SPECIFICATIONS

TEMPERATURE VS RESISTANCE

Temperature vs Resistance

° C	° F	OHMS
Temperature vs Resistance Values (Approximate)		
150	302	47
140	284	60
130	266	77
120	248	100
110	230	132
100	212	177
90	194	241
80	176	332
70	158	467
60	140	667
50	122	973
45	113	1188
40	104	1459
35	95	1802
30	86	2238
25	77	2796
20	68	3520
15	59	4450
10	50	5670
5	41	7280
0	32	9420
-5	23	12300
-10	14	16180
-15	5	21450
-20	-4	28680
-30	-22	52700
-40	-40	100700

ALTITUDE VS BAROMETRIC PRESSURE

Altitude vs Barometric Pressure

Altitude Measured in Meters (m)	Altitude Measured in Feet (ft)	Barometric Pressure Measured in Kilopascals (kPa)
Determine your altitude by contacting a local weather station or by using another reference source.		
4 267	14,000	56-64
3 962	13,000	58-66
3 658	12,000	61-69
3 353	11,000	64-72
3 048	10,000	66-74
2 743	9,000	69-77
2 438	8,000	71-79
2 134	7,000	74-82
1 829	6,000	77-85
1 524	5,000	80-88
1 219	4,000	83-91
914	3,000	87-95
610	2,000	90-98
305	1,000	94-102
0	0 Sea Level	96-104
-305	-1,000	101-105

IGNITION SYSTEM SPECIFICATIONS

Ignition System Specifications

Application	Specification	
	Metric	English
Firing Order	1-8-7-2-6-5-4-3	
Spark Plug Wire Resistance	1000 ohms per ft	
Spark Plug Torque	15 N.m	11 lb ft
Spark Plug Gap	1.52 mm	0.060 in
Spark Plug Type	25171803 [AC plug type] 12567759 [NGK plug type]	

FASTENER TIGHTENING SPECIFICATIONS

Fastener Tightening Specifications

Application	Specifications	
	Metric	English
Accelerator Pedal Nut	20 N.m	15 lb ft
Air Cleaner Housing Bolt	10 N.m	89 lb in
Air Cleaner Outlet Duct Clamp	7 N.m	62 lb in
Camshaft Position (CMP) Sensor Bolt	25 N.m	18 lb ft

Corner Brace Bolt	25 N.m	18 lb ft
Crankshaft Position (CKP) Sensor Bolt	25 N.m	18 lb ft
Engine Coolant Temperature (ECT) Sensor	20 N.m	15 lb ft
Engine Sight Shield Bracket Bolt	10 N.m	89 lb in
Engine Wiring Harness Bracket Nut	5 N.m	44 lb in
EVAP Canister Bolt	25 N.m	18 lb ft
EVAP Canister Purge Solenoid Bolt	10.5 N.m	93 lb in
Fuel Fill Hose/Vent Hose to Tank Clamp	2.5 N.m	22 lb in
Fuel Fill Pipe Bracket Bolt	12 N.m	106 lb in
Fuel Rail Bolts	10 N.m	89 lb in
Fuel Tank Ground Strap Bolt	9 N.m	80 lb in
Fuel Tank Fill Pipe Clamp	2.5 N.m	22 lb in
Fuel Tank Filler Housing to Body Screw	2.3 N.m	20 lb in
Fuel Tank Shield Bolt	25 N.m	18 lb ft
Fuel Tank Strap Bolt	40 N.m	30 lb ft
Heated Oxygen Sensor (HO2S)	42 N.m	31 lb ft
Ignition Coil Bolt	8 N.m	71 lb in
Knock Sensor	20 N.m	15 lb ft
Mass Air Flow/Intake Air Temperature (MAF/IAT) Sensor Clamp	7 N.m	62 lb in
Powertrain Control Module (PCM) Electrical Connector Bolt	8 N.m	71 lb in
Spark Plug		
• Used Head	15 N.m	11 lb ft
• New Head (Aluminum)	20 N.m	15 lb ft
• New Head (Iron)	30 N.m	22 lb ft
Throttle Actuator Control (TAC) Module Nut	9 N.m	80 lb in
Throttle Body Nut	10 N.m	89 lb in

DIAGNOSTIC TROUBLE CODE (DTC) TYPE DEFINITIONS

Emissions Related DTCs

Action Taken When the DTC Sets - Type A

The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Action Taken When the DTC Sets - Type B

The control module illuminates the MIL on the second consecutive ignition cycle that the diagnostic runs and fails.

Conditions for Clearing the MIL/DTC - Type A or Type B

- The control module turns OFF the MIL after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC Last Test Failed clears when the diagnostic runs and passes.
- Use a scan tool in order to clear the MIL and the DTC.

Non-Emissions Related DTCs

Action Taken When the DTC Sets - Type C

- The control module stores the DTC information into memory when the diagnostic runs and fails.
- The MIL will not illuminate.
- The driver information center, if equipped, may display a message.

Conditions for Clearing the DTC - Type C

- A last test failed, or current DTC, clears when the diagnostic runs and passes.
- Use a scan tool in order to clear the DTC.

Conditions for Clearing the DTC - Type X

This DTC is available in the PCM software, but has been disabled, or turned OFF. In this case, the diagnostic does not run, no DTCs are stored, and the MIL does not illuminate. Type X DTCs are used primarily for export vehicles that do not require MIL illumination or DTC storing.

DIAGNOSTIC TROUBLE CODE (DTC) TYPE(S)

Diagnostic Trouble Code (DTC) Type(s)

DTC	United States Canada	Unleaded Export
P0068	A	A
P0101	B	B
P0102	B	B
P0103	B	B
P0106	B	B
P0107	B	B
P0108	B	B
P0112	B	B
P0113	B	B
P0116	B	B
P0117	B	B
P0118	B	B
P0120	A	A
P0125	B	B

P0128	B	B
P0131	B	B
P0132	B	B
P0133	B	B
P0134	B	B
P0135	B	B
P0136	B	B
P0137	B	B
P0138	B	B
P0140	B	B
P0141	B	B
P0151	B	B
P0152	B	B
P0153	B	B
P0154	B	B
P0155	B	B
P0156	B	B
P0157	B	B
P0158	B	B
P0160	B	B
P0161	B	B
P0171	B	B
P0172	B	B
P0174	B	B
P0175	B	B
P0200	B	B
P0218	C	C
P0220	A	A
P0230	B	B
P0300	B	B
P0315	A	A
P0325	B	B
P0327	B	B
P0332	B	B
P0335	B	B
P0336	B	B
P0341	B	B
P0342	B	B
P0343	B	B
P0351	B	B
P0352	B	B

P0353	B	B
P0354	B	B
P0355	B	B
P0356	B	B
P0357	B	B
P0358	B	B
P0420	A	A
P0430	A	A
P0442	A	X
P0443	B	B
P0446	A	A
P0449	B	B
P0452	B	B
P0453	B	B
P0455	A	A
P0461	C	C
P0462	C	C
P0463	C	C
P0496	B	B
P0502	B	B
P0503	B	B
P0506	B	B
P0507	B	B
P0522	C	C
P0523	C	C
P0530	C	C
P0562	C	C
P0563	C	C
P0567	C	C
P0568	C	C
P0601	A	A
P0602	A	A
P0604	A	A
P0606	A	A
P0608	C	C
P0622	C	C
P0641	B	B
P0650	B	B
P0651	B	B
P0654	C	C
P0706	C	C

P0711	C	C
P0712	C	C
P0713	C	C
P0719	C	C
P0724	C	C
P0740	B	B
P0741	B	B
P0742	B	B
P0748	C	C
P0751	B	B
P0752	B	B
P0753	B	B
P0756	A	A
P0757	A	A
P0758	A	A
P0785	B	B
P0894	B	B
P1106	C	C
P1107	C	C
P1111	C	C
P1112	C	C
P1114	C	C
P1115	C	C
P1125	A	A
P1133	B	B
P1134	B	B
P1153	B	B
P1154	B	B
P1258	A	A
P1380	C	X
P1381	C	X
P1516	A	A
P1574	C	C
P1626	C	C
P1631	C	C
P1637	C	C
P1810	B	B
P2101	A	A
P2108	A	A
P2120	C	C
P2121	C	C

P2125	C	C
P2135	A	A
P2610	B	B
P2761	B	B
P2771	B	B
U0107	A	A

SCHEMATIC AND ROUTING DIAGRAMS

EMISSION HOSE ROUTING DIAGRAM

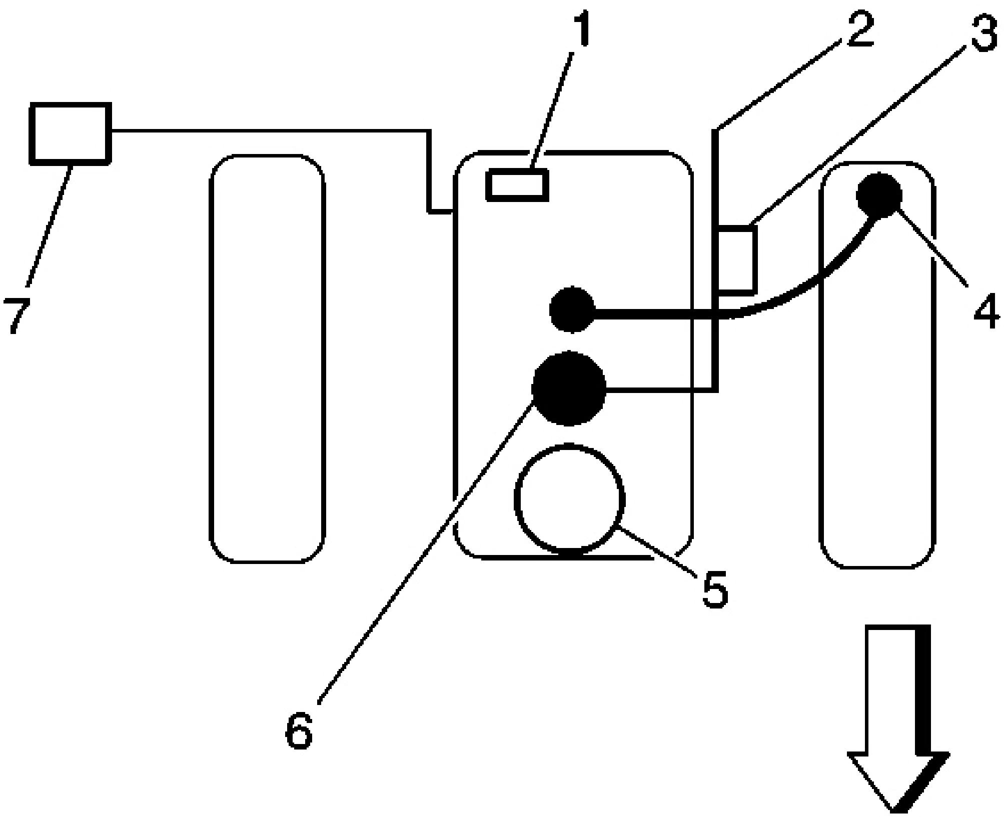


Fig. 1: Vacuum Hose Routing
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 1

Callout	Component Name
1	Manifold Absolute Pressure (MAP) Sensor
2	EVAP Canister Purge Hose
3	EVAP Service Port
4	Positive Crankcase Ventilation (PCV) Valve
5	Throttle Body
6	EVAP Canister Purge Valve
7	AIR Module, if equipped

EVAPORATIVE EMISSIONS (EVAP) HOSE ROUTING DIAGRAM

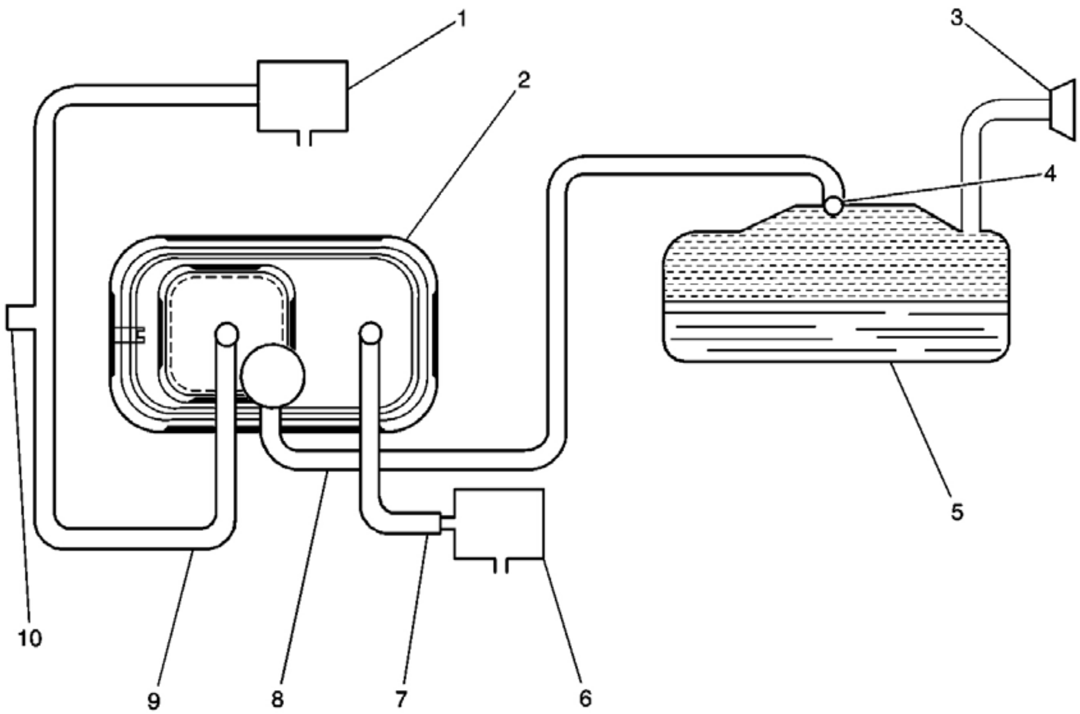


Fig. 2: EVAP System Overview
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 2

Callout	Component Name
1	EVAP Canister Purge Solenoid Valve
2	EVAP Canister
3	Fuel Fill Neck/Fill Cap
4	Rollover Valve/Fuel Tank Pressure (FTP) Sensor
5	Fuel Tank

6	EVAP Canister Vent Solenoid Valve
7	Vent Hose/Pipe
8	EVAP Vapor Pipe
9	EVAP Purge Pipe
10	EVAP Service Port

FUEL HOSE/PIPES ROUTING DIAGRAM (SINGLE FUEL TANK)

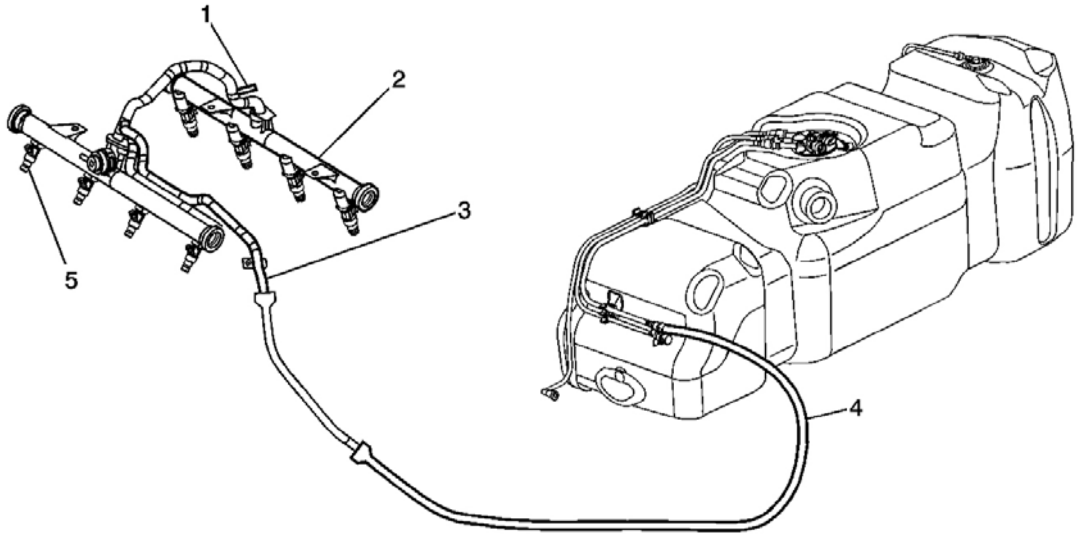


Fig. 3: Fuel Hose/Pipes (Single Fuel Tank)
Courtesy of GENERAL MOTORS CORP.

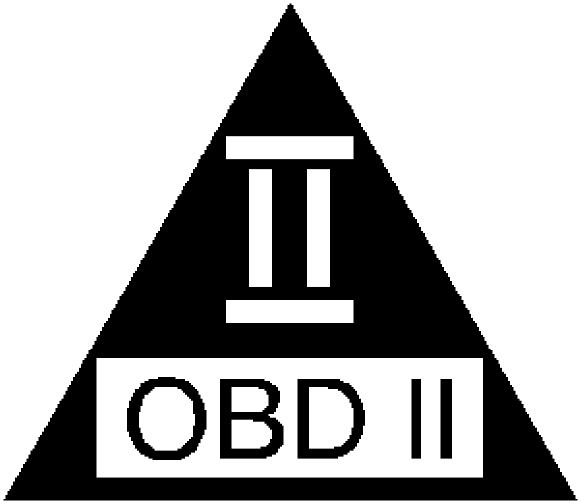
Callouts For Fig. 3

Callout	Component Name
1	Fuel Pressure Service Connection
2	Fuel Injector Rail
3	Fuel Rail Feed Pipe
4	Fuel Feed Hose
5	Fuel Injector

ENGINE CONTROLS SCHEMATIC ICONS

Engine Controls Schematic Icons

Icon	Icon Definition
	NOTE: **The OBD II symbol is used on the circuit diagrams in order to alert the technician that**

	the circuit is essential for proper OBD II emission control circuit operation. Any circuit which fails and causes the malfunction indicator lamp (MIL) to turn ON, or causes emissions-related component damage, is identified as an OBD II circuit.

ENGINE CONTROLS SCHEMATICS

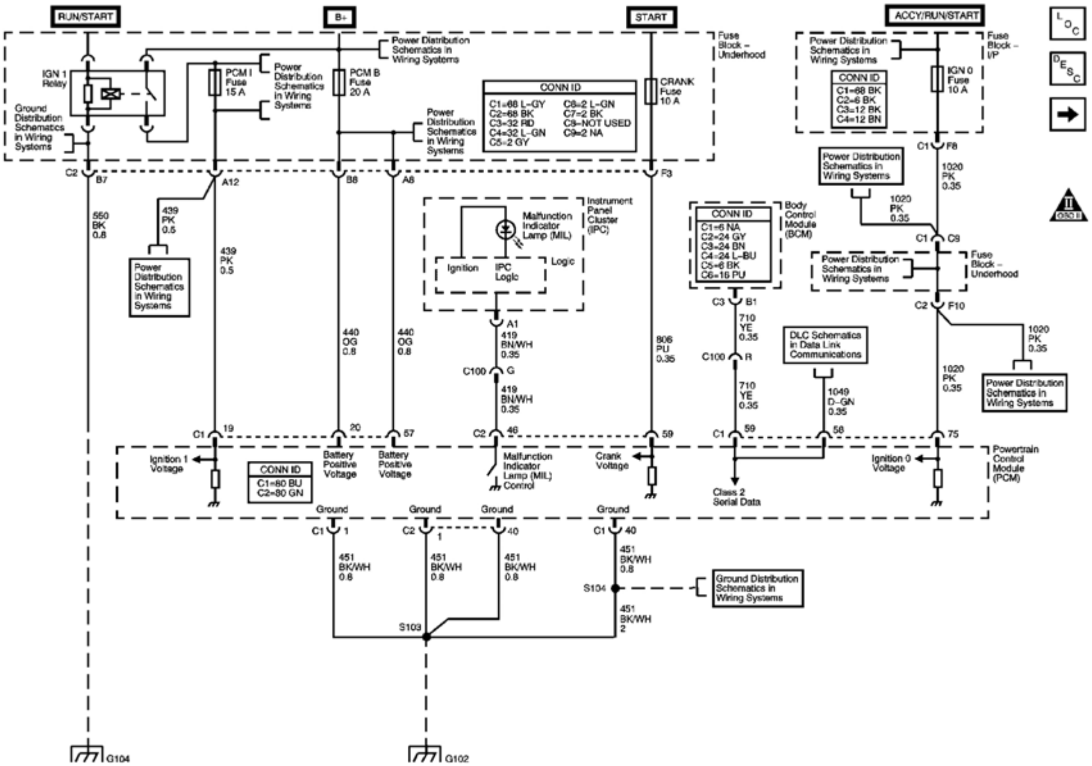


Fig. 4: PCM Power, Grounding, Serial Data, and MIL Schematics
Courtesy of GENERAL MOTORS CORP.

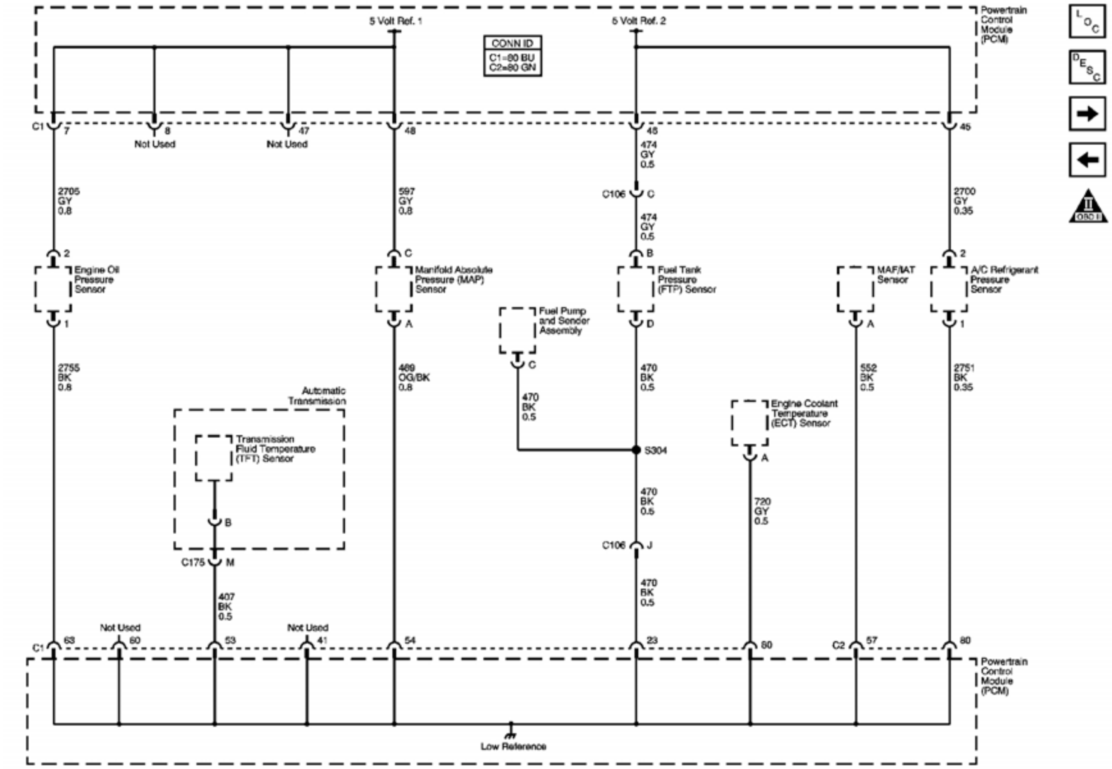


Fig. 5: 5 Volt and Low Reference Busses Schematics
Courtesy of GENERAL MOTORS CORP.

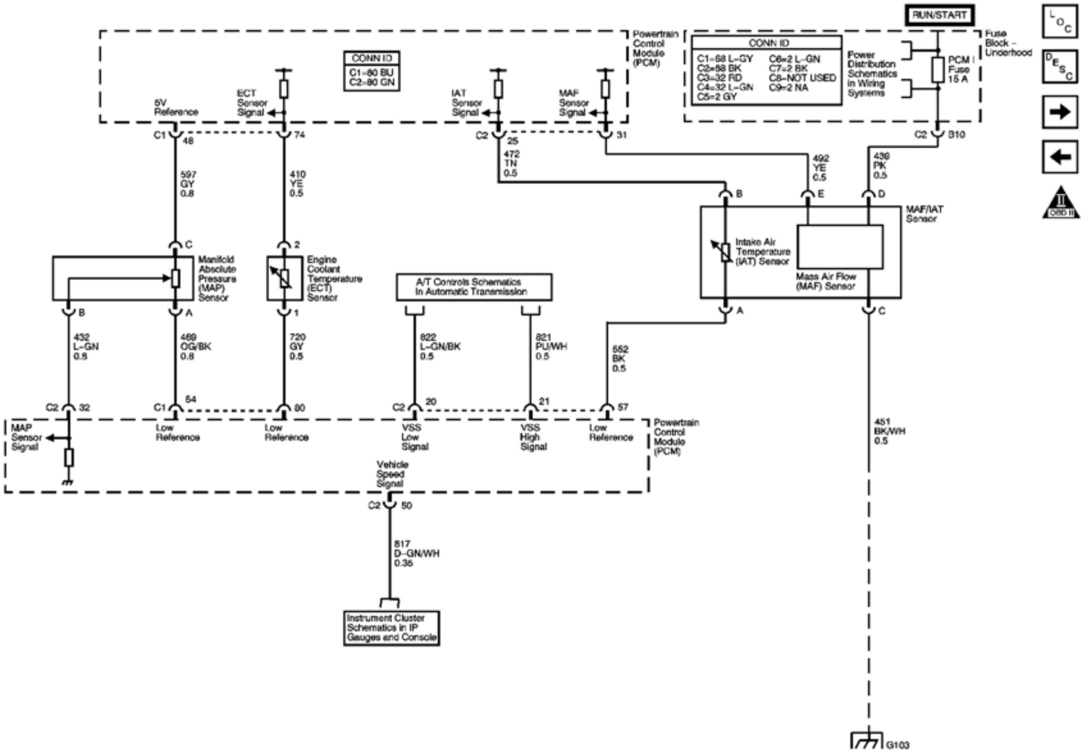


Fig. 6: MAP, ECT, VSS Circuit, and IAT/MAF Schematics
Courtesy of GENERAL MOTORS CORP.

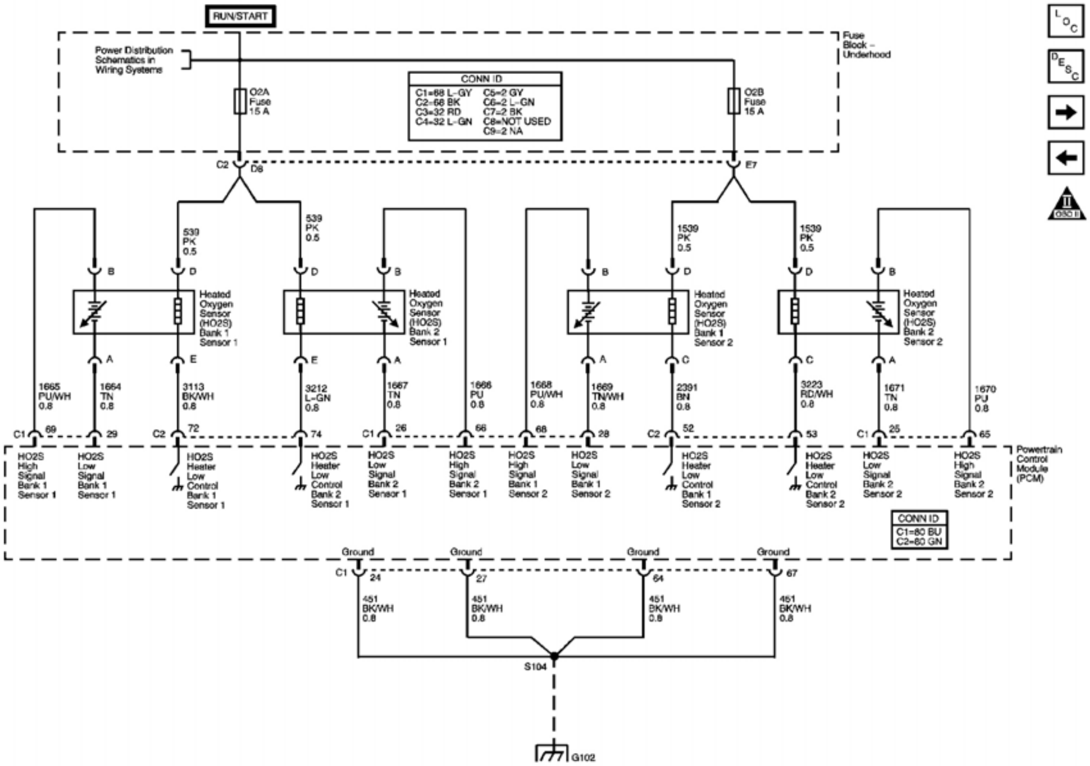


Fig. 7: HO2S Circuits Schematics
Courtesy of GENERAL MOTORS CORP.

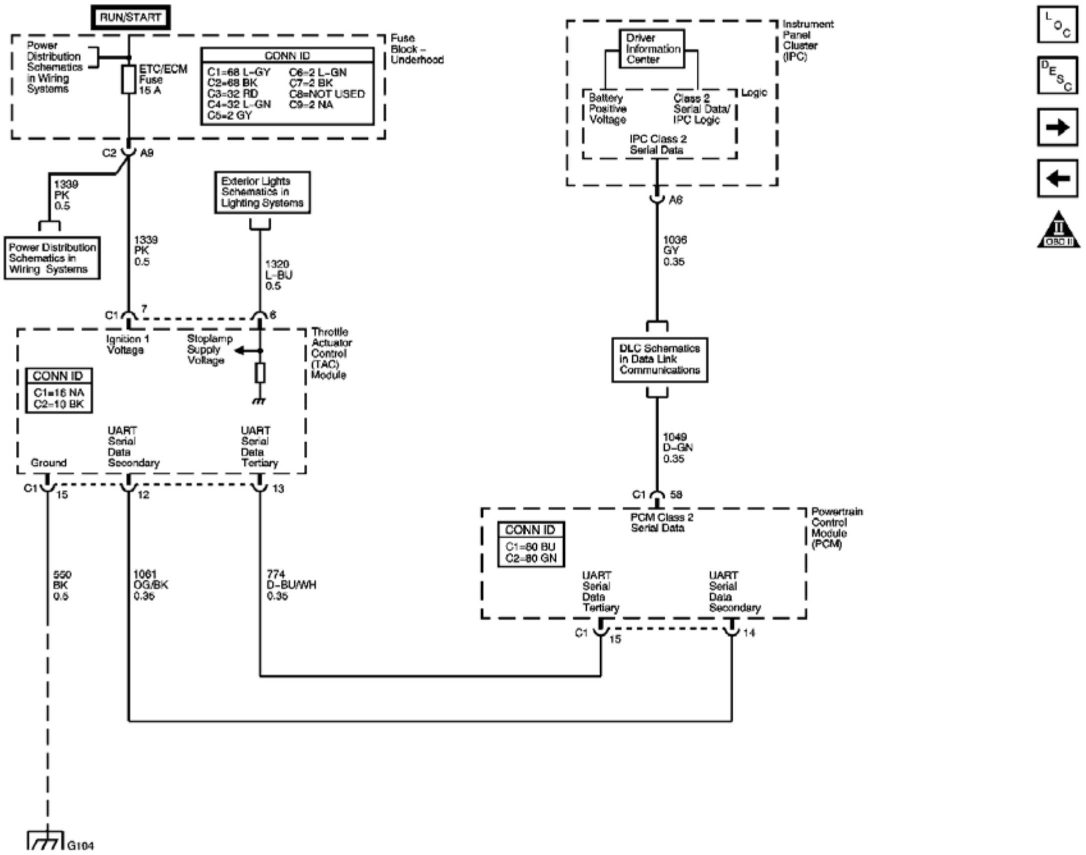


Fig. 8: TAC Power, Grounding, Data Circuits, and Indicator Control Schematics
Courtesy of GENERAL MOTORS CORP.

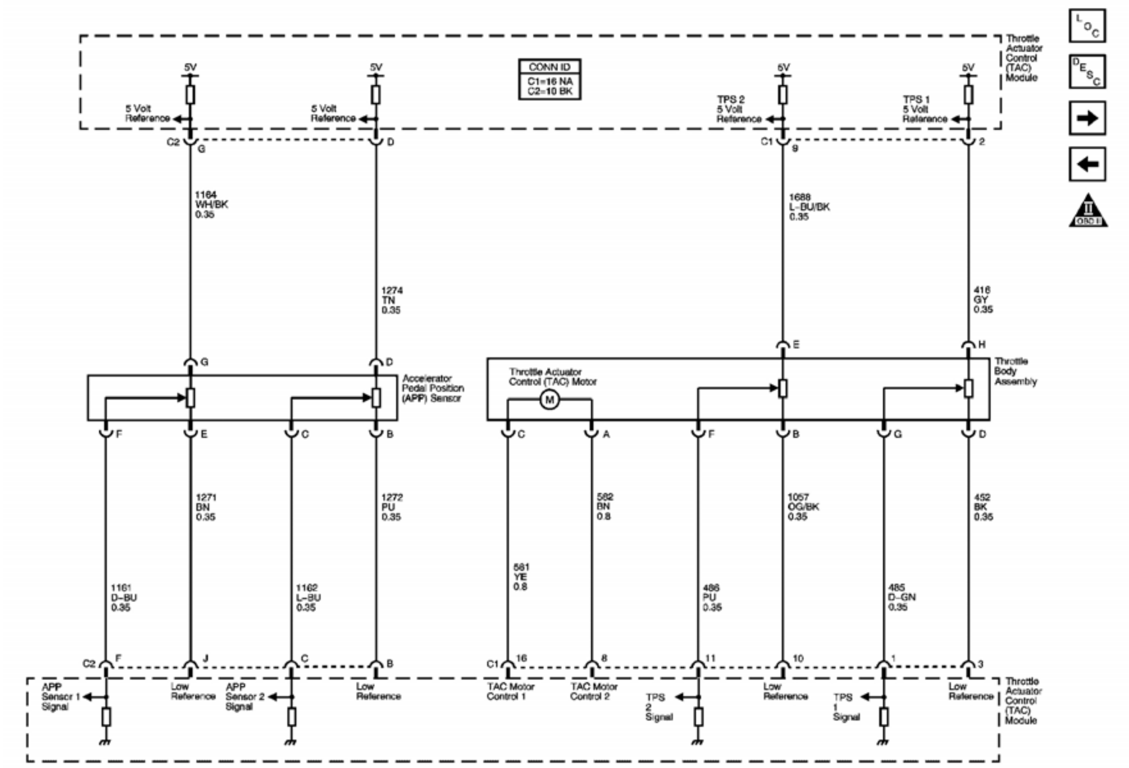


Fig. 9: Accelerator Pedal Position Sensor and Throttle Control Circuits Schematics
Courtesy of GENERAL MOTORS CORP.

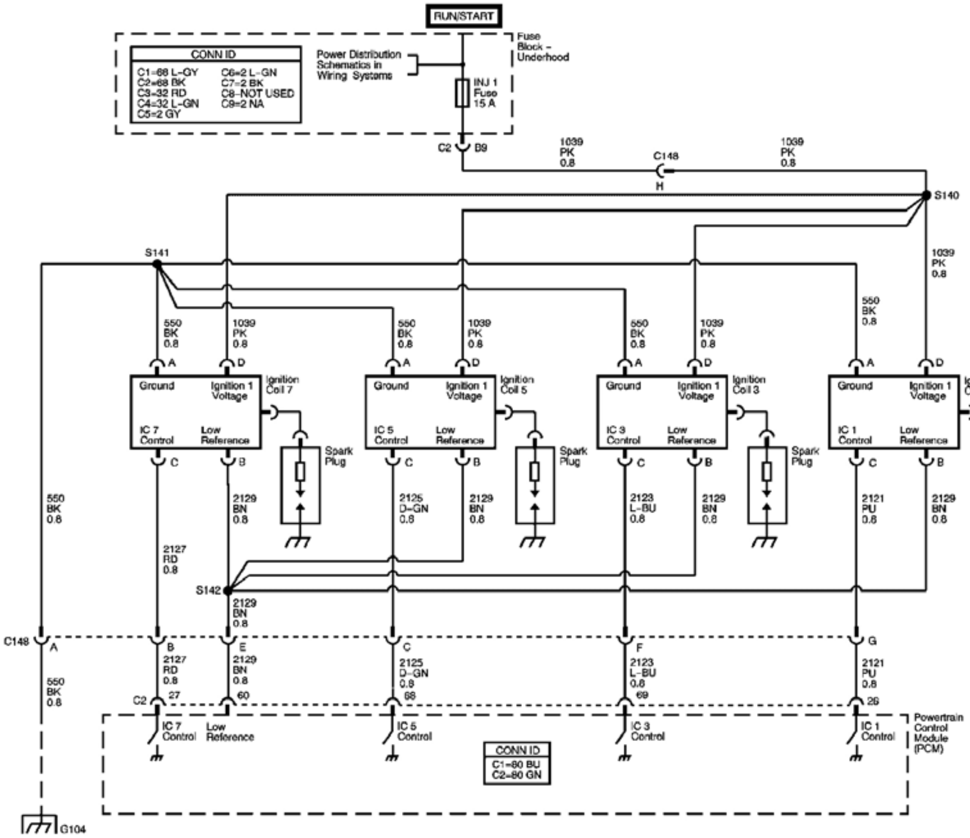


Fig. 10: Ignition Control, Bank 1 (LH) Schematics
Courtesy of GENERAL MOTORS CORP.

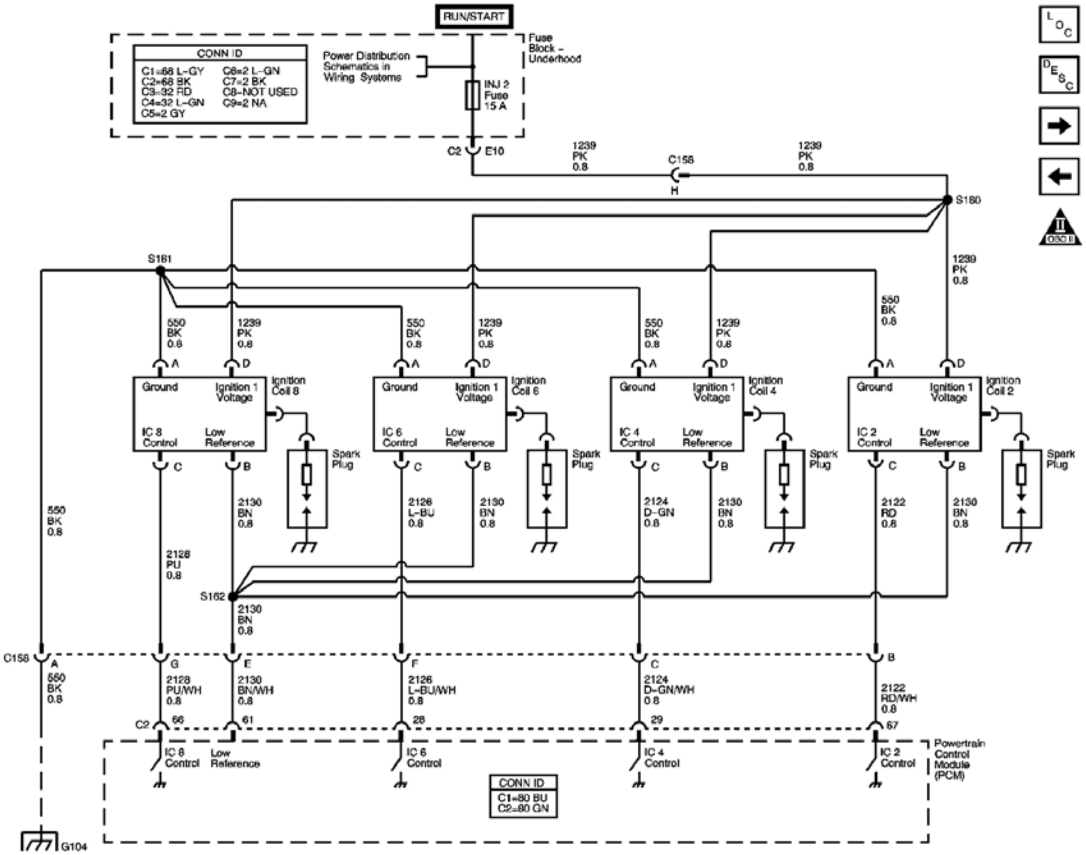


Fig. 11: Ignition Control, Bank 2 (RH) Schematics
Courtesy of GENERAL MOTORS CORP.

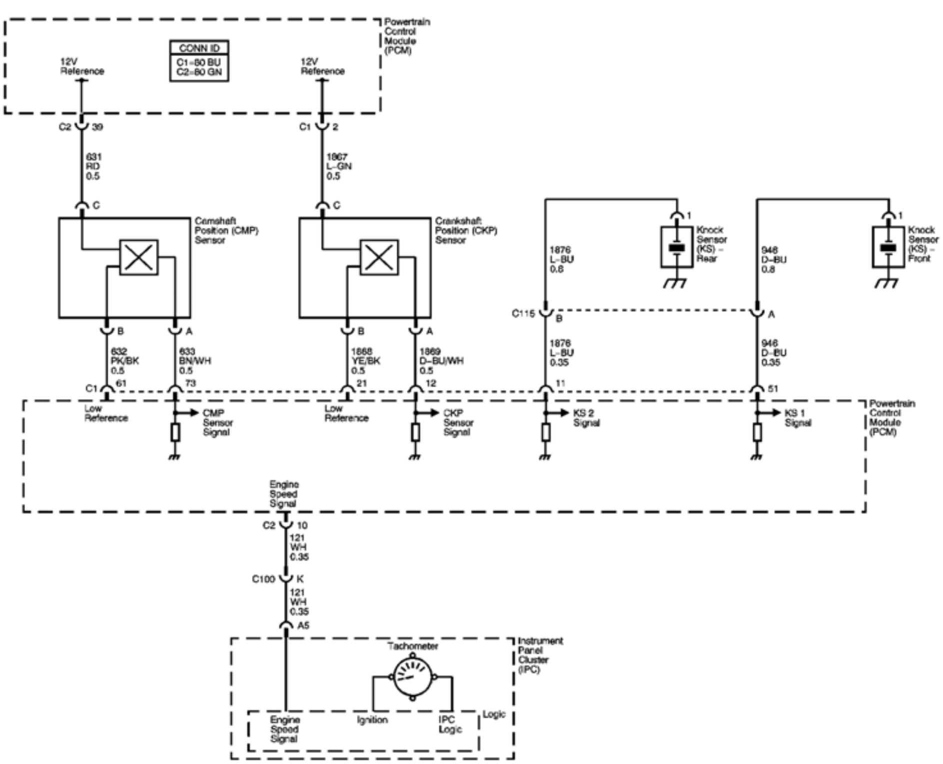
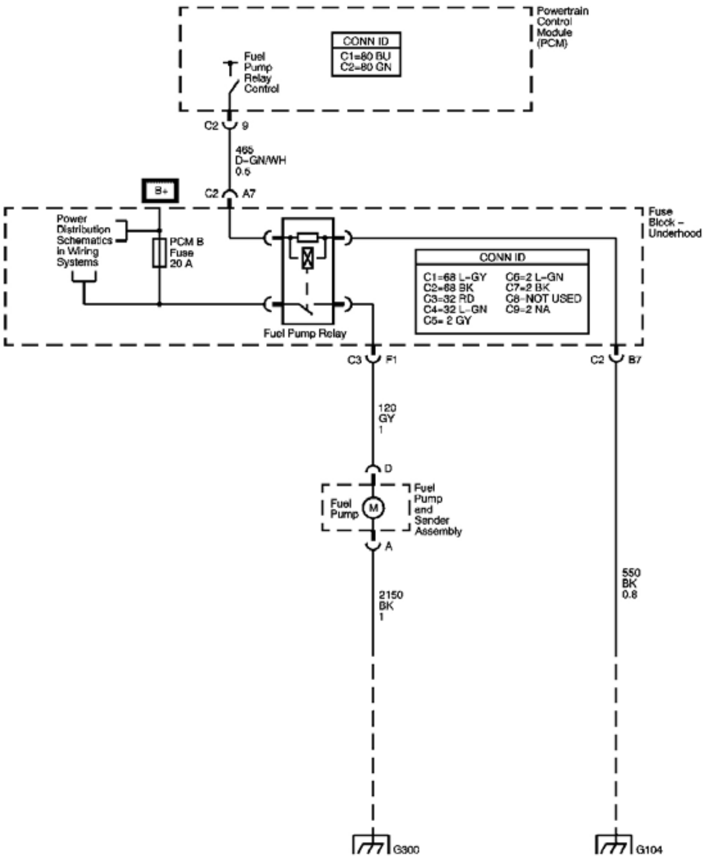


Fig. 12: CMP, CKP, KS, and Engine Speed Output
Courtesy of GENERAL MOTORS CORP.



<u>Fig. 13: Fuel Pump Controls Schematics</u>
Courtesy of GENERAL MOTORS CORP.

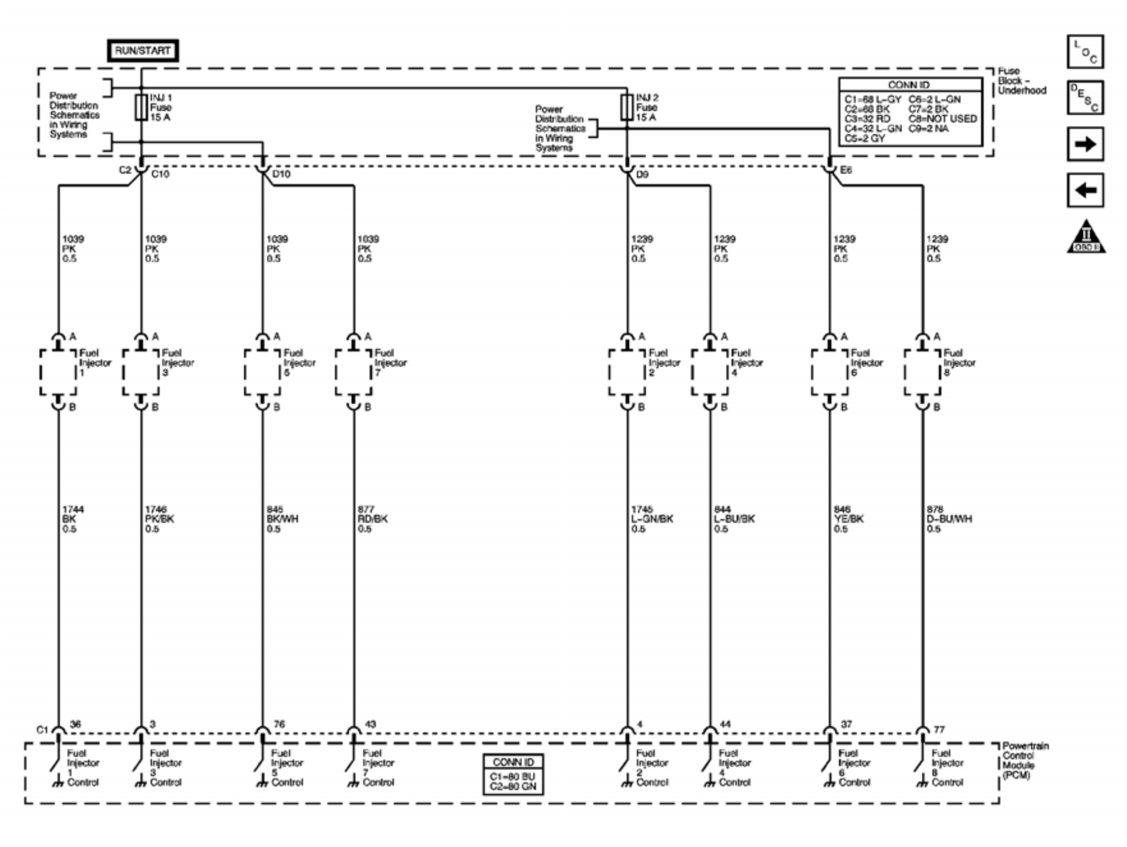


Fig. 14: Fuel Injector Controls Schematics
Courtesy of GENERAL MOTORS CORP.

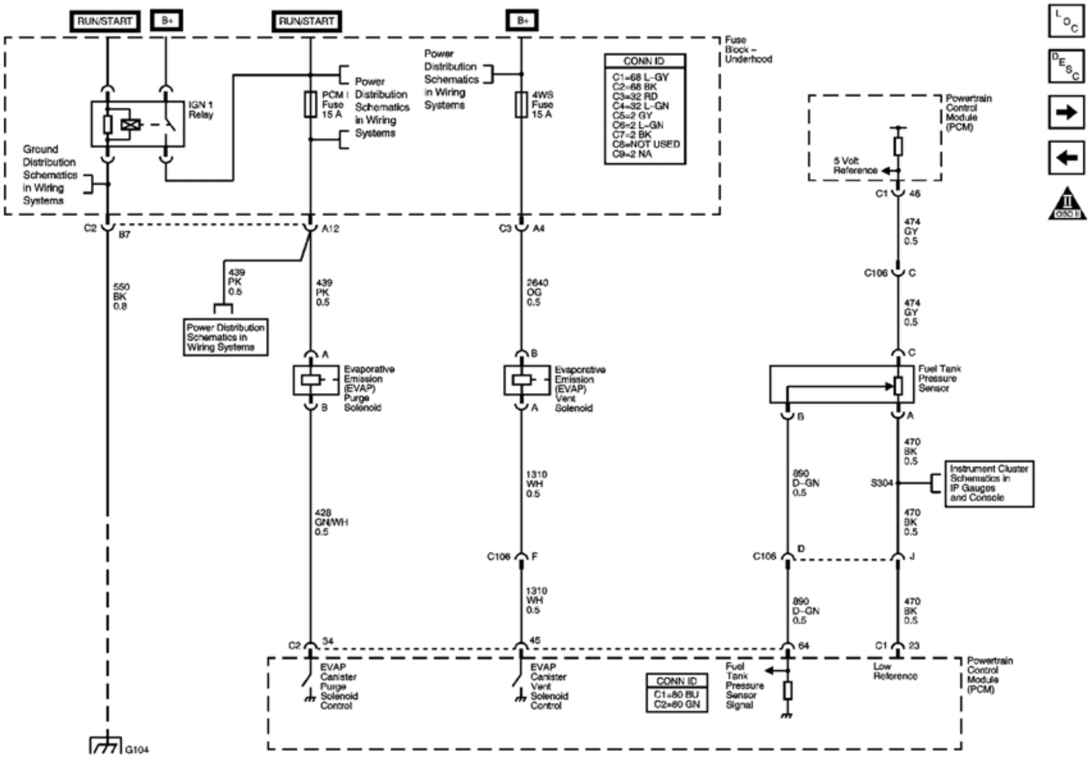


Fig. 15: EVAP and Fuel Tank Pressure Sensor Schematics
Courtesy of GENERAL MOTORS CORP.

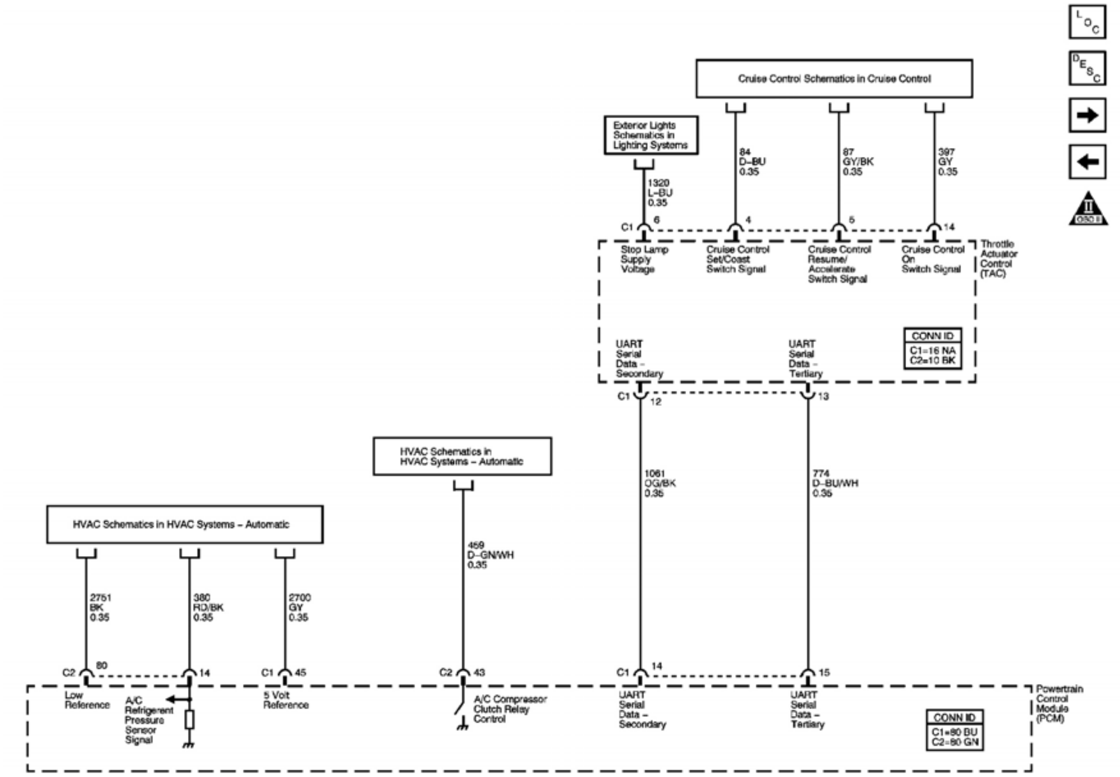


Fig. 16: HVAC and Cruise Control Circuits Schematics
Courtesy of GENERAL MOTORS CORP.

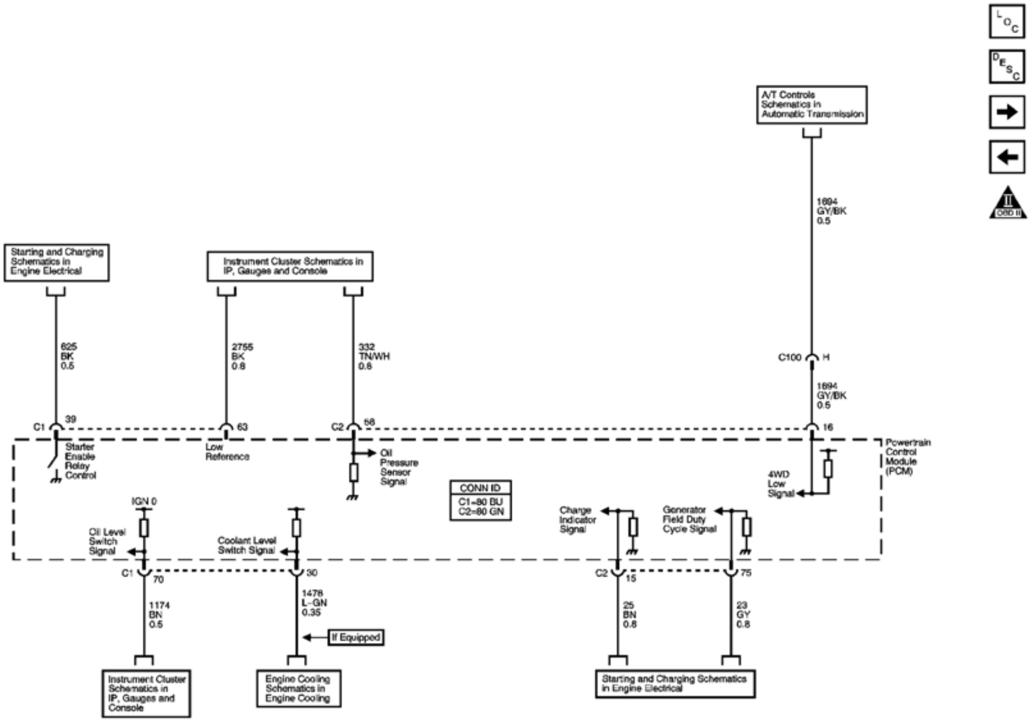


Fig. 17: Starter, Generator Oil Level and Pressure, and 4WD Circuits Schematics
Courtesy of GENERAL MOTORS CORP.

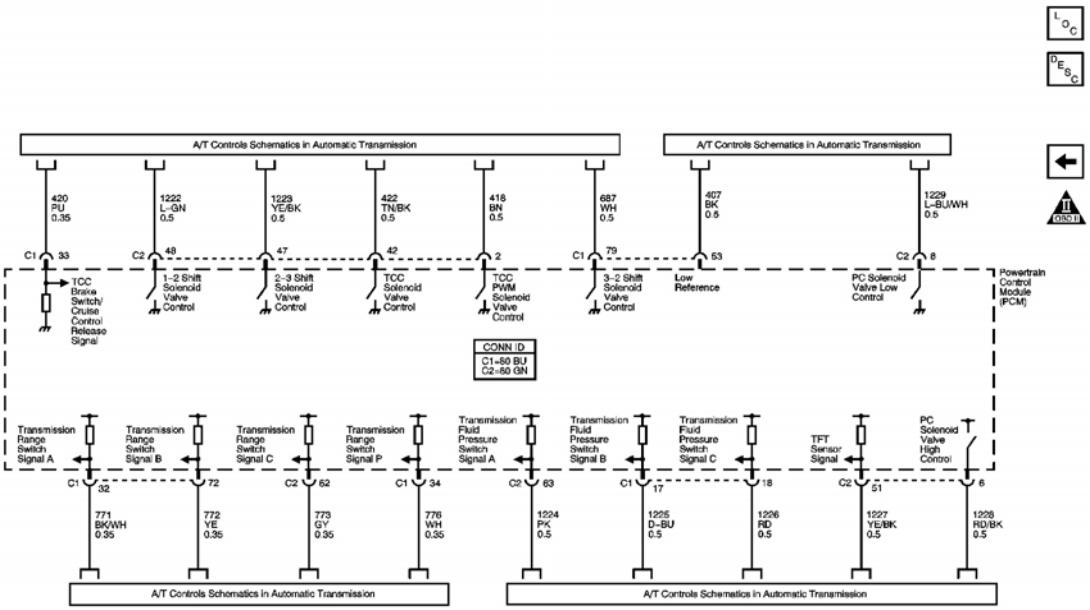


Fig. 18: Automatic Transmission Circuits Schematics

Courtesy of GENERAL MOTORS CORP.

