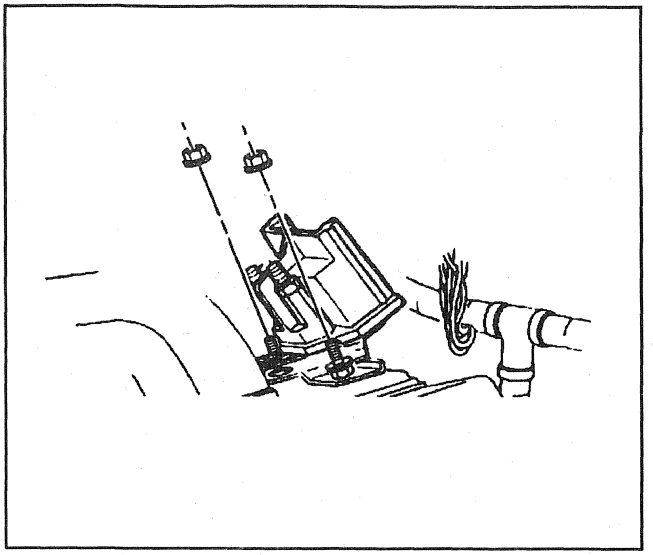
   Tighten nut to 25 N·m (20 lb. ft.).
4. Install fuel return hoses (1) on nozzle (2).
5. Install fuel line clip.
6. Install negative battery cables.

## Glow Plug Relay

### Removal Procedure

1. Remove the negative battery cable. Refer to *Battery Disconnect Caution.*
2. Remove the upper intake manifold cover.
3. Remove the wiring harness connector to the relay.
4. Remove the glow plug wiring harness wires.

5. Remove the relay mounting bolts.



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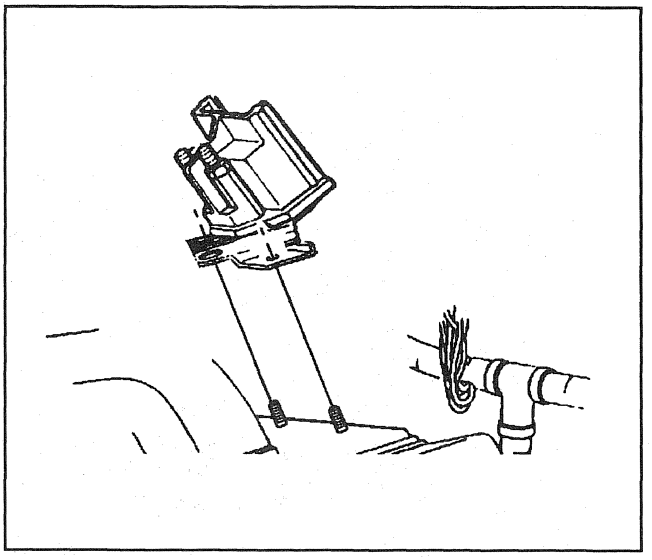
6. Remove the relay from the studs on the engine.



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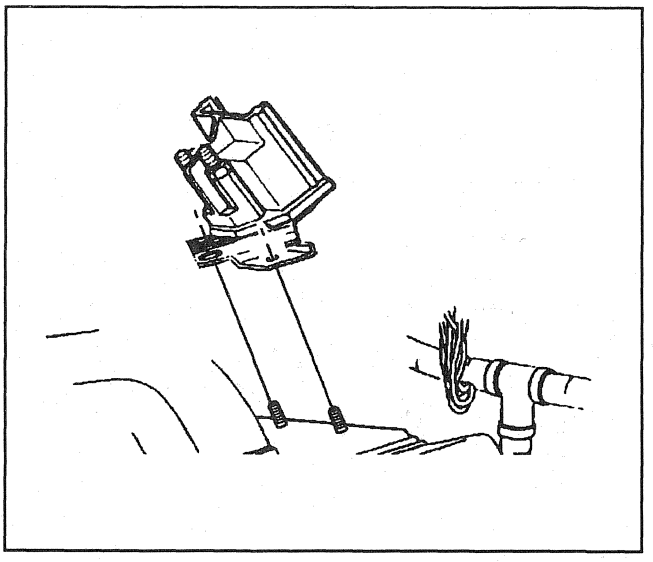
## Installation Procedure

1. Install the relay to the studs on the engine.



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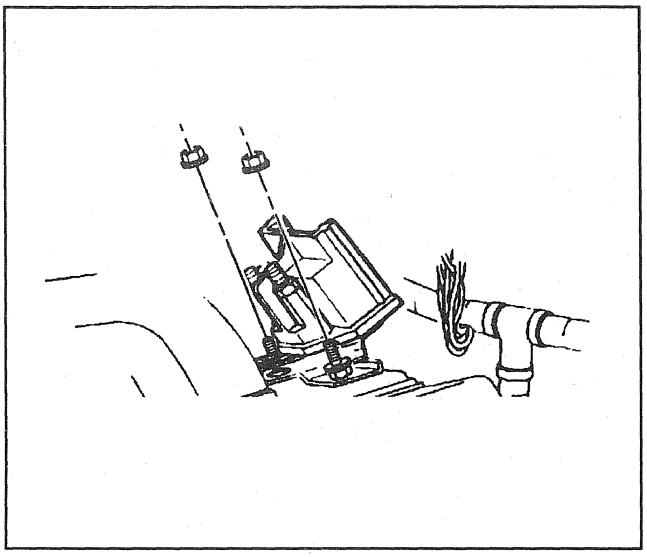

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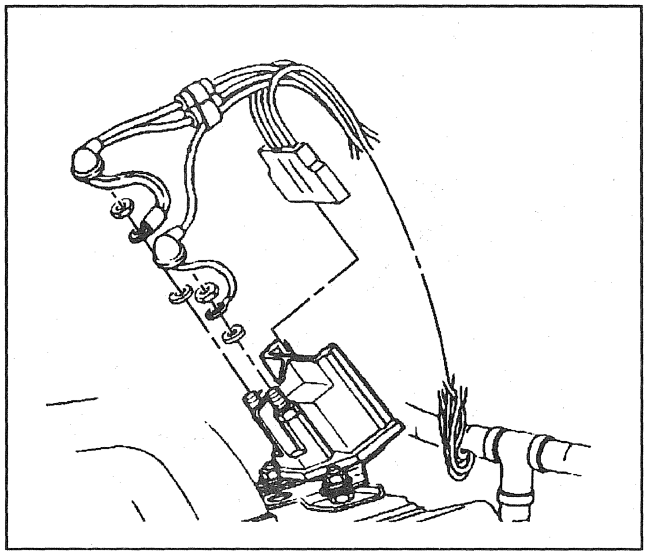
2. Install the relay mounting nuts.
   **Tighten**
   Tighten the nuts to 35 N·m (25 lb ft).
   Refer to *Fastener Notice*.



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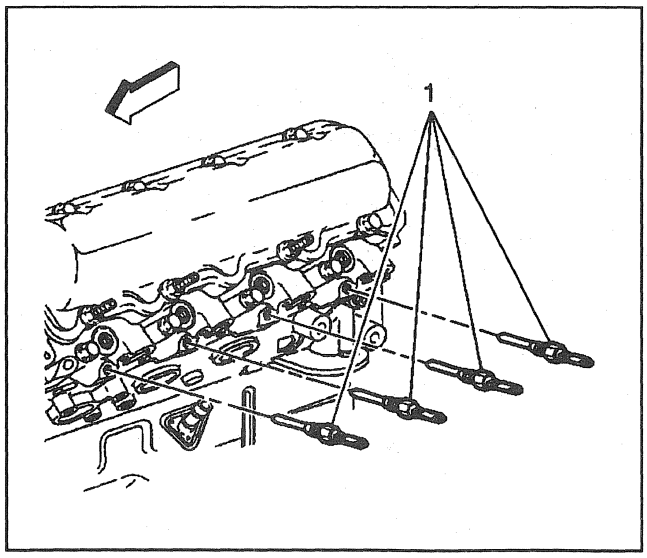
3. Install the wiring harness connector to the relay.
4. Install the glow plug wiring harness nuts.
   **Tighten**
   Tighten the nuts to 5 N·m (44 lb. in.).
5. Install the upper intake manifold cover.
6. Install the negative battery cables.




26774

## Glow Plugs

### Removal Procedure

Remove the negative battery cable(s). Refer to *Battery Disconnect Caution*

**Left Side of Vehicle**

1. Remove the glow plug lead wires using J 39083 glow plug connector remover and installer.

   ***Notice:*** Serious engine damage will occur if the damaged glow plug is not retrieved from the cylinder. There are two methods to remove glow plugs with blistered or swollen heater coil sheaths.

   **Method I**

   1. Remove injector nozzle from failed glow plug cylinder.

2. Place shop towel in the precup chamber 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 griping devise) to grasp the tip and remove it from the precup chamber.
4. Remove the shop towel and reinstall the injector nozzle.

