EMISSION CONTROL SYSTEMS

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ON-BOARD DIAGNOSTICS

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GENERAL INFORMATION

SYSTEM DESCRIPTION

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 two different methods. Refer to Diagnostic Trouble Codes in this section. For DTC information, refer to charts in this section.

DESCRIPTION AND OPERATION

MALFUNCTION INDICATOR LAMP (MIL)

As a functional test, the Malfunction Indicator Lamp (MIL) illuminates at key-on before engine

DESCRIPTION AND OPERATION (Continued)

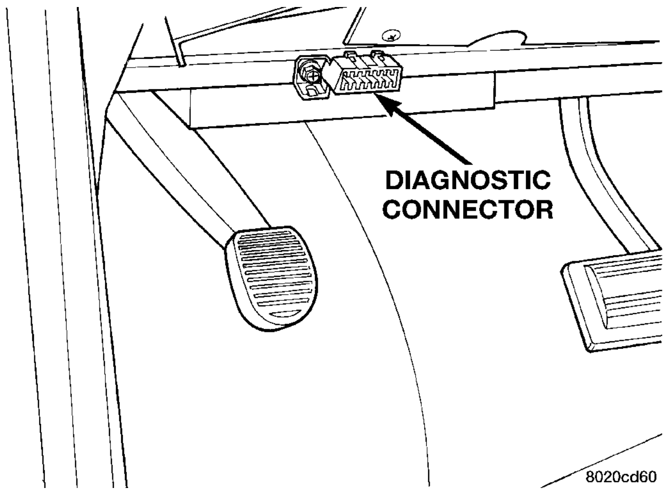


Fig. 1 Data Link (Diagnostic) Connector

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.

STATE DISPLAY TEST MODE

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.

CIRCUIT ACTUATION TEST MODE

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

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

The technician can retrieve and display DTC's in two different ways:

- The preferred and most accurate method of retrieving a DTC is by using the DRB scan tool. The scan tool supplies detailed diagnostic information which can be used to more accurately diagnose causes for a DTC.
- The second method is by observing the two-digit number displayed at the Malfunction Indicator Lamp (MIL). The MIL is displayed on the instrument panel as the Check Engine lamp. This method is to be used as a "quick-test" only. Always use the DRB scan tool for detailed information.

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.

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 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**

DESCRIPTION AND OPERATION (Continued)

DTC's until problems have been investigated and repairs have been performed.

OBTAINING DTC'S USING MIL LAMP

(1) Cycle the ignition key On - Off - On - Off - On within 5 seconds.

(2) Count the number of times the MIL (check engine lamp) on the instrument panel flashes on and off. The number of flashes represents the trouble code. There is a slight pause between the flashes representing the first and second digits of the code. Longer pauses separate individual two digit trouble codes.

An example of a flashed DTC is as follows:

- Lamp flashes 4 times, pauses, and then flashes 6 more times. This indicates a DTC code number 46.
- Lamp flashes 5 times, pauses, and flashes 5 more times. This indicates a DTC code number 55. A DTC 55 will always be the last code to be displayed. This indicates the end of all stored codes.

DIAGNOSTIC TROUBLE CODE DESCRIPTIONS

HEX CODE	MIL CODE	GENERIC SCAN TOOL CODE	DRB SCAN TOOL DISPLAY	DESCRIPTION OF DIAGNOSTIC TROUBLE CODE
	12*		Battery Disconnect	Direct battery input to PCM was disconnected within the last 50 Key-on cycles.
	55*			Completion of fault code display on Check Engine lamp.
01	54**	P0340	No Cam Signal at PCM	No camshaft signal detected during engine cranking.
02	53**	P0601	Internal Controller Failure	PCM Internal fault condition detected.
05	47***		Charging System Voltage Too Low	Battery voltage sense input below target charging during engine operation. Also, no significant change detected in battery voltage during active test of generator output circuit.
06	46***		Charging System Voltage Too High	Battery voltage sense input above target charging voltage during engine operation.
0A	42*		Auto Shutdown Relay Control Circuit	An open or shorted condition detected in the auto shutdown relay circuit.
0B	41***		Generator Field Not Switching Properly	An open or shorted condition detected in the generator field control circuit.
0C	37**	P0743	Torque Converter Clutch Soleniod/Trans Relay Circuits	An open or shorted condition detected in the torque converter part throttle unlock solenoid control circuit (3 speed auto RH trans. only).
0E	35**	P1491	Rad Fan Control Relay Circuit	An open or shorted condition detected in the low speed radiator fan relay control circuit.
0F	34*		Speed Control Solenoid Circuits	An open or shorted condition detected in the Speed Control vacuum or vent solenoid circuits.
10	33*		A/C Clutch Relay Circuit	An open or shorted condition detected in the A/C clutch relay circuit.
11	32**	P0403	EGR Solenoid Circuit	An open or shorted condition detected in the EGR transducer solenoid circuit.
12	31**	P0443	EVAP Purge Solenoid Circuit	An open or shorted condition detected in the duty cycle purge solenoid circuit.
13	27**	P0203	Injector #3 Control Circuit	Injector #3 output driver does not respond properly to the control signal.

DESCRIPTION AND OPERATION (Continued)

HEX CODE	MIL CODE	GENERIC SCAN TOOL CODE	DRB SCAN TOOL DISPLAY	DESCRIPTION OF DIAGNOSTIC TROUBLE CODE
		or		
14		P0202	Injector #2 Control Circuit	Injector #2 output driver does not respond properly to the control signal.
		or		
15		P0201	Injector #1 Control Circuit	Injector #1 output driver does not respond properly to the control signal.
19	25**	P0505	Idle Air Control Motor Circuits	A shorted or open condition detected in one or more of the idle air control motor circuits.
1A	24**	P0122	Throttle Position Sensor Voltage Low	Throttle position sensor input below the minimum acceptable voltage.
		or		
1B		P0123	Throttle Position Sensor Voltage High	Throttle position sensor input above the maximum acceptable voltage.
1E	22**	P0117	ECT Sensor Voltage Too Low	Engine coolant temperature sensor input below minimum acceptable voltage.
		or		
1F		P0118	ECT Sensor Voltage Too High	Engine coolant temperature sensor input above maximum acceptable voltage.
20	21**	P0134	Right Rear (or just) Upstream O2S Stays at Center	Neither rich or lean condition detected from the oxygen sensor.
21	17*		Engine Is Cold Too Long	Engine did not reach operating temperature within acceptable limits.
23	15**	P0500	No Vehicle Speed Sensor Signal	No vehicle speed sensor signal detected during road load conditions.
24	14**	P0107	MAP Sensor Voltage Too Low	MAP sensor input below minimum acceptable voltage.
		or		
25		P0108	MAP Sensor Voltage Too High	MAP sensor input above maximum acceptable voltage.
27	13**	P1297	No Change in MAP From Start to Run	No difference recognized between the engine MAP reading and the barometric (atmospheric) pressure reading from start-up.
28	11*		No Crank Reference Signal at PCM	No crank reference signal detected during engine cranking.
2A		P0352	Ignition Coil #2 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time.
		or		
2B		P0351	Ignition Coil #1 Primary Circuit	Peak primary circuit current not achieved with maximum dwell time.
2C	42*		No ASD Relay Output Voltage at PCM	An Open condition Detected In The ASD Relay Output Circuit.
2E	32**	P0401	EGR System Failure	Required change in air/fuel ratio not detected during diagnostic test.