COMPONENT LOCATOR

ENGINE CONTROLS COMPONENT VIEWS

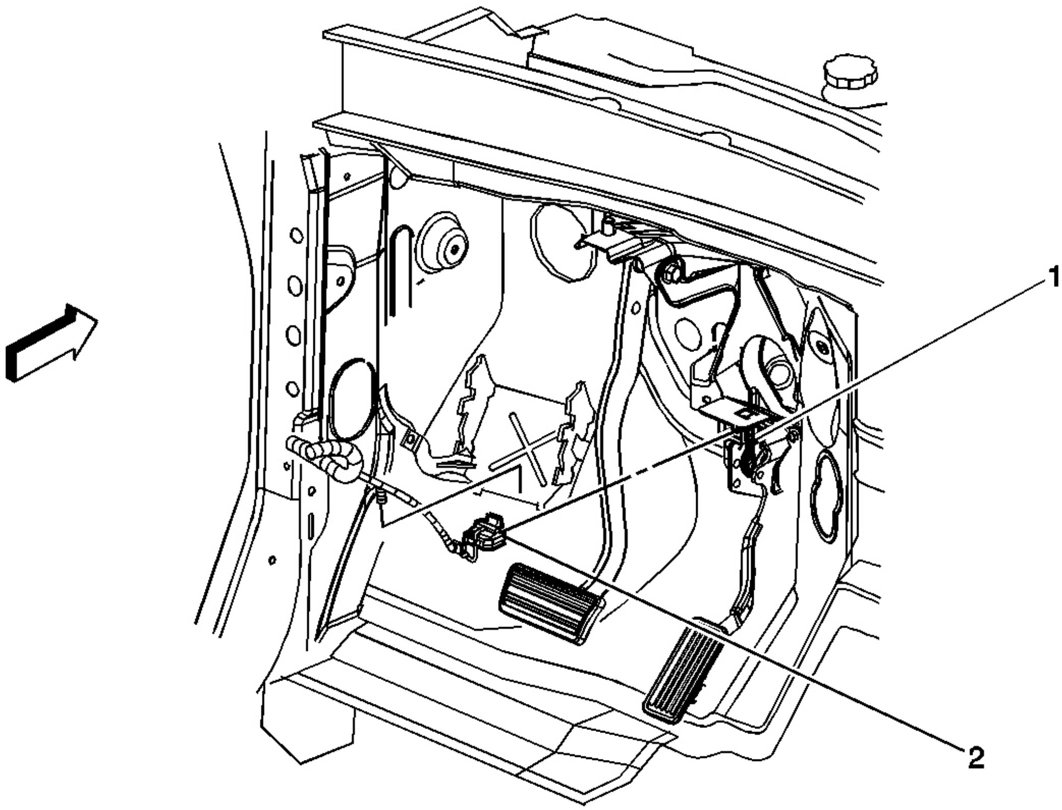


Fig. 19: Lower Left Of I/P Component Views
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 19

Callout	Component Name
1	APP Sensor
2	APP Sensor Connector

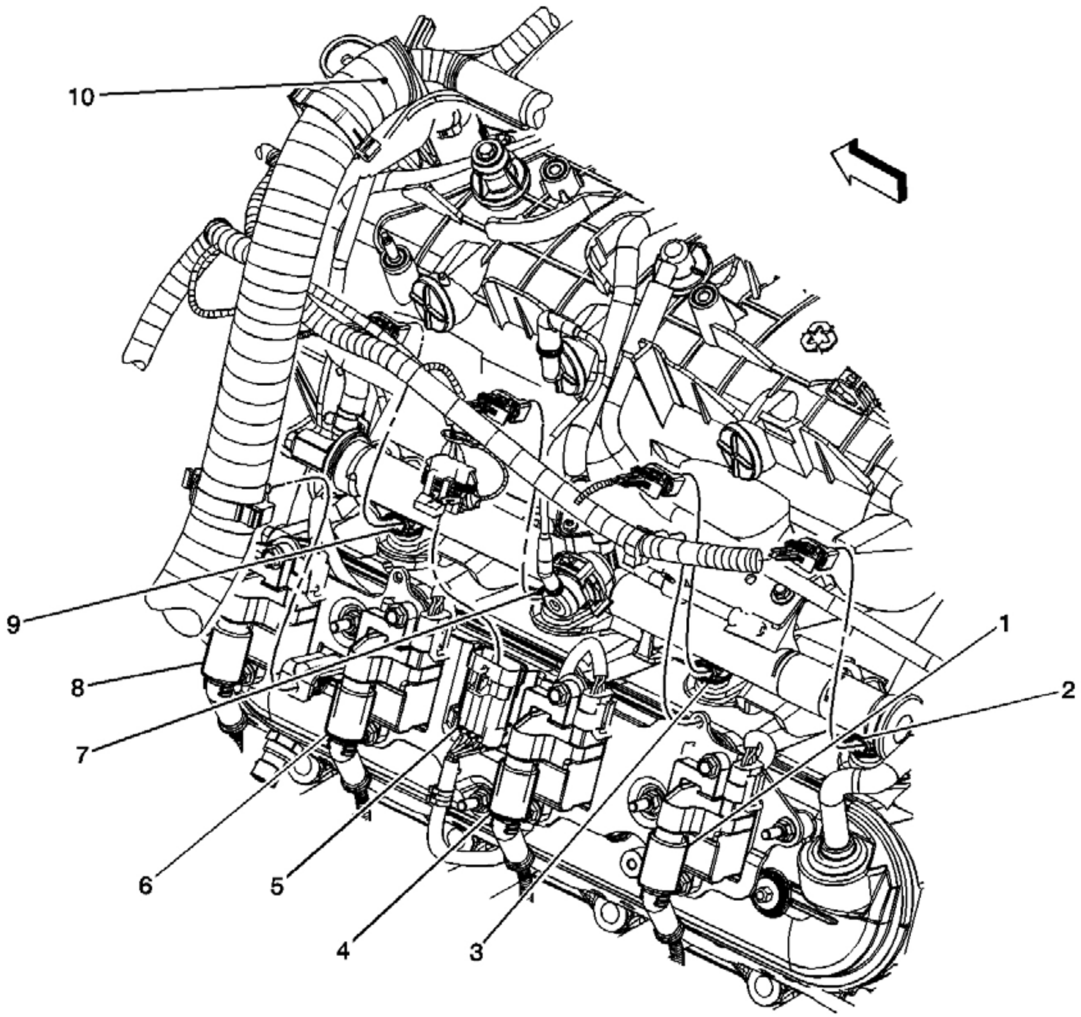
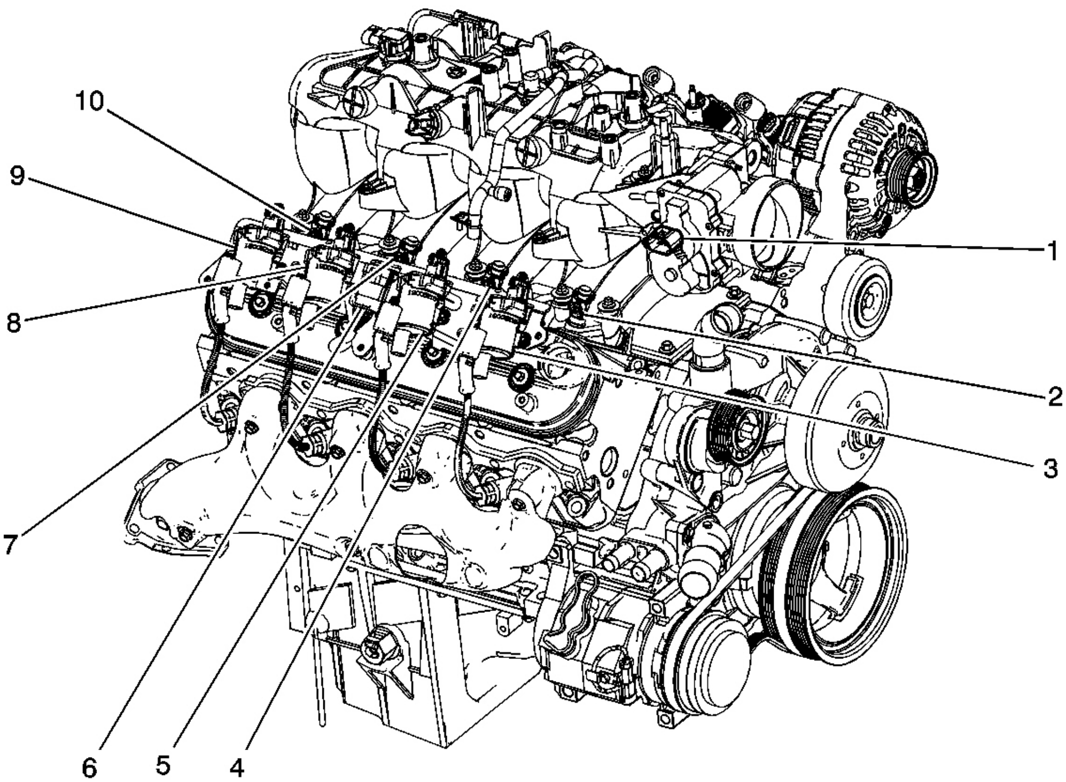


Fig. 20: Left Side Of Engine Component Views
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 20

Callout	Component Name
1	Ignition Coil 7
2	Fuel Injector 7
3	Fuel Injector 5
4	Ignition Coil 5
5	Inline C148
6	Ignition Coil 3
7	Fuel Injector 3
8	Ignition Coil 1
9	Fuel Injector 1

10	Engine Harness



<u>**Fig. 21: Right Side Of Engine Component Views**</u>
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 21

Callout	Component Name
1	Throttle Body Assembly
2	Fuel Injector 2
3	Ignition Coil 2
4	Fuel Injector 4
5	Ignition Coil 4
6	C158-Ignition Coil Inline
7	Fuel Injector 6
8	Ignition Coil 6
9	Ignition Coil 8
10	Fuel Injector 8

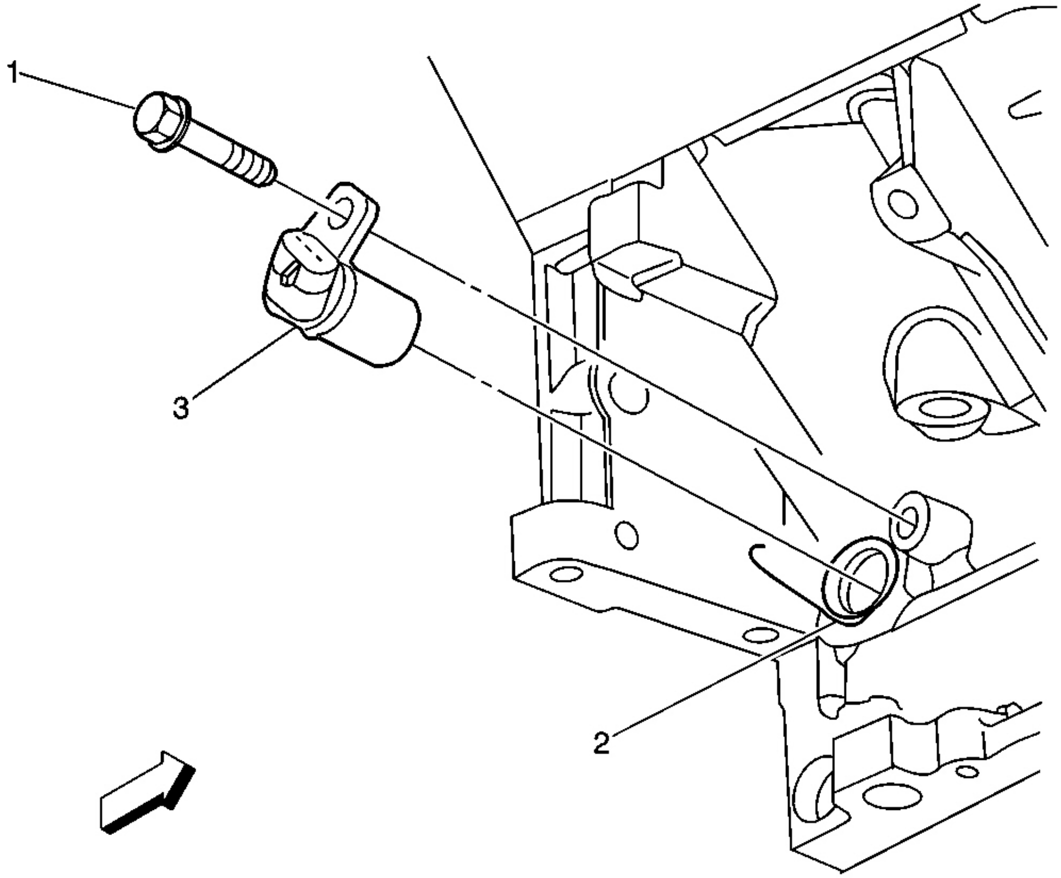


Fig. 22: Crankshaft Position (CKP) Sensor Location Component Views
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 22

Callout	Component Name
1	CKP Mounting Bolt
2	CKP Mounting Location
3	Crankshaft Position (CKP) Sensor

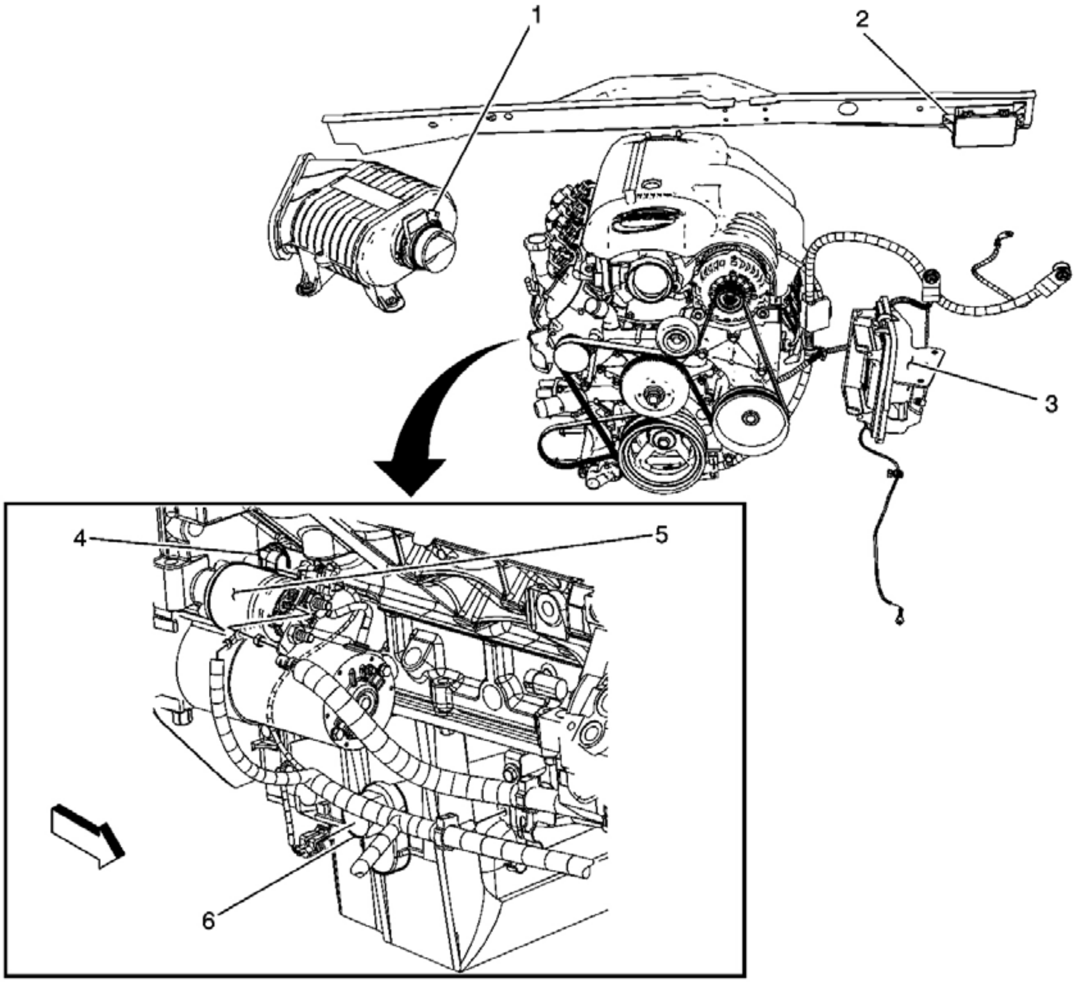


Fig. 23: Engine Controls Component Views (1 Of 3)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 23

Callout	Component Name
1	Intake Air Temperature (IAT)/Mass Air Flow (MAF) Sensor
2	Throttle Actuator Control (TAC) Module
3	Powertrain Control Module (PCM)
4	Crankshaft Position (CKP) Sensor
5	Starter Solenoid
6	Engine Oil Level Switch

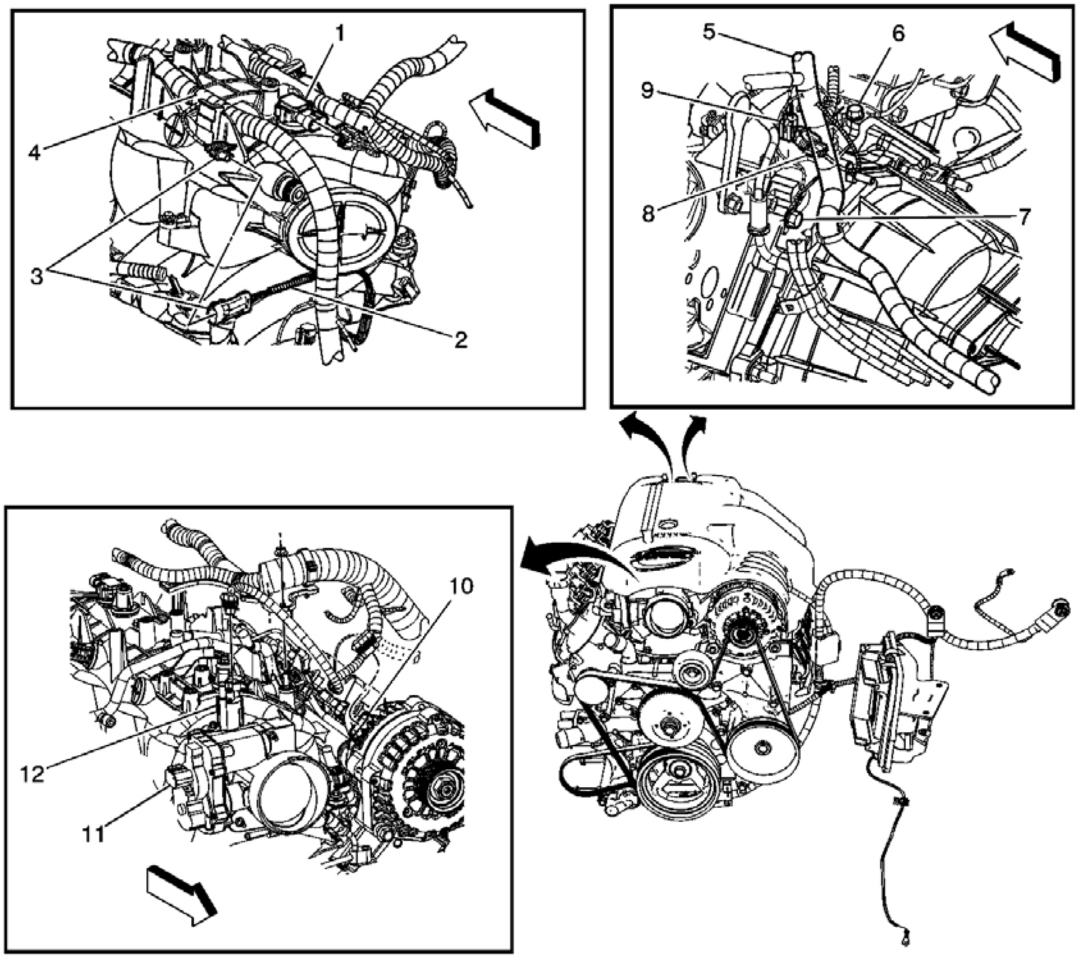


Fig. 24: Engine Controls Component Views (2 Of 3)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 24

Callout	Component Name
1	Manifold Absolute Pressure (MAP) Sensor
2	Knock Sensor Pigtail
3	C115
4	Engine Harness
5	Engine Harness
6	G103
7	G104
8	Camshaft Position (CMP) Sensor Connector
9	Engine Oil Pressure (EOP) Sensor Connector
10	Generator

11	Throttle Body Connector
12	Evaporative Emission (EVAP) Canister Purge Solenoid

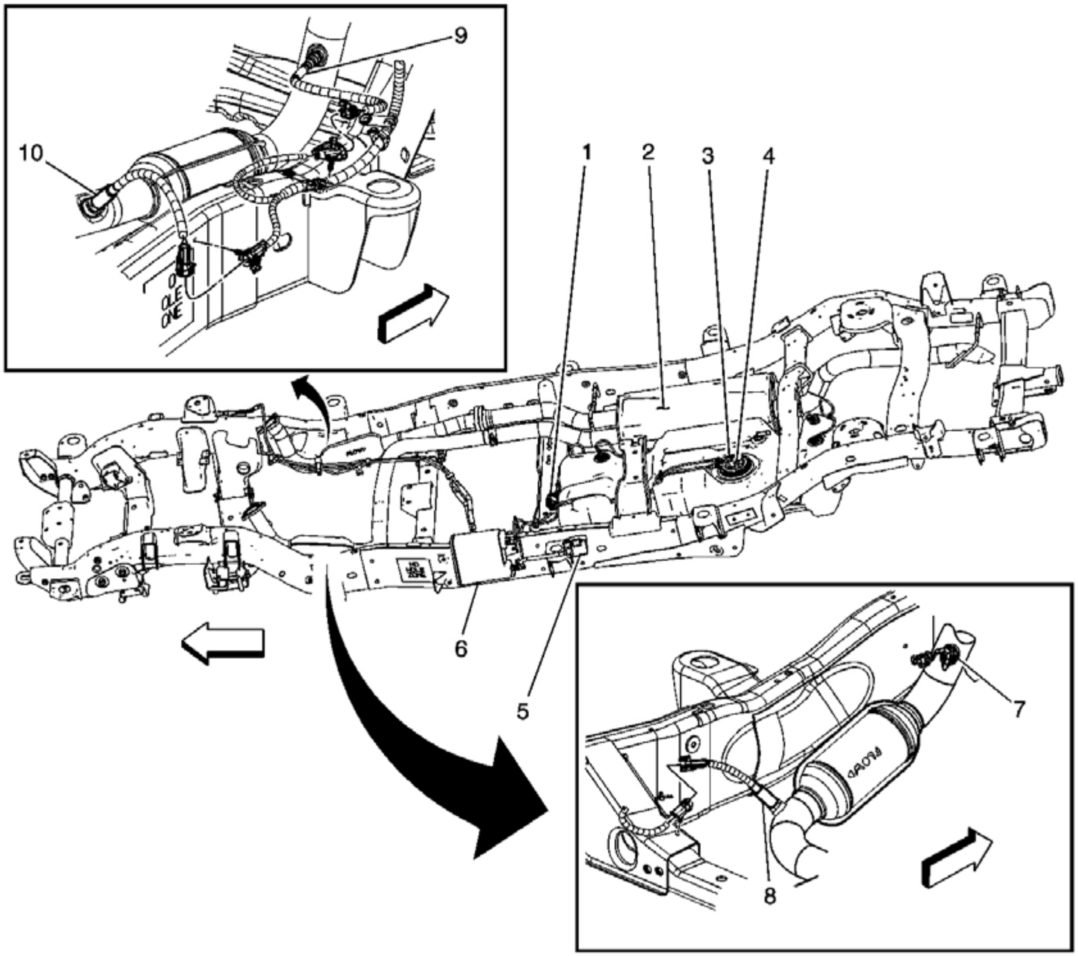


Fig. 25: Engine Controls Component Views (3 Of 3)
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 25

Callout	Component Name
1	Fuel Filter
2	Fuel Tank
3	Fuel Pump and Sender Assembly
4	Fuel Tank Pressure (FTP) Sensor
5	Evaporative Emission Canister Vent (EVAP) Solenoid
6	EVAP Canister
7	Heated Oxygen Sensor (HO2S) Bank 1 Sensor 1

8	Heated Oxygen Sensor (HO2S) Bank 1 Sensor 2
9	Heated Oxygen Sensor (HO2S) Bank 2 Sensor 1
10	Heated Oxygen Sensor (HO2S) Bank 2 Sensor 2

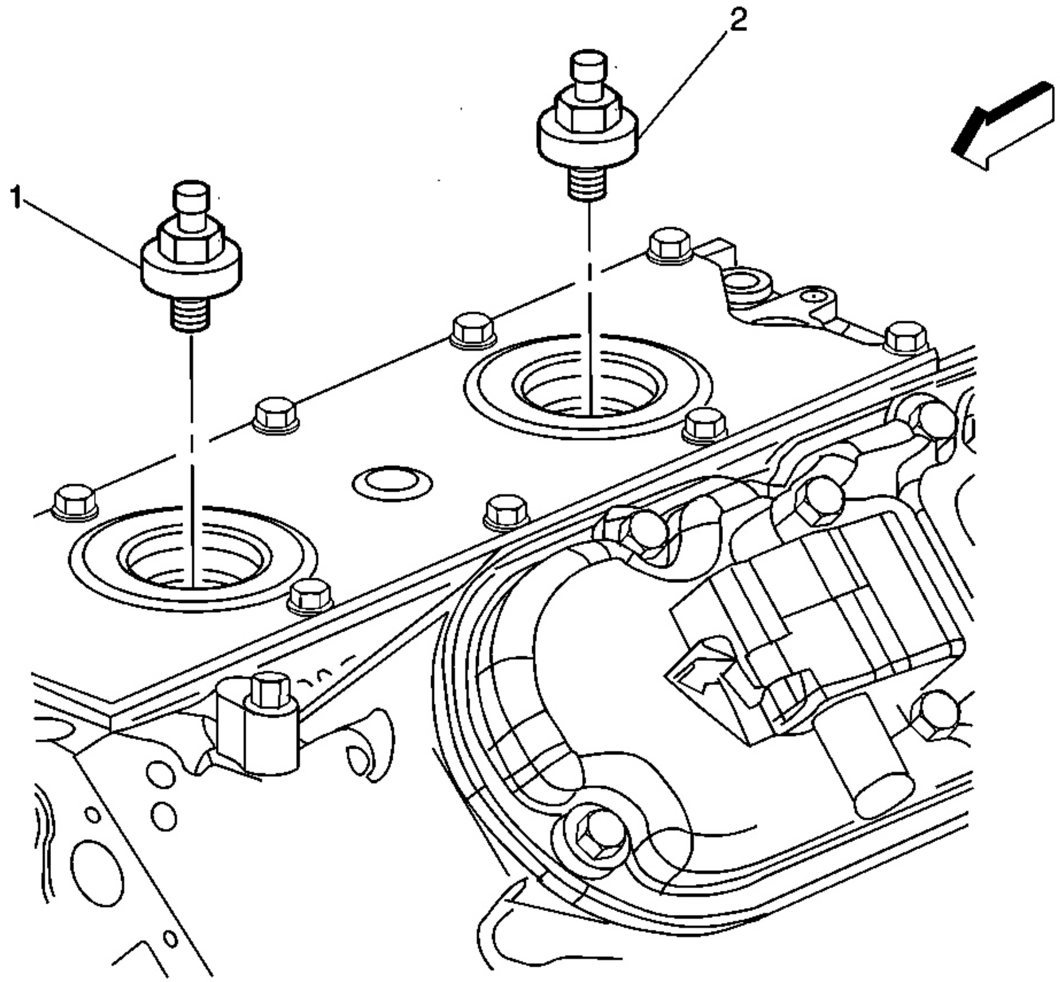


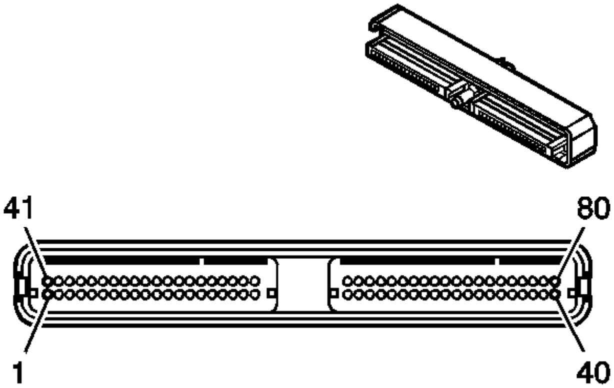
Fig. 26: Knock Sensors Component Views
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 26

Callout	Component Name
1	Knock Sensor (KS) 1
2	Knock Sensor (KS) 2

POWERTRAIN CONTROL MODULE (PCM) CONNECTOR END VIEWS

Powertrain Control Module (PCM) - C1 Terminal Identification

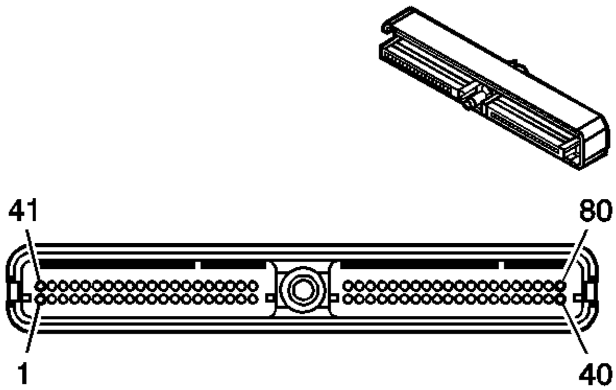


Connector Part Information	• 12191489 • 80-Way F Micro-Pack 100W Sealed (BU)		
Pin	**Wire Color**	**Circuit No.**	**Function**
1	BK/WH	451	Ground
2	L-GN	1867	12 Volt Reference
3	PK/BK	1746	Fuel Injector 3 Control
4	L-GN/ BK	1745	Fuel Injector 2 Control
5-6	-	-	Not Used
7	GY	2705	5 Volt Reference
8-10	-	-	Not Used
11	L-BU	1876	Knock Sensor 2 Signal
12	D-BU/ WH	1869	CKP Sensor Signal
13	-	-	Not Used
14	OG/BK	1061	UART Serial Data-Secondary
15	D-BU/ WH	774	UART Serial Data-Tertiary
16	-	-	Not Used
17	D-BU	1225	Transmission Fluid Pressure Switch Signal B
18	RD	1226	Transmission Fluid Pressure Switch Signal C
19	PK	439	Ignition 1 Voltage
20	OG	440	Battery Positive Voltage
21	YE/BK	1868	Low Reference
22	-	-	Not Used
23	BK	470	Low Reference
24	BK/WH	451	Ground

25	TN	1671	HO2S Low Signal - Bank 2 Sensor 2
26	TN	1667	HO2S Low Signal - Bank 2 Sensor 1
27	BK/WH	451	Ground
28	TN/WH	1669	HO2S Low Signal - Bank 1 Sensor 2
29	TN	1664	HO2S Low Signal - Bank 1 Sensor 1
30	L-GN	1478	Coolant Level Switch Signal
31	-	-	Not Used
32	BK/WH	771	Transmission Range Switch Signal A
33	PU	420	TCC Brake Switch/Cruise Control Release Signal
34	WH	776	Transmission Range Switch Signal P
35	-	-	Not Used
36	BK	1744	Fuel Injector 1 Control
37	YE/BK	846	Fuel Injector 6 Control
38	-	-	Not Used
39	YE/BK	625	Starter Enable Relay Control
40	BK/WH	451	Ground
41-42	-	-	Not Used
43	RD/BK	877	Fuel Injector 7 Control
44	L-BU/BK	844	Fuel Injector 4 Control
45	GY	2700	5 Volt Reference
46	GY	474	5 Volt Reference
47	-	-	Not Used
48	GY	597	5 Volt Reference
49-50	-	-	Not Used
51	D-BU	496	Knock Sensor 1 Signal
52	-	-	Not Used
53	BK	407	Low Reference
54	OG/BK	469	Low Reference
55-56	-	-	Not Used
57	OG	440	Battery Positive Voltage
58	D-GN	1049	PCM Class 2 Serial Data
59	YE	710	PCM Class 2 Serial Data
60	-	-	Not Used
61	PK/BK	632	Low Reference
62	-	-	Not Used
63	BK	2755	Low Reference
64	BK/WH	451	Ground
65	PU	1670	HO2S High Signal - Bank 2 Sensor 2
66	PU	1666	HO2S High Signal - Bank 2 Sensor 1
67	BK/WH	451	Ground
68	PU/WH	1668	HO2S High Signal - Bank 1 Sensor 2

69	PU/WH	1665	HO2S High Signal - Bank 1 Sensor 1
70	BN	1174	Oil Level Switch Signal
71	-	-	Not Used
72	YE	772	Transmission Range Switch Signal B
73	BN/WH	633	CMP Sensor Signal
74	YE	410	ECT Sensor Signal
75	PK	1020	Off/Run/Crank Voltage
76	BK/WH	845	Fuel Injector 5 Control
77	D-BU/WH	878	Fuel Injector 8 Control
78	-	-	Not Used
79	WH	687	3-2 Shift Solenoid Valve Control
80	GY	720	Low Reference

Powertrain Control Module (PCM) - C2 Terminal Identification



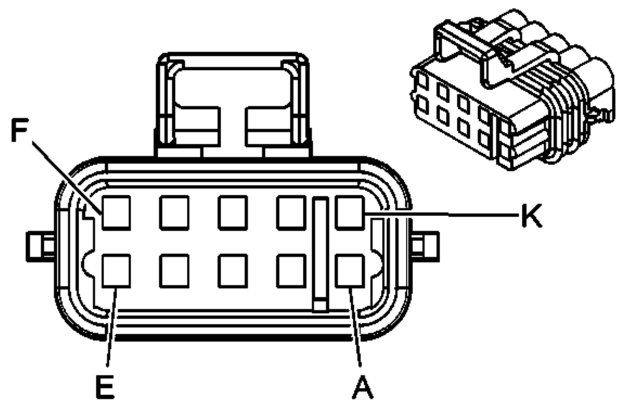
Connector Part Information			• **12191488** • **80-Way F Micro-Pack 100W Sealed (GN)**
Pin	**Wire Color**	**Circuit No.**	**Function**
1	BK/WH	451	Ground
2	BN	418	TCC PWM Solenoid Valve Control
3-5	-	-	Not Used
6	RD/BK	1228	PC Solenoid Valve High Control (Sol. A)
7	-	-	Not Used
8	L-BU/WH	1229	PC Solenoid Valve Low Control (Sol. A)
9	D-GN/WH	465	Fuel Pump Relay Control
10	WH	121	Engine Speed Signal
11-13	-	-	Not Used
14	RD/BK	380	A/C Refrigerant Pressure Sensor Signal

15	BN	25	Charge Indicator Control
16	GY/BK	1694	4WD Low Signal
17-19	-	-	Not Used
20	L-GN/BK	822	VSS Low Signal
21	PU/WH	821	VSS High Signal
22-24	-	-	Not Used
25	TN	472	IAT Sensor Signal
26	PU	2121	IC 1 Control
27	RD	2127	IC 7 Control
28	L-BU/WH	2126	IC 6 Control
29	D-GN/WH	2124	IC 4 Control
30	-	-	Not Used
31	YE	492	MAF Sensor Signal
32	L-GN	432	MAP Sensor Signal
33	-	-	Not Used
34	D-GN/WH	428	EVAP Canister Purge Solenoid Control
35-38	-	-	Not Used
39	RD	631	12 Volt Reference
40	BK/WH	451	Ground
41	-	-	Not Used
42	TN/BK	422	TCC Solenoid Valve Control
43	D-GN/ WH	459	A/C Compressor Clutch Relay Control
44	-	-	Not Used
45	WH	1310	EVAP Canister Vent Solenoid Control
46	BN/WH	419	MIL Control
47	YE/BK	1223	Shift Solenoid B Valve Control
48	L-GN	1222	Shift Solenoid A Valve Control
49	-	-	Not Used
50	D-GN/WH	817	Vehicle Speed Signal
51	YE/BK	1227	TFT Sensor Signal
52	BN	2391	HO2S Heater Low Control - Bank 1 Sensor 2
53	RD/WH	3223	HO2S Heater Low Control - Bank 2 Sensor 2
54	PU/WH	1589	Fuel Level Sensor Signal
55-56	-	-	Not Used
57	BK	552	Low Reference
58	TN/WH	332	Oil Pressure Sensor Signal
59	PU	806	Crank Voltage
60	BN	2129	Low Reference
61	BN/WH	2130	Low Reference
62	GY	773	Transmission Range Switch Signal C

63	PK	1224	Transmission Fluid Pressure Switch Signal A
64	D-GN	890	Fuel Tank Pressure Sensor Signal
65	-	-	Not Used
66	PU/WH	2128	IC 8 Control
67	RD/WH	2122	IC 2 Control
68	D-GN	2125	IC 5 Control
69	L-BU	2123	IC 3 Control
70-71	-	-	Not Used
72	BK/WH	3113	HO2S Heater Low Control - Bank 1 Sensor 1
73	-	-	Not Used
74	L-GN	3212	HO2S Heater Low Control - Bank 2 Sensor 1
75	GY	23	Generator Field Duty Cycle Signal
76-79	-	-	Not Used
80	BK	2751	Low Reference

ENGINE CONTROLS CONNECTOR END VIEWS

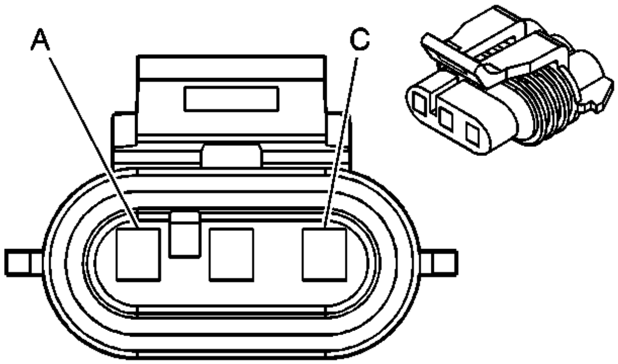
Accelerator Pedal Position (APP) Sensor Terminal Identification



Connector Part Information	• 15318071 • 10-Way F Metri-Pack 150 Series (GY)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	-	-	Not Used
B	PU	1272	5 Volt Reference
C	L-BU	1162	APP Sensor 2 Signal
D	TN	1274	Low Reference
E	BN	1271	Low Reference
F	D-BU	1161	APP Sensor 1 Signal

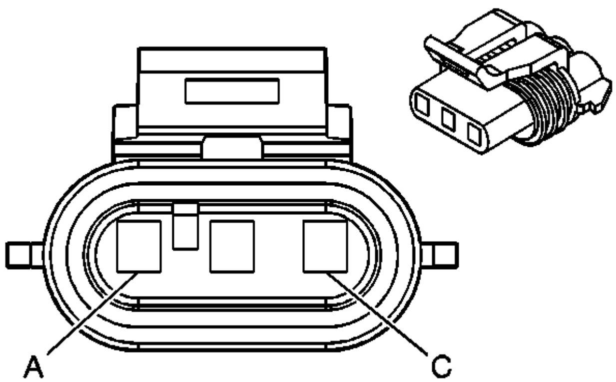
G	WH/BK	1164	5 Volt Reference
H-K	-	-	Not Used

Camshaft Position (CMP) Sensor Terminal Identification



Connector Part Information	• **12059595** • **3-Way F Metri-Pack 150 Series Sealed (BK)**		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BN/WH	633	CMP Sensor Signal
B	PK/BK	632	Low Reference
C	RD	631	12 Volt Reference

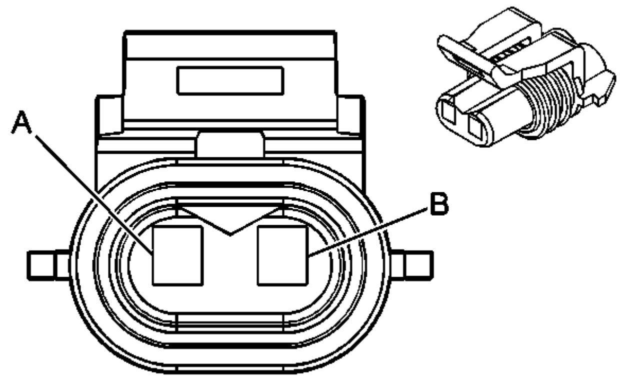
Crankshaft Position (CKP) Sensor Terminal Identification



Connector Part Information	• **15324165** • **3-Way F Metri-Pack 150 Series (WH)**		
Pin	**Wire Color**	**Circuit No.**	**Function**

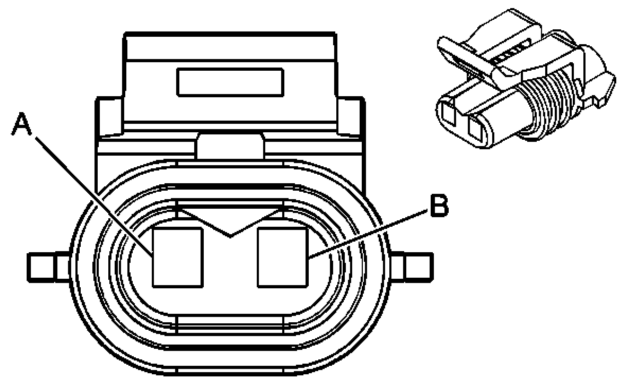
A	D-BU/WH	1869	CKP Sensor Signal
B	YE/BK	1868	Low Reference
C	L-GN	1867	12 Volt Reference

Evaporative Emission (EVAP) Canister Purge Solenoid Terminal Identification



Connector Part Information		• **12124037** • **2-Way F Metri-Pack 150 Series Sealed (BK)**	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	PK	439	Ignition 1 Voltage
B	D-GN/ WH	428	EVAP Canister Purge Solenoid Control

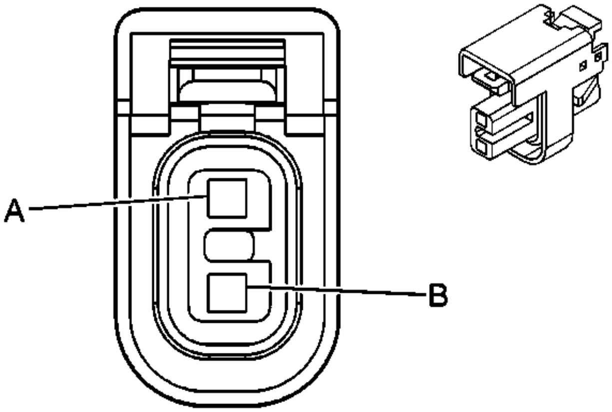
Evaporative Emission (EVAP) Canister Vent Solenoid Terminal Identification



Connector Part Information	• **12052643**

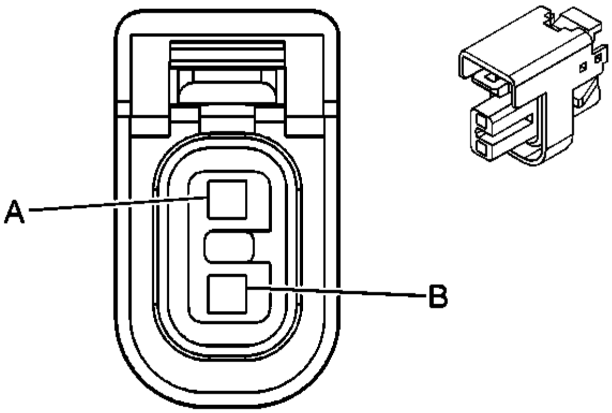
		• 2-Way F Metri-Pack 150 Series Sealed (RD)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	WH	1310	EVAP Canister Vent Solenoid Control
B	OG	2640	Ignition 1 Voltage

Fuel Injector 1 Terminal Identification



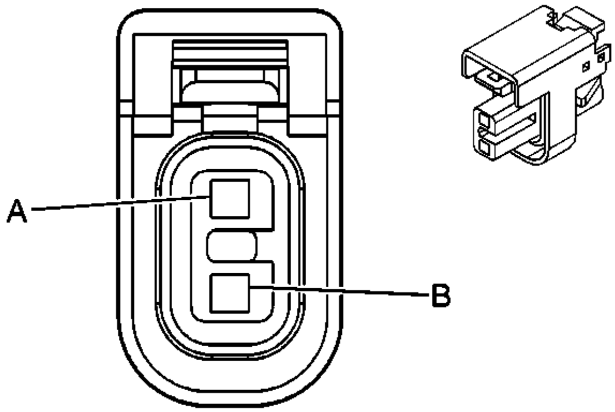
Connector Part Information		• **15326181** • **2-Way F (GY)**	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	PK	1039	Ignition 1 Voltage
B	BK	1744	Fuel Injector 1 Control

Fuel Injector 2 Terminal Identification



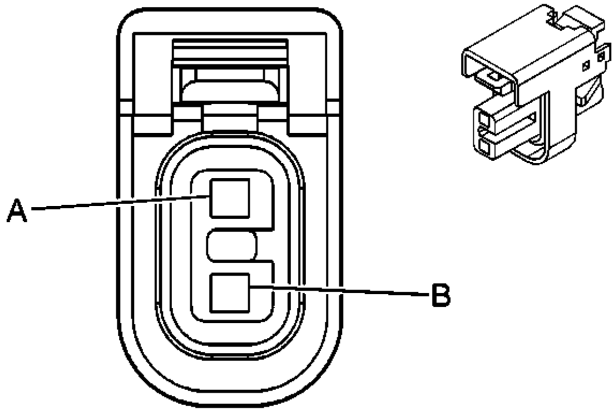
Connector Part Information		• **15326181** • **2-Way F (GY)**	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	PK	1239	Ignition 1 Voltage
B	L-GN/BK	1745	Fuel Injector 2 Control

Fuel Injector 3 Terminal Identification



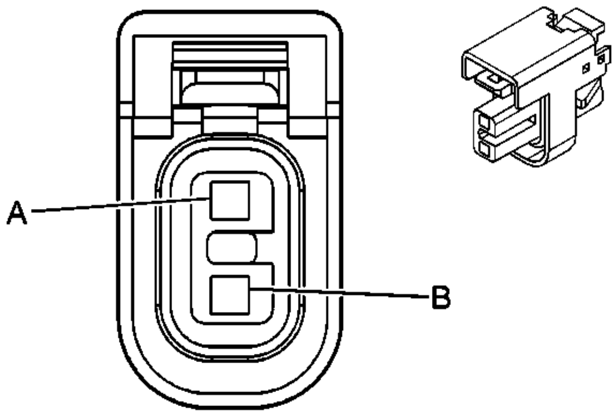
Connector Part Information		• **15326181** • **2-Way F (GY)**	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	PK	1039	Ignition 1 Voltage
B	PK/BK	1746	Fuel Injector 3 Control

Fuel Injector 4 Terminal Identification



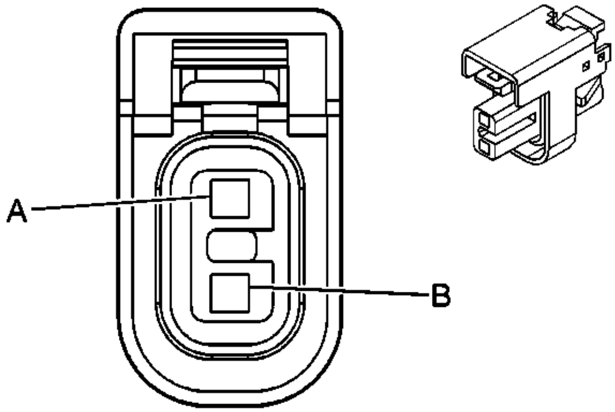
Connector Part Information		• **15326181** • **2-Way F (GY)**	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	PK	1239	Ignition 1 Voltage
B	L-BU/BK	844	Fuel Injector 4 Control

Fuel Injector 5 Terminal Identification



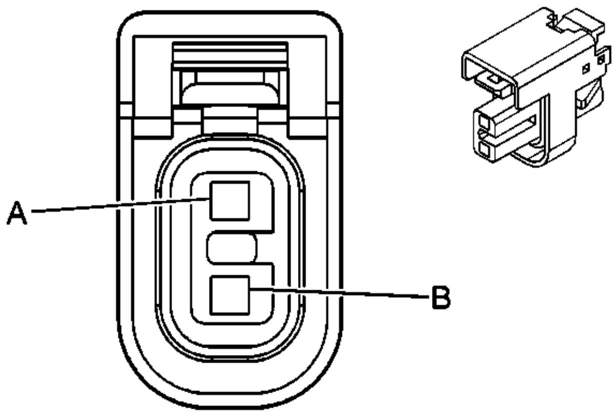
Connector Part Information		• **15326181** • **2-Way F (GY)**	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	PK	1039	Ignition 1 Voltage
B	BK/WH	845	Fuel Injector 5 Control

Fuel Injector 6 Terminal Identification



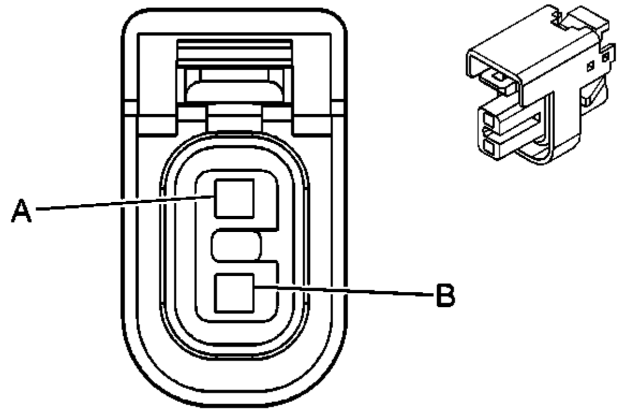
Connector Part Information		• 15326181 • 2-Way F (GY)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	PK	1239	Ignition 1 Voltage
B	YE/BK	846	Fuel Injector 6 Control

Fuel Injector 7 Terminal Identification



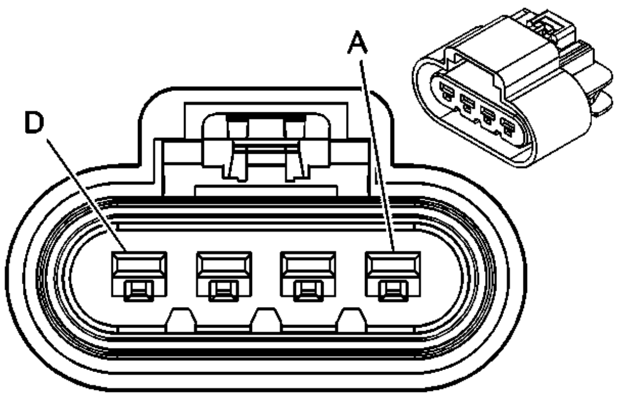
Connector Part Information		• 15326181 • 2-Way F (GY)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	PK	1039	Ignition 1 Voltage
B	RD/BK	877	Fuel Injector 7 Control

Fuel Injector 8 Terminal Identification



Connector Part Information		• 15326181 • 2-Way F (GY)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	PK	1239	Ignition 1 Voltage
B	D-BU/WH	878	Fuel Injector 8 Control

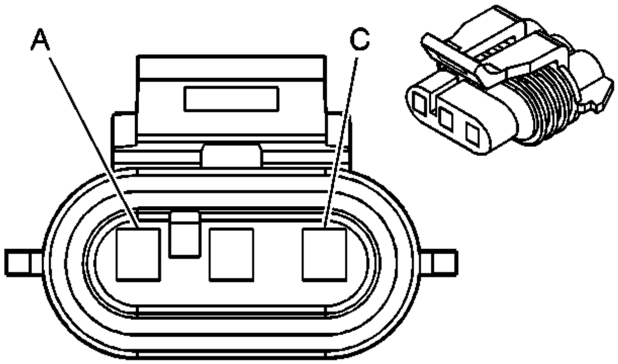
Fuel Pump and Sender Assembly Terminal Identification



Connector Part Information		• 15326631 • 4-Way F GT 280 Sealed 5.8 (BK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BK	2150	Ground
B	PU	1589	Fuel Level Sensor Signal

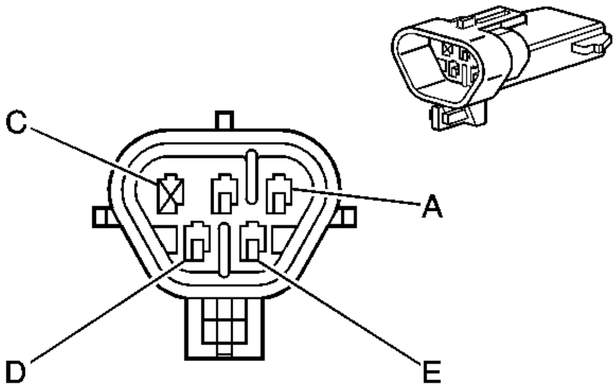
C	BK	470	Low Reference
D	GY	120	Fuel Pump Supply Voltage

Fuel Tank Pressure (FTP) Sensor Terminal Identification



Connector Part Information			
	• **12059595** • **3-Way F Metri-Pack 150 Series Sealed (BK)**		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BK	470	Low Reference
B	D-GN	890	Fuel Tank Pressure Sensor Signal
C	GY	474	5 Volt Reference

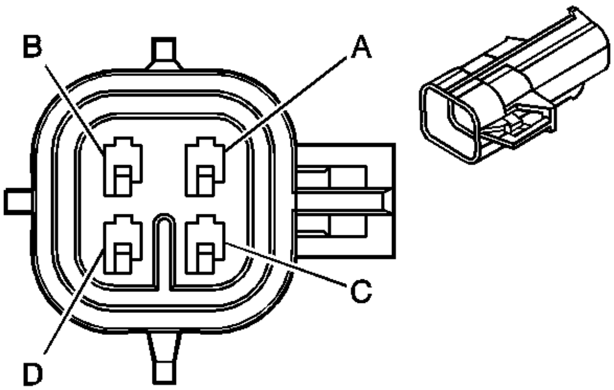
Heated Oxygen Sensor (HO2S) Bank 1 Sensor 1 Terminal Identification



Connector Part Information			
	• **12092839** • **4-Way M Metri- Pack 150 Series (BK)**		
Pin	**Wire Color**	**Circuit No.**	**Function**

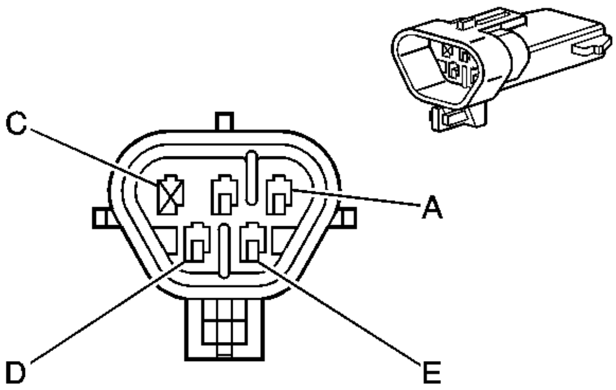
A	TN	1664	HO2S Low Signal - Bank 1 Sensor 1
B	PU/WH	1665	HO2S High Signal - Bank 1 Sensor 1
D	PK	539	Ignition 1 Voltage
E	BK/WH	3113	HO2S Heater Low Control - Bank 1 Sensor 1

Heated Oxygen Sensor (HO2S) Bank 1 Sensor 2 Terminal Identification



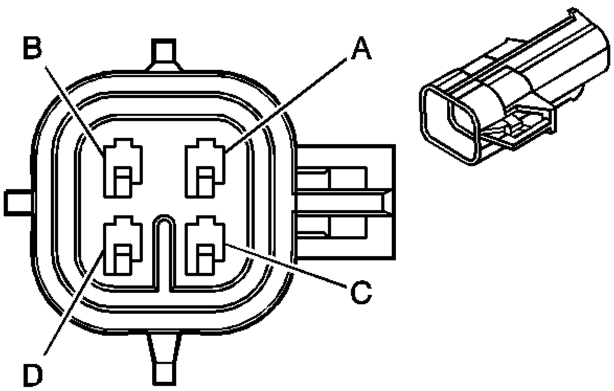
Connector Part Information		• **15326423** • **4-Way M Metri-Pack 150 Sealed (GY)**	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	TN/WH	1669	HO2S Low Signal - Bank 1 Sensor 2
B	PU/WH	1668	HO2S High Signal - Bank 1 Sensor 2
C	BN	2391	HO2S Heater Low Control - Bank 1 Sensor 2
D	PK	1539	Ignition 1 Voltage

Heated Oxygen Sensor (HO2S) Bank 2 Sensor 1 Terminal Identification



Connector Part Information		• 12092839 • 4-Way M Metri- Pack 150 Series (BK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	TN	1667	HO2S Low Signal - Bank 2 Sensor 1
B	PU	1666	HO2S High Signal - Bank 2 Sensor 1
D	PK	539	Ignition 1 Voltage
E	L-GN	3212	HO2S Heater Low Control - Bank 2 Sensor 1

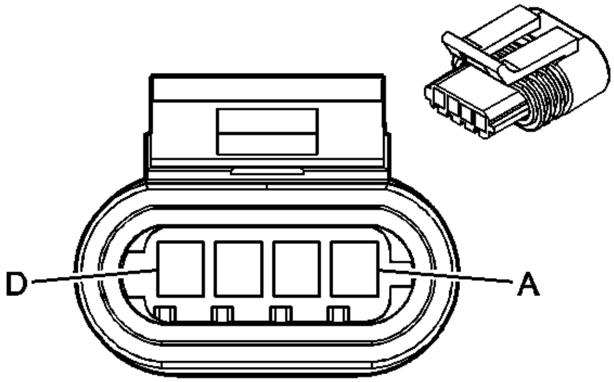
Heated Oxygen Sensor (HO2S) Bank 2 Sensor 2 Terminal Identification



Connector Part Information		• 15326423 • 4-Way M Metri-Pack 150 Sealed (GY)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	TN	1671	HO2S Low Signal - Bank 2 Sensor 2
B	PU	1670	HO2S High Signal - Bank 2 Sensor 2

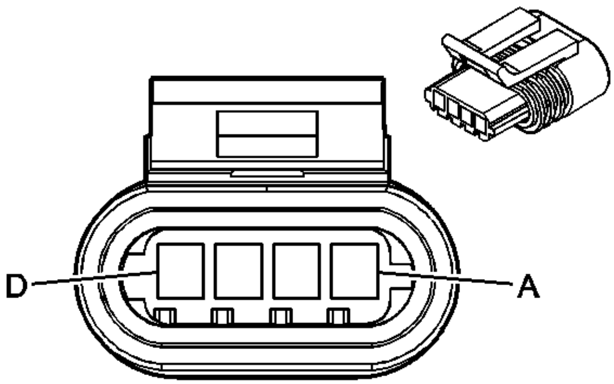
C	RD/WH	3223	HO2S Heater Low Control - Bank 2 Sensor 2
D	PK	1539	Ignition 1 Voltage

Ignition Coil #1 Terminal Identification



Connector Part Information		• 12162724 • 4-Way F Metri-Pack 150 Sealed (BK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BK	550	Ground
B	BN	2129	Low Reference
C	PU	2121	IC 1 Control
D	PK	1039	Ignition 1 Voltage

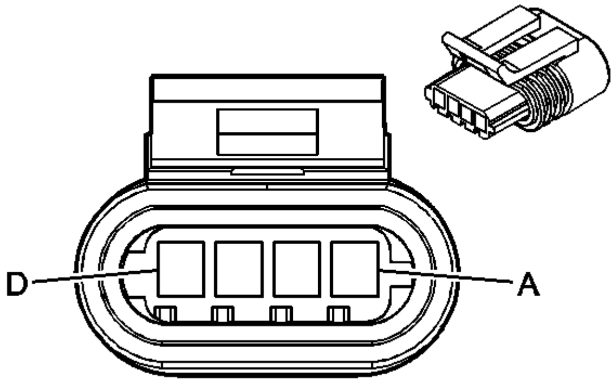
Ignition Coil #2 Terminal Identification



Connector Part Information	• 12162724

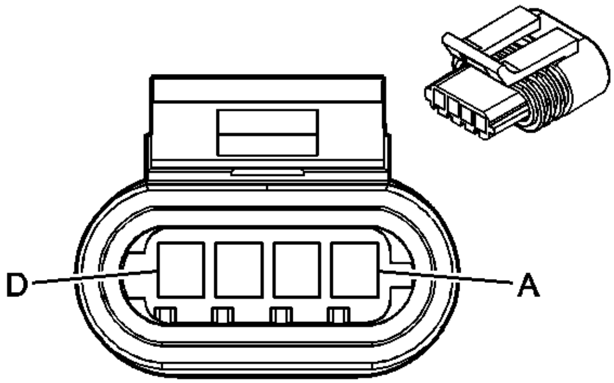
	• 4-Way F Metri-Pack 150 Sealed (BK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BK	550	Ground
B	BN	2130	Low Reference
C	RD	2122	IC 2 Control
D	PK	1239	Ignition 1 Voltage

Ignition Coil #3 Terminal Identification



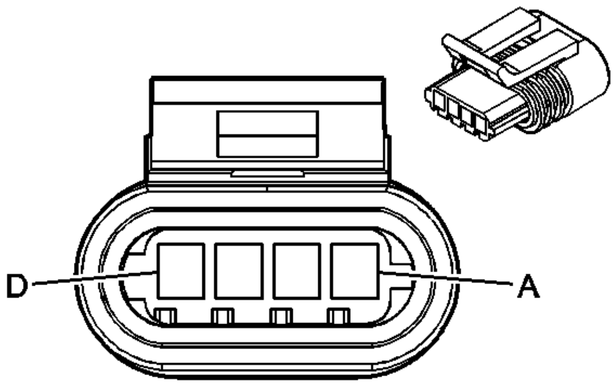
Connector Part Information	• 12162724 • 4-Way F Metri-Pack 150 Sealed (BK)		
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BK	550	Ground
B	BN	2129	Low Reference
C	L-BU	2123	IC 3 Control
D	PK	1039	Ignition 1 Voltage

Ignition Coil #4 Terminal Identification



Connector Part Information		• 12162724 • 4-Way F Metri-Pack 150 Sealed (BK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BK	550	Ground
B	BN	2130	Low Reference
C	D-GN	2124	IC 4 Control
D	PK	1239	Ignition 1 Voltage

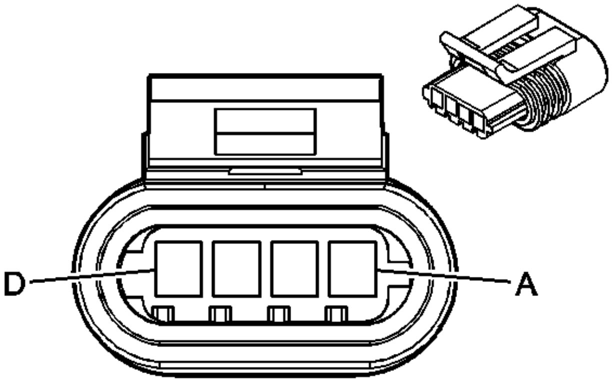
Ignition Coil #5 Terminal Identification



Connector Part Information		• 12162724 • 4-Way F Metri-Pack 150 Sealed (BK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BK	550	Ground
B	BN	2129	Low Reference

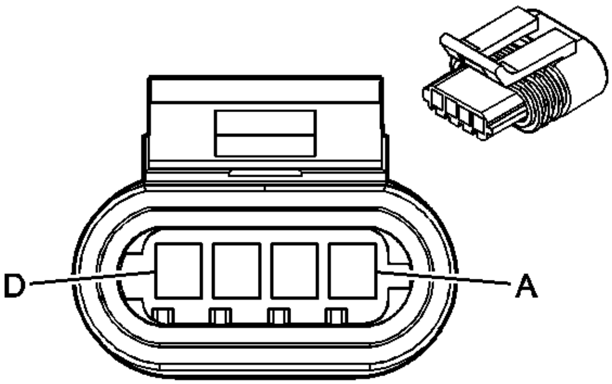
C	D-GN	2125	IC 5 Control
D	PK	1039	Ignition 1 Voltage

Ignition Coil #6 Terminal Identification



Connector Part Information		• 12162724 • 4-Way F Metri-Pack 150 Sealed (BK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BK	550	Ground
B	BN	2130	Low Reference
C	L-BU	2126	IC 6 Control
D	PK	1239	Ignition 1 Voltage

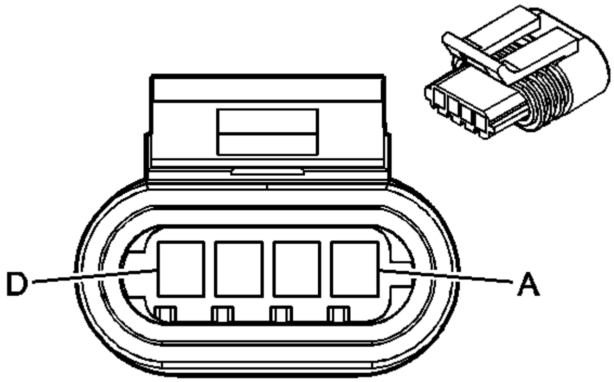
Ignition Coil #7 Terminal Identification



Connector Part Information		• 12162724	

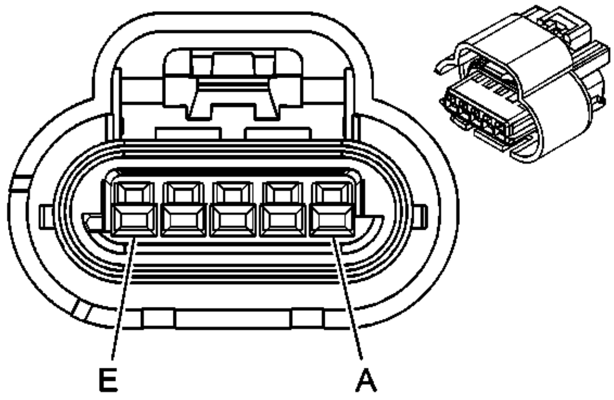
		• 4-Way F Metri-Pack 150 Sealed (BK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BK	550	Ground
B	BN	2129	Low Reference
C	RD	2127	IC 7 Control
D	PK	1039	Ignition 1 Voltage

Ignition Coil #8 Terminal Identification



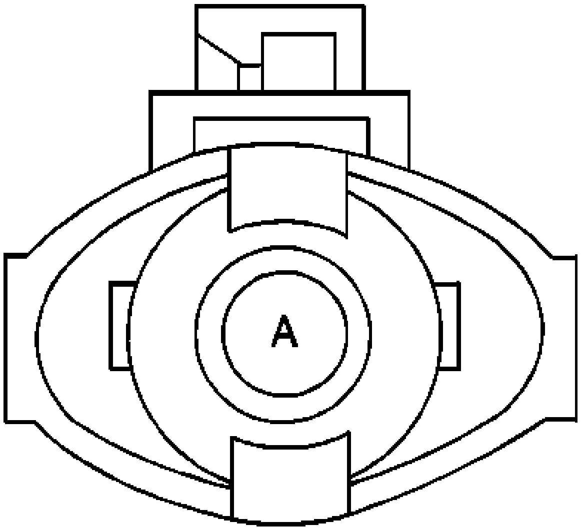
Connector Part Information		• 12162724 • 4-Way F Metri-Pack 150 Sealed (BK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BK	550	Ground
B	BN	2130	Low Reference
C	PU	2128	IC 8 Control
D	PK	1239	Ignition 1 Voltage

Intake Air Temperature (IAT)/Mass Air Flow (MAF) Sensor Terminal Identification



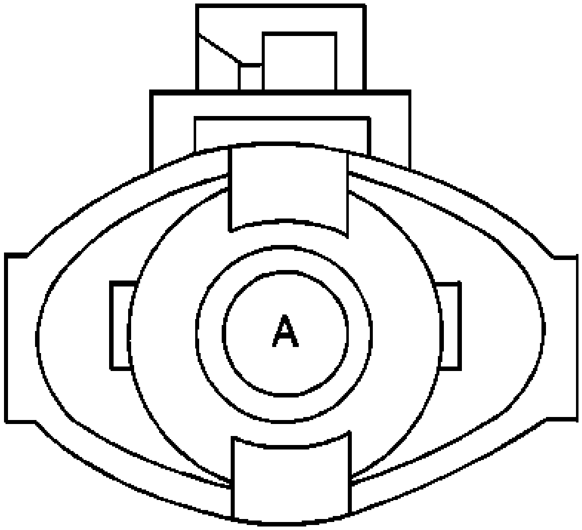
Connector Part Information		• **15305555** • **5-Way F Metri-Pack 150 Series (BK)**	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	BK	552	Low Reference
B	TN	472	IAT Sensor Signal
C	BK/WH	451	Ground
D	PK	439	Ignition 1 Voltage
E	YE	492	MAF Sensor Signal

Knock Sensor Terminal Identification - Front



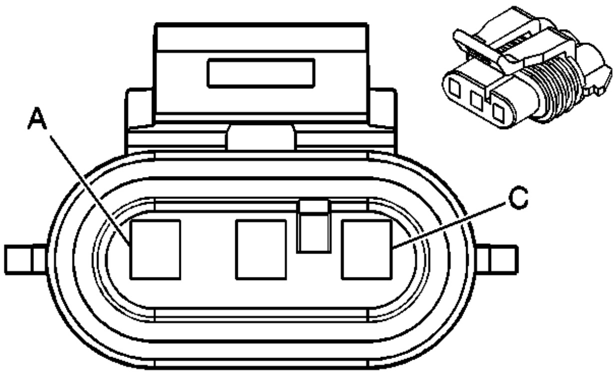
Connector Part Information		• 12103023 • 1-Way TRW (M-GY)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	D-BU	496	Knock Sensor 1 Signal

Knock Sensor Terminal Identification - Rear



Connector Part Information		• 12103023 • 1-Way TRW (M-GY)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	L-BU	1876	Knock Sensor 2 Signal

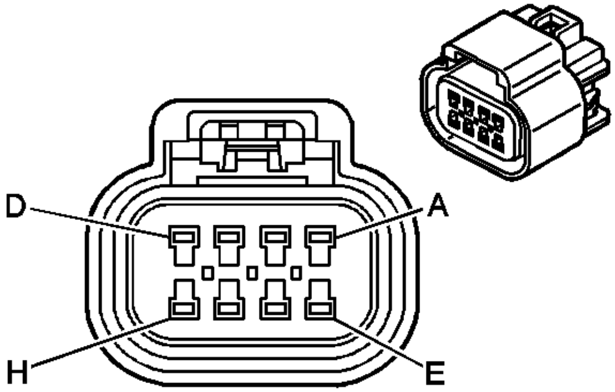
Manifold Absolute Pressure (MAP) Sensor Terminal Identification



Connector Part Information		• 12129946 • 3-Way F Metri-Pack 150 Series Sealed (M-GY)	
Pin	**Wire Color**	**Circuit No.**	**Function**

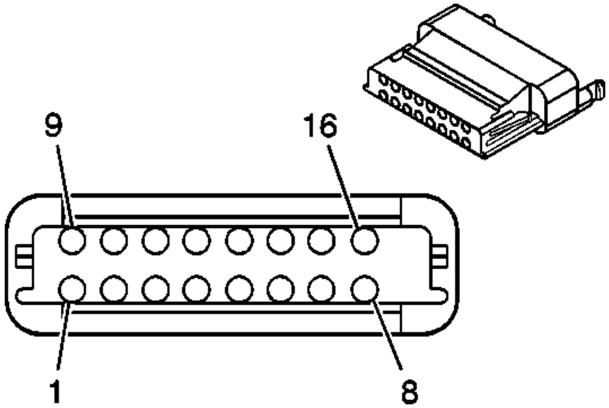
A	OG/BK	469	Low Reference
B	L-GN	432	MAP Sensor Signal
C	GY	597	5 Volt Reference

Throttle Actuator Control (TAC) Assembly Terminal Identification



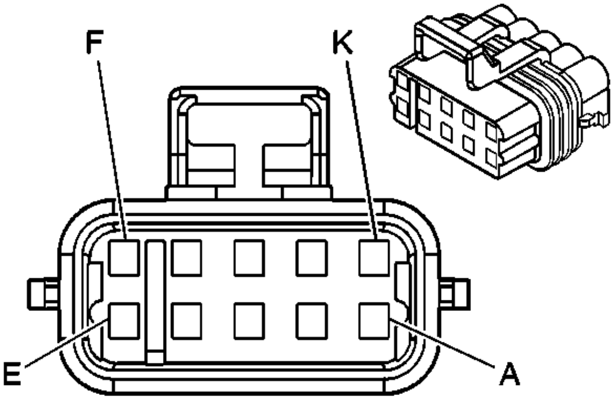
Connector Part Information		• 15326836 • 8-Way F GT 150 SLD (BK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	YE	581	TAC Motor Control - 1
B	OG/BK	1057	Low Reference
C	BN	582	TAC Motor Control - 2
D	BK	452	Low Reference
E	L-BU/ BK	1688	5 Volt Reference
F	PU	486	TP Sensor 2 Signal
G	D-GN	485	TP Sensor 1 Signal
H	GY	416	5 Volt Reference

Throttle Actuator Control (TAC) Module C1 Terminal Identification



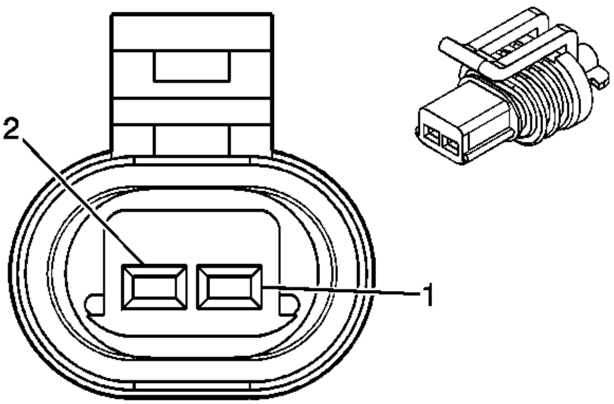
Connector Part Information		• **12191065** • **16-Way F Micro-Pack 100 Series (M-GY)**	
Pin	**Wire Color**	**Circuit No.**	**Function**
1	D-GN	485	TP Sensor 1 Signal
2	GY	416	5 Volt Reference
3	BK	452	Low Reference
4	D-BU	84	Cruise Control Set/Coast Switch Signal
5	GY/BK	87	Cruise Control Resume/Accel Switch Signal
6	L-BU	1320	Stop Lamp Supply Voltage
7	PK	1339	Ignition 1 Voltage
8	BN	582	TAC Motor Control - 2
9	L-BU/ BK	1688	5 Volt Reference
10	OG/BK	1057	Low Reference
11	PU	486	TP Sensor 2 Signal
12	OG/BK	1061	UART Serial Data-Secondary
13	D-BU/ WH	774	UART Serial Data-Tertiary
14	GY	397	Cruise Control On Switch Signal
15	BK	550	Ground
16	YE	581	TAC Motor Control - 1

Throttle Actuator Control (TAC) Module C2 Terminal Identification



Connector Part Information		• 12177081 • 10-Way F 150 Series Sealed (BK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
A	-	-	Not Used
B	PU	1272	5 Volt Reference
C	L-BU	1162	APP Sensor 2 Signal
D	TN	1274	Low Reference
E	-	-	Not Used
F	D-BU	1161	APP Sensor 1 Signal
G	WH/BK	1164	5 Volt Reference
H	-	-	Not Used
J	BN	1271	Low Reference
K	-	-	Not Used

Vehicle Speed Sensor (VSS) Terminal Identification



Connector Part Information		• 15336024 • 2-Way F GT 150 Sealed (BK)	
Pin	**Wire Color**	**Circuit No.**	**Function**
1	PU/WH	821	VSS High Signal
2	L-GN/BK	822	VSS Low Signal

REPAIR INSTRUCTIONS

POWERTRAIN CONTROL MODULE (PCM) REPLACEMENT

Service of the powertrain control module (PCM) should normally consist of either replacement of the PCM or electrically erasable programmable read only memory (EEPROM) programming. If the diagnostic procedures call for the PCM to be replaced, the PCM should be inspected first to see if the correct part is being used. If the correct part is being used, remove the faulty PCM and install the new service PCM.

