

EMISSION CONTROL SYSTEMS

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ON-BOARD DIAGNOSTICS

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DESCRIPTION AND OPERATION

SYSTEM DESCRIPTION

OPERATION

The Powertrain Control Module (PCM) monitors many different circuits in the fuel injection, ignition, emission and engine systems. If the PCM senses a problem with a monitored circuit often enough to indicate an actual problem, it stores a Diagnostic Trouble Code (DTC) in the PCM's memory. If the code applies to a non-emissions related component or system, and the problem is repaired or ceases to exist, the PCM cancels the code after 40 warmup cycles. Diagnostic trouble codes that affect vehicle emissions illuminate the Malfunction Indicator Lamp (MIL). Refer to Malfunction Indicator Lamp in this section.

Certain criteria must be met before the PCM stores a DTC in memory. The criteria may be a specific range of engine RPM, engine temperature, and/or input voltage to the PCM.

The PCM might not store a DTC for a monitored circuit even though a malfunction has occurred. This may happen because one of the DTC criteria for the circuit has not been met. **For example**, assume the

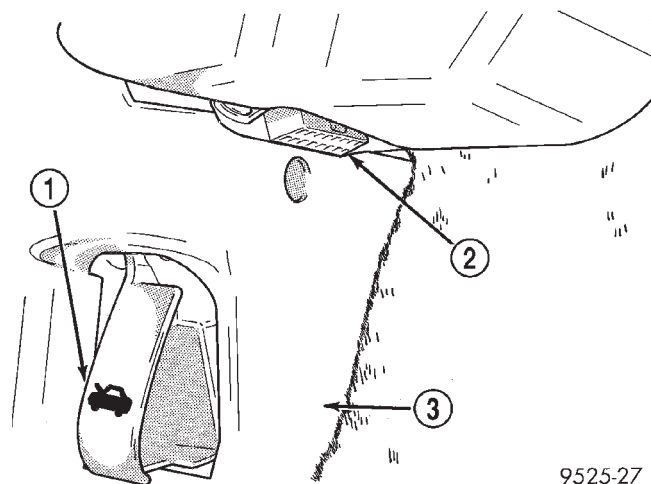
diagnostic trouble code criteria requires the PCM to monitor the circuit only when the engine operates between 750 and 2000 RPM. Suppose the sensor's output circuit shorts to ground when engine operates above 2400 RPM (resulting in 0 volt input to the PCM). Because the condition happens at an engine speed above the maximum threshold (2000 rpm), the PCM will not store a DTC.

There are several operating conditions for which the PCM monitors and sets DTC's. Refer to Monitored Systems, Components, and Non-Monitored Circuits in this section.

NOTE: Various diagnostic procedures may actually cause a diagnostic monitor to set a DTC. For instance, pulling a spark plug wire to perform a spark test may set the misfire code. When a repair is completed and verified, use the DRB scan tool to erase all DTC's and extinguish the MIL.

Technicians can display stored DTC's by using the DRB scan tool. Refer to Diagnostic Trouble Codes in this section. For DTC information, refer to charts in this section.

DESCRIPTION AND OPERATION (Continued)



9525-27

Fig. 1 Data Link (Diagnostic) Connector

- 1 - HOOD RELEASE
- 2 - DIAGNOSTIC CONNECTOR
- 3 - DRIVER'S SIDE KICK PANEL

MALFUNCTION INDICATOR LAMP (MIL)**OPERATION**

As a functional test, the Malfunction Indicator Lamp (MIL) illuminates at key-on before engine cranking. Whenever the Powertrain Control Module (PCM) sets a Diagnostic Trouble Code (DTC) that affects vehicle emissions, it illuminates the MIL. If a problem is detected, the PCM sends a message over the CCD Bus to the instrument cluster to illuminate the lamp. The PCM illuminates the MIL only for DTC's that affect vehicle emissions. The MIL stays on continuously when the PCM has entered a Limp-In mode or identified a failed emission component or system. The MIL remains on until the DTC is erased. Refer to the Diagnostic Trouble Code charts in this group for emission related codes.

Also, the MIL either flashes or illuminates continuously when the PCM detects active engine misfire. Refer to Misfire Monitoring in this section.

Additionally, the PCM may reset (turn off) the MIL when one of the following occur:

- PCM does not detect the malfunction for 3 consecutive trips (except misfire and fuel system monitors).
- PCM does not detect a malfunction while performing three successive engine misfire or fuel system tests. The PCM performs these tests while the engine is operating within ± 375 RPM of and within 10 % of the load of the operating condition at which the malfunction was first detected.

DRB III STATE DISPLAY TEST MODE**OPERATION**

The switch inputs to the Powertrain Control Module (PCM) have two recognized states; HIGH and LOW. For this reason, the PCM cannot recognize the difference between a selected switch position versus an open circuit, a short circuit, or a defective switch. If the State Display screen shows the change from HIGH to LOW or LOW to HIGH, assume the entire switch circuit to the PCM functions properly. From the state display screen, access either State Display Inputs and Outputs or State Display Sensors.

DRB III CIRCUIT ACTUATION TEST MODE**OPERATION**

The Circuit Actuation Test Mode checks for proper operation of output circuits or devices the Powertrain Control Module (PCM) may not internally recognize. The PCM attempts to activate these outputs and allow an observer to verify proper operation. Most of the tests provide an audible or visual indication of device operation (click of relay contacts, fuel spray, etc.). Except for intermittent conditions, if a device functions properly during testing, assume the device, its associated wiring, and driver circuit work correctly.

DIAGNOSTIC TROUBLE CODES**DESCRIPTION**

A Diagnostic Trouble Code (DTC) indicates the PCM has recognized an abnormal condition in the system.

Remember that DTC's are the results of a system or circuit failure, but do not directly identify the failed component or components.

NOTE: For a list of DTC's, refer to the charts in this section.

OPERATION**BULB CHECK**

Each time the ignition key is turned to the ON position, the malfunction indicator (check engine) lamp on the instrument panel should illuminate for approximately 2 seconds then go out. This is done for a bulb check.

OBTAINING DTC'S USING DRB SCAN TOOL

(1) Connect the DRB scan tool to the data link (diagnostic) connector. This connector is located in

DESCRIPTION AND OPERATION (Continued)

the passenger compartment; at the lower edge of instrument panel; near the steering column.

(2) Turn the ignition switch on and access the "Read Fault" screen.

(3) Record all the DTC's and "freeze frame" information shown on the DRB scan tool.

(4) To erase DTC's, use the "Erase Trouble Code" data screen on the DRB scan tool. **Do not erase any DTC's until problems have been investigated and repairs have been performed.**

DIAGNOSTIC TROUBLE CODE DESCRIPTIONS

(M) Check Engine Lamp (MIL) will illuminate during engine operation if this Diagnostic Trouble Code was recorded.		
(G) Generator Lamp Illuminated		
GENERIC SCAN TOOL CODE	DRB SCAN TOOL DISPLAY	DESCRIPTION OF DIAGNOSTIC TROUBLE CODE
P0106 (M)	Barometric Pressure Out of Range	MAP sensor input voltage out of an acceptable range detected during reading of barometric pressure at key-on.
P0107 (M)	Map Sensor Voltage Too Low	MAP sensor input below minimum acceptable voltage.
P0108 (M)	Map Sensor Voltage Too High	MAP sensor input above maximum acceptable voltage.
P0112 (M)	Intake Air Temp Sensor Voltage Low	Intake air (charge) temperature sensor input below the minimum acceptable voltage.
P0113 (M)	Intake Air Temp Sensor Voltage High	Intake air (charge) temperature sensor input above the maximum acceptable voltage.
P0116		A rationatily error has been detected in the coolant temp sensor.
P0117 (M)	ECT Sensor Voltage Too Low	Engine coolant temperature sensor input below the minimum acceptable voltage.
P0118 (M)	ECT Sensor Voltage Too High	Engine coolant temperature sensor input above the maximum acceptable voltage.
P0121 (M)	TPS Voltage Does Not Agree With MAP	TPS signal does not correlate to MAP sensor signal.
P0122 (M)	Throttle Position Sensor Voltage Low	Throttle position sensor input below the acceptable voltage range.
P0123 (M)	Throttle Position Sensor Voltage High	Throttle position sensor input above the maximum acceptable voltage.
P0125 (M)	Closed Loop Temp Not Reached	Time to enter Closed Loop Operation (Fuel Control) is excessive.
P0130	1/1 O2 Sensor Heater Relay Circuit	An open or shorted condition detected in the ASD or CNG shutoff relay control ckt.
P0131 (M)	1/1 O2 Sensor Shorted To Ground	Oxygen sensor input voltage maintained below normal operating range.
P0132 (M)	1/1 O2 Sensor Shorted To Voltage	Oxygen sensor input voltage maintained above normal operating range.
P0133 (M)	1/1 O2 Sensor Slow Response	Oxygen sensor response slower than minimum required switching frequency.
P0134 (M)	1/1 O2 Sensor Stays at Center	Neither rich or lean condition is detected from the oxygen sensor input.
P0135 (M)	1/1 O2 Sensor Heater Failure	Oxygen sensor heater element malfunction.
P0136	1/2 O2 Sensor Heater Relay Circuit	An open or shorted condition detected in the ASD or CNG shutoff relay control ckt.

DESCRIPTION AND OPERATION (Continued)

(M) Check Engine Lamp (MIL) will illuminate during engine operation if this Diagnostic Trouble Code was recorded.		
(G) Generator Lamp Illuminated		
GENERIC SCAN TOOL CODE	DRB SCAN TOOL DISPLAY	DESCRIPTION OF DIAGNOSTIC TROUBLE CODE
P0137 (M)	1/2 O2 Sensor Shorted To Ground	Oxygen sensor input voltage maintained below normal operating range.
P0138 (M)	1/2 O2 Sensor Shorted To Voltage	Oxygen sensor input voltage maintained above normal operating range.
P0139 (M)	1/2 O2 Sensor Slow Response	Oxygen sensor response not as expected.
P0140 (M)	1/2 O2 Sensor Stays at Center	Neither rich or lean condition is detected from the oxygen sensor.
P0141 (M)	1/2 O2 Sensor Heater Failure	Oxygen sensor heater element malfunction.
P0143	1/3 O2 Sensor Shorted To Ground	Oxygen sensor input voltage maintained below normal operating range.
P0144	1/3 O2 Sensor Shorted To Voltage	Oxygen sensor input voltage maintained above normal operating range.
P0145	1/3 O2 Sensor Slow Response	Oxygen sensor response slower than minimum required switching frequency.
P0146	1/3 O2 Sensor Stays at Center	Neither rich or lean condition is detected from the oxygen sensor.
P0147	1/3 O2 Sensor Heater Failure	Oxygen sensor heater element malfunction.
P0151 (M)	2/1 O2 Sensor Shorted To Ground	Oxygen sensor input voltage maintained below normal operating range.
P0152 (M)	2/1 O2 Sensor Shorted To Voltage	Oxygen sensor input voltage sustained above normal operating range.
P0153 (M)	2/1 O2 Sensor Slow Response	Oxygen sensor response slower than minimum required switching frequency.
P0154 (M)	2/1 O2 Sensor Stays at Center	Neither rich or lean condition is detected from the oxygen sensor.
P0155 (M)	2/1 O2 Sensor Heater Failure	Oxygen sensor heater element malfunction.
P0157 (M)	2/2 O2 Sensor Shorted To Ground	Oxygen sensor input voltage maintained below normal operating range.
P0158 (M)	2/2 O2 Sensor Shorted To Voltage	Oxygen sensor input voltage maintained above normal operating range.
P0159	2/2 O2 Sensor Slow Response	Oxygen sensor response slower than minimum required switching frequency.
P0160 (M)	2/2 O2 Sensor Stays at Center	Neither rich or lean condition is detected from the oxygen sensor.
P0161 (M)	2/2 O2 Sensor Heater Failure	Oxygen sensor heater element malfunction.
P0165	Starter Relay Control Circuit	An open or shorted condition detected in the starter relay control circuit.
P0171 (M)	1/1 Fuel System Lean	A lean air/fuel mixture has been indicated by an abnormally rich correction factor.
P0172 (M)	1/1 Fuel System Rich	A rich air/fuel mixture has been indicated by an abnormally lean correction factor.
P0174 (M)	2/1 Fuel System Lean	A lean air/fuel mixture has been indicated by an abnormally rich correction factor.

DESCRIPTION AND OPERATION (Continued)

(M) Check Engine Lamp (MIL) will illuminate during engine operation if this Diagnostic Trouble Code was recorded.		
(G) Generator Lamp Illuminated		
GENERIC SCAN TOOL CODE	DRB SCAN TOOL DISPLAY	DESCRIPTION OF DIAGNOSTIC TROUBLE CODE
P0175 (M)	2/1 Fuel System Rich	A rich air/fuel mixture has been indicated by an abnormally lean correction factor.
P0178	Water in Fuel Sensor Voltage Too Low	Flex fuel sensor input below minimum acceptable voltage.
P0179	Flex Fuel Sensor Volts Too High	Flex fuel sensor input above maximum acceptable voltage.
P0182	CNG Temp Sensor Voltage Too Low	Compressed natural gas temperature sensor voltage below acceptable voltage.
P0183	CNG Temp Sensor Voltage Too High	Compressed natural gas temperature sensor voltage above acceptable voltage.
P0201 (M)	Injector #1 Control Circuit	An open or shorted condition detected in control circuit for injector #1 or the INJ 1 injector bank.
P0202 (M)	Injector #2 Control Circuit	An open or shorted condition detected in control circuit for injector #2 or the INJ 2 injector bank.
P0203 (M)	Injector #3 Control Circuit	An open or shorted condition detected in control circuit for injector #3 or the INJ 3 injector bank.
P0204 (M)	Injector #4 Control Circuit	Injector #4 or INJ 4 injector bank output driver stage does not respond properly to the control signal.
P0205 (M)	Injector #5 Control Circuit	Injector #5 output driver stage does not respond properly to the control signal.
P0206 (M)	Injector #6 Control Circuit	Injector #6 output driver stage does not respond properly to the control signal.
P0207	Injector #7 Control Circuit	Injector #7 output driver stage does not respond properly to the control signal.
P0208	Injector #8 Control Circuit	Injector #8 output driver stage does not respond properly to the control signal.
P0209	Injector #9 Control Circuit	Injector #9 output driver stage does not respond properly to the control signal.
P0210	Injector #10 Control Circuit	Injector #10 output driver stage does not respond properly to the control signal.
P0300 (M)	Multiple Cylinder Mis-fire	Misfire detected in multiple cylinders.
P0301 (M)	CYLINDER #1 MISFIRE	Misfire detected in cylinder #1.
P0302 (M)	CYLINDER #2 MISFIRE	Misfire detected in cylinder #2.
P0303 (M)	CYLINDER #3 MISFIRE	Misfire detected in cylinder #3.
P0304 (M)	CYLINDER #4 MISFIRE	Misfire detected in cylinder #4.
P0305 (M)	CYLINDER #5 MISFIRE	Misfire detected in cylinder #5.
P0306 (M)	CYLINDER #6 MISFIRE	Misfire detected in cylinder #6.
P0307 (M)	CYLINDER #7 MISFIRE	Misfire detected in cylinder #7.
P0308 (M)	CYLINDER #8 MISFIRE	Misfire detected in cylinder #8.
P0309 (M)	CYLINDER #9 MISFIRE	Misfire detected in cylinder #9.
P0310 (M)	CYLINDER #10 MISFIRE	Misfire detected in cylinder #10.

DESCRIPTION AND OPERATION (Continued)

(M) Check Engine Lamp (MIL) will illuminate during engine operation if this Diagnostic Trouble Code was recorded.		
(G) Generator Lamp Illuminated		
GENERIC SCAN TOOL CODE	DRB SCAN TOOL DISPLAY	DESCRIPTION OF DIAGNOSTIC TROUBLE CODE
P0320	No Crank Reference Signal at PCM	No reference signal (crankshaft position sensor) detected during engine cranking.
P0325	Knock Sensor #1 Circuit	Knock sensor (#1) signal above or below minimum acceptable threshold voltage at particular engine speeds.
P0330	Knock Sensor #2 Circuit	Knock sensor (#2) signal above or below minimum acceptable threshold voltage at particular engine speeds.
P0340 (M)	No Cam Signal At PCM	No fuel sync
P0350	Ignition Coil Draws Too Much Current	A coil (1-5) is drawing too much current.
P0351 (M)	Ignition Coil # 1 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time.
P0352 (M)	Ignition Coil # 2 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time.
P0353 (M)	Ignition Coil # 3 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time.
P0354 (M)	Ignition Coil # 4 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time (High Impedance).
P0355 (M)	Ignition Coil # 5 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time (High Impedance).
P0356 (M)	Ignition Coil # 6 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time (high impedance).
P0357	Ignition Coil # 7 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time (high impedance).
P0358	Ignition Coil # 8 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time (high impedance).
P0401 (M)	EGR System Failure	Required change in air/fuel ration not detected during diagnostic test.
P0403 (M)	EGR Solenoid Circuit	An open or shorted condition detected in the EGR solenoid control circuit.
P0404 (M)	EGR Position Sensor Rationality	EGR position sensor signal does not correlate to EGR duty cycle.
P0405 (M)	EGR Position Sensor Volts Too Low	EGR position sensor input below the acceptable voltage range.
P0406 (M)	EGR Position Sensor Volts Too High	EGR position sensor input above the acceptable voltage range.
P0412	Secondary Air Solenoid Circuit	An open or shorted condition detected in the secondary air (air switching/aspirator) solenoid control circuit.
P0420 (M)	1/1 Catalytic Converter Efficiency	Catalyst 1/1 efficiency below required level.
P0432 (M)	1/2 Catalytic Converter Efficiency	Catalyst 2/1 efficiency below required level.
P0441 (M)	Evap Purge Flow Monitor	Insufficient or excessive vapor flow detected during evaporative emission system operation.
P0442 (M)	Evap Leak Monitor Medium Leak Detected	A small leak has been detected in the evaporative system.