DESCRIPTION AND OPERATION (Continued)

HEX CODE	MIL CODE	GENERIC SCAN TOOL CODE	DRB SCAN TOOL DISPLAY	DESCRIPTION OF DIAGNOSTIC TROUBLE CODE
30	62*	P1697	PCM Failure SRI Miles Not Stored	Unsuccessful attempt to update EMR mileage in the PCM EEPROM
31	63**	P1696	PCM Failure EEPROM Write Denied	Unsuccessful attempt to write to an EEPROM location by the PCM.
39 3A	23**	P0112 or P0113	Intake Air Temp Sensor Voltage Low Intake Air Temp Sensor Voltage High	Intake air temperature sensor input below the maximum acceptable voltage. Intake air temperature sensor input above the minimum acceptable voltage.
3C	61	P0106	Baro Out of Range	
3D	27**	P0204	Injector #4 Control Circuit	Injector #4 output driver does not respond properly to the control signal.
3E	21**	P0132	Right Rear (or just) Upstream O2S Shorted to Voltage	Oxygen sensor input voltage maintained above the normal operating range.
44	53**	P0600	PCM Failure SPI Communications	PCM Internal fault condition detected.
52	77		S/C Power Relay Ckt	
65	42*		Fuel Pump Relay Control Circuit	An open or shorted condition detected in the fuel pump relay control circuit.
66 67 69	21**	P0133 or P0135 or P0141	Right Bank Upstream O2S Slow Response Right Rear (or just) Upstream O2S Heater Failure Right Rear (or just) Downstream O2S Heater Failure	Oxygen sensor response slower than minimum required switching frequency. Upstream oxygen sensor heating element circuit malfunction. Oxygen sensor heating element circuit malfunction.
6A 6B 6C 6D 6E	43**	P0300 or P0301 or P0302 or P0303 or P0304	Multiple Cylinder Mis-fire Cylinder #1 Mis-fire Cylinder #2 Mis-fire Cylinder #3 Mis-fire Cylinder #4 Mis-fire	Misfire detected in multiple cylinders. Misfire detected in cylinder #1. Misfire detected in cylinder #2. Misfire detected in cylinder #3. Misfire detected in cylinder #4.
70	72**	P0420	Right Rear (or just) Catalyst Efficency Failure	Catalyst efficiency below required level.
71	31	P0441	Incurrect Pruge Flow	

DESCRIPTION AND OPERATION (Continued)

HEX CODE	MIL CODE	GENERIC SCAN TOOL CODE	DRB SCAN TOOL DISPLAY	DESCRIPTION OF DIAGNOSTIC TROUBLE CODE
72	37**	P1899	P/N Switch Stuck in Park or in Gear	Incorrect input state detected for the Park/Neutral switch, auto. trans. only.
73	65*	P0551	Power Steering Switch Failure	Power steering high pressure seen at high speed (2.5L only).
76	52**	P0172	Right Rear (or just) Fuel System Rich	A rich air/fuel mixture has been indicated by an abnormally lean correction factor.
77	51**	P0171	Right Rear (or just) Fuel System Lean	A lean air/fuel mixture has been indicated by an abnormally rich correction factor.
7E	21**	P0138	Right Rear (or just) Downstream O2S Shorted to Voltage	Oxygen sensor input voltage maintained above the normal operating range.
80	17**	P0125	Closed Loop Temp Not Reached	Engine does not reach 20°F within 5 minutes with a vehicle speed signal.
81	21**	P0140	Right Rear (or just) Downstream O2S Stays at Center	Neither reich or lean condition detected from the downstream oxygen sensor.
84	24**	P0121	TPS Voltage Does Not Agree With MAP	TPS signal does not correlate to MAP sensor.
8A	25**	P1294	Target Idle Not Reached	Actual idle speed does not equal target idle speed.
91	25**	P1299	Vacuum Leak Found (IAC Fully Seated)	MAP sensor signal does not correlate to throttle position sensor signal. Possible vacuum leak.
92	71**	P1496	5 Volt Supply Output Too Low	5 volt output from regulator does not meet minimum requirement.
94	37*	P0740	Torq Conv Clu, No RPM Drop At Lockup	Relationship between engine speed and vehicle speed indicates no torque converter clutch engagement (auto. trans. only).
95	42*		Fuel Level Sending Unit Volts Too Low	Open circuit between PCM and fuel gauge sending unit.
		or		
96			Fuel Level Sending Unit Volts Too High	Circuit shorted to voltage between PCM and fuel gauge sending unit.
		or		
97			Fuel Level Unit No Change Over Miles	No movement of fuel level sender detected.
98	65**	P0703	Brake Switch Stuck Pressed or Released	No release of brake switch seen after too many accelerations.
99	44**	P1493	Ambient/Batt Temp Sen VoltsToo Low	Battery temperature sensor input voltage below an acceptable range.
		or		
9A		P1492	Ambient/Batt Temp Sensor VoltsToo High	Battery temperature sensor input voltage above an acceptable range.
9B	21**	P0131	Right Rear (or just) Upstream O2S Shorted to Ground	O2 sensor voltage too low, tested after cold start.

DESCRIPTION AND OPERATION (Continued)

HEX CODE	MIL CODE	GENERIC SCAN TOOL CODE	DRB SCAN TOOL DISPLAY	DESCRIPTION OF DIAGNOSTIC TROUBLE CODE
9C		or P0137	Right Rear (or just) Downstream O2S Shorted to Ground	O2 sensor voltage too low, tested after cold start.
9D	11**	P1391	Intermittent Loss of CMP or CKP	Intermittent loss of either camshaft or crankshaft position sensor.
AO A1	31**	PO442 or PO455	Evap Leak Monitor Small Leak detected Evap Leak Monitor Large Leak Detected	A small leak has been detected by the leak detection monitor. The leak detection monitor is unable to pressurize Evap system, indicating a large leak.
B7 B8	31**	P1495 or P1494	Leak DetectionPump Soleniod Circuit Leak detect Pump Sw or Mechanical Fault	Leak detection pump soleniod circuit fault (open or Short). Leak detection pump switch does not respond to input.
BA	11**	P1398	Mis-fire Adaptive Numerator at Limit	CKP sensor target windows have too much variation.
BB	31	P1486	Evap Hose Pinched	A pinched or bent Evap hose.
CO	21	PO133	Cat Mon Slow O2 Upstream	Oxygen sensor response slower than minimum required switching frequency.

* Check Engine Lamp (MIL) will not illuminate if this Diagnostic Trouble Code was recorded. Cycle Ignition key as described in manual and observe code flashed by Check Engine lamp.

** Check Engine Lamp (MIL) will illuminate during engine operation if this Diagnostic Trouble Code was recorded.

*** Generator Lamp illuminated

MONITORED SYSTEMS

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 system monitors:

- EGR Monitor
- Misfire Monitor
- Fuel System Monitor
- Oxygen Sensor Monitor
- Oxygen Sensor Heater Monitor
- Catalyst Monitor
- Evaporative System Leak Detection Monitor

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

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

DTC 21—HEX 66, and 7A—OXYGEN SENSOR (O2S) MONITOR

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. The information obtained by the sensor is used to calcu-

DESCRIPTION AND OPERATION (Continued)

late the fuel injector pulse width. This maintains 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
- Reduced output voltage
- Dynamic shift
- Shorted or open circuits

Response rate is the time required for the sensor to switch from lean to rich once it is exposed to a richer than optimum A/F mixture or vice versa. As the sensor starts malfunctioning, it could take longer to detect the changes in the oxygen content of the exhaust gas.

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.

DTC 21—HEX 67, 69, 7C, and 7D—OXYGEN SENSOR HEATER MONITOR

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.

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. The information obtained by the sensor is used to calculate the fuel injector pulse width. This maintains a14.7 to 1 Air Fuel (A/F) ratio. At this mixture ratio, the catalyst works best to remove hydrocarbons (HC), carbon monoxide (CO) and nitrogen oxide (NOx) from the exhaust.

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

The O2S circuit is monitored for a drop in voltage. 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.

DTC 32—HEX 2E—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 and a vacuum operated valve with a back pressure transducer. 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. The O2S data should indicate an increase in the O2 concentration in the combustion chamber when the exhaust gases are no longer recirculated. 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.

DTC 43—HEX 6A,6B, 6C, 6D, 6E, AE, and AF—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.