IMPORTANT: To prevent internal PCM damage, the ignition must be OFF when disconnecting or reconnecting power to the PCM. For example, when working with a battery cable, PCM pigtail, PCM fuse, or jumper cables.

- Remove any debris from the PCM connector surfaces before servicing the PCM. Inspect the PCM module connector gaskets when diagnosing or replacing the PCM. Ensure that the gaskets are installed correctly. The gaskets prevent contaminant intrusion into the PCM.
- The replacement PCM must be programmed.

Removal Procedure

IMPORTANT: It is necessary to record the remaining engine oil life. If the replacement module is not programed with the remaining engine oil life, the engine oil life will default to 100%. If the replacement module is not programmed

with the remaining engine oil life, the engine oil will need to be changed at 5000 km (3,000 mi) from the last engine oil change.

1. Using a scan tool, retrieve the percentage of remaining engine oil. Record the remaining engine oil life.

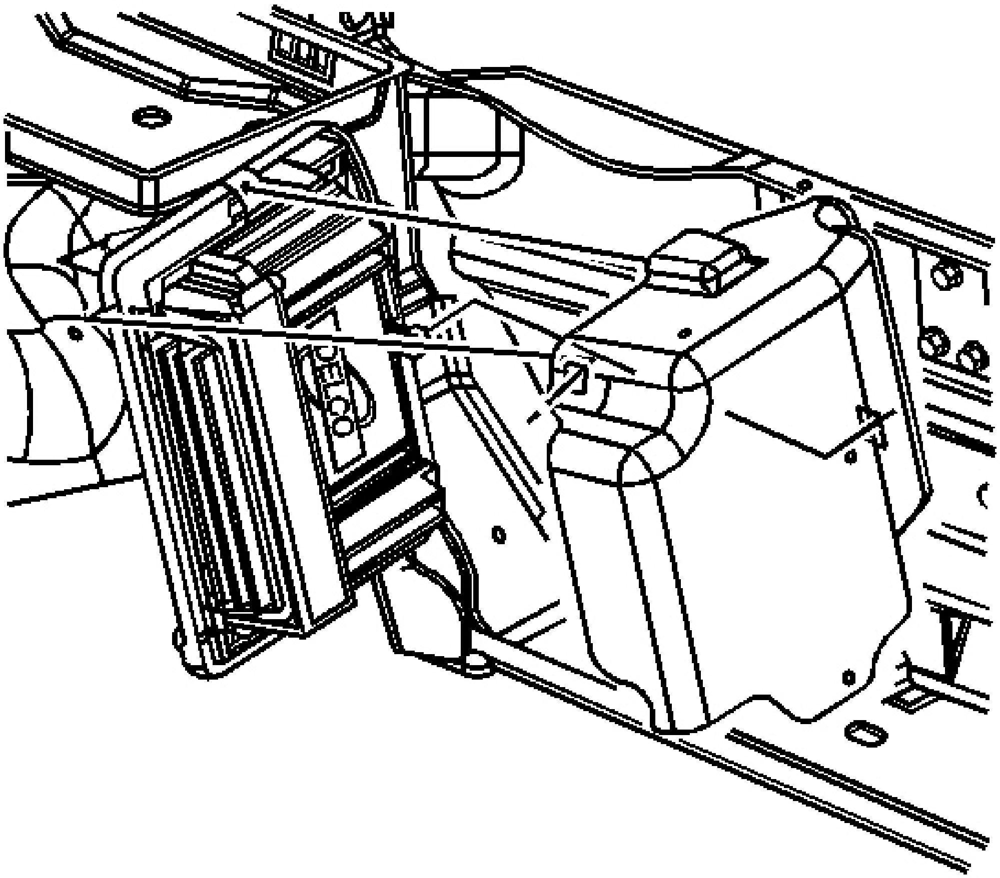


Fig. 27: PCM Cover
Courtesy of GENERAL MOTORS CORP.

2. Release the PCM cover mounting holes away from the mounting tabs on the PCM mounting bracket.
3. Release the PCM cover from the mounting bracket.
4. Remove the PCM cover.

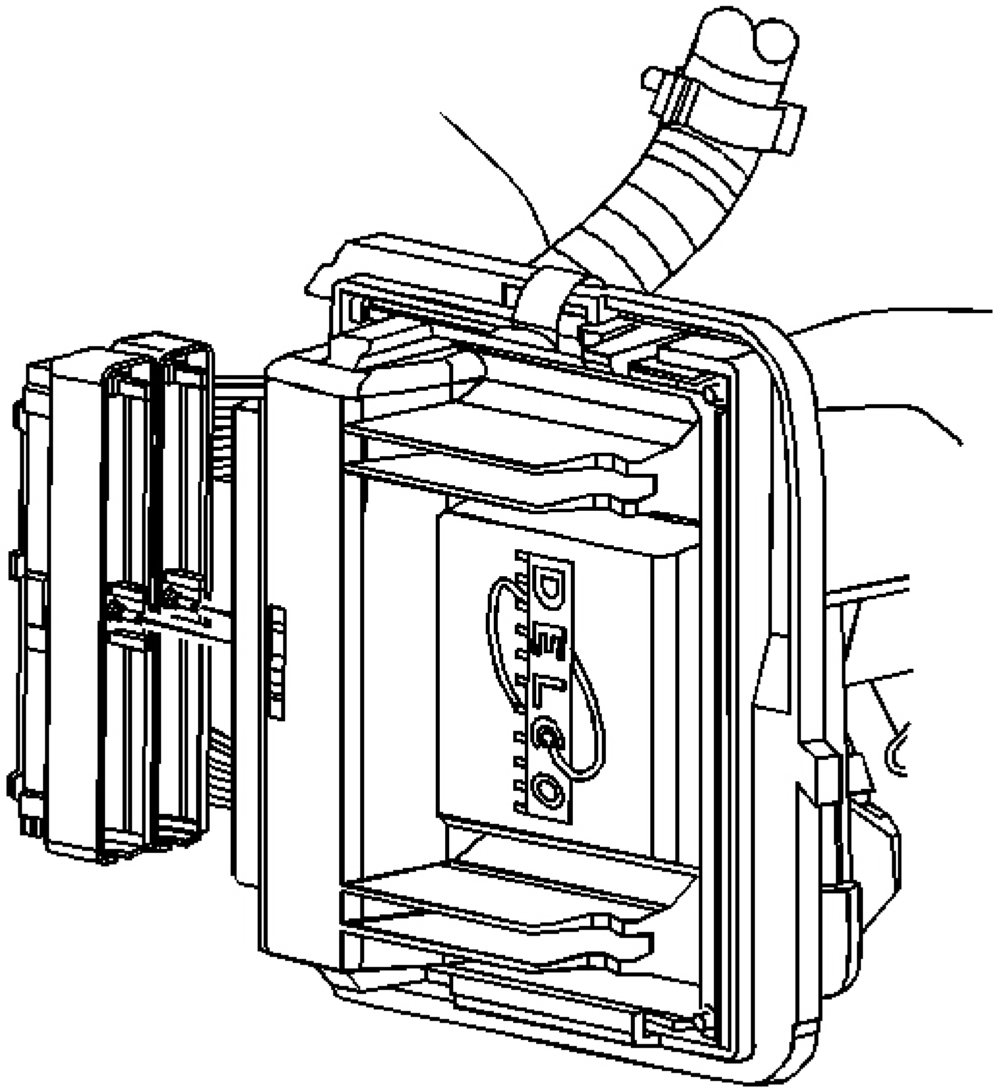


Fig. 28: PCM Harness Connectors
Courtesy of GENERAL MOTORS CORP.

NOTE:	**Refer to PCM and ESD Notice in Cautions and Notices.**

NOTE:	**In order to prevent internal damage to the PCM, the ignition must be OFF when disconnecting or reconnecting the PCM connector.**

5. Loosen both PCM connector retaining bolts.
6. Disconnect the PCM harness connectors.
7. Release the spring latch from the PCM.
8. Release the PCM mounting tabs from the PCM.

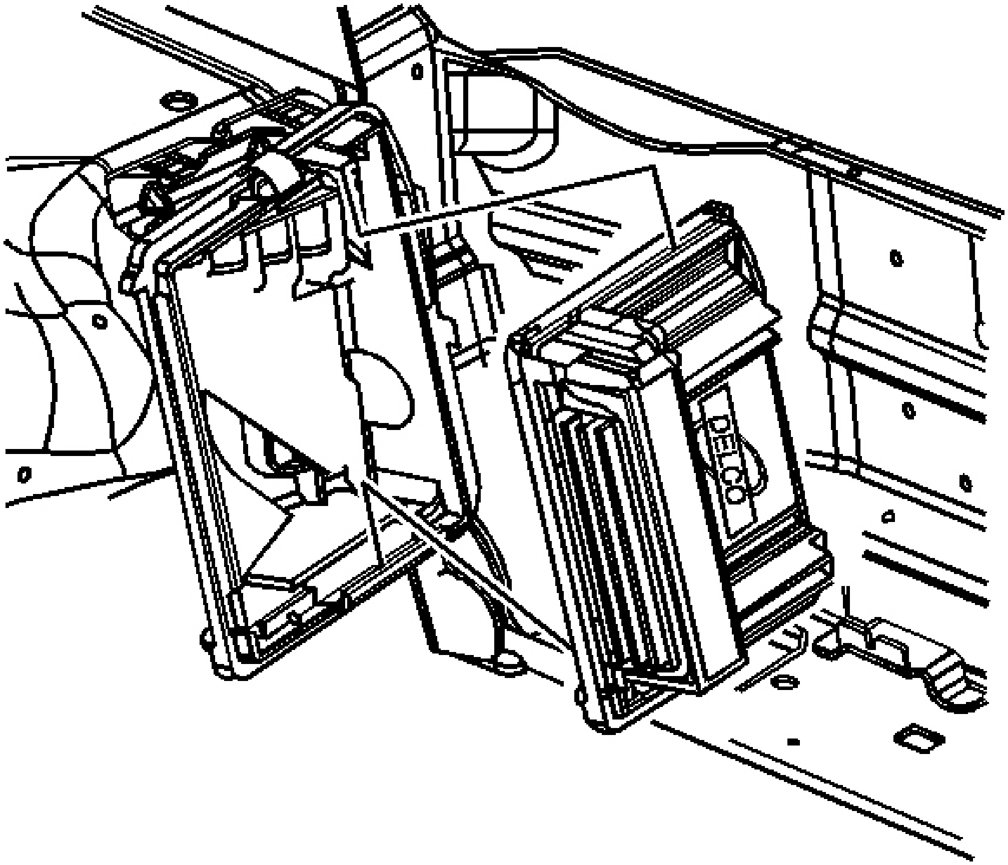


Fig. 29: PCM & Engine Compartment
Courtesy of GENERAL MOTORS CORP.

9. Remove the PCM from the engine compartment.

Installation Procedure

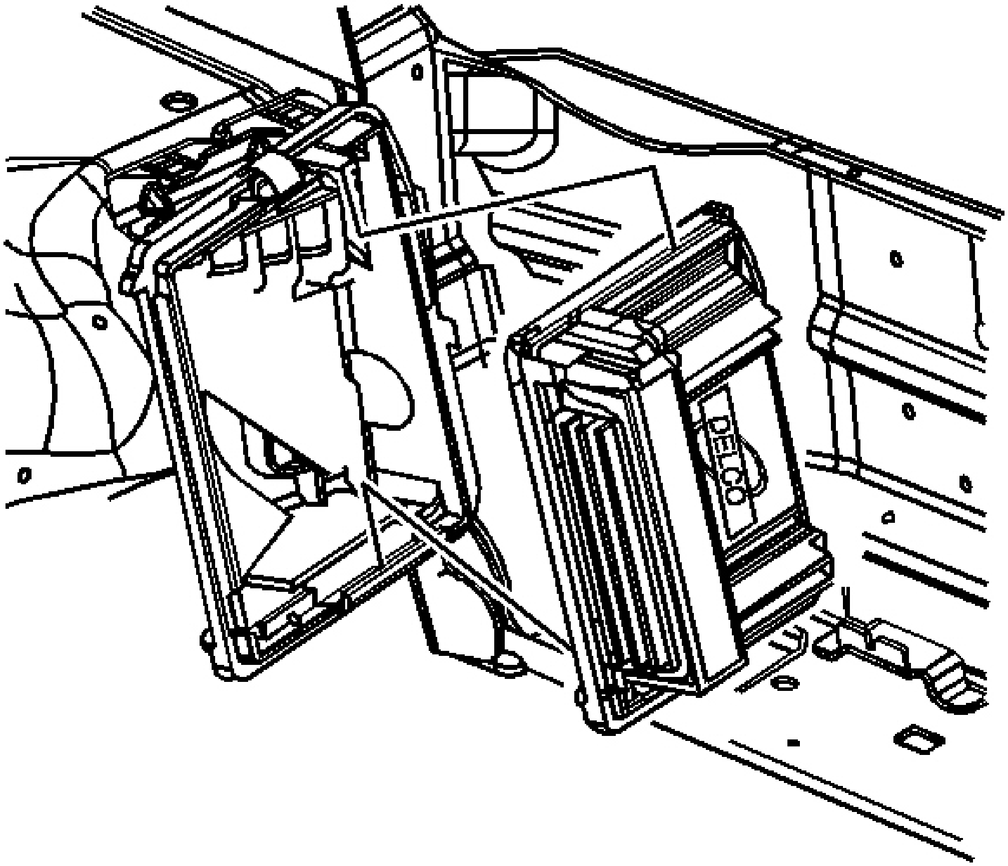


Fig. 30: PCM & Engine Compartment
Courtesy of GENERAL MOTORS CORP.

1. Install the PCM to the PCM mounting bracket ensuring that the mounting tabs are engaged.
2. Secure the spring latch to the PCM.

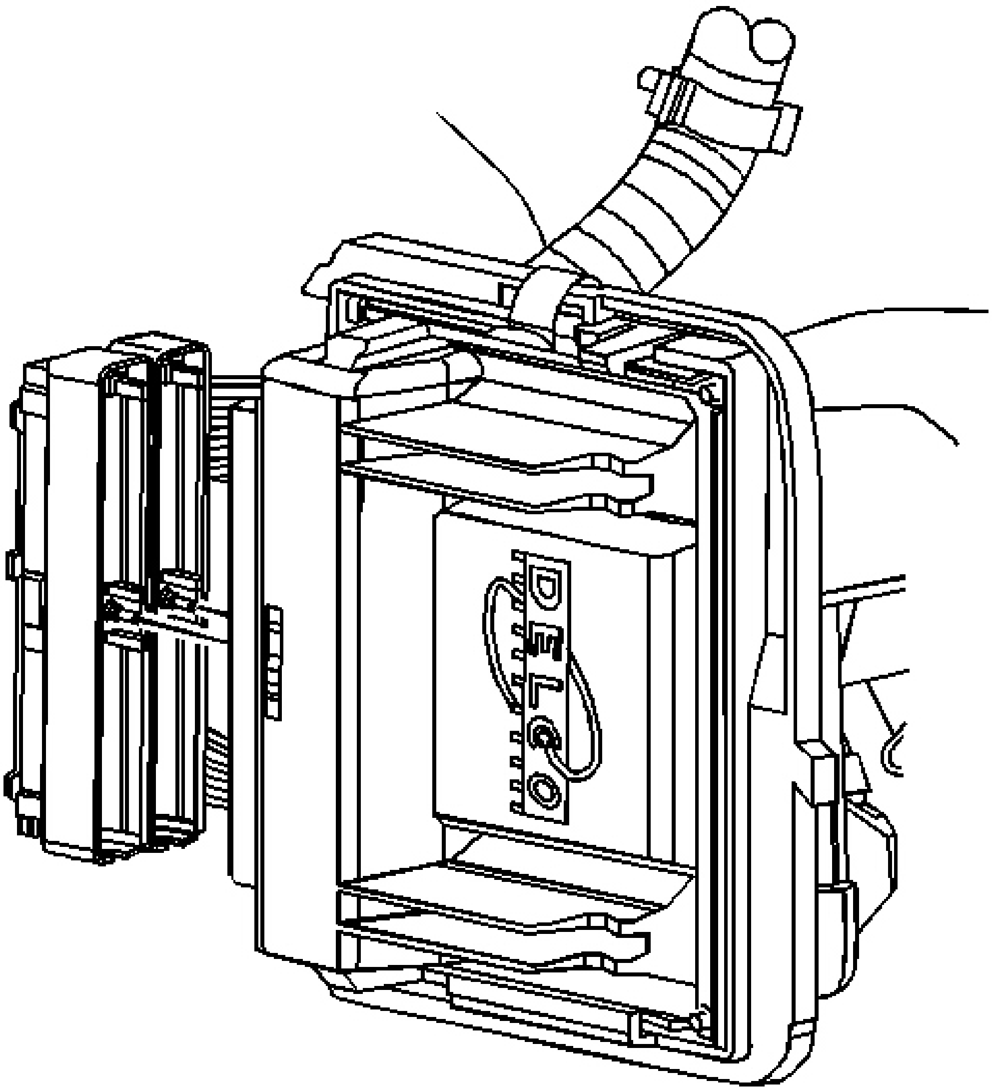


Fig. 31: PCM Harness Connectors
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Connect the PCM connectors to the PCM.

Tighten: Tighten the PCM connector end fasteners to 8 N.m (71 lb in).

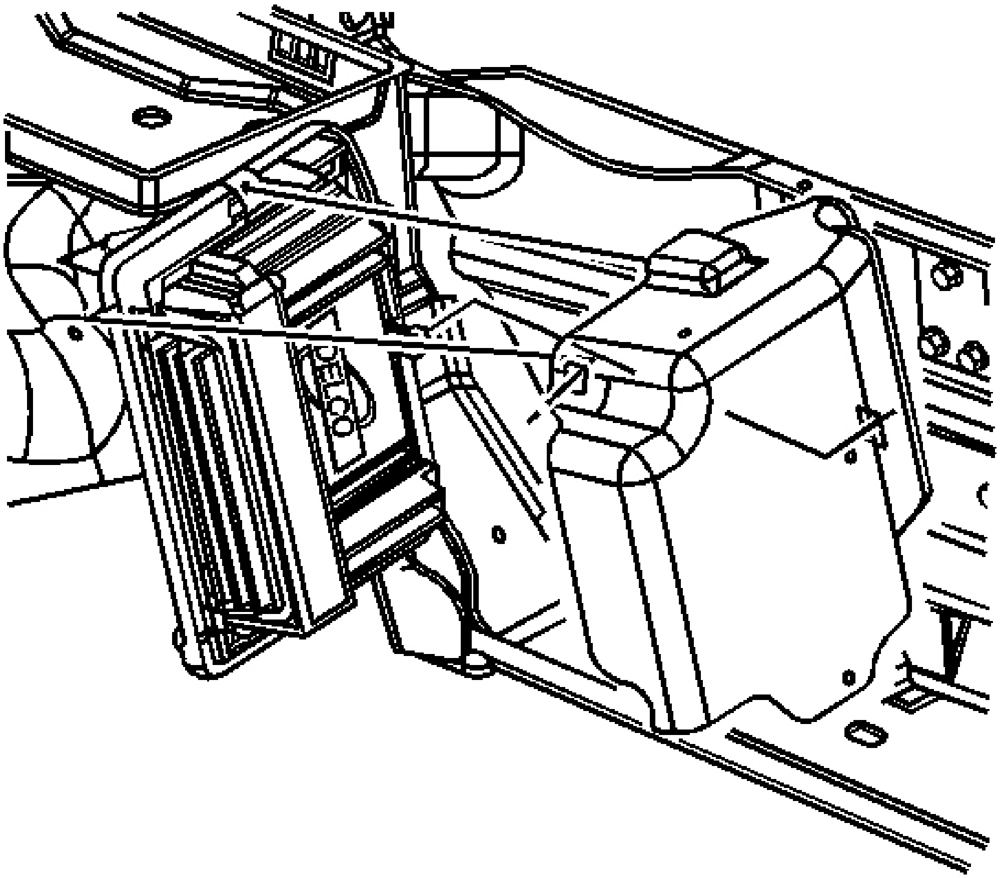


Fig. 32: PCM Cover
Courtesy of GENERAL MOTORS CORP.

4. Install the PCM cover to the PCM mounting bracket, ensuring the mounting tabs on the PCM mounting bracket are engaged into the mounting holes in the PCM cover.
5. If a new PCM is being installed, program the PCM. Refer to **Service Programming System (SPS)** in Programming.

THROTTLE ACTUATOR CONTROL (TAC) MODULE REPLACEMENT

Removal Procedure

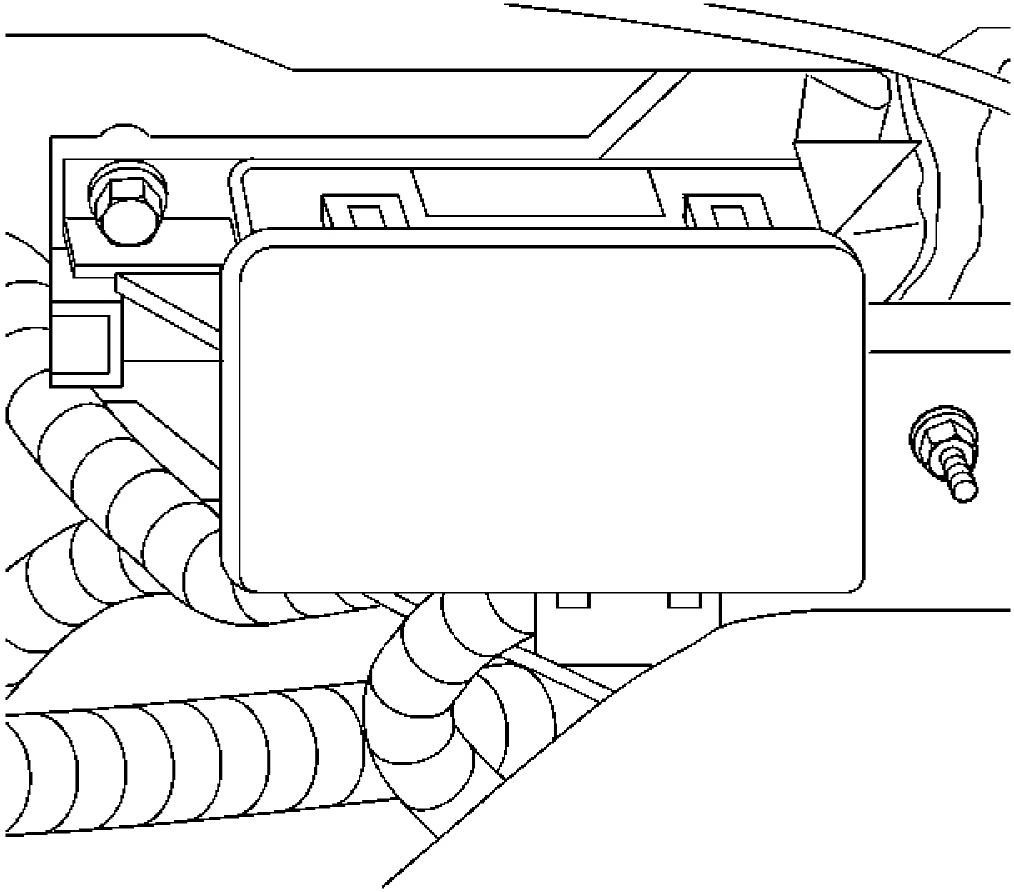


Fig. 33: TAC Module Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

1. Remove the left hand corner brace from the cowl.
2. Remove the TAC module mounting nuts.
3. Disconnect the TAC module electrical connectors from the TAC module.

Installation Procedure

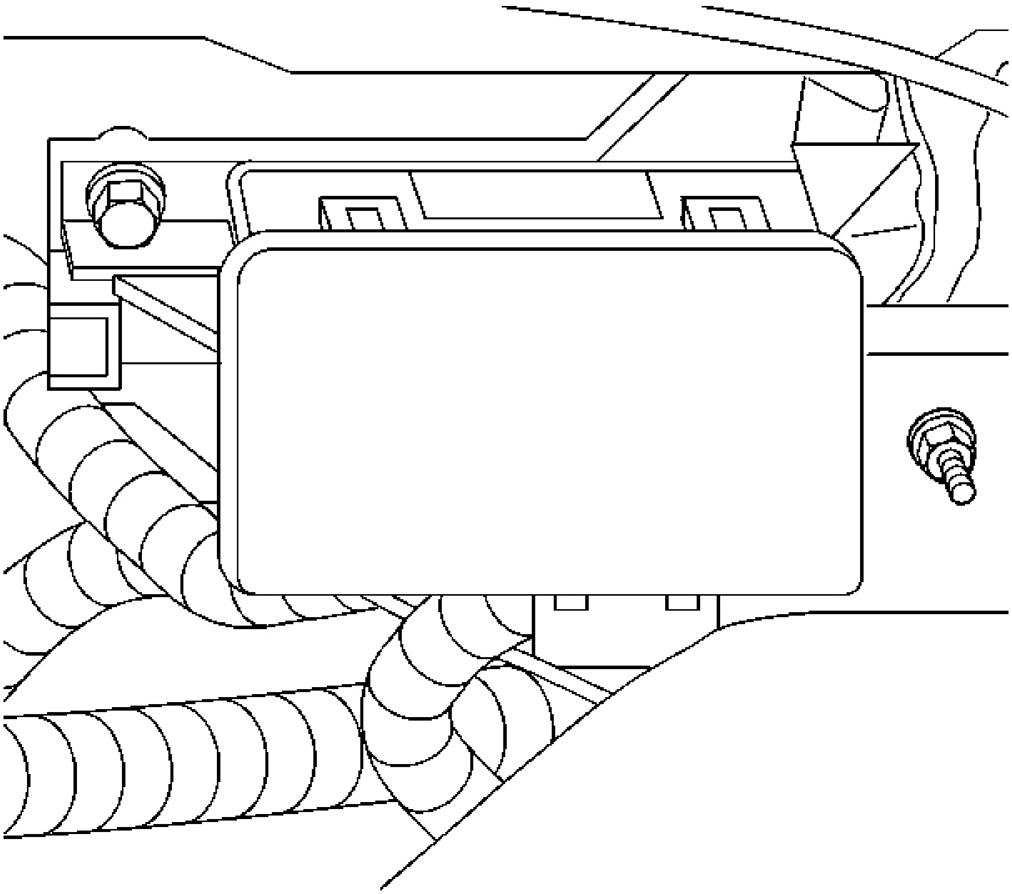


Fig. 34: TAC Module Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

1. Connect the TAC module electrical connectors to the TAC module.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the TAC module onto the studs and install the mounting nuts.

   Tighten: Tighten the TAC mounting nuts to 9 N.m (80 lb in).

3. Install the left hand corner brace.

   Tighten: Tighten the corner brace bolts to 25 N.m (18 lb ft).

CKP SYSTEM VARIATION LEARN PROCEDURE

1. Install a scan tool.
2. Monitor the powertrain control module (PCM) for DTCs with a scan tool. If other DTCs are set, except DTC P0315, refer to **Diagnostic Trouble Code (DTC) List** for the applicable DTC that set.
3. Select the crankshaft position (CKP) variation learn procedure with a scan tool.
4. The scan tool instructs you to perform the following:
    1. Accelerate to wide open throttle (WOT).
    2. Release throttle when fuel cut-off occurs.
    3. Observe fuel cut-off for applicable engine.
    4. Engine should not accelerate beyond calibrated RPM value.
    5. Release throttle immediately if value is exceeded.
    6. Block drive wheels.
    7. Set parking brake.
    8. DO NOT apply brake pedal.
    9. Cycle ignition from OFF to ON.
    10. Apply and hold brake pedal.
    11. Start and idle engine.
    12. Turn A/C OFF.
    13. Vehicle must remain in Park or Neutral.
    14. The scan tool monitors certain component signals to determine if all the conditions are met to continue with the procedure. The scan tool only displays the condition that inhibits the procedure. The scan tool monitors the following components:
        - CKP sensors activity-If there is a CKP sensor condition, refer to the applicable DTC that set.
        - Camshaft position (CMP) sensor activity-If there is a CMP sensor condition, refer to the applicable DTC that set.
        - Engine coolant temperature (ECT)-If the ECT is not warm enough, idle the engine until the engine coolant temperature reaches the correct temperature.
5. Enable the CKP system variation learn procedure with a scan tool.

IMPORTANT: While the learn procedure is in progress, release the throttle immediately when the engine starts to decelerate. The engine control is returned to the operator and the engine responds to throttle position after the learn procedure is complete.

6. Accelerate to WOT.
7. Release when the fuel cut-off occurs.
8. The scan tool displays Test In Progress.
9. The scan tool displays Learn Status: Learned this ignition. If the scan tool indicates that DTC P0315 ran and passed, the CKP variation learn procedure is complete. If the scan tool indicates DTC P0315 failed or

did not run, refer to **DTC P0315** . If any other DTCs set, refer to **Diagnostic Trouble Code (DTC) List** for the applicable DTC that set.

10. Turn OFF the ignition for 30 seconds after the learn procedure is completed successfully.
11. The CKP system variation learn procedure is also required when the following service procedures have been performed, regardless of whether DTC P0315 is set:
    - A CKP sensor replacement
    - An engine replacement
    - A PCM replacement
    - A harmonic balancer replacement
    - A crankshaft replacement
    - Any engine repairs which disturb the CKP sensor relationship

ENGINE COOLANT TEMPERATURE (ECT) SENSOR REPLACEMENT

Removal Procedure

NOTE: Use care when handling the coolant sensor. Damage to the coolant sensor will affect the operation of the fuel control system.

1. Turn OFF the ignition.

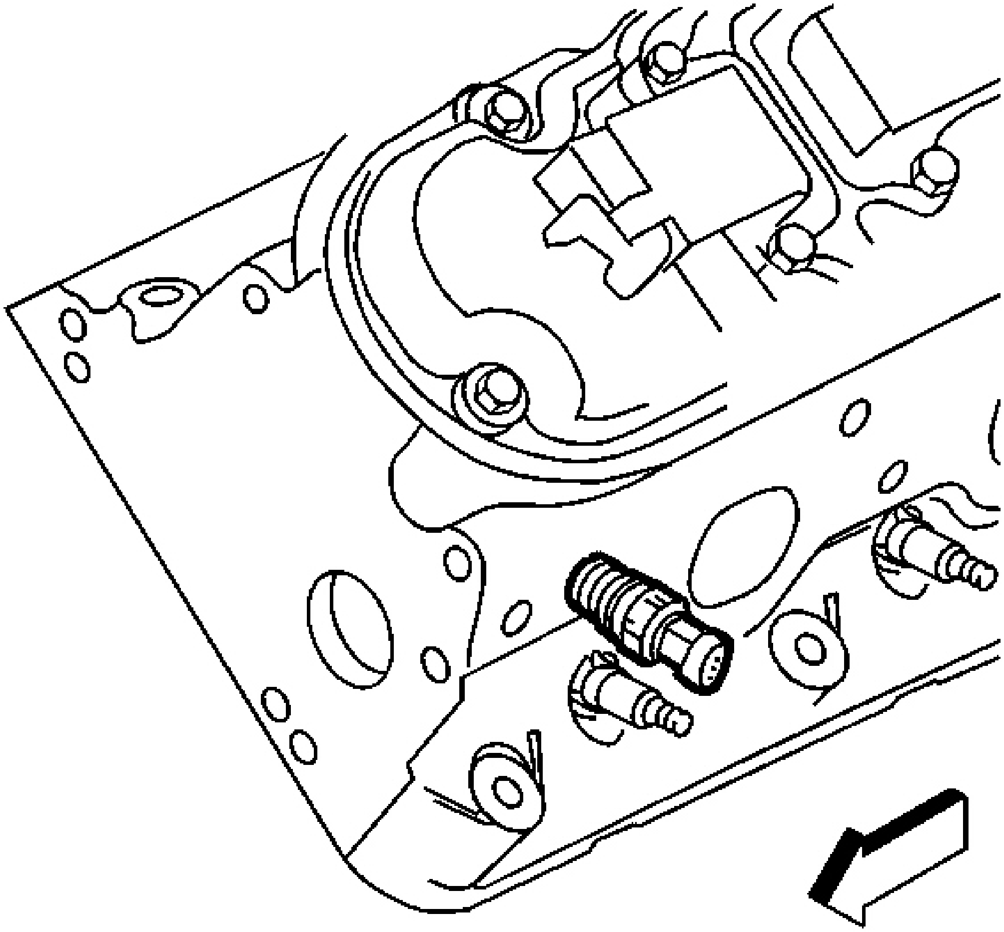


Fig. 35: ECT Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

2. Drain the cooling system below the level of the ECT sensor. Refer to **Draining and Filling Cooling System** in Engine Cooling.
3. Disconnect the electrical connector from the engine coolant temperature (ECT) sensor.

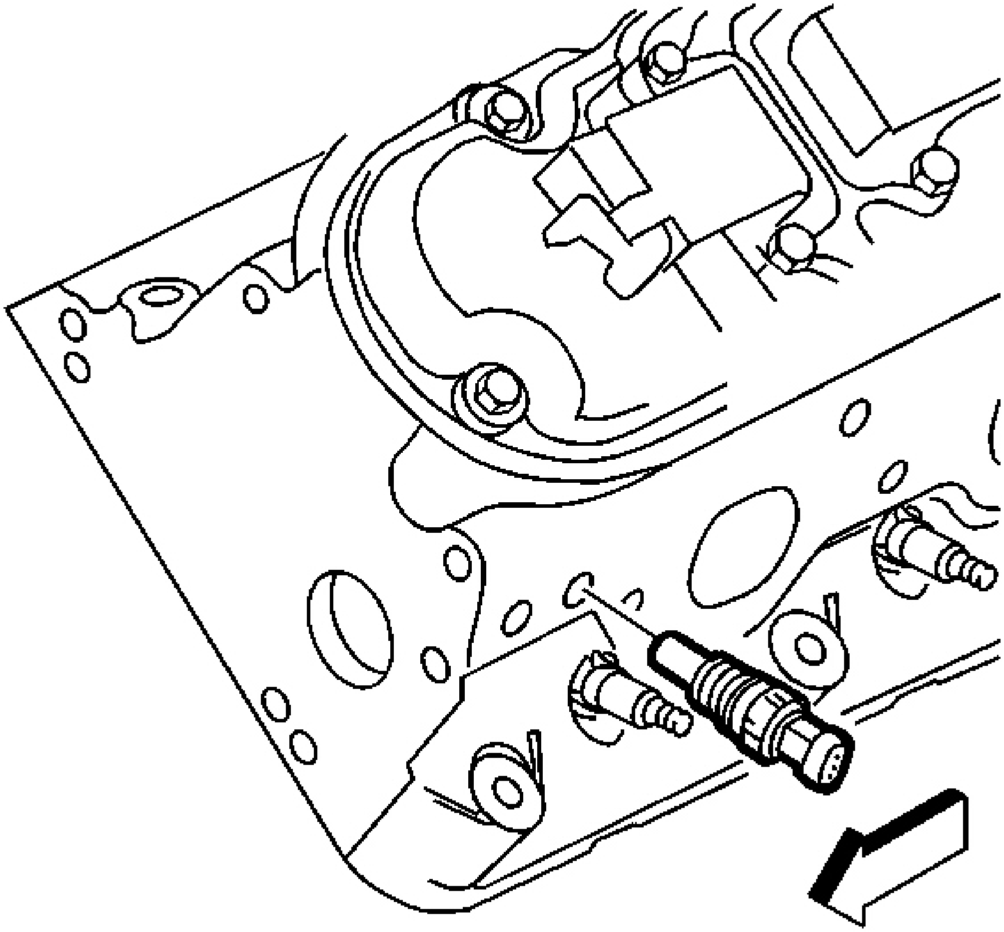


Fig. 36: Locating Temp Sensor
Courtesy of GENERAL MOTORS CORP.

4. Remove the ECT sensor.

Installation Procedure

NOTE:	**Replacement components must be the correct part number for the application. Components requiring the use of the thread locking compound, lubricants, corrosion inhibitors, or sealants are identified in the service procedure. Some replacement components may come with these coatings already applied. Do not use these coatings on components unless specified. These coatings can affect the final torque, which may**

affect the operation of the component. Use the correct torque specification when installing components in order to avoid damage.

NOTE: **Use care when handling the coolant sensor. Damage to the coolant sensor will affect the operation of the fuel control system.**

1. Coat the ECT sensor threads with sealer GM P/N 12346004 (Canadian P/N 10953480) or the equivalent.

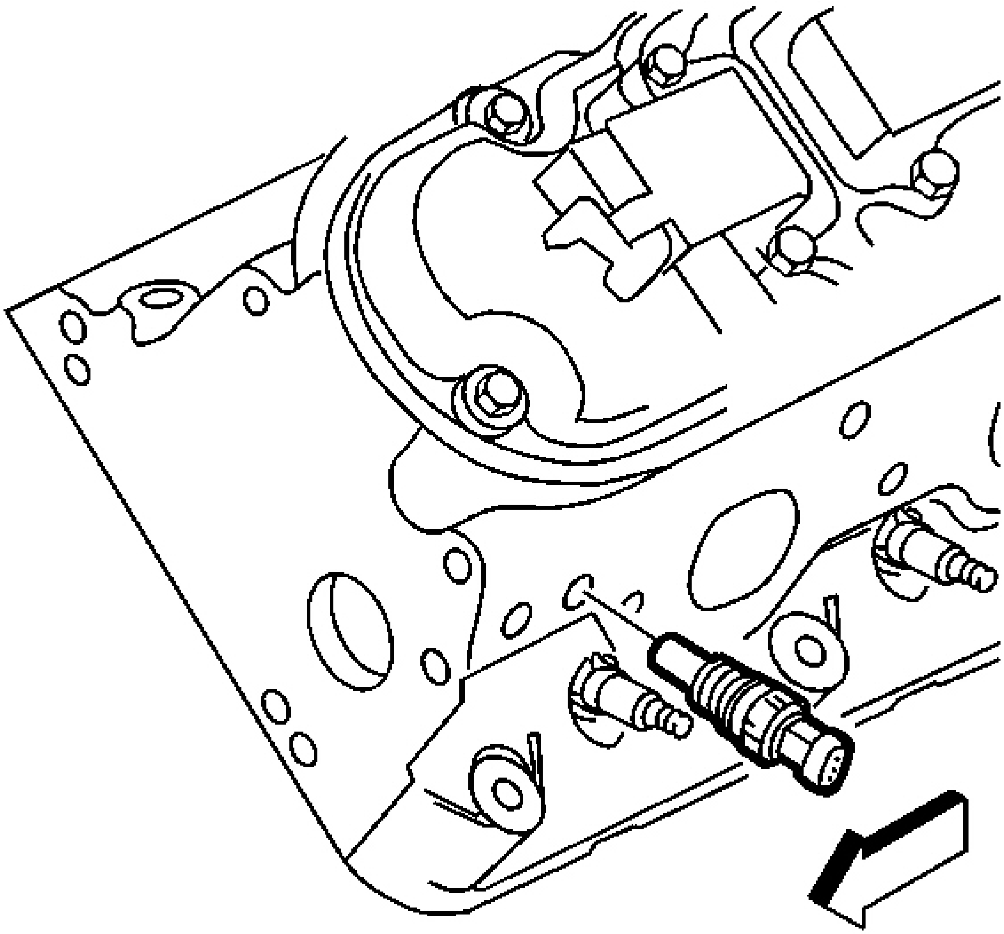


Fig. 37: Locating Temp Sensor
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

2. Install the ECT sensor.

Tighten: Tighten the ECT sensor to 20 N.m (15 lb ft).

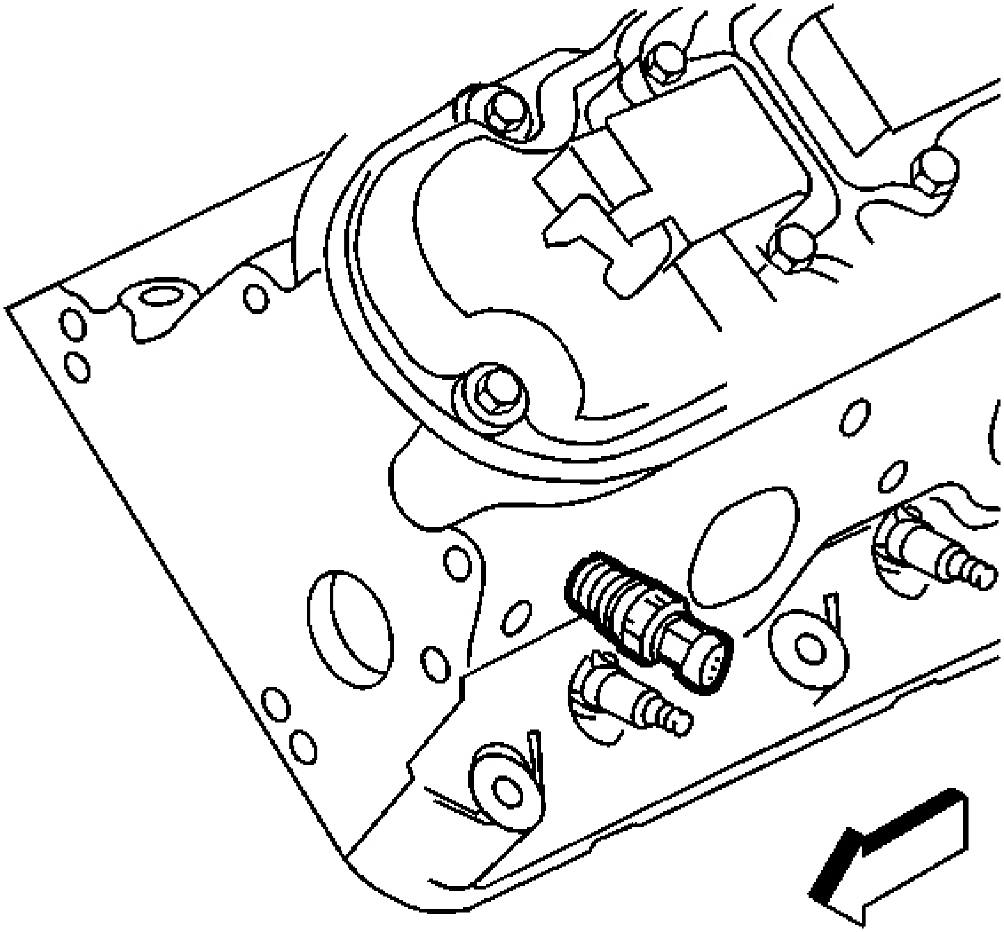


Fig. 38: ECT Sensor Electrical Connector
Courtesy of GENERAL MOTORS CORP.

3. Connect the ECT sensor electrical connector.
4. Refill the engine coolant. Refer to **Draining and Filling Cooling System** in Engine Cooling.

MASS AIR FLOW (MAF)/INTAKE AIR TEMPERATURE (IAT) SENSOR REPLACEMENT

Removal Procedure

IMPORTANT: Take care when handling the mass air flow/intake air temperature (MAF/IAT) sensor. Do not dent, puncture, or otherwise damage the honeycell located at the air inlet end of the MAF/IAT. Do not touch the sensing elements or allow anything including cleaning solvents and lubricants to come in contact with them. Use a small amount of a non-silicone based lubricant, on the air duct only, to aid in installation. Do not drop or roughly handle the MAF/IAT sensor.

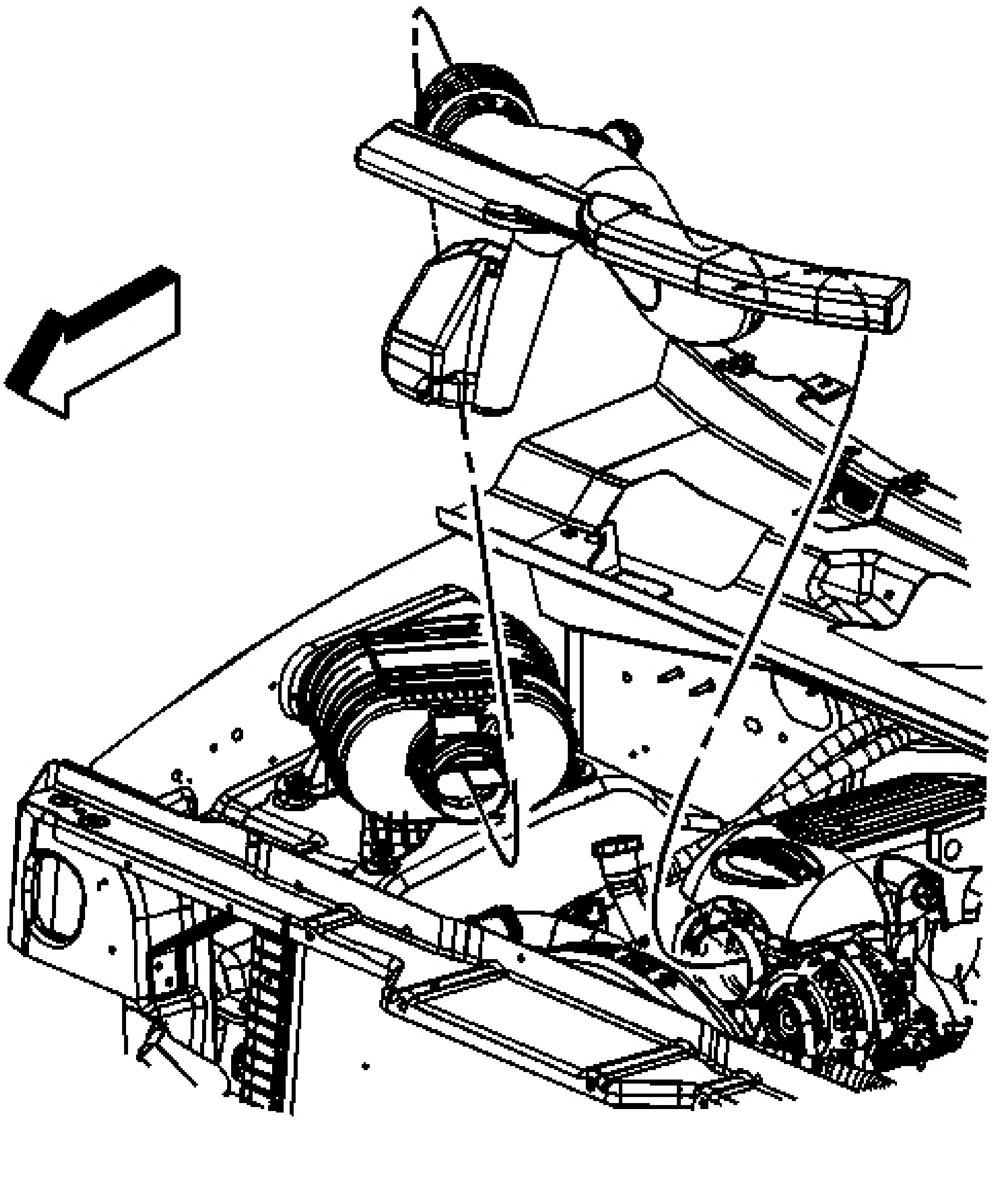
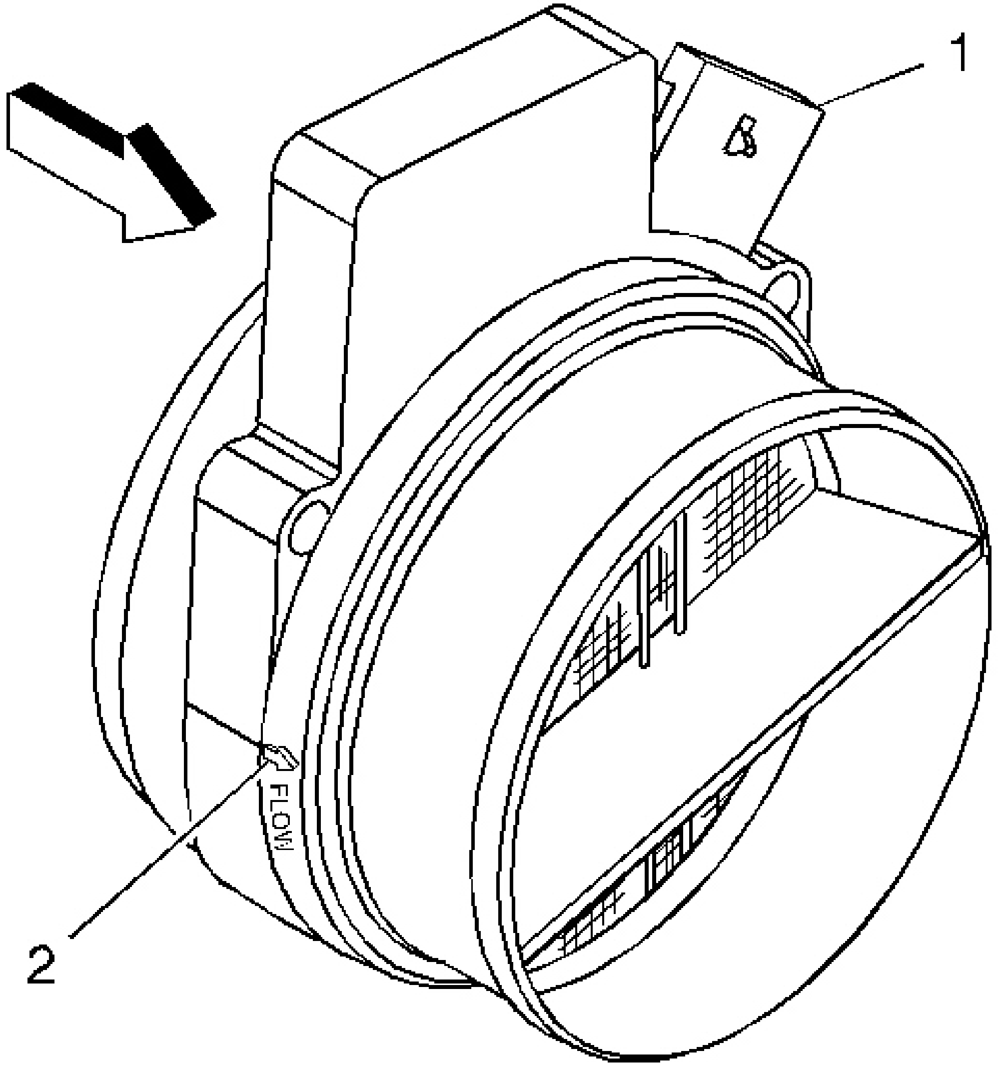


Fig. 39: MAF/IAT Sensor & Air Cleaner Assembly
Courtesy of GENERAL MOTORS CORP.

1. Remove air intake resonator. Refer to **Air Cleaner Resonator Outlet Duct Replacement** .
2. Disconnect the MAF/IAT sensor electrical connector.
3. Loosen the clamp securing the MAF/IAT sensor to the air cleaner housing.
4. Remove the MAF/IAT sensor from the air cleaner assembly.

Installation Procedure

IMPORTANT: The embossed arrow on the MAF/IAT sensor indicates the proper air flow direction. The arrow must point toward the engine.



<u>Fig. 40: Locating Air Flow Direction Arrow On MAF/IAT Sensor</u>
Courtesy of GENERAL MOTORS CORP.

1. Locate the air flow direction arrow (2) on the MAF/IAT sensor.

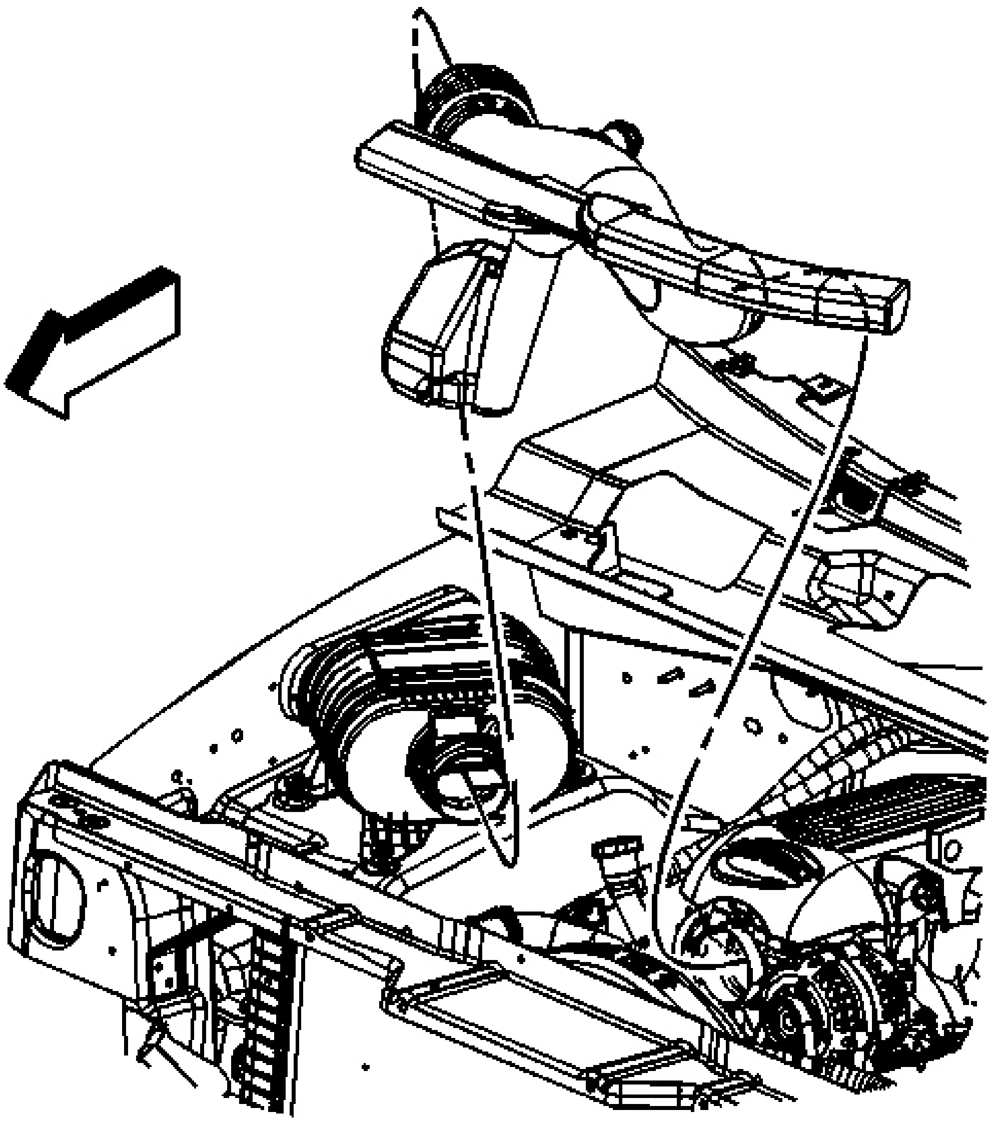


Fig. 41: MAF/IAT Sensor & Air Cleaner Assembly
Courtesy of GENERAL MOTORS CORP.

2. Install the MAF/IAT sensor on to the air cleaner housing.
3. Tighten the clamp securing the MAF/IAT sensor to the air cleaner housing.
4. Connect the MAF/IAT electrical connector.
5. Install air intake resonator. Refer to **Air Cleaner Resonator Outlet Duct Replacement** .

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR REPLACEMENT

Removal Procedure

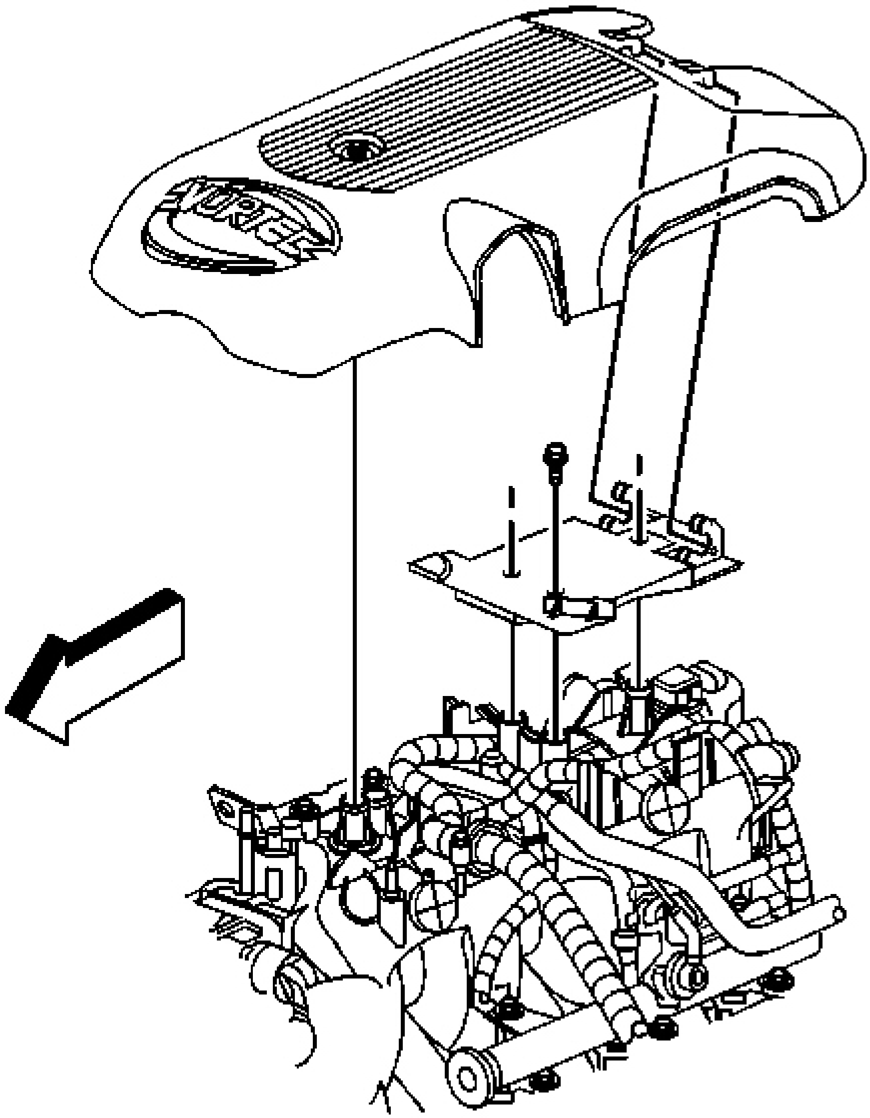


Fig. 42: View Of Top Engine Cover
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine sight shield. Refer to **Engine Sight Shield Replacement (6.0L (LQ4))** in Engine

Mechanical.

2. Remove the engine sight shield bracket bolts. Position the bracket to the side
3. Disconnect the manifold absolute pressure (MAP) sensor electrical connector.

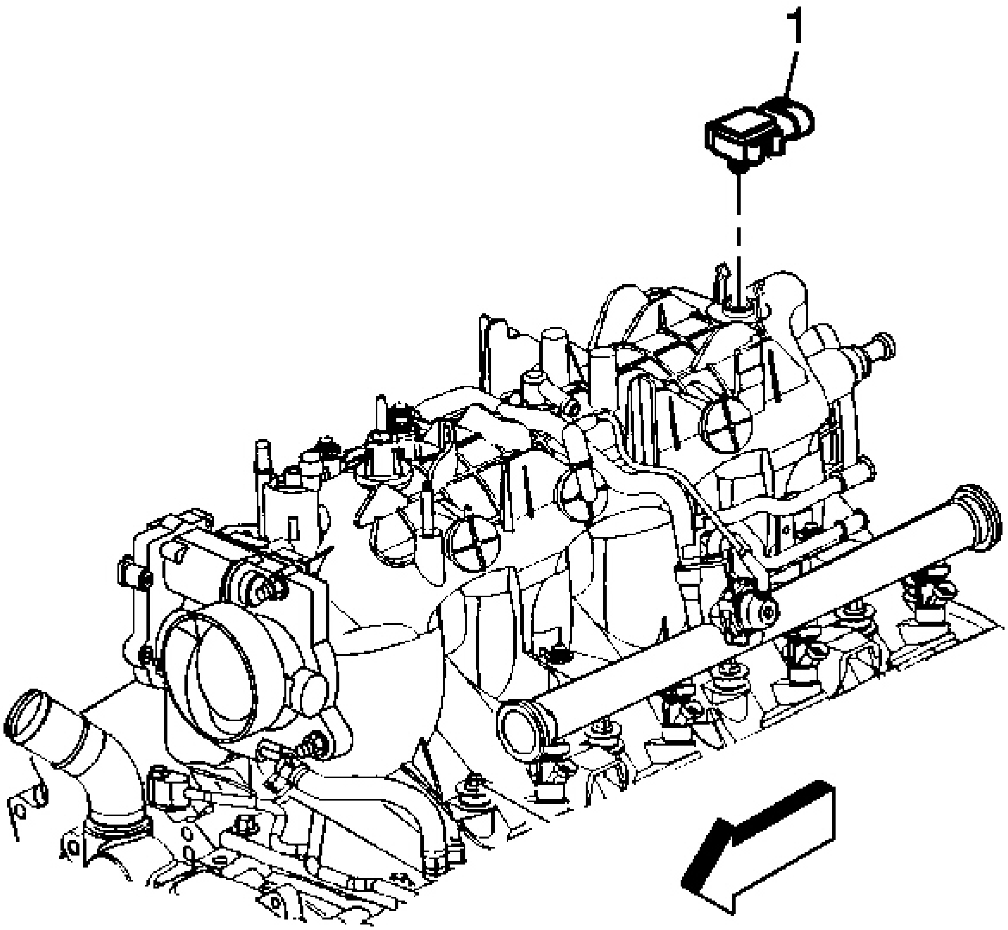


Fig. 43: MAP Sensor & Intake Manifold
Courtesy of GENERAL MOTORS CORP.

4. Remove the MAP sensor (1) from the intake manifold.

Installation Procedure

IMPORTANT: Lightly coat the MAP sensor seal with clean engine oil before installing the sensor.

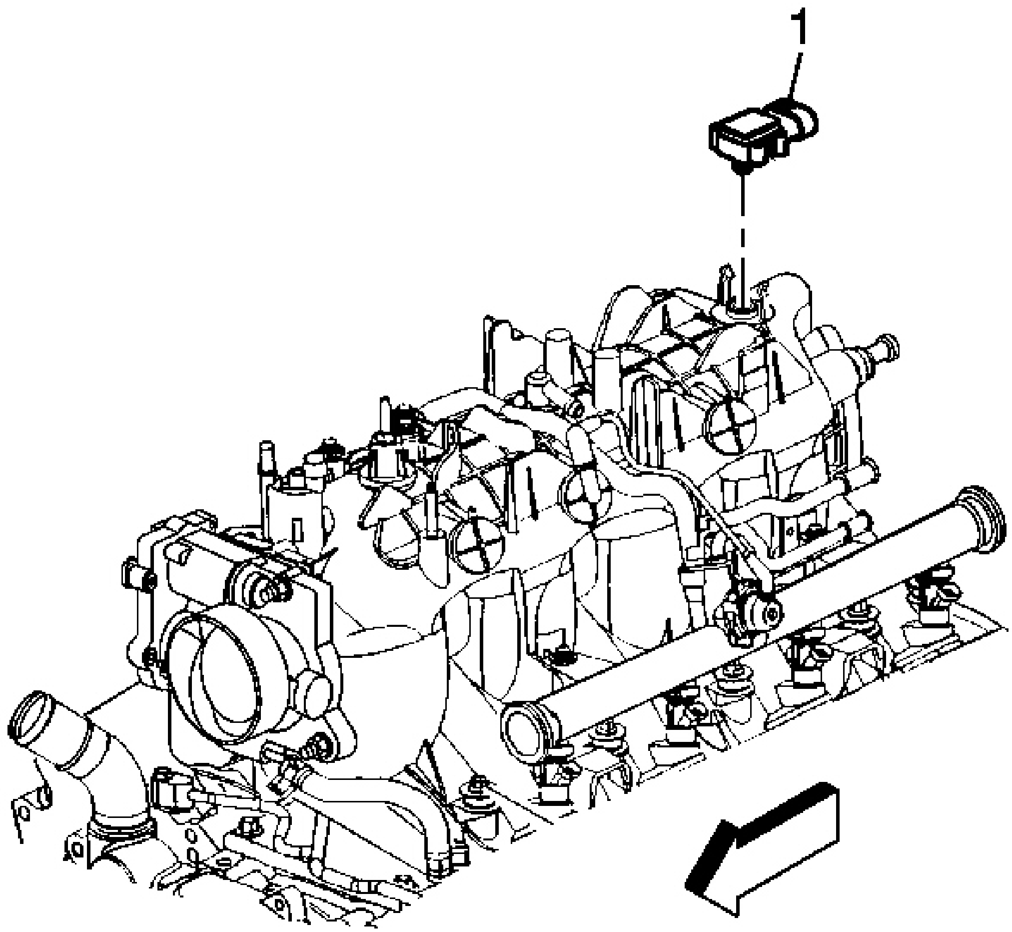


Fig. 44: MAP Sensor & Intake Manifold
Courtesy of GENERAL MOTORS CORP.