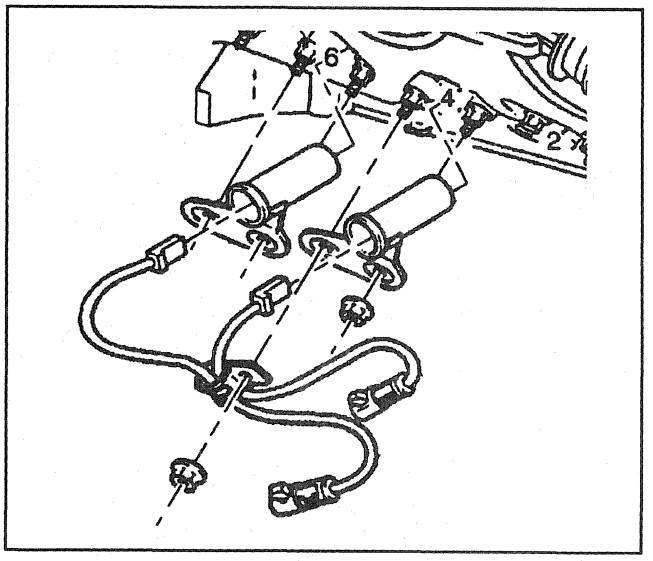
**Method II**

If the glow plug tip has already broken off the glow plug and it is not retrievable from the precup chamber, then the cylinder head must be removed so that the tip can be retrieved from the piston cylinder. Refer to cylinder head removal.

Remove the glow plugs from cylinders 1, 3, 5 and 7.

**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.

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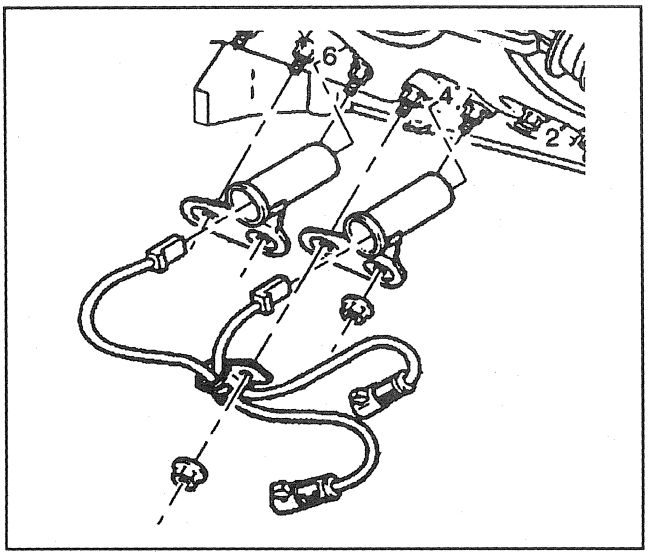


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- Slide the shrouds back far enough to allow access for unplugging the wires at cylinder 4 and 6 glow plugs.
- Use J 39083 to disconnect the glow plug wires.

***Notice:*** Serious engine damage will occur if the damaged glow plug is not retrieved from the cylinder. There are two methods to remove glow plugs with blistered or swollen heater coil sheaths.

**Method I**

1. Remove injector nozzle from failed glow plug cylinder.
2. Place shop towel in the precup chamber 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 griping devise) to grasp the tip and remove it from the precup chamber.
4. Remove the shop towel and reinstall the injector nozzle.

**Method II**

If the glow plug tip has already broken off the glow plug and it is not retrievable from the precup chamber, then the cylinder head must be removed so that the tip can be retrieved from the piston cylinder. Refer to cylinder head removal.

8. Remove the glow plugs from cylinders 2, 4, and 6.
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.

    For easier access to glow plugs on cylinders 6 and 8, it may be necessary to remove the exhaust down pipe from turbocharger.

## Installation Procedure

**Right Side of Vehicle**

1. Install the glow plug into cylinder 8.

   **Tighten**

   Tighten the glow plugs to 17 N·m (13 lb ft).

   Refer to *Fastener Notice*.
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.

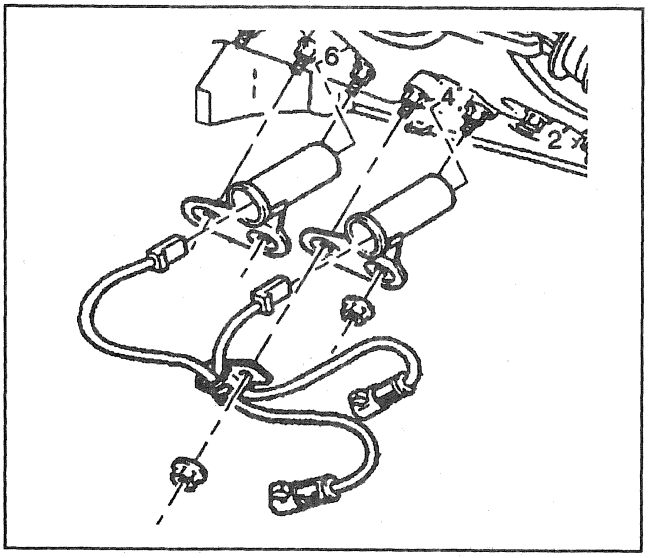
   **Tighten**

   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.



26775

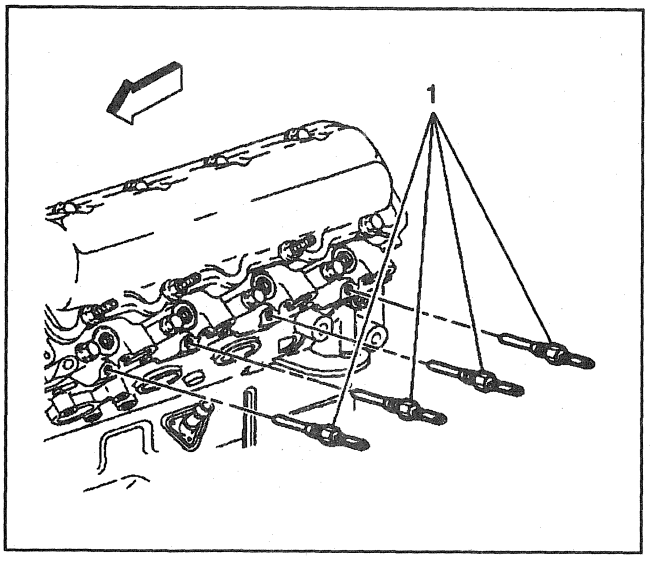
7. Install the splash shield in the right front wheel well.
8. Inspect the wire routing, making sure the lead wires are not rubbing against the exhaust manifold or any part that may harm the wire insulation.
9. Install the right front tire.

**Left Side of Vehicle**

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.