DTC 51/52—HEX 76, 77, 78, and 79—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 specifications, 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

DESCRIPTION AND OPERATION (Continued)

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.

DTC 64—HEX 70, and B4—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 O2Ss 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 downstraem 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.

DTC 31—HEX A0, A1, B7, and B8—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” H20. 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

DESCRIPTION AND OPERATION (Continued)

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 02 control system. If fuel vapor, indicated by a shift in the 02 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.

TRIP DEFINITION

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.

COMPONENT MONITORS

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 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.

NON-MONITORED CIRCUITS

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.

SECONDARY IGNITION CIRCUIT

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

DESCRIPTION AND OPERATION (Continued)

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

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.

LOAD VALUE

ENGINE	IDLE/NEUTRAL	2500 RPM/NEUTRAL
2.0L SOHC	2% to 8% of Maximum Load	8% to 15% of Maximum Load
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

INDEX

DESCRIPTION AND OPERATION

EVAPORATION CONTROL SYSTEM

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 a charcoal 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 duty cycle purge system. The PCM controls vapor flow by operating the duty cycle EVAP purge solenoid. Refer to Duty Cycle EVAP Purge Solenoid in this section.

NOTE: The evaporative system uses specially manufactured hoses. If they need replacement, only use fuel resistant hose.

PRESSURE RELIEF/ROLLOVER VALVE

All vehicles have a combination pressure relief and rollover valve. The dual function valve relieves fuel tank pressure. The valve also prevents fuel flow through the fuel tank vent valve hoses should the vehicle rollover. All vehicles pass a 360° rollover.

The pressure relief valve opens at a certain pressure. When fuel tank pressure increases above the calibrated pressure, the valve opens to release fuel tank vapors pressure. The charcoal filled evaporative canister stores the vapors. For pressure relief/rollover valve service, refer to the Fuel Tank section of Group 14.

EVAP CANISTER

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 PCM purges the canister through the duty cycle EVAP purge solenoid. The PCM purges the canister at predetermined intervals and engine conditions.

The canister mounts to a bracket behind the front fascia on the passengers side of the vehicle (Fig. 1). The vacuum and vapor tube connect to the top of the canister.

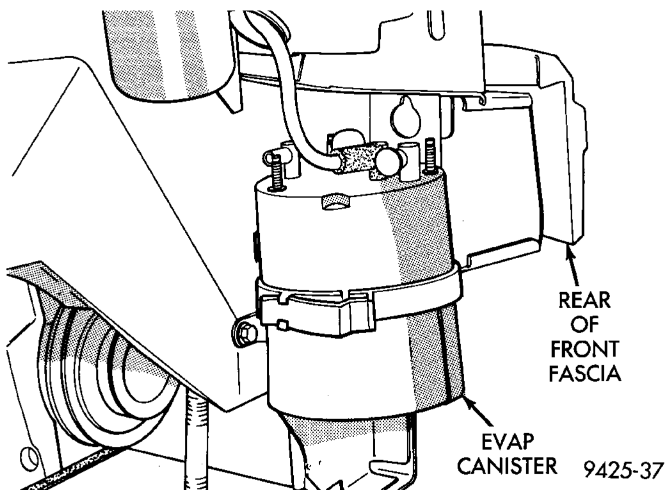


Fig. 1 EVAP Canister

DUTY CYCLE EVAP PURGE SOLENOID VALVE

The duty cycle EVAP purge 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.

When purging, the PCM energizes and de-energizes the solenoid approximately 5 or 10 times per second, depending upon operating conditions. The PCM varies the vapor flow rate by changing solenoid pulse width. Pulse width is the amount of time the solenoid energizes.

DESCRIPTION AND OPERATION (Continued)

The solenoid attaches to a bracket which is attached to the front engine mount (Fig. 2). The solenoid will not operate properly unless it is installed with the electrical connector at the top.

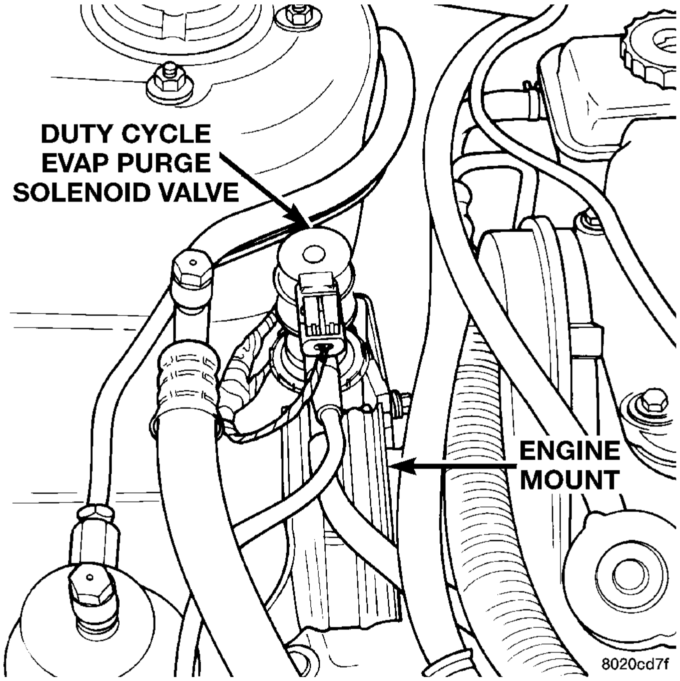


Fig. 2 Duty Cycle EVAP Purge Solenoid Valve

PRESSURE-VACUUM FILLER CAP

CAUTION: Remove the fuel filler cap to relieve fuel tank pressure. The cap must be removed prior to disconnecting any fuel system component or servicing the fuel tank.

A pressure-vacuum relief cap seals the fuel tank (Fig. 3). Tightening the cap on the fuel filler tube forms a seal between them. The relief valves in the cap are a safety feature. They prevent possible excessive pressure or vacuum in the tank. Excessive fuel tank pressure could be caused by a malfunction in the system or damage to the vent lines.

The seal between the cap and filler tube breaks when the cap is removed and relieves fuel tank pressure.

If the filler cap needs replacement, only use the correct part.

LEAK DETECTION PUMP

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.

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 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:

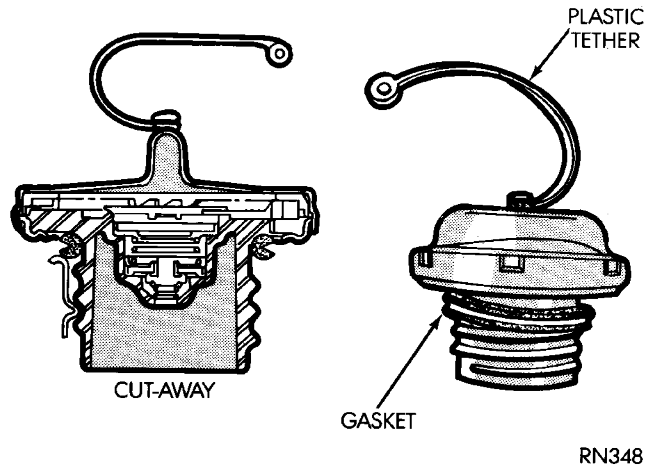


Fig. 3 Pressure Vacuum Filler Cap

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.