1. Install the MAP sensor (1). Push the MAP sensor down in order to engage the sensor into the retainer.

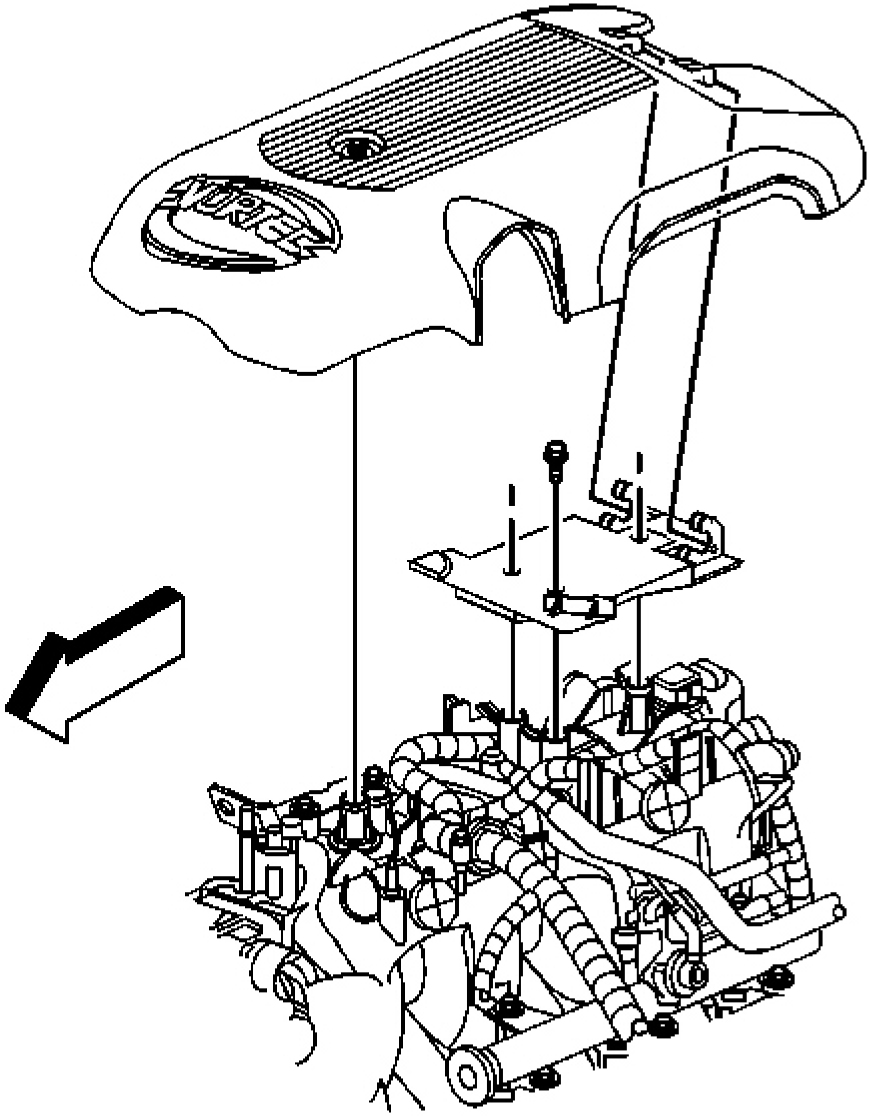


Fig. 45: View Of Top Engine Cover
Courtesy of GENERAL MOTORS CORP.

2. Connect the MAP sensor electrical connector.
3. Position the engine harness and sight shield bracket to the intake manifold.

NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Install the engine sight shield bracket bolts.

   Tighten: Tighten the bracket bolts to 10 N.m (89 lb in).

5. Install the engine sight shield. Refer to **Engine Sight Shield Replacement (6.0L (LQ4))** in Engine Mechanical.

HEATED OXYGEN SENSOR (HO2S) REPLACEMENT BANK 1 SENSOR 1

Tools Required

J 39194-B Oxygen Sensor Wrench. See **Special Tools and Equipment** .

Removal Procedure

CAUTION: Refer to Vehicle Lifting Caution in Cautions and Notices.

1. Raise the vehicle.

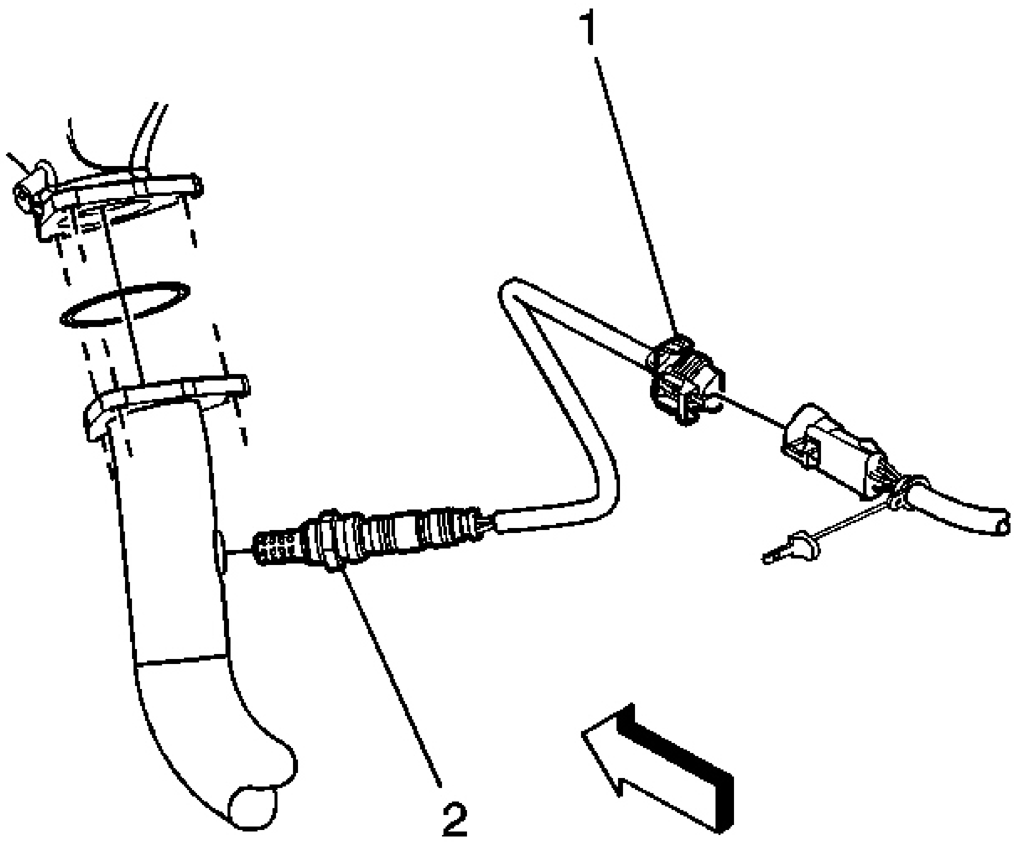


Fig. 46: O2 Sensor & Related Components
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.**

2. Disconnect the connector (1) for the HO2S.

NOTE: **Refer to Excessive Force and Oxygen Sensor Notice in Cautions and Notices.**

3. Remove the HO2S (2) using a **J 39194-B** . See **Special Tools and Equipment** .

Installation Procedure

IMPORTANT: **A special anti-seize compound is used on the heated oxygen sensor**

(HO2S) threads. The compound consists of liquid graphite and glass beads. The graphite tends to burn away, but the glass beads remain, making the sensor easier to remove. New, or service replacement sensors already have the compound applied to the threads. If the sensor is removed from an engine and if for any reason the sensor is to be reinstalled, the threads must have anti-seize compound applied before the reinstallation.

1. Coat the threads of the oxygen sensor with anti-seize compound GM P/N 5613695, if necessary.

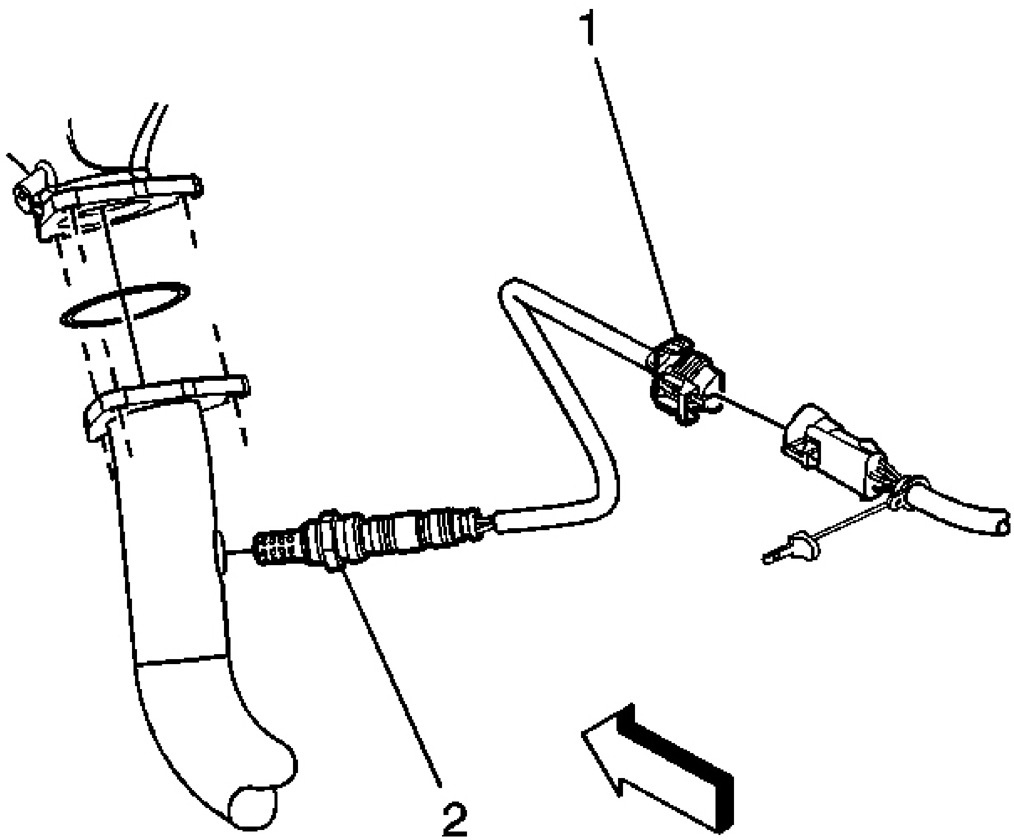


Fig. 47: O2 Sensor & Related Components
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Component Fastener Tightening Notice in Cautions and Notices.**

2. Install the HO2S (2) using a **J 39194-B** . See **Special Tools and Equipment** .

Tighten: Tighten the sensor to 42 N.m (31 lb ft).

3. Connect the HO2S harness connector (1).
4. Lower the vehicle.

HEATED OXYGEN SENSOR (HO2S) REPLACEMENT BANK 1 SENSOR 2

Tools Required

J 39194-B Oxygen Sensor Wrench. See **Special Tools and Equipment** .

Removal Procedure

CAUTION: Refer to Vehicle Lifting Caution in Cautions and Notices.

1. Raise the vehicle.

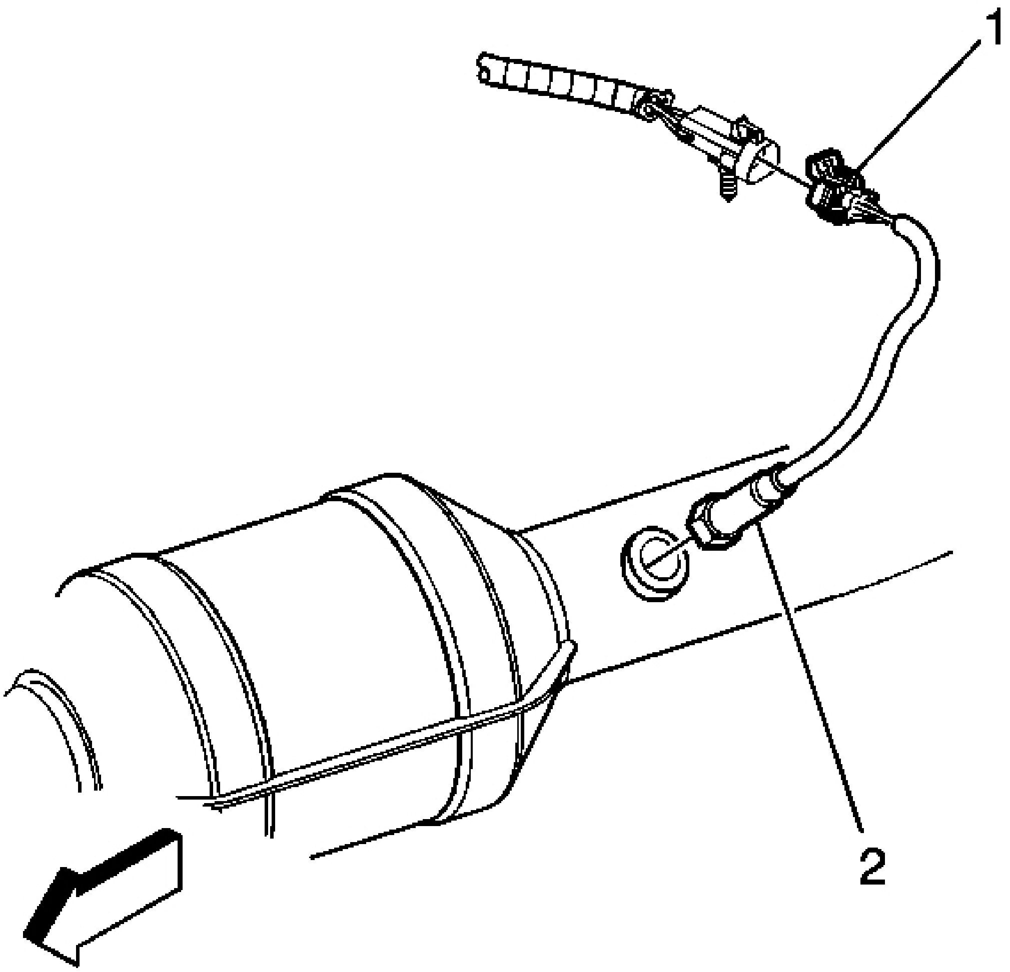


Fig. 48: Locating O2 Sensor
Courtesy of GENERAL MOTORS CORP.

NOTE:	**Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.**

2. Disconnect the connector (1) for the HO2S.

NOTE:	**Refer to Excessive Force and Oxygen Sensor Notice in Cautions and Notices.**

3. Remove the HO2S (2) using a **J 39194-B** . See **Special Tools and Equipment** .

Installation Procedure

IMPORTANT: A special anti-seize compound is used on the heated oxygen sensor (HO2S) threads. The compound consists of liquid graphite and glass beads. The graphite tends to burn away, but the glass beads remain, making the sensor easier to remove. New, or service replacement sensors already have the compound applied to the threads. If the sensor is removed from an engine and if for any reason the sensor is to be reinstalled, the threads must have anti-seize compound applied before the reinstallation.

1. Coat the threads of the oxygen sensor with anti-seize compound GM P/N 5613695, if necessary.

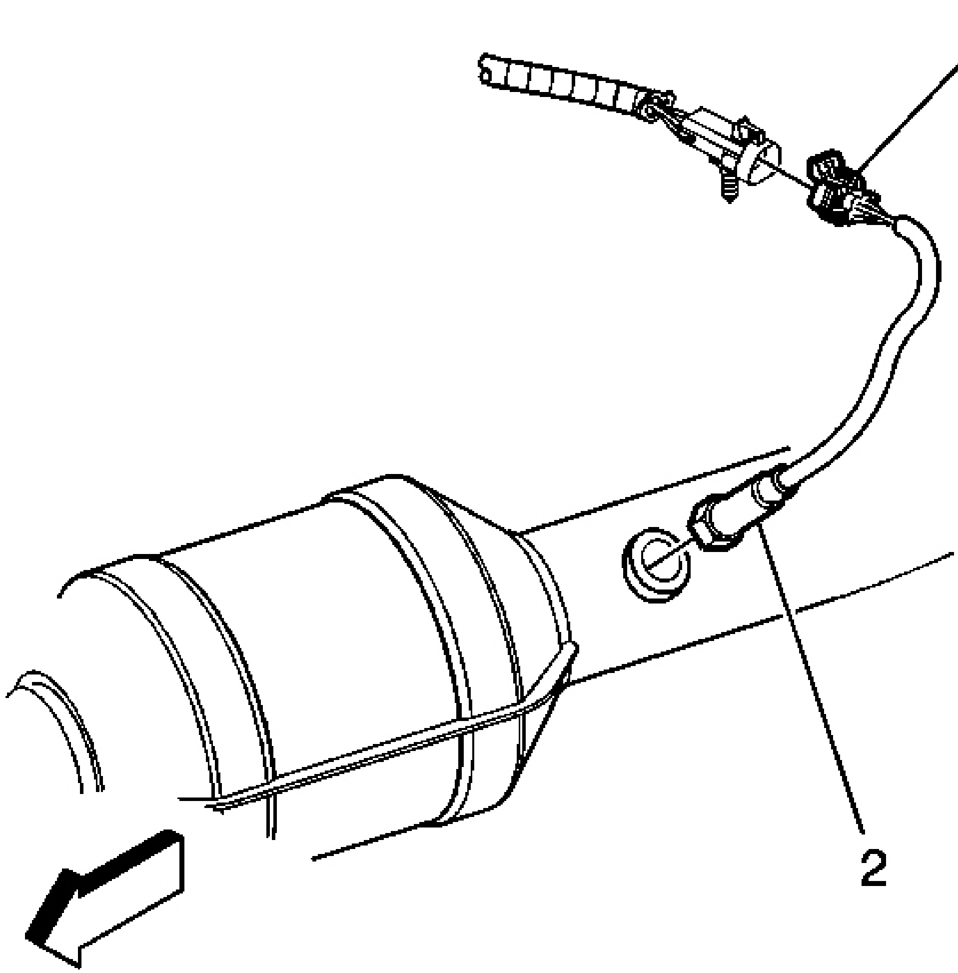


Fig. 49: Locating O2 Sensor
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Component Fastener Tightening Notice in Cautions and Notices.

2. Install the HO2S (2) using a **J 39194-B** . See **Special Tools and Equipment** .

   Tighten: Tighten the sensor to 42 N.m (31 lb ft).

3. Connect the HO2S harness connector (1).
4. Lower the vehicle.

HEATED OXYGEN SENSOR (HO2S) REPLACEMENT BANK 2 SENSOR 1

Tools Required

J 39194-B Oxygen Sensor Wrench. See **Special Tools and Equipment** .

Removal Procedure

CAUTION: Refer to Vehicle Lifting Caution in Cautions and Notices.

1. Raise the vehicle.

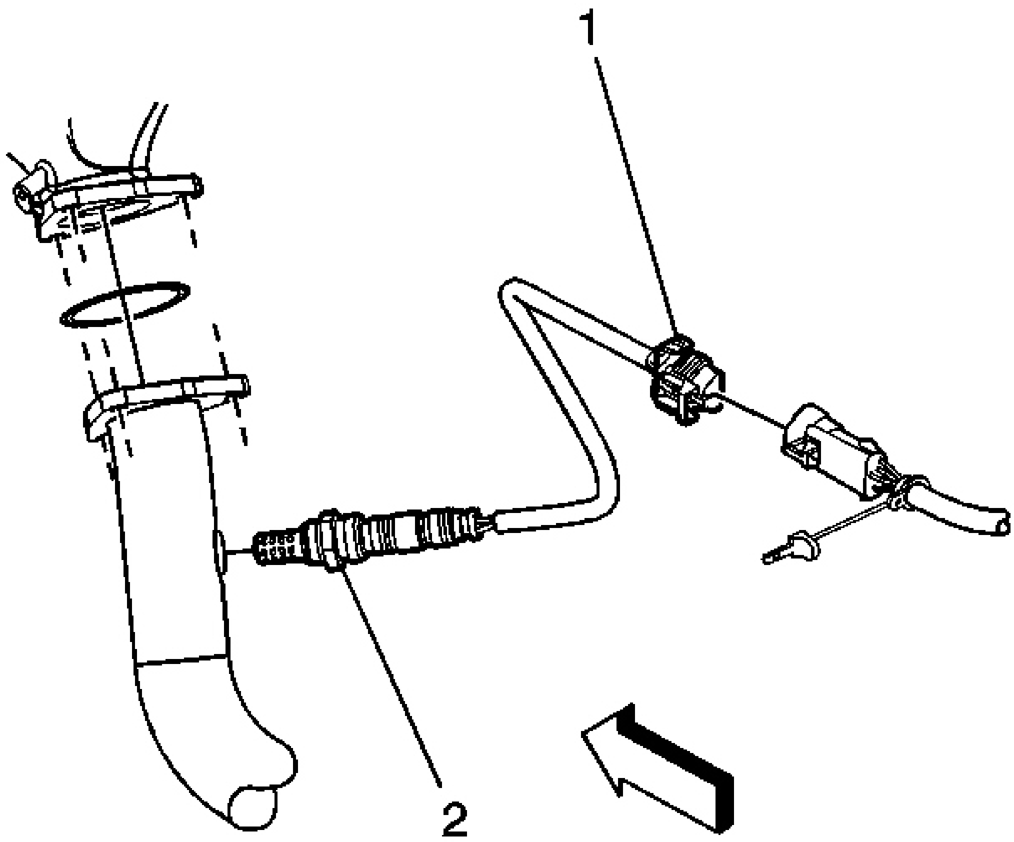


Fig. 50: O2 Sensor & Related Components
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.

2. Disconnect the connector (1) for the HO2S.

NOTE: Refer to Excessive Force and Oxygen Sensor Notice in Cautions and Notices.

3. Remove the HO2S (2) using a **J 39194-B** . See **Special Tools and Equipment** .

Installation Procedure

IMPORTANT: A special anti-seize compound is used on the heated oxygen sensor

(HO2S) threads. The compound consists of liquid graphite and glass beads. The graphite tends to burn away, but the glass beads remain, making the sensor easier to remove. New, or service replacement sensors already have the compound applied to the threads. If the sensor is removed from an engine and if for any reason the sensor is to be reinstalled, the threads must have anti-seize compound applied before the reinstallation.

1. Coat the threads of the oxygen sensor with anti-seize compound GM P/N 5613695, if necessary.

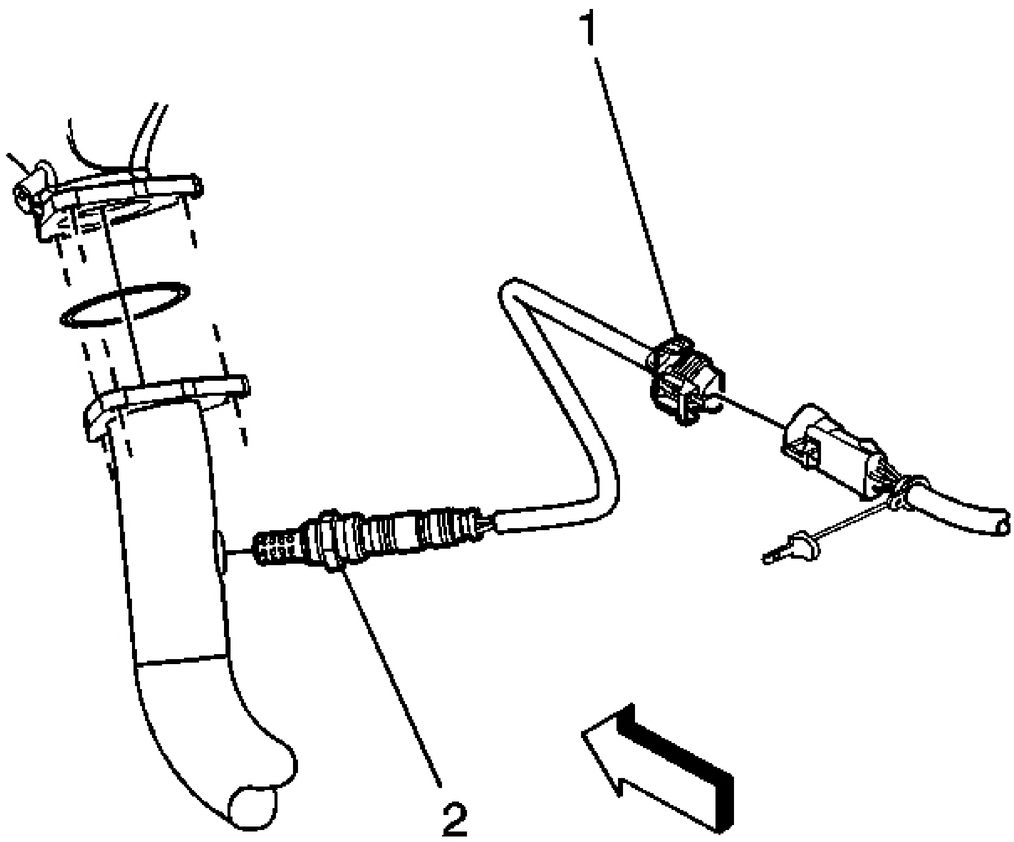


Fig. 51: O2 Sensor & Related Components
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Component Fastener Tightening Notice in Cautions and Notices.

2. Install the HO2S (2) using a **J 39194-B** . See **Special Tools and Equipment** .

Tighten: Tighten the sensor to 42 N.m (31 lb ft).

3. Connect the HO2S harness connector (1).
4. Lower the vehicle.

HEATED OXYGEN SENSOR (HO2S) REPLACEMENT BANK 2 SENSOR 2

Tools Required

J 39194-B Oxygen Sensor Wrench. See **Special Tools and Equipment** .

Removal Procedure

CAUTION: Refer to Vehicle Lifting Caution in Cautions and Notices.

1. Raise the vehicle.

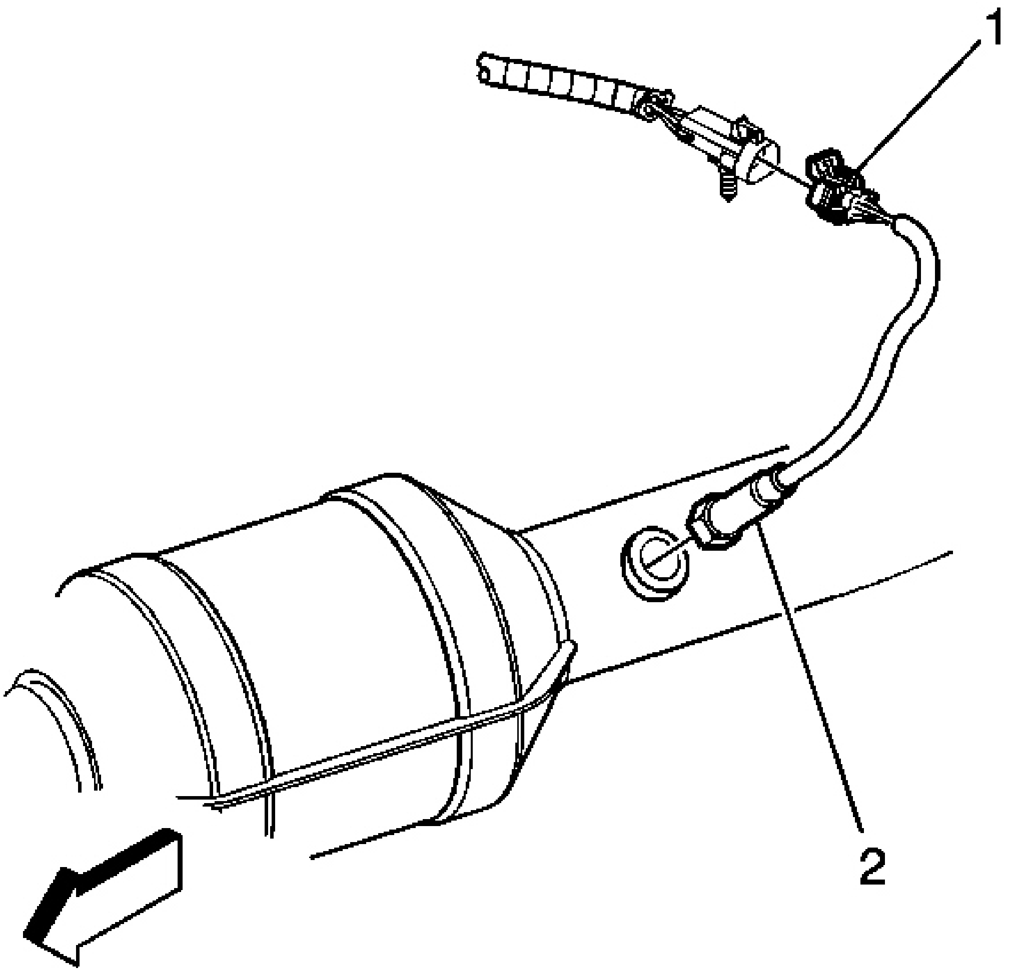


Fig. 52: Locating O2 Sensor
Courtesy of GENERAL MOTORS CORP.

NOTE: **Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.**

2. Disconnect the connector (1) for the HO2S.

NOTE: **Refer to Excessive Force and Oxygen Sensor Notice in Cautions and Notices.**

3. Remove the HO2S (2) using a **J 39194-B** . See **Special Tools and Equipment** .

Installation Procedure

IMPORTANT: A special anti-seize compound is used on the heated oxygen sensor (HO2S) threads. The compound consists of liquid graphite and glass beads. The graphite tends to burn away, but the glass beads remain, making the sensor easier to remove. New, or service replacement sensors already have the compound applied to the threads. If the sensor is removed from an engine and if for any reason the sensor is to be reinstalled, the threads must have anti-seize compound applied before the reinstallation.

1. Coat the threads of the oxygen sensor with anti-seize compound GM P/N 5613695, if necessary.

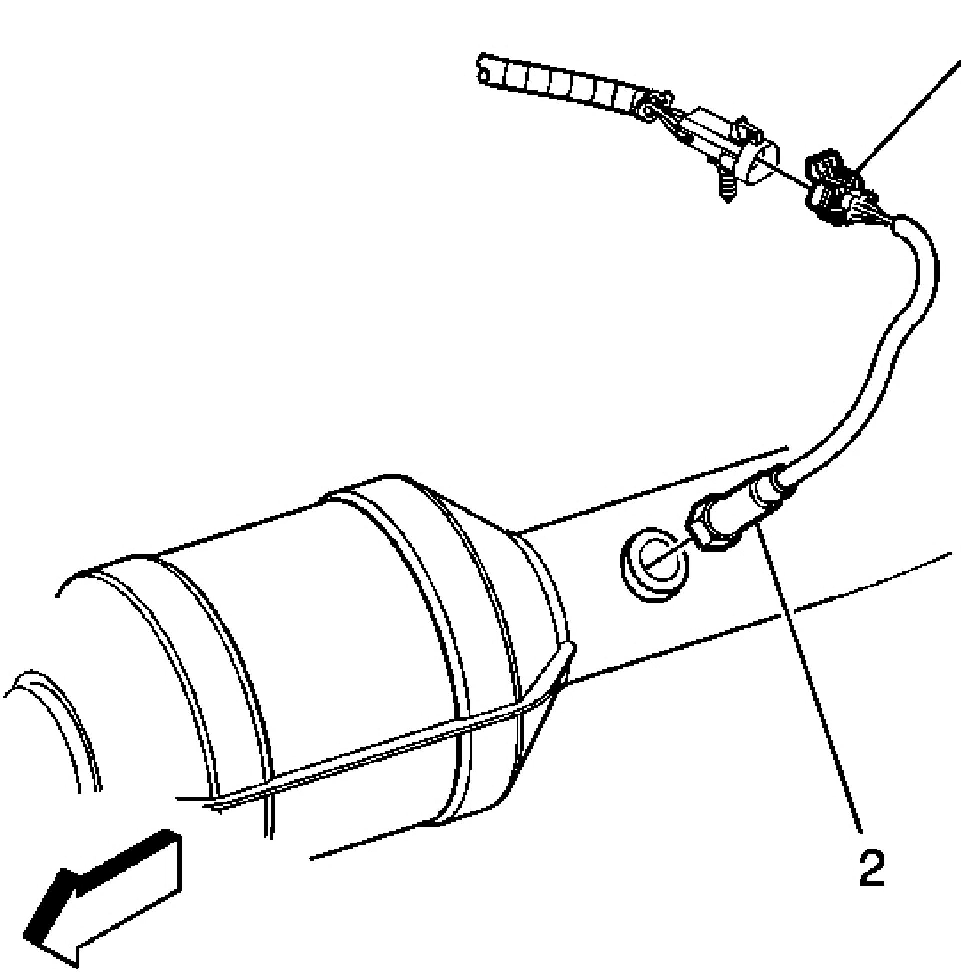


Fig. 53: Locating O2 Sensor
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Component Fastener Tightening Notice in Cautions and Notices.

2. Install the HO2S (2) using a **J 39194-B** . See **Special Tools and Equipment** .

   Tighten: Tighten the sensor to 42 N.m (31 lb ft).

3. Connect the HO2S harness connector (1).
4. Lower the vehicle.

ACCELERATOR PEDAL POSITION (APP) SENSOR REPLACEMENT

Removal Procedure

NOTE: Handle the electronic throttle control components carefully. Use cleanliness in order to prevent damage. Do not drop the electronic throttle control components. Do not roughly handle the electronic throttle control components. Do not immerse the electronic throttle control components in cleaning solvents of any type.

1. Remove the left instrument panel (I/P) lower closeout insulator panel.
2. Disconnect the accelerator pedal position (APP) sensor harness connector.

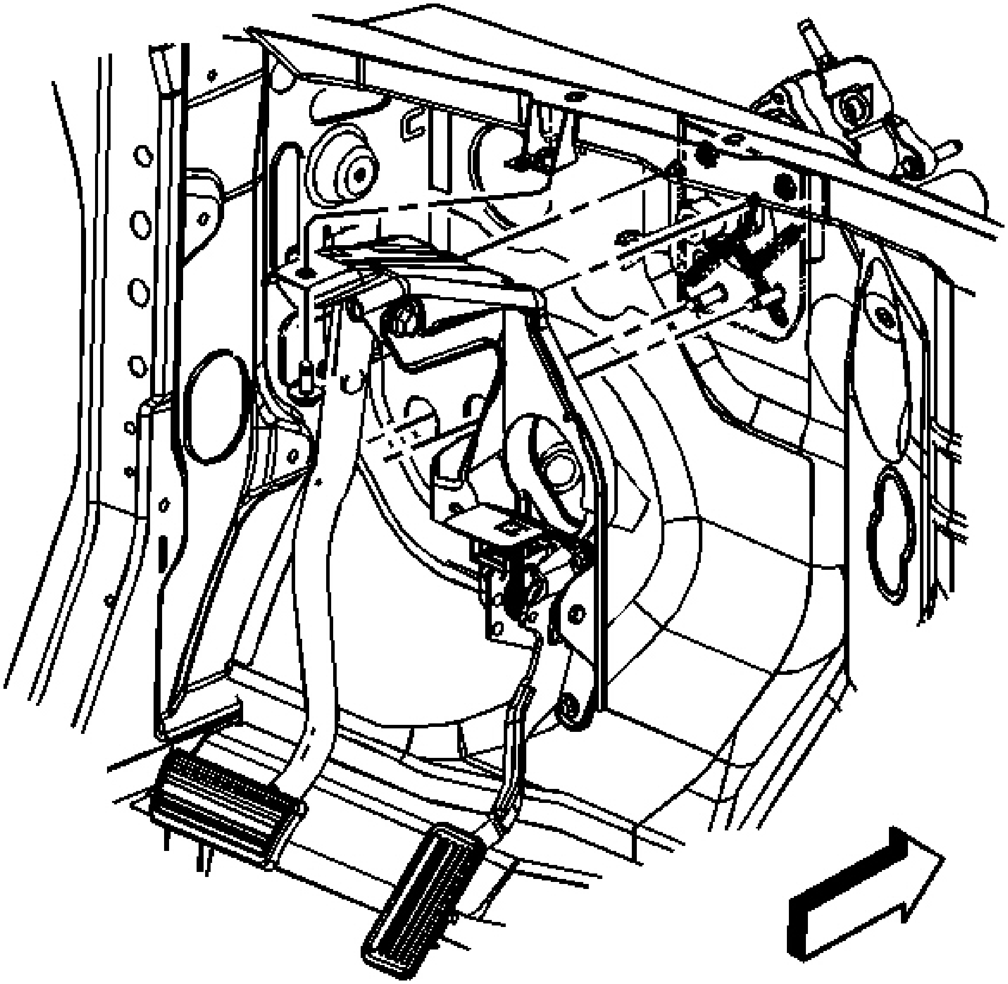


Fig. 54: APP Assembly
Courtesy of GENERAL MOTORS CORP.

Remove the accelerator pedal mounting bolts.

3. Remove the APP assembly.

Installation Procedure

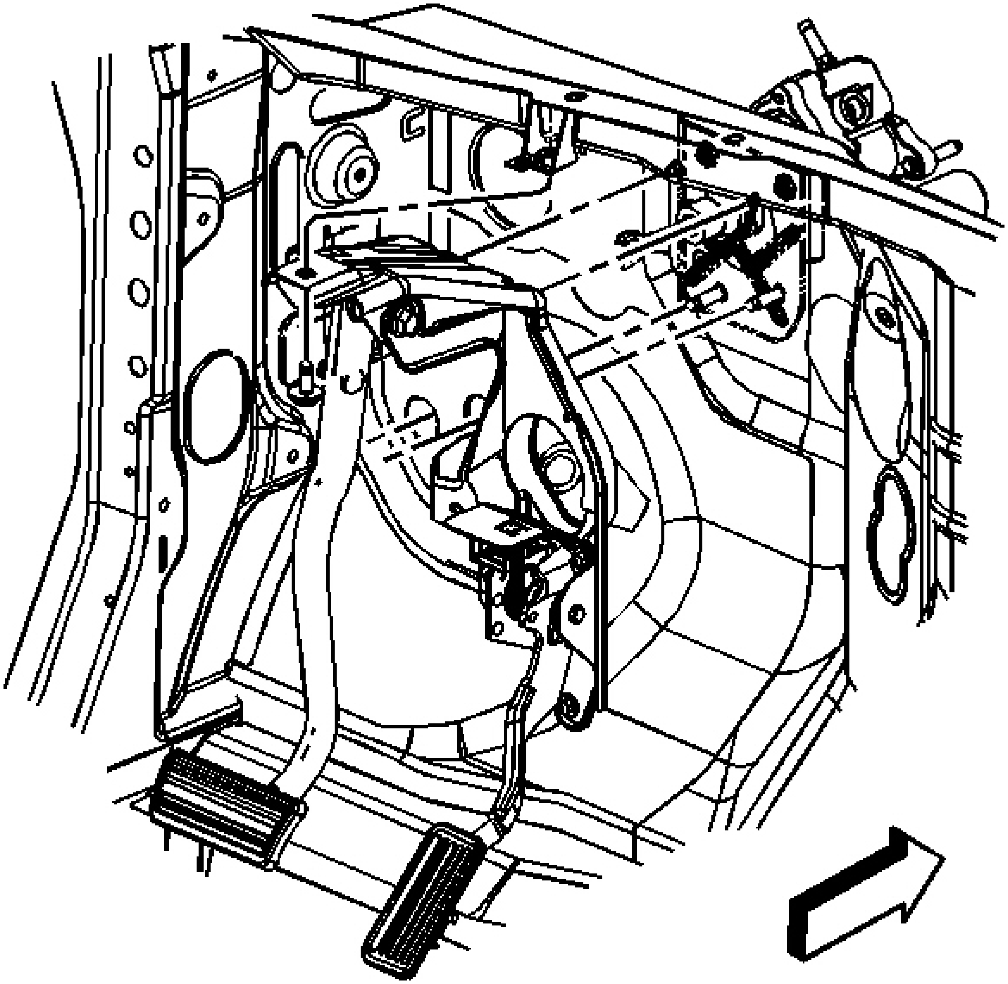


Fig. 55: APP Assembly
Courtesy of GENERAL MOTORS CORP.

1. Install the APP assembly to the steering column support bracket.

NOTE: **Refer to the Fastener Notice in Cautions and Notices.**

IMPORTANT: **Always use a torque wrench in order to obtain the proper torque.**

2. Install the accelerator pedal mounting bolts.

Tighten: Tighten the accelerator pedal mounting bolts to 20 N.m (15 lb ft).

3. Connect the APP sensor harness connector.
4. Verify that the vehicle meets the following conditions:
   - The vehicle is not in a Reduced Engine Power mode.
   - The ignition is ON.
   - The engine is OFF.
5. Connect a scan tool in order to test for a proper throttle-opening and throttle-closing range.
6. Operate the accelerator pedal and monitor the throttle angles. The accelerator pedal should operate freely, without binding, between a closed throttle, and a wide open throttle (WOT).
7. Inspect the carpet fit under the accelerator pedal.
8. Install the left I/P lower closeout insulator panel.

THROTTLE BODY ASSEMBLY REPLACEMENT

Removal Procedure

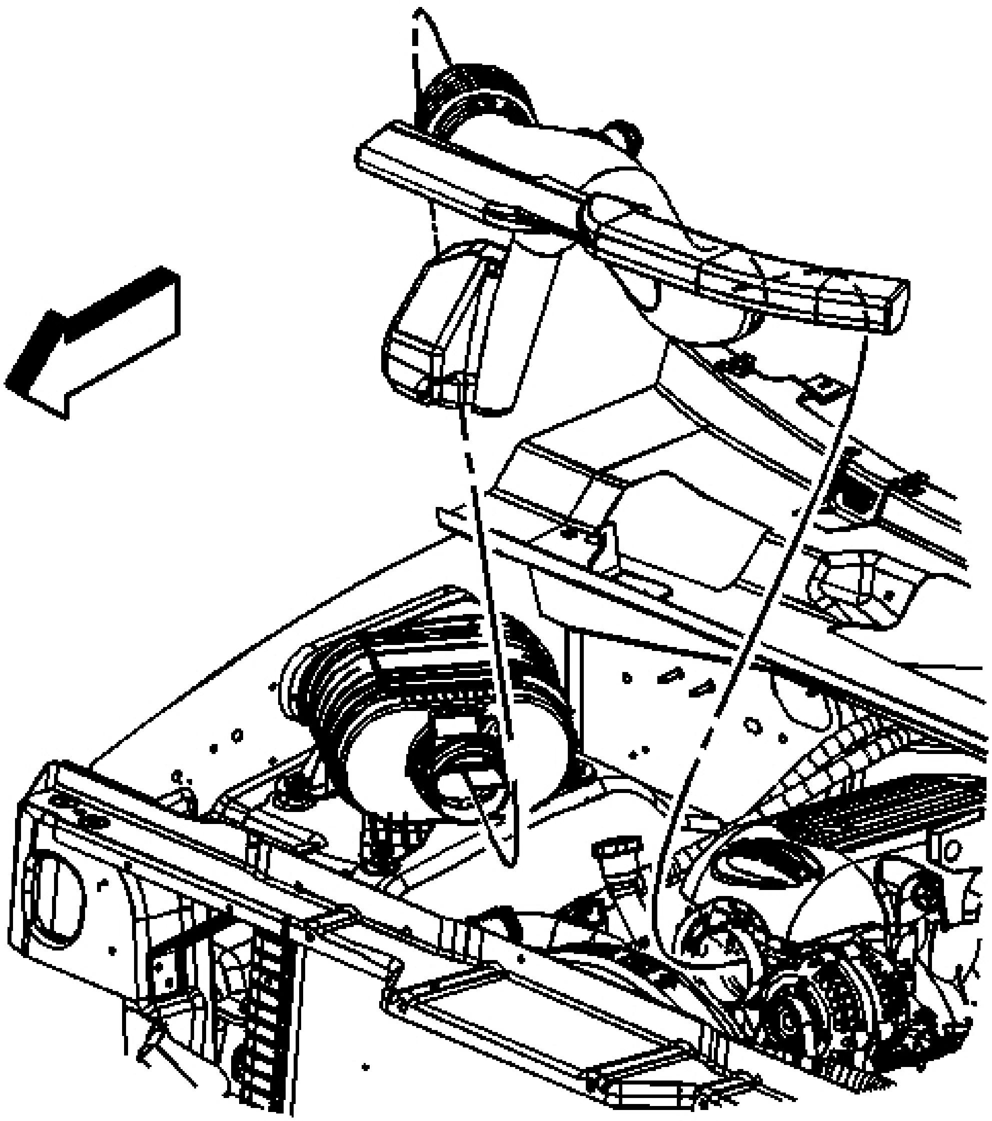


Fig. 56: MAF/IAT Sensor & Air Cleaner Assembly
Courtesy of GENERAL MOTORS CORP.

NOTE: **Handle the electronic throttle control components carefully. Use cleanliness in order to prevent damage. Do not drop the electronic throttle control components. Do not roughly handle the electronic throttle control components. Do not immerse the electronic throttle control components in**

cleaning solvents of any type.

IMPORTANT: An eight digit part identification number is stamped on the throttle body casting. Refer to this number if servicing, or part replacement is required.

1. Partially drain the cooling system in order to allow the hoses at the throttle body to be removed. Refer to **Draining and Filling Cooling System** in Engine Cooling.

IMPORTANT: Cover or plug any openings when servicing the throttle body in order to prevent possible contamination.

2. Remove the air intake duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** .

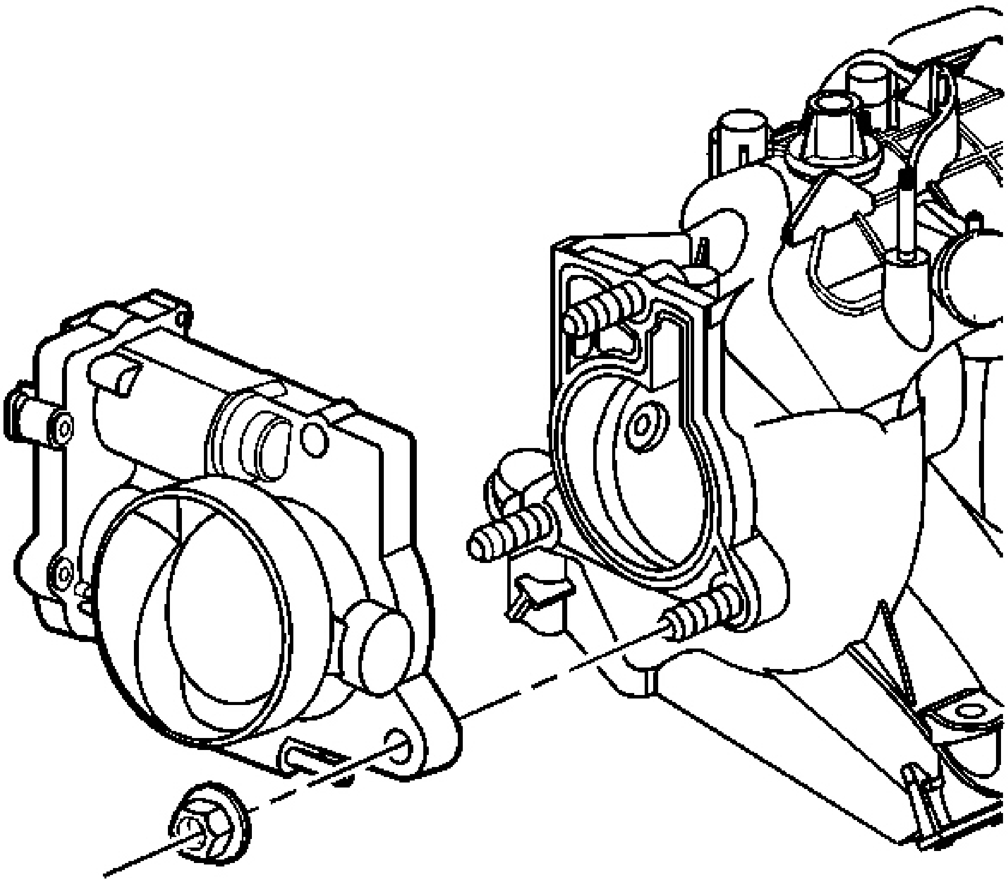


Fig. 57: View Of Throttle Body

Courtesy of GENERAL MOTORS CORP.

3. Disconnect the throttle actuator motor harness connector.
4. Disconnect the coolant hoses from the throttle body.
5. Remove the throttle body attaching bolts.
6. Remove the throttle body and the gasket.

IMPORTANT: Do not reuse the throttle body gasket. Install a new gasket during assembly.

7. Discard the throttle body gasket.
8. Inspect the crankcase ventilation hose and the tube. Replace any damaged components.

Installation Procedure

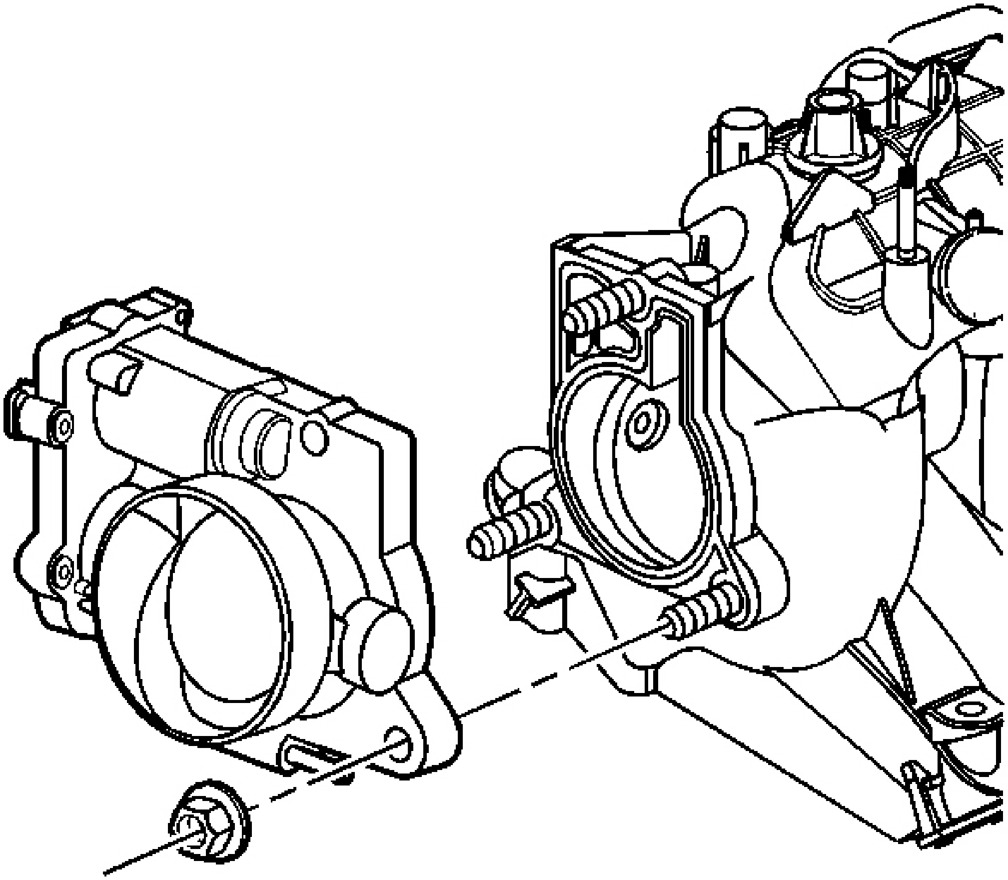


Fig. 58: View Of Throttle Body
Courtesy of GENERAL MOTORS CORP.

1. Install a new throttle body gasket.
2. Install the throttle body assembly.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

IMPORTANT: **Always use a torque wrench in order to obtain the proper torque.**

3. Install the throttle body attaching bolts.

Tighten: Tighten the throttle body bolts to 10 N.m (89 lb in).

4. Connect the coolant hoses to the throttle body.

IMPORTANT: Verify that the TAC harness connector and the connector seal are properly installed and not damaged.

5. Connect the TAC harness connector.

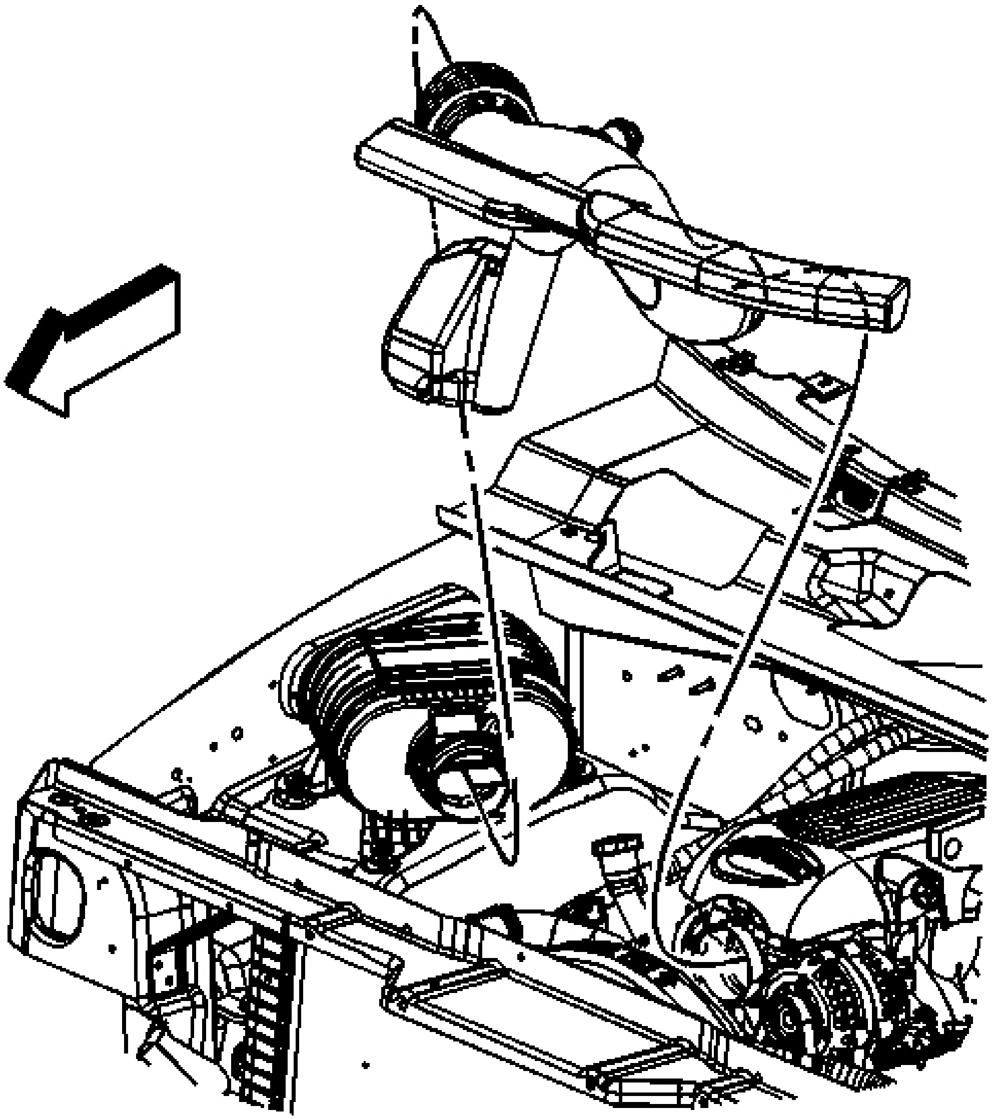


Fig. 59: MAF/IAT Sensor & Air Cleaner Assembly
Courtesy of GENERAL MOTORS CORP.

6. Install the air intake duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** .
7. Connect the intake air temperature sensor harness connector.
8. Refill the cooling system. Refer to **Draining and Filling Cooling System** in Engine Cooling.
9. Verify that the vehicle meets the following conditions:
   - The vehicle is not in a Reduced Engine Power mode.
   - The ignition is ON.
   - The engine is OFF.
10. Connect a scan tool in order to test for a proper throttle-opening and throttle-closing range.
11. Operate the accelerator pedal and monitor the throttle angles. The accelerator pedal should operate freely, without binding, between a closed throttle, and a wide open throttle (WOT).
12. Start the engine.
13. Inspect for coolant leaks.

FUEL PRESSURE RELIEF PROCEDURE

Tools Required

J 34730-1A Fuel Pressure Gauge. See **Special Tools and Equipment** .

CAUTION: Relieve the fuel system pressure before servicing fuel system components in order to reduce the risk of fire and personal injury.
After relieving the system pressure, a small amount of fuel may be released when servicing the fuel lines or connections. In order to reduce the chance of personal injury, cover the regulator and the fuel line fittings with a shop towel before disconnecting. This will catch any fuel that may leak out. Place the towel in an approved container when the disconnection is complete.

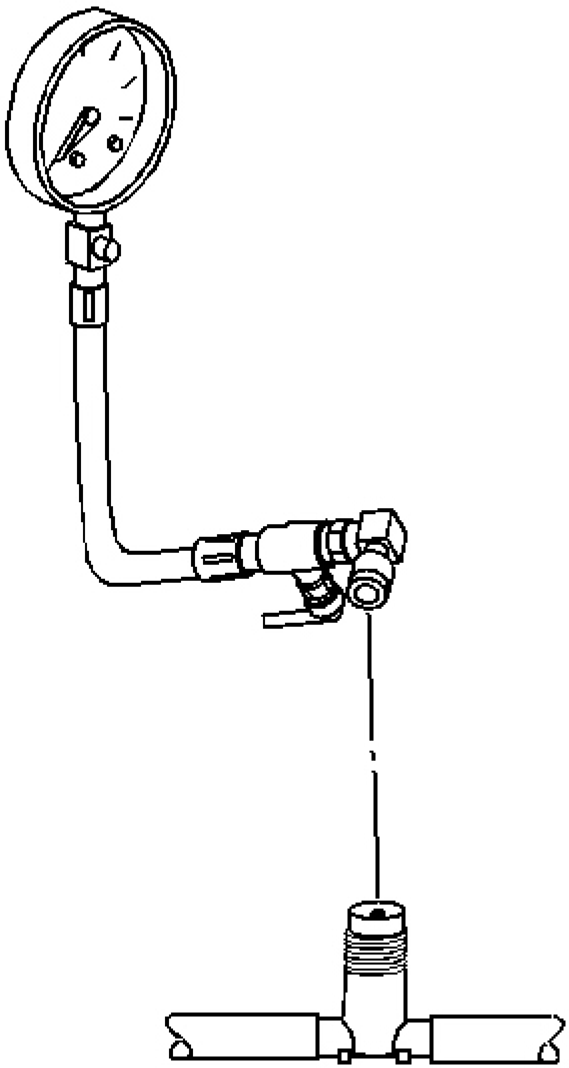


Fig. 60: Identifying Fuel Pressure Gauge J 34730-1A
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable in order to avoid possible fuel discharge if an accidental attempt is made to start the engine. Refer to **Battery Negative Cable Disconnect/Connect Procedure (Single Battery)** in Engine Electrical.
2. Remove the engine sight shield. Refer to **Engine Sight Shield Replacement (6.0L (LQ4))** in Engine Mechanical.
3. Loosen the fuel filler cap in order to relieve the fuel tank vapor pressure.

4. Connect the **J 34730-1A** to the fuel pressure valve. Wrap a shop towel around the fitting while connecting the gauge in order to avoid spillage. See **Special Tools and Equipment** .
5. Install the bleed hose of the gauge into an approved container.
6. Open the valve on the gauge to bleed the system pressure. The fuel connections are now safe for servicing.
7. Drain any fuel remaining in the gauge into an approved container.

FUEL PRESSURE GAUGE INSTALLATION AND REMOVAL

Installation Procedure

CAUTION: Refer to Gasoline/Gasoline Vapors Caution in Cautions and Notices.

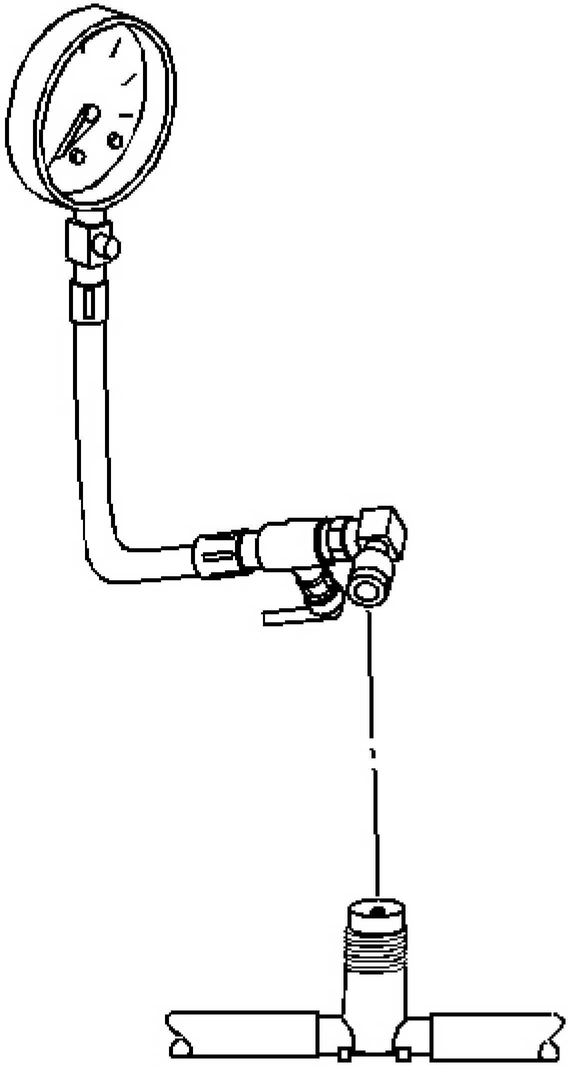


Fig. 61: Identifying Fuel Pressure Gauge J 34730-1A
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fuel Gauge Leak Caution in Cautions and Notices.

NOTE: Clean all of the following areas before performing any disconnections in order to avoid possible contamination in the system:

- **The fuel pipe connections**
- **The hose connections**
- **The areas surrounding the connections**

1. Install the fuel pressure gauge to the fuel pressure service connection, located on the fuel rail.
2. Turn ON the ignition.

CAUTION: Refer to Fuel Storage Caution in Cautions and Notices.

3. Place the bleed hose of the fuel pressure gauge into an approved gasoline container.
4. Open the bleed valve on the fuel pressure gauge in order to bleed the air from the fuel pressure gauge.
5. Command the fuel pump ON with a scan tool.
6. Close the bleed valve on the fuel pressure gauge.
7. Inspect for fuel leaks.

QUICK CONNECT FITTING(S) SERVICE (METAL COLLAR)

Tool Required

J 37088-A Tool Set, Fuel Line Quick-Connect Separator. See **Special Tools and Equipment** .

Removal Procedure

1. Relieve the fuel system pressure before servicing any fuel system connection. Refer to the **Fuel Pressure Relief Procedure** .
2. Remove the retainer from the quick-connect fitting.

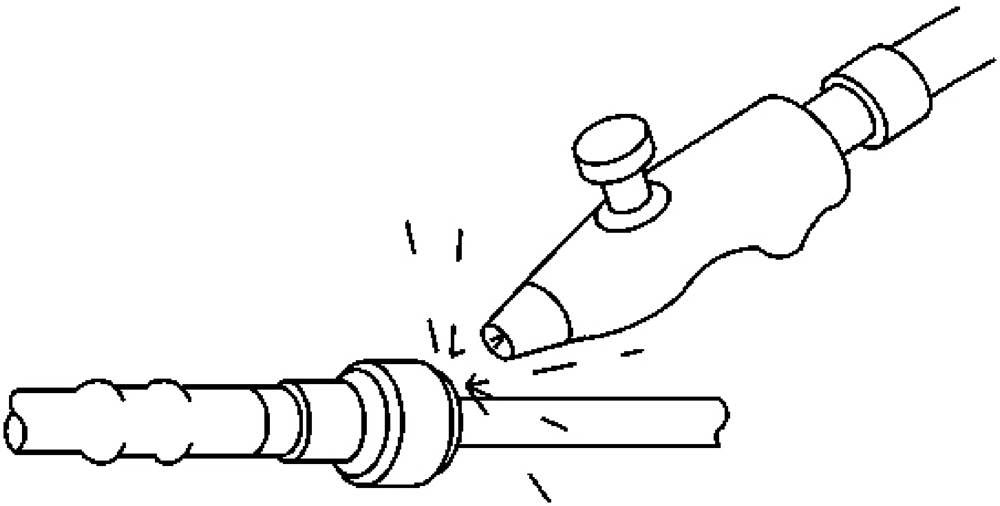


Fig. 62: Blowing Dirt Out Of Fitting (Metal Collar)
Courtesy of GENERAL MOTORS CORP.

CAUTION: Wear safety glasses when using compressed air in order to prevent eye injury.

3. Blow dirt out of the fitting using compressed air.

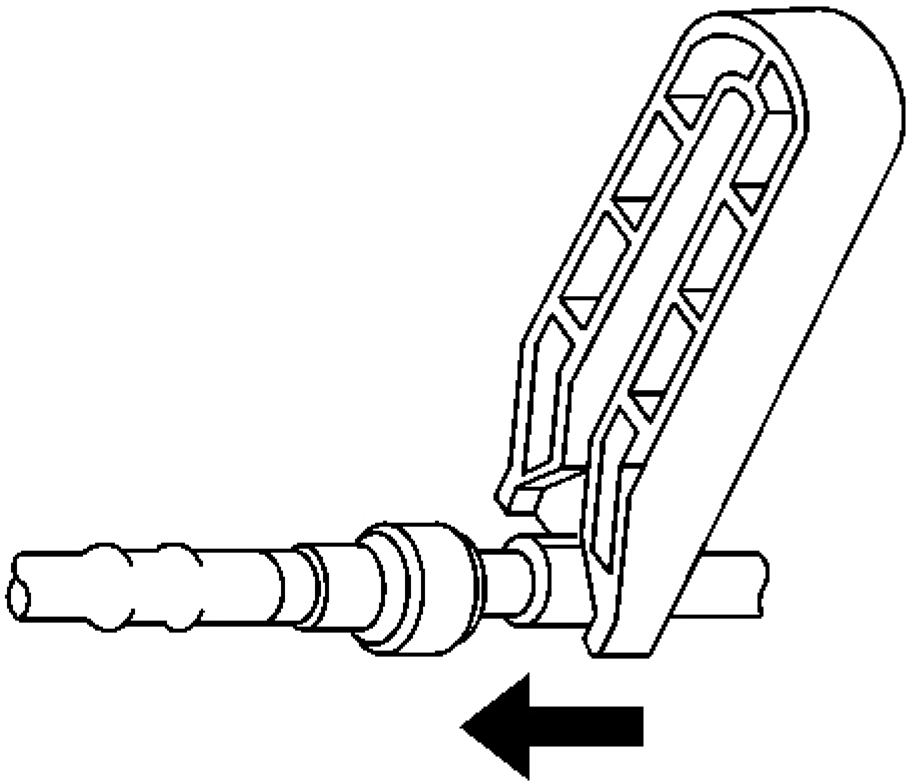


Fig. 63: Releasing Locking Tabs (Metal Collar)
Courtesy of GENERAL MOTORS CORP.

4. Choose the correct tool from the **J 37088-A** tool set for the size of the fitting. Insert the tool into the female connector, then push inward in order to release the locking tabs. See **Special Tools and Equipment** .