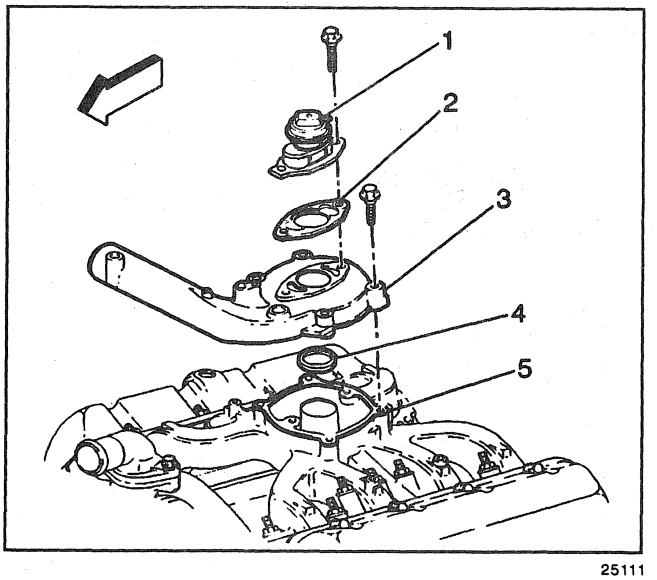


26774

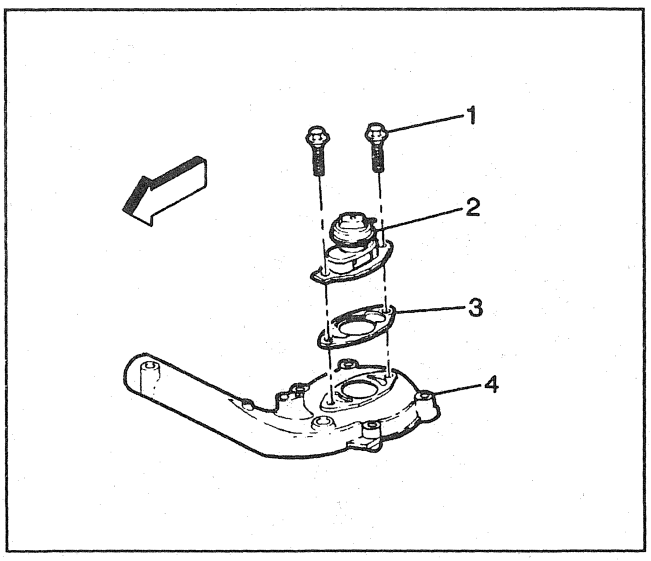
## EGR Valve

### Removal Procedure

1. Remove negative battery cable(s). Refer to *Battery Disconnect Caution.*
2. Remove the upper intake manifold cover.

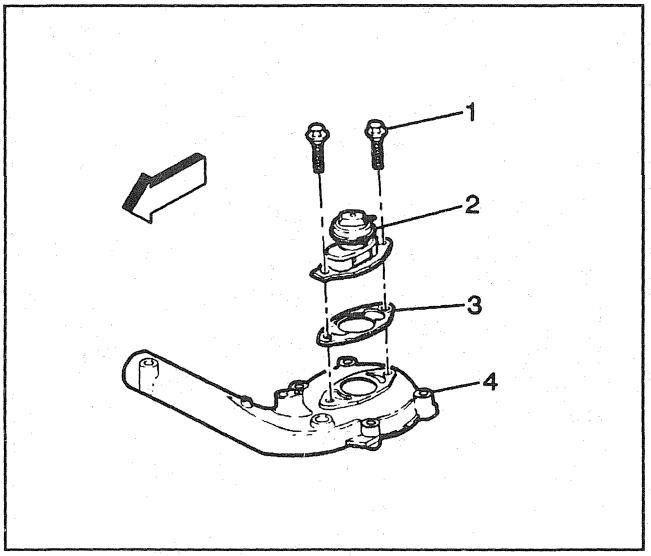


25111




25113

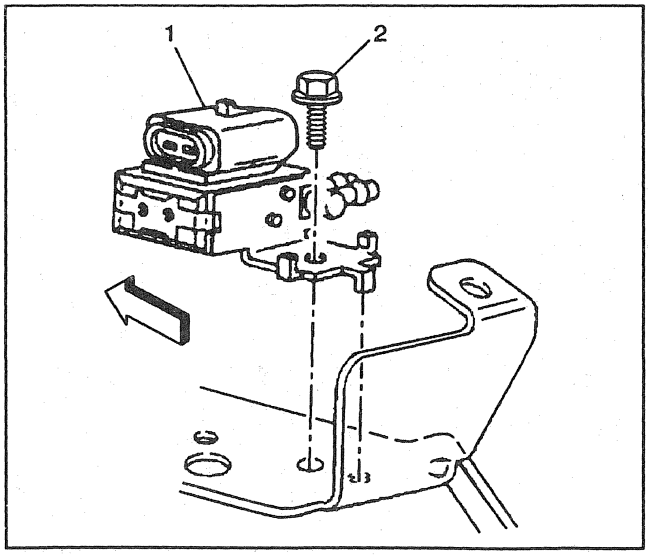
3. Remove the vacuum hose from the EGR valve.
4. Remove the EGR valve mounting bolts and the EGR gasket.
5. Remove the EGR valve.




25113

### Installation Procedure

1. Install the EGR valve (2) and gasket (3).
2. Install EGR valve mounting bolts (1).
   **Tighten**
   Tighten bolts to 25 N·m (18 lb ft).
   Refer to *Fastener Notice*.
3. Install the vacuum hose.
4. Install the upper intake manifold cover.
5. Install negative battery cable(s).




25300

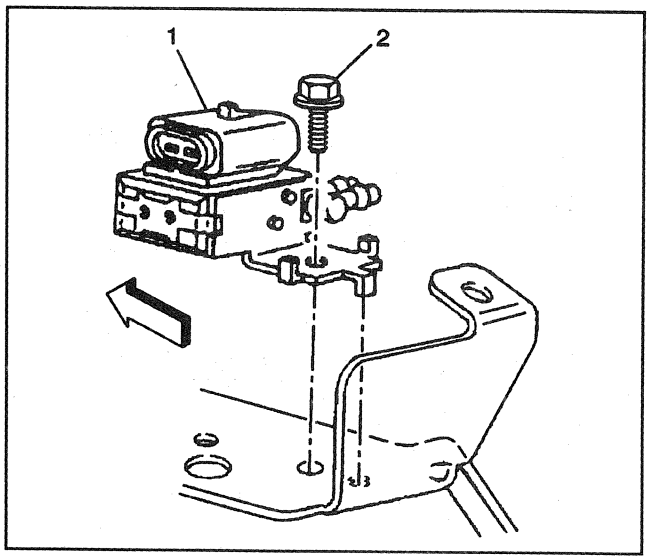
## EGR Solenoid

### Removal Procedure

1. Remove the negative battery cables. Refer to *Battery Disconnect Caution*.
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).

### Installation Procedure

1. Install the EGR solenoid (1).
2. Install mounting bolt (2).
   **Tighten**
   Tighten mounting bolt to 6.0 N.m (53 lb in).
   Refer to *Fastener Notice*.
3. Install the vacuum hoses.
4. Install the electrical connector to the solenoid.
5. Install the negative battery cable(s).

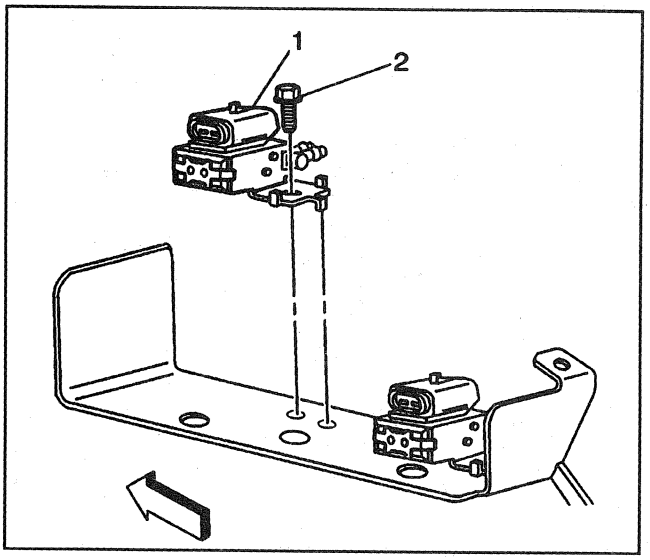



25300

## EGR Vent Solenoid

### Removal Procedure

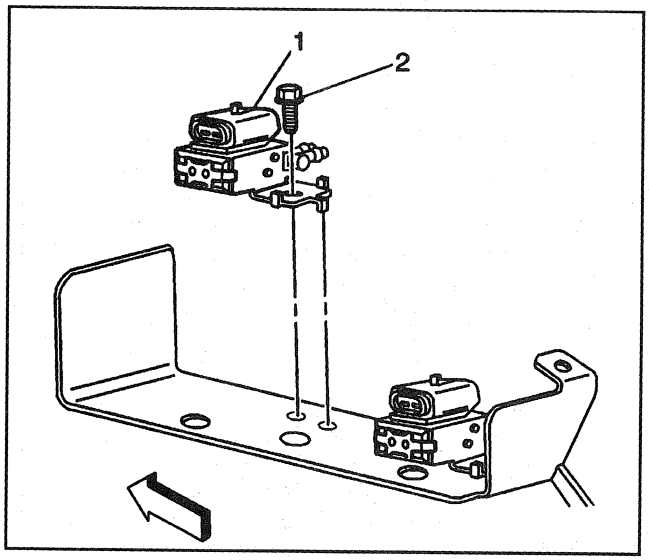
1. Remove the negative battery cables. Refer to *Battery Disconnect Caution*.
2. Remove the electrical connector from the solenoid.
3. Remove the vacuum hoses.
4. Remove the EGR Vent solenoid mounting bolt (2).
5. Remove the EGR vent solenoid (1).



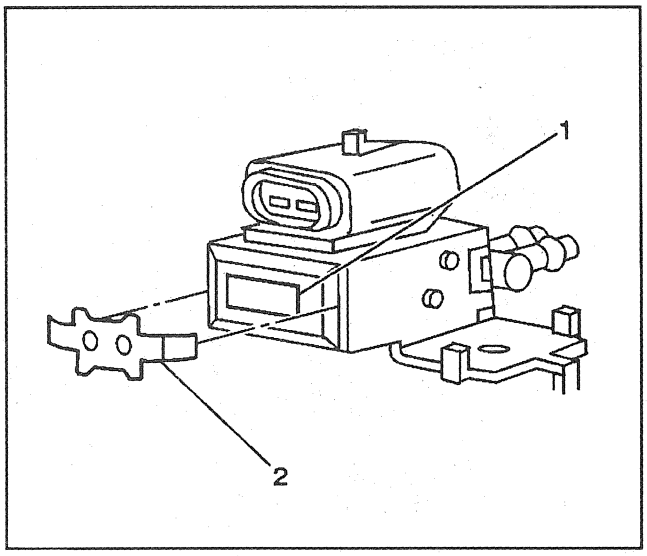

25303

### Installation Procedure

1. Install the EGR vent solenoid (1).
2. Install EGR Vent Solenoid mounting bolt (2).
   **Tighten**
   Tighten mounting bolt to 6.0 N.m (53 lb. in.)
   Refer to *Fastener Notice*.
3. Install the vacuum hoses.
4. Install the electrical connector to the solenoid.
5. Install the negative battery cables.