DESCRIPTION AND OPERATION (Continued)

(M) Check Engine Lamp (MIL) will illuminate during engine operation if this Diagnostic Trouble Code was recorded.		
(G) Generator Lamp Illuminated		
GENERIC SCAN TOOL CODE	DRB SCAN TOOL DISPLAY	DESCRIPTION OF DIAGNOSTIC TROUBLE CODE
P0443 (M)	Evap Purge Solenoid Circuit	An open or shorted condition detected in the EVAP purge solenoid control circuit.
P0455 (M)	Evap Leak Monitor Large Leak Detected	A large leak has been detected in the evaporative system.
P0456	Evap Leak Monitor Small Leak Detected	A small leak has been detected in the evaporative system.
P0460	Fuel Level Unit No Change Over Miles	No movement of fuel level sender detected.
P0461	Fuel Level Unit No Changeover Time	No level of fuel level sender detected.
P0462	Fuel Level Sending Unit Volts Too Low	Fuel level sensor input below acceptable voltage.
P0463	Fuel Level Sending Unit Volts Too High	Fuel level sensor input above acceptable voltage.
P0500 (M)	No Vehicle Speed Sensor Signal	No vehicle speed sensor signal detected during road load conditions.
P0505 (M)	Idle Air Control Motor Circuits	Replace
P0522	Oil Pressure Sens Low	Oil pressure sensor input below acceptable voltage.
P0523	Oil Pressure Sens High	Oil pressure sensor input above acceptable voltage.
P0551 (M)	Power Steering Switch Failure	Incorrect input state detected for the power steering switch circuit. PL: High pressure seen at high speed.
P0600 (M)	PCM Failure SPI Communications	No communication detected between co-processors in the control module.
P0601 (M)	Internal Controller Failure	Internal control module fault condition (check sum) detected.
P0604	Internal Trans Controller	Transmission control module RAM self test fault detected. -Aisin transmission.
P0605	Internal Trans Controller	Transmission control module ROM self test fault detected -Aisin transmission.
P0622 (G)	Generator Field Not Switching Properly	An open or shorted condition detected in the generator field control circuit.
P0645	A/C Clutch Relay Circuit	An open or shorted condition detected in the A/C clutch relay control circuit.
P0700 (M)	EATX Controller DTC Present	This SBEC III or JTEC DTC indicates that the EATX or Aisin controller has an active fault and has illuminated the MIL via a CCD (EATX) or SCI (Aisin) message. The specific fault must be acquired from the EATX via CCD or from the Aisin via ISO-9141.
P0703 (M)	Brake Switch Stuck Pressed or Released	Incorrect input state detected in the brake switch circuit. (Changed from P1595).
P0711	Trans Temp Sensor, No Temp Rise After Start	Relationship between the transmission temperature and overdrive operation and/or TCC operation indicates a failure of the Transmission Temperature Sensor. OBD II Rationality.

DESCRIPTION AND OPERATION (Continued)

(M) Check Engine Lamp (MIL) will illuminate during engine operation if this Diagnostic Trouble Code was recorded.		
(G) Generator Lamp Illuminated		
GENERIC SCAN TOOL CODE	DRB SCAN TOOL DISPLAY	DESCRIPTION OF DIAGNOSTIC TROUBLE CODE
P0712	Trans Temp Sensor Voltage Too Low	Transmission fluid temperature sensor input below acceptable voltage.
P0713	Trans Temp Sensor Voltage Too High	Transmission fluid temperature sensor input above acceptable voltage.
P0720	Low Output SPD Sensor RPM, Above 15 MPH	The relationship between the Output Shaft Speed Sensor and vehicle speed is not within acceptable limits.
P0740 (M)	Torq Con Clu, No RPM Drop at Lockup	Relationship between engine and vehicle speeds indicated failure of torque converter clutch lock-up system (TCC/PTU sol).
P0743	Torque Converter Clutch Solenoid/Trans Relay Circuits	An open or shorted condition detected in the torque converter clutch (part throttle unlock) solenoid control circuit. Shift solenoid C electrical fault - Aisin transmission
P0748	Governor Pressur Sol Control/Trans Relay Circuits	An open or shorted condition detected in the Governor Pressure Solenoid circuit or Trans Relay Circuit in JTEC RE transmissions.
P0751	O/D Switch Pressed (Lo) More Than 5 Minutes	Overdrive override switch input is in a prolonged depressed state.
P0753	Trans 3-4 Shift Sol/Trans Relay Circuits	An open or shorted condition detected in the overdrive solenoid control circuit or Trans Relay Circuit in JTEC RE transmissions.
P0756	AW4 Shift Sol B (2-3) Functional Failure	Shift solenoid B (2-3) functional fault - Aisin transmission
P0783	3-4 Shift Sol, No RPM Drop at Lockup	The overdrive solenoid is unable to engage the gear change from 3rd gear to the overdrive gear.
P0801	Reverse Gear Lockout Circuit Open or Short	An open or shorted condition detected in the transmission reverse gear lock-out solenoid control circuit.
P01192	Inlet Air Temp. Circuit Low	Inlet Air Temp. sensor input below acceptable voltage
P01193	Inlet Air Temp. Circuit High	Inlet Air Temp. sensor input above acceptable voltage.
P1195 (M)	1/1 O2 Sensor Slow During Catalyst Monitor	A slow switching oxygen sensor has been detected in bank 1/1 during catalyst monitor test. (was P0133)
P1196 (M)	2/1 O2 Sensor Slow During Catalyst Monitor	A slow switching oxygen sensor has been detected in bank 2/1 during catalyst monitor test. (was P0153)
P1197	1/2 O2 Sensor Slow During Catalyst Monitor	A slow switching oxygen sensor has been detected in bank 1/2 during catalyst monitor test. (was P0139)
P1198	Radiator Temperature Sensor Volts Too High	Radiator coolant temperature sensor input above the maximum acceptable voltage.
P1199	Radiator Temperature Sensor Volts Too Low	Radiator coolant temperature sensor input below the minimum acceptable voltage.
P1281	Engine is Cold Too Long	Engine coolant temperature remains below normal operating temperatures during vehicle travel (Thermostat).
P1282	Fuel Pump Relay Control Circuit	An open or shorted condition detected in the fuel pump relay control circuit.
P1288	Intake Manifold Short Runner Solenoid Circuit	An open or shorted condition detected in the short runner tuning valve circuit.

DESCRIPTION AND OPERATION (Continued)

(M) Check Engine Lamp (MIL) will illuminate during engine operation if this Diagnostic Trouble Code was recorded.		
(G) Generator Lamp Illuminated		
GENERIC SCAN TOOL CODE	DRB SCAN TOOL DISPLAY	DESCRIPTION OF DIAGNOSTIC TROUBLE CODE
P1289	Manifold Tune Valve Solenoid Circuit	An open or shorted condition detected in the manifold tuning valve solenoid control circuit.
P1290	CNG Fuel System Pressure Too High	Compressed natural gas system pressure above normal operating range.
P1291	No Temp Rise Seen From Intake Heaters	Energizing Heated Air Intake does not change intake air temperature sensor an acceptable amount.
P1292	CNG Pressure Sensor Voltage Too High	Compressed natural gas pressure sensor reading above acceptable voltage.
P1293	CNG Pressure Sensor Voltage Too Low	Compressed natural gas pressure sensor reading below acceptable voltage.
P1294 (M)	Target Idle Not Reached	Target RPM not achieved during drive idle condition. Possible vacuum leak or IAC (AIS) lost steps.
P1295	No 5 Volts to TP Sensor	Loss of a 5 volt feed to the Throttle Position Sensor has been detected.
P1296	No 5 Volts to MAP Sensor	Loss of a 5 volt feed to the MAP Sensor has been detected.
P1297 (M)	No Change in MAP From Start To Run	No difference is recognized between the MAP reading at engine idle and the stored barometric pressure reading.
P1298	Lean Operation at Wide Open Throttle	A prolonged lean condition is detected during Wide Open Throttle.
P1299 (M)	Vacuum Leak Found (IAC Fully Seated)	MAP Sensor signal does not correlate to Throttle Position Sensor signal. Possible vacuum leak.
P1388	Auto Shutdown Relay Control Circuit	An open or shorted condition detected in the ASD or CNG shutoff relay control ckt.
P1389	No ASD Relay Output Voltage At PCM	No Z1 or Z2 voltage sensed when the auto shutdown relay is energized.
P1390 (M)	Timing Belt Skipped 1 Tooth or More	Relationship between Cam and Crank signals not correct.
P1391 (M)	Intermittent Loss of CMP or CKP	Loss of the Cam Position Sensor or Crank Position sensor has occurred. For PL 2.0L
P1398 (M)	Mis-Fire Adaptive Numerator at Limit	PCM is unable to learn the Crank Sensor's signal in preparation for Misfire Diagnostics. Probable defective Crank Sensor.
P1399	Wait To Start Lamp Cicuit	An open or shorted condition detected in the Wait to Start Lamp circuit.
P1403	No 5 Volts to EGR Sensor	Loss of 5v feed to the EGR position sensor.
P1476	Too Little Secondary Air	Insufficient flow of secondary air injection detected during aspirator test.(was P0411)
P1477	Too Much Secondary Air	Excessive flow of secondary air injection detected during aspirator test (was P0411).
P1478 (M)	Battery Temp Sensor Volts Out of Limit	Internal temperature sensor input voltage out of an acceptable range.
P1479	Transmission Fan Relay Circuit	An open or shorted condition detected in the transmission fan relay circuit.

DESCRIPTION AND OPERATION (Continued)

(M) Check Engine Lamp (MIL) will illuminate during engine operation if this Diagnostic Trouble Code was recorded.		
(G) Generator Lamp Illuminated		
GENERIC SCAN TOOL CODE	DRB SCAN TOOL DISPLAY	DESCRIPTION OF DIAGNOSTIC TROUBLE CODE
P1480	PCV Solenoid Circuit	An open or shorted condition detected in the PCV solenoid circuit.
P1482	Catalyst Temperature Sensor Circuit Shorted Low	Catalyst temperature sensor circuit shorted low.
P1483	Catalyst Temperature Sensor Circuit Shorted High.	Catalyst temperature sensor circuit shorted high.
P1484	Catalytic Converter Overheat Detected	A catalyst overheat condition has been detected by the catalyst temperature sensor.
P1485	Air Injection Solenoid Circuit	An open or shorted condition detected in the air assist solenoid circuit.
P1486 (M)	Evap Leak Monitor Pinched Hose Found	LDP has detected a pinched hose in the evaporative hose system.
P1487	Hi Speed Rad Fan CTRL Relay Circuit	An open or shorted condition detected in the control circuit of the #2 high speed radiator fan control relay.
P1488	Auxiliary 5 Volt Supply Output Too Low	Auxiliary 5 volt sensor feed is sensed to be below an acceptable limit.
P1489 (M)	High Speed Fan CTRL Relay Circuit	An open or shorted condition detected in the control circuit of the high speed radiator fan control relay.
P1490 (M)	Low Speed Fan CTRL Relay Circuit	An open or shorted condition detected in control circuit of the low speed radiator fan control relay.
P1491	Rad Fan Control Relay Circuit	An open or shorted condition detected in the radiator fan control relay control circuit. This includes PWM solid state relays.
P1492 (M,G)	Ambient/Batt Temp Sen Volts Too High	External temperature sensor input above acceptable voltage.
P1493 (M,G)	Ambient/Batt Temp Sen Volts Too Low	External temperature sensor input below acceptable voltage.
P1494 (M)	Leak Detection Pump Sw or Mechanical Fault	Incorrect input state detected for the Leak Detection Pump (LDP) pressure switch.
P1495 (M)	Leak Detection Pump Solenoid Circuit	An open or shorted condition detected in the Leak Detection Pump (LDP) solenoid circuit.
P1496 (M)	5 Volt Supply, Output Too Low	5 volt sensor feed is sensed to be below an acceptable limit. (< 4v for 4 sec).
P1498	High Speed Rad Fan Ground CTRL Rly Circuit	An open or shorted condition detected in the control circuit of the #3 high speed radiator fan control relay.
P1594 (G)	Charging System Voltage Too High	Battery voltage sense input above target charging voltage during engine operation.
P1595	Speed Control Solenoid Circuits	An open or shorted condition detected in either of the speed control vacuum or vent solenoid control circuits.
P1596	Speed Control Switch Always High	Speed control switch input above maximum acceptable voltage.
P1597	Speed Control Switch Always Low	Speed control switch input below minimum acceptable voltage.

DESCRIPTION AND OPERATION (Continued)

(M) Check Engine Lamp (MIL) will illuminate during engine operation if this Diagnostic Trouble Code was recorded.		
(G) Generator Lamp Illuminated		
GENERIC SCAN TOOL CODE	DRB SCAN TOOL DISPLAY	DESCRIPTION OF DIAGNOSTIC TROUBLE CODE
P1598	A/C Pressure Sensor Volts Too High	A/C pressure sensor input above maximum acceptable voltage.
P1599	A/C Pressure Sensor Volts Too Low	A/C pressure sensor input below minimum acceptable voltage.
P1680	Clutch Released Switch Circuit	
P1681	No I/P Cluster CCD/J1850 Messages Received	No CCD/J1850 messages received from the cluster control module.
P1682 (G)	Charging System Voltage Too Low	Battery voltage sense input below target charging voltage during engine operation and no significant change in voltage detected during active test of generator output circuit.
P1683	SPD CTRL PWR Relay; or S/C 12v Driver CKT	An open or shorted condition detected in the speed control servo power control circuit. (SBECII: ext relay).
P1684		The battery has been disconnected within the last 50 starts.
P1685	Skim Invalid Key	The engine controller has received an invalid key from the SKIM.
P1686	No SKIM BUS Messages Received	No CCD/J1850 messages received from the Smart Key Immobilizer Module (SKIM).
P1687	No MIC BUS Message	No CCD/J1850 messages received from the Mechanical Instrument Cluster (MIC) module.
P1693	DTC Detected in Companion Module	A fault has been generated in the companion engine control module.
P1694	Fault In Companion Module	No CCD/J1850 messages received from the powertrain control module-Aisin transmission.
P1695	No CCD/J1850 Message From Body Control Module	No CCD/J1850 messages received from the body control module.
P1696 (M)	PCM Failure EEPROM Write Denied	Unsuccessful attempt to write to an EEPROM location by the control module.
P1697 (M)	PCM Failure SRI Mile Not Stored	Unsuccessful attempt to update Service Reminder Indicator (SRI or EMR) mileage in the control module EEPROM.
P1698 (M)	No CCD/J1850 Message From TCM	No CCD/J1850 messages received from the electronic transmission control module (EATX) or the Aisin transmission controller.
P1719	Skip Shift Solenoid Circuit	An open or shorted condition detected in the transmission 2-3 gear lock-out solenoid control circuit.
P1756	GOV Press Not Equal to Target @ 15-20 PSI	The requested pressure and the actual pressure are not within a tolerance band for the Governor Control System which is used to regulate governor pressure to control shifts for 1st, 2nd, and 3rd gear. (Mid Pressure Malfunction)

DESCRIPTION AND OPERATION (Continued)

(M) Check Engine Lamp (MIL) will illuminate during engine operation if this Diagnostic Trouble Code was recorded.		
(G) Generator Lamp Illuminated		
GENERIC SCAN TOOL CODE	DRB SCAN TOOL DISPLAY	DESCRIPTION OF DIAGNOSTIC TROUBLE CODE
P1757	GOV Press Not Equal to Target @ 15-20 PSI	The requested pressure and the actual pressure are not within a tolerance band for the Governor Control System which is used to regulate governor pressure to control shifts for 1st, 2nd, and 3rd gear (Zero Pressure Malfunction)
P1762	Gov Press Sen Offset Volts Too Lo or High	The Governor Pressure Sensor input is greater than a calibration limit or is less than a calibration limit for 3 consecutive park/neutral calibrations.
P1763	Governor Pressure Sensor Volts Too Hi	The Governor Pressure Sensor input is above an acceptable voltage level.
P1764	Governor Pressure Sensor Volts Too Low	The Governor Pressure Sensor input is below an acceptable voltage level.
P1765	Trans 12 Volt Supply Relay CTRL Circuit	An open or shorted condition is detected in the Transmission Relay control circuit. This relay supplies power to the TCC>
P1899 (M)	P/N Switch Stuck in Park or in Gear	Incorrect input state detected for the Park/Neutral switch.