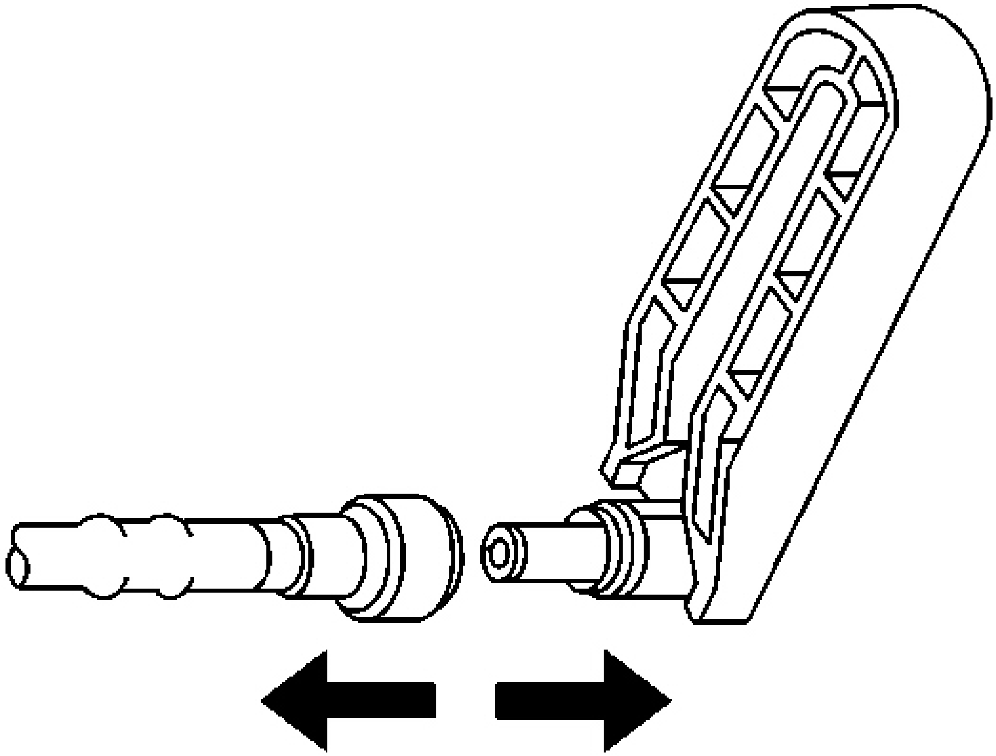


Fig. 64: Pulling Connection Apart (Metal Collar)
Courtesy of GENERAL MOTORS CORP.

5. Pull the connection apart.

NOTE: **If necessary, remove rust or burrs from the fuel pipes with an emery cloth. Use a radial motion with the fuel pipe end in order to prevent damage to the O-ring sealing surface. Use a clean shop towel in order to wipe off the male tube ends. Inspect all the connections for dirt and burrs. Clean or replace the components and assemblies as required.**

6. Use a clean shop towel in order to wipe off the male pipe end.
7. Inspect both ends of the fitting for dirt and burrs. Clean or replace the components as required.

Installation Procedure

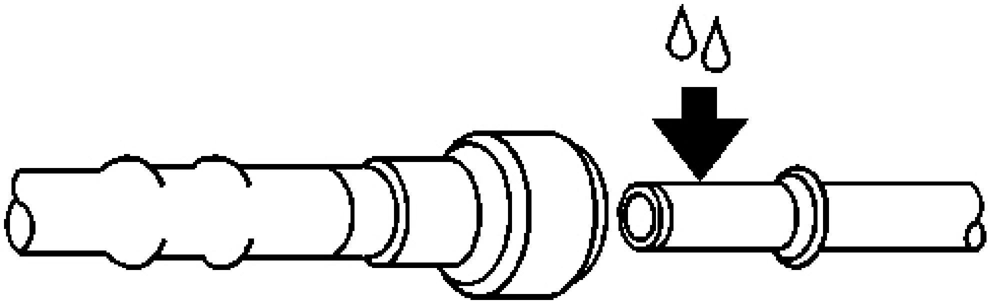


Fig. 65: Oiling Male Pipe Ends (Metal Collar)
Courtesy of GENERAL MOTORS CORP.

> **CAUTION: Always apply a few drops of clean engine oil to the male pipe ends before connecting the fuel pipe fittings in order to reduce the risk of fire and personal injury. This will ensure proper reconnection and prevent a possible fuel leak. During normal operation, the O-rings located in the female connector will swell and may prevent proper reconnection if not lubricated.**

1. Apply a few drops of clean engine oil to the male pipe end.

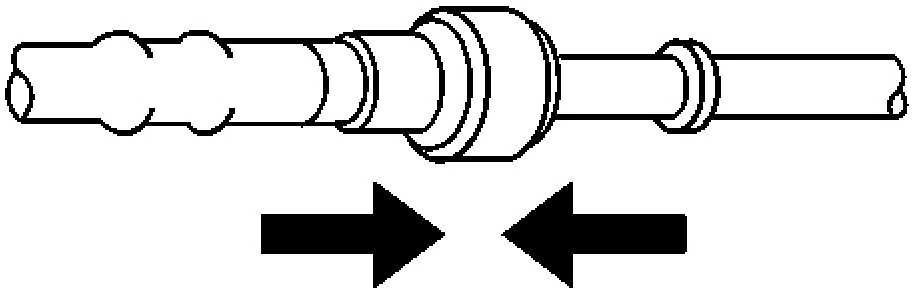


Fig. 66: Connecting Fittings (Metal Collar)
Courtesy of GENERAL MOTORS CORP.

2. Push both sides of the fitting together in order to snap the retaining tabs into place.

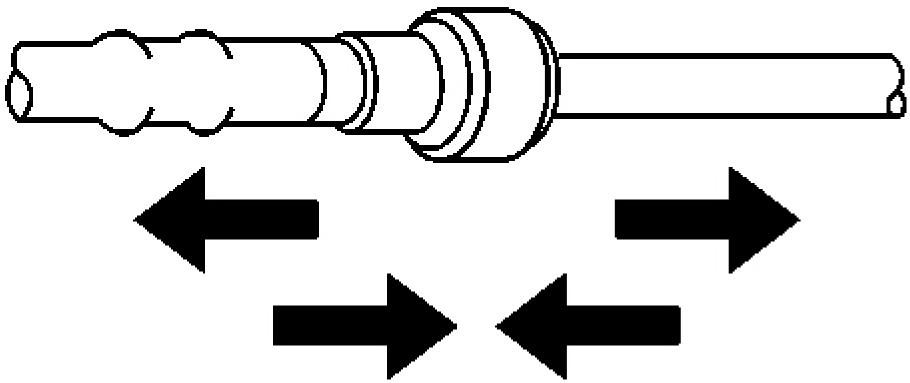


Fig. 67: Ensuring Secure Connection (Metal Collar)
Courtesy of GENERAL MOTORS CORP.

3. Once installed, pull on both sides of the fitting in order to make sure the connection is secure.
4. Install the retainer to the quick-connect fitting.

QUICK CONNECT FITTING(S) SERVICE (PLASTIC COLLAR)

Removal Procedure

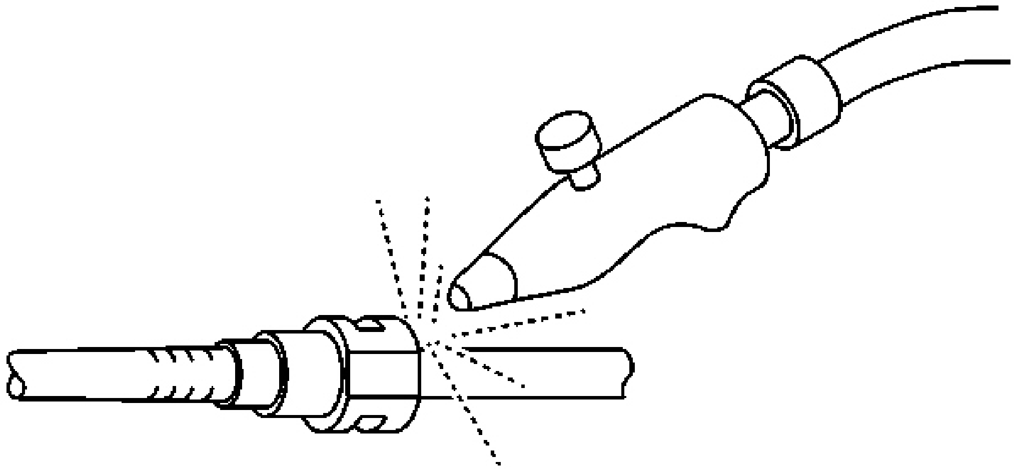


Fig. 68: Blowing Out Dirt (Plastic Collar)
Courtesy of GENERAL MOTORS CORP.

1. Relieve the fuel system pressure before servicing any fuel system connection. Refer to **Fuel Pressure Relief Procedure** .

   CAUTION: Refer to Safety Glasses and Compressed Air Caution in Cautions and Notices.

2. Using compressed air, blow any dirt out of the quick-connect fitting.

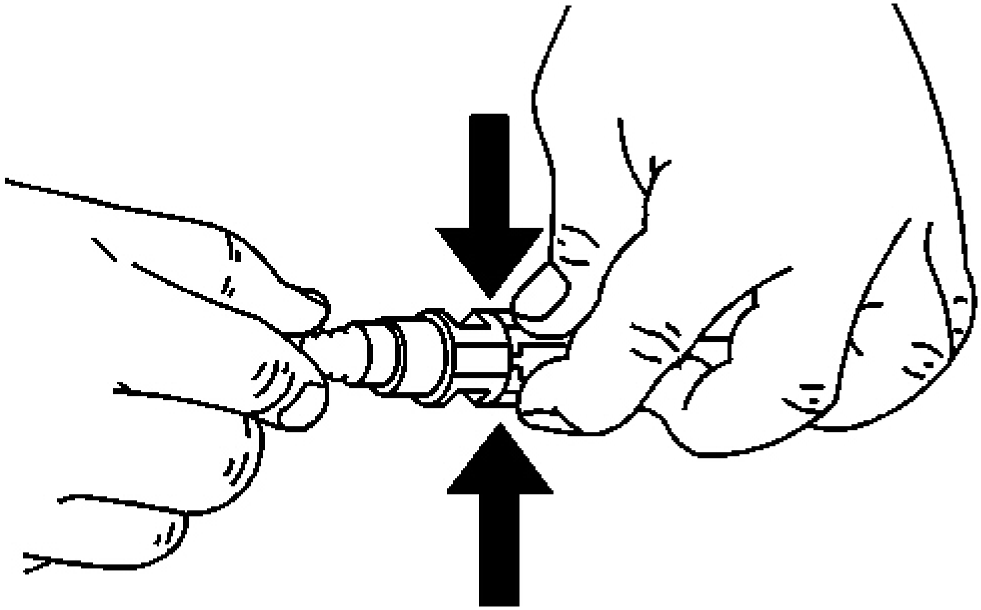


Fig. 69: Squeezing Plastic Tabs Of Male End Connector (Plastic Collar)
Courtesy of GENERAL MOTORS CORP.

3. Squeeze the plastic retainer release tabs.

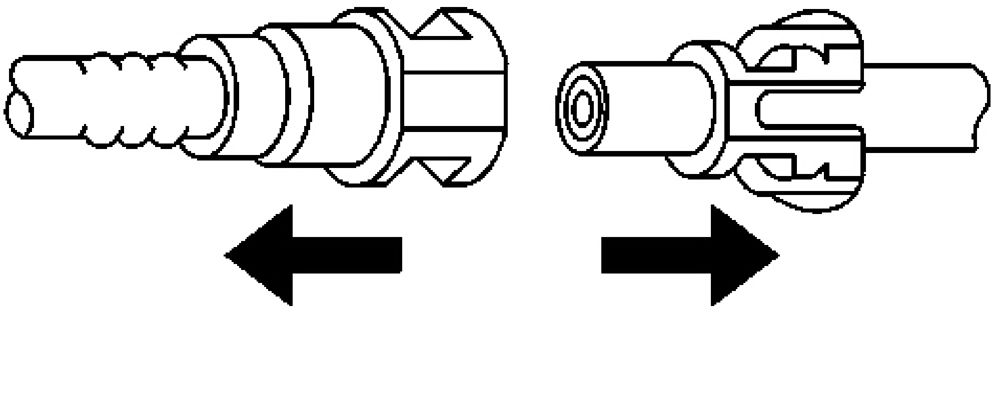


Fig. 70: Pulling Connection Apart (Plastic Collar)
Courtesy of GENERAL MOTORS CORP.

4. Pull the connection apart.

Installation Procedure

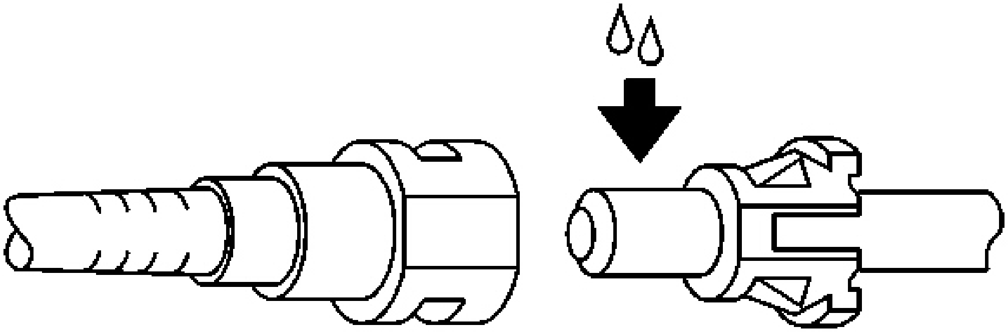


Fig. 71: Oiling Male Pipe End (Plastic Collar)
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Fuel Pipe Fitting Caution in Cautions and Notices.

1. Apply a few drops of clean engine oil to the male fuel pipe end.

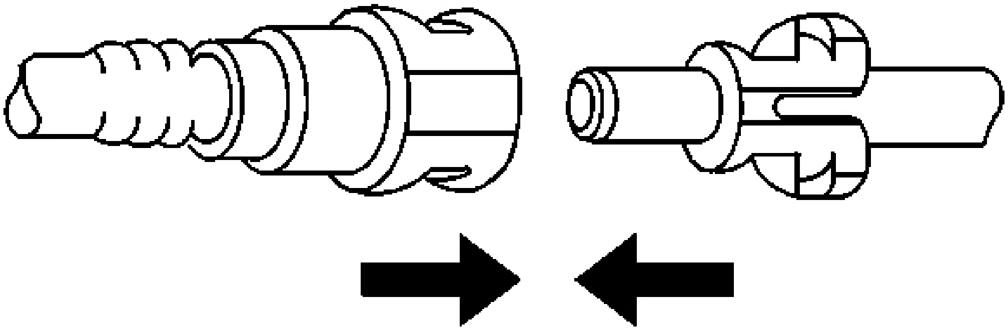


Fig. 72: Connecting Quick-Connect Fittings (Plastic Collar)
Courtesy of GENERAL MOTORS CORP.

2. Push both sides of the quick-connect fitting together in order to cause the retaining tabs to snap into place.

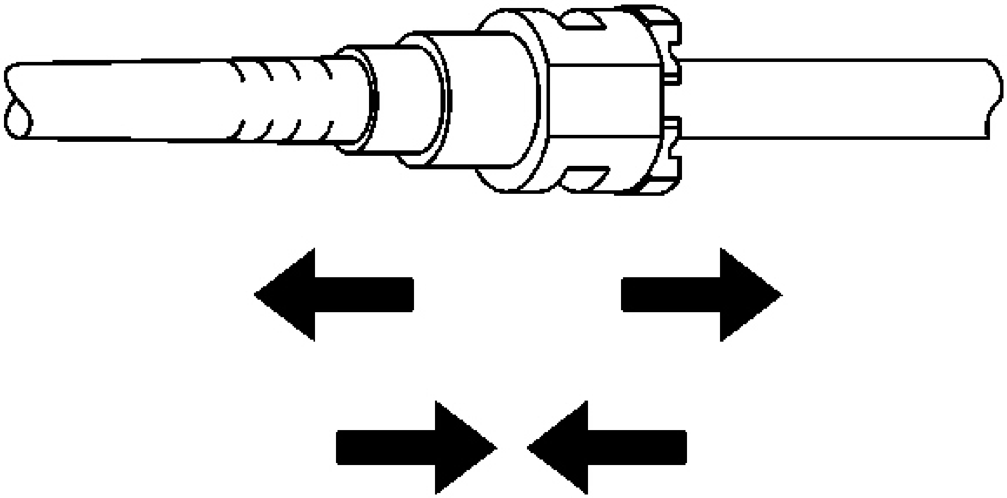


Fig. 73: Ensuring Secure Connection (Plastic Collar)
Courtesy of GENERAL MOTORS CORP.

3. Once installed, pull on both sides of the quick-connect fitting in order to make sure the connection is

secure.

FUEL TANK DRAINING PROCEDURE

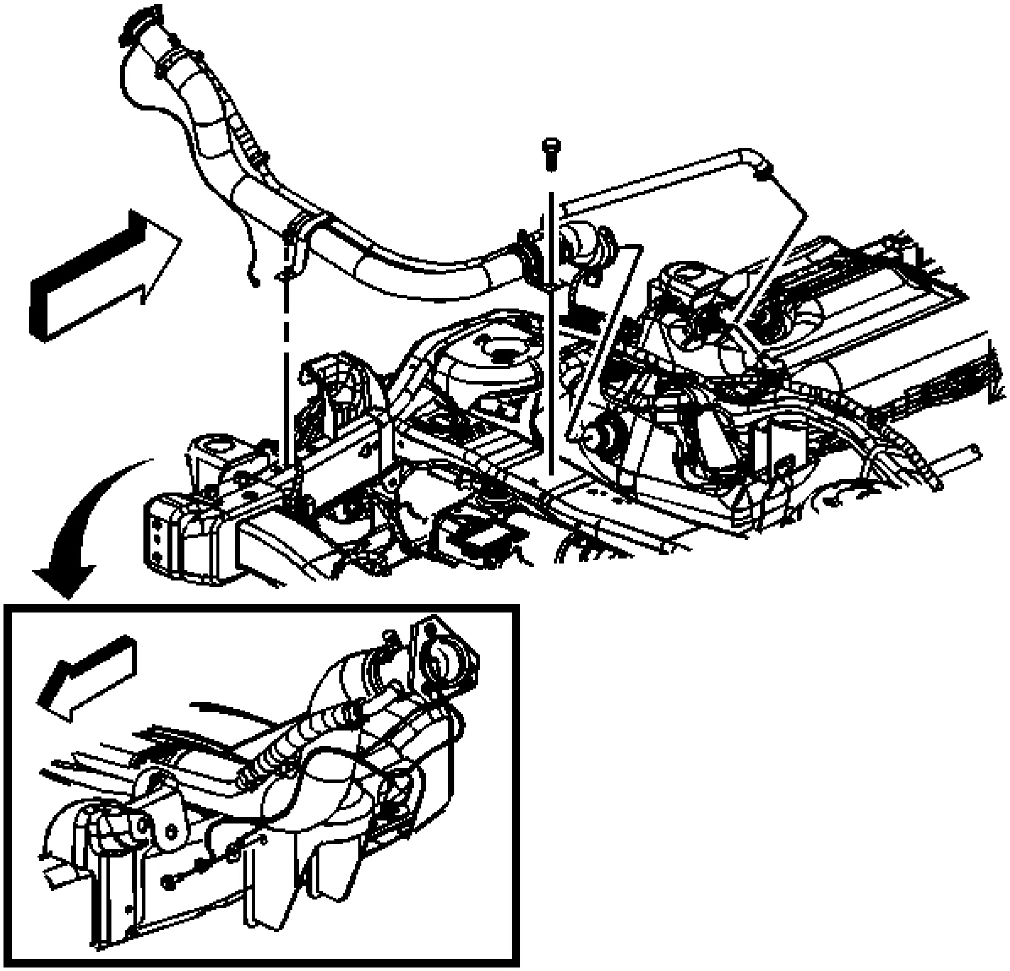


Fig. 74: Fuel Fill Hose & Hose Clamps
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to Gasoline/Gasoline Vapors Caution in Cautions and Notices.

1. Loosen the fuel filler cap in order to relieve the fuel tank vapor pressure.
2. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

3. Loosen the fuel fill hose clamp.
4. Disconnect the fuel fill hose from the fuel fill pipe.
5. Use a hand or air operated pump device in order to drain as much fuel through the fuel fill hose as possible.

FUEL TANK REPLACEMENT

Removal Procedure

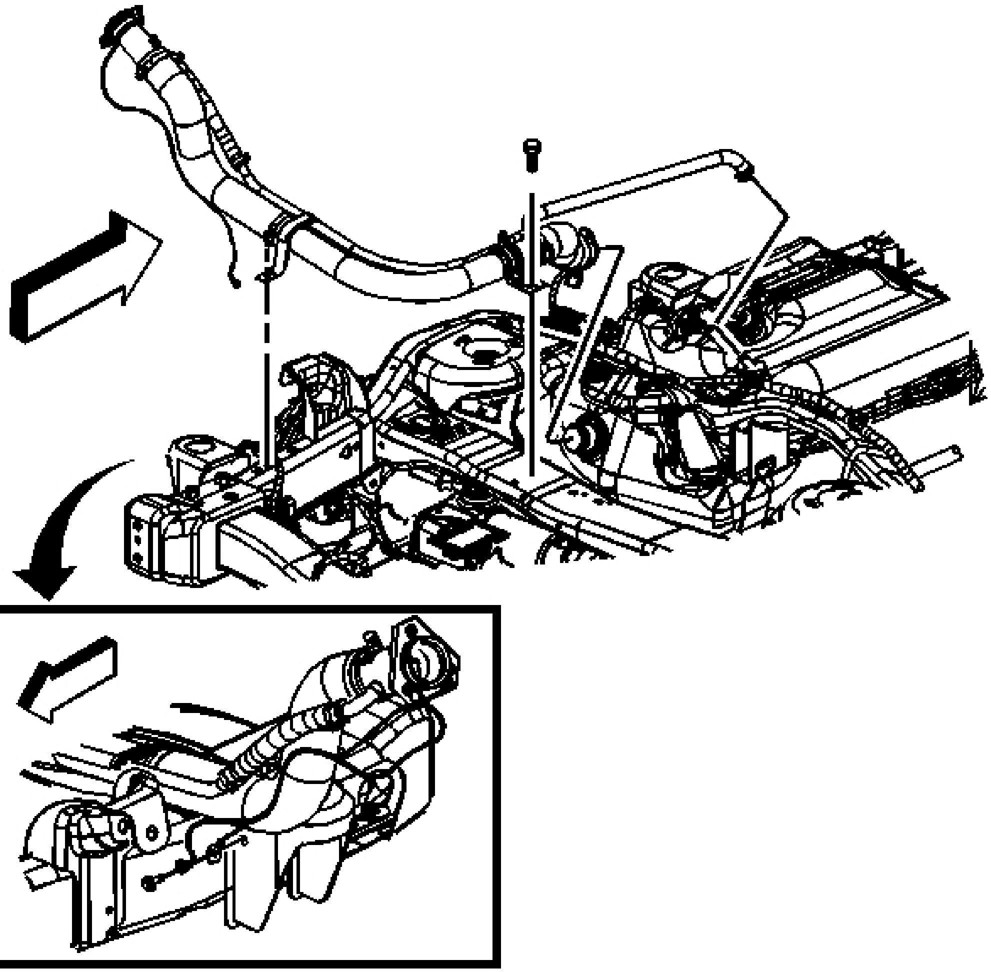


Fig. 75: Fuel Fill Hose & Hose Clamps
Courtesy of GENERAL MOTORS CORP.

1. Relieve the fuel system pressure. Refer to the **Fuel Pressure Relief Procedure** .
2. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
3. Drain the fuel tank. Refer to **Fuel Tank Draining Procedure** .
4. Remove the fuel fill pipe from the fuel tank.
5. Disconnect the chassis fuel pipes at the fuel filter.
6. Cap the fuel and EVAP pipes in order to prevent possible fuel system contamination.

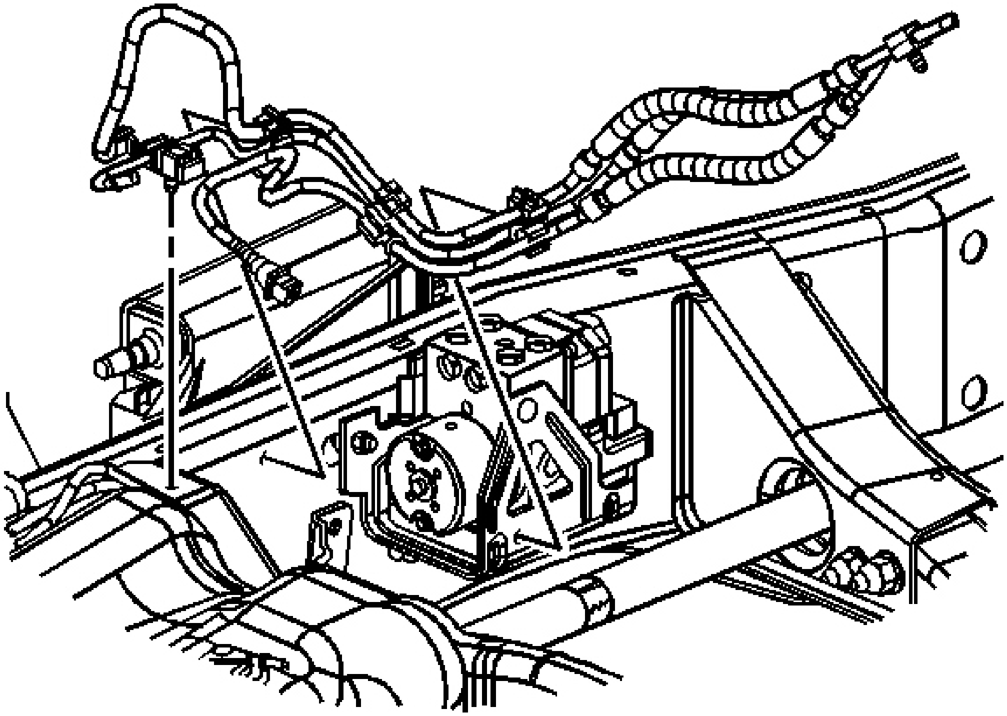


Fig. 76: EVAP Vent Pipe
Courtesy of GENERAL MOTORS CORP.

7. Disconnect the EVAP vent pipe at the fuel canister.

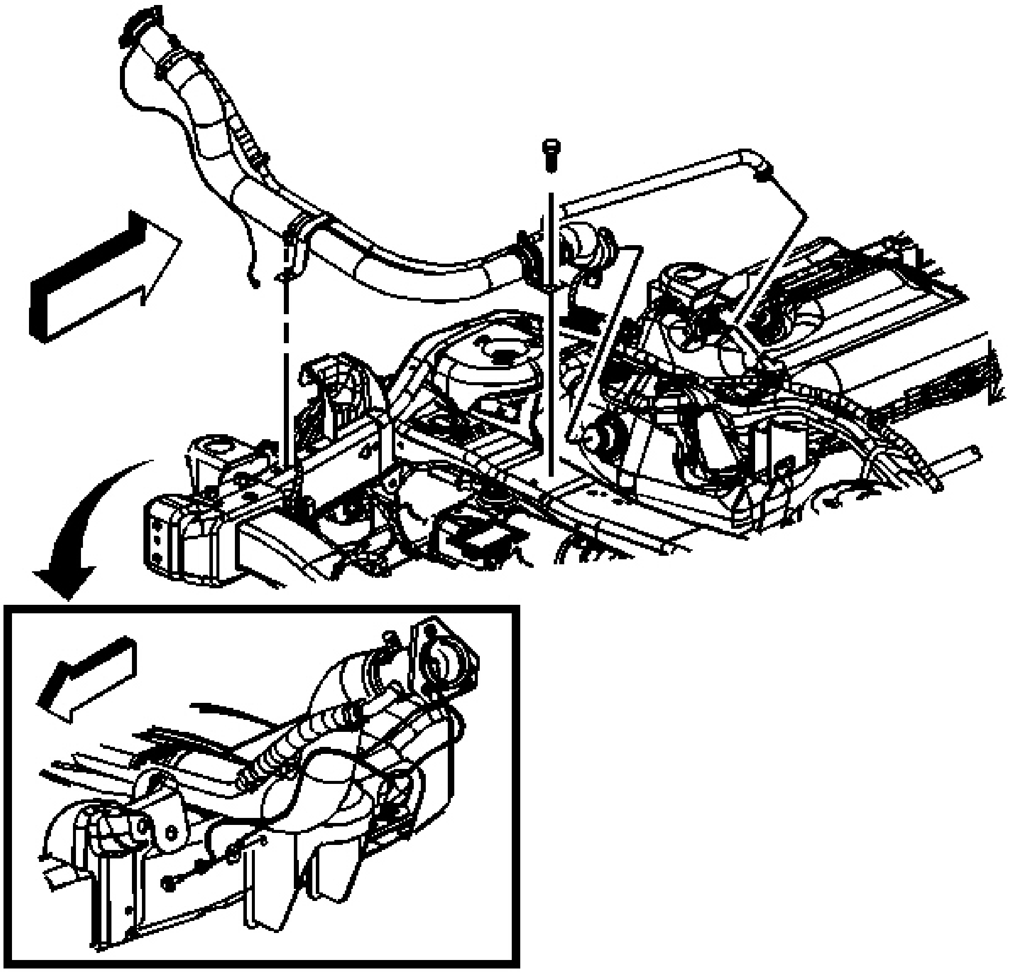


Fig. 77: Fuel Fill Hose & Hose Clamps
Courtesy of GENERAL MOTORS CORP.

8. Loosen the vent hose and filler hose clamp.
9. Disconnect the vent hose and filler hose from the pipe.
10. Remove the fuel tank protective shield.

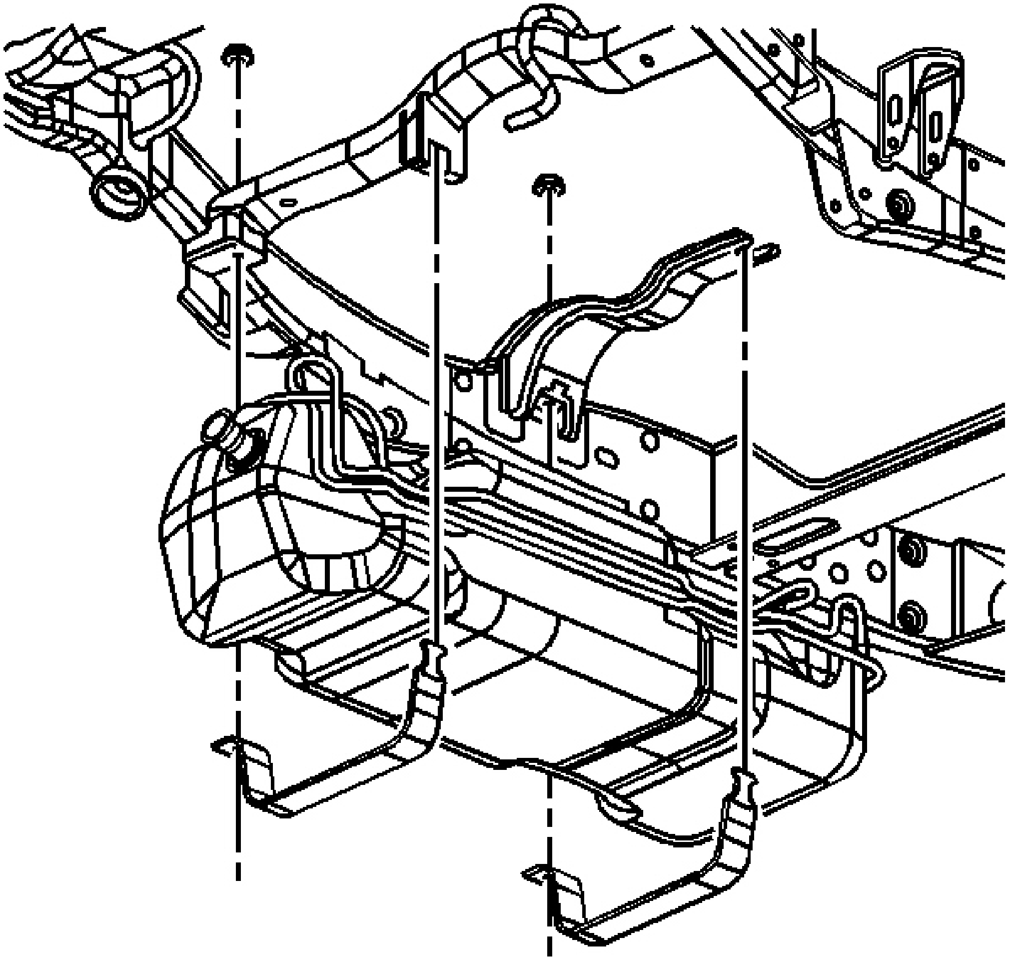


Fig. 78: Fuel Tank Straps & Attaching Bolts
Courtesy of GENERAL MOTORS CORP.

11. With the aid of an assistant, support the fuel tank.

NOTE: **Do not bend the fuel tank straps. Bending the fuel tank straps may damage the straps.**

12. Remove the fuel tank strap attaching bolts.
13. Remove the fuel tank straps.
14. Carefully lower the rear of the fuel tank slightly.

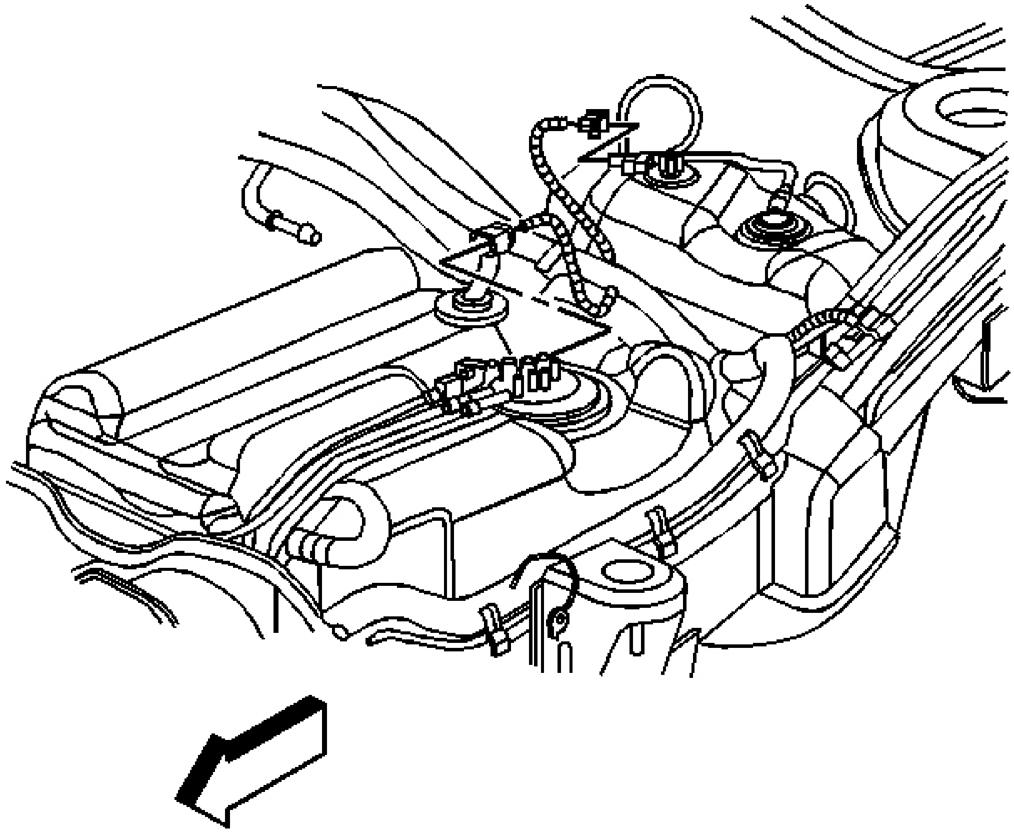


Fig. 79: Fuel Sender & Fuel Pressure Sensor Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

15. Disconnect the fuel sender and the fuel pressure sensor electrical connectors.
16. Remove the fuel tank.
17. Place the fuel tank in a suitable work area.
18. Remove the fuel feed and return pipes from the fuel sender and the retaining clips.
19. Remove the fuel sender assembly from the fuel tank. Refer to **Fuel Sender Assembly Replacement** .
20. Remove the EVAP pipe from the fuel tank roll over valves and the retaining clips.

Installation Procedure

1. Connect the EVAP pipe to the fuel tank roll over valves and the retaining clips.
2. Install the fuel sender assembly to the fuel tank. Refer to **Fuel Sender Assembly Replacement** .
3. Connect the fuel feed and return pipes to the fuel sender and the retaining clips.

NOTE: Refer to Fastener Notice in Cautions and Notices.

4. Install the fuel fill hose and the vent hose to the fuel tank.

   Tighten: Tighten the hose clamps to 2.5 N.m (22 lb in).

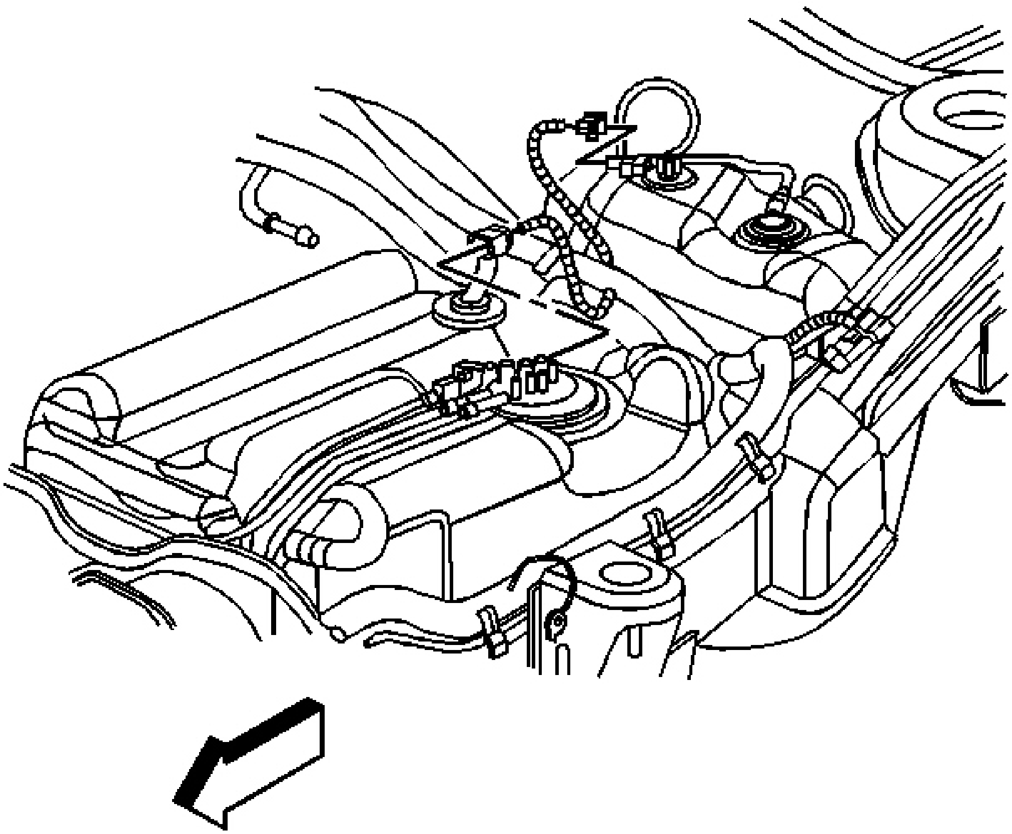


Fig. 80: Fuel Sender & Fuel Pressure Sensor Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

5. With the aid of an assistant, support and partially raise the fuel tank front end first.
6. Connect the fuel sender and the fuel pressure sensor electrical connectors.

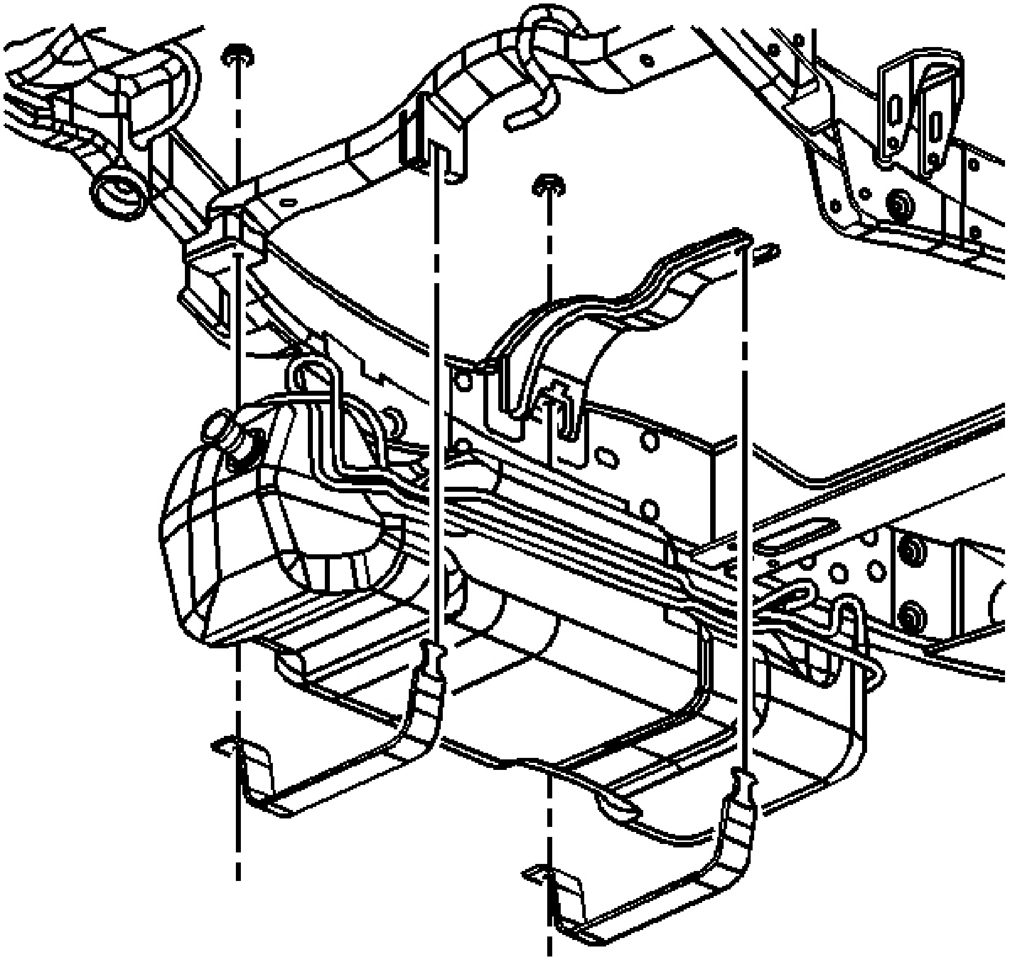


Fig. 81: Fuel Tank Straps & Attaching Bolts
Courtesy of GENERAL MOTORS CORP.

7. Fully raise the fuel tank.
8. Install the fuel tank straps.
9. Install the fuel tank strap attaching bolts.

   Tighten: Tighten the bolts to 40 N.m (30 lb ft).

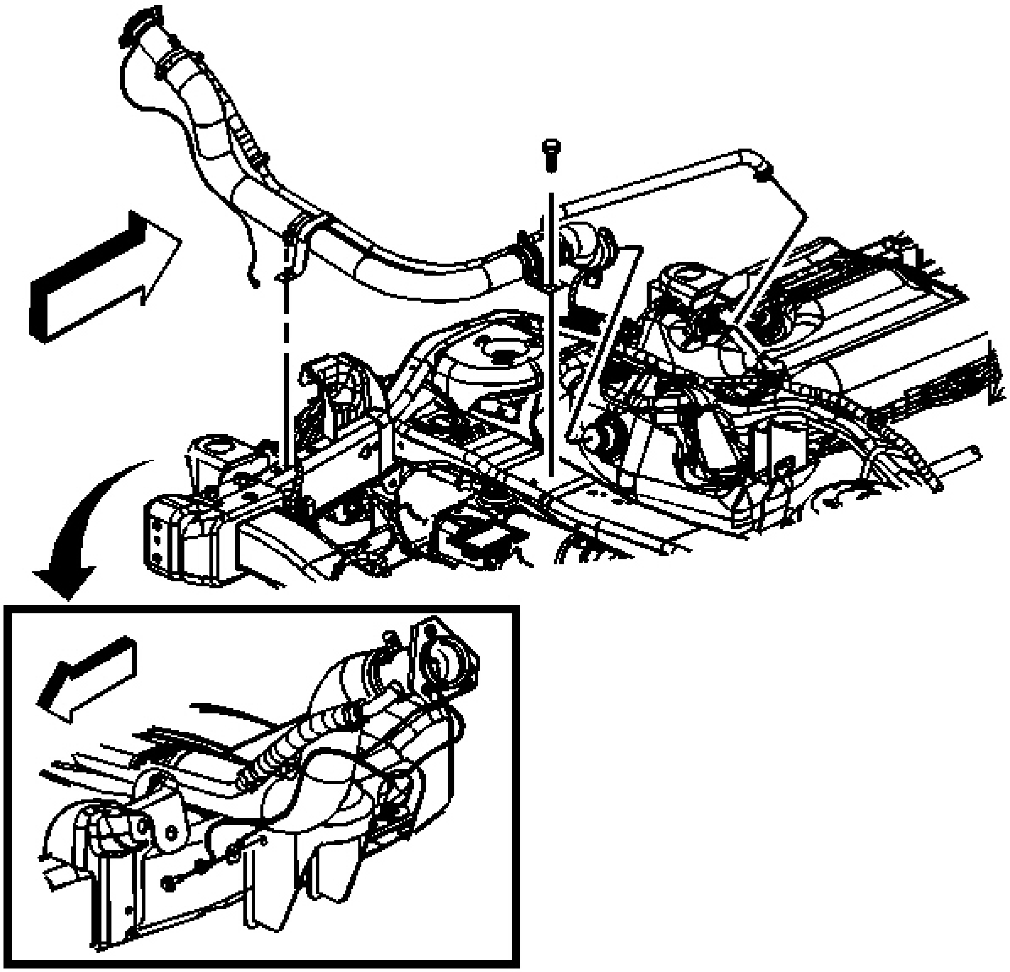


Fig. 82: Fuel Fill Hose & Hose Clamps
Courtesy of GENERAL MOTORS CORP.

10. Connect the fuel fill hose and the vent hose to the pipes.

    Tighten:

    - Tighten the fuel fill hose clamp to 2.5 N.m (22 lb in).
    - Tighten the vent hose clamp to 2.5 N.m (22 lb in).

11. Install the fuel fill pipe to the fuel tank.
12. Remove the caps from the fuel and EVAP pipes.

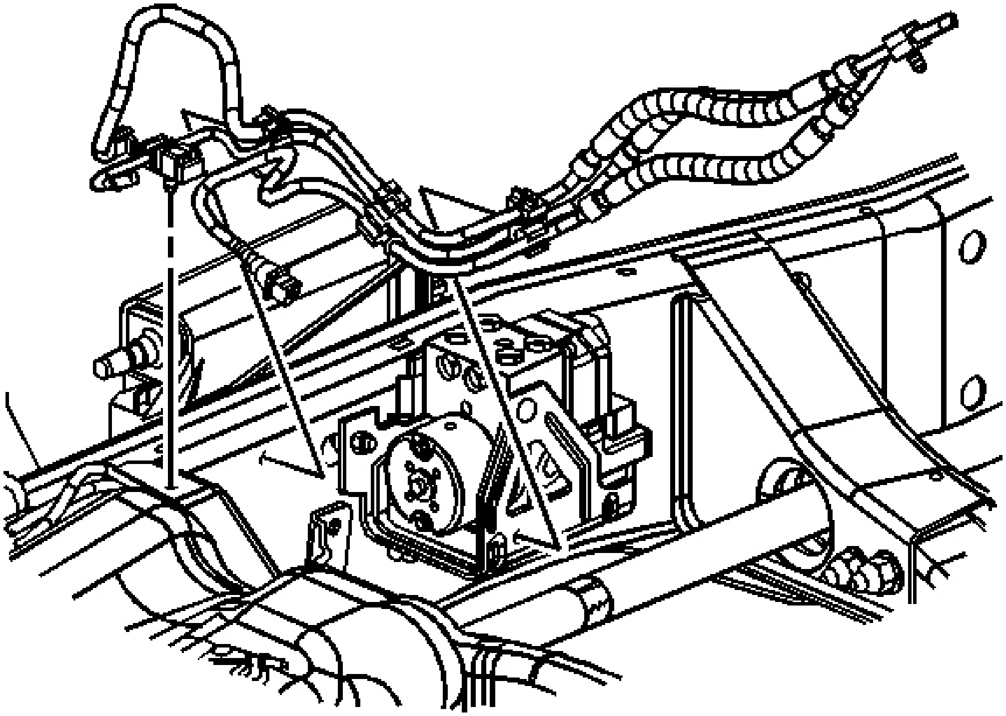


Fig. 83: EVAP Vent Pipe
Courtesy of GENERAL MOTORS CORP.

13. Connect the EVAP vent pipe to the fuel canister.
14. Connect the chassis fuel pipes at the fuel filter.

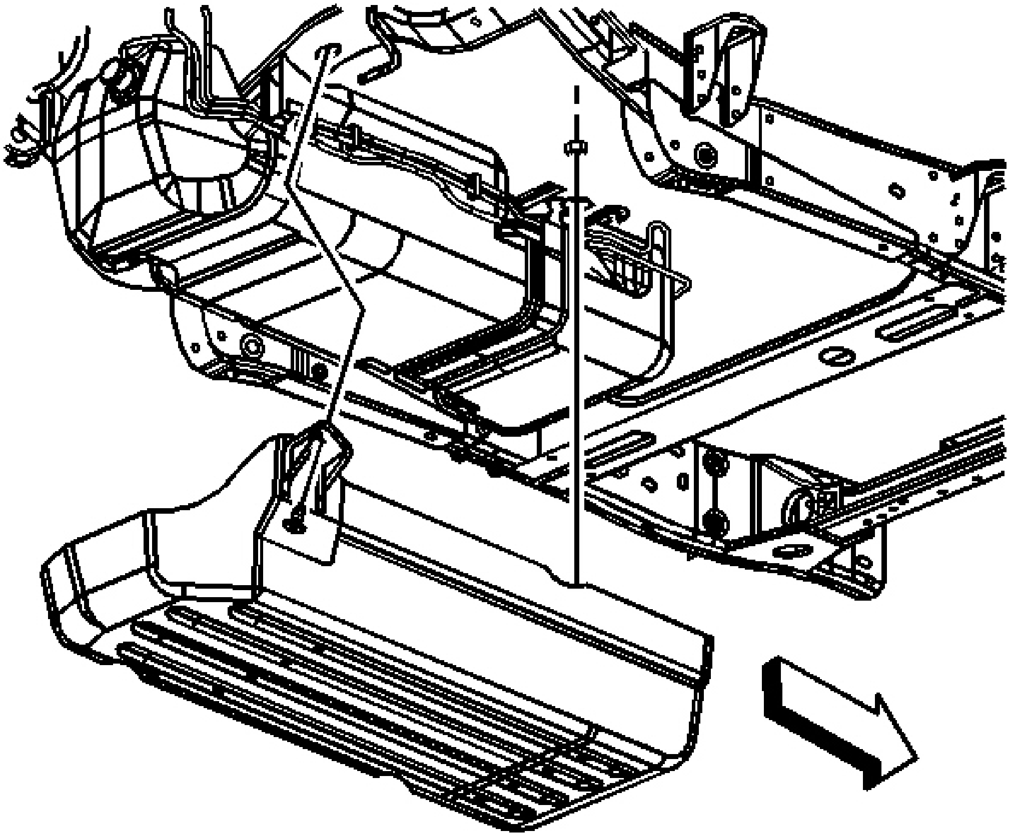


Fig. 84: Installing Fuel Tank Protective Shield
Courtesy of GENERAL MOTORS CORP.

15. Install the fuel tank protective shield.

    Tighten: Tighten fuel tank protective shield bolts to 25 N.m (18 lb ft).

16. Lower the vehicle.
17. Refill the fuel tank.
18. Install the fuel filler cap.
19. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (Single Battery)** in Engine Electrical.
20. Use the following procedure in order to inspect for leaks:
    1. Turn ON the ignition, with the engine OFF, for 2 seconds.
    2. Turn OFF the ignition for 10 seconds.

3. Turn ON the ignition, with the engine OFF.
4. Inspect for fuel leaks.

21. Install the engine sight shield. Refer to **Engine Sight Shield Replacement (6.0L (LQ4))** in Engine Mechanical.

FUEL TANK PRESSURE SENSOR REPLACEMENT

Removal Procedure

1. Remove the fuel tank. Refer to **Fuel Tank Replacement** .

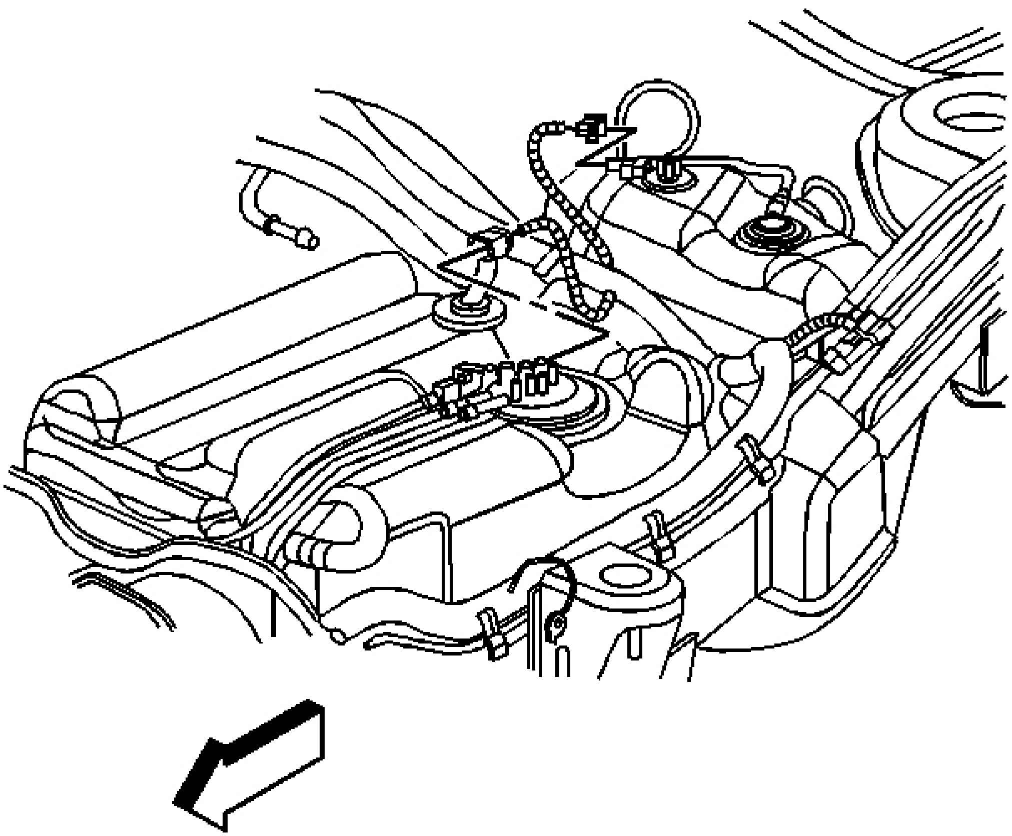


Fig. 85: Fuel Sender & Fuel Pressure Sensor Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

2. Remove the fuel pressure sensor.

Installation Procedure

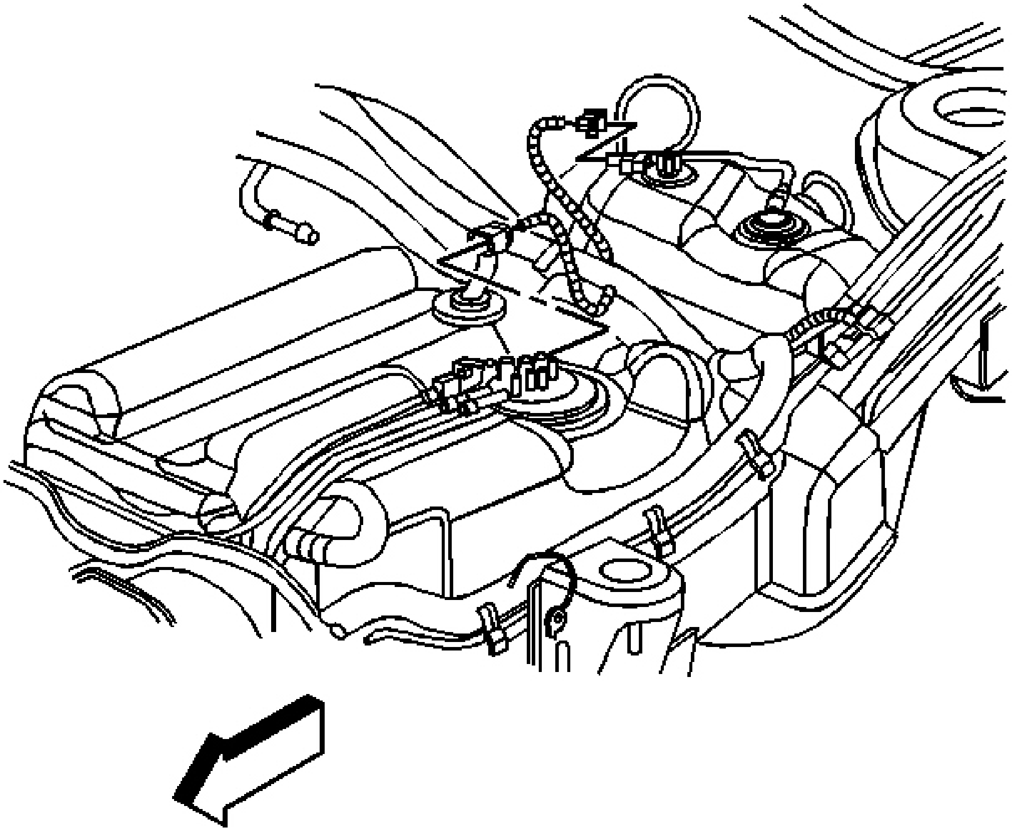


Fig. 86: Fuel Sender & Fuel Pressure Sensor Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

1. Install the fuel pressure sensor.
2. Install the fuel tank. Refer to **Fuel Tank Replacement** .

FUEL LEVEL SENSOR REPLACEMENT

Removal Procedure

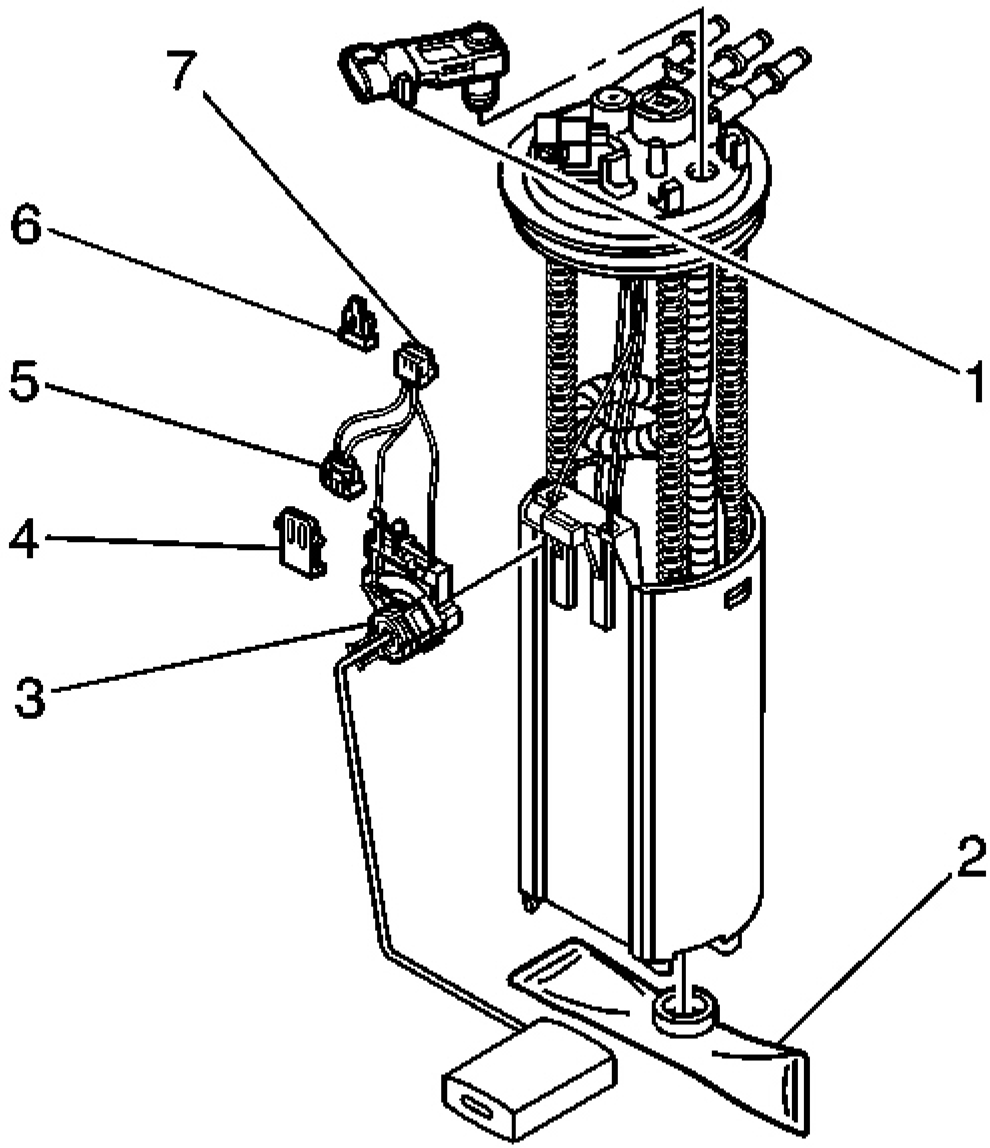


Fig. 87: Identifying Fuel Sender Assembly
Courtesy of GENERAL MOTORS CORP.

1. Remove the fuel sender. Refer to **Fuel Sender Assembly Replacement** .
2. Place the fuel sender on a clean work surface.
3. Disconnect the fuel level sensor electrical connector from the module connector.

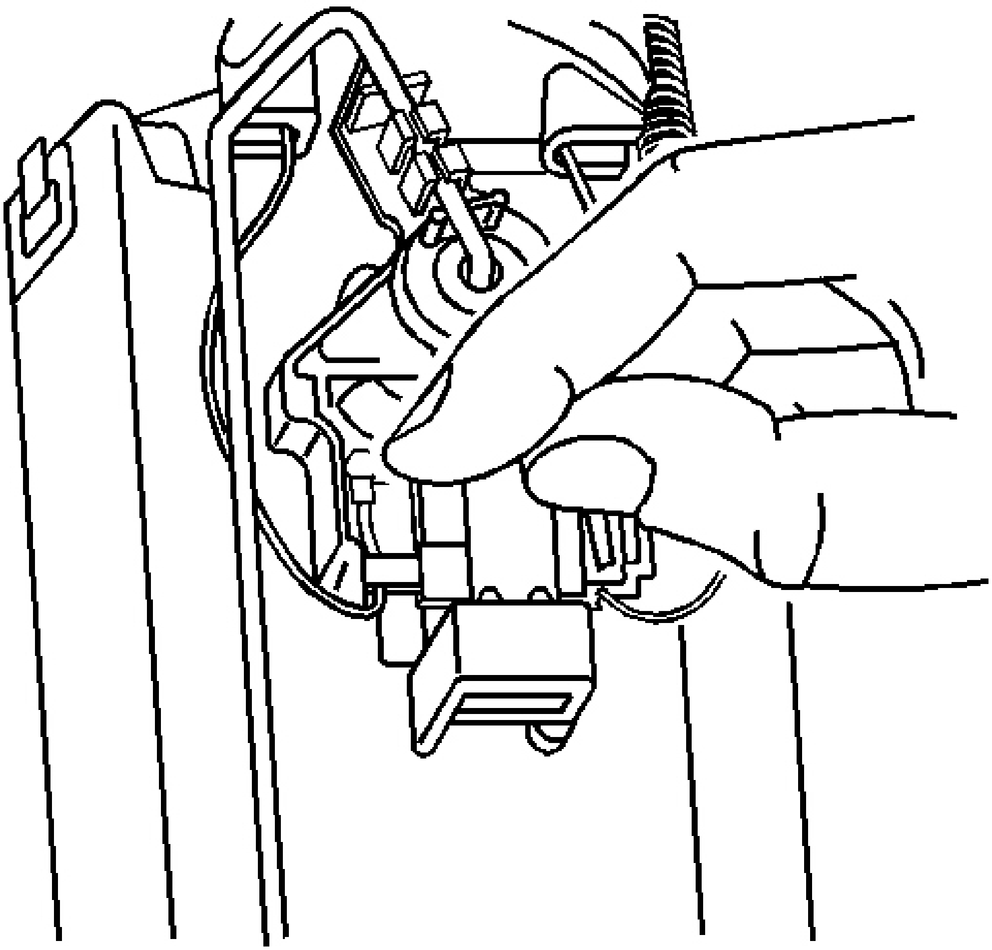


Fig. 88: Removing Fuel Level Sensor Retaining Clip
Courtesy of GENERAL MOTORS CORP.

4. Remove the fuel level sensor retaining clip.
5. Squeeze the retaining tabs together in order to slide the fuel lever sensor off of the reservoir.