25303

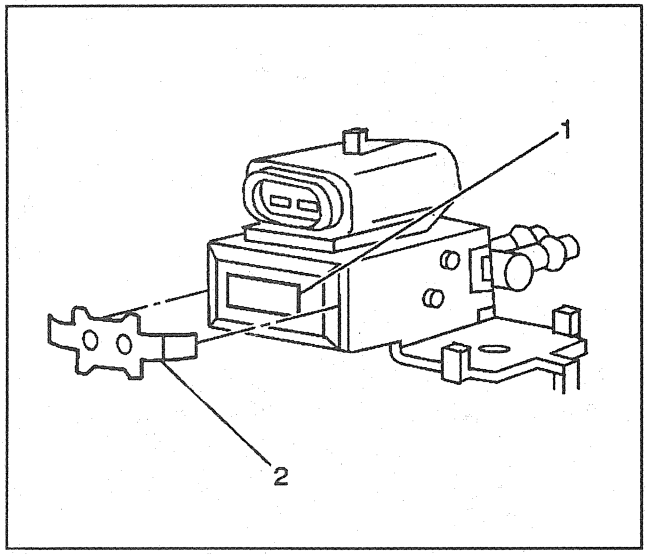



25479

## EGR Solenoid Filter Replacement

### Removal Procedure

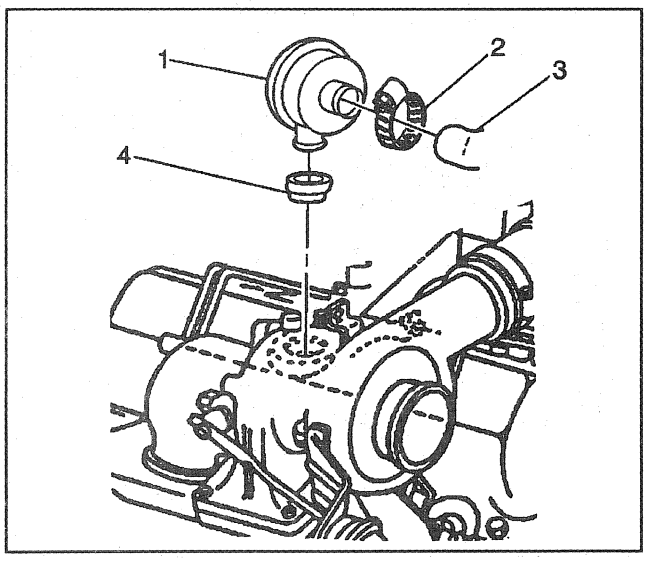
1. Remove the filter retainer clip (2).
2. Remove the solenoid filter (1).




25479

### Installation Procedure

1. Install the solenoid filter (1).
2. Install the filter retainer clip (2).




25616

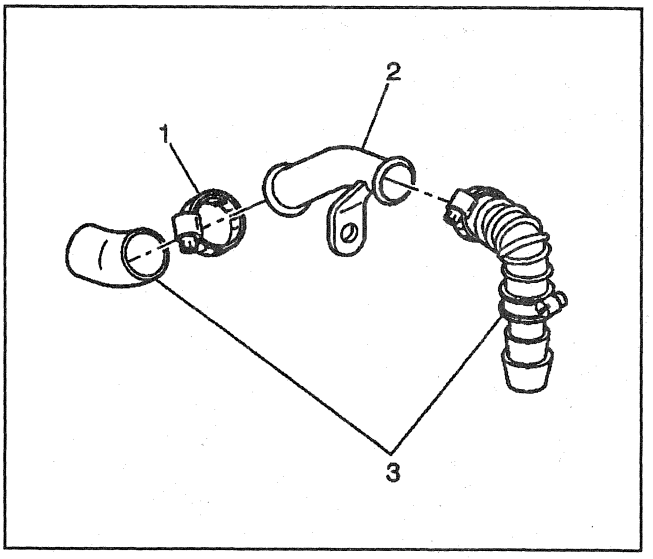
## CDR Valve and Hoses

### Removal Procedure

The crankcase depression regulator valve (1) is replaced as an assembly. Replace hoses (3) and pipes (3) and grommet (4) as required, if inspection indicates cracks or decay.

Refer to the appropriate service information for diesel crankcase ventilation system maintenance requirements.

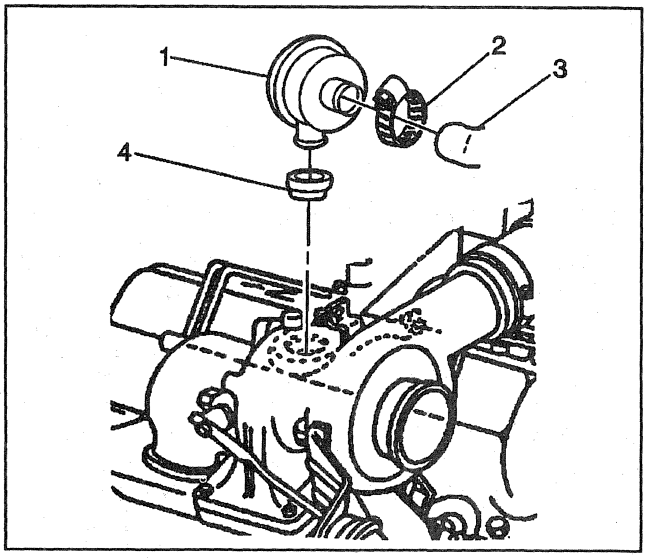
1. Remove clamp (1) at CDR valve (1).
2. Remove hose (3) from CDR valve (1).
3. Remove CDR valve by pulling straight up.



25622

## Installation Procedure

1. Install CDR valve (1) into valve cover.
2. Install hose (3).
3. Install the clamp (2).
   **Tighten**
   Tighten clamp to 1.7 N·m (15 lb in).
   Refer to *Fastener Notice*.

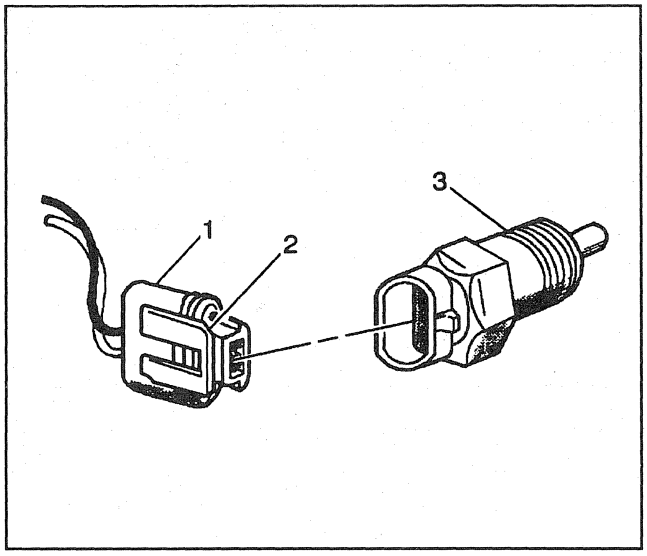


25616

# Description and Operation

## Information Sensors

### Engine Coolant Temperature (ECT) Sensor




13578

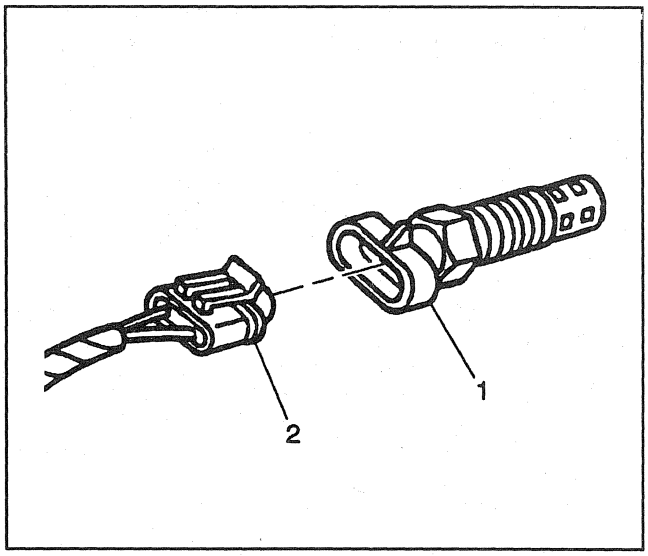
**Legend**

(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 Ω at -40 °C/-40 °) while high temperature causes low resistance (70 Ω at 130 °C/266 °F).

The PCM supplies a 5 volt signal to the Engine Coolant Temperature (ECT) sensor through a resistor in the PCM and measures the voltage. 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

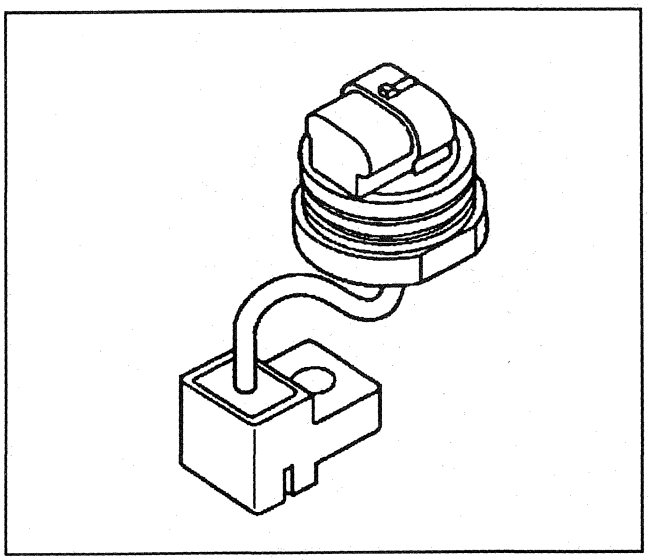
The Intake Air Temperature (IAT) sensor is a thermistor (a resistor which changes value based on temperature) mounted in the intake manifold.

Low temperature produces a high resistance (100,000 ohms at –40 °C/–40 °F) while high temperature causes low resistance (70 Ω at 130 °C/266 °F).

The control module supplies a 5 volt signal to the sensor through a resistor in the control module and 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 IAT signal is used by the control module to control fuel.