DESCRIPTION AND OPERATION (Continued)

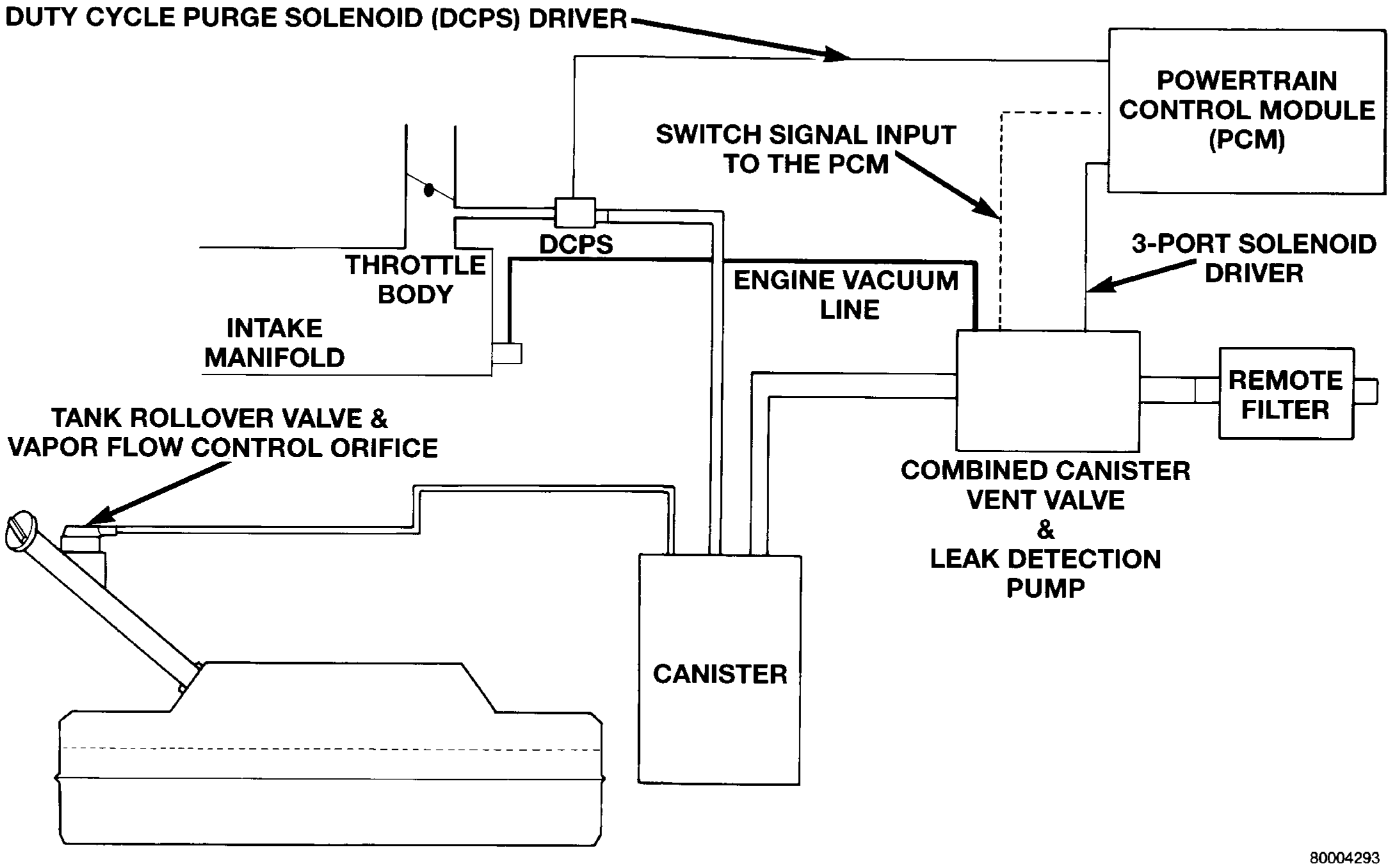


Fig. 4 Evaporative System Monitor Schematic

POSITIVE CRANKCASE VENTILATION (PCV) SYSTEMS

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

PCV VALVE

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. 7).

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. 8). 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 the inlet. This results in maximum vapor flow through the valve (Fig. 9).

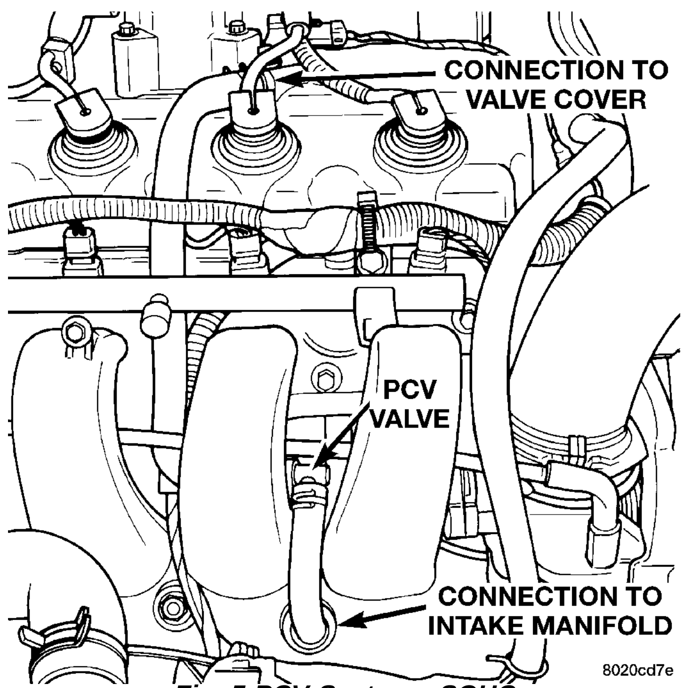


Fig. 5 PCV System—SOHC

DESCRIPTION AND OPERATION (Continued)

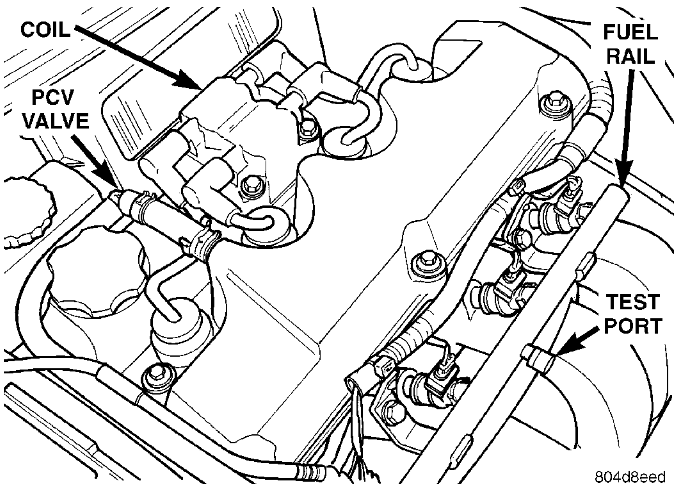


Fig. 6 PCV System—DOHC

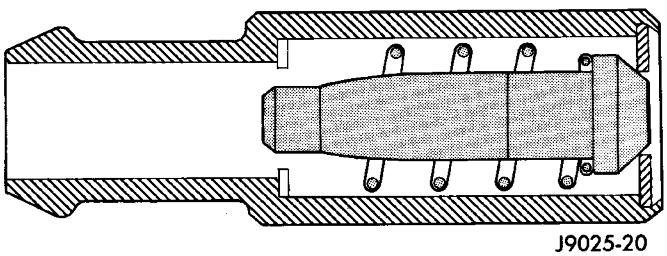


Fig. 7 Engine Off or Engine Backfire—No Vapor Flow

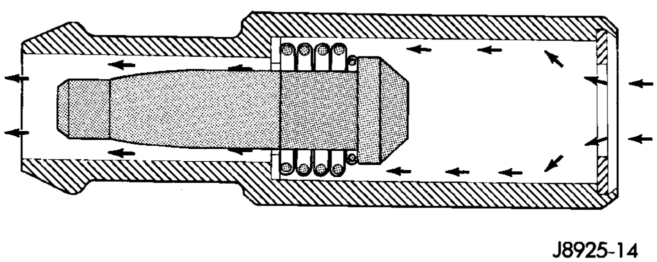


Fig. 8 High Intake Manifold Vacuum—Minimal Vapor Flow

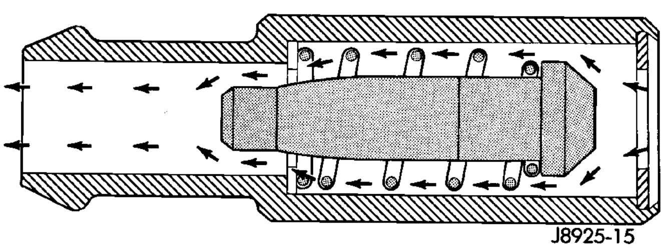


Fig. 9 Moderate Intake Manifold Vacuum—Maximum Vapor Flow

VEHICLE EMISSION CONTROL INFORMATION LABEL

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.