Installation Procedure

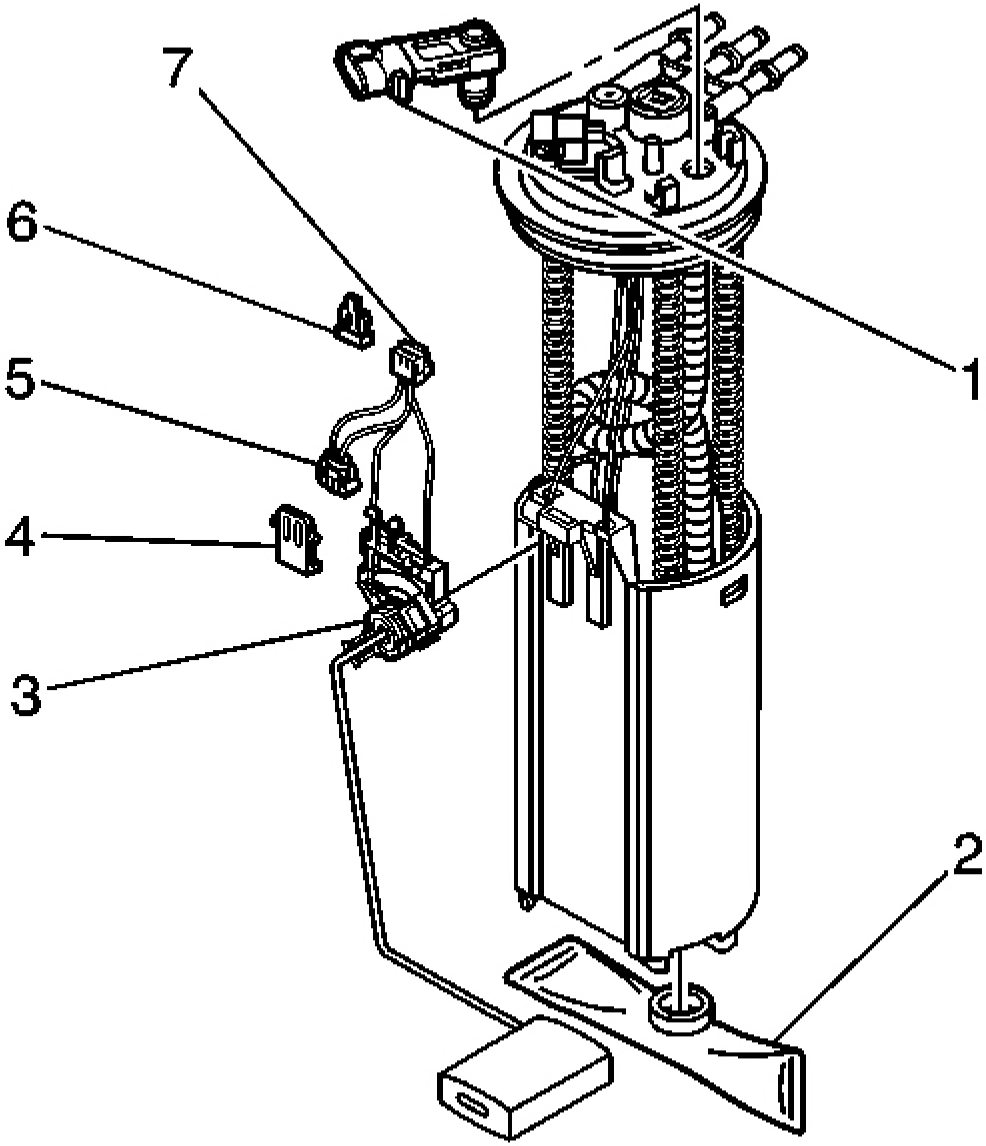


Fig. 89: Identifying Fuel Sender Assembly
Courtesy of GENERAL MOTORS CORP.

1. Slide the fuel lever sensor (3) onto the reservoir until the retaining tabs snap into place.

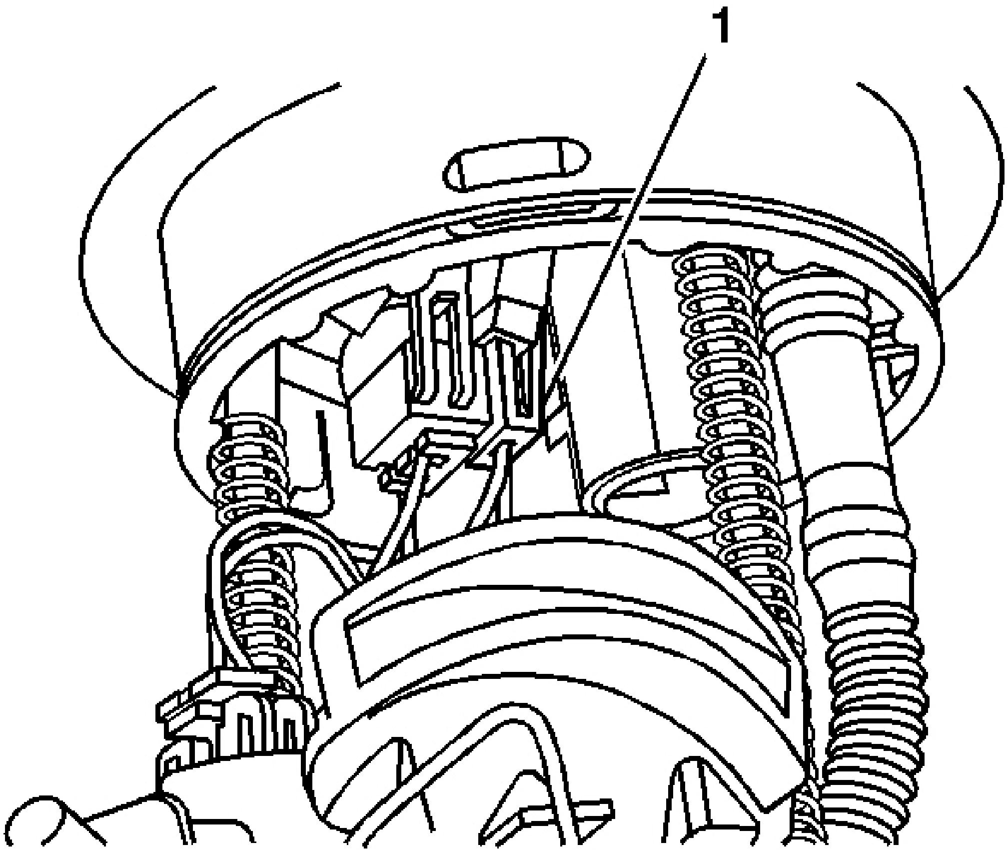


Fig. 90: Connecting Fuel Level Sensor Electrical Connectors To Module Connector
Courtesy of GENERAL MOTORS CORP.

2. Connect the fuel level sensor electrical connectors (1) to the module connector.
3. Install the fuel sender. Refer to **Fuel Sender Assembly Replacement** .

FILLER TUBE REPLACEMENT

Removal Procedure

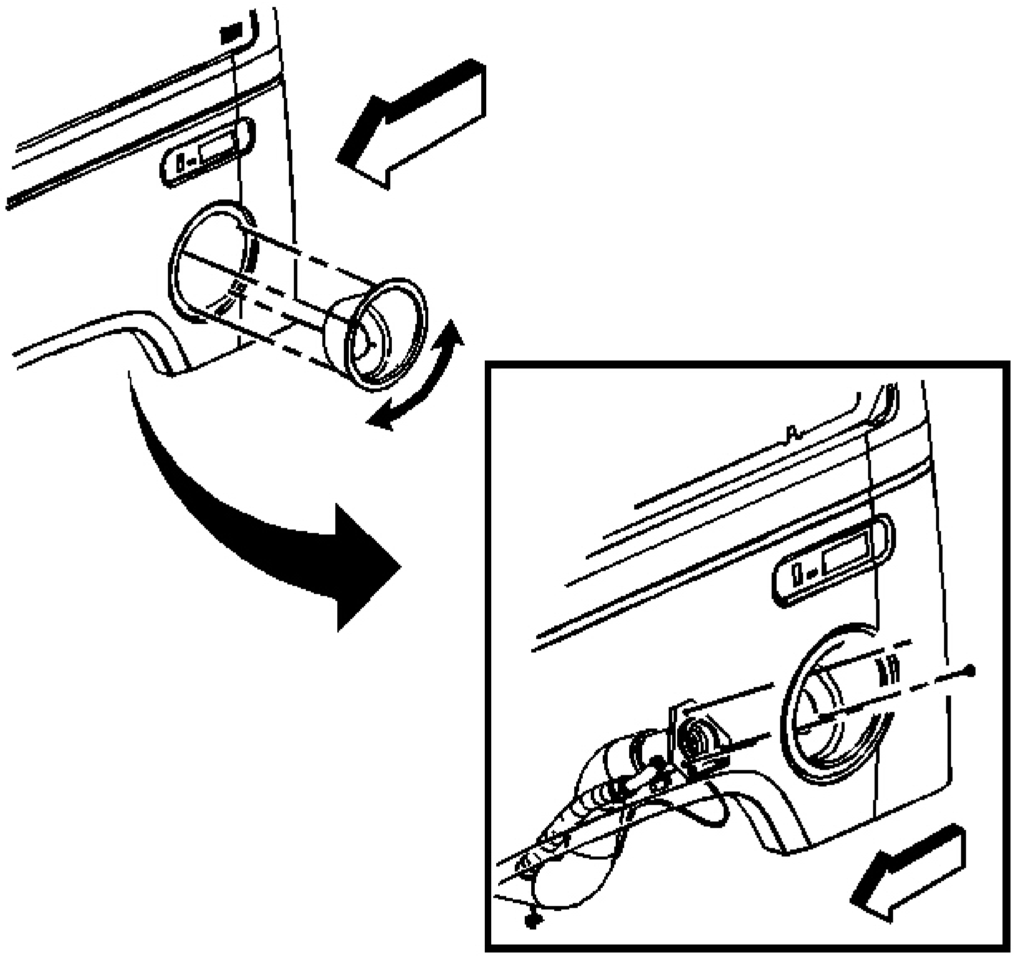


Fig. 91: Fuel Filler Cap
Courtesy of GENERAL MOTORS CORP.

1. Clean all the fuel pipe and hose connections and the surrounding areas before disconnection in order to avoid possible contamination of the fuel system.
2. Remove the fuel filler cap.
3. Drain the fuel below the level of the fuel filler hose. Refer to **Fuel Tank Draining Procedure** .

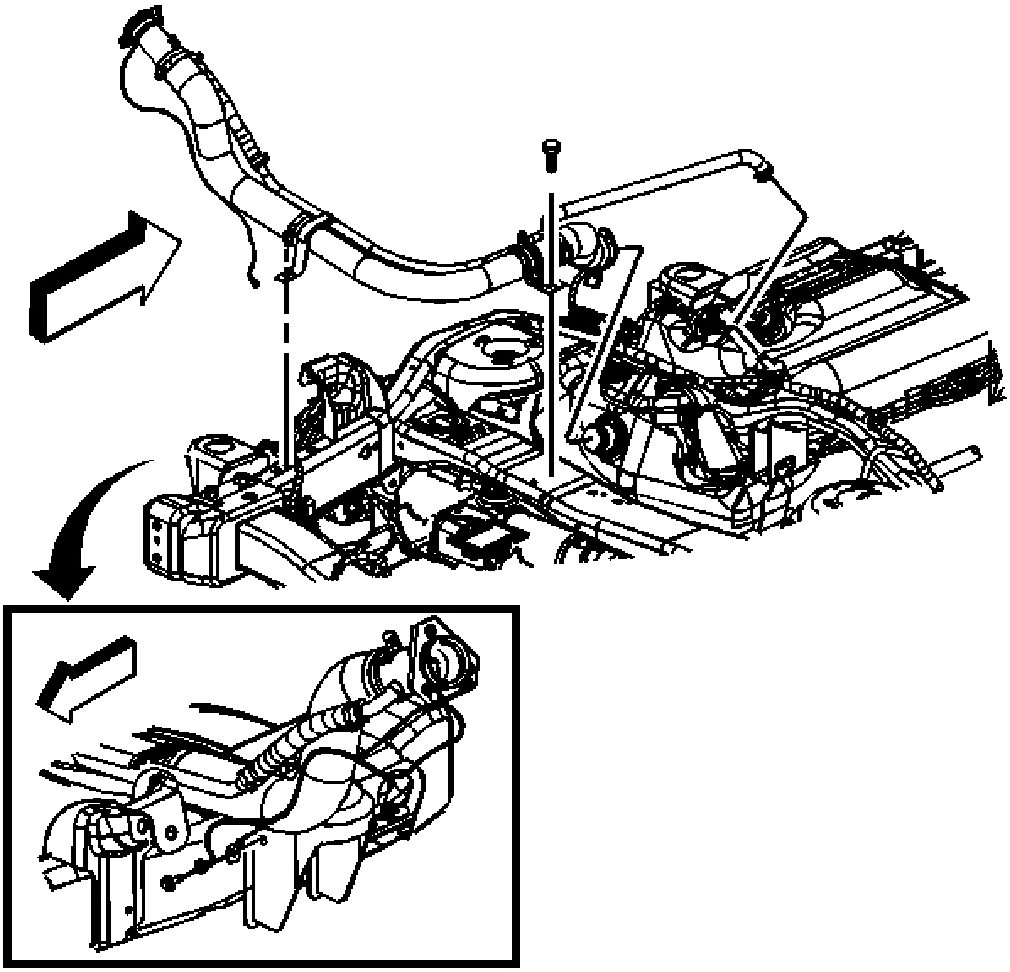


Fig. 92: Fuel Fill Hose & Hose Clamps
Courtesy of GENERAL MOTORS CORP.

4. Remove the fuel fill pipe housing/bezel to fuel fill pipe bolts.
5. Remove housing/bezel by rotating clockwise.
6. Remove the left rear wheelhouse panel. Refer to **Wheelhouse Panel Replacement** in Body Rear End.
7. Disconnect the rear axle vent and air spring compressor hoses from the retainer on the fuel fill pipe, if applicable.
8. Loosen the fuel vent hose to fuel tank clamp.
9. Loosen the fuel fill hose to fuel tank clamp.
10. Disconnect the fuel fill pipe bracket bolt.

11. Disconnect the fuel fill and vent hoses from the fuel tank.
12. Remove the fuel fill and vent pipe and hose assembly.
13. Cap the open end of the fuel tank.

Installation Procedure

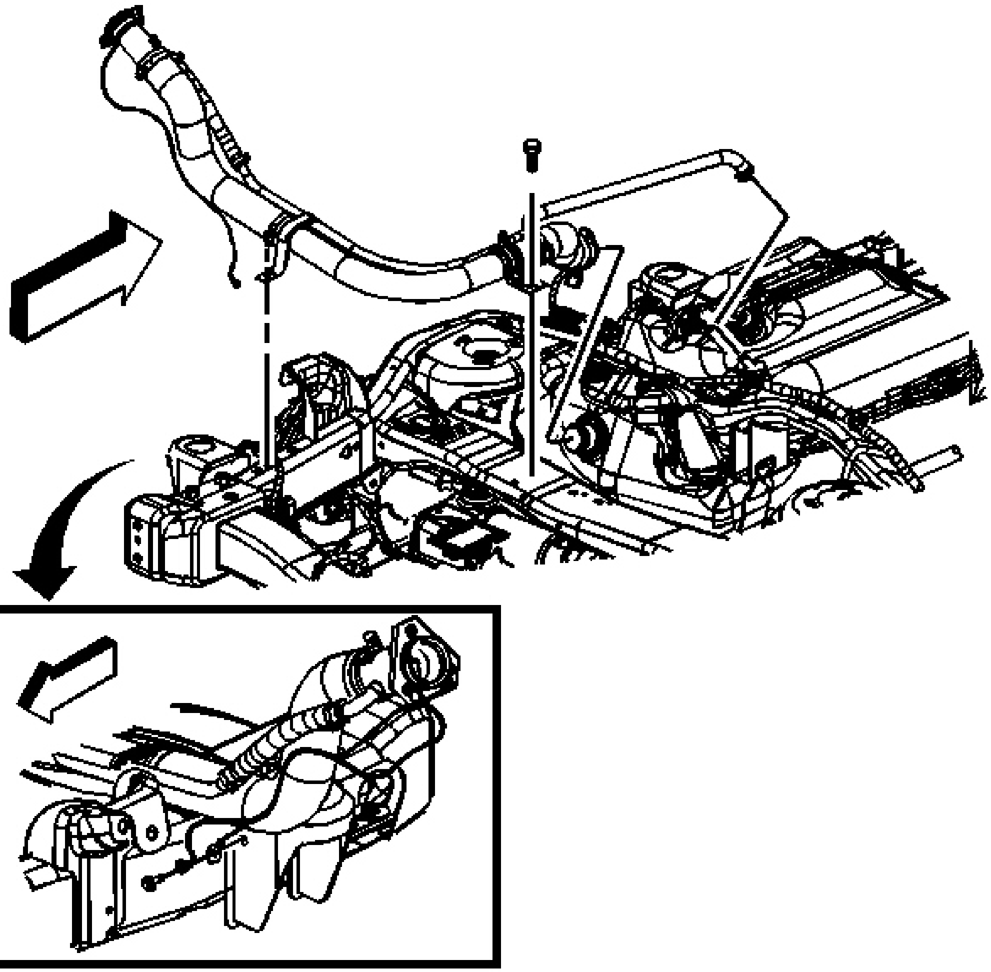


Fig. 93: Fuel Fill Hose & Hose Clamps
Courtesy of GENERAL MOTORS CORP.

1. Uncap the fuel tank.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the fuel fill and vent pipe hose assembly to the fuel tank.

   Tighten: Tighten the vent hose clamp and the fuel fill pipe clamp to 2.5 N.m (22 lb in).

3. Install the fuel fill pipe bracket bolt.

   Tighten: Tighten the bolt to 12 N.m (106 lb in).

4. Connect the rear axle vent and air spring compressor hoses to the retainer on the fuel fill pipe, if applicable.
5. Install the left rear wheelhouse panel. Refer to **Wheelhouse Panel Replacement** in Body Rear End.
6. Lower the vehicle.
7. Install fill pipe/housing bezel by fitting into offset slots and rotating clockwise.
8. Install the fuel fill pipe housing to the fuel fill pipe bolts.

   Tighten: Tighten the fuel fill pipe housing to fuel fill pipe bolts to 2.3 N.m (20 lb in).

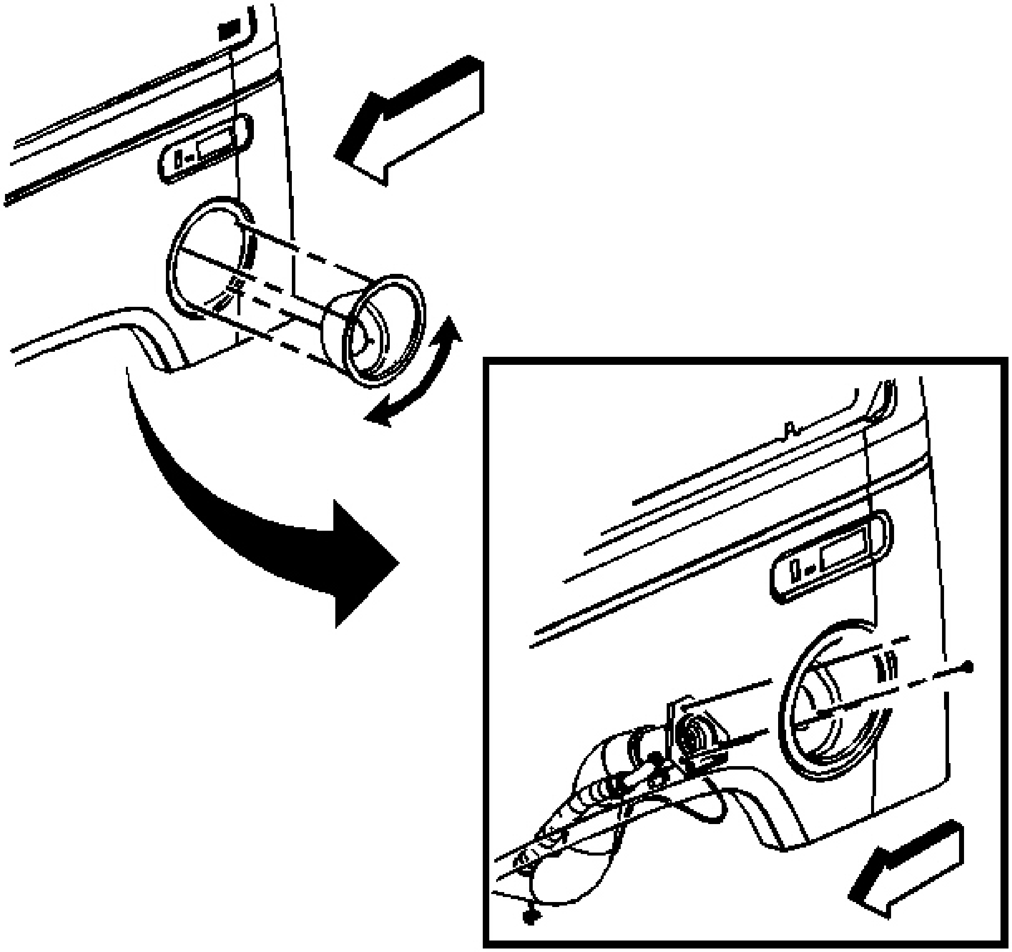


Fig. 94: Fuel Filler Cap
Courtesy of GENERAL MOTORS CORP.

9. Refill the fuel system.
10. Install the fuel filler cap.

FUEL SENDER ASSEMBLY REPLACEMENT

Tools Required

J 44402 Fuel Tank Sending Unit Wrench

Removal Procedure

1. Remove the fuel tank. Refer to **Fuel Tank Replacement** .
2. Remove fuel lines from sender assembly. Refer to **Fuel Hose/Pipes Assembly Replacement** .

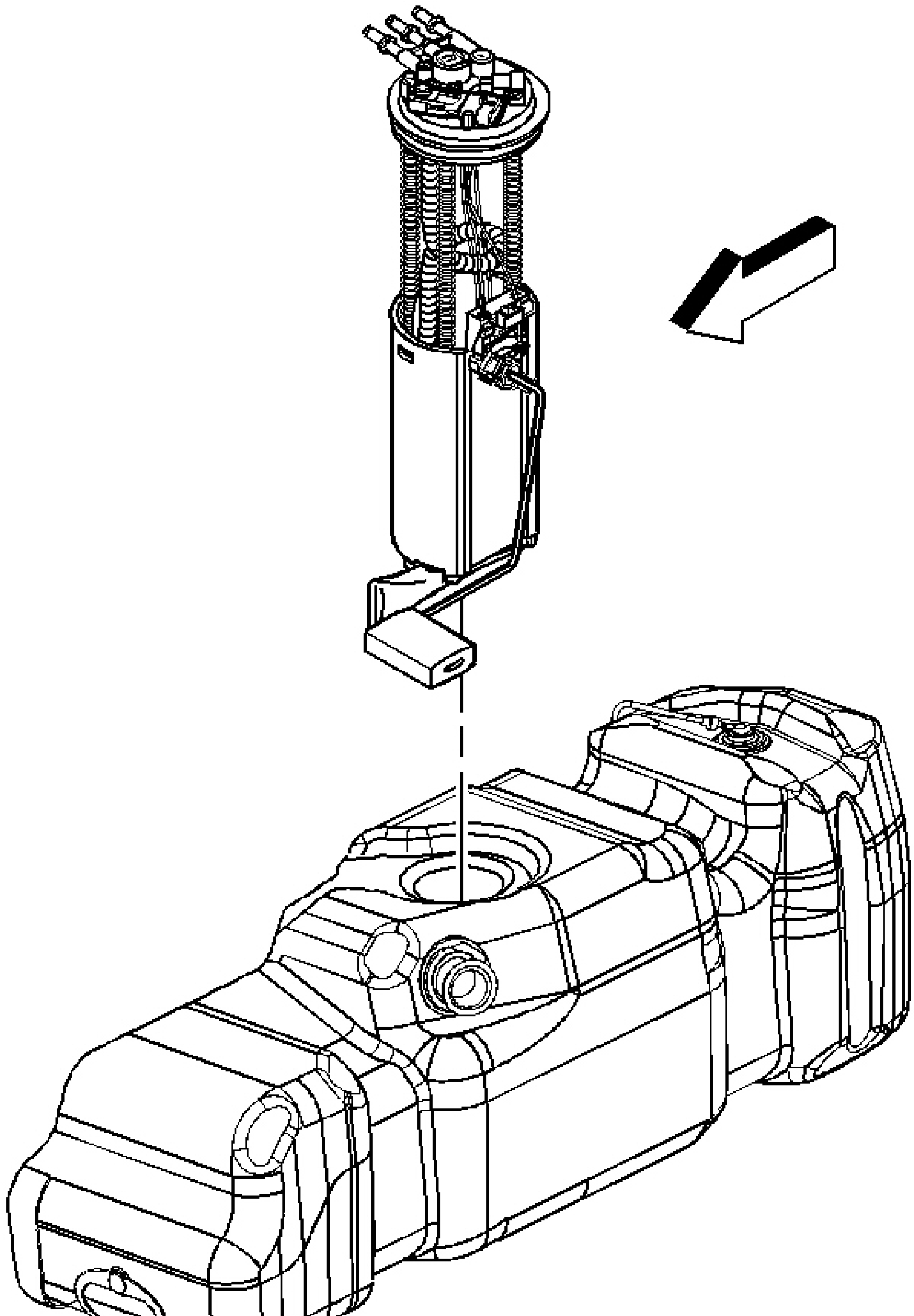


Fig. 95: Fuel Sender Assembly
Courtesy of GENERAL MOTORS CORP.

3. Remove the fuel sender assembly retaining ring using the J 44402 .
4. Remove the fuel sender assembly and the seal. Discard the seal.

CAUTION: Drain the fuel from the fuel sender assembly into an approved container in order to reduce the risk of fire and personal injury. Never store the fuel in an open container.

5. Clean the fuel sender sealing surfaces.

Installation Procedure

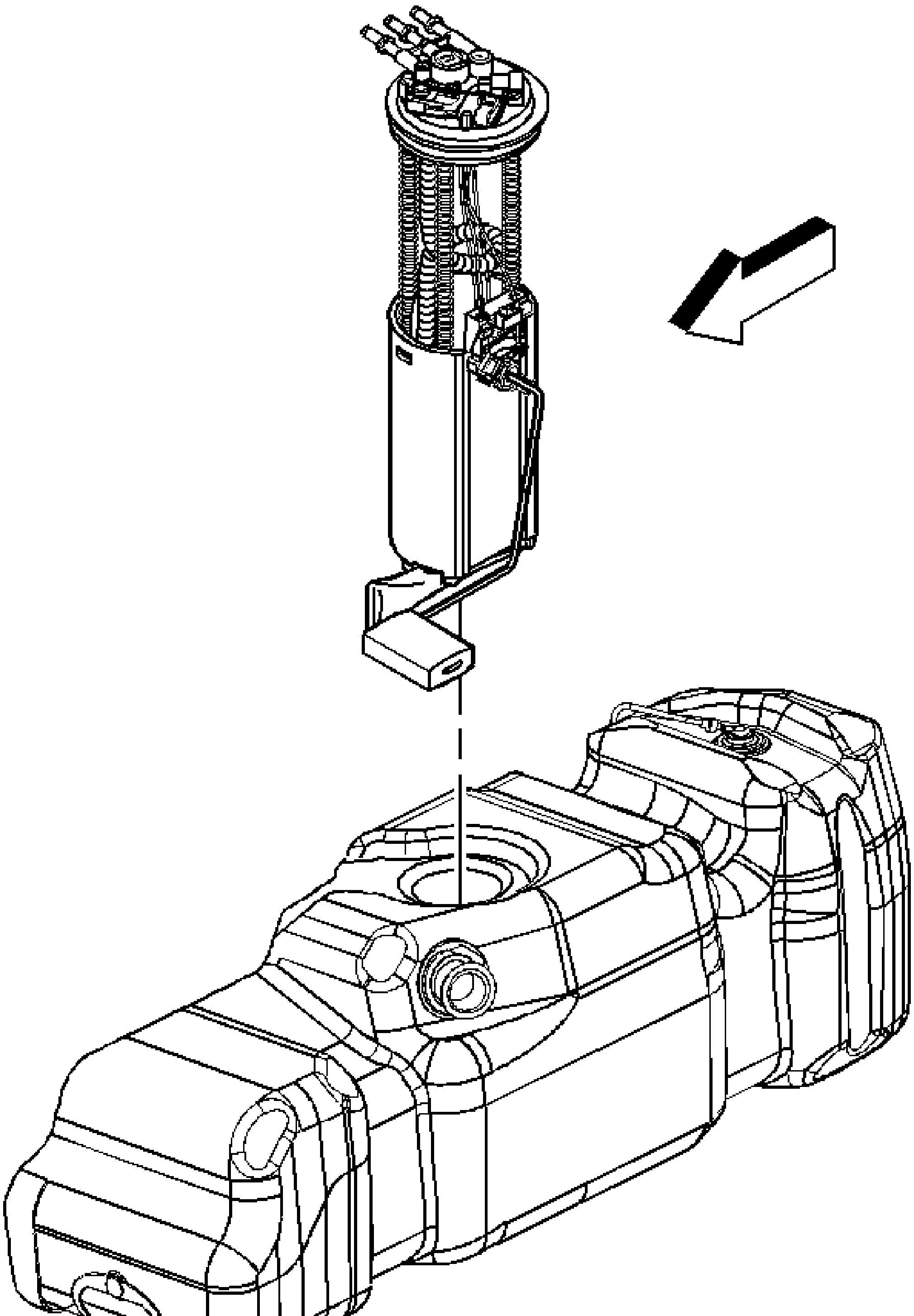


Fig. 96: Fuel Sender Assembly
Courtesy of GENERAL MOTORS CORP.

CAUTION: Drain the fuel from the fuel sender assembly into an approved container in order to reduce the risk of fire and personal injury. Never store the fuel in an open container.

IMPORTANT: The fuel pump strainer must be in a horizontal position when the fuel sender is installed in the tank. When installing the fuel sender assembly, assure that the fuel pump strainer does not block full travel of the float arm.

1. Install the new seal on the fuel tank.
2. Install the fuel sender assembly into the fuel tank.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the fuel sender assembly retaining ring using the J 44402 .
4. Install fuel lines to sender assembly. Refer to **Fuel Hose/Pipes Assembly Replacement** .
5. Install the fuel tank. Refer to **Fuel Tank Replacement** .

FUEL HOSE/PIPES REPLACEMENT - CHASSIS

Removal Procedure

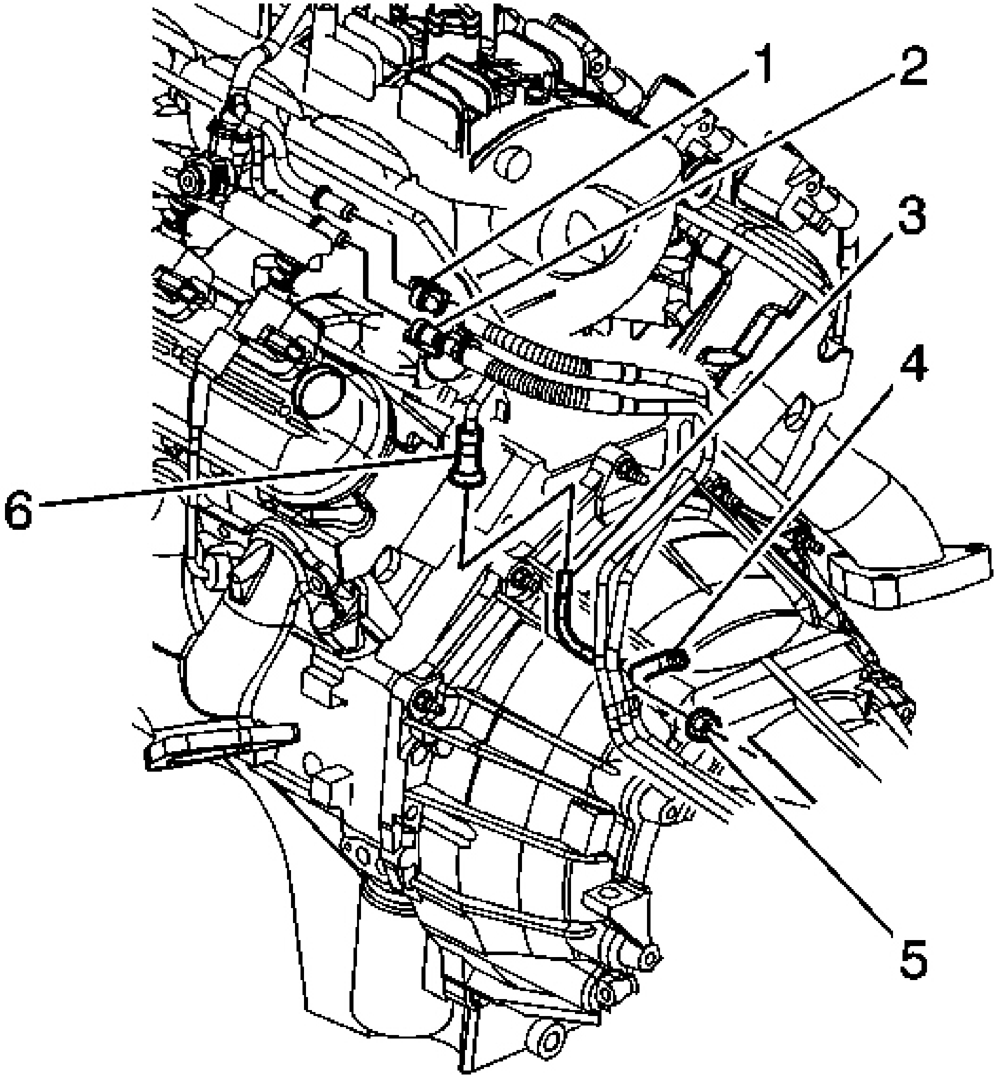


Fig. 97: View Of Rear Engine
Courtesy of GENERAL MOTORS CORP.

1. Relieve the fuel system pressure. Refer to the **Fuel Pressure Relief Procedure** .
2. Clean all the fuel pipe connections and the surrounding areas before disconnecting the pipes in order to avoid possible contamination of the fuel system.
3. Disconnect the fuel feed and return pipes (1, 2) from the fuel rail. Refer to **Quick Connect Fitting(s) Service (Metal Collar)** .

4. Cap the fuel rail pipes.
5. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
6. Remove the left hand catalytic converter. Refer to **Catalytic Converter Replacement (Right Hand)** in Engine Exhaust.
7. Remove the fuel pipes from the bellhousing stud clip (4).
8. Remove the fuel pipes from the transmission bracket clip.

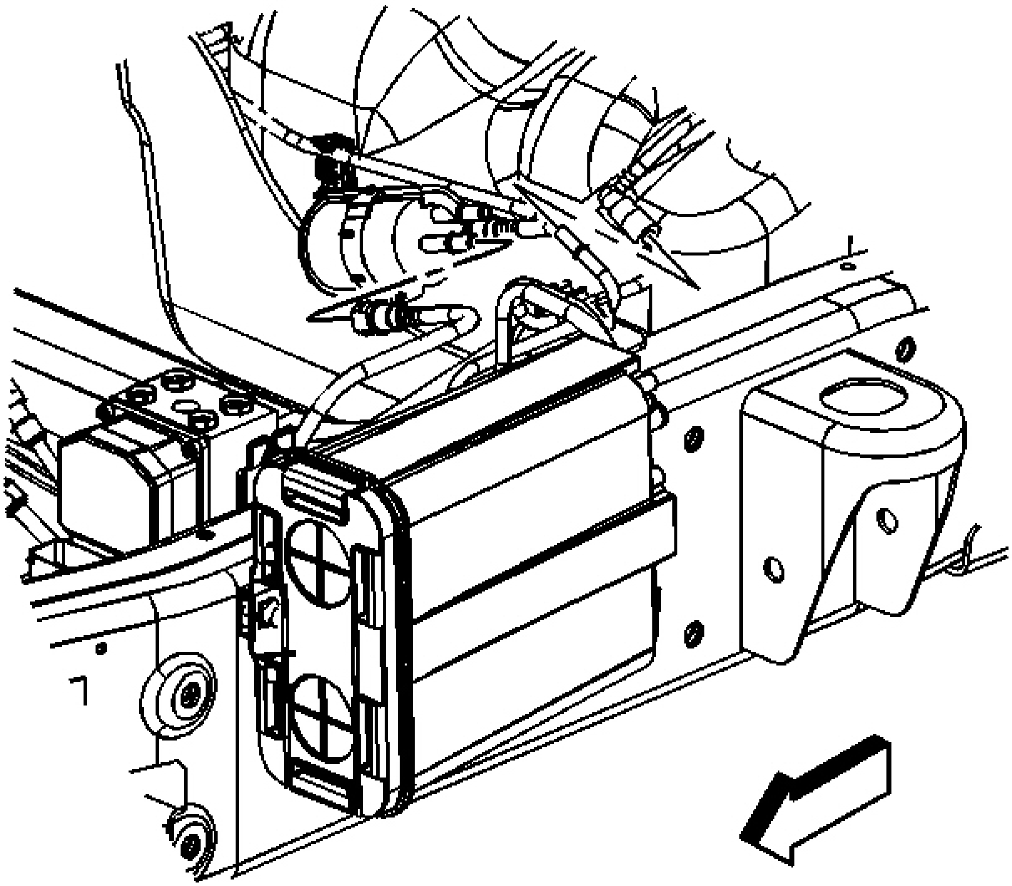


Fig. 98: Chassis Fuel Feed Hose & Fuel Filter
Courtesy of GENERAL MOTORS CORP.

9. Disconnect the chassis fuel feed hose at the fuel filter. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .
10. Cap the rear fuel pipes.
11. Note the position of the fuel pipes for aid in installation.

12. Remove the fuel pipes from the retaining clips.
13. Remove the fuel pipes.

Installation Procedure

IMPORTANT:

- **When replacing the fuel pipes, always replace them with original equipment or parts that meet the GM specifications for those parts. The replacement pipes must have the same type of fittings as the original pipes in order to ensure the integrity of the connection.**
- **DO NOT use copper or aluminum tubing to replace steel tubing. Only tubing meeting the 124-M specification or the equivalent is capable of meeting all pressure, corrosion and vibration characteristics necessary to ensure the durability standard required.**

1. Install the fuel pipes into the retaining clips.

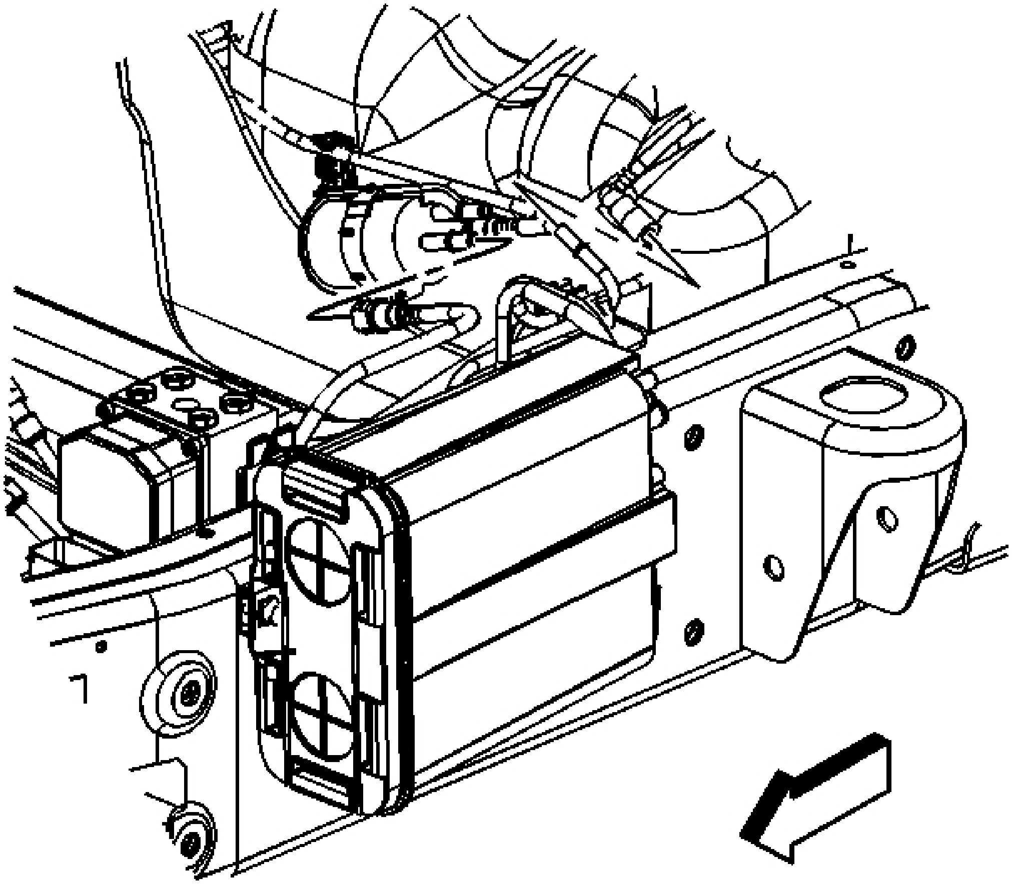


Fig. 99: Chassis Fuel Feed Hose & Fuel Filter
Courtesy of GENERAL MOTORS CORP.

2. Remove the caps from the rear fuel pipes.
3. Connect the chassis fuel feed hose at the fuel filter. Refer to **Quick Connect Fitting(s) Service (Plastic Collar)** .

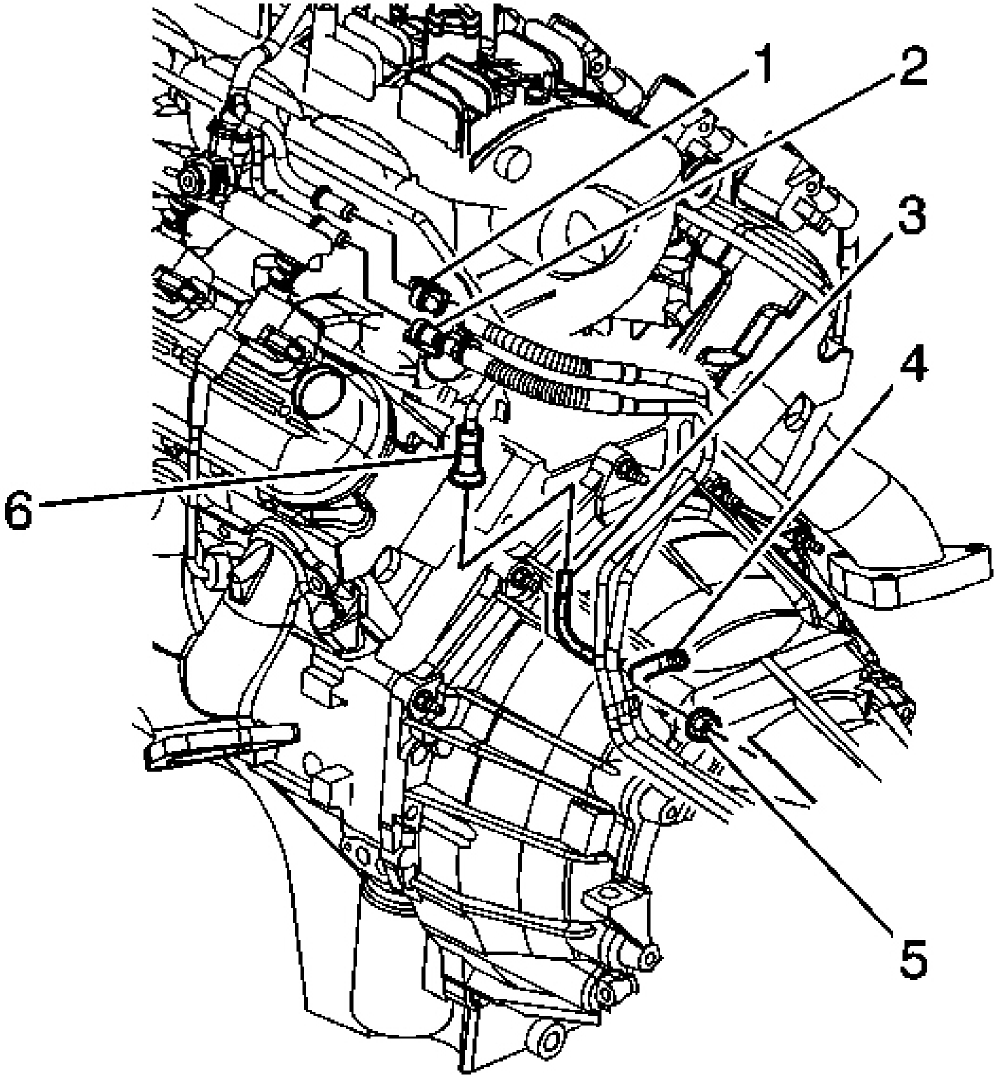


Fig. 100: View Of Rear Engine
Courtesy of GENERAL MOTORS CORP.

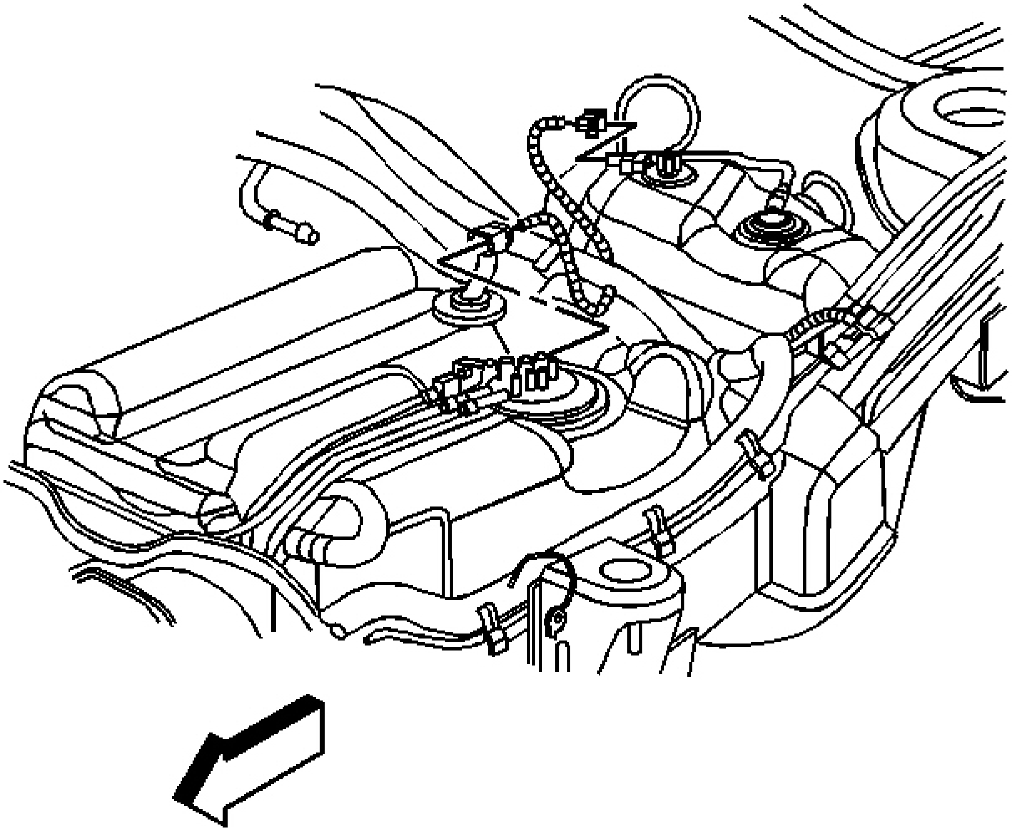
4. Install the fuel pipes into the transmission bracket clip.
5. Install the fuel pipes into the bellhousing stud clip (4).
6. Lower the vehicle.
7. Install the left hand catalytic converter. Refer to **Catalytic Converter Replacement (Right Hand)** in Engine Exhaust.

8. Remove the caps from the fuel rail pipes.
9. Connect the fuel feed and return pipes (1, 2) to the fuel rail.
10. Tighten the fuel filler cap.
11. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (Single Battery)** in Engine Electrical.
12. Use the following procedure in order to inspect for leaks:
    1. Turn ON the ignition, with the engine OFF, for 2 seconds.
    2. Turn OFF the ignition for 10 seconds.
    3. Turn ON the ignition, with the engine OFF.
    4. Inspect for fuel leaks.
13. Install the engine sight shield. Refer to **Engine Sight Shield Replacement (6.0L (LQ4))** in Engine Mechanical.

FUEL HOSE/PIPES ASSEMBLY REPLACEMENT

Removal Procedure

1. Clean all the fuel pipe and hose connections and the surrounding areas before disconnecting in order to avoid possible contamination of the fuel system.
2. Remove the fuel tank. Refer to **Fuel Tank Replacement** .



<u>**Fig. 101: Fuel Sender & Fuel Pressure Sensor Electrical Connectors**</u>
Courtesy of GENERAL MOTORS CORP.

3. Remove the rear fuel feed pipe and the rear fuel return pipe from the fuel sender and the fuel tank clips.
4. Cap the fuel pipes in order to prevent possible fuel system contamination.

Installation Procedure

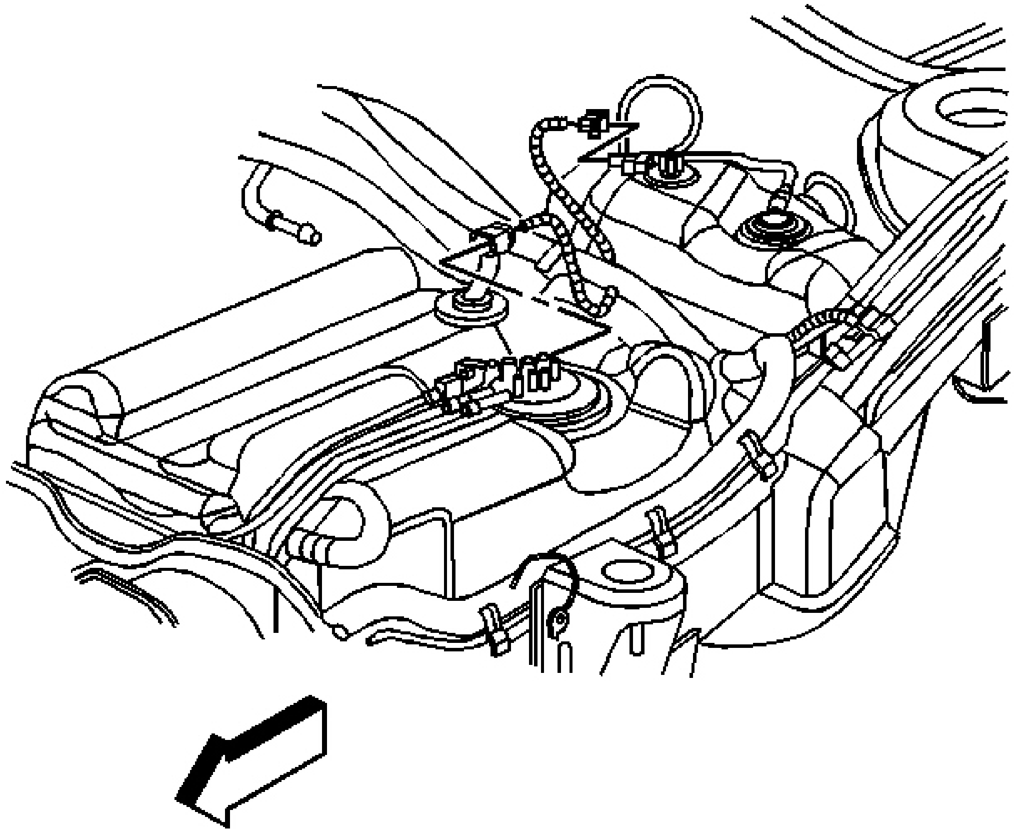


Fig. 102: Fuel Sender & Fuel Pressure Sensor Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

1. Remove the caps from the fuel pipes.
2. Connect the rear fuel feed pipe and the rear fuel return pipe to the fuel sender and the fuel tank clips.
3. Install the fuel tank. Refer to **Fuel Tank Replacement** .

FUEL FILLER HOSE REPLACEMENT

Removal Procedure

1. Clean all the fuel pipe and hose connections and the surrounding areas before disconnecting in order to avoid possible contamination of the fuel system.
2. Drain the fuel below the level of the filler tube and hose assembly. Refer to **Fuel Tank Draining Procedure** .
3. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.

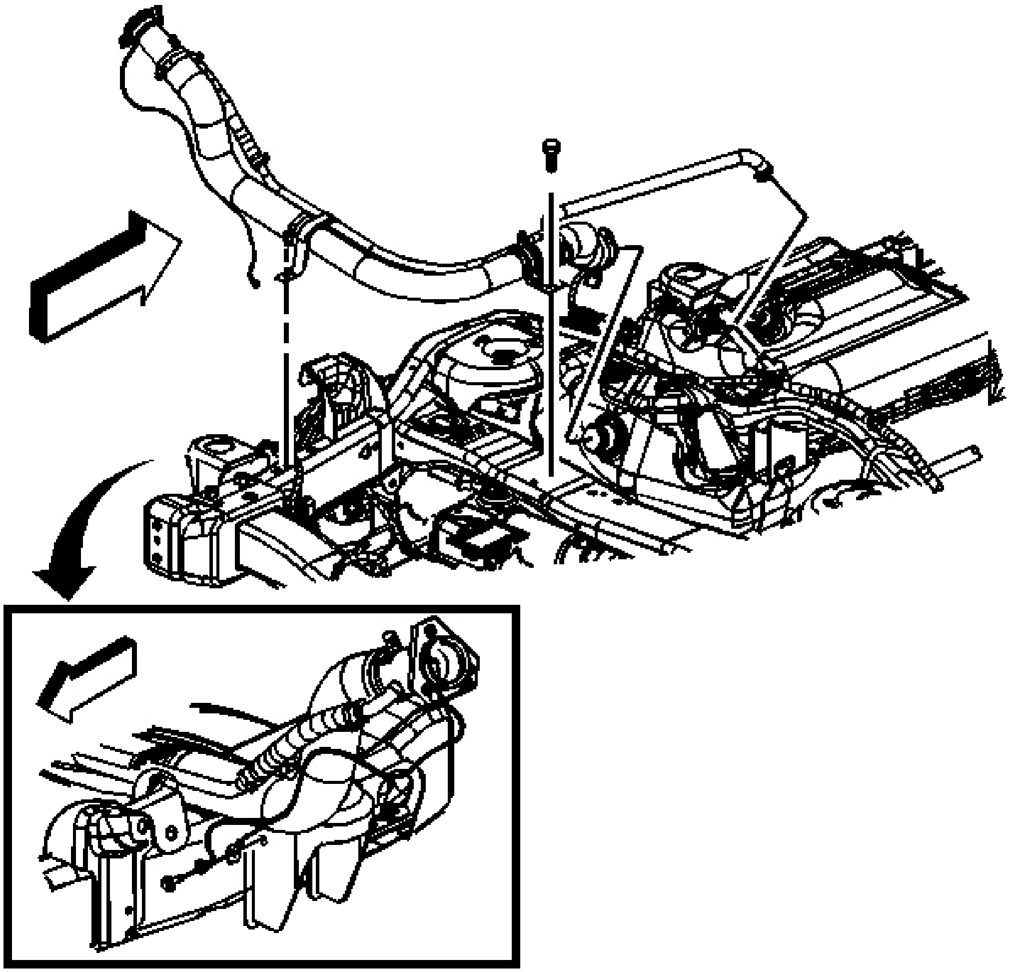


Fig. 103: Fuel Fill Hose & Hose Clamps
Courtesy of GENERAL MOTORS CORP.

4. Loosen the fuel fill hose clamp at the fuel tank.
5. Loosen the fuel fill hose clamp at the fuel fill pipe.
6. Remove the fuel fill hose and the hose clamps.
7. Cap the fuel tank opening.

Installation Procedure

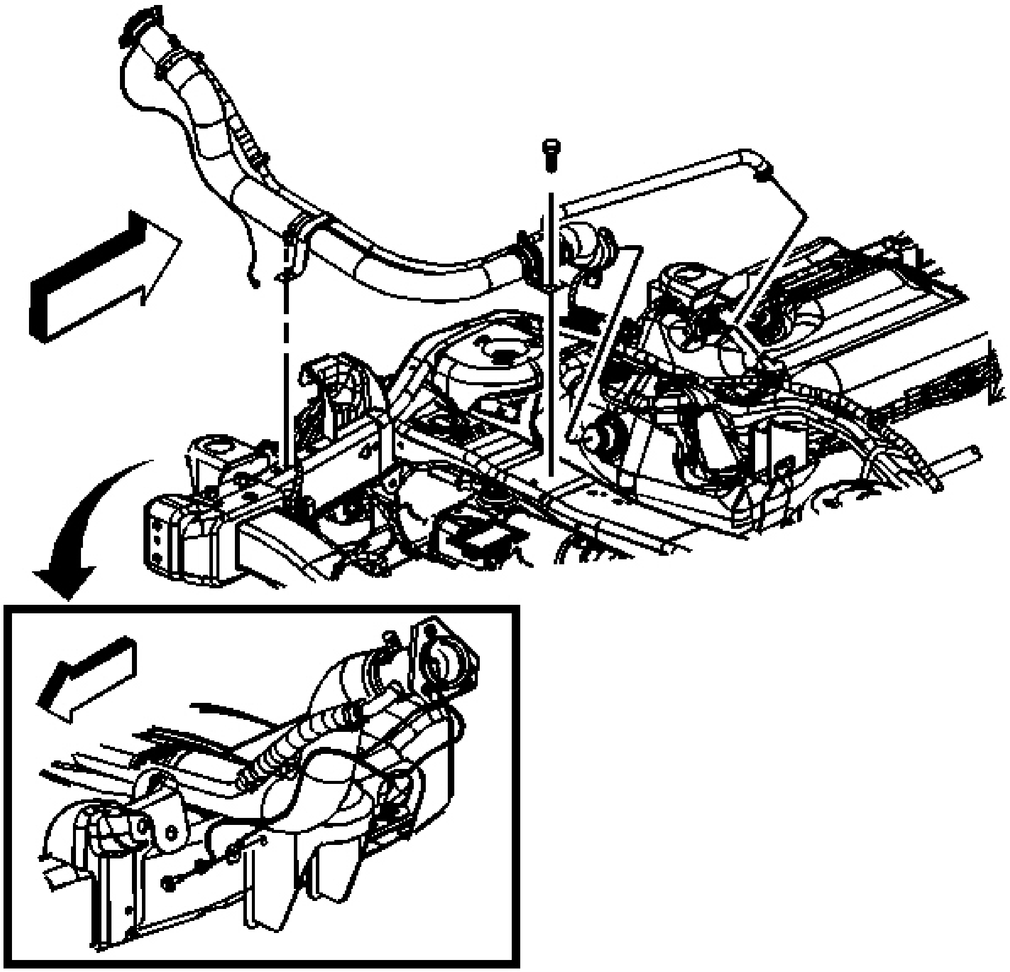


Fig. 104: Fuel Fill Hose & Hose Clamps
Courtesy of GENERAL MOTORS CORP.

1. Uncap the fuel tank opening.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the fuel fill hose and the hose clamps to the fuel fill pipe.

   Tighten: Tighten the hose clamps to 2.5 N.m (22 lb in).

3. Lower the vehicle.

4. Refill the fuel system.

FUEL SYSTEM CLEANING

Fuel Tank Cleaning

IMPORTANT:

- **Only use oil free compressed air to blow out the fuel pipes.**
- **Inspect the fuel tank internally and clean the fuel tank if you find a plugged fuel filter.**

1. Disconnect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (Single Battery)** in Engine Electrical.
2. Relieve the fuel system pressure. Refer to **Fuel Pressure Relief Procedure** .
3. Drain the fuel tank. Refer to **Fuel Tank Draining Procedure** .
4. Remove the fuel tank. Refer to **Fuel Tank Replacement** .
5. Remove the fuel sender assembly. Refer to **Fuel Sender Assembly Replacement** .
6. Inspect the fuel pump strainer. Replace a contaminated strainer and inspect the fuel pump.
7. Inspect the fuel pump inlet for dirt and debris. Replace the fuel pump if you find dirt or debris in the fuel pump inlet.

IMPORTANT: When flushing the fuel tank, handle the fuel and water mixture as a hazardous material. Handle the fuel and water mixture in accordance with all applicable local, state, and federal laws and regulations.

8. Flush the fuel tank with hot water.
9. Pour the water out of the fuel sender assembly opening. Rock the tank to be sure that removal of the water from the tank is complete.
10. Remove the fuel rail assembly. Refer to **Fuel Rail Assembly Replacement** .
11. Drain the fuel from the fuel rail. It will be necessary to remove the fuel injectors from the fuel rail to properly clear all debris from the fuel rail and fuel injectors. Use light shop air to remove any debris from the fuel rail and injectors.
12. Replace the fuel injector O-rings.
13. Use light shop air in the opposite direction of the fuel flow in order to remove any debris from the fuel lines. Catch any fuel from the fuel lines with an approved gasoline container.
14. Install the injectors to the fuel rail.
15. Install the fuel rail assembly onto the engine. Refer to **Fuel Rail Assembly Replacement** .
16. If equipped with a serviceable fuel filter, replace the fuel filter.
17. Install the fuel sender assembly. Refer to **Fuel Sender Assembly Replacement** .
18. Install the fuel tank. Refer to **Fuel Tank Replacement** .
19. Refill the fuel tank.
20. Install the fuel filler cap.

21. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (Single Battery)** in Engine Electrical.

IMPORTANT: If the fuel pump or sender assembly was not replaced, purge the fuel sender assembly.

22. Purge the fuel sender assembly.
    1. Disconnect the fuel feed line from the fuel filter.
    2. Connect a length of hose to the fuel feed pipe.
    3. Insert the other end of the hose into an empty 3.8 liter (1 gallon) approved gasoline container.
    4. Add 23 liters (6 gallons) of clean fuel into the fuel tank.
    5. Turn on the fuel pump using the scan tool until 2 liters (1/2 gallon) of fuel flows into the fuel container.
23. Inspect for leaks.
    1. Turn the ignition switch ON for 2 seconds.
    2. Turn the ignition switch OFF for 10 seconds.
    3. Turn the ignition switch ON.
    4. Inspect for fuel leaks.

FUEL RAIL ASSEMBLY REPLACEMENT

Removal Procedure

IMPORTANT: An 8-digit identification number is located on the fuel rail. Refer to this identification number when servicing or when part replacement is required.

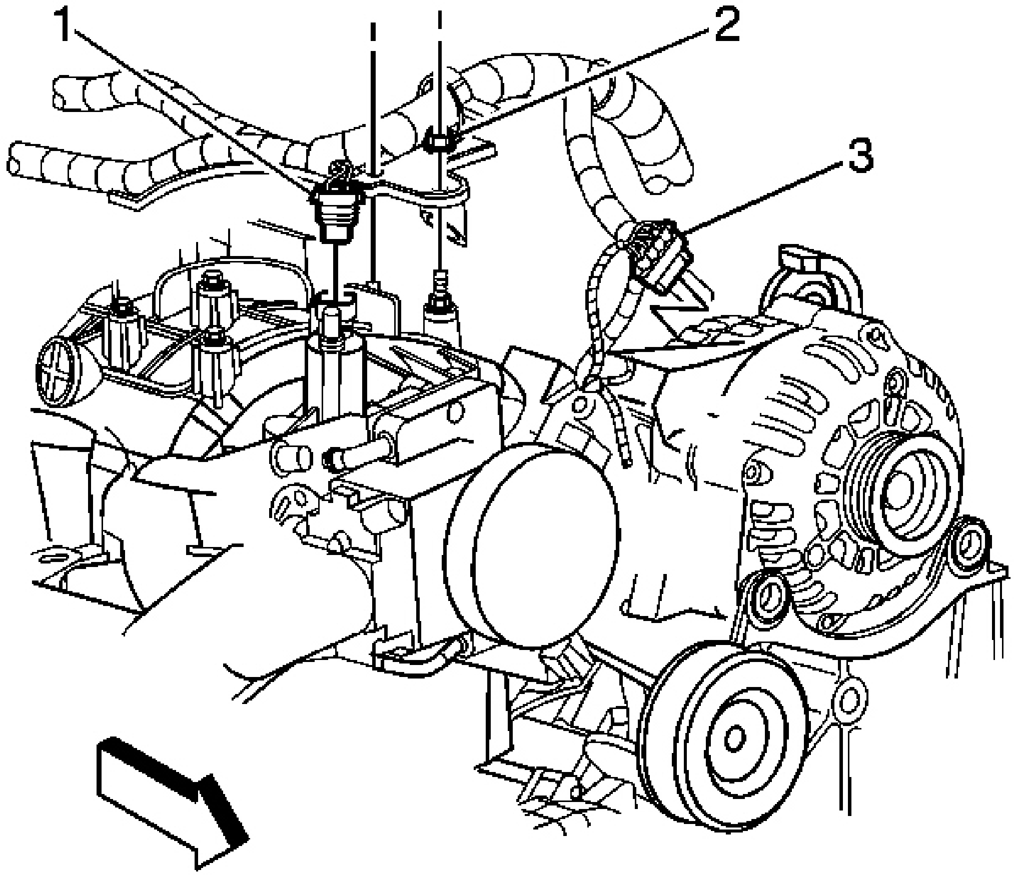


Fig. 105: View Of EVAP Canister Purge Solenoid & Generator Electrical Connectors & Bracket Nut
Courtesy of GENERAL MOTORS CORP.

1. Relieve the fuel system pressure. Refer to **Fuel Pressure Relief Procedure** .
2. Remove the wire harness bracket nut (2).
3. Disconnect the evaporative emission (EVAP) purge solenoid electrical connector (1).
4. Disconnect the generator electrical connector (3).

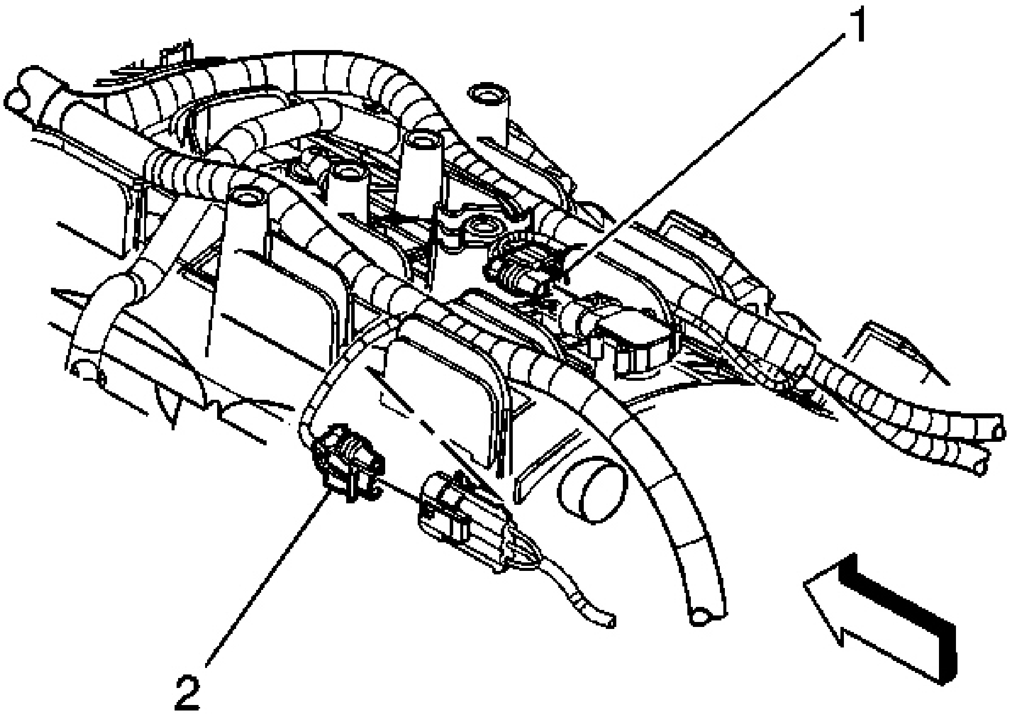


Fig. 106: View Of MAP Sensor & Knock Sensor Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

5. Disconnect the following electrical connectors:
    - Manifold absolute pressure (MAP) sensor (1)
    - Knock sensor (2)
6. Remove the knock sensor harness connector from the intake manifold.