MONITORED SYSTEMS

DESCRIPTION

There are new electronic circuit monitors that check fuel, emission, engine and ignition performance. These monitors use information from various sensor circuits to indicate the overall operation of the fuel, engine, ignition and emission systems and thus the emissions performance of the vehicle.

The fuel, engine, ignition and emission systems monitors do not indicate a specific component problem. They do indicate that there is an implied problem within one of the systems and that a specific problem must be diagnosed.

If any of these monitors detect a problem affecting vehicle emissions, the Malfunction Indicator (Check Engine) Lamp will be illuminated. These monitors generate Diagnostic Trouble Codes that can be displayed with the check engine lamp or a scan tool.

The following is a list of the monitored systems:

- EGR Monitor
- Misfire Monitor
- Fuel System Monitor
- Evaporative Emissions Monitor

Following is a description of each system monitor, and its DTC.

Refer to the appropriate Powertrain Diagnostics Procedures manual for diagnostic procedures.

EGR MONITOR

The Powertrain Control Module (PCM) performs an on-board diagnostic check of the EGR system.

The EGR system consists of two main components: a vacuum solenoid back pressure transducer and a vacuum operated valve. The EGR monitor is used to test whether the EGR system is operating within specifications. The diagnostic check activates only during selected engine/driving conditions. When the conditions are met, the EGR is turned off (solenoid energized) and the O2S compensation control is monitored. Turning off the EGR shifts the air fuel (A/F) ratio in the lean direction. Oxygen sensor voltage then indicates increased oxygen in the exhaust. Consequently, Short Term Compensation shifts to rich (increased injector pulse width). By monitoring the shift, the PCM can indirectly monitor the EGR system. While this test does not directly measure the operation of the EGR system, it can be inferred from the shift in the O2S data whether the EGR system is operating correctly. Because the O2S is being used, the O2S test must pass its test before the EGR test.

Enabling Conditions—

- Engine Temperature
- Engine Run Time
- Engine RPM
- MAP Sensor
- TPS
- Vehicle Speed
- Short Term Compensation

DESCRIPTION AND OPERATION (Continued)

Pending Conditions— The EGR Monitor does not run when any of the following example faults have illuminated the MIL:

- Misfire
- Oxygen Sensor Monitor
- Oxygen Sensor Heater Monitor
- Fuel System Rich/Lean
- Limp in for MAP, TPS or ECT
- Vehicle Speed Sensor
- Cam or Crank Sensor
- EGR Electrical
- EVAP Electrical
- Fuel Injector
- Ignition Coil
- Idle Speed
- Engine Coolant Temperature (ECT)
- MAP Sensor
- Intake Air Temperature (IAT)

Conflict Conditions— The EGR Monitor typically does not run if any of the following conditions are present:

- Fuel System Monitor
- Purge Monitor
- Catalyst Monitor
- Low Fuel Level
- High Altitude
- Low Ambient Air Temperature

The EGR Monitor does not run if any of the following example DTCs are present:

- Misfire Monitor, Priority 2
- Upstream Oxygen Sensor Heater, Priority 1
- Fuel System Monitor, Priority 2
- Oxygen Sensor Monitor, Priority 1

MISFIRE MONITOR

Excessive engine misfire results in increased catalyst temperature and causes an increase in HC emissions. Severe misfires could cause catalyst damage. To prevent catalytic convertor damage, the PCM monitors engine misfire.

The Powertrain Control Module (PCM) monitors for misfire during most engine operating conditions (positive torque) by looking at changes in the crankshaft speed. If a misfire occurs the speed of the crankshaft will vary more than normal.

OBD II regulations for misfire monitoring require two different tests for misfire. The first is a Catalyst Damage level of misfire test. The second is for emissions greater than 1.5 times the Federal Tailpipe (FTP) standards. The tests are monitored by two different counters. These counters are:

- 200 revolution increments for immediate catalyst damage
- 1000 revolution increments for emissions violation and Inspection/Maintenance (I/M) test failure

NOTE: The percent of misfire for malfunction criteria varies due to RPM and load. As the engine speed increases or load decreases, the effects of a misfire diminishes due to crankshaft momentum. Failure percentages also vary from engine to engine.

Monitor Operation— The PCM utilizes the Crankshaft Speed Fluctuation method to monitor for misfire. The misfire monitor utilizes a crankshaft position sensor to determine engine RPM. The sensor can detect slight variations in engine speed due to misfire. Misfire is continuously monitored once the enabling conditions are met.

Once enabling conditions are met, the PCM counts the number of misfires in every 200 revolutions of the crankshaft. If, during **five** 200 counters, the misfire percentage exceeds a predetermined value, a maturing code is set and a Freeze Frame is entered. Freeze Frame data is recorded during the last 200 revolutions of the 1000 revolution period. A failure on the second consecutive trip matures the code and a DTC is set.

If misfire continues during the initial trip, the MIL is not illuminated. However, the MIL flashes when the misfire percentage exceeds the malfunction percentage, in any 200 revolution period, that would cause permanent catalyst damage. This is a one trip monitor. If misfire reaches a point in which catalyst damage is likely to occur, the MIL flashes and a DTC is stored in a Freeze Frame. The engine defaults to open loop operation to prevent increased fuel flow to the cylinders. Once misfire is below the predetermined percentage, the MIL stops flashing but remains illuminated.

The 1000 revolution counters are two trip monitors. As with the fuel system monitor, Freeze Frame data is from the original fault, and MIL extinguishing requires the monitor to pass under similar conditions.

The Adaptive Numerator— The Misfire Monitor takes into account component wear, sensor fatigue and machining tolerances. The PCM compares the crankshaft in the vehicle to data on an ideal crank and uses this as a basis to determine variance. To do this, the crankshaft sensor monitors the reference notches in the crank. The PCM uses the first signal set as a point of reference. It then measures where the second set of signals is, compared to where engineering data has determined it should be. This variance is the Adaptive Numerator. The monitor will not run if the numerator is not set.

If the Adaptive Numerator is equal to the default value, the adaptive Numerator has not been learned and the Misfire Monitor does not run. If the Adaptive Numerator exceeds its limits, the PCM sets a DTC for Adaptive Numerator and illuminates the MIL.

DESCRIPTION AND OPERATION (Continued)

RPM Error— The PCM also checks the machining tolerances for each group of slots. By monitoring the speed of the crank from the first slot to the last slot in a group, the PCM can calculate engine RPM. The variance between groups of slots is known as the RPM error. In order for the PCM to run the Misfire Monitor, RPM error must be less than approximately 5%.

Enabling Conditions— The following conditions must be met before the PCM runs the Misfire Monitor:

- RPM
- Engine Coolant Temperature (ECT)
- Barometric Pressure (MAP)
- Fuel level
- Ambient air Temperature

Pending Conditions— The Misfire Monitor does not run when the MIL is illuminated for any of the following:

- Limp in mode for
- MAP
- TPS
- Crankshaft Sensor
- Engine Coolant Temperature Sensor
- Speed Sensor DTC
 - EGR Electrical
 - EVAP Electrical
 - Idle Speed Faults
 - Intake Air Temperature
 - Oxygen Sensor Monitor
 - Oxygen Sensor Electrical

Conflict Conditions— If any of the following conditions conflict with the Misfire Monitor, the monitor will not run:

- Low fuel level
- MAP voltage rapidly changing
- Severe engine decel
- TPS toggling OPEN/CLOSED
- Engine RPM too low (RPM levels by vehicle)
- Engine RPM too high (RPM levels vary by vehicle)
- Full Lean or Decel Fuel Shut-off
- Cold start

FUEL SYSTEM MONITOR

To comply with clean air regulations, vehicles are equipped with catalytic converters. These converters reduce the emission of hydrocarbons, oxides of nitrogen and carbon monoxide. The catalyst works best when the air fuel (A/F) ratio is at or near the optimum of 14.7 to 1.

The PCM is programmed to maintain the optimum air/fuel ratio of 14.7 to 1. This is done by making short term corrections in the fuel injector pulse width based on the O2S output. The programmed memory acts as a self calibration tool that the engine controller uses to compensate for variations in engine spec-

ifications, sensor tolerances and engine fatigue over the life span of the engine. By monitoring the actual air-fuel ratio with the O2S (short term) and multiplying that with the program long-term (adaptive) memory and comparing that to the limit, it can be determined whether it will pass an emissions test. If a malfunction occurs such that the PCM cannot maintain the optimum A/F ratio, then the MIL will be illuminated.

Monitor Operation— Fuel systems monitors do not have a pre-test because they are continuously running monitors. Therefore, the PCM constantly monitors Short Term Compensation and Long Term Adaptive memory.

Lean: If at anytime during a lean engine operation, short term compensation multiplied by long term adaptive exceeds a certain percentage for an extended period, the PCM sets a Fuel System Lean Fault for that trip and a Freeze Frame is entered.

Rich: If at anytime during a rich operation, Short Term Compensation multiplied by Long Term Adaptive is less than a predetermined value, the PCM checks the Purge Free Cells.

Purge Free Cells are values placed in Adaptive Memory cells when the EVAP Purge Solenoid is OFF. Two, three or four Purge Free cells are used. One corresponds to an Adaptive Memory cell at idle, the other to a cell that is off-idle. For example, if a Purge Free cell is labeled PFC1, it would hold the value for Adaptive Memory cell C1 under non-purge conditions.

If all Purge Free Cells are less than a certain percentage, and the Adaptive Memory factor is less than a certain percentage, the PCM sets a Fuel System Rich fault for that trip and a Freeze Frame is entered.

The Fuel Monitor is a two trip monitor. The PCM records engine data in Freeze Frame upon setting of the first fault, or maturing code. When the fuel monitor fails on a second consecutive trip, the code is matured and the MIL is illuminated. The stored Freeze Frame data is still from the first fault.

In order for the PCM to extinguish the MIL, the Fuel Monitor must pass in a Similar Condition Window. The similar conditions relate to RPM and load. The engine must be within a predetermined percentage of both RPM and load when the monitor runs to count a good trip. As with all DTCs, three good trips are required to extinguish the MIL and 40 warm up cycles are required to erase the DTC. If the engine does not run in a Similar Conditions Window, the Task Manager extinguishes the MIL after 80 good trips.

Enabling Conditions— The following conditions must be met to operate the fuel control monitor:

- PCM not in fuel crank mode (engine running)

DESCRIPTION AND OPERATION (Continued)

- PCM in Closed Loop fuel control
- Fuel system updating Long Term Adaptive
- Fuel level above 15% of capacity
- Fuel level below 85% of capacity

Pending Conditions— The Fuel Control Monitor does not operate if the MIL is illuminated for any of the following:

- Misfire Monitor
- Upstream O2S
- EVAP Purge Solenoid Electrical PCM Self Test

Fault

- Camshaft or Crankshaft Position Sensor
- Fuel Injectors
- Ignition Coil Primary
- Throttle Position (TPS) Sensor
- Engine Coolant Temperature (ECT) Sensor
- Manifold Absolute Pressure (MAP) Sensor
- Idle Air Control (IAC)
- 5V Output Too Low
- EGR Monitor
- EGR Solenoid Circuit
- Vehicle Speed Sensor
- Oxygen Sensor Monitor
- Oxygen Sensor Heater Monitor
- Oxygen Sensor Electrical
- Idle Speed Rationality
- Intake Air Temperature

Suspend— The Task Manager will suspend maturing a Fuel System fault if any of the following are present:

- Oxygen Sensor Response, Priority 1
- O2 Heater, Priority 1
- Misfire Monitor, Priority 2

EVAPORATIVE EMISSIONS MONITOR

LEAK DETECTION PUMP MONITOR— The leak detection assembly incorporates two primary functions: it must detect a leak in the evaporative system and seal the evaporative system so the leak detection test can be run.

The primary components within the assembly are: A three port solenoid that activates both of the functions listed above; a pump which contains a switch, two check valves and a spring/diaphragm, a canister vent valve (CVV) seal which contains a spring loaded vent seal valve.

Immediately after a cold start, between predetermined temperature thresholds limits, the three port solenoid is briefly energized. This initializes the pump by drawing air into the pump cavity and also closes the vent seal. During non test conditions the vent seal is held open by the pump diaphragm assembly which pushes it open at the full travel position. The vent seal will remain closed while the pump is cycling due to the reed switch triggering of the three port solenoid that prevents the diaphragm

assembly from reaching full travel. After the brief initialization period, the solenoid is de-energized allowing atmospheric pressure to enter the pump cavity, thus permitting the spring to drive the diaphragm which forces air out of the pump cavity and into the vent system. When the solenoid is energized and de energized, the cycle is repeated creating flow in typical diaphragm pump fashion. The pump is controlled in 2 modes:

Pump Mode: The pump is cycled at a fixed rate to achieve a rapid pressure build in order to shorten the overall test length.

Test Mode: The solenoid is energized with a fixed duration pulse. Subsequent fixed pulses occur when the diaphragm reaches the Switch closure point.

The spring in the pump is set so that the system will achieve an equalized pressure of about 7.5" H2O. The cycle rate of pump strokes is quite rapid as the system begins to pump up to this pressure. As the pressure increases, the cycle rate starts to drop off. If there is no leak in the system, the pump would eventually stop pumping at the equalized pressure. If there is a leak, it will continue to pump at a rate representative of the flow characteristic of the size of the leak. From this information we can determine if the leak is larger than the required detection limit (currently set at .040" orifice by CARB). If a leak is revealed during the leak test portion of the test, the test is terminated at the end of the test mode and no further system checks will be performed.

After passing the leak detection phase of the test, system pressure is maintained by turning on the LDP's solenoid until the purge system is activated. Purge activation in effect creates a leak. The cycle rate is again interrogated and when it increases due to the flow through the purge system, the leak check portion of the diagnostic is complete.

The canister vent valve will unseal the system after completion of the test sequence as the pump diaphragm assembly moves to the full travel position.

Evaporative system functionality will be verified by using the stricter evap purge flow monitor. At an appropriate warm idle the LDP will be energized to seal the canister vent. The purge flow will be clocked up from some small value in an attempt to see a shift in the O2 control system. If fuel vapor, indicated by a shift in the O2 control, is present the test is passed. If not, it is assumed that the purge system is not functioning in some respect. The LDP is again turned off and the test is ended.

Enabling Conditions for Systems with LDP

- Ambient Air Temperature
- Barometric Pressure
- Fuel level
- Engine Temperature
- No stalling

DESCRIPTION AND OPERATION (Continued)

- Battery voltage

NON-LDP VEHICLES— On a vehicle without an EVAP leak detection pump system, changes in short term memory and movement in target IAC at idle or idle speed change, are used to monitor the system. There are two stages for this test.

Stage One— Stage one is a non-intrusive test. The PCM compares adaptive memory values between purge and purge-free cells. The PCM uses these values to determine the amount of fuel vapors entering the system. If the difference between the cells exceeds a predetermined value, the test passes. If not, then the monitor advances to state two.

Stage Two— Once the enabling conditions are met, the PCM de-energizes the Duty Cycle Purge (DCP) solenoid. The PCM then waits until engine RPM, Short Term Compensation and Idle Air Control have all stabilized. Once stable, the PCM increments the DCP solenoid cycle rate approximately 6% every 8 engine revolutions. If during the test any one of three conditions occur before the DCP cycle reaches 100%, the EVAP system is considered to be operational and the test passes. These conditions are as follows:

- RPM rises by a predetermined amount
- Short Term drops by a predetermined amount
- Idle Air Control closes by a predetermined amount

When none of the previous conditions occur, the test fails and the PCM increments a counter by one. When the PCM runs the test three times during a trip, and the counter has been incremented to three, the monitor fails and a Freeze Frame is stored.

Enabling Conditions (Stage Two)— The following conditions must be met to enable the EVAP Monitor (without LDP)

- Ambient Air Temperature
- Barometric Pressure
- Fuel level
- Engine Temperature
- Engine run time
- RPM stable
- MAP
- Generator, radiator fans, A/C clutch

Pending Conditions-With or Without LDP— The EVAP Monitor is suspended and does not run, when the MIL is illuminated due to any of the following faults:

- Misfire
- Oxygen Sensor Monitor
- Fuel System Rich
- Fuel System Lean
- EGR Monitor
- MAP
- TPS
- ECT

- DCP Solenoid

Conflict Conditions-With or Without LDP

The EVAP Monitor does not run if any of the following tests are in progress:

- Catalyst
- EGR
- Fuel System
- Misfire

TRIP DEFINITION

OPERATION

A "Trip" means vehicle operation (following an engine-off period) of duration and driving mode such that all components and systems are monitored at least once by the diagnostic system. The monitors must successfully pass before the PCM can verify that a previously malfunctioning component is meeting the normal operating conditions of that component. For misfire or fuel system malfunction, the MIL may be extinguished if the fault does not recur when monitored during three subsequent sequential driving cycles in which conditions are similar to those under which the malfunction was first determined.