If any difference exists between the VECI label on the vehicle and the vacuum schematic in the Service Manual, refer to the label on the vehicle.

DIAGNOSIS AND TESTING

LEAK DETECTION PUMP

Refer to the appropriate Powertrain Diagnostic Procedures Manual for testing procedures.

PCV VALVE TEST

WARNING: APPLY PARKING BRAKE AND/OR BLOCK WHEELS BEFORE PERFORMING ANY TEST OR ADJUSTMENT WITH THE ENGINE OPERATING.

With the engine idling, remove the PCV valve from its attaching point. If the valve is operating properly, a hissing noise will be heard and a strong vacuum felt when placing a finger over the valve inlet (Fig. 10). With the engine off, shake the valve. The valve should rattle when shaken. Replace the valve if it does not operate properly. **Do not attempt to clean the PCV valve.**

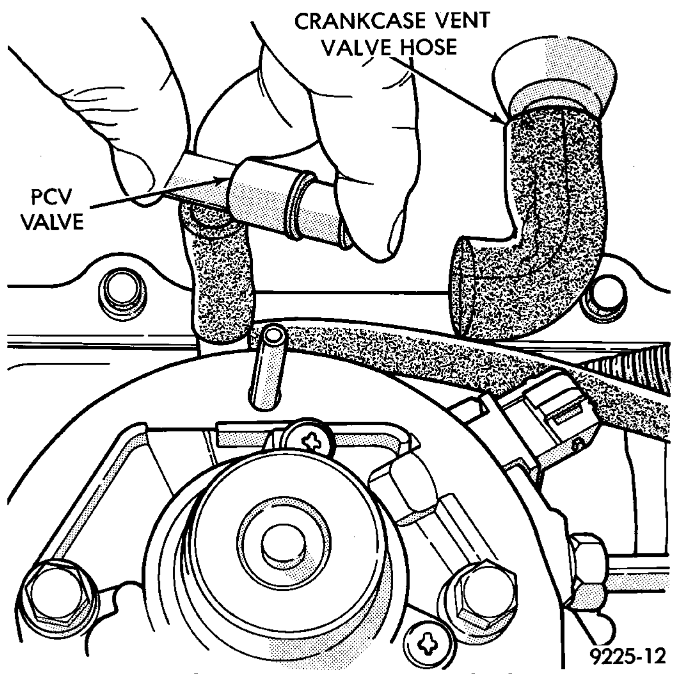
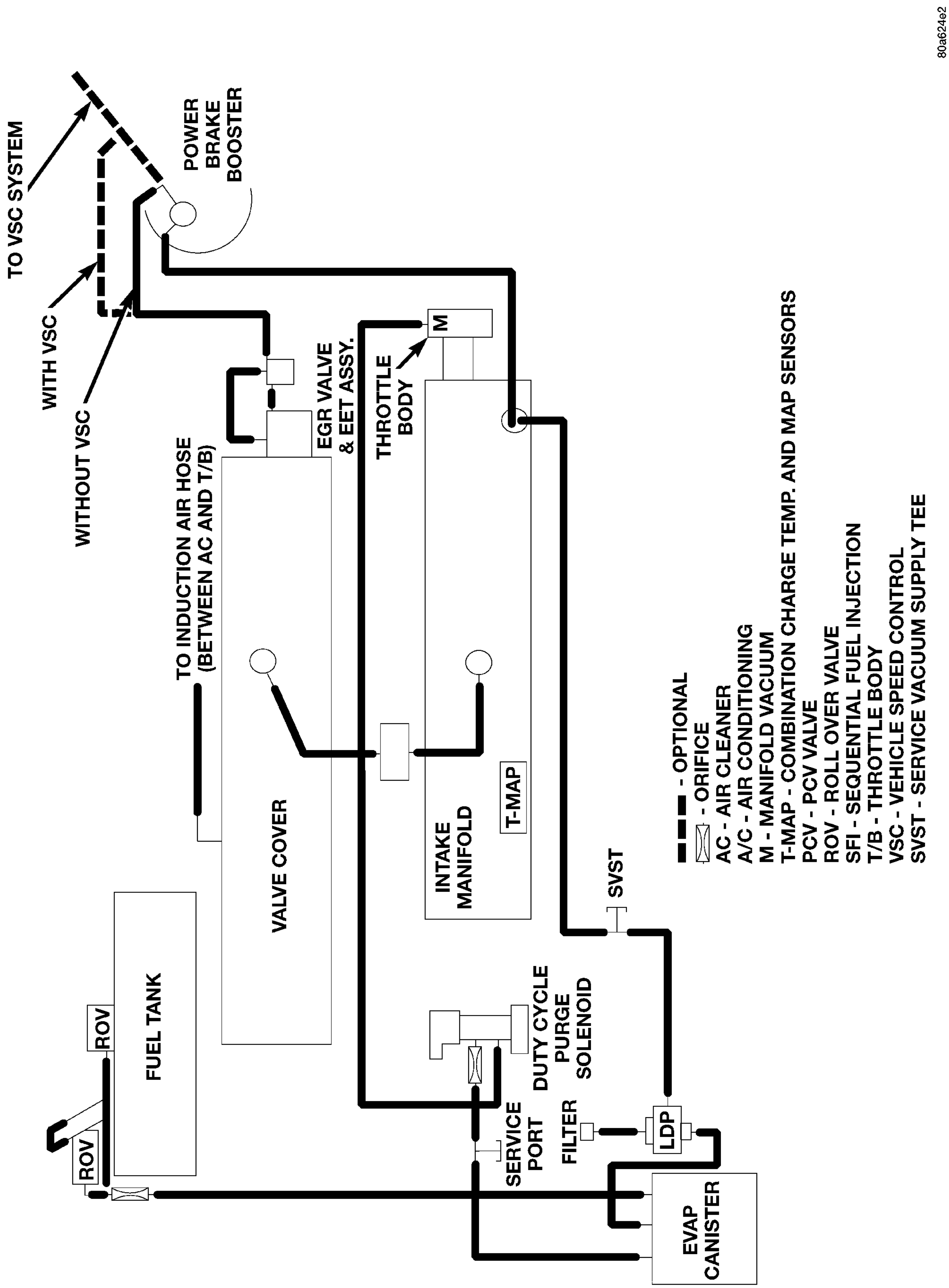