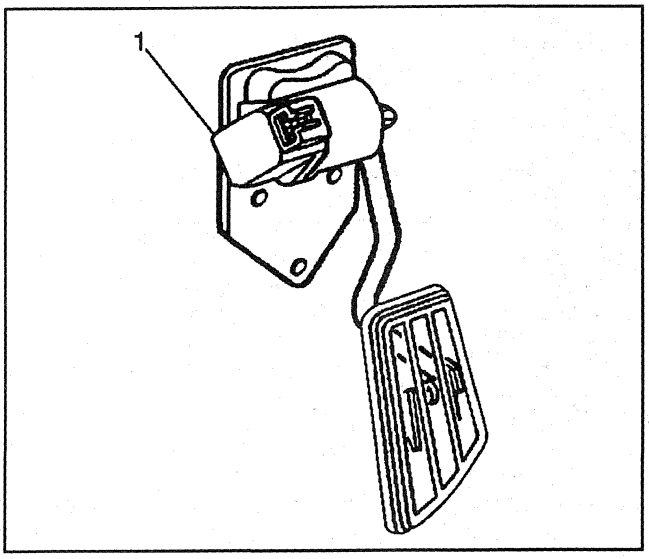
### Optical/Fuel Temperature Sensor



27619

The optical sensor sends what is called a High Resolution Signal and a Pump Cam signal to the PCM. There is a harness filter inline to the Optical/Fuel temperature sensor that is used to filter the shared 5 volt reference signal.

### Accelerator Pedal Position (APP) Module




27618

The APP 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).

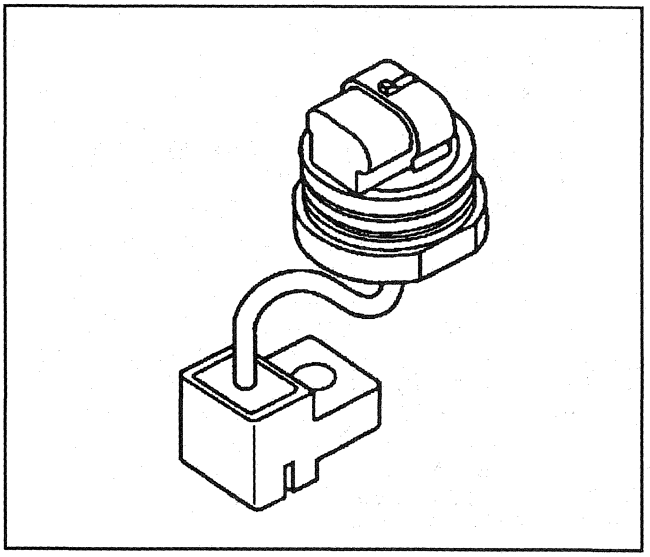
### High Resolution Signal (256X)

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 located the start of injection event for each cylinder (i.e. timing) with the 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 crankshaft position sensor and the high resolution circuit.

### Fuel Temperature Sensor



27619

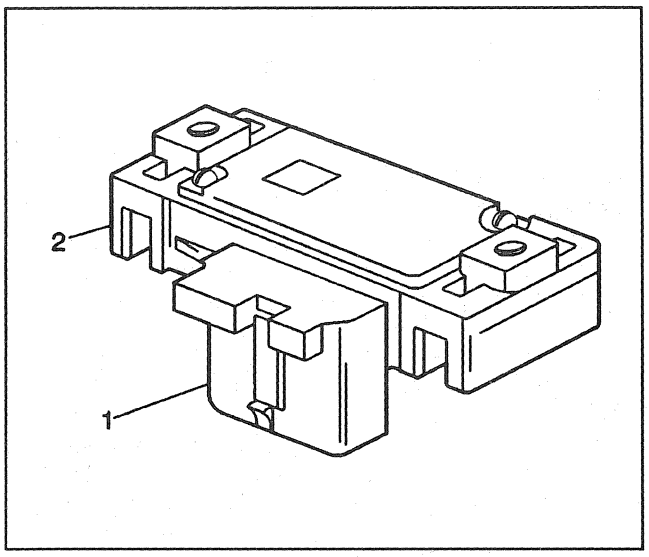
The Fuel Temperature sensor is a thermistor (a resistor which changes value based on temperature) mounted in the injection pump.

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.

### 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. If there is a difference in the PCM command and what is at the EGR valve sensed by the EGR control pressure/BARO sensor, on vehicles not equipped with EGR the Boost sensors is used to measure BARO. This sensor reads barometric pressure (BARO) under certain conditions, which allows the PCM to automatically adjust for different altitudes.

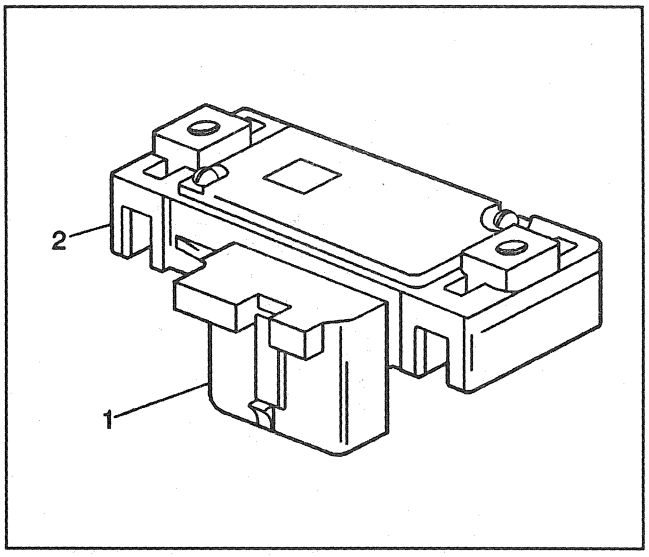
### Boost (BARO) Sensor

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) required 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 vehicle 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)




13693

**Legend**

(1) Electrical Connector
(2) Manifold Absolute Pressure (MAP) Sensor

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

The VSS buffer module is an electronic device. The VSS buffer module process 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 an 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 indicated that the A/C compressor clutch is engaged. The PCM uses this signal to adjust the idle speed.

### APP Module

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.

## Powertrain Control Module Serial Data

### Class II Serial Data

U.S. Federal regulations require that all automobile manufacturers establish a common communications system. General Motors utilizes the Class II communications system. Each bit of information can have one of two lengths: long or short. This allows vehicle wiring to be reduced by the transmission and reception of multiple signals over a single wire. The messages 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 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 scan tool manufacturers with the capability of accessing 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 Diagnotic 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 diagnostics as been met allowing the diagnostic to run vehicle operation, followed by an engine off period of duration and driving mode such that any particular diagnostic test has had sufficient time to complete at least once. 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 engine start-up and vehicle operation such that the coolant temperature has risen greater than 40°F from 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 functional checks are designed to locate a faulty circuit or 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 not multiple faults present.

There is a continuous self-diagnosis on certain control functions. This diagnostic capability is complemented by the diagnostic procedures 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) Malfunction Indicator Lamp will illuminate on some applications.

### Malfunction Indicator Lamp (MIL)

The MIL (Malfunction Indicator Lamp) is on the instrument panel. The MIL has the following functions:

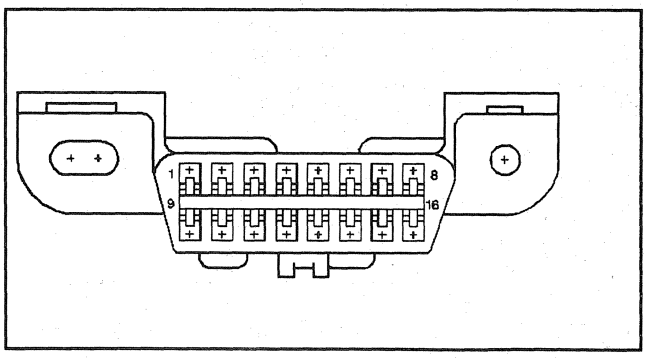
- The MIL informs the driver that a fault that affects the vehicle's emission levels has occurred. The owner should take the vehicle for service as soon as possible.
- As a bulb and system check, the MIL (Malfunction Indicator Lamp) comes on with the key on and the engine not running. When the engine 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 MIL (Malfunction Indicator Lamp 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)




5895

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 output control tests
- Reading serial data

### Reprograming (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 re-programming 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 frame data for the DTC which was diagnosed. Record the fail records or freeze frame 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 unnecessary repair.

### Reading Diagnostic Trouble Codes

The procedure for reading the diagnostic trouble codes is to use a diagnostic scan tool. When reading DTCs follow these steps could result in unnecessary repairs.

### DTC Modes

On the OBD II vehicles there are three options available in the scan tool DTC mode to display the enhanced information available. A description of the new modes, DTC Info and Specific DTC, follows. After selecting DTC, the following menu appears:

- DTC Info
- Specific DTC
- Freeze Frame
- Fail Records
- Clear Info

The following is a brief description of each of the sub menus in DTC Info and 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 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 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 a 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 DTCs that have failed during the present ignition cycle.

### History

This selection displays only DTCs that are stored to the control modules history memory. The history memory will not display Type B DTCs that have not requested the MIL. The history memory will display all 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 type C DTCs that have failed within the last 40 warm-up cycles.