Anytime the MIL is illuminated, a DTC is stored. The DTC can self erase only when the MIL has been extinguished. Once the MIL is extinguished, the PCM must pass the diagnostic test for the most recent DTC for 40 warm-up cycles (80 warm-up cycles for the Fuel System Monitor and the Misfire Monitor). A warm-up cycle can best be described by the following:

- The engine must be running
- A rise of 40°F in engine temperature must occur from the time when the engine was started
- Engine coolant temperature must reach at least 160°F
- A "driving cycle" that consists of engine start up and engine shut off.

Once the above conditions occur, the PCM is considered to have passed a warm-up cycle. Due to the conditions required to extinguish the MIL and erase the DTC, it is most important that after a repair has been made, all DTC's be erased and the repair verified.

MONITORED COMPONENT

DESCRIPTION

There are several components that will affect vehicle emissions if they malfunction. If one of these components malfunctions the Malfunction Indicator Lamp (Check Engine) will illuminate.

Some of the component monitors are checking for proper operation of the part. Electrically operated

DESCRIPTION AND OPERATION (Continued)

components now have input (rationality) and output (functionality) checks. Previously, a component like the Throttle Position sensor (TPS) was checked by the PCM for an open or shorted circuit. If one of these conditions occurred, a DTC was set. Now there is a check to ensure that the component is working. This is done by watching for a TPS indication of a greater or lesser throttle opening than MAP and engine rpm indicate. In the case of the TPS, if engine vacuum is high and engine rpm is 1600 or greater and the TPS indicates a large throttle opening, a DTC will be set. The same applies to low vacuum and 1600 rpm.

Any component that has an associated limp in will set a fault after 1 trip with the malfunction present.

Refer to the Diagnostic Trouble Codes Description Charts in this section and the appropriate Powertrain Diagnostic Procedure Manual for diagnostic procedures.

The following is a list of the monitored components:

- Comprehensive Components
- Oxygen Sensor Monitor
- Oxygen Sensor Heater Monitor
- Catalyst Monitor

COMPREHENSIVE COMPONENTS

Along with the major monitors, OBD II requires that the diagnostic system monitor any component that could affect emissions levels. In many cases, these components were being tested under OBD I. The OBD I requirements focused mainly on testing emissions-related components for electrical opens and shorts.

However, OBD II also requires that inputs from powertrain components to the PCM be tested for **rationality**, and that outputs to powertrain components from the PCM be tested for **functionality**. Methods for monitoring the various Comprehensive Component monitoring include:

- (1) Circuit Continuity
 - Open
 - Shorted high
 - Shorted to ground
- (2) Rationality or Proper Functioning
 - Inputs tested for rationality
 - Outputs tested for functionality

NOTE: Comprehensive component monitors are continuous. Therefore, enabling conditions do not apply.

Input Rationality— While input signals to the PCM are constantly being monitored for electrical opens and shorts, they are also tested for rationality. This means that the input signal is compared against

other inputs and information to see if it makes sense under the current conditions.

PCM sensor inputs that are checked for rationality include:

- Manifold Absolute Pressure (MAP) Sensor
- Oxygen Sensor (O2S)
- Engine Coolant Temperature (ECT) Sensor
- Camshaft Position (CMP) Sensor
- Vehicle Speed Sensor
- Crankshaft Position (CKP) Sensor
- Intake Air Temperature (IAT) Sensor
- Throttle Position (TPS) Sensor
- Ambient/Battery Temperature Sensors
- Power Steering Switch
- Oxygen Sensor Heater
- Engine Controller
- Brake Switch
- Leak Detection Pump Switch
- P/N Switch
- Trans Controls

Output Functionality— PCM outputs are tested for functionality in addition to testing for opens and shorts. When the PCM provides a voltage to an output component, it can verify that the command was carried out by monitoring specific input signals for expected changes. For example, when the PCM commands the Idle Air Control (IAC) Motor to a specific position under certain operating conditions, it expects to see a specific (target) idle speed (RPM). If it does not, it stores a DTC.

PCM outputs monitored for functionality include:

- Fuel Injectors
- Ignition Coils
- Torque Converter Clutch Solenoid
- Idle Air Control
- Purge Solenoid
- EGR Solenoid
- LDP Solenoid
- Radiator Fan Control
- Trans Controls

OXYGEN SENSOR (O2S) MONITOR

DESCRIPTION— Effective control of exhaust emissions is achieved by an oxygen feedback system. The most important element of the feedback system is the O2S. The O2S is located in the exhaust path. Once it reaches operating temperature 300° to 350°C (572° to 662°F), the sensor generates a voltage that is inversely proportional to the amount of oxygen in the exhaust. When there is a large amount of oxygen in the exhaust caused by a lean condition, the sensor produces a low voltage, below 450 mV. When the oxygen content is lower, caused by a rich condition, the sensor produces a higher voltage, above 450mV.

The information obtained by the sensor is used to calculate the fuel injector pulse width. This main-

DESCRIPTION AND OPERATION (Continued)

tains a 14.7 to 1 air fuel (A/F) ratio. At this mixture ratio, the catalyst works best to remove hydrocarbons (HC), carbon monoxide (CO) and nitrous oxide (NOx) from the exhaust.

The O2S is also the main sensing element for the EGR, Catalyst and Fuel Monitors.

The O2S may fail in any or all of the following manners:

- Slow response rate (Big Slope)
- Reduced output voltage (Half Cycle)
- Heater Performance

Slow Response Rate (Big Slope)— Response rate is the time required for the sensor to switch from lean to rich signal output once it is exposed to a richer than optimum A/F mixture or vice versa. As the PCM adjusts the air/fuel ratio, the sensor must be able to rapidly detect the change. As the sensor ages, it could take longer to detect the changes in the oxygen content of the exhaust gas. The rate of change that an oxygen sensor experiences is called 'Big Slope'. The PCM checks the oxygen sensor voltage in increments of a few milliseconds.

Reduced Output Voltage (Half Cycle)— The output voltage of the O2S ranges from 0 to 1 volt. A good sensor can easily generate any output voltage in this range as it is exposed to different concentrations of oxygen. To detect a shift in the A/F mixture (lean or rich), the output voltage has to change beyond a threshold value. A malfunctioning sensor could have difficulty changing beyond the threshold value. Each time the voltage signal surpasses the threshold, a counter is incremented by one. This is called the Half Cycle Counter.

Heater Performance— The heater is tested by a separate monitor. Refer to the Oxygen Sensor Heater Monitor.

OPERATION— As the Oxygen Sensor signal switches, the PCM monitors the half cycle and big slope signals from the oxygen sensor. If during the test neither counter reaches a predetermined value, a malfunction is entered and a Freeze Frame is stored. Only one counter reaching its predetermined value is needed for the monitor to pass.

The Oxygen Sensor Monitor is a two trip monitor that is tested only once per trip. When the Oxygen Sensor fails the test in two consecutive trips, the MIL is illuminated and a DTC is set. The MIL is extinguished when the Oxygen Sensor monitor passes in three consecutive trips. The DTC is erased from memory after 40 consecutive warm-up cycles without test failure.

Enabling Conditions— The following conditions must typically be met for the PCM to run the oxygen sensor monitor:

- Battery voltage
- Engine temperature

- Engine run time
- Engine run time at a predetermined speed
- Engine run time at a predetermined speed and throttle opening
- Transmission in gear (automatic only)
- Fuel system in Closed Loop
- Long Term Adaptive (within parameters)
- Power Steering Switch in low PSI (no load)
- Engine at idle
- Fuel level above 15%
- Ambient air temperature
- Barometric pressure
- Engine RPM within acceptable range of desired idle
- Closed throttle speed

Pending Conditions— The Task Manager typically does not run the Oxygen Sensor Monitor if overlapping monitors are running or the MIL is illuminated for any of the following:

- Misfire Monitor
- Front Oxygen Sensor and Heater Monitor
- MAP Sensor
- Vehicle Speed Sensor
- Engine Coolant Temperature Sensor
- Throttle Position Sensor
- Engine Controller Self Test Faults
- Cam or Crank Sensor
- Injector and Coil
- Idle Air Control Motor
- EVAP Electrical
- EGR Solenoid Electrical
- Intake Air Temperature
- 5 Volt Feed

Conflict— The Task Manager does not run the Oxygen Sensor Monitor if any of the following conditions are present:

- A/C ON (A/C clutch cycling temporarily suspends monitor)
- Purge flow in progress

Suspend— The Task Manager suspends maturing a fault for the Oxygen Sensor Monitor if any of the following are present:

- Oxygen Sensor Heater Monitor, Priority 1
- Misfire Monitor, Priority 2

OXYGEN SENSOR HEATER MONITOR

DESCRIPTION— If there is an oxygen sensor (O2S) DTC as well as a O2S heater DTC, the O2S fault MUST be repaired first. After the O2S fault is repaired, verify that the heater circuit is operating correctly.

The voltage readings taken from the O2S are very temperature sensitive. The readings are not accurate below 300°C. Heating of the O2S is done to allow the engine controller to shift to closed loop control as soon as possible. The heating element used to heat

DESCRIPTION AND OPERATION (Continued)

the O2S must be tested to ensure that it is heating the sensor properly.

The heater element itself is not tested. The sensor output is used to test the heater by isolating the effect of the heater element on the O2S output voltage from the other effects. The resistance is normally between 100 ohms and 4.5 megaohms. When oxygen sensor temperature increases, the resistance in the internal circuit decreases. The PCM sends a 5 volts biased signal through the oxygen sensors to ground this monitoring circuit. As the temperature increases, resistance decreases and the PCM detects a lower voltage at the reference signal. Inversely, as the temperature decreases, the resistance increases and the PCM detects a higher voltage at the reference signal. The O2S circuit is monitored for a drop in voltage.

OPERATION— The Oxygen Sensor Heater Monitor begins after the ignition has been turned OFF and the O2 sensors have cooled. The PCM sends a 5 volt bias to the oxygen sensor every 1.6 seconds. The PCM keeps it biased for 35 ms each time. As the sensor cools down, the resistance increases and the PCM reads the increase in voltage. Once voltage has increased to a predetermined amount, higher than when the test started, the oxygen sensor is cool enough to test heater operation.

When the oxygen sensor is cool enough, the PCM energizes the ASD relay. Voltage to the O2 sensor begins to increase the temperature. As the sensor temperature increases, the internal resistance decreases. The PCM continues biasing the 5 volt signal to the sensor. Each time the signal is biased, the PCM reads a voltage decrease. When the PCM detects a voltage decrease of a predetermined value for several biased pulses, the test passes.

The heater elements are tested each time the engine is turned OFF if all the enabling conditions are met. If the monitor fails, the PCM stores a maturing fault and a Freeze Frame is entered. If two consecutive tests fail, a DTC is stored. Because the ignition is OFF, the MIL is illuminated at the beginning of the next key cycle.

Enabling Conditions— The following conditions must be met for the PCM to run the oxygen sensor heater test:

- Engine run time of at least 5.1 minutes
- Key OFF power down
- Battery voltage of at least 10 volts
- Sufficient Oxygen Sensor cool down

Pending Conditions— There are not conditions or situations that prompt conflict or suspension of testing. The oxygen sensor heater test is not run pending resolution of MIL illumination due to oxygen sensor failure.

Suspend— There are no conditions which exist for suspending the Heater Monitor.

CATALYST MONITOR

To comply with clean air regulations, vehicles are equipped with catalytic converters. These converters reduce the emission of hydrocarbons, oxides of nitrogen and carbon monoxide.

Normal vehicle miles or engine misfire can cause a catalyst to decay. A meltdown of the ceramic core can cause a reduction of the exhaust passage. This can increase vehicle emissions and deteriorate engine performance, driveability and fuel economy.

The catalyst monitor uses dual oxygen sensors (O2S's) to monitor the efficiency of the converter. The dual O2S strategy is based on the fact that as a catalyst deteriorates, its oxygen storage capacity and its efficiency are both reduced. By monitoring the oxygen storage capacity of a catalyst, its efficiency can be indirectly calculated. The upstream O2S is used to detect the amount of oxygen in the exhaust gas before the gas enters the catalytic converter. The PCM calculates the A/F mixture from the output of the O2S. A low voltage indicates high oxygen content (lean mixture). A high voltage indicates a low content of oxygen (rich mixture).

When the upstream O2S detects a lean condition, there is an abundance of oxygen in the exhaust gas. A functioning converter would store this oxygen so it can use it for the oxidation of HC and CO. As the converter absorbs the oxygen, there will be a lack of oxygen downstream of the converter. The output of the downstream O2S will indicate limited activity in this condition.

As the converter loses the ability to store oxygen, the condition can be detected from the behavior of the downstream O2S. When the efficiency drops, no chemical reaction takes place. This means the concentration of oxygen will be the same downstream as upstream. The output voltage of the downstream O2S copies the voltage of the upstream sensor. The only difference is a time lag (seen by the PCM) between the switching of the O2S's.

To monitor the system, the number of lean-to-rich switches of upstream and downstream O2S's is counted. The ratio of downstream switches to upstream switches is used to determine whether the catalyst is operating properly. An effective catalyst will have fewer downstream switches than it has upstream switches i.e., a ratio closer to zero. For a totally ineffective catalyst, this ratio will be one-to-one, indicating that no oxidation occurs in the device.

The system must be monitored so that when catalyst efficiency deteriorates and exhaust emissions increase to over the legal limit, the MIL (check engine lamp) will be illuminated.

Monitor Operation— To monitor catalyst efficiency, the PCM expands the rich and lean switch points of the heated oxygen sensor. With extended

DESCRIPTION AND OPERATION (Continued)

switch points, the air/fuel mixture runs richer and leaner to overburden the catalytic converter. Once the test is started, the air/fuel mixture runs rich and lean and the O₂ switches are counted. A switch is counted when an oxygen sensor signal goes from below the lean threshold to above the rich threshold. The number of Rear O₂ sensor switches is divided by the number of Front O₂ sensor switches to determine the switching ratio.

The test runs for 20 seconds. As catalyst efficiency deteriorated over the life of the vehicle, the switch rate at the downstream sensor approaches that of the upstream sensor. If at any point during the test period the switch ratio reaches a predetermined value, a counter is incremented by one. The monitor is enabled to run another test during that trip. When the test fails three times, the counter increments to three, a malfunction is entered, and a Freeze Frame is stored. When the counter increments to three during the next trip, the code is matured and the MIL is illuminated. If the test passes the first, no further testing is conducted during that trip.

The MIL is extinguished after three consecutive good trips. The good trip criteria for the catalyst monitor is more stringent than the failure criteria. In order to pass the test and increment one good trip, the downstream sensor switch rate must be less than 80% of the upstream rate (60% for manual transmissions). The failure percentages are 90% and 70% respectively.

Enabling Conditions— The following conditions must typically be met before the PCM runs the catalyst monitor. Specific times for each parameter may be different from engine to engine.

- Accumulated drive time
- Enable time
- Ambient air temperature
- Barometric pressure
- Catalyst warm-up counter
- Engine coolant temperature
- Accumulated throttle position sensor
- Vehicle speed
- MAP
- RPM
- Engine in closed loop
- Fuel level

Pending Conditions—

- Misfire DTC
- Front Oxygen Sensor Response
- Front Oxygen Sensor Heater Monitor
- Front Oxygen Sensor Electrical
- Rear Oxygen Sensor Rationality (middle check)
- Rear Oxygen Sensor Heater Monitor
- Rear Oxygen Sensor Electrical
- Fuel System Monitor
- All TPS faults

- All MAP faults
- All ECT sensor faults
- Purge flow solenoid functionality
- Purge flow solenoid electrical
- All PCM self test faults
- All CMP and CKP sensor faults
- All injector and ignition electrical faults
- Idle Air Control (IAC) motor functionality
- Vehicle Speed Sensor
- Brake switch
- Intake air temperature

Conflict— The catalyst monitor does not run if any of the following are conditions are present:

- EGR Monitor in progress
- Fuel system rich intrusive test in progress
- EVAP Monitor in progress
- Time since start is less than 60 seconds
- Low fuel level
- Low ambient air temperature

Suspend— The Task Manager does not mature a catalyst fault if any of the following are present:

- Oxygen Sensor Monitor, Priority 1
- Upstream Oxygen Sensor Heater, Priority 1
- EGR Monitor, Priority 1
- EVAP Monitor, Priority 1
- Fuel System Monitor, Priority 2
- Misfire Monitor, Priority 2

NON-MONITORED CIRCUITS

OPERATION

The PCM does not monitor all circuits, systems and conditions that could have malfunctions causing driveability problems. However, problems with these systems may cause the PCM to store diagnostic trouble codes for other systems or components. For example, a fuel pressure problem will not register a fault directly, but could cause a rich/lean condition or misfire. This could cause the PCM to store an oxygen sensor or misfire diagnostic trouble code.

The major non-monitored circuits are listed below along with examples of failures modes that do not directly cause the PCM to set a DTC, but for a system that is monitored.

FUEL PRESSURE

The fuel pressure regulator controls fuel system pressure. The PCM cannot detect a clogged fuel pump inlet filter, clogged in-line fuel filter, or a pinched fuel supply or return line. However, these could result in a rich or lean condition causing the PCM to store an oxygen sensor or fuel system diagnostic trouble code.