Fig. 10 PCV Test —Typical

VACUUM SCHEMATIC

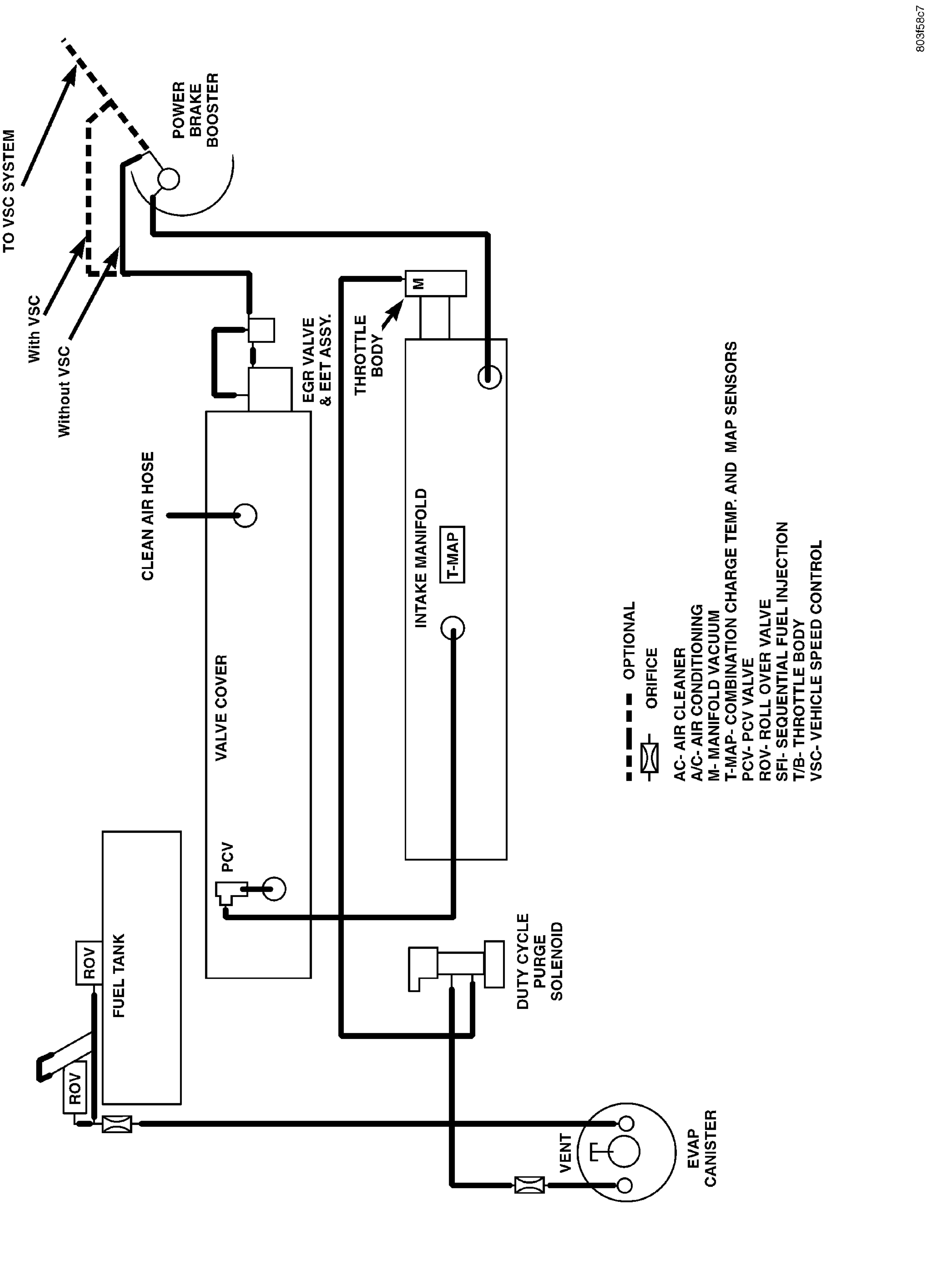
If any difference exists between the diagram on the Vehicle Emission Control Information (VECI) label and this illustration, refer to the label on the vehicle.

DIAGNOSIS AND TESTING (Continued)



ENGINE VACUUM SCHEMATIC—SOHC

DIAGNOSIS AND TESTING (Continued)



ENGINE VACUUM SCHEMATIC—DOHC

REMOVAL AND INSTALLATION

LEAK DETECTION PUMP REPLACEMENT

REMOVAL

(1) Raise and support vehicle on a hoist.
(2) Remove right front wheel.
(3) Remove splash shield.
(4) Disconnect vacuum lines from EVAP canister.
(5) Push locking tab on electrical connector to unlock and remove connector.
(6) Remove 3 nuts from EVAP canister and remove canister.
(7) Remove pump and bracket as an assembly.
(8) Remove pump from bracket.

INSTALLATION

(1) Install pump to bracket and tighten bolts to 1.2 N·m (10.6 in. lbs.).
(2) Install pump and bracket assembly to body and tighten bolts to 10 N·m (90 in. lbs.).
(3) Install EVAP canister to bracket and tighten nutts to 5.6 N·m (50 in. lbs.).
(4) Install electrical connetor to pump and push locking tab to lock.
(5) **Before installing hoses to LDP, make sure they are not cracked or split. If a hose leaks, it will cause the Check Engine Lamp to illumunate.** Connect lines to EVAP canister and LDP.
(6) Use the DRB scan tool, verify proper operation of LDP.
(7) Install splash shield.
(8) Install wheel.
(9) Lower vehicle

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

INDEX

DESCRIPTION AND OPERATION

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

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, 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 EGR system consists of (Fig. 1):

- EGR tube
- EGR valve
- Electronic EGR Transducer (EET)
- Connecting hoses.

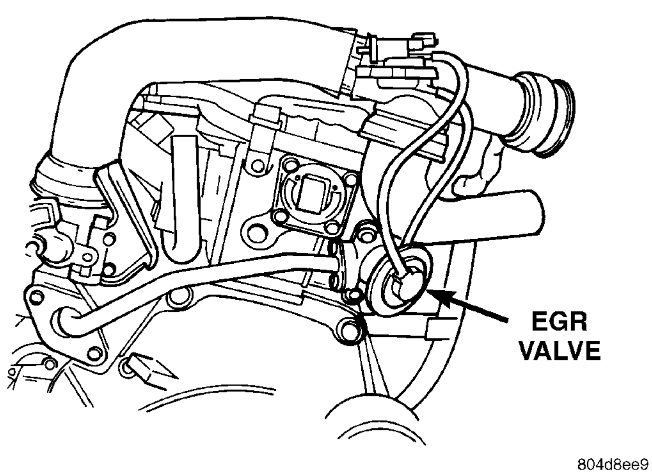


Fig. 1 EGR System

The electronic EGR transducer contains an electrically operated solenoid and a back-pressure transducer (Fig. 2). The Powertrain Control Module (PCM) operates the solenoid. The PCM determines when to energize the solenoid. Exhaust system back- pressure controls the transducer.

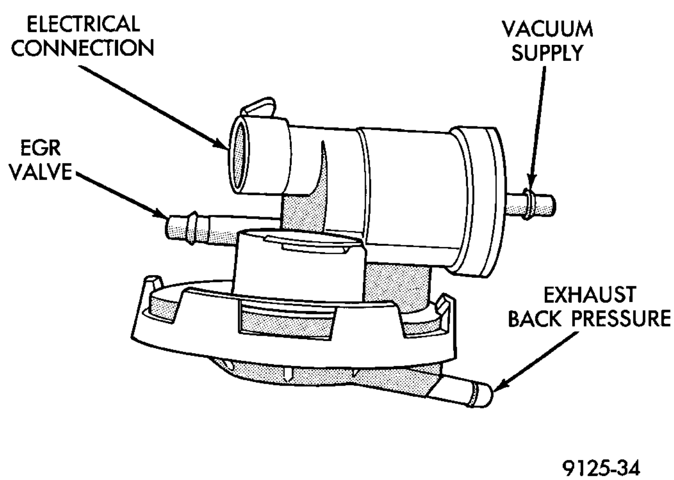


Fig. 2 Electronic EGR Transducer

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, vacuum 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.

DIAGNOSIS AND TESTING

EGR SYSTEM ON-BOARD DIAGNOSTICS

The PCM performs an on-board diagnostic check of the EGR system. The diagnostic system uses the electronic EGR transducer for the system tests.

The diagnostic check activates only during selected engine/driving conditions. When the conditions are met, the PCM energizes the transducer solenoid to disable the EGR. The PCM checks for a change in the heated oxygen sensor signal. If the air-fuel mixture goes lean, the PCM will attempt to enrichen the mixture. The PCM registers a Diagnostic Trouble Code (DTC) if the EGR system has failed or degraded. After registering a DTC, the PCM turns on the malfunction indicator (Check Engine) lamp. The Malfunction Indicator Lamp (MIL) indicates the need for service.