### Last Test Fail

This selection displays only DTCs that have failed the last time the test ran. The last test may have ran during a previous ignition cycle if the 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 DTCs that are requesting the MIL. Type C DTCs can not be displayed 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 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 active and history DTCs that have reported a test failure since the last time 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 individual diagnostic tests by 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 DTC numbers that are supported by the vehicle being tested. If an attempt is made to enter 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 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 the conditions necessary for reporting a fault have 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 Ig after a repair verification, then the repair is incomplete. 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.

## Powertrain Control Module 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 (Figure 3-1) 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 Section 10 of this service manual.

The diesel Powertrain Control Module (PCM) is located in the passenger compartment and is the control center of the control module system. The PCM used on the electronic fuel injected 6.5L diesel is referred to as 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 diagnosis Section for more information.

The PCM is designed to process the various input information (Figure 3-1) and then 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 systems operation.

### Aftermarket (Add-On) Electrical And Vacuum Equipment

Aftermarket (Add-On) Electrical and Vacuum Equipment is defined as any equipment installed on a vehicle after leaving the factory that connects to the vehicle's electrical or vacuum systems. No allowances have been made in the vehicle design for this type of equipment.

***Notice:*** Do not add on any Add-On vacuum operated equipment to this vehicle.

***Notice:*** Connect the Add-On electrical operated equipment to the vehicle's electrical system at the battery (power and ground).

Add-On electrical equipment, even when installed to these strict guidelines, may still cause the Powertrain system to malfunction. This may also include equipment not connected to the vehicle's electrical system such as portable telephones and radios. Therefore, the first step in diagnosing any Powertrain problem is to eliminate all Aftermarket electrical equipment from the vehicle. After this is done, if the problem still exists, diagnose the problem in the normal manner.

### Electrostatic Discharge Damage

***Notice:*** In order to prevent possible Electrostatic Discharge damage to the PCM, Do Not touch the connector pins or the soldered components on the circuit board.

Electronic components used in the control systems are often designed in order to carry very low voltage. Electronic components are susceptible to damage caused by electrostatic discharge. Less than 100 volts of static electricity can cause damage to some electronic components. There are several ways for a person to become statically charged. The most common methods of charging are by friction and by induction. An example of charging by friction is a person sliding across a car seat. Charging by induction occurs when a person with well insulated shoes stands near a highly charged object and momentarily touches ground. Charges of the same polarity are drained off leaving the person highly charged with the opposite polarity. Static charges can cause damage; therefore, it is important to use care when handling and testing electronic components.

## 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.

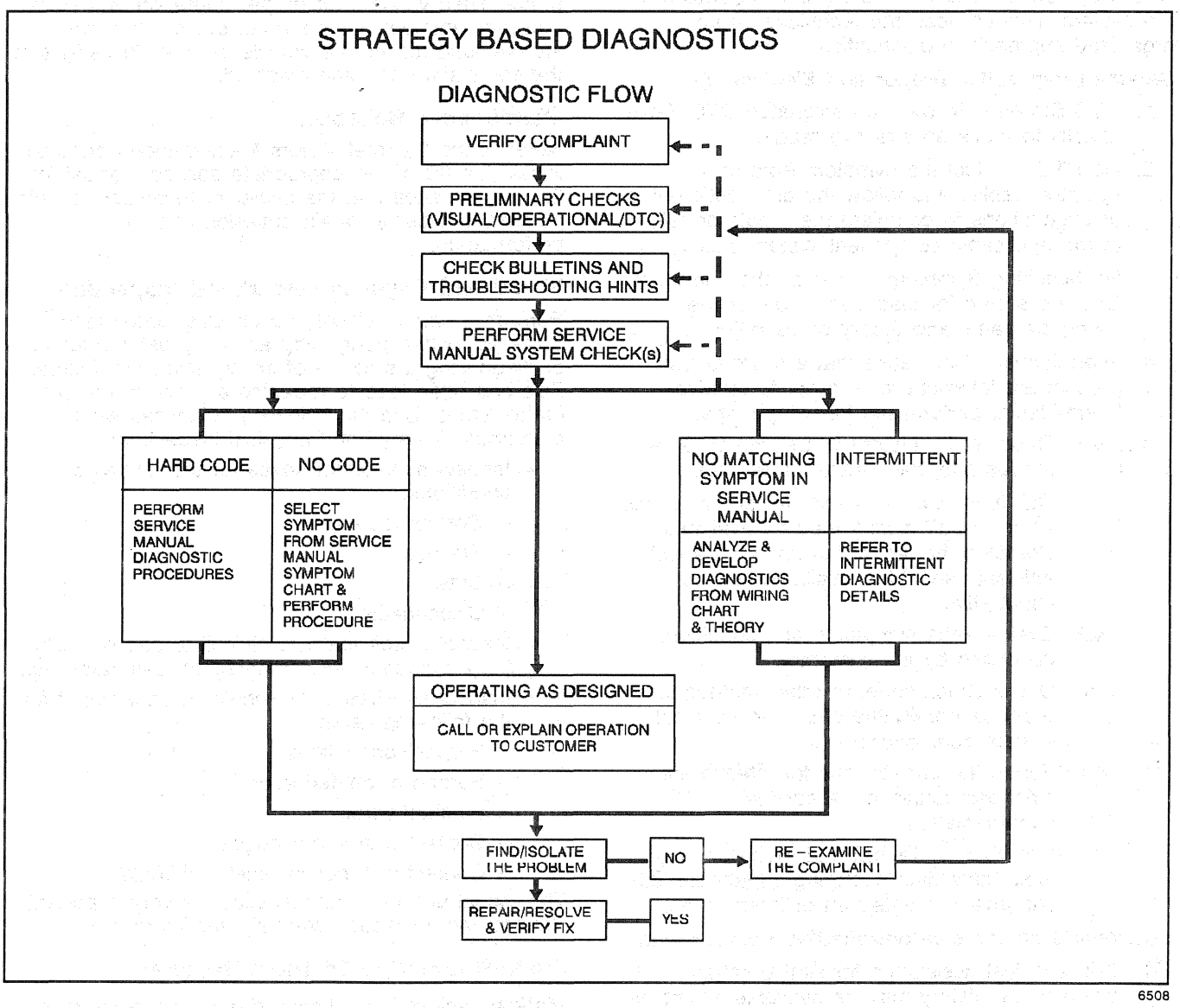
Engine Components, Wiring Diagrams, and Diagnostic Tables (DTCs):

- Component Locations
- Wiring Diagrams
- Control Module Terminal End View and Terminal Definitions
- OnBoard Diagnostic (OBD) System Check
- Diagnostic Trouble Code Tables (DTCs)

The Component System includes the following items:

- Component and circuit description
- On-vehicle service for each sub-system
- Functional checks and Diagnostic Tables
- How To Use Electrical Systems Diagnostic Information

The DTCs also contain diagnostic support information containing circuit diagrams, circuit or system information, and helpful diagnostic information.




The strategy based diagnostic is a uniform approach to repair all Electrical and Electronic (E/E) systems. Resolve an E/E system problem using the diagnostic flow. The diagnostic flow is also a starting point when repairs are necessary. The steps below are defined in order to instruct the technician how to proceed with a diagnosis.

### Verify the Customer Complaint

In order to verify the customer complaint the technician should know the normal operation of the system.

**Preliminary Checks**
Perform the following steps:

1. Conduct a thorough visual inspection
2. Review the service history
3. Detect unusual sounds or odors
4. Gather diagnostic trouble code information in order to achieve an effective repair

**Check Bulletins and Other Service Information**
This should include videos, newsletters, and Pulsat programs.

**Service Information System Checks**
A system may not be supported by one or more DTCs. System checks verify the proper operation of the system. This will lead the technician in an organized approach to diagnostics.

**Service Diagnostics (Paper and Electronic)**

1. DTC Stored - Follow the designated DTC Table exactly to make an effective repair.
2. No DTC - Select the symptom from the symptom tables and follow the diagnostic paths or suggestions to complete the repair, or refer to the applicable component/system check.
3. No Matching Symptom - Analyze the complaint. Develop a plan for diagnostics. Utilize the wiring diagrams and theory of operation.
4. Intermittents - Conditions that are not always present are intermittent. In order to resolve Intermittents, perform the following steps:
   4.1. Observe the history DTCs, the DTC modes and, the freeze frame data.
   Call technical assistance for similar cases where repair history may be available. Combine the technician knowledge with efficient use of the available service information.
   4.2. Evaluate the symptoms and conditions described by the customer.
   4.3. Use a check sheet or other method in order to identify the circuit or electrical system component.
   4.4. Follow the suggestions for intermittent diagnosis found in the service documentation.
   4.5. The Tech 1, Tech 2 and Fluke 87 scan tools have data capturing capabilities that can assist in detection of Intermittents.
5. Vehicle operates as designed/No trouble found
6. Call technical assistance for similar cases where repair history may be available. Combine technician knowledge with efficient use of the available service information.
   6.1. This condition exists when the vehicle is found to operate normally.
   6.2. The condition described by the customer may be normal. Verify against another vehicle that is operating normally.
   6.3. The condition may be intermittent. Verify the complaint under the conditions described by the customer before releasing the vehicle.

**Re-Examine the Complaint**
When the complaint cannot be successfully found or isolated, a reevaluation is necessary. The complaint should be re-verified and could be intermittent or normal.