DESCRIPTION AND OPERATION (Continued)

SECONDARY IGNITION CIRCUIT

The PCM cannot detect an inoperative ignition coil, fouled or worn spark plugs, ignition cross firing, or open spark plug cables.

CYLINDER COMPRESSION

The PCM cannot detect uneven, low, or high engine cylinder compression.

EXHAUST SYSTEM

The PCM cannot detect a plugged, restricted or leaking exhaust system. It may set a EGR or Fuel system fault or O2S.

FUEL INJECTOR MECHANICAL MALFUNCTIONS

The PCM cannot determine if a fuel injector is clogged, the needle is sticking or if the wrong injector is installed. However, these could result in a rich or lean condition causing the PCM to store a diagnostic trouble code for either misfire, an oxygen sensor, or the fuel system.

EXCESSIVE OIL CONSUMPTION

Although the PCM monitors engine exhaust oxygen content when the system is in closed loop, it cannot determine excessive oil consumption.

THROTTLE BODY AIR FLOW

The PCM cannot detect a clogged or restricted air cleaner inlet or filter element.

VACUUM ASSIST

The PCM cannot detect leaks or restrictions in the vacuum circuits of vacuum assisted engine control

system devices. However, these could cause the PCM to store a MAP sensor diagnostic trouble code and cause a high idle condition.

PCM SYSTEM GROUND

The PCM cannot determine a poor system ground. However, one or more diagnostic trouble codes may be generated as a result of this condition. The module should be mounted to the body at all times, also during diagnostic.

PCM CONNECTOR ENGAGEMENT

The PCM may not be able to determine spread or damaged connector pins. However, it might store diagnostic trouble codes as a result of spread connector pins.

HIGH AND LOW LIMITS**OPERATION**

The PCM compares input signal voltages from each input device with established high and low limits for the device. If the input voltage is not within limits and other criteria are met, the PCM stores a diagnostic trouble code in memory. Other diagnostic trouble code criteria might include engine RPM limits or input voltages from other sensors or switches that must be present before verifying a diagnostic trouble code condition.

SPECIFICATIONS

LOAD VALUE

ENGINE	IDLE/NEUTRAL	2500 RPM/NEUTRAL
2.4L DOHC	2% to 8% of Maximum Load	7% to 15% of Maximum Load
2.5L SOHC	2% to 8% of Maximum Load	7% to 15% of Maximum Load

EVAPORATIVE EMISSION CONTROLS

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DESCRIPTION AND OPERATION

EVAPORATION CONTROL SYSTEM

OPERATION

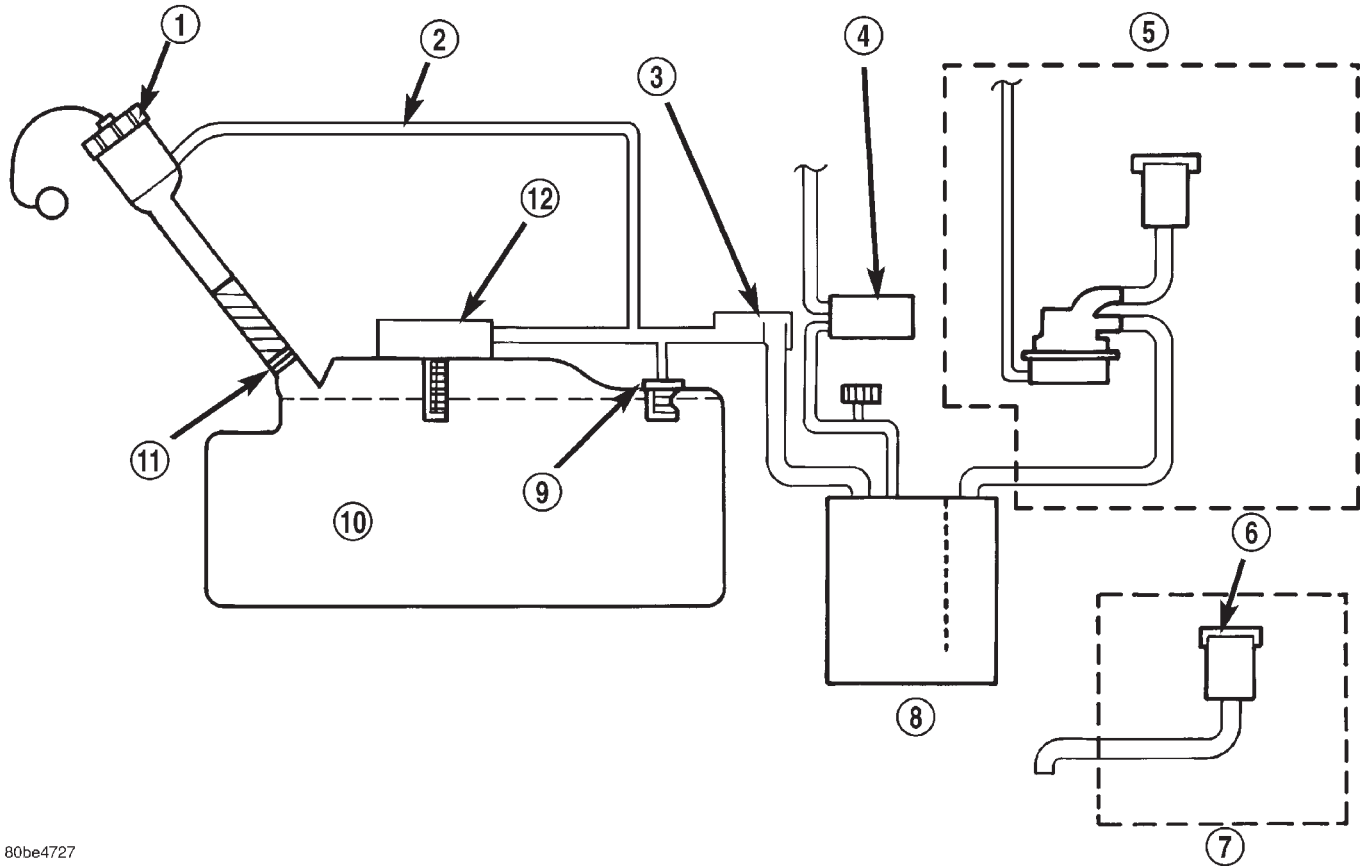
The evaporation control system prevents the emission of fuel tank vapors into the atmosphere. When fuel evaporates in the fuel tank, the vapors pass through vent hoses or tubes to an activated carbon filled evaporative canister. The canister temporarily holds the vapors. The Powertrain Control Module (PCM) allows intake manifold vacuum to draw vapors into the combustion chambers during certain operating conditions.

All engines use a proportional purge solenoid system. The PCM controls vapor flow by operating the purge solenoid. Refer to Proportional Purge Solenoid in this section.

NOTE: The evaporative system uses specially manufactured hoses. If they need replacement, only use fuel resistant hose. Also the hoses must be able to pass an Ozone compliance test.

NOTE: For more information on Onboard Refueling Vapor Recovery (ORVR), refer to the Fuel Delivery section.

DESCRIPTION AND OPERATION (Continued)



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ORVR System Schematic

- | | |
|------------------------|--------------------|
| 1 - FUEL CAP | 7 - W/O LDP |
| 2 - RECIRCULATION TUBE | 8 - CANISTER |
| 3 - LIQUID SEPARATOR | 9 - ROLLOVER VALVE |
| 4 - PURGE | 10 - FUEL TANK |
| 5 - W/LDP | 11 - CHECK VALVE |
| 6 - BREATHER ELEMENT | 12 - CONTROL VALVE |

EVAP CANISTER**DESCRIPTION**

The canister mounts to a bracket on top of the fuel tank (Fig. 1). The vacuum and vapor tube connect to the top of the canister.

OPERATION

All vehicles use a sealed, maintenance free, evaporative (EVAP) canister. Fuel tank pressure vents into the canister. The canister temporarily holds the fuel vapors until intake manifold vacuum draws them into the combustion chamber. The Powertrain Control Module (PCM) purges the canister through the duty cycle EVAP purge solenoid. The PCM purges the canister at predetermined intervals and engine conditions.

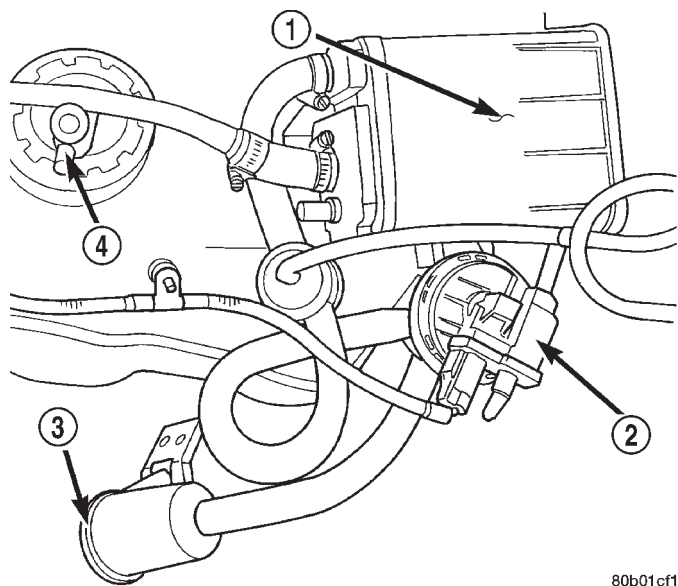
PROPORTIONAL PURGE SOLENOID**DESCRIPTION****OPERATION**

All vehicles use a proportional purge solenoid. The solenoid regulates the rate of vapor flow from the EVAP canister to the throttle body. The PCM operates the solenoid.

During the cold start warm-up period and the hot start time delay, the PCM does not energize the solenoid. When de-energized, no vapors are purged.

The proportional purge solenoid operates at a frequency of 200 hz and is controlled by an engine controller circuit that senses the current being applied to the proportional purge solenoid and then adjusts that current to achieve the desired purge flow. The proportional purge solenoid controls the purge rate of

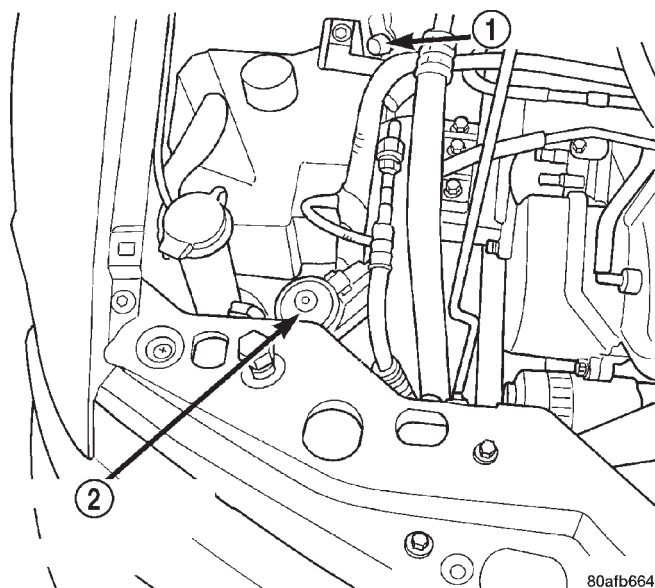
DESCRIPTION AND OPERATION (Continued)



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Fig. 1 EVAP Canister

- 1 - EVAP CANISTER
- 2 - LDP
- 3 - LDP FILTER
- 4 - ORVR VALVE



80afb664

Fig. 2 Proportional Purge Solenoid

- 1 - TEST PORT
- 2 - PROPORTIONAL PURGE SOLENOID

fuel vapors from the vapor canister and fuel tank to the engine intake manifold.

LEAK DETECTION PUMP**DESCRIPTION**

The leak detection pump is a device used to detect a leak in the evaporative system.

The pump contains a 3 port solenoid, a pump that contains a switch, a spring loaded canister vent valve seal, 2 check valves and a spring/diaphragm.

OPERATION

Immediately after a cold start, when the engine temperature is between 40°F and 86°F, the 3 port solenoid is briefly energized. This initializes the pump by drawing air into the pump cavity and also closes the vent seal. During non-test conditions, the vent seal is held open by the pump diaphragm assembly which pushes it open at the full travel position. The vent seal will remain closed while the pump is cycling. This is due to the operation of the 3 port solenoid which prevents the diaphragm assembly from reaching full travel. After the brief initialization period, the solenoid is de-energized, allowing atmospheric pressure to enter the pump cavity. This permits the spring to drive the diaphragm which forces air out of the pump cavity and into the vent system. When the solenoid is energized and de-energized, the cycle is repeated creating flow in typical diaphragm pump fashion. The pump is controlled in 2 modes:

PUMP MODE: The pump is cycled at a fixed rate to achieve a rapid pressure build in order to shorten the overall test time.

TEST MODE: The solenoid is energized with a fixed duration pulse. Subsequent fixed pulses occur when the diaphragm reaches the switch closure point.

The spring in the pump is set so that the system will achieve an equalized pressure of about 7.5 inches of water.

When the pump starts, the cycle rate is quite high. As the system becomes pressurized, pump rate drops. If there is no leak, the pump will quit. If there is a leak, the test is terminated at the end of the test mode.

If there is no leak, the purge monitor is run. If the cycle rate increases due to the flow through the purge system, the test is passed and the diagnostic is complete.

The canister vent valve will unseal the system after completion of the test sequence as the pump diaphragm assembly moves to the full travel position.

LEAK DETECTION PUMP PRESSURE SWITCH**OPERATION**

The leak detection pump LDP assembly incorporates two primary functions: it detects a leak in the evaporative system, and it seals the evaporative system so that the required leak detection monitor test can be run.

DESCRIPTION AND OPERATION (Continued)

The primary components within the leak detection pump assembly are: a three-port leak detection solenoid valve, a pump assembly that includes a spring loaded diaphragm, a reed switch which is used to monitor the pump diaphragm movement (position), two check valves, and a spring loaded vent seal valve.

The three-port LDP solenoid valve is used to expose either engine vacuum or atmospheric pressure to the top side of the leak detection pump diaphragm.

When the LDP solenoid valve is deenergized its port (opening) to engine vacuum is blocked off. This allows ambient air (atmospheric pressure) to enter the top of the pump diaphragm. The spring load on the diaphragm will push the diaphragm down, as long as there is no pressure present in the rest of the evaporative system. If there is sufficient evaporative system pressure present, then the pump diaphragm will stay in the "up" position. If the evaporative system pressure decays, then the pump diaphragm will eventually fall. The rate of this decent is dependent upon the size of the evaporative system leak (Large or small).

When the LDP solenoid valve is energized the port (opening) to atmosphere is blocked off. At the same time, the port to engine vacuum is opened. Engine vacuum replaces atmospheric pressure. When engine vacuum is sufficient, it over comes the spring pressure load on the pump diaphragm and causes the diaphragm to rise to its "up" position. The reed switch will change state depending upon the position of the pump diaphragm.

If the diaphragm is in the "up" position the reed switch will be in its "open" state. This means that the 12 volt signal sense to the PCM is interrupted. Zero volts is detected by the PCM. If the pump diaphragm is in the "down" position the reed switch will be in its "closed" state. 12 volts is sent to the PCM via the switch sense circuit.

The check valves are one-way valves. The first check valve is used to draw outside air into the lower chamber of the LDP (the space that is below the pump diaphragm). The second check valve is used to vent this outside air, which has become pressurized from the fall of the pump diaphragm, into the evaporative system.

The spring loaded vent seal valve, inside the LDP is used to seal off the evaporative system. When the pump diaphragm is in the "up" position the spring pushes the vent seal valve closed. The vent seal valve opens only when the pump diaphragm is in its "full down" position. When the pump assembly is in its pump mode the pump diaphragm is not allowed to descend (fall) so far as to allow the vent seal valve to open. This allows the leak detection pump to develop

the required pressure within the evaporative system for system leak testing.

A pressure build up within the evaporative system may cause pressure on the lower side of the LDP diaphragm. This will cause the LDP diaphragm to remain in its "up" position (stuck in the up position). This condition can occur even when the solenoid valve is deenergized. This condition can be caused by previous cycling (pumping) of the LDP by the technician (dealer test). Another way that this condition is created is immediately following the running of the vehicle evaporative system monitor. In this case, the PCM has not yet opened the proportional purge solenoid in order to vent the pressure that has been built up in the evaporative system to the engine combustion system. The technician will need to vent the evaporative system pressure via the vehicle fuel filler cap and its fuel filler secondary seal (if so equipped in the fuel filler neck). This will allow the technician to cycle the LDP and to watch switch state changes.

After passing the leak detection phase of the test, system pressure is maintained until the purge system is activated, in effect creating a leak. If the diaphragm falls (as is expected), causing the reed switch to change state, then the diagnostic test is completed.

When of the evaporative system leak monitor begins its various tests, a test is performed to determine that no part of the evaporative system is blocked. In this test, the LDP is cycled (pumped) a calibrated (few) number of times. Pressure should not build up in the evaporative system. If pressure is present, then LDP diaphragm is forced to stay in its "up" position. The reed switch now stays open and the PCM senses this open (incorrect) state. The evaporative system monitor will fail the test because of a detected obstruction within the system.