If a problem is indicated by the MIL and a DTC for the EGR system is set, check for proper operation of the EGR system. Use the System Test, EGR Gas Flow Test and EGR Diagnosis Chart. If the EGR system tests properly, check the system using the DRB scan tool. Refer to On-Board Diagnosis sections in this Group. Also, refer to the DRB scan tool and the appropriate Powertrain Diagnostics Procedure manual.

EGR SYSTEM TEST

WARNING: APPLY PARKING BRAKE AND/OR BLOCK WHEELS BEFORE TESTING THE EGR SYSTEM.

(1) Check the condition of all EGR system hoses and tubes for leaks, cracks, kinks and hardening of rubber hoses. Repair and correct these conditions before performing any tests.

(2) Be sure the hoses at both the EGR valve and EGR valve control are connected to the proper fittings (Fig. 3).

(3) Be sure the electrical connector is firmly connected at the valve control.

(4) To check EGR system operation, connect the DRB scan tool to the 16–way data link connector. The data link connector is located on the lower edge of the instrument panel near the steering column. Refer to the appropriate Powertrain Diagnostic Procedures service manual for operation of the DRB scan tool when diagnosing the EGR system.

(5) After checking the system with the DRB scan tool, proceed to the following EGR Valve Leakage and EGR Valve Control Tests and repair as necessary.

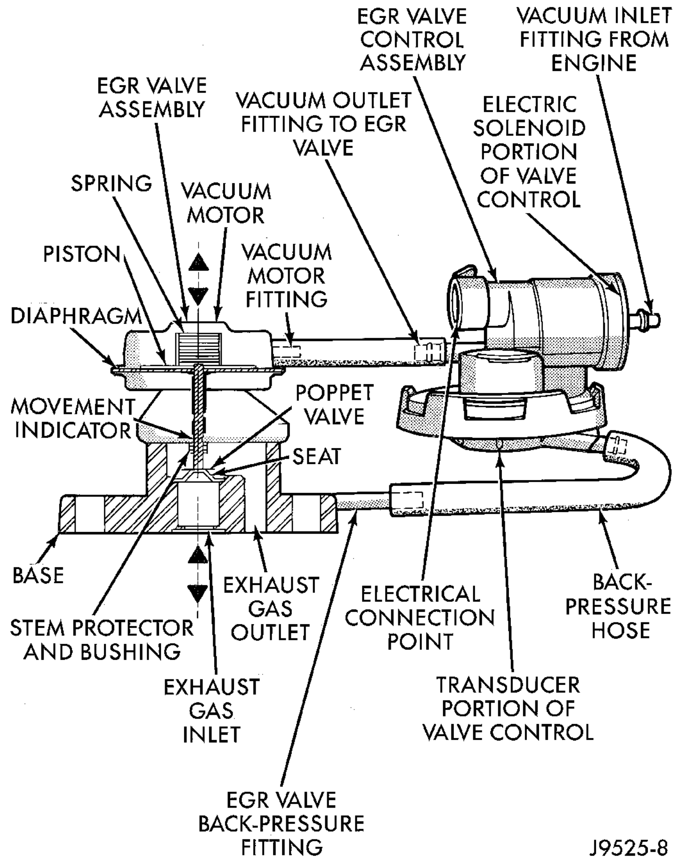


Fig. 3 EGR Value and EGR Value —Typical

EGR GAS FLOW TEST

Use the following test procedure to determine if exhaust gas is flowing through the EGR valve. It can also be used to determine if the EGR tube is plugged, or the system passages in the intake or exhaust manifolds are plugged.

This is not to be used as a complete test of the EGR system.

The engine must be started, running and warmed to operating temperature for this test.

DIAGNOSIS AND TESTING (Continued)

(1) All engines are equipped with two fittings located on the EGR valve (Fig. 4). The upper fitting (located on the vacuum motor) supplies engine vacuum to a diaphragm within the EGR valve for valve operation. The lower fitting (located on the base of the EGR valve) is used to supply exhaust back-pressure to the EGR valve control.

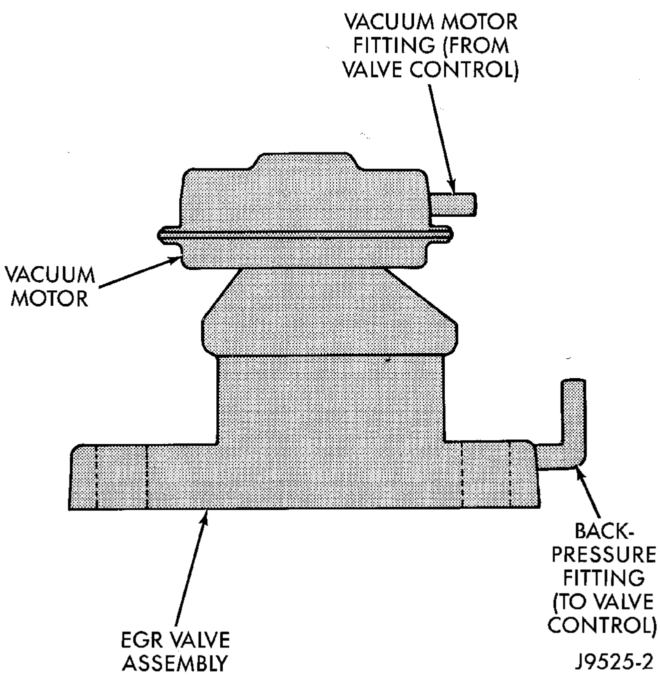


Fig. 4 Typical EGR Valve

(2) Disconnect the rubber hose at the vacuum motor fitting (Fig. 4) on the top of the EGR valve vacuum motor.

(3) Connect a hand-held vacuum pump to this fitting.

(4) Start the engine.

(5) Slowly apply 5 inches of vacuum to the fitting on the EGR valve motor.

(6) While applying vacuum, a minimum of 3 inches of vacuum, and with the engine running at idle speed, the idle speed should drop or the engine may even stall, if the vacuum is applied quickly. This is indicating that exhaust gas is flowing through the EGR tube between the intake and exhaust manifolds.

(7) If the engine speed did not change, the EGR valve may be defective, or EGR tube may be plugged with carbon, or the passages in the intake and exhaust manifolds may be plugged with carbon.

(a) Remove EGR valve from engine. Refer to EGR Valve Removal in this group.

(b) Apply vacuum to the vacuum motor fitting and observe the stem on the EGR valve. If the stem is moving, it can be assumed that the EGR valve is functioning correctly. The problem is in either a plugged EGR tube or plugged passages at the intake or exhaust manifolds, refer to step (c). If the stem will not move, replace the EGR valve. Note: The EGR valve, valve control and attaching hoses are serviced as one unit. Refer to EGR Valve Removal/Installation in this group.

(c) Remove the EGR tube between the intake and exhaust manifolds. Check and clean the EGR tube and its related openings on the manifolds. Refer to EGR Tube in this group for procedures.

(8) Do not attempt to clean the EGR valve. If the valve shows evidence of heavy carbon build-up near the base, replace it.

EGR VALVE LEAKAGE TEST

This is not to be used as a complete test of the EGR system.

If the engine will not idle, dies out on idle, or idle is rough or slow, the poppet valve (Fig. 3) at the base of the EGR valve may be leaking in the closed position.

(1) The engine should be off for the following test.

(2) Disconnect the rubber hose from the fitting (Fig. 3) at the top (vacuum motor) side of the EGR valve.

(a) Connect a hand-held vacuum pump to this fitting.

(b) Apply 15 inches of vacuum to the pump.

(c) Observe the gauge reading on the pump.

(d) If vacuum falls off, the diaphragm in the EGR valve has ruptured.

(e) Replace the EGR valve. Note: The EGR valve, valve control and attaching hoses are serviced as one assembly. Refer to EGR Valve Removal/Installation in this group.