**Repair and Verification Tests**
After isolating the cause, the repairs should be made. Then validate for proper operation and verify that the symptom has been corrected. This may involve road testing the vehicle in order to verify that the complaint has been resolved.

## Maintenance Schedule

Refer to the General Motors Maintenance Schedule in Section 0B of the appropriate service manual for the maintenance that the owner or technician should perform in order to retain emission control performance.

## Visual and Physical Underhood Inspection

Perform a careful visual and physical underhood inspection when performing any diagnostic procedure or diagnosing the cause of an emission test failure. This can often lead to repairing a problem without further steps. Use the following guidelines when performing a visual and physical inspection:

- Inspect all vacuum hoses for the following conditions:
  - Correct routing
  - Pinches
  - Cuts
  - Disconnects
- Inspect hoses that are difficult to see beneath the air cleaner, A/C compressor, generator, etc.
- Inspect all wires in the engine compartment for the following items:
  - Proper connections
  - Burned or chafed spots
  - Pinched wires
  - Contact with sharp edges
  - Contact with hot exhaust manifolds

This visual and physical inspection is very important. Preform the inspection carefully and thoroughly.

## Basic Knowledge Of Tools Required

***Notice:*** Lack of basic knowledge of this powertrain when performing diagnostic procedures could result in incorrect diagnostic performance or damage to powertrain components. Do not attempt to diagnose a powertrain problem without this basic knowledge.

A basic understanding of hand tools is necessary in order to effectively use this information.

### Wiring Harness Service

The control module harness electrically connects the control module to the various solenoids, switches, and sensors in the vehicle engine room 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 Weather-Pack seals.

Use the tachometer adapter J 35812, or the equivalent, which provides a convenient connection to the tachometer lead. The connector test adapter kit *J 35616*, or the equivalent, contains an assortment of flexible connectors used to probe terminals during diagnosis. Fuse remover and 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.

## Powertrain Control Module General Description

### Powertrain Control Module

The PCM processes the various input information. The PCM sends the necessary electrical responses to the 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:

- The OBD system check is completed.
- The on-board diagnostics is functioning properly.
- No diagnostic trouble codes are displayed.

The Engine Scan Tool Definitions are an average of display values recorded from normal operating vehicles. The Definitions are intended 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 faulty scan tool can result in misdiagnosis and unnecessary parts replacement.

Only the parameters listed in the Engine Scan Tool Definitions are used for diagnosis. When a scan tool reads other parameters, the values are not recommended by General Motors for use in diagnosis.

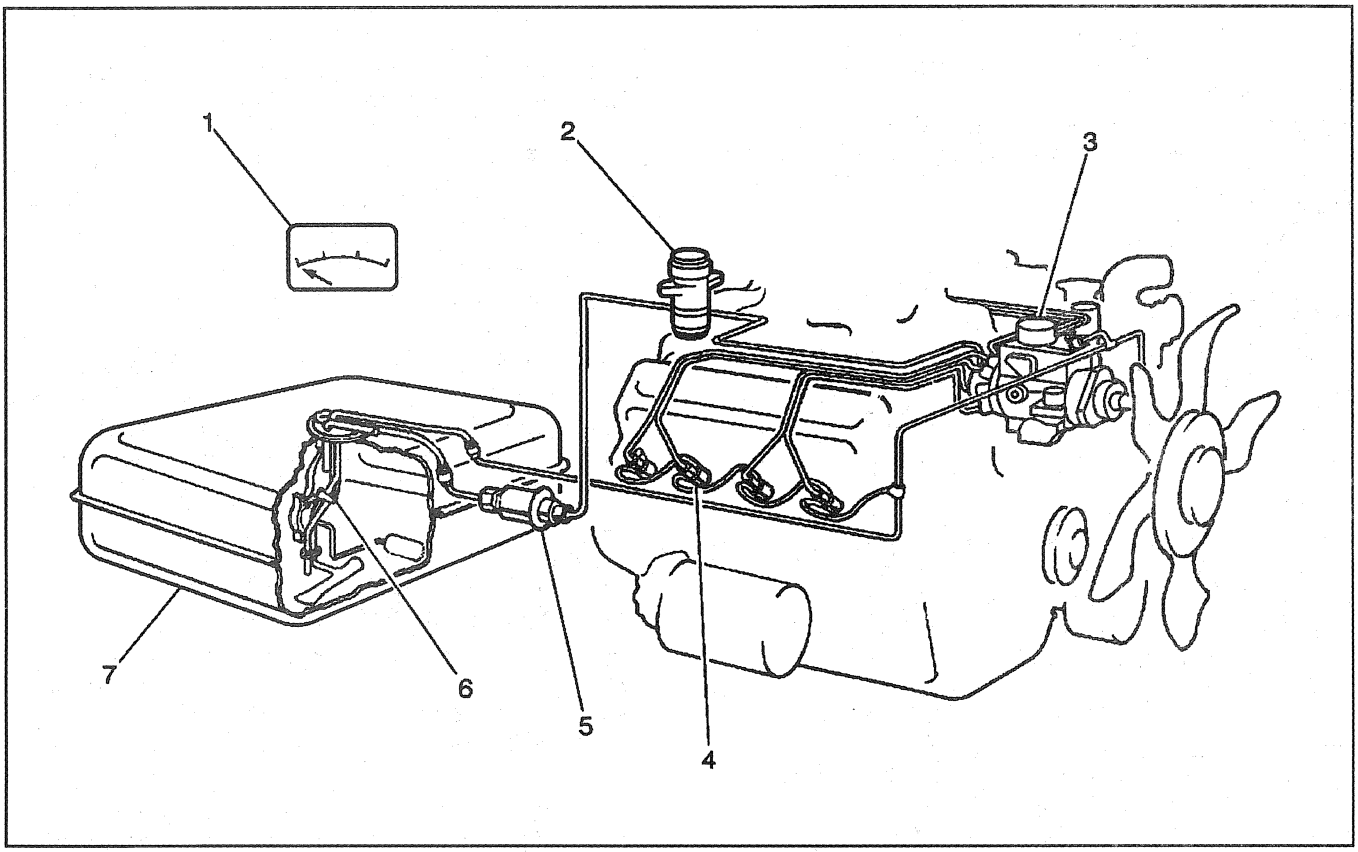
For more description on the values and the use of the scan tool to diagnose the PCM inputs, refer to the applicable diagnostic file.

When all the values are within the ranged illustrated in the Engine Scan Tool Data Definitions, refer to Driveability Symptoms.

## Air Induction System

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 Section 6J of the appropriate service manual for more information on the turbocharger.

## Fuel Supply System




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

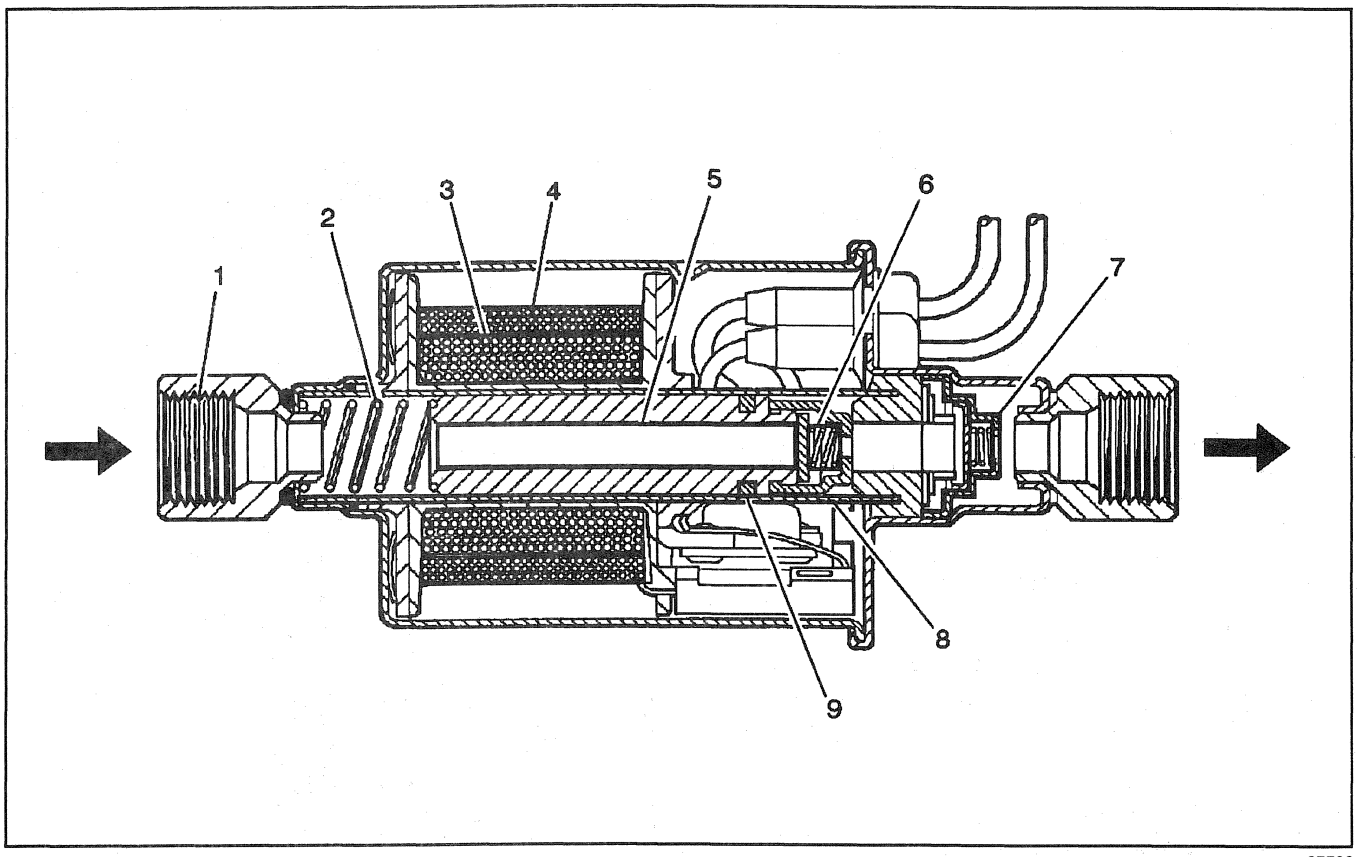
The fuel tank filler neck is equipped with a threaded-type cap. The threaded part of the cap requires several turns counterclockwise to remove. A built-in torque-limiting device prevents over tightening. To install, turn the cap clockwise until a clicking noise is heard. This signals that the correct torque has been reached and the cap is fully seated.