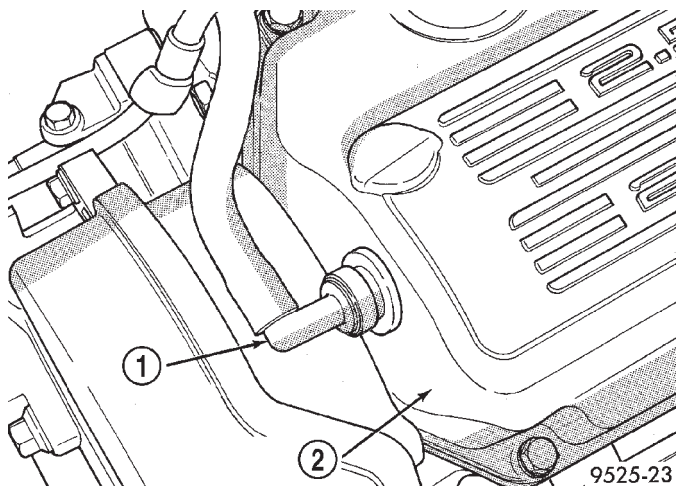
Possible causes:

- Open or shorted LDP switch sense circuit
- Leak Detection Pump switch failure
- Open fused ignition switch output
- Restricted, disconnected, or blocked manifold vacuum source
- Obstruction of hoses or lines
- PCM failure

POSITIVE CRANKCASE VENTILATION (PCV) SYSTEMS**DESCRIPTION****OPERATION**

Intake manifold vacuum removes crankcase vapors and piston blow-by from the engine (Fig. 3). The emissions pass through the PCV valve into the intake manifold where they become part of the cali-

DESCRIPTION AND OPERATION (Continued)

**Fig. 3 PCV System—2.5L**

- 1 - PCV VALVE
2 - FRONT VALVE COVER

brated air-fuel mixture. They are burned and expelled with the exhaust gases. The air cleaner supplies make up air when the engine does not have enough vapor or blow-by gases. In this system, fresh air does not enter the crankcase.

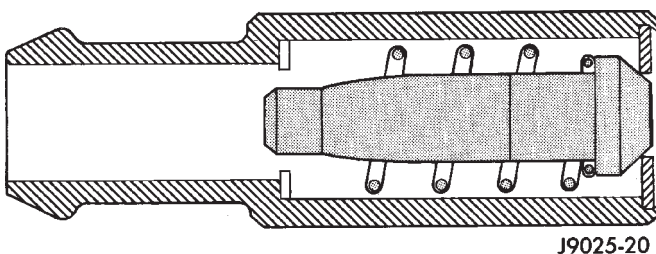
POSITIVE CRANKCASE VENTILATION VALVE**OPERATION**

The PCV valve contains a spring loaded plunger. The plunger meters the amount of crankcase vapors routed into the combustion chamber based on intake manifold vacuum.

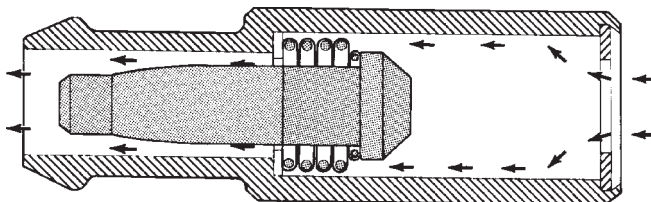
When the engine is not operating or during an engine backfire, the spring forces the plunger back against the seat. This prevents vapors from flowing through the valve (Fig. 4).

When the engine is at idle or cruising, high manifold vacuum is present. At these times manifold vacuum is able to completely compress the spring and pull the plunger to the top of the valve (Fig. 5). In this position there is minimal vapor flow through the valve.

During periods of moderate intake manifold vacuum the plunger is only pulled part way back from



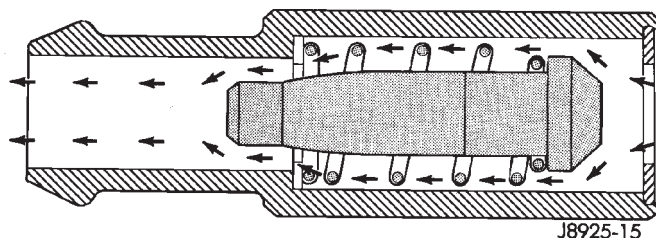
J9025-20

Fig. 4 Engine Off or Engine Backfire—No Vapor Flow

J8925-14

Fig. 5 High Intake Manifold Vacuum—Minimal Vapor Flow

the inlet. This results in maximum vapor flow through the valve (Fig. 6).



J8925-15

Fig. 6 Moderate Intake Manifold Vacuum—Maximum Vapor Flow**VEHICLE EMISSION CONTROL INFORMATION LABEL****DESCRIPTION**

All models have a Vehicle Emission Control Information (VECI) Label. Chrysler permanently attaches the label in the engine compartment. It cannot be removed without defacing information and destroying the label.

The label contains the vehicle's emission specifications and vacuum hose routings. All hoses must be connected and routed according to the label.

REMOVAL AND INSTALLATION

LEAK DETECTION PUMP

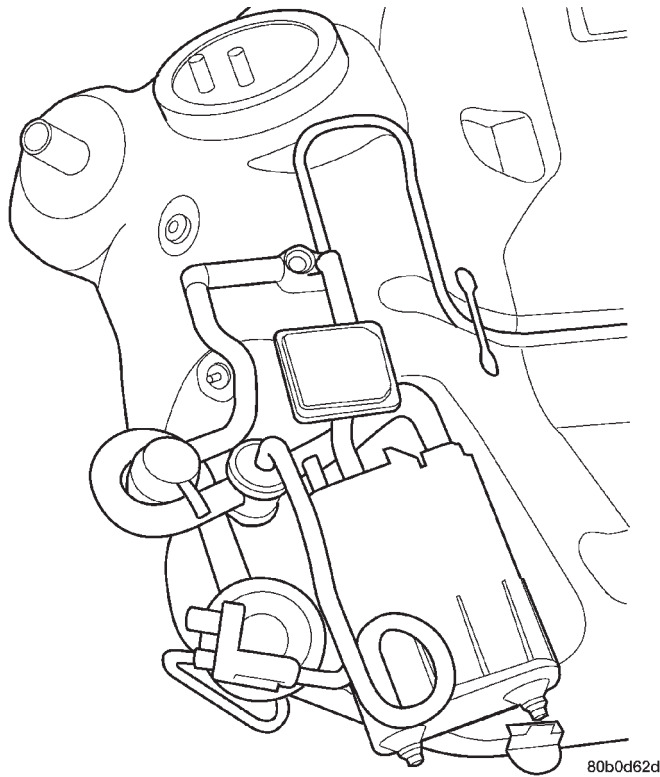


Fig. 7 Fuel Tank Assembly

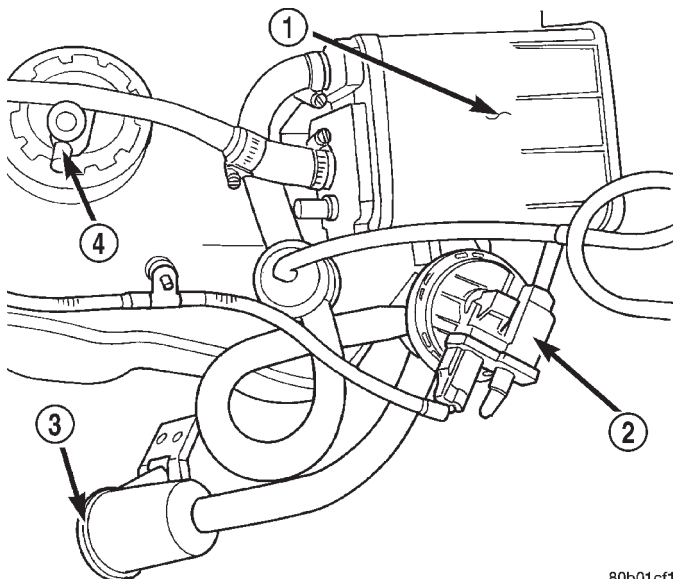


Fig. 8 EVAP System

- 1 - EVAP CANISTER
- 2 - LDP
- 3 - LDP FILTER
- 4 - ORVR VALVE

REMOVAL

(1) Release fuel pressure, Refer to Fuel System Pressure Release Procedure in the Fuel Delivery section.

(2) Disconnect battery cable (Fig. 9).

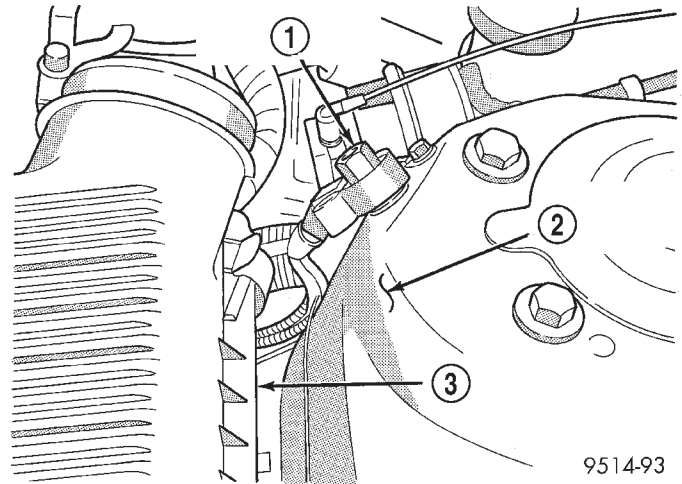


Fig. 9 Battery Cable

- 1 - AUXILIARY JUMPER TERMINAL
- 2 - LEFT STRUT TOWER
- 3 - AIR CLEANER HOUSING

(3) Raise vehicle and support.

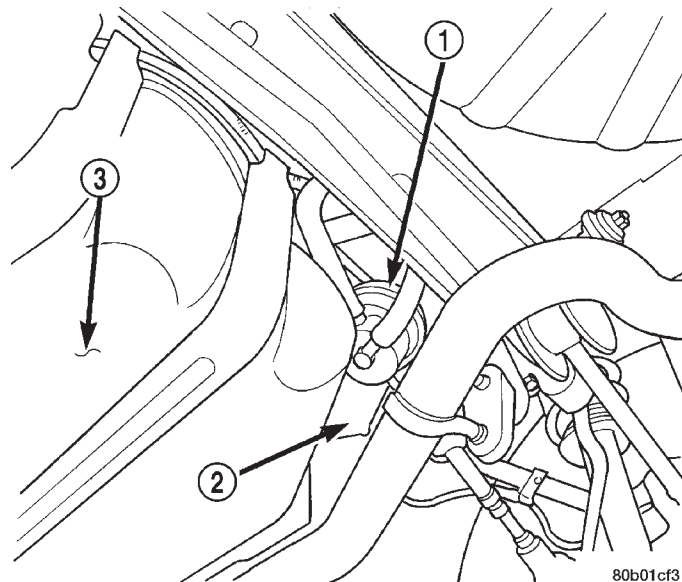


Fig. 10 EVAP System

- 1 - LDP
- 2 - EVAP CANISTER
- 3 - FUEL TANK

REMOVAL AND INSTALLATION (Continued)

(4) Drain fuel tank, refer to Draining Fuel Tank in the Fuel Delivery section (Fig. 11).

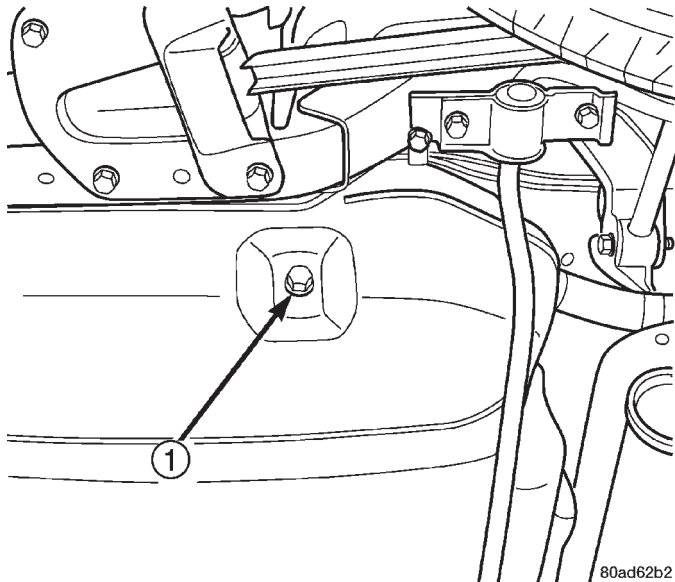


Fig. 11 Fuel Tank Drain

1 - FUEL TANK DRAIN

(5) Loosen and remove fuel filler tube from fuel tank (Fig. 12).

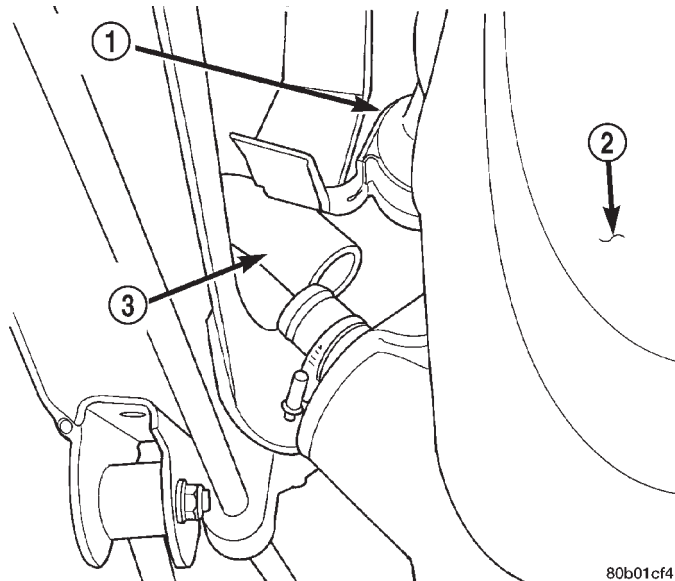


Fig. 12 Fuel Filler Tube

1 - FUEL FILTER
2 - FUEL TANK
3 - FUEL FILLER TUBE

(6) Disconnect fuel line (Fig. 13).

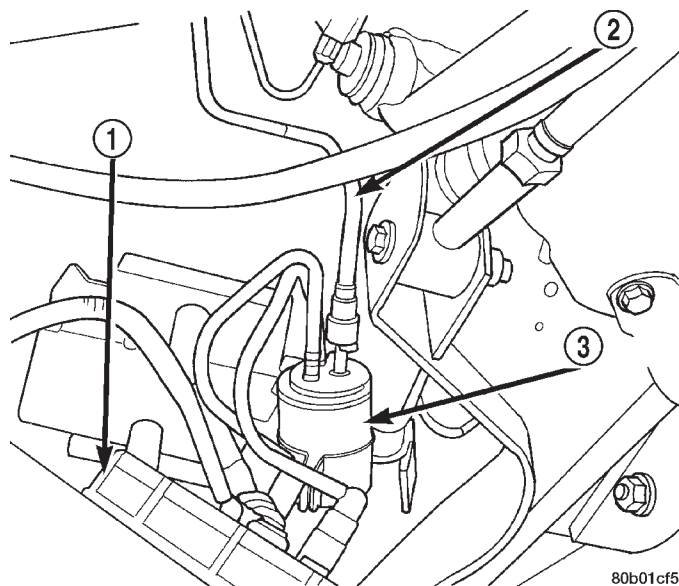


Fig. 13 Fuel Line

1 - FUEL PUMP MODULE
2 - FUEL LINE
3 - FUEL FILTER

(7) Position transmission jack under fuel tank assembly.

(8) Remove fuel tank straps bolts. Passenger side first.

(9) Lower fuel tank and remove the purge line and vent line (Fig. 14).

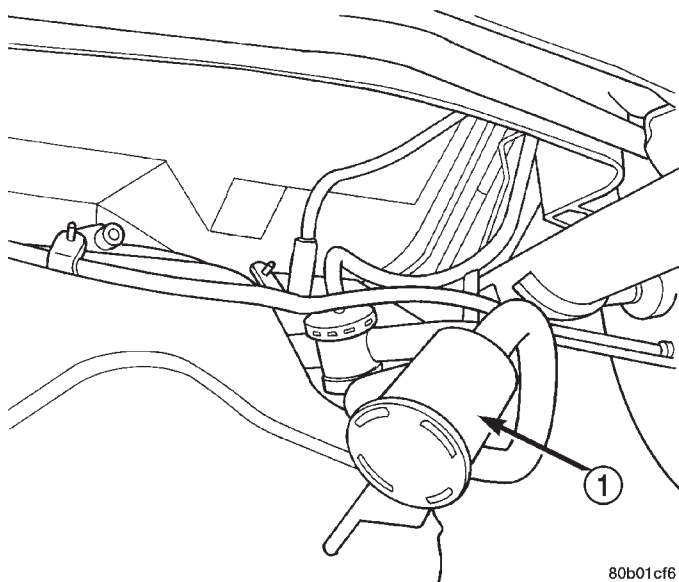


Fig. 14 Evap Components

1 - LDP FILTER

REMOVAL AND INSTALLATION (Continued)

- (10) Remove hoses from EVAP canister.
- (11) Disconnect electrical connector for Leak Detection Pump (LDP).
- (12) Remove push pin from bracket for EVAP canister (Fig. 15).