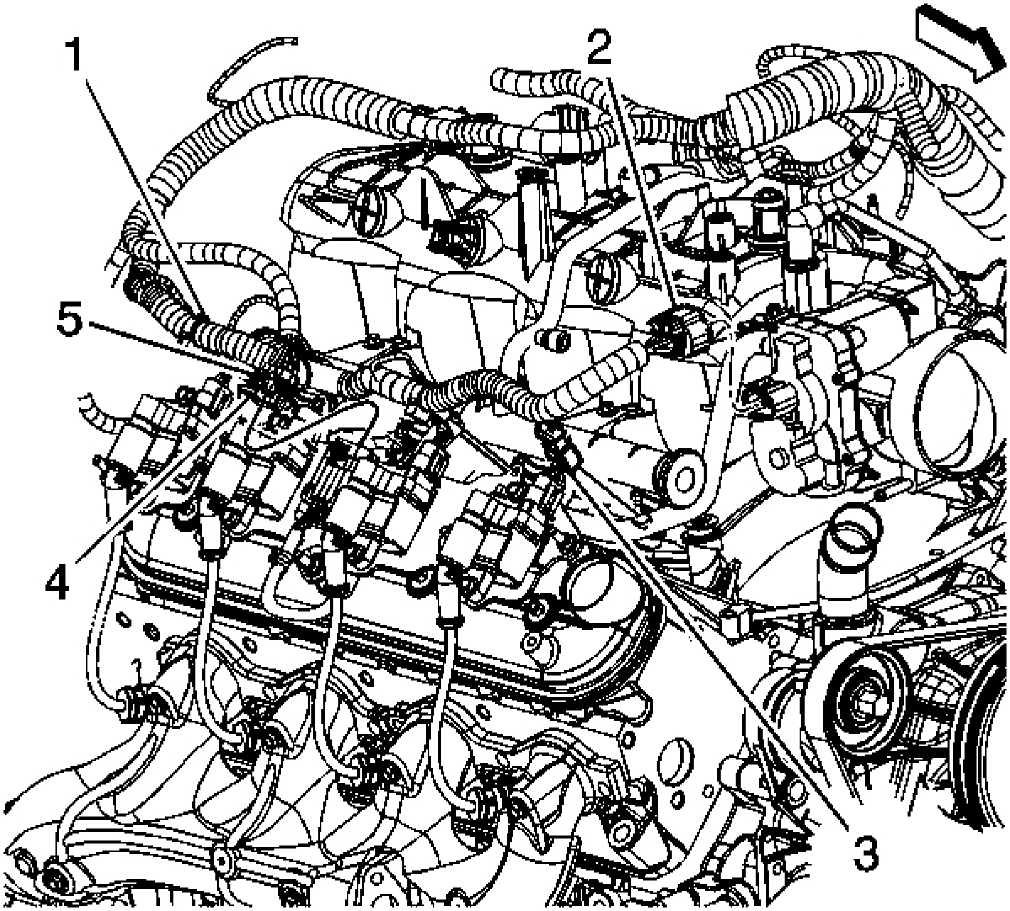


Fig. 107: View Of Right Side Main Electrical Connector
Courtesy of GENERAL MOTORS CORP.

7. Disconnect the electronic throttle control (ETC) electrical connector (2). Perform the following:
    1. Disengage the gray retainer.
    2. Push down the black clip.
    3. Disconnect the connector.
8. Remove the connector position assurance (CPA) retainer (5).
9. Disconnect the following electrical connectors from the right side of the engine:
    - Main coil (4)
    - Fuel injectors (3)
10. Remove the harness clips from the fuel rail (1).

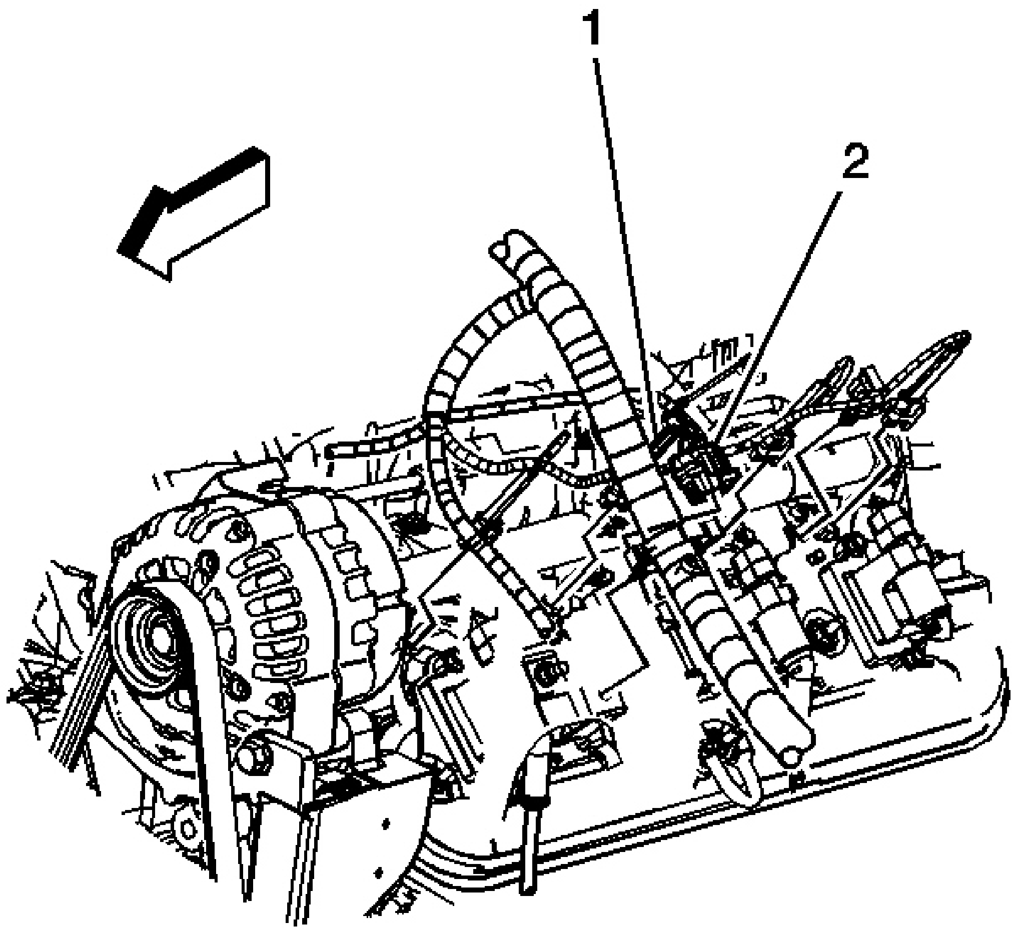


Fig. 108: View Of Main Ignition Coil Wire Harness Connector & Clips
Courtesy of GENERAL MOTORS CORP.

11. Remove the CPA retainer from the left side of the engine.
12. Disconnect the following electrical connectors from the left side of the engine:
    - Main coil (2)
    - Fuel injectors
13. Remove the harness clips from the fuel rail (1).
14. Reposition the engine wire harness aside.

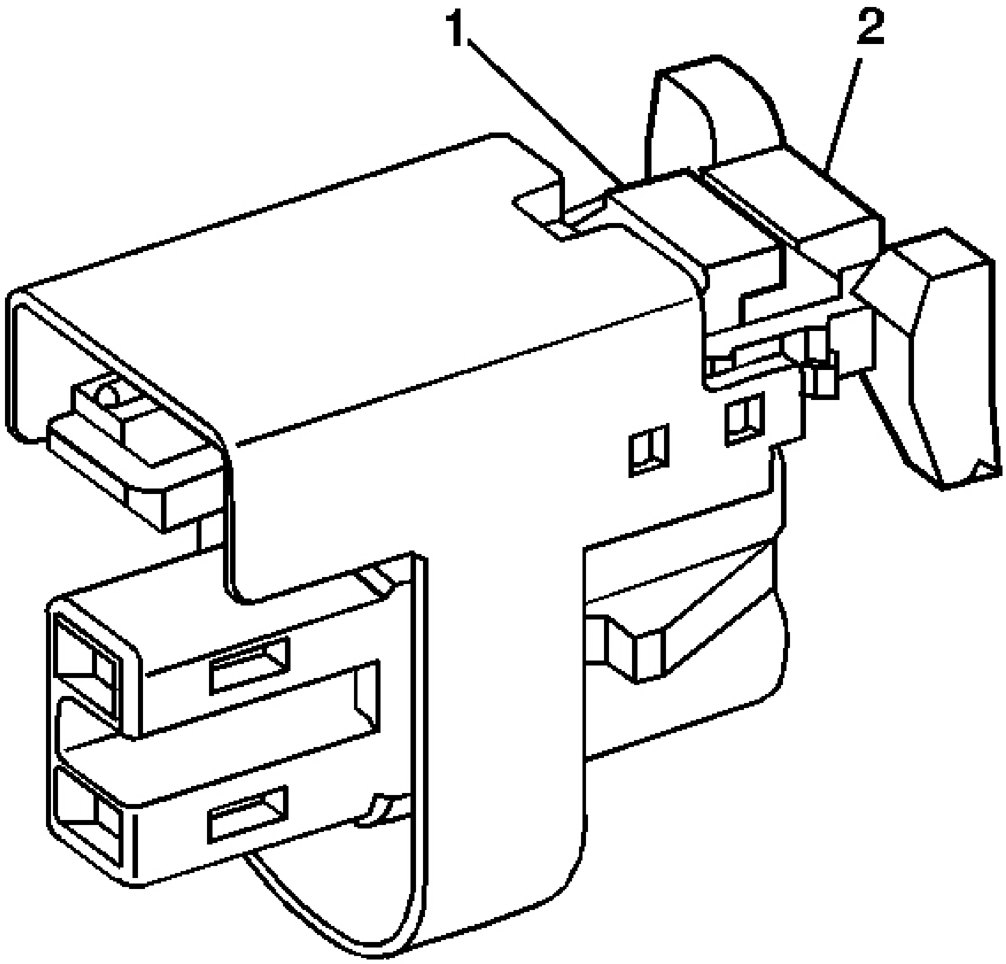
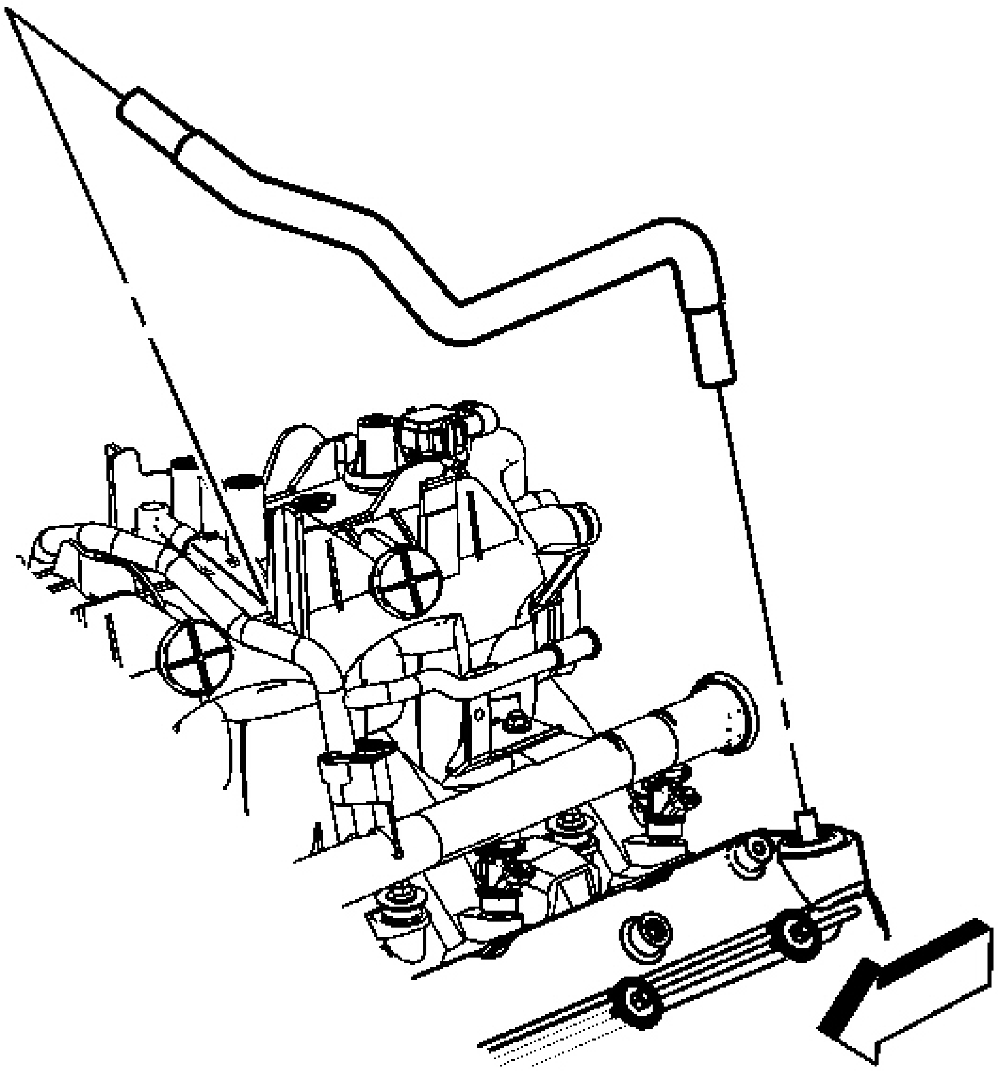


Fig. 109: CPA Retainer & Tab
Courtesy of GENERAL MOTORS CORP.

15. Perform the following steps in order to disconnect the fuel injector electrical connectors:
    1. Mark the connectors to their corresponding injectors to ensure correct reassembly.
    2. Pull the CPA retainer (2) on the connector up one click.
    3. Push the tab (1) on the connector in.
    4. Disconnect the fuel injector electrical connector.
    5. Repeat the steps for each injector electrical connector.



<u>Fig. 110: View Of PCV Hose</u>
Courtesy of GENERAL MOTORS CORP.

16. Remove the positive crankcase ventilation (PCV) hose.

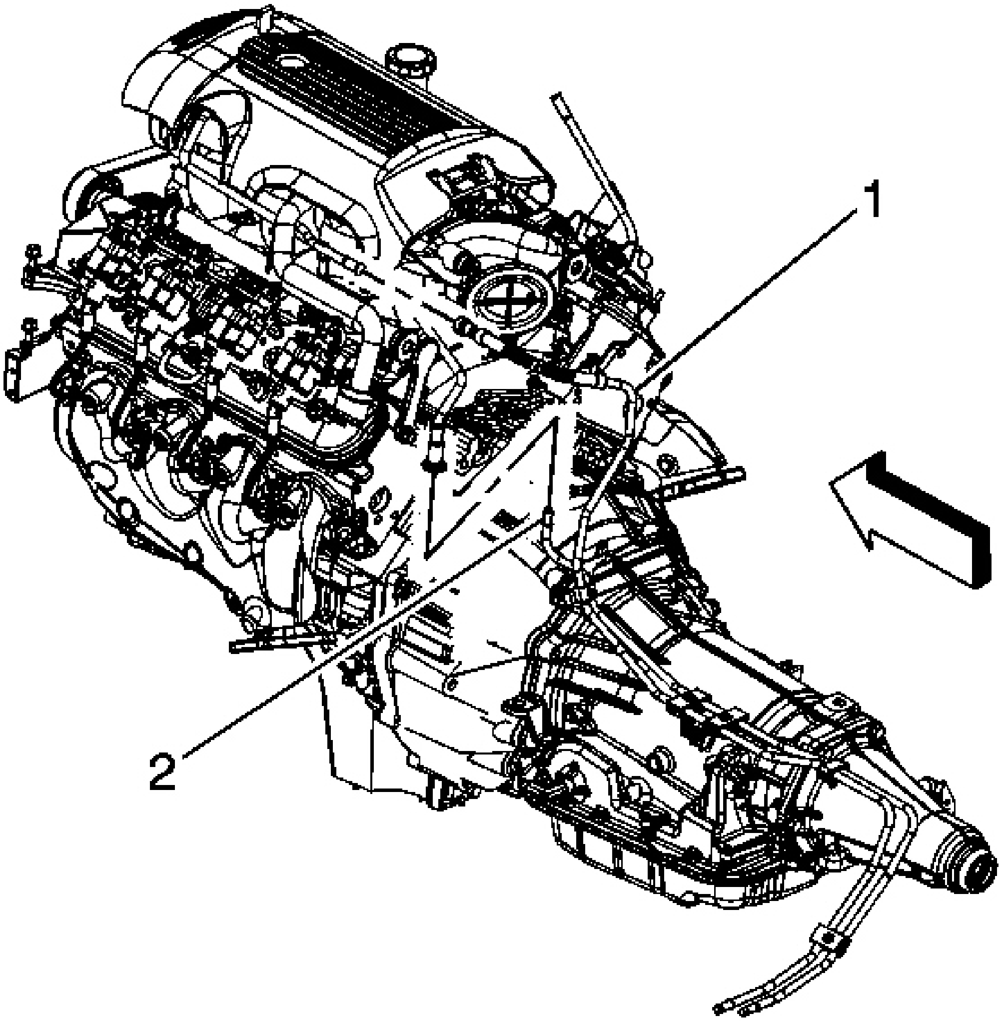


Fig. 111: Identifying Fuel Feed & EVAP Pipes
Courtesy of GENERAL MOTORS CORP.

17. Disconnect the fuel feed pipe (1) from the fuel rail. Refer to **Quick Connect Fitting(s) Service (Metal Collar)** .

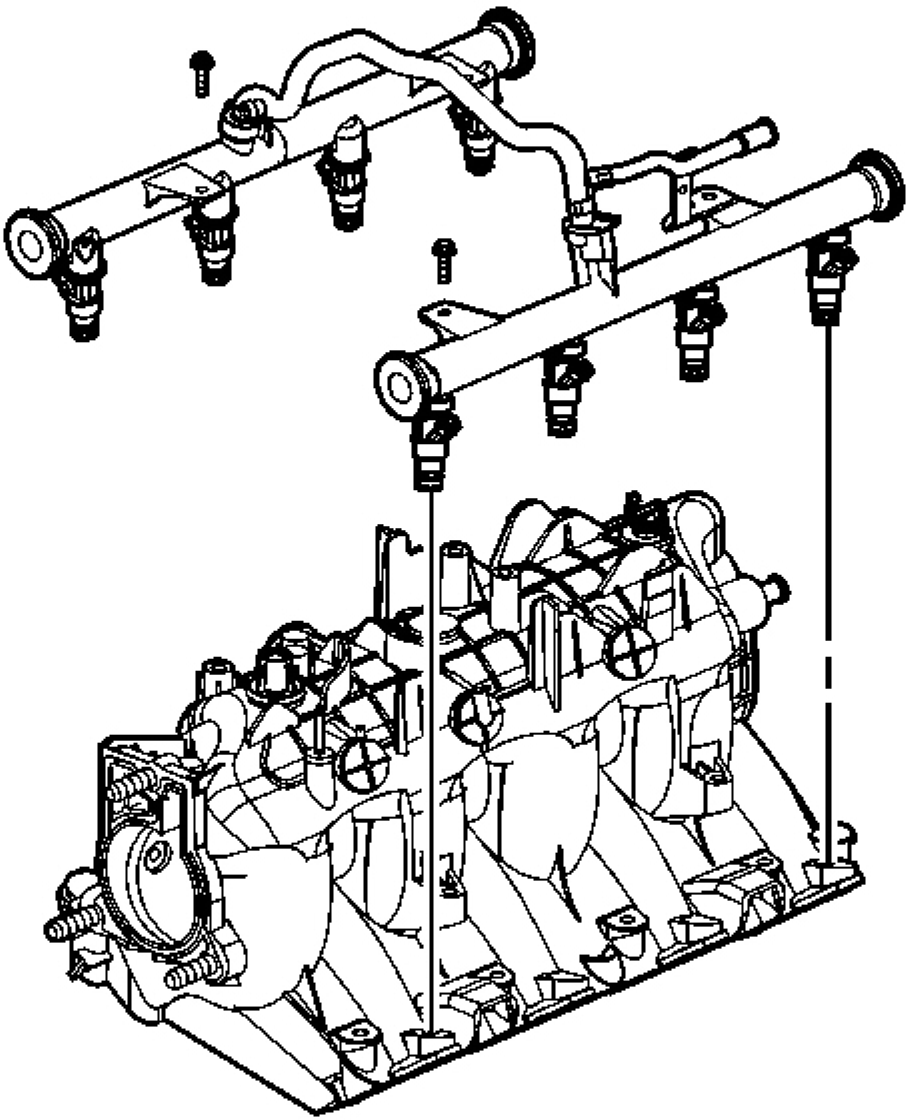


Fig. 112: View Of Fuel Rail & Injectors
Courtesy of GENERAL MOTORS CORP.

18. Remove the fuel rail bolts.

NOTE:

- **Remove the fuel rail assembly carefully in order to prevent damage to the injector electrical connector terminals and the injector spray**

tips. Support the fuel rail after the fuel rail is removed in order to avoid damaging the fuel rail components.

- **Cap the fittings and plug the holes when servicing the fuel system in order to prevent dirt and other contaminants from entering open pipes and passages.**

IMPORTANT: Before removal, clean the fuel rail with a spray type engine cleaner, such as GM X-30A or equivalent, if necessary. Follow the package instructions. Do not soak the fuel rail in liquid cleaning solvent.

19. Remove the fuel rail.

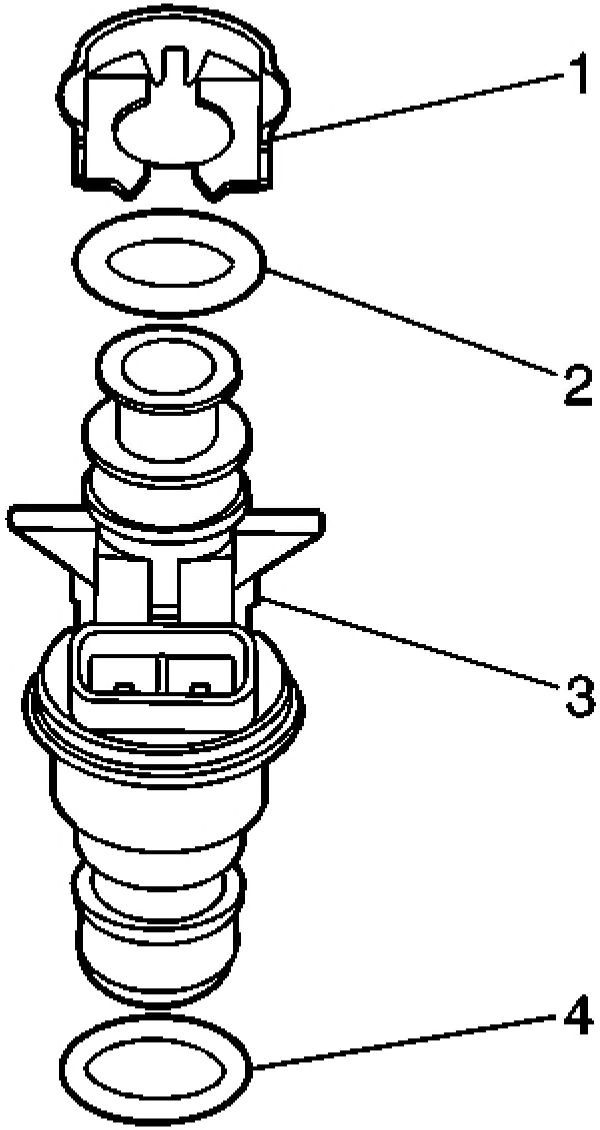


Fig. 113: Exploded View Of Fuel Injector
Courtesy of GENERAL MOTORS CORP.

20. Remove the fuel injector lower O-ring seal (4) from each injector, if necessary.
21. Discard the O-ring seal.

Installation Procedure

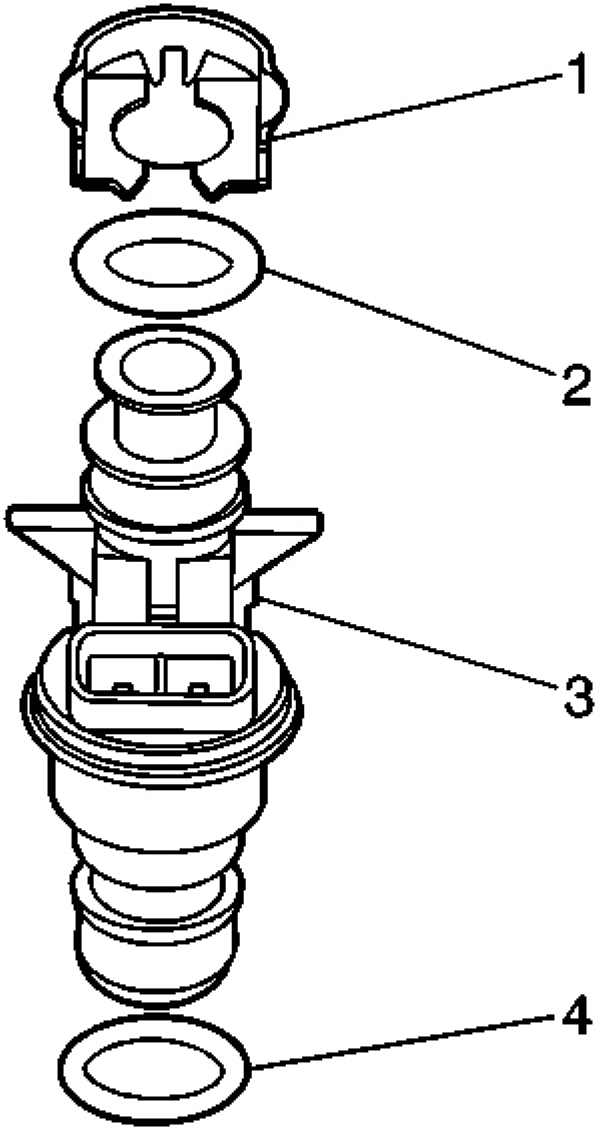


Fig. 114: Exploded View Of Fuel Injector
Courtesy of GENERAL MOTORS CORP.

1. Lubricate NEW fuel injector lower O-ring seals (4) with clean engine oil.
2. Install the NEW O-ring seals (4) onto each injector, if necessary.

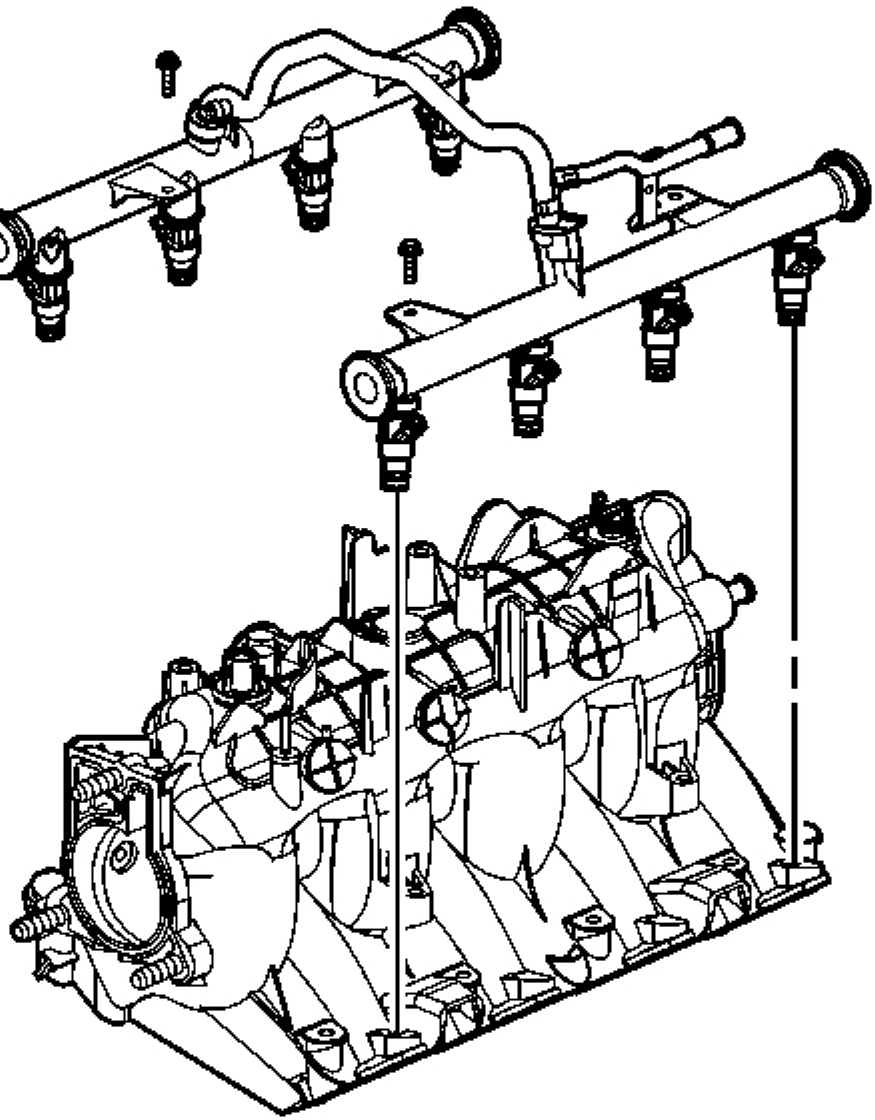


Fig. 115: View Of Fuel Rail & Injectors
Courtesy of GENERAL MOTORS CORP.

3. Install the fuel rail.
4. Apply a 5 mm (0.2 in) band of threadlock GM P/N 12345382 (Canadian P/N 10953489), or equivalent to the threads of the fuel rail bolts.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

5. Install the fuel rail bolts.

   Tighten: Tighten the bolts to 10 N.m (89 lb in).

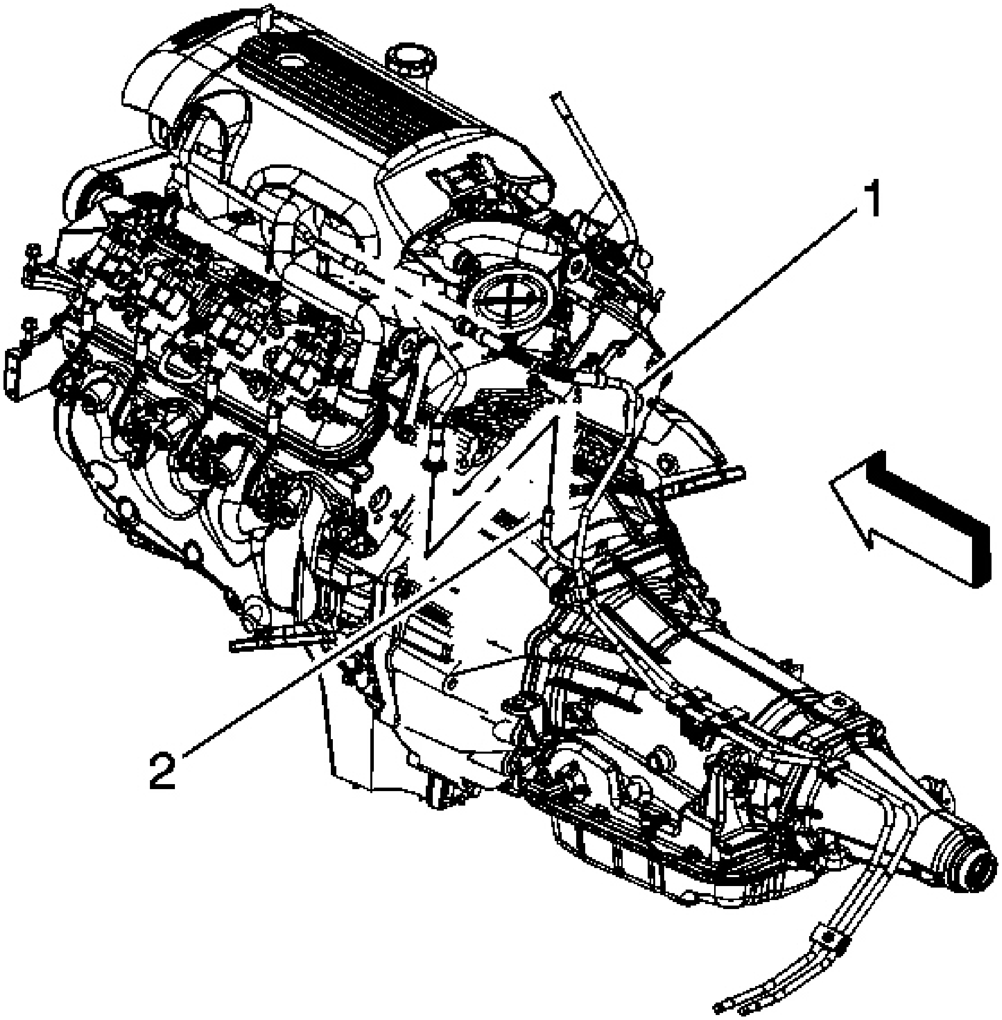


Fig. 116: Identifying Fuel Feed & EVAP Pipes
Courtesy of GENERAL MOTORS CORP.

6. Connect the fuel feed pipe (1) to the fuel rail. Refer to **Quick Connect Fitting(s) Service (Metal Collar)** .

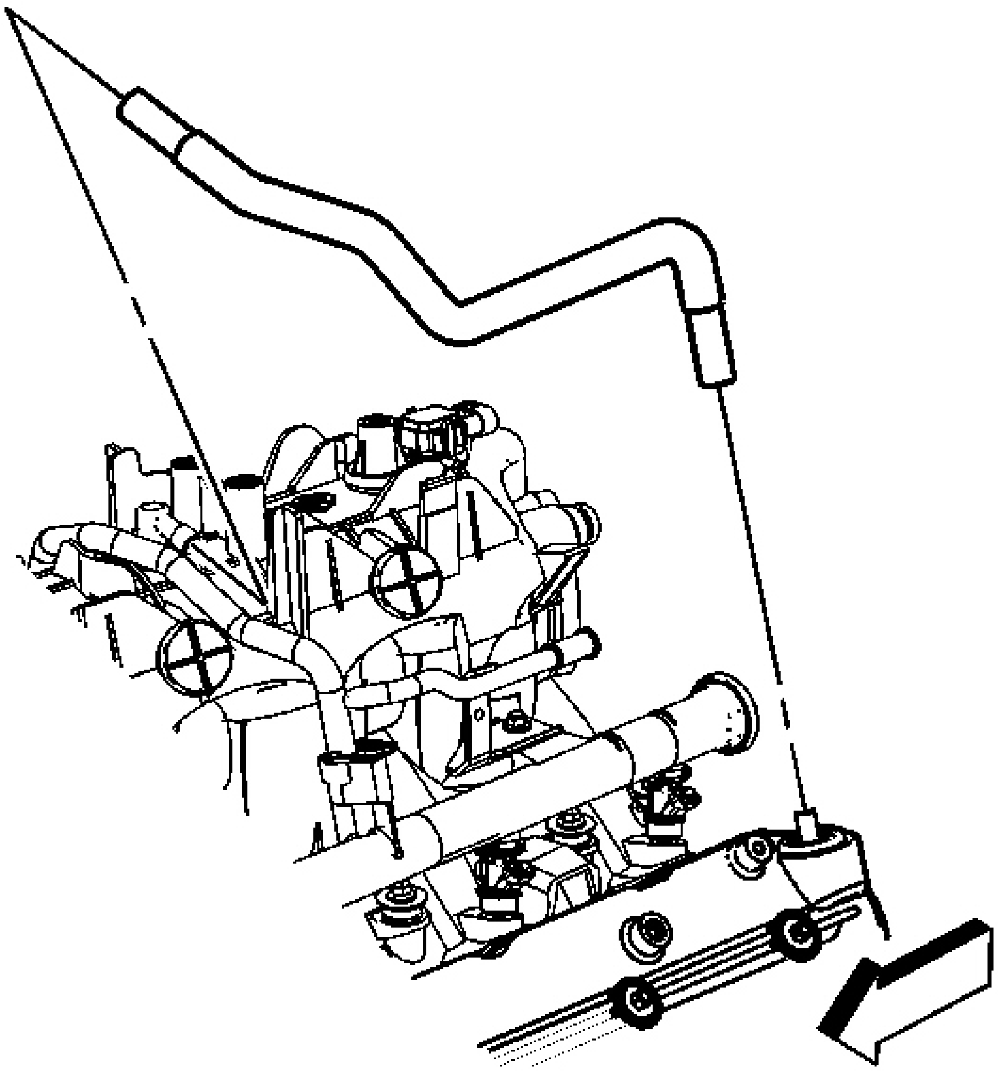


Fig. 117: View Of PCV Hose
Courtesy of GENERAL MOTORS CORP.

7. Install the PCV hose.

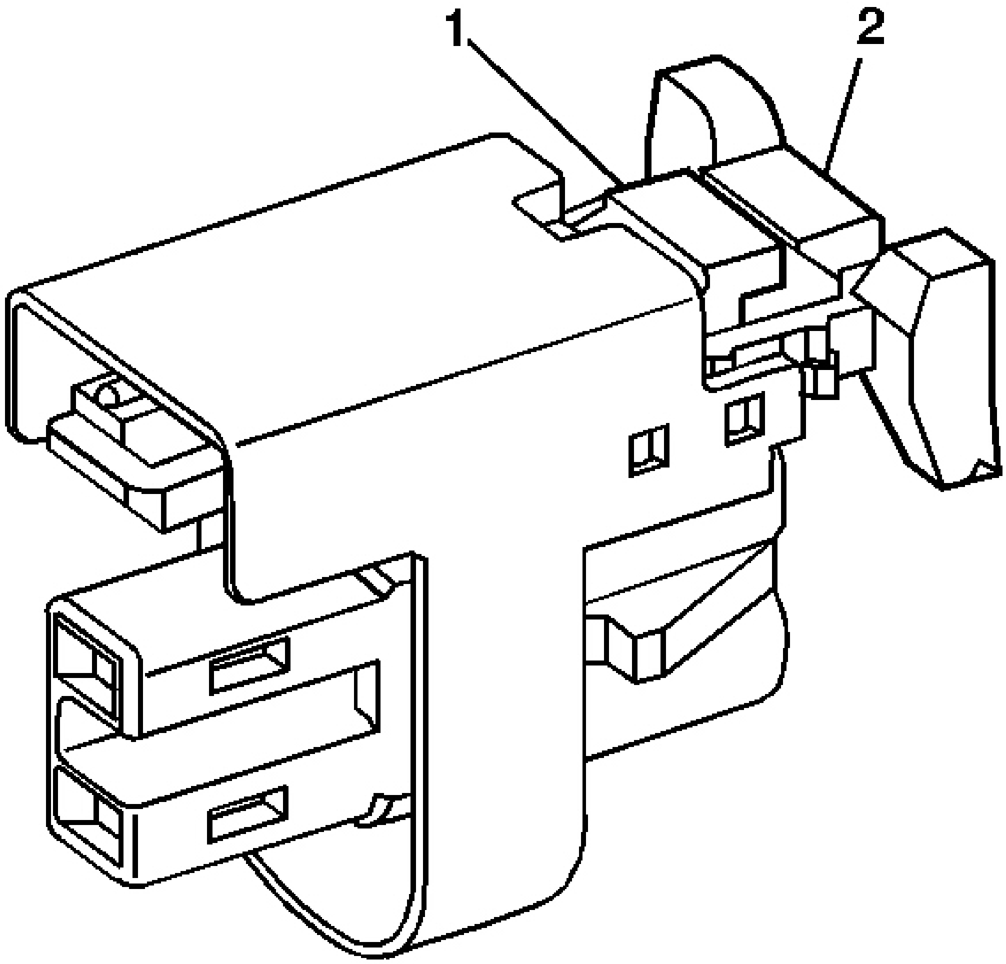


Fig. 118: CPA Retainer & Tab
Courtesy of GENERAL MOTORS CORP.

8. Perform the following steps in order to connect the fuel injector electrical connectors:
   1. Install the connectors to their corresponding injectors to ensure correct reassembly.
   2. Connect the fuel injector electrical connector.
   3. Push the CPA retainer (2) on the connector in one click.
   4. Repeat the steps for each injector electrical connector.

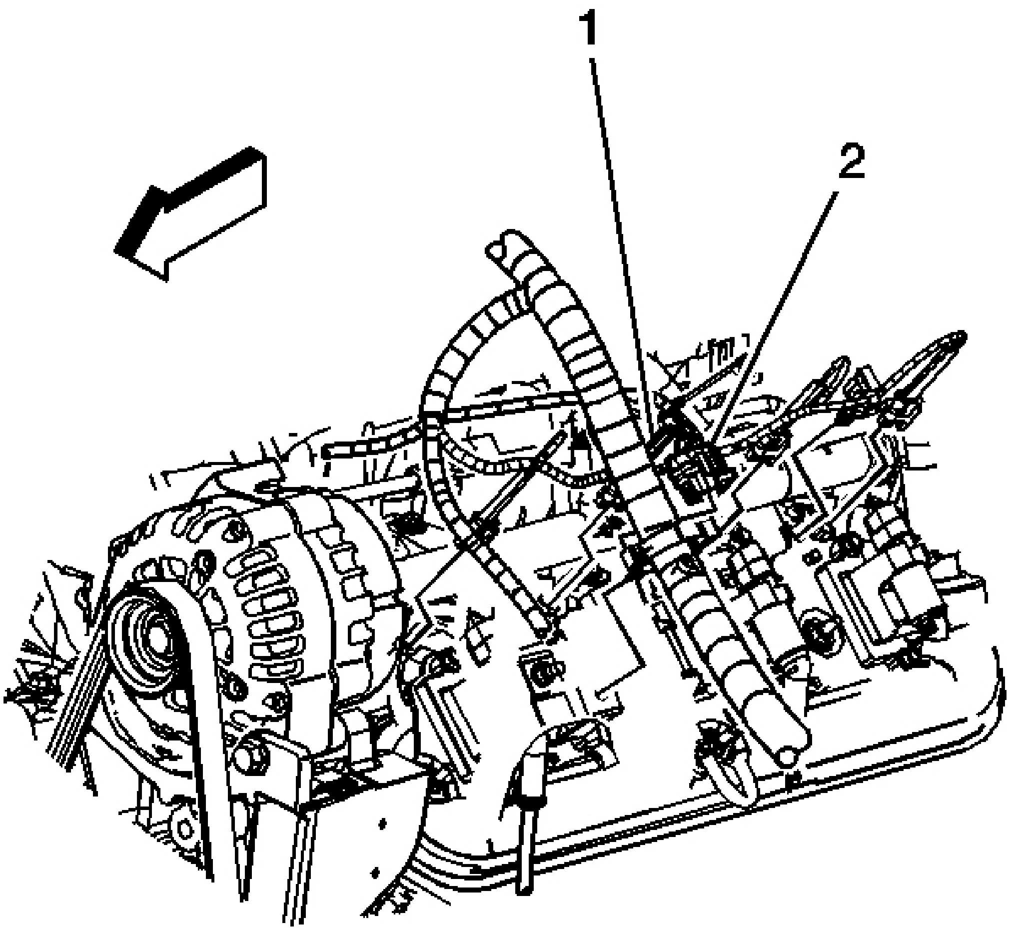


Fig. 119: View Of Main Ignition Coil Wire Harness Connector & Clips
Courtesy of GENERAL MOTORS CORP.

9. Position the engine wire harness.
10. Connect the following electrical connectors to the left side of the engine:
    - Main coil (2)
    - Fuel injectors
11. Install the harness clips to the fuel rail (1).
12. Install the CPA retainer.

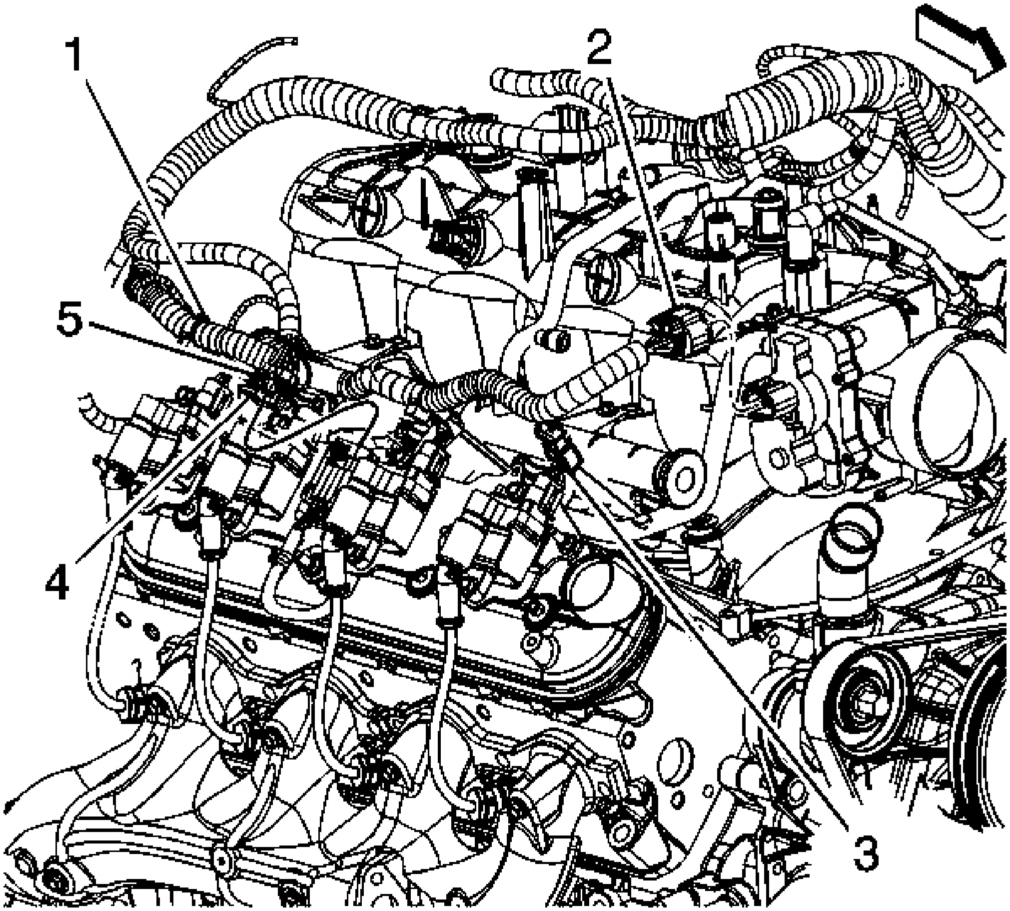


Fig. 120: View Of Right Side Main Electrical Connector
Courtesy of GENERAL MOTORS CORP.

13. Connect the following electrical connectors to the right side of the engine:
    - Main coil (4)
    - Fuel injectors (3)
14. Install the CPA retainer (5).
15. Install the harness clips to the fuel rail (1).
16. Connect the ETC electrical connector (2). Perform the following:
    1. Connect the connector.
    2. Engage the gray retainer.

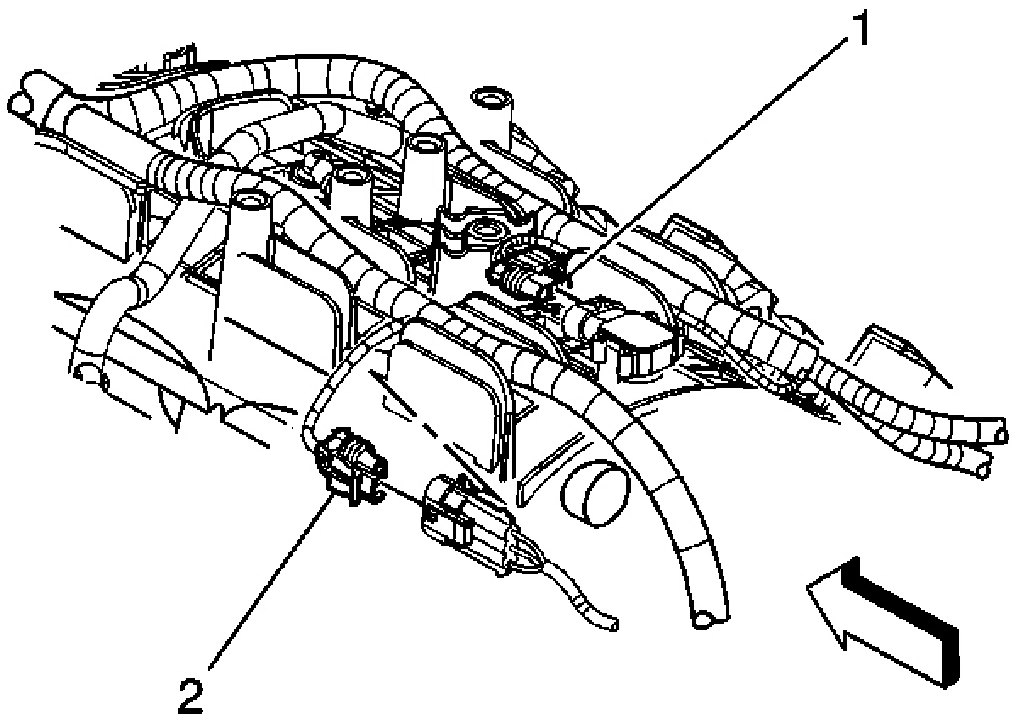


Fig. 121: View Of MAP Sensor & Knock Sensor Electrical Connectors
Courtesy of GENERAL MOTORS CORP.

17. Connect the following electrical connectors:
    - MAP sensor (1)
    - Knock sensor (2)
18. Install the knock sensor harness connector to the intake manifold.

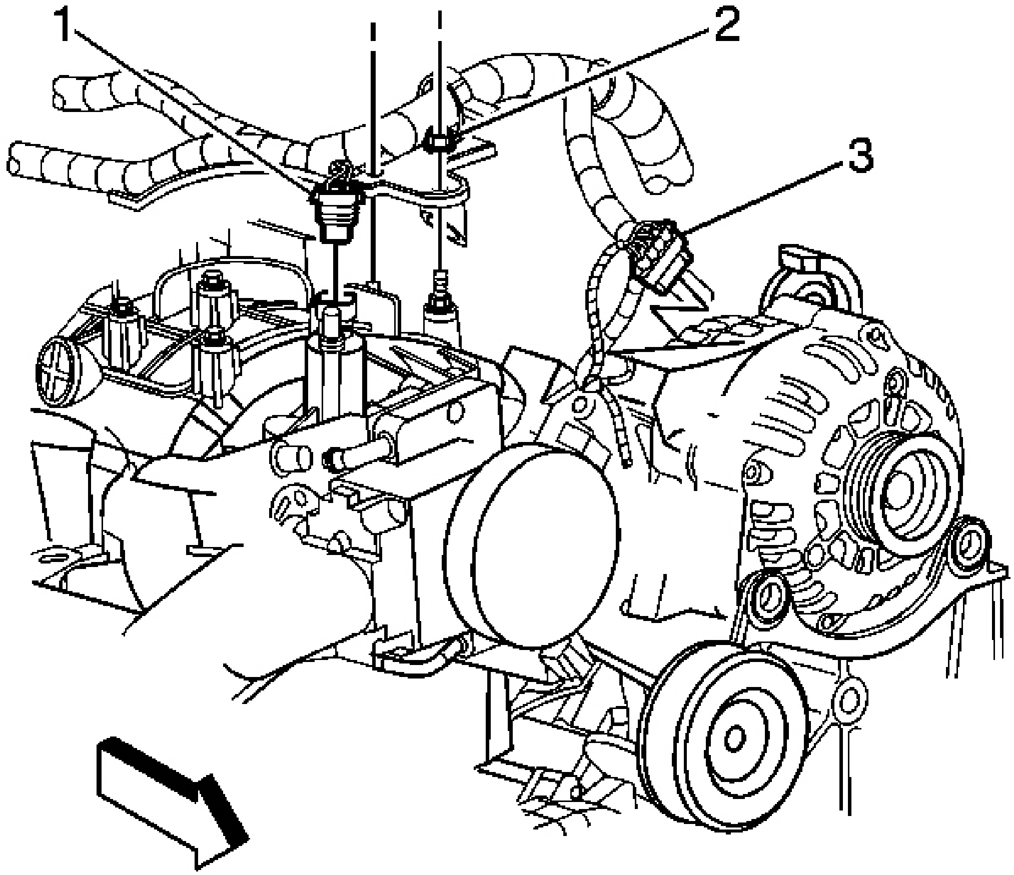


Fig. 122: View Of EVAP Canister Purge Solenoid & Generator Electrical Connectors & Bracket Nut
Courtesy of GENERAL MOTORS CORP.

19. Connect the EVAP purge solenoid electrical connector (1).
20. Connect the generator electrical connector (3).
21. Install the wire harness bracket nut (2).

    Tighten: Tighten the nut to 5 N.m (44 lb in).

22. Tighten the fuel fill cap.
23. Connect the negative battery cable. Refer to **Battery Negative Cable Disconnect/Connect Procedure (Single Battery)** in Engine Electrical.
24. Use the following procedure in order to inspect for leaks:

1. Turn the ignition ON, with the engine OFF, for 2 seconds.
2. Turn the ignition OFF for 10 seconds.
3. Turn the ignition ON, with the engine OFF.
4. Inspect for fuel leaks.

FUEL INJECTOR REPLACEMENT

Removal Procedure

NOTE: Use care in removing the fuel injectors in order to prevent damage to the fuel injector electrical connector pins or the fuel injector nozzles. Do not immerse the fuel injector in any type of cleaner. The fuel injector is an electrical component and may be damaged by this cleaning method.

IMPORTANT: The Denso fuel injectors that are installed on the 5.3L (L59) E85 application will not have O-rings and retaining clips serviced separately. Therefore the fuel injectors will be replaced whenever an O-ring or clip needs to be replaced.

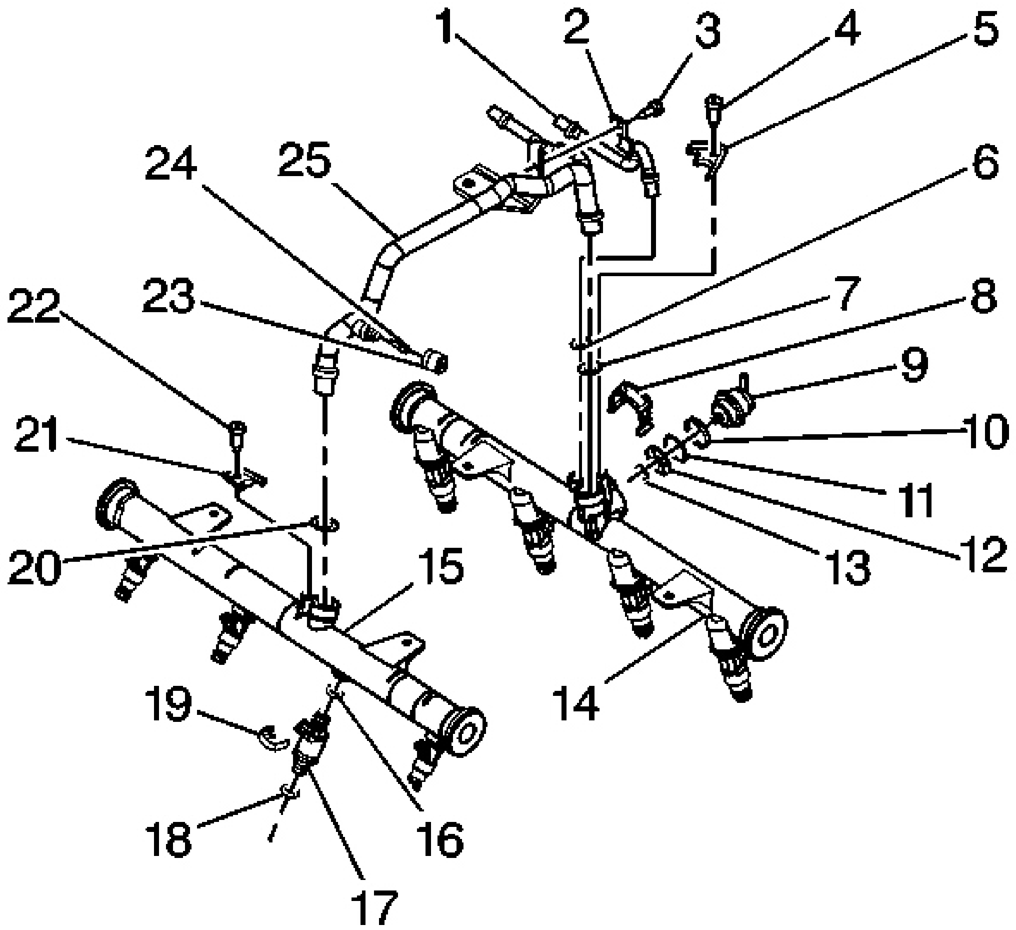


Fig. 123: Expanded View Of Fuel Rails & Injectors
Courtesy of GENERAL MOTORS CORP.

IMPORTANT: The engine oil may be contaminated with fuel if the fuel injectors are leaking.

1. Remove the fuel rail. Refer to **Fuel Rail Assembly Replacement** .
2. Remove the fuel injector retainer clip (19).
3. Remove the fuel injector (17).

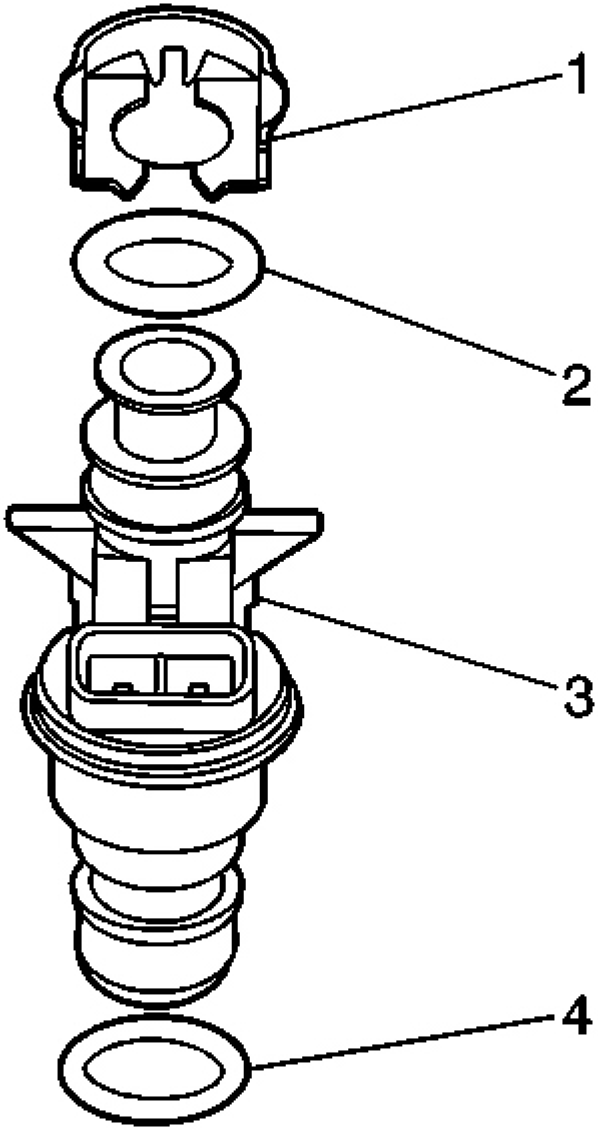


Fig. 124: Exploded View Of Fuel Injector
Courtesy of GENERAL MOTORS CORP.

4. Discard the fuel injector retainer clip (1).
5. Remove and discard the fuel injector O-ring seals (2, 4) from the injector.

Installation Procedure

IMPORTANT: When ordering new fuel injectors, you must order the correct injector for the application being serviced.

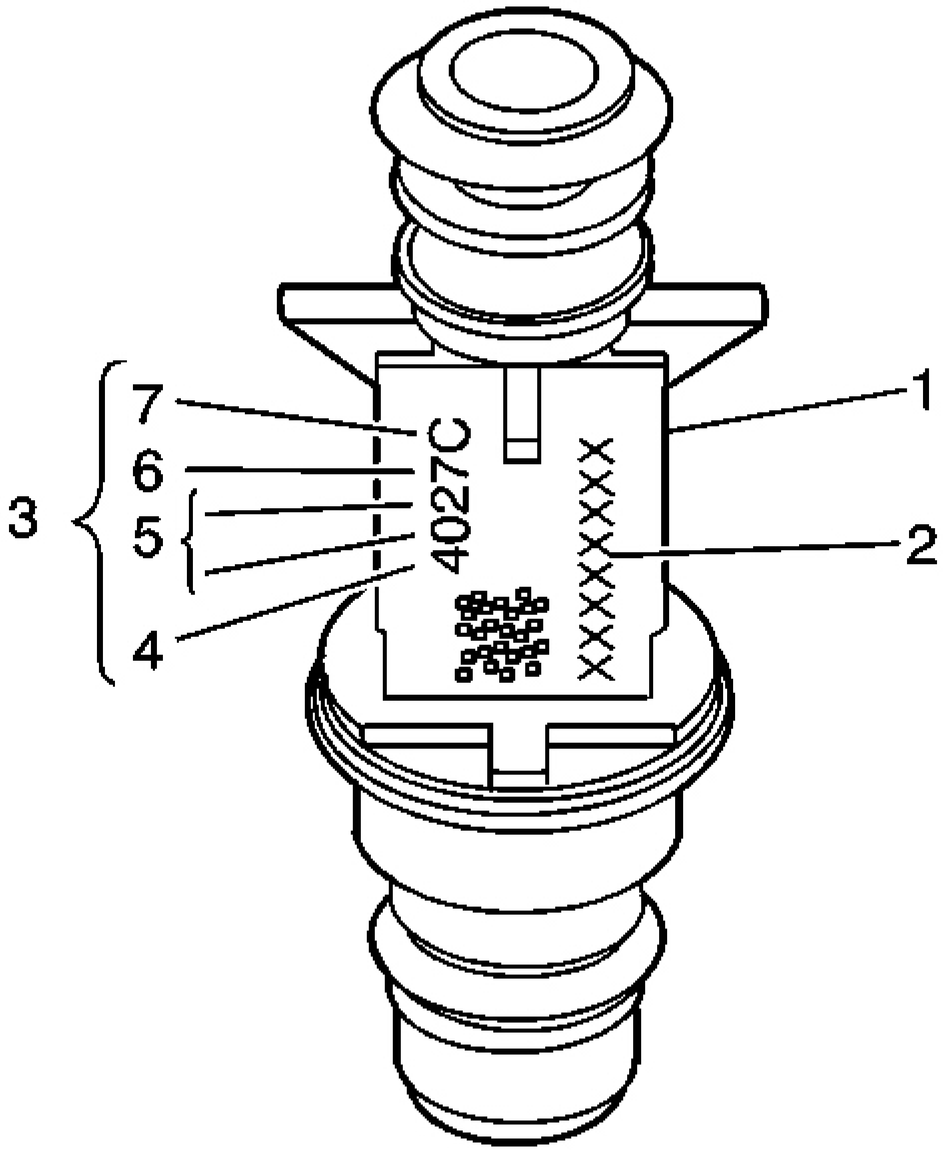


Fig. 125: Identifying Fuel Injector ID Number
Courtesy of GENERAL MOTORS CORP.

1. The fuel injector (1) is stamped with a part number identification (2). A four-digit build date code (3), which indicates the month (4), day (5), year (6), and the shift (7) that built the fuel injector.

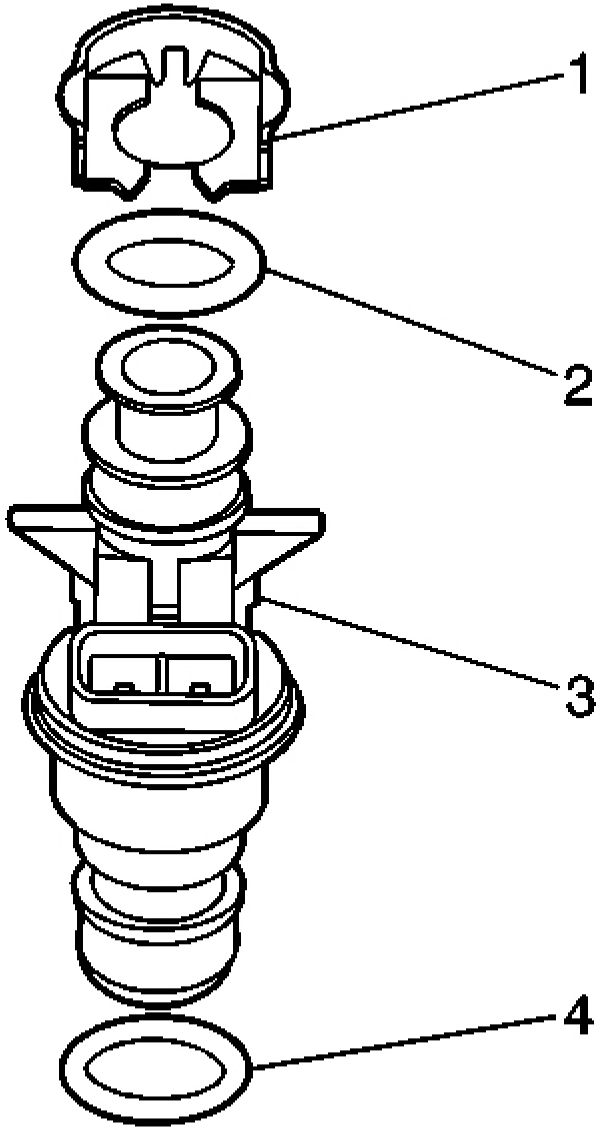


Fig. 126: Exploded View Of Fuel Injector
Courtesy of GENERAL MOTORS CORP.

2. Lubricate the NEW fuel injector O-ring seals (2, 4) with clean engine oil.

3. Install the NEW fuel injector O-ring seals onto the fuel injector.
4. Install a NEW retainer clip (1) onto the fuel injector.