(f) Proceed to the next step.

(3) A small metal fitting (back-pressure fitting) is located at the base of the EGR valve (Fig. 3). A rubber back-pressure hose connects it to the back-pressure fitting on the EGR valve control. Disconnect this rubber hose at the EGR valve fitting.

(4) Remove the air cleaner housing from the throttle body.

(5) Using compressed air, and using an air nozzle with a rubber tip, apply approximately 50 psi of regulated shop air to the metal back- pressure fitting on the EGR valve.

(6) By hand, open the throttle to the wide open position. Air **SHOULD NOT BE HEARD** emitting from the intake manifold while applying air pressure at the back-pressure fitting.

(7) If air **CAN BE HEARD** emitting from the intake manifold, the poppet valve (Fig. 3) is leaking at the bottom of the EGR valve. Replace the EGR valve. Note: The EGR valve, valve control and attaching hoses are serviced as one assembly. Refer to EGR Valve Removal/Installation in this group. Do not attempt clean the old EGR valve.

DIAGNOSIS AND TESTING (Continued)

EGR VALVE CONTROL (TRANSDUCER) TEST

TESTING ELECTRICAL SOLENOID PORTION OF VALVE

This is not to be used as a complete test of the EGR system.

Electrical operation of the valve should be checked with the DRB scan tool. Refer to the appropriate Powertrain Diagnostic Procedures service manual for operation of the DRB scan tool. Replace solenoid if necessary, unit serviced only as an assembly.

TESTING VACUUM TRANSDUCER PORTION OF VALVE

The first part of this test will determine if the transducer diaphragm at the back-pressure side of the valve has ruptured or is leaking. The second part of the test will determine if engine vacuum (full-manifold) is flowing from the inlet to the outlet side of the valve. This is not to be used as a complete test of the EGR system.

(1) Disconnect the rubber back-pressure hose from the fitting at the bottom of EGR valve (Fig. 3).

(2) Connect a hand-held vacuum pump to this fitting.

(3) Apply 10 inches of vacuum to this fitting.

(4) If vacuum falls off, the valve diaphragm is leaking.

(5) Replace the EGR valve assembly. Proceed to next step for further testing.

(6) Remove the rubber hose at the vacuum **inlet** fitting (Fig. 3) on the EGR valve.

(7) Connect a vacuum gauge to this disconnected hose.

(8) Start the engine and bring to operating temperature. Hold engine speed at approximately 1500 rpm.

(9) Check for steady engine vacuum (full-manifold) at this hose.

(10) If engine vacuum (full-manifold) is not present, check vacuum line to engine and repair as necessary before proceeding to next step.

(11) Reconnect the rubber hose to the vacuum **inlet** fitting (Fig. 3) on the EGR valve.

(12) Disconnect the rubber hose at the vacuum **outlet** fitting (Fig. 3) on the EGR valve.

(13) Connect a vacuum gauge to this fitting.

(14) Disconnect the electrical connector (Fig. 3) at the valve control. This will simulate an open circuit (no ground from the PCM) at the valve.

(15) Start the engine and bring to operating temperature.

(16) Hold the engine speed to approximately 2000 rpm while checking for engine vacuum (full-manifold) at this fitting. **To allow full manifold vacuum to flow through the valve, exhaust back-pressure must be present at valve. It must be high enough to hold the bleed valve in the transducer portion of the valve closed.** Have a helper momentarily (a second or two) hold a rag over the tailpipe opening to build some exhaust back-pressure while observing the vacuum gauge. Heavy gloves should be worn. **Do not cover the tailpipe opening for an extended period of time as damage to components or overheating may result.**

(17) As temporary back-pressure is built, full manifold vacuum should be observed at the vacuum outlet fitting. Without back-pressure, and engine at approximately 2000 rpm, the gauge reading will be low. This low reading is normal. At idle speed, the gauge reading will be erratic. This is also normal.

(18) If full manifold vacuum is not present at the outlet fitting, but was present at the inlet fitting, replace the valve. Note: The EGR valve, valve control and attaching hoses are serviced as one assembly. Refer to EGR Valve Removal/Installation in this group.

REMOVAL AND INSTALLATION

EGR VALVE

If the EGR system operates incorrectly, replace the entire EGR valve and transducer together. The EGR valve and electrical transducer (EET) are calibrated together.

REMOVAL

The EGR valve attaches to the rear of the cylinder head (Fig. 5). EGR transducer is attached to the air inlet duct.

(1) Remove EGR transducer from air inlet duct.

(2) Disconnect vacuum supply tube from EGR transducer solenoid.

(3) Disconnect electrical connector from solenoid.

(4) Remove air inlet duct.

(5) Remove EGR tube to EGR valve screws.

(6) Remove EGR valve mounting screws. Remove EGR valve and transducer.

(7) 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 tube fasteners to 11 N·m (95 in. lbs.) torque.

(4) Tightening EGR valve mounting screws to 22 N·m (200 in. lbs.) torque.

(5) Install air inlet duct.

(6) Connect vacuum supply tube to solenoid.

(7) Attach electrical connector to solenoid.

(8) Install EGR transducer onto air inlet duct.

EGR TUBE

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

REMOVAL

(1) Remove screws attaching EGR tube to intake manifold (Fig. 6).

(2) Remove EGR tube to EGR valve screws.

(3) Remove EGR tube. Clean gasket surface on the EGR valve. Wipe clean the grommet on the intake manifold.

INSTALLATION

The rubber grommet that seals the EGR tube to intake manifold connection is reusable.

(1) Loosely install the EGR tube and fasteners.

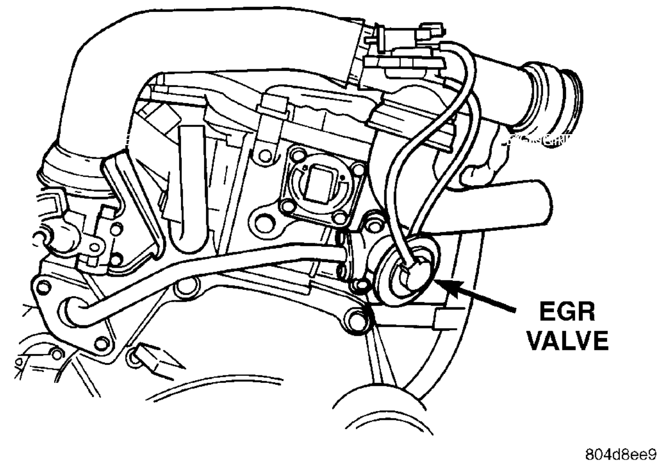


Fig. 5 EGR System

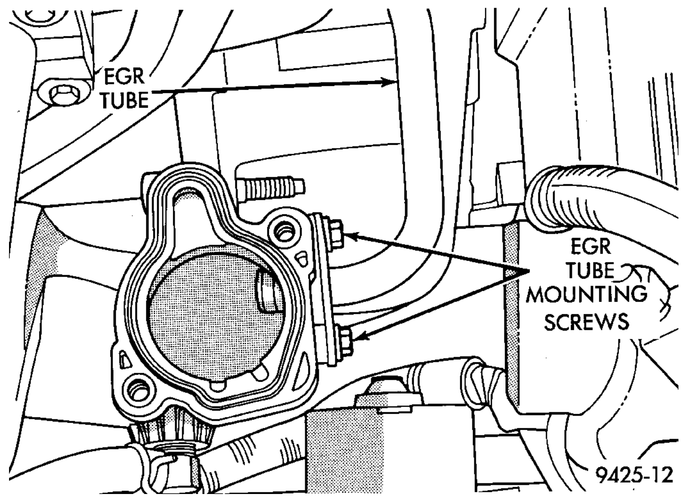


Fig. 6 EGR Tube Stud Bolts

(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.

SPECIFICATIONS

TORQUE

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