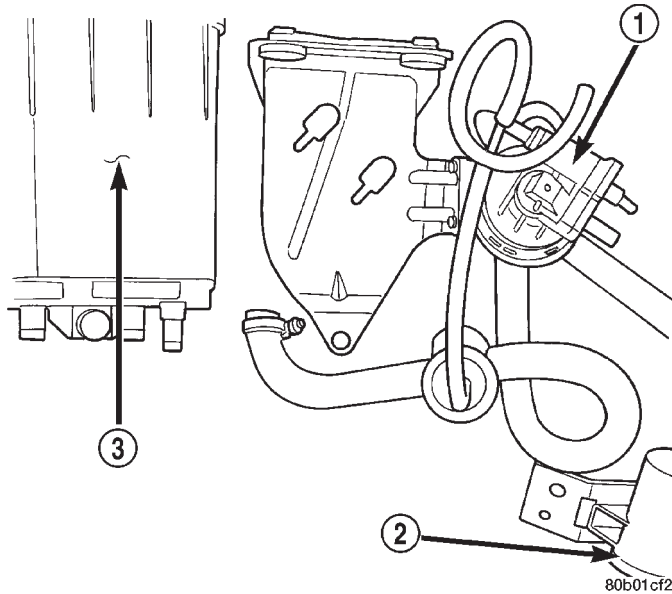


Fig. 15 LDP and EVAP Canister

- 1 - LDP
- 2 - LDP FILTER
- 3 - EVAP CANISTER

- (13) Remove bracket and Leak Detection Pump.
- (14) Remove LDP from bracket.

INSTALLATION

- (1) Install LDP onto bracket.
- (2) Install bracket and LDP onto fuel tank assembly.
- (3) Install EVAP canister to bracket install push pin.
- (4) Install hoses and lines.
- (5) Raise the fuel tank on the transmission stand.
- (6) Connect the purge and vent lines.
- (7) Connect LDP and fuel pump electrical connector.
- (8) Raise tank into position and install tank straps.
- (9) Install the fuel filler tube and tighten the clamp.
- (10) Lower vehicle.
- (11) Connect the battery cable.
- (12) Fill fuel tank. Use the DRB scan tool to pressurize the fuel system. Check for leaks.

EVAP CANISTER

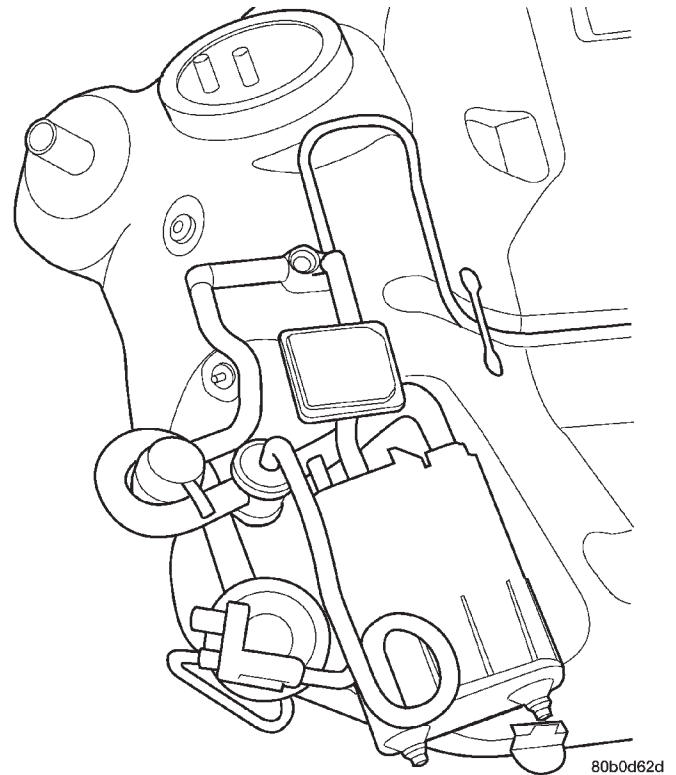


Fig. 16 Fuel Tank Assembly

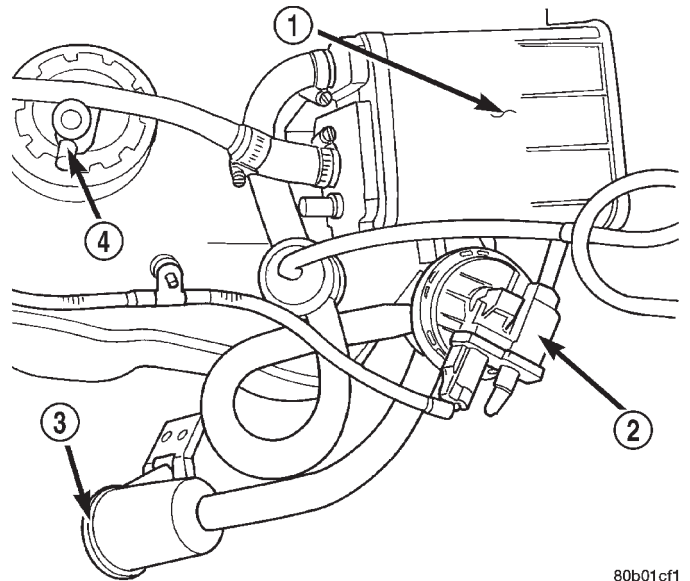


Fig. 17 EVAP System

- 1 - EVAP CANISTER
- 2 - LDP
- 3 - LDP FILTER
- 4 - ORVR VALVE

REMOVAL AND INSTALLATION (Continued)

REMOVAL

(1) Release fuel pressure, Refer to Fuel System Pressure Release Procedure in the Fuel Delivery section.

(2) Disconnect battery cable (Fig. 18).

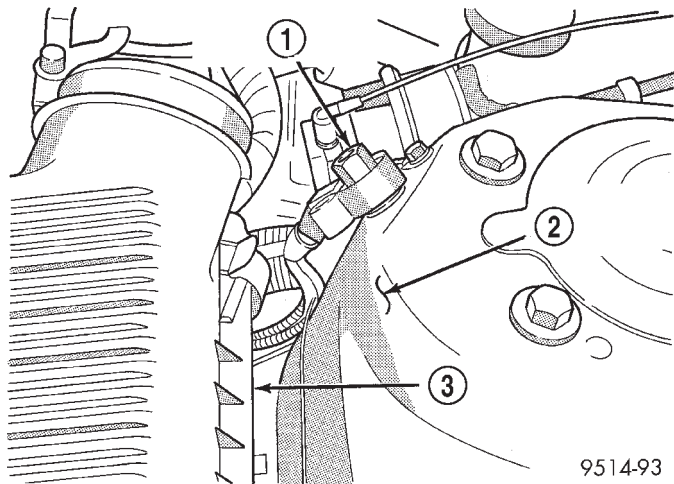


Fig. 18 Battery Cable

- 1 - AUXILIARY JUMPER TERMINAL
- 2 - LEFT STRUT TOWER
- 3 - AIR CLEANER HOUSING

(3) Raise vehicle and support.

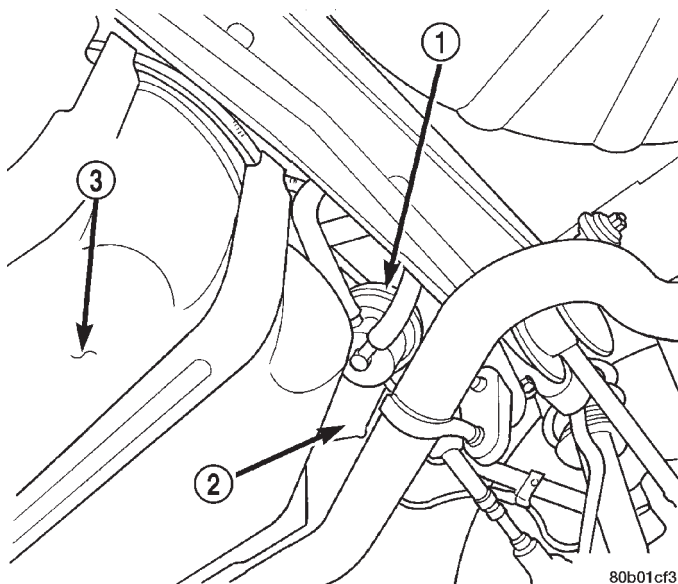


Fig. 19 EVAP System

- 1 - LDP
- 2 - EVAP CANISTER
- 3 - FUEL TANK

(4) Drain fuel tank, refer to Draining Fuel Tank in the Fuel Delivery section (Fig. 20).

(5) Loosen and remove fuel filler tube from fuel tank (Fig. 21).

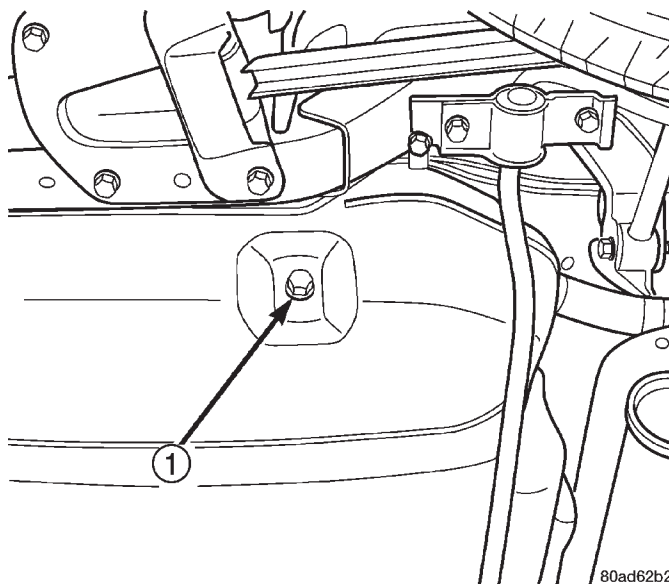


Fig. 20 Fuel Tank Drain

- 1 - FUEL TANK DRAIN

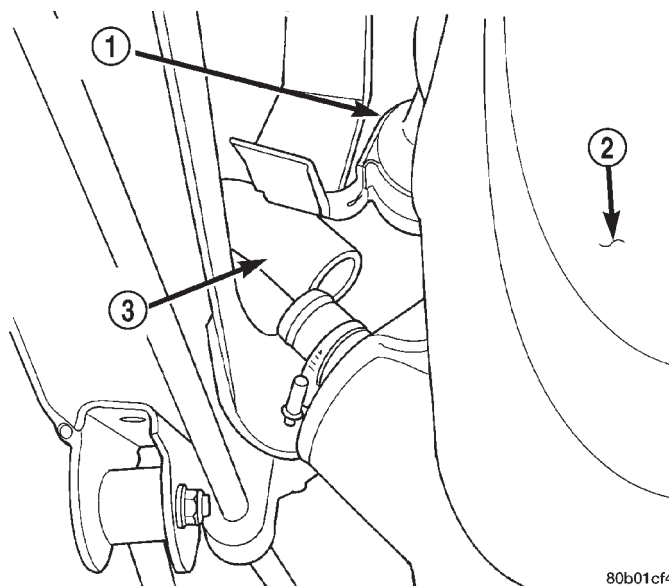


Fig. 21 Fuel Filler Tube

- 1 - FUEL FILTER
- 2 - FUEL TANK
- 3 - FUEL FILLER TUBE

(6) Disconnect fuel line (Fig. 22).

(7) Position transmission jack under fuel tank assembly.

(8) Remove fuel tank straps bolts. Passenger side first.

(9) Lower fuel tank and remove the purge line and vent line (Fig. 23).

(10) Remove hoses from EVAP canister.

(11) Disconnect electrical connector for Leak Detection Pump (LDP).

REMOVAL AND INSTALLATION (Continued)

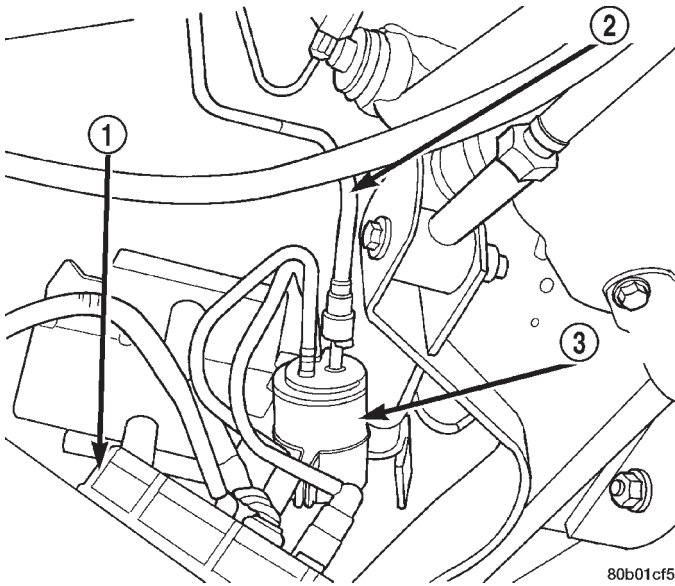


Fig. 22 Fuel Line

- 1 – FUEL PUMP MODULE
- 2 – FUEL LINE
- 3 – FUEL FILTER

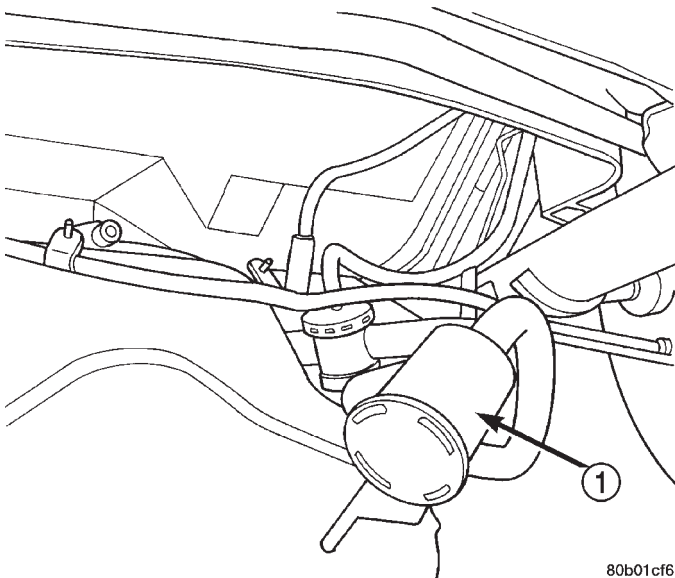


Fig. 23 Evap Components

- 1 – LDP FILTER

(12) Remove push pin from bracket for EVAP canister (Fig. 24). Remove canister.

INSTALLATION

- (1) Install EVAP canister to bracket install push pin.
- (2) Install hoses and lines.
- (3) Raise the fuel tank on the transmission stand.

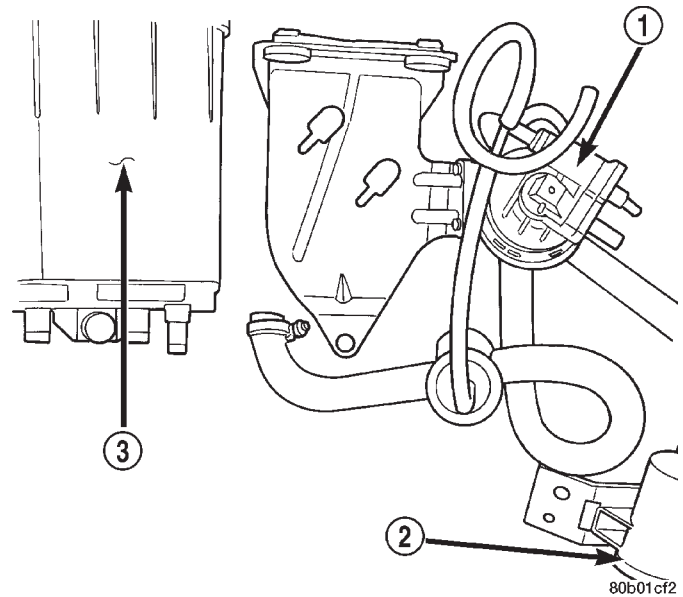


Fig. 24 LDP and EVAP Canister

- 1 – LDP
- 2 – LDP FILTER
- 3 – EVAP CANISTER

- (4) Connect the purge and vent lines.
- (5) Connect LDP and fuel pump electrical connector.
- (6) Raise tank into position and install tank straps.
- (7) Install the fuel filler tube and tighten the clamp.
- (8) Lower vehicle.
- (9) Connect the battery cable.
- (10) Fill fuel tank. Use the DRB scan tool to pressurize the fuel system. Check for leaks.