### Fuel Sender Assembly

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




27783

**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 (1/2 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 engin 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.

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.

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.

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.

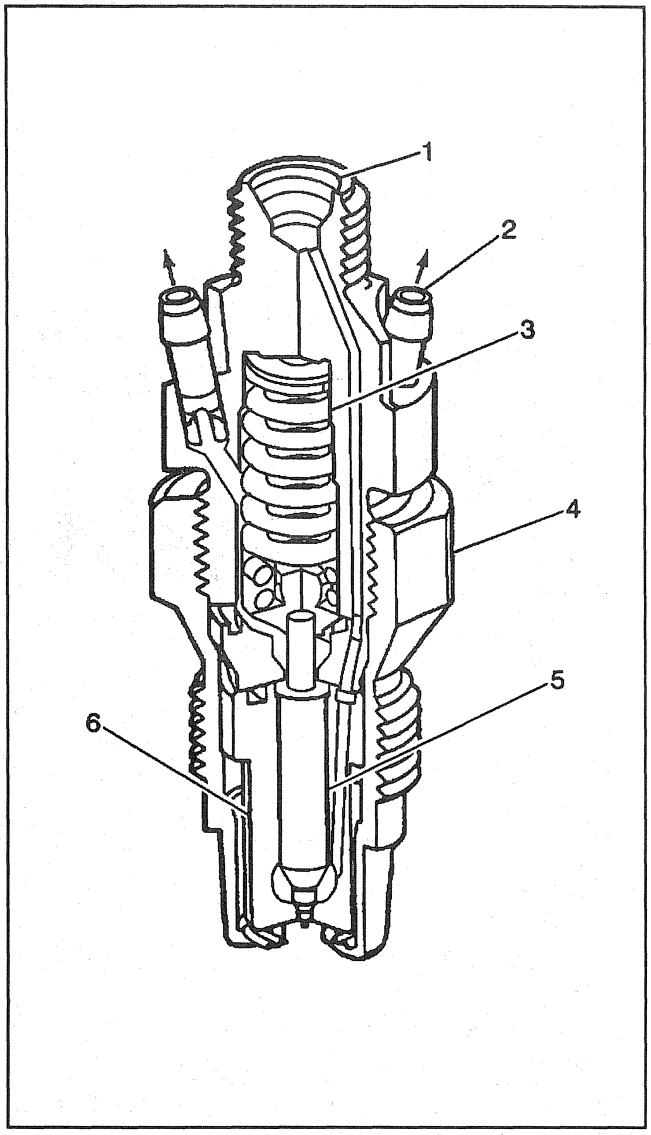
## Fuel Pipe O-Rings

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.

## Fuel Injection System

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.

## Injection Nozzles




27821

**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.

## 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.

## 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.

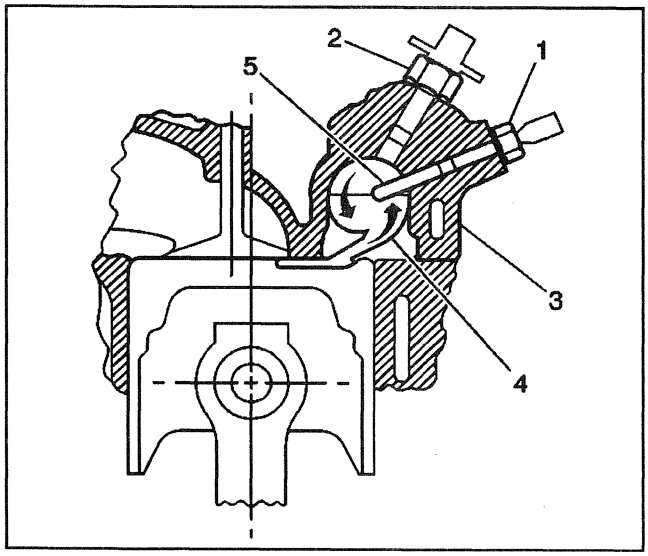
A Glow Plug lamp on the instrument panel, provides information on engine starting conditions.

## EGR Solenoid Assembly

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.

## Glow Plug System Operation




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 to preheat the chamber 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.

Glow plug ON times may range from 1 to 16 seconds, because they vary with initial engine temperature. The initial ON time and cycling ON/OFF times vary also with sysytem 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.

## EGR System

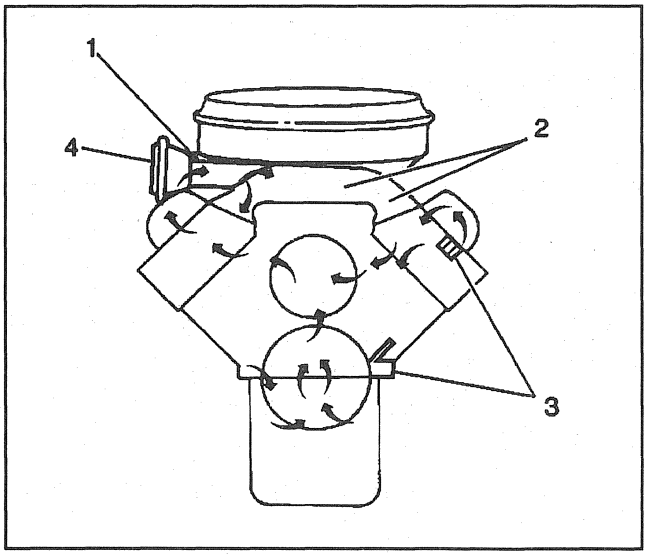
The EGR system lowers the formation of nitrogen oxides by reducing combustion temperature. This is done by introducing exhaust gases into the cylinders through an EGR valve. The PCM, in the control module system, controls the amount of EGR to meet emission control requirements and maintains good driveability 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.

An EGR control pressure/BARO sensor mounted on the right side of the plenum panel is used to measure the amount of absolute pressure in the EGR vacuum line and for a BARO reading on vehicles equipped with EGR.

## Crankcase Ventilation System




26779

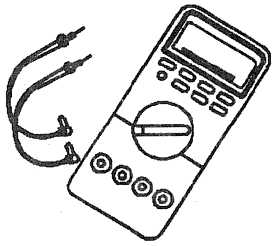
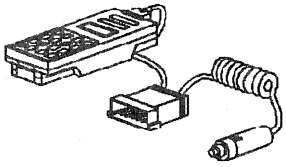
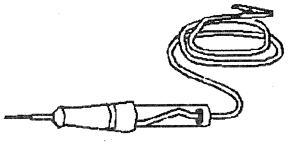
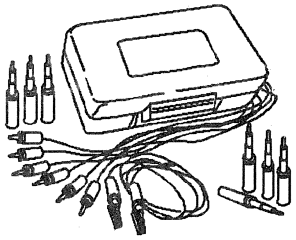
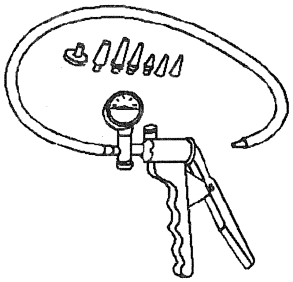
**Legend**

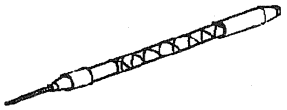
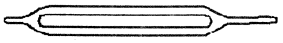
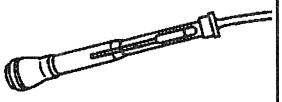
(1) Crankcase Vapors to Induction System
(3) Blowby Leakage At Valves and Pistons
(4) Crankcase Vapors

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 4' 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.

## Special Tools and Equipment

| | |
|---|---|
|  | J 39200 Digital Multimeter |
|  | TKO-A Tech 1A 7000001 Cartridge Kit |
|  | J 34142-B Unpowered Test Light |
|  | J 35616-A Connector Test Adapter Kit |
|  | J 23738-A Vacuum Pump |

| | |
|---|---|
|  | J 35689-A Metri-Pack Terminal Remover |
|  | J 33095 Control Module Connector Terminal Remover |
|  | J 34616-A/BT-8637 Connector Test Adapter Kit |
|  | Diesel Fuel Quality Tester |
|  | Injection Pump Wrench |

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