PROPORTIONAL PURGE SOLENOID

REMOVAL

- (1) Remove the negative battery cable.
- (2) Remove solenoid from bracket by pulling up on solenoid.
- (3) Disconnect electrical connector from solenoid.
- (4) Disconnect vacuum tubes from solenoid.

INSTALLATION

The top of the solenoid has TOP printed on it. The solenoid will not operate unless it is installed correctly.

- (1) Connect vacuum tube to solenoid.
- (2) Connect electrical connector to solenoid.
- (3) Install solenoid on bracket.
- (4) Install the negative battery cable.

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

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DESCRIPTION AND OPERATION

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

DESCRIPTION

The EGR system consists of (Fig. 1), and (Fig. 2):

- EGR tube
- EGR valve
- Electric EGR Transducer
- Connecting hoses

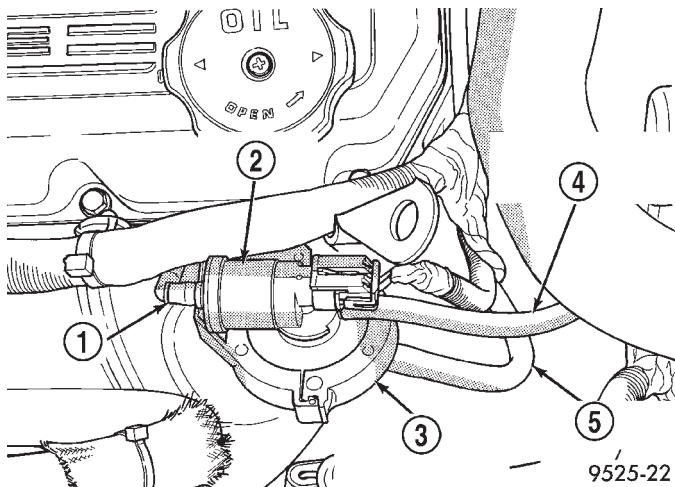


Fig. 1 EGR Control Valve—2.5L

- 1 - VACUUM INLET
- 2 - EGR SOLENOID
- 3 - EGR BACK PRESSURE TRANSDUCER
- 4 - VACUUM OUTLET TO EGR VALVE
- 5 - BACK PRESSURE HOSE

OPERATION

Refer to Monitored Systems - EGR Monitor in this group for more information.

The EGR system reduces oxides of nitrogen (NOx) in engine exhaust and helps prevent detonation (engine knock). Under normal operating conditions,

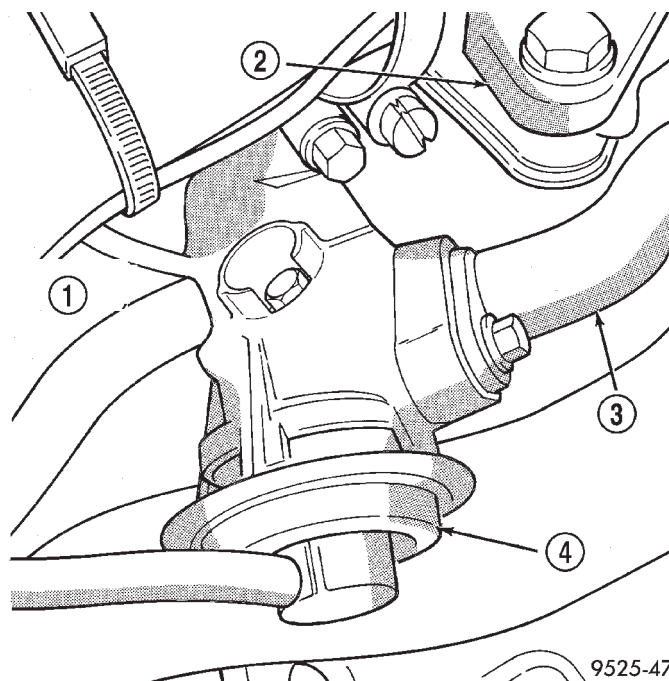


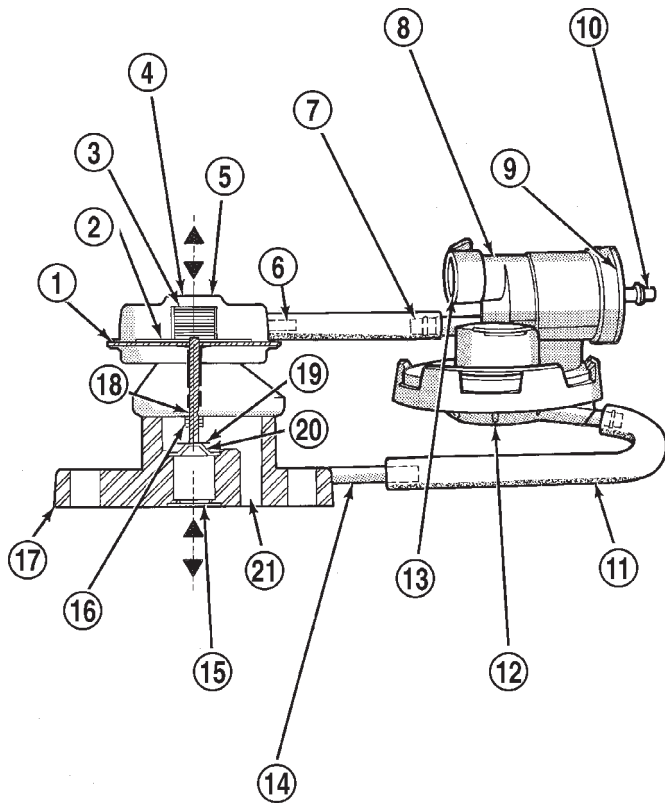
Fig. 2 EGR Valve—2.5L

- 1 - EGR VALVE SCREW (2)
- 2 - THERMOSTAT HOUSING
- 3 - EGR TUBE
- 4 - EGR VALVE

engine cylinder temperature can reach more than 3000°F. Formation of NOx increases proportionally with combustion temperature. To reduce the emission of these oxides, the cylinder temperature must be lowered. The system allows a predetermined amount of hot exhaust gas to recirculate and dilute the incoming air/fuel mixture. The diluted air/fuel mixture reduces peak flame temperature during combustion.

The electric EGR transducer contains an electrically operated solenoid and a back-pressure transducer (Fig. 3). The Powertrain Control Module (PCM) operates the solenoid. The PCM determines when to energize the solenoid. Exhaust system back-pressure controls the transducer.

DESCRIPTION AND OPERATION (Continued)



J9525-8

Fig. 3 Electric EGR Transducer

- 1 – DIAPHRAGM
- 2 – PISTON
- 3 – SPRING
- 4 – EGR VALVE ASSEMBLY
- 5 – VACUUM MOTOR
- 6 – VACUUM MOTOR FITTING
- 7 – VACUUM OUTLET FITTING TO EGR VALVE
- 8 – EGR VALVE CONTROL ASSEMBLY
- 9 – ELECTRIC SOLENOID PORTION OF VALVE CONTROL
- 10 – VACUUM INLET FITTING FROM ENGINE
- 11 – BACK-PRESSURE HOSE
- 12 – TRANSDUCER PORTION OF VALVE CONTROL
- 13 – ELECTRICAL CONNECTION POINT
- 14 – EGR VALVE BACK-PRESSURE FITTING
- 15 – EXHAUST GAS INLET
- 16 – STEM PROTECTOR AND BUSHING
- 17 – BASE
- 18 – MOVEMENT INDICATOR
- 19 – POPPET VALVE
- 20 – SEAT
- 21 – EXHAUST GAS OUTLET

When the PCM energizes the solenoid, vacuum does not reach the transducer. Vacuum flows to the transducer when the PCM de-energizes the solenoid.

When exhaust system back-pressure becomes high enough, it fully closes a bleed valve in the transducer. When the PCM de-energizes the solenoid and back-pressure closes the transducer bleed valve, vac-

uum flows through the transducer to operate the EGR valve.

De-energizing the solenoid, but not fully closing the transducer bleed hole (because of low back-pressure), varies the strength of vacuum applied to the EGR valve. Varying the strength of the vacuum changes the amount of EGR supplied to the engine. This provides the correct amount of exhaust gas recirculation for different operating conditions.

This system does not allow EGR at idle.

A failed or malfunctioning EGR system can cause engine spark knock, sags or hesitation, rough idle, engine stalling and increased emissions.

REMOVAL AND INSTALLATION**EGR VALVE AND TRANSDUCER—2.5L**

If the EGR system operates incorrectly, replace the entire EGR valve and transducer together. The EGR valve and electrical transducer are calibrated together. The EGR valve attaches to the front exhaust manifold. The transducer/solenoid attach to the front cylinder head.

REMOVAL

- (1) Remove the negative battery cable.
- (2) Disconnect vacuum supply from solenoid.
- (3) Disconnect electrical connector from solenoid.
- (4) Remove screws holding transducer to bracket.
- (5) Remove screws holding Transmission Control Module (TCM) to bracket (Fig. 4). Swing TCM up to allow access to EGR screws (Fig. 5).
- (6) Remove screws holding EGR tube.
- (7) Remove EGR valve mounting screws. Remove EGR valve and transducer.
- (8) Clean gasket surfaces. Discard old gaskets. If necessary, clean EGR passages.

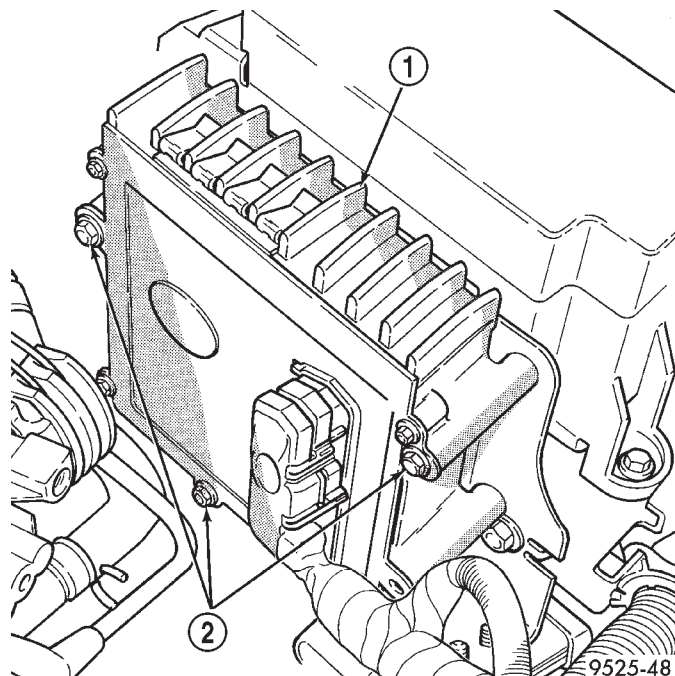
INSTALLATION

- (1) Loosely install EGR valve with new gaskets.
- (2) Finger tighten EGR tube fasteners.
- (3) Tighten EGR valve mounting screws to 22 N·m (200 in. lbs.) torque.
- (4) Tighten EGR tube fasteners to 11 N·m (95 in. lbs.) torque.
- (5) Install transducer to bracket.
- (6) Connect vacuum supply to solenoid.
- (7) Attach electrical connector to solenoid.
- (8) Install the negative battery cable.

EGR TUBE—2.5L

The EGR tube attaches to the intake manifold plenum behind the throttle body and to the EGR valve.

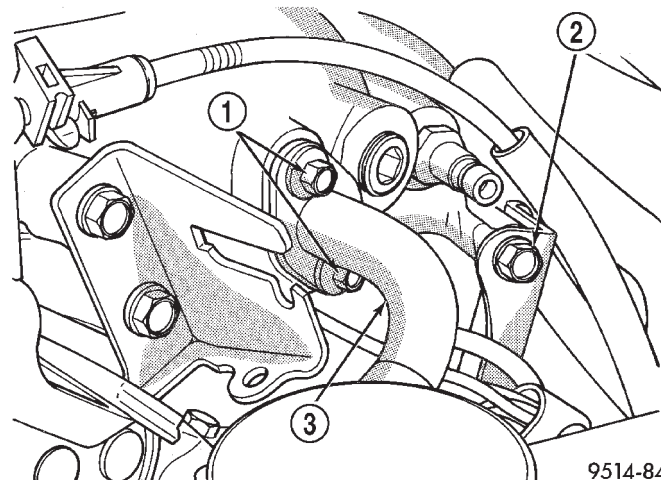
REMOVAL AND INSTALLATION (Continued)

**Fig. 4 TCM Removal**

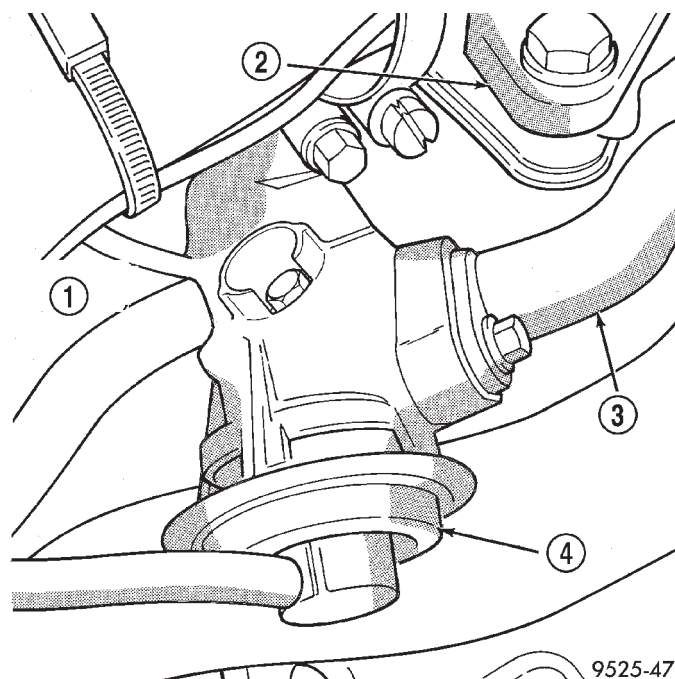
- 1 - TRANSMISSION CONTROL MODULE (TCM)
2 - ATTACHING SCREWS

REMOVAL

- (1) Remove the negative battery cable.
(2) Remove the air cleaner cover and hose.
(3) Remove screws attaching EGR tube to intake manifold (Fig. 6).

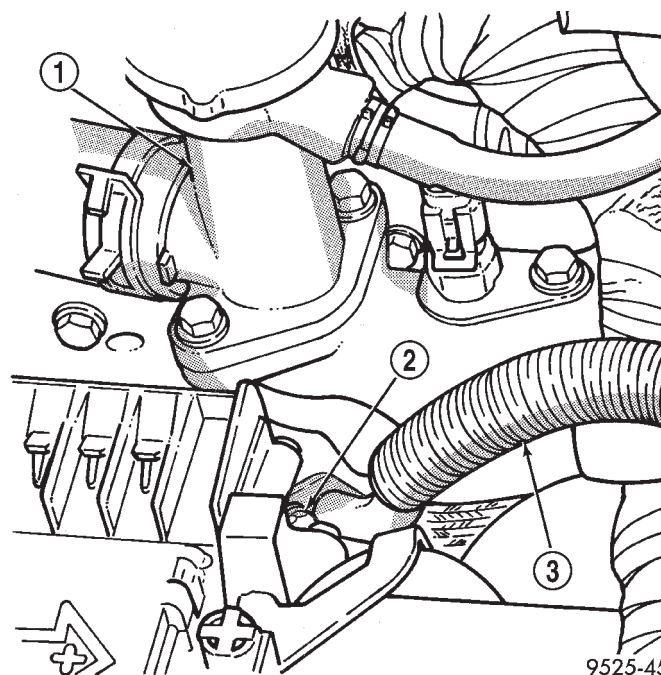
**Fig. 6 EGR Tube at Intake Manifold**

- 1 - EGR TUBE BOLTS
2 - SUPPORT BRACKET BOLT
3 - EGR TUBE

**Fig. 5 EGR Removal**

- 1 - EGR VALVE SCREW (2)
2 - THERMOSTAT HOUSING
3 - EGR TUBE
4 - EGR VALVE

- (4) Remove EGR tube to EGR valve screws (Fig. 7).

**Fig. 7 EGR Tube at EGR Valve**

- 1 - COOLANT FILL NECK
2 - EGR TUBE BOLTS (2)
3 - EGR TUBE

REMOVAL AND INSTALLATION (Continued)

(5) Remove EGR tube. Discard old gasket. If necessary clean EGR passage.

INSTALLATION

- Use new gaskets on both ends of the EGR tube.
- (1) Loosely install the EGR tube and fasteners.
 - (2) Tighten the EGR tube to intake manifold plenum screws to 11 N·m (95 in. lbs) torque.
 - (3) Tighten the EGR tube to EGR valve screws to 11 N·m (95 in. lbs.) torque.
 - (4) Install the air cleaner cover and hose.
 - (5) Install the negative battery cable.

SPECIFICATIONS

TORQUE

Description	Torque
EGR valve to cyl. head	22 N·m (200 in. lbs.)
EGR tube to EGR valve	11 N·m (95 in. lbs.)
EGR tube to intake manifold . .	11 N·m (95 in. lbs.)