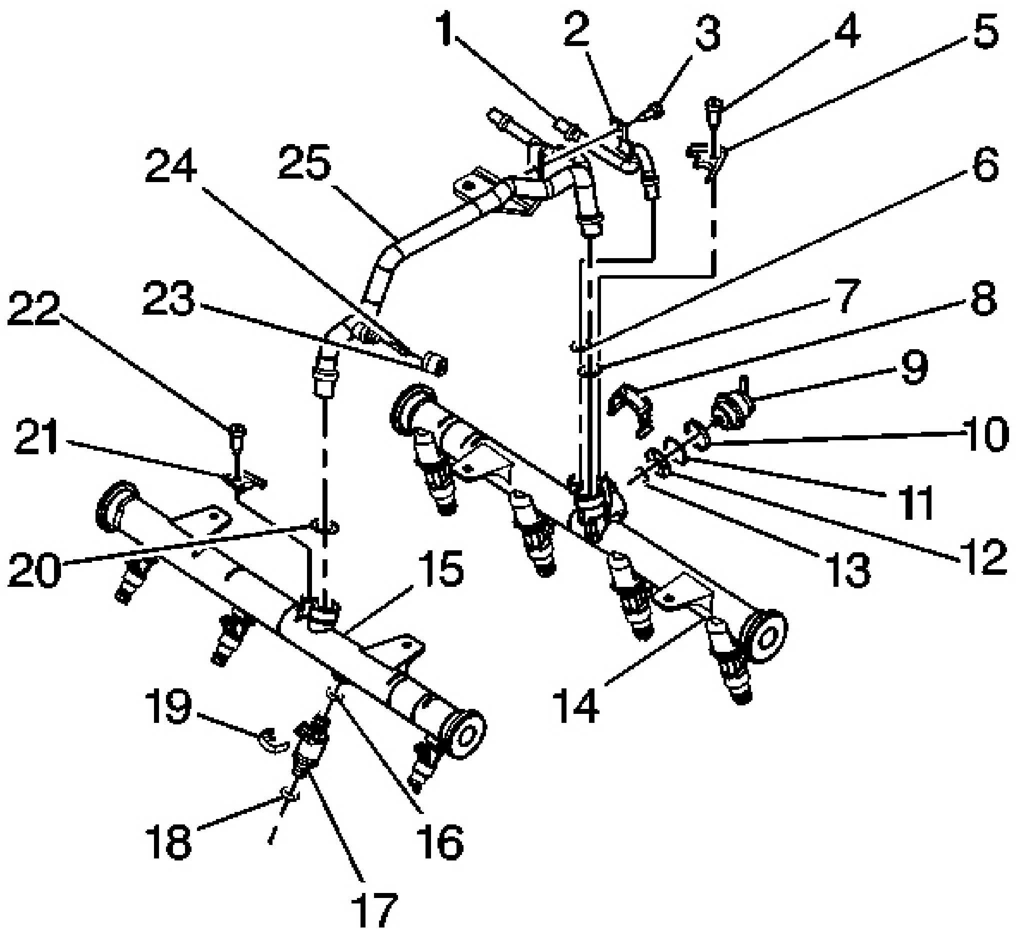


Fig. 127: Expanded View Of Fuel Rails & Injectors
Courtesy of GENERAL MOTORS CORP.

5. Install the fuel injector (17) into the fuel rail injector socket with the electrical connector facing outward. The retainer clip (19) locks on to a flange on the fuel rail injector socket.
6. Install the fuel rail. Refer to **Fuel Rail Assembly Replacement** .

FUEL INJECTOR CLEANING PROCEDURE

Tools Required

- **J 37287** Fuel Line Shut-Off Adapters. See **Special Tools and Equipment** .
- J 35800-A Fuel Injector Cleaner
- J 42873-1 3/8 Fuel Line Shut-Off Valve
- J 42873-2 5/16 Return Pipe Shut-Off Valve
- J 42964-1 3/8 Fuel Pipe Shut-Off Valve
- J 42964-2 5/16 Fuel Pipe Shut-Off Valve

NOTE:

- **GM Top-Engine Cleaner is the only injector cleaning agent recommended. Do not use other cleaning agents, as they may contain methanol which can damage fuel system components.**
- **Under NO circumstances should the top engine cleaner be added to the vehicles fuel tank, as it may damage the fuel pump and other system components.**
- **Do not exceed a 10 percent cleaning solution concentration. Higher concentrations may damage fuel system components. Testing has demonstrated that exceeding the 10 percent cleaning solution concentration does not improve the effectiveness of this procedure.**

IMPORTANT: Vehicles with less than 160 km (100 mi) on the odometer should not have the injectors cleaned. These vehicles should have the injectors replaced.

IMPORTANT: During this procedure you will need a total of 960 ml (32.4 oz) of cleaning solution. That is 2 tanks of solution for the J 35800-A . Other brands of tools may have a different capacity and would therefore require more or less tanks to complete the procedure. You must use all 960 ml (32.4 oz) of solution to ensure complete injector cleaning.

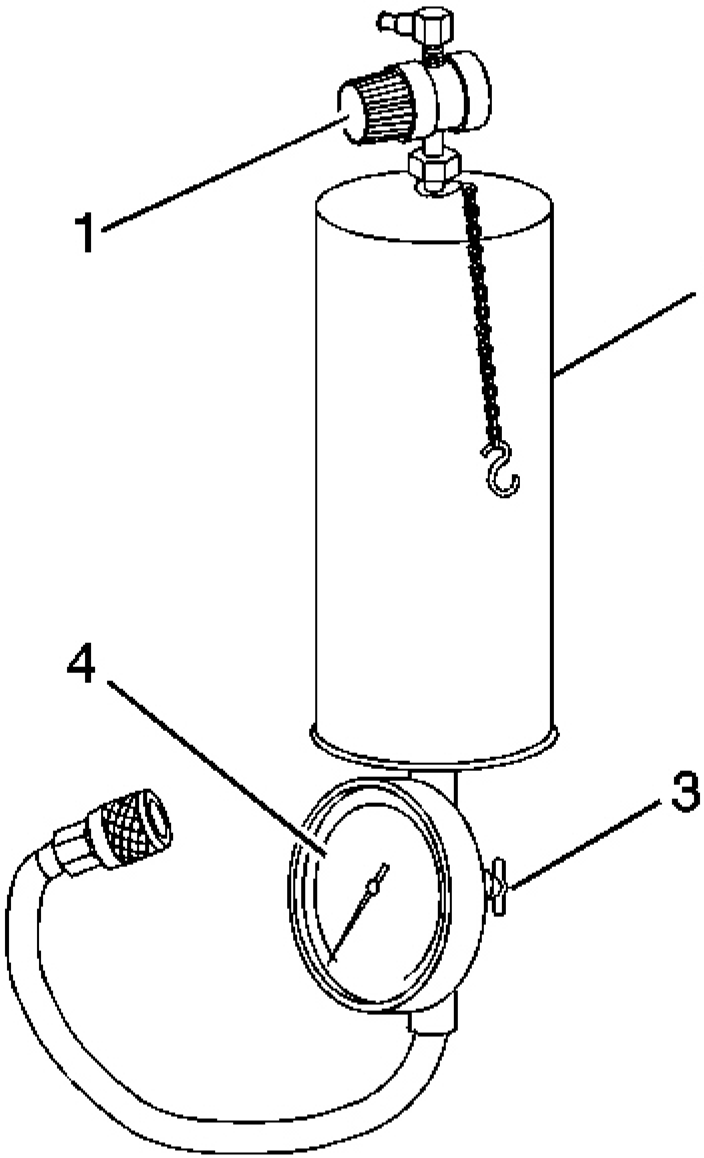


Fig. 128: Identifying Fuel Injector Cleaner J 38500-A
Courtesy of GENERAL MOTORS CORP.

1. Obtain J 35800-A (2).

IMPORTANT: Make sure the valve at the bottom of the canister (3) is closed.

2. For US dealers, empty 2 pre-measured GM Top-Engine Cleaner containers, 24 ml (0.812 oz) each, GM P/N 12346535, into the J 35800-A .
3. For Canadian dealers, measure and dispense 48 ml (1.62 oz) of Top-Engine Cleaner, Canadian P/N 992872, into the J 35800-A .
4. If you are using any other brand of tank you will need a total of 96 ml (3.24 oz) of Top-Engine Cleaner mixed with 864 ml (29.16 oz) of regular unleaded gasoline.
5. Fill the injector cleaning tank with regular unleaded gasoline. Be sure to follow all additional instructions provided with the tool.
6. Electrically disable the vehicle fuel pump by removing the fuel pump relay and disconnecting the oil pressure switch connector, if equipped.
7. Disconnect the fuel feed and return line, if equipped, at the fuel rail. Plug the fuel feed and return line, if equipped, coming off the fuel rail with **J 37287** , or J 42964-1 , and J 42964-2 or J 42873-1 , and J 42873-2 as appropriate for the fuel system. See **Special Tools and Equipment** .
8. Connect the J 35800-A to the vehicle fuel rail.
9. Pressurize the J 35800-A to 510 kPa (75 psi).
10. Start and idle the engine until it stalls due to lack of fuel. This should take approximately 15-20 minutes.
11. Disconnect J 35800-A from the fuel rail.
12. Reconnect the vehicle fuel pump relay and oil pressure switch connector, if equipped.
13. Remove **J 37287** or J 42964-1 , and J 42964-2 or J 42873-1 , and J 42873-2 and reconnect the vehicle fuel feed and return lines. See **Special Tools and Equipment** .
14. Start and idle the vehicle for an additional 2 minutes to ensure residual injector cleaner is flushed from the fuel rail and fuel lines.
15. Repeat steps 1-5 of the Injector Balance Test, and record the fuel pressure drop from each injector.
16. Subtract the lowest fuel pressure drop from the highest fuel pressure drop. If the value is 15 kPa (2 psi) or less, no additional action is required. If the value is greater than 15 kPa (2 psi), replace the injector with the lowest fuel pressure drop.
17. Add one ounce of Port Fuel Injector Cleaner, GM P/N 12345104 (Canadian P/N 10953467), to the vehicle fuel tank for each gallon of gasoline estimated to be in the fuel tank. Instruct the customer to add the reminder of the bottle of Port Fuel Injector Cleaner to the vehicle fuel tank at the next fill-up.
18. Advise the customer to change brands of fuel and to add GM Port Fuel Injector Cleaner every 5 000 km (3,000 mi). GM Port Fuel Injector Cleaner contains the same additives that the fuel companies are removing from the fuel to reduce costs. Regular use of GM Port Fuel Injector Cleaner should keep the customer from having to repeat the injector cleaning procedure.
19. Road test the vehicle to verify that the customer concern has been corrected.

EVAPORATIVE EMISSION (EVAP) CANISTER PURGE SOLENOID VALVE REPLACEMENT

Removal Procedure

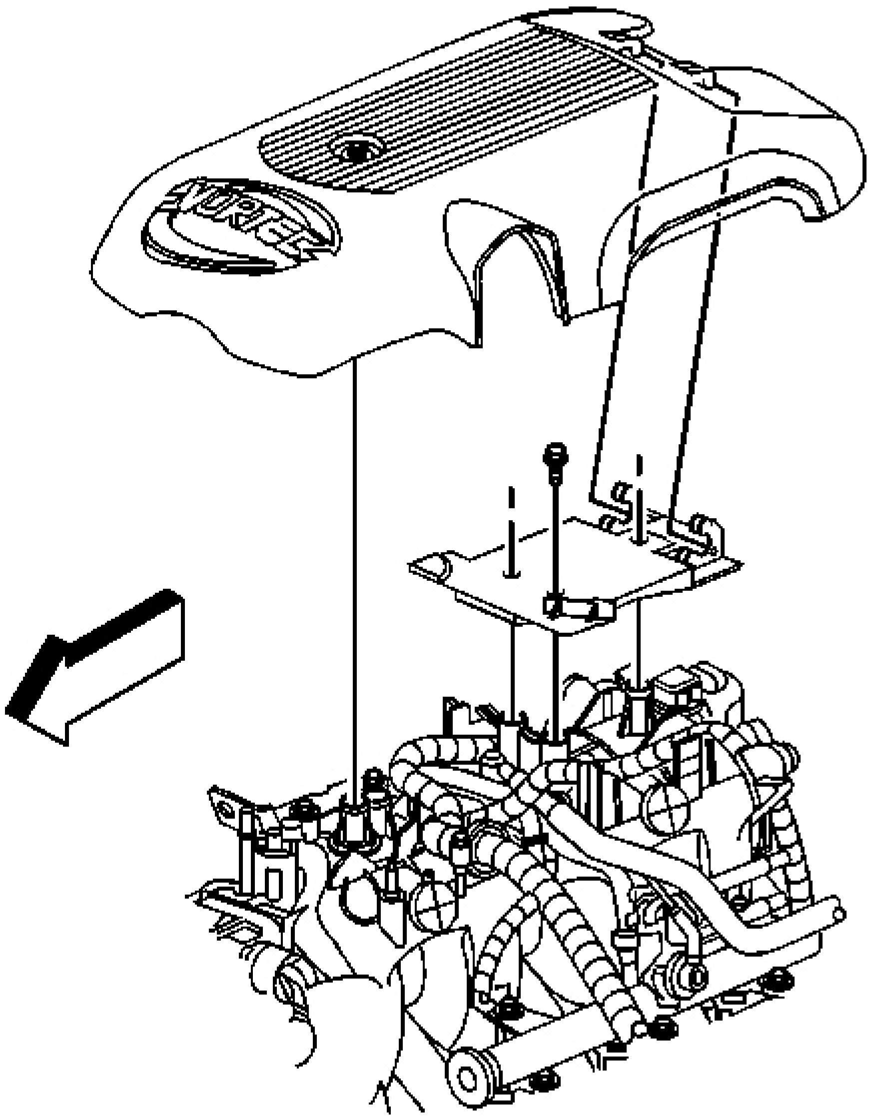


Fig. 129: View Of Top Engine Cover
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine sight shield. Refer to **Engine Sight Shield Replacement (6.0L (LQ4))** in Engine Mechanical.

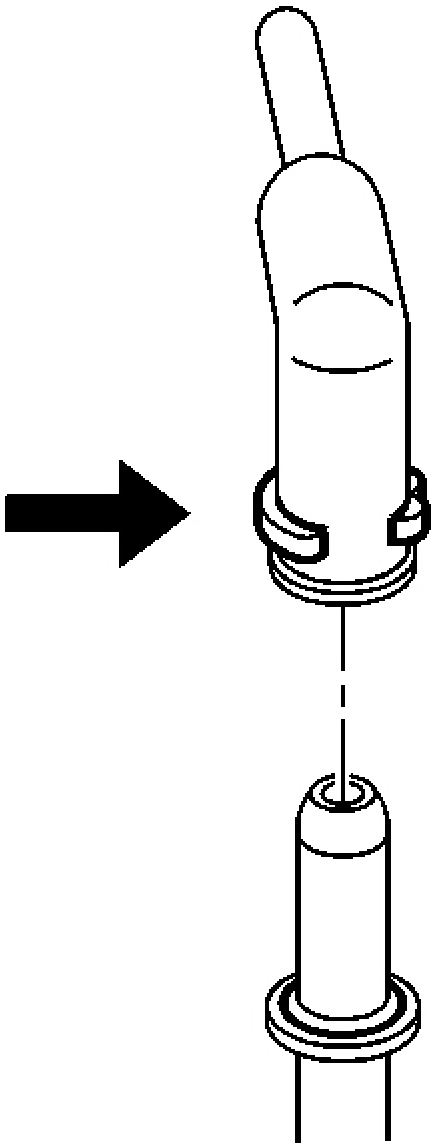


Fig. 130: Pushing Evaporative Emission (EVAP) Pipe Quick Connect Fitting Retainer Inward
Courtesy of GENERAL MOTORS CORP.

2. Push the evaporative emission (EVAP) pipe quick connect fitting retainer inward.

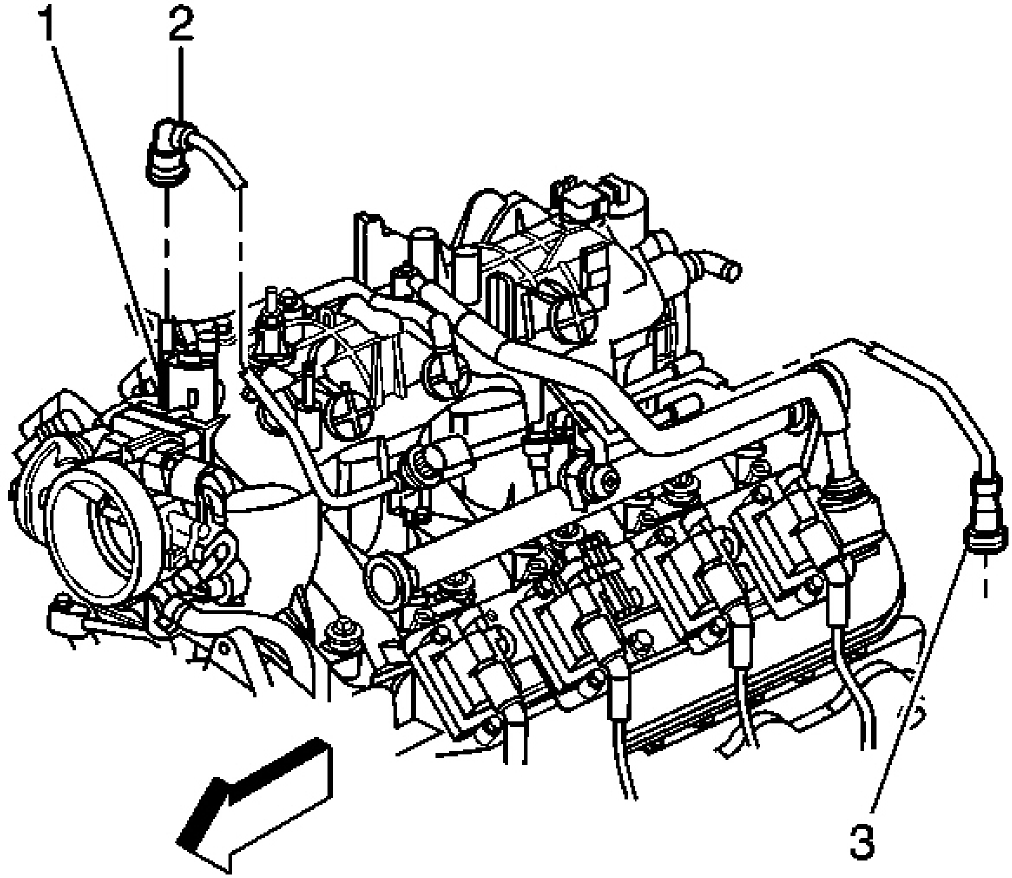


Fig. 131: Top View Of Engine
Courtesy of GENERAL MOTORS CORP.

3. Disconnect the EVAP pipe (2) from the EVAP purge solenoid (1).

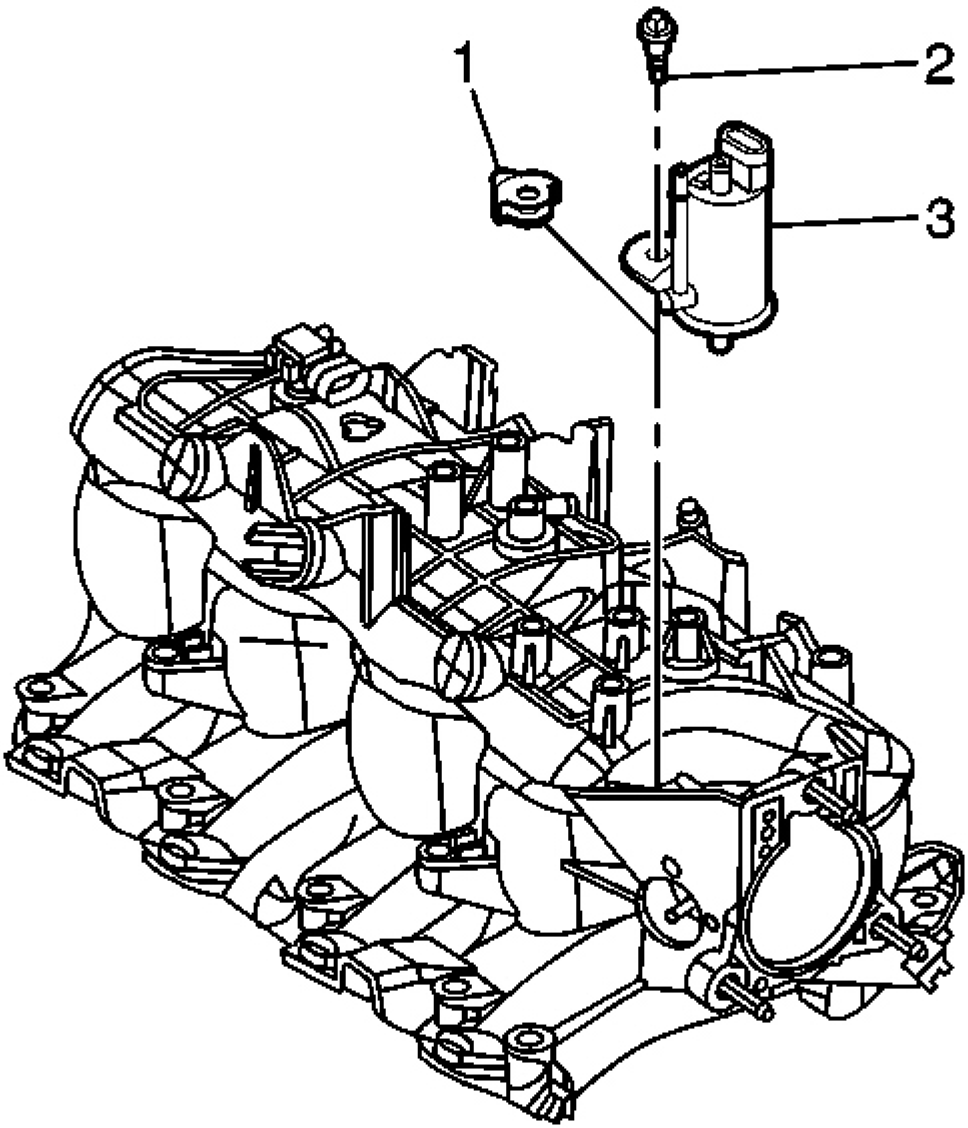
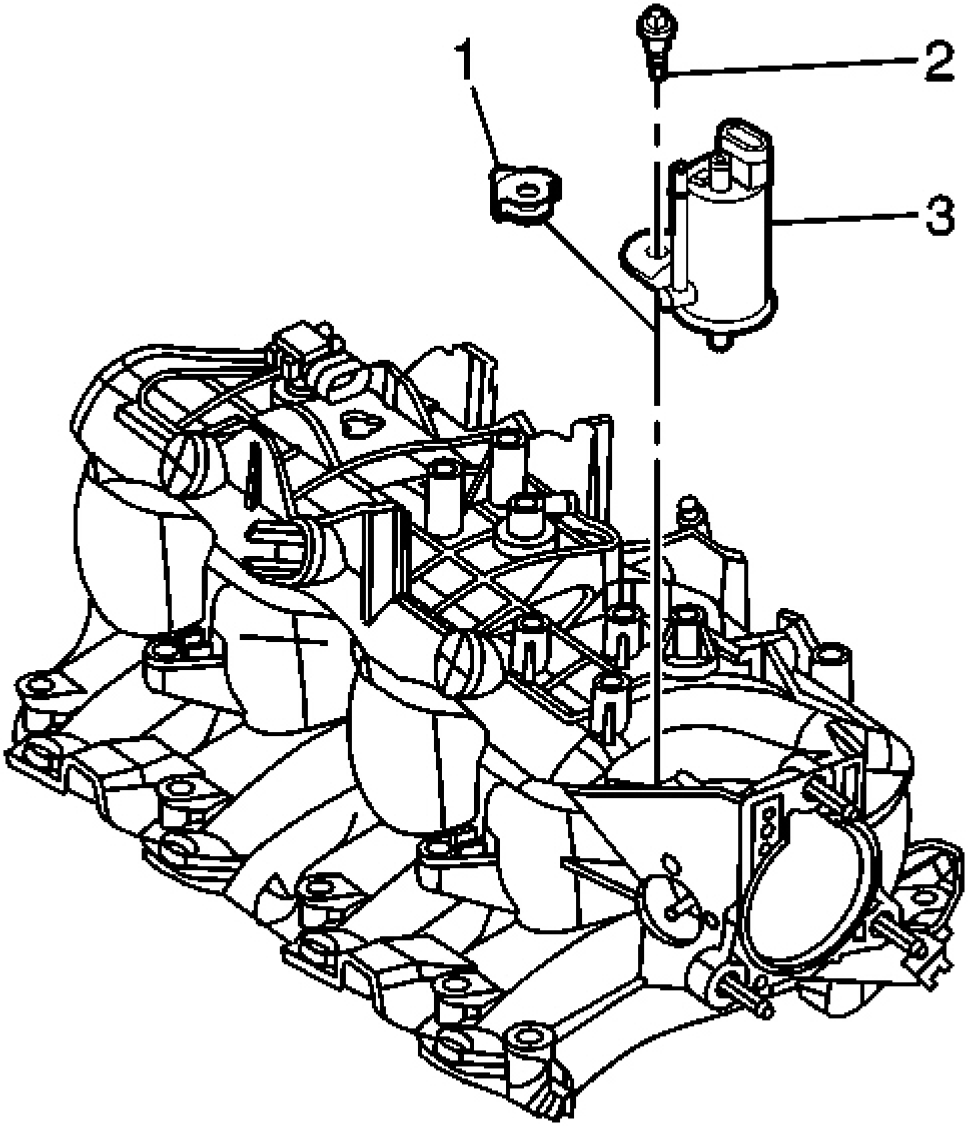


Fig. 132: View Of EVAP Purge Solenoid Bolt, Solenoid & Isolator
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the EVAP purge solenoid electrical connector.
5. Remove the EVAP purge solenoid mount bolt (2).
6. Remove the EVAP purge solenoid (3) and the insulator (1) from the engine.

Installation Procedure



<u>**Fig. 133: View Of EVAP Purge Solenoid Bolt, Solenoid & Isolator**</u>
Courtesy of GENERAL MOTORS CORP.

1. Install the insulator (1) on the EVAP canister purge valve (3).
2. Install the EVAP canister purge valve (3) to the engine.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the EVAP canister purge valve mount bolt (2).

   Tighten: Tighten the EVAP canister purge valve mount bolt to 10.5 N.m (93 lb in).

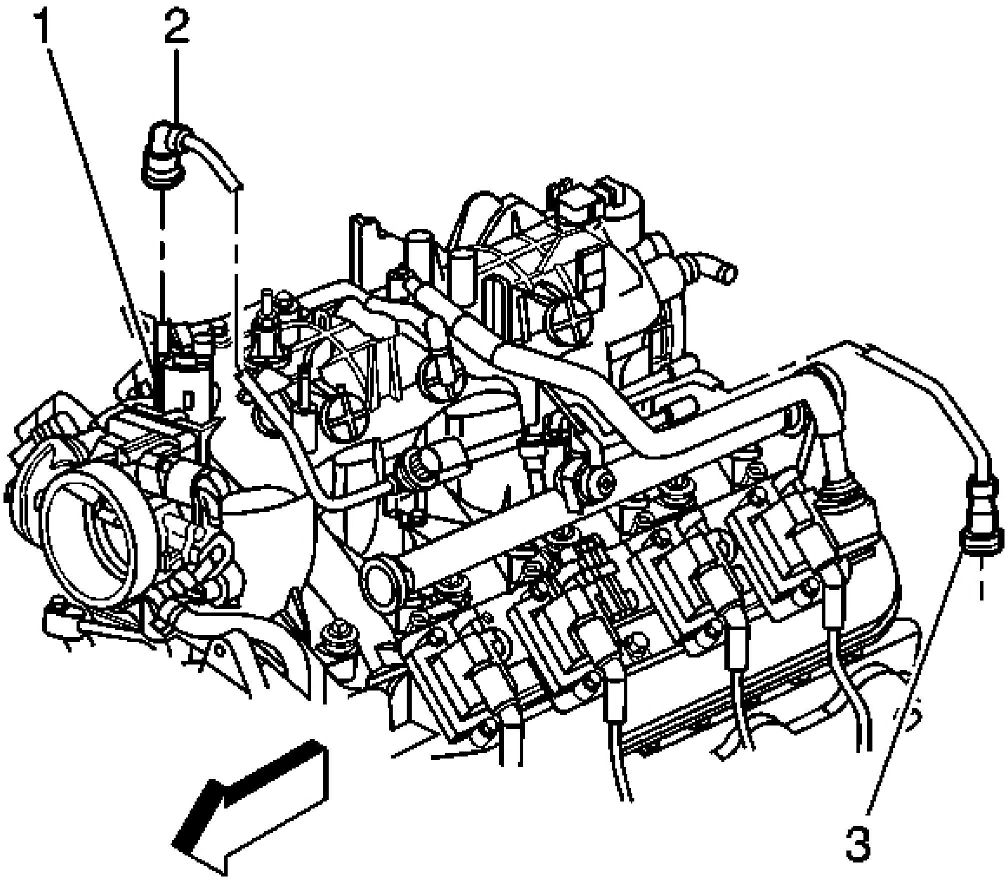


Fig. 134: Top View Of Engine
Courtesy of GENERAL MOTORS CORP.

4. Connect the EVAP pipe (2) to the EVAP canister purge valve (1).
5. Connect the EVAP canister purge valve electrical connector.

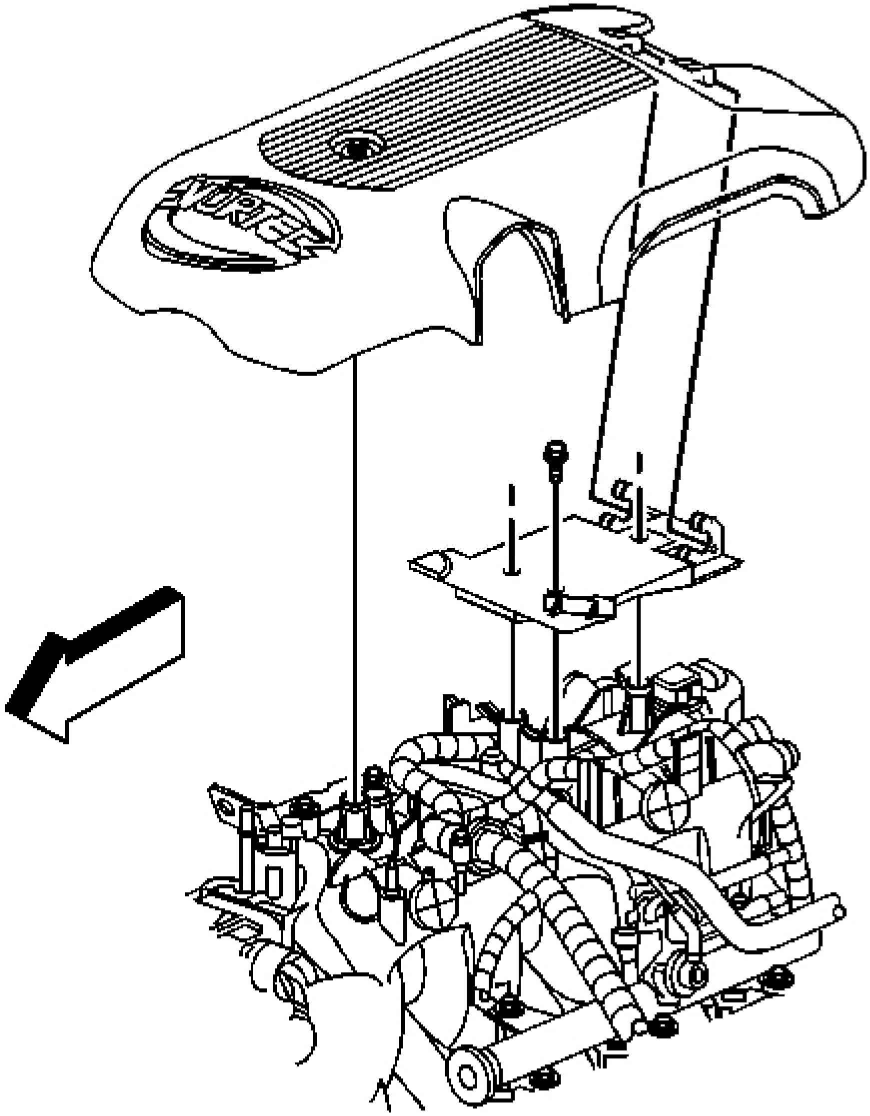


Fig. 135: View Of Top Engine Cover
Courtesy of GENERAL MOTORS CORP.

6. Install the engine sight shield. Refer to **Engine Sight Shield Replacement (6.0L (LQ4))** in Engine Mechanical.

EVAPORATIVE EMISSION (EVAP) CANISTER VENT SOLENOID VALVE REPLACEMENT

Removal Procedure

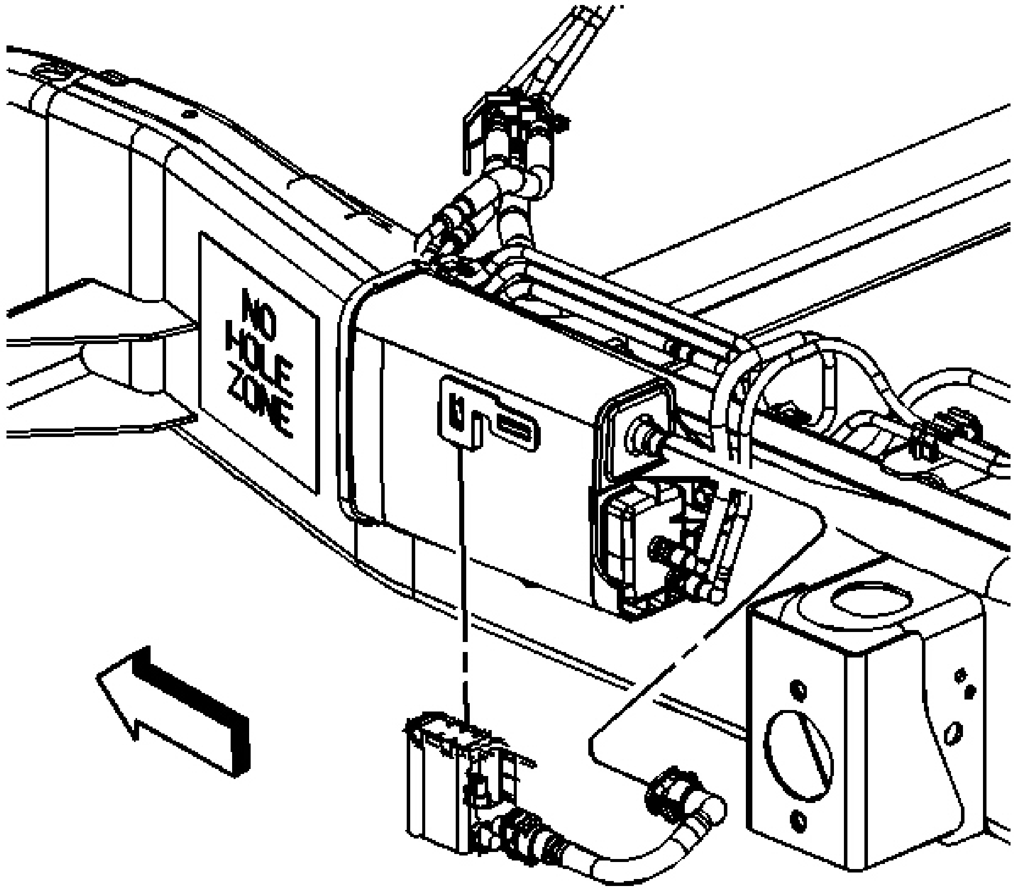


Fig. 136: Vent Pipe & EVAP Canister Vent Valve Electrical Connector
Courtesy of GENERAL MOTORS CORP.

1. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Disconnect the vent pipe from the evaporative emission (EVAP) canister vent valve.
3. Disconnect the EVAP canister vent valve electrical connector.
4. Detach the EVAP canister vent valve from the EVAP canister vent valve bracket.

Installation Procedure

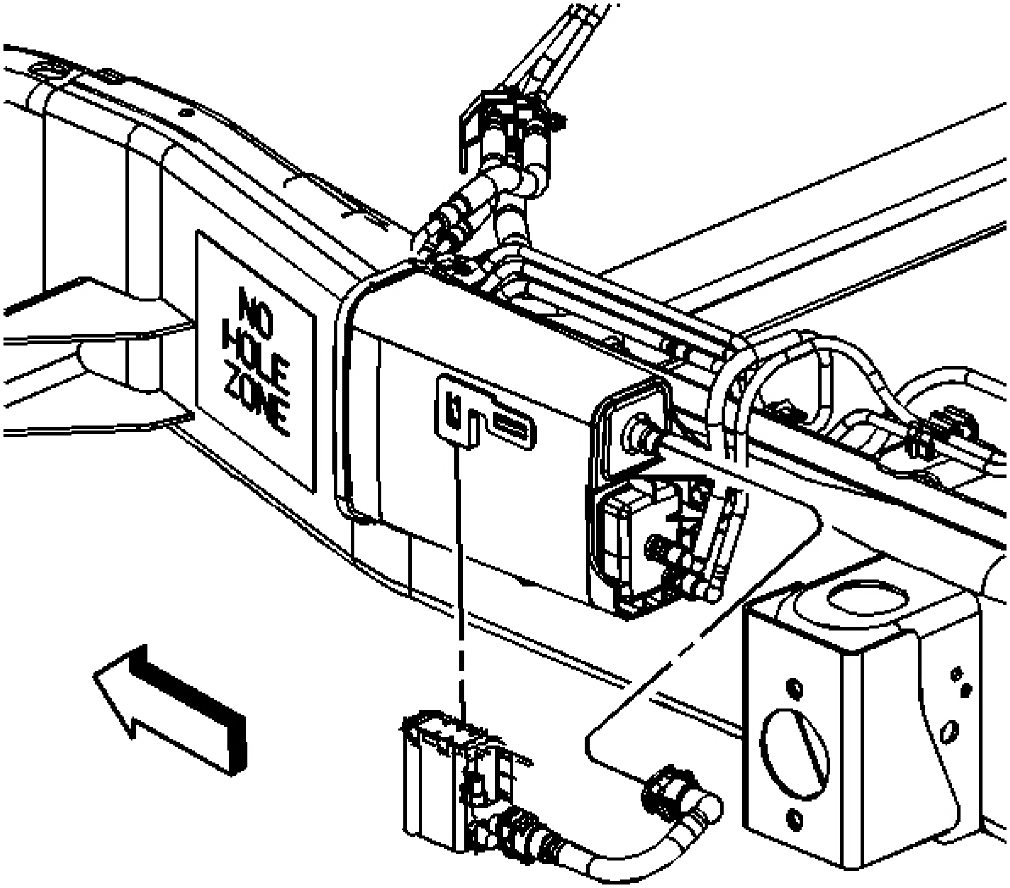


Fig. 137: Vent Pipe & EVAP Canister Vent Valve Electrical Connector
Courtesy of GENERAL MOTORS CORP.

1. Install the EVAP canister vent valve to the EVAP canister vent valve bracket.
2. Connect the EVAP canister vent valve electrical connector.
3. Connect the vent pipe to the EVAP canister vent valve.
4. Lower the vehicle.

EVAPORATIVE EMISSION (EVAP) SYSTEM HOSES/PIPES REPLACEMENT (ENGINE COMPARTMENT EVAP PIPE)

Removal Procedure

IMPORTANT: When replacing the evaporative emission (EVAP) pipe, always replace the pipe

with original equipment or parts that meet the GM specifications for this part. The replacement pipe must have the same type of fittings as the original pipe in order to ensure the integrity of the connection.

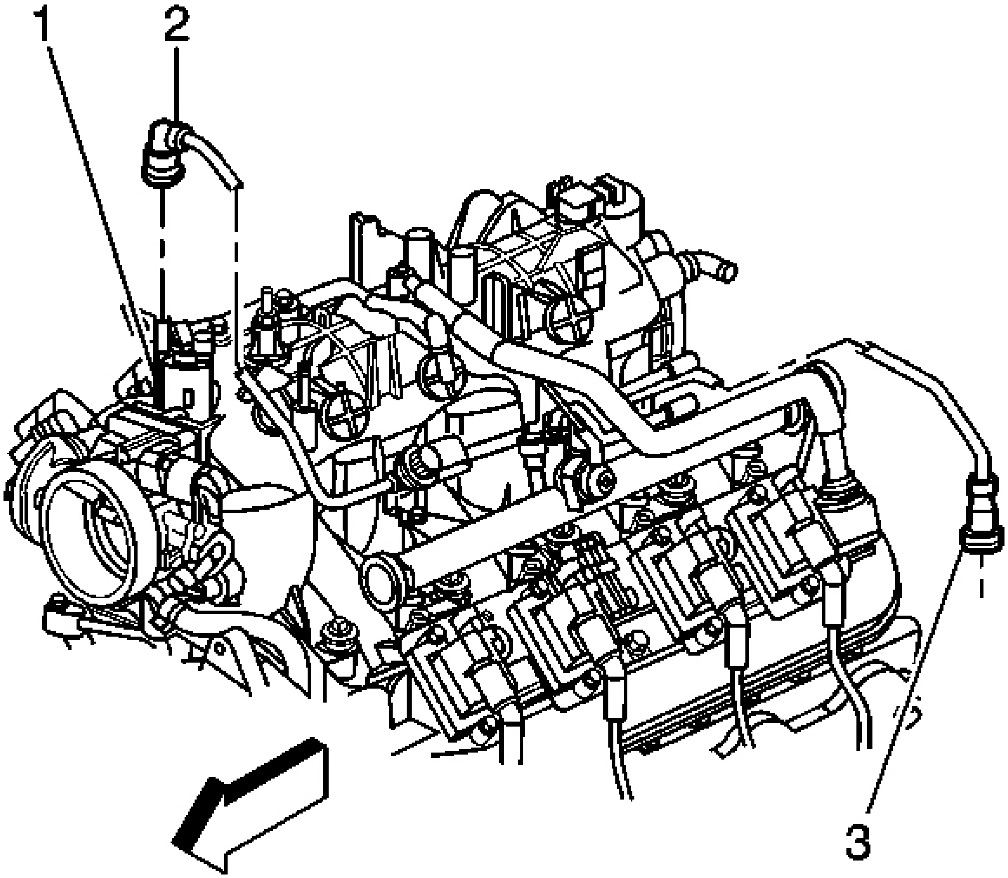


Fig. 138: Top View Of Engine
Courtesy of GENERAL MOTORS CORP.

1. Clean the pipe connections and the surrounding areas before disconnecting in order to avoid possible contamination of the EVAP system.
2. Disconnect the engine compartment EVAP pipe (2) at the EVAP canister purge solenoid (1).
3. Disconnect the engine compartment EVAP pipe (3) at the chassis EVAP pipe.
4. Remove the EVAP pipe from the engine.
5. Cap the EVAP canister purge solenoid and the chassis EVAP pipe in order to prevent possible EVAP system contamination.

Installation Procedure

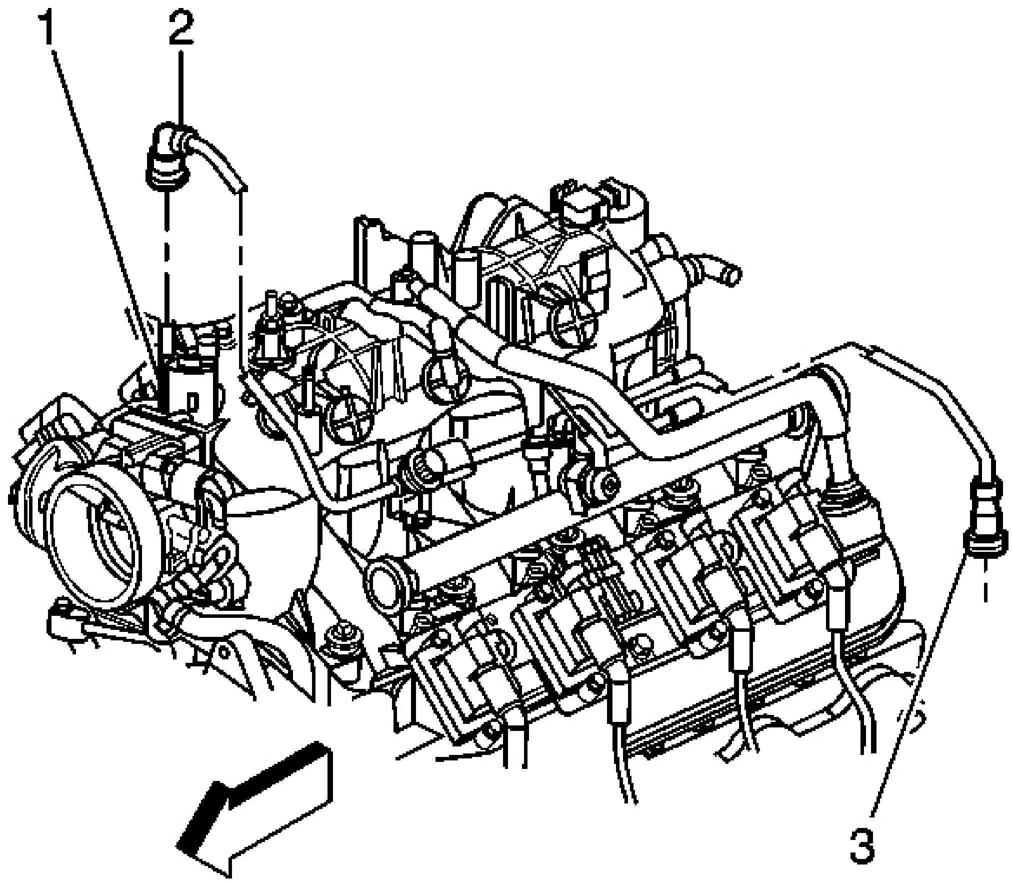


Fig. 139: Top View Of Engine
Courtesy of GENERAL MOTORS CORP.

1. Remove the caps from the EVAP canister purge solenoid and the chassis EVAP pipe.
2. Install the EVAP pipe on the engine.
3. Connect the engine compartment EVAP pipe (3) to the chassis EVAP pipe.
4. Connect the engine compartment EVAP pipe (2) to the EVAP canister purge solenoid (1).

EVAPORATIVE EMISSION (EVAP) SYSTEM HOSES/PIPES REPLACEMENT (CHASSIS EVAP PIPE)

Removal Procedure

IMPORTANT: When replacing the EVAP pipe, always replace the pipe with original equipment or parts that meet the GM specifications for this part. The replacement pipe must have the same type of fittings as the original pipe in order to ensure the integrity of the connection.

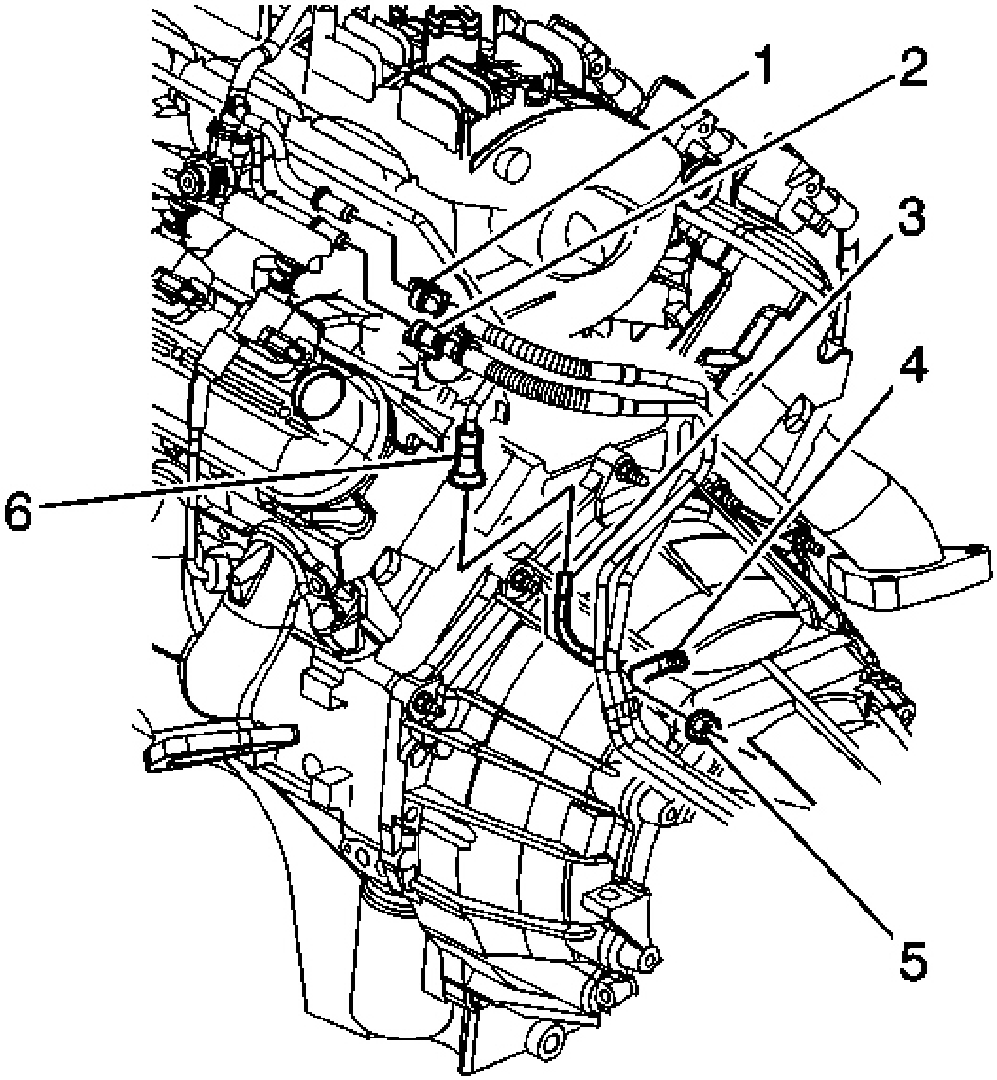


Fig. 140: View Of Rear Engine
Courtesy of GENERAL MOTORS CORP.

1. Clean all the EVAP pipe connections and the surrounding areas before disconnecting the pipes in order to

avoid possible contamination of the EVAP system.

2. Disconnect the engine compartment EVAP pipe (6) from the chassis EVAP pipe (3).
3. Cap the engine compartment EVAP pipe.
4. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
5. Remove the left hand catalytic converter. Refer to **Catalytic Converter Replacement (Right Hand)** in Engine Exhaust.
6. Remove the EVAP pipe from the bellhousing stud clip (4).
7. Remove the EVAP pipe from the transmission bracket clip.

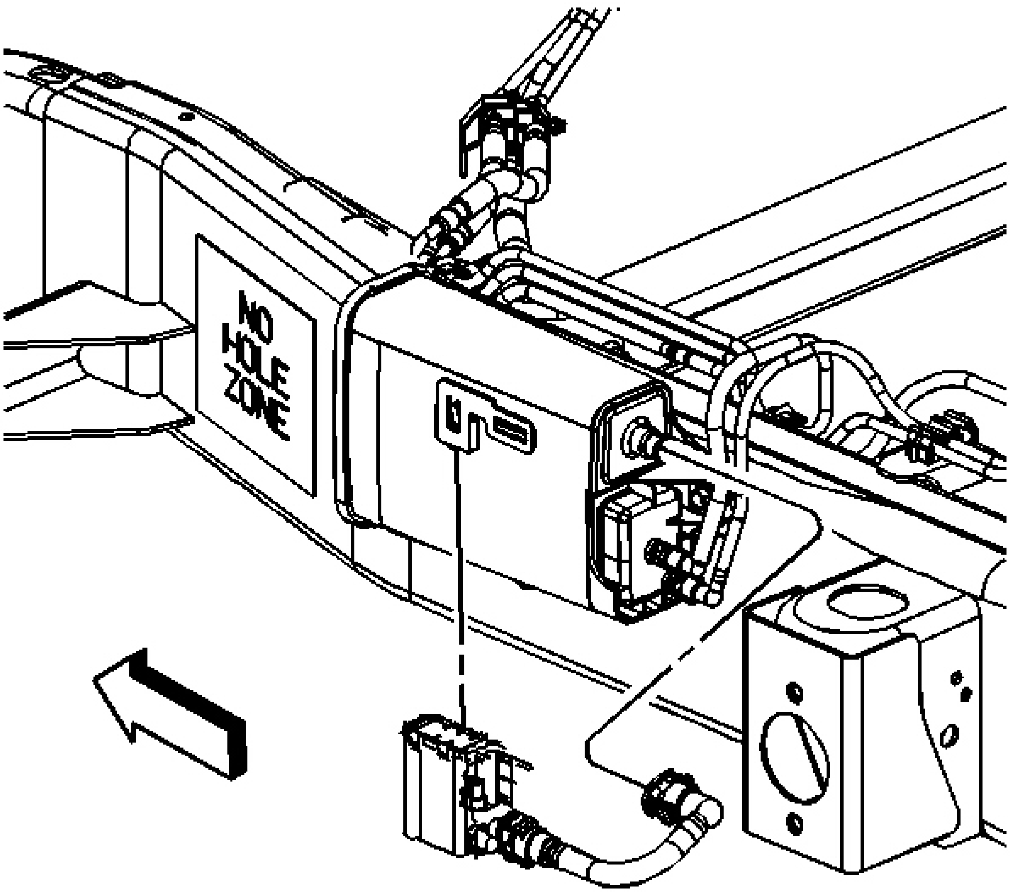


Fig. 141: Vent Pipe & EVAP Canister Vent Valve Electrical Connector
Courtesy of GENERAL MOTORS CORP.

8. Disconnect the rear EVAP purge pipe from the EVAP canister.

9. Cap the rear EVAP purge pipe.
10. Note the position of the EVAP pipe for aid in installation.
11. Remove the EVAP pipe from the retaining clips.
12. Remove the EVAP pipe.

Installation Procedure

1. Install the EVAP pipe into the retaining clips.

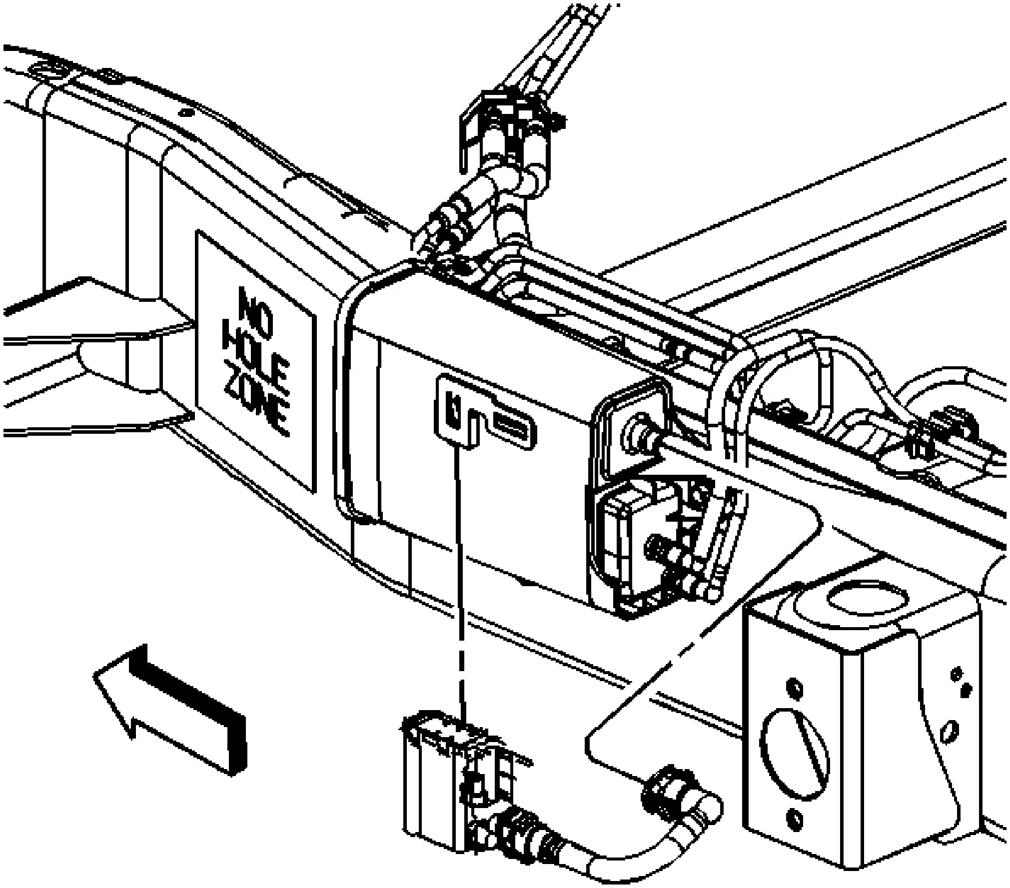


Fig. 142: Vent Pipe & EVAP Canister Vent Valve Electrical Connector
Courtesy of GENERAL MOTORS CORP.

2. Remove the cap from the rear EVAP pipe.
3. Connect the rear EVAP purge pipe to the EVAP canister.

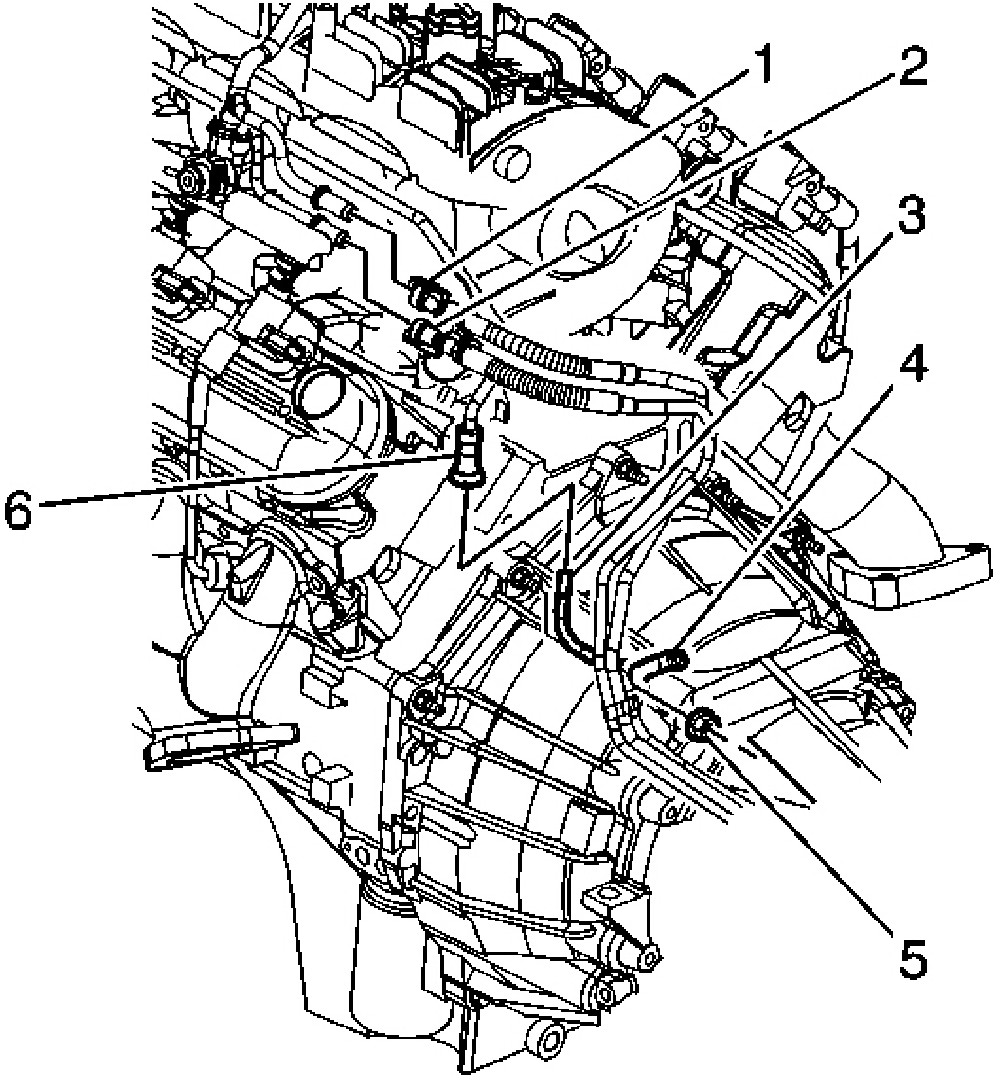


Fig. 143: View Of Rear Engine
Courtesy of GENERAL MOTORS CORP.

4. Install the EVAP pipe into the transmission bracket clip.
5. Install the EVAP pipe into the bellhousing stud clip (4).
6. Install the left hand catalytic converter. Refer to **Catalytic Converter Replacement (Right Hand)** in Engine Exhaust.
7. Lower the vehicle.

8. Remove the cap from the engine compartment EVAP pipe.
9. Connect the engine compartment EVAP pipe (6) to the chassis EVAP pipe (3).

EVAPORATIVE EMISSION (EVAP) SYSTEM HOSES/PIPES REPLACEMENT (EVAP VENT PIPE)

Removal Procedure

IMPORTANT: When replacing the EVAP pipe, always replace the pipe with original equipment or parts that meet the GM specifications for this part. The replacement pipe must have the same type of fittings as the original pipe in order to ensure the integrity of the connection.

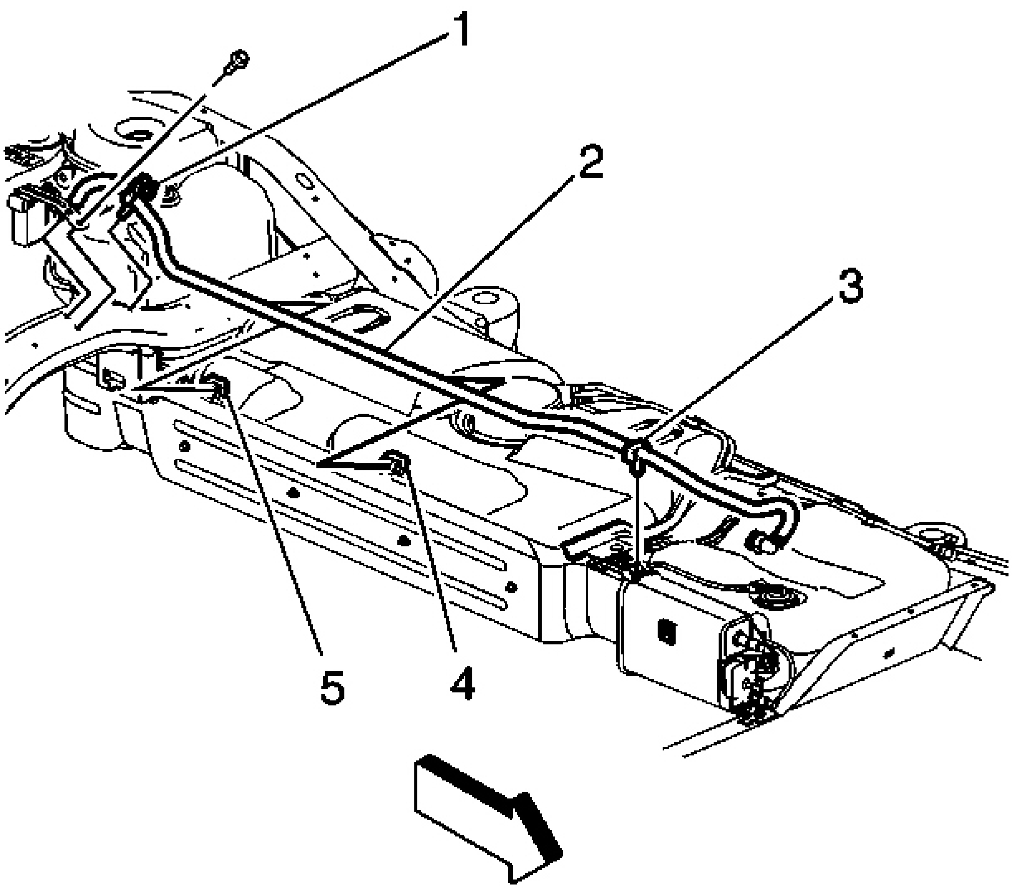


Fig. 144: EVAP Vent Pipe & Mounting Clips
Courtesy of GENERAL MOTORS CORP.

1. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Clean all the EVAP pipe connections and the surrounding areas before disconnecting in order to avoid possible contamination of the EVAP system.
3. Disconnect the EVAP vent pipe at the EVAP canister.
4. Disconnect the EVAP vent pipe at the EVAP vent valve.
5. Remove the EVAP vent pipe from the mounting clips (1,3,4, and 5).
6. Cap the EVAP vent valve and the EVAP canister in order to prevent possible EVAP system contamination.

Installation Procedure

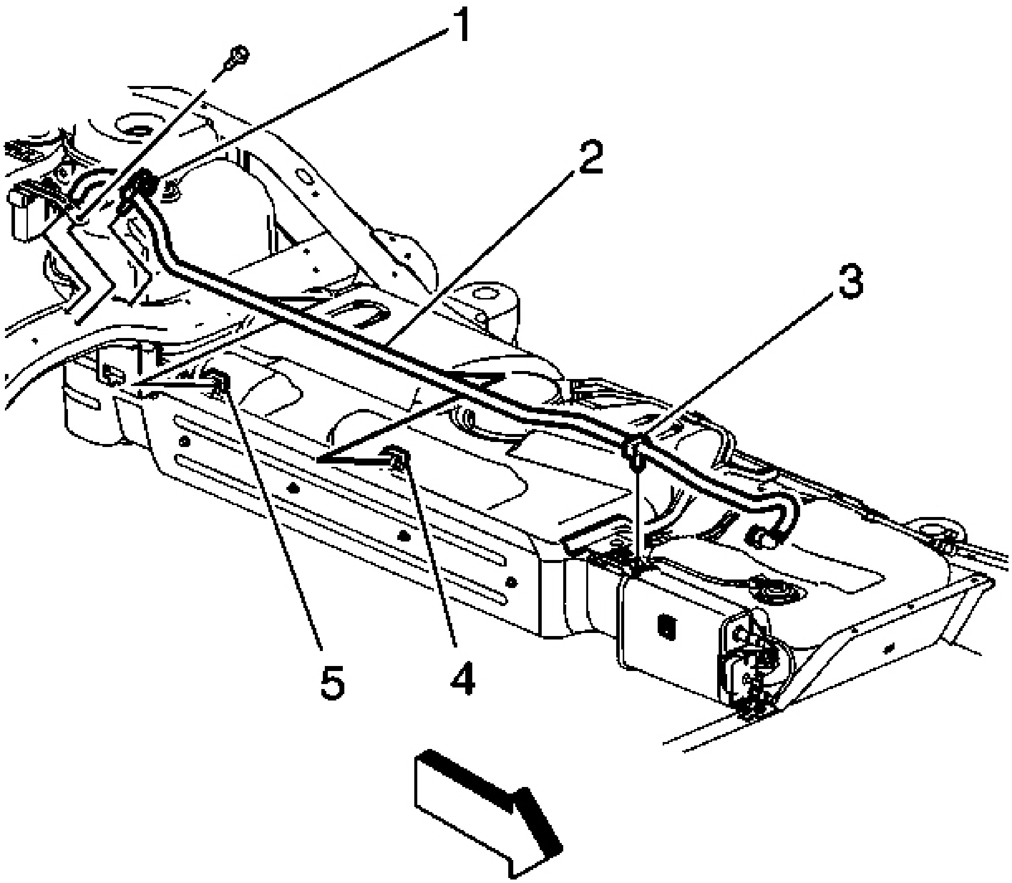


Fig. 145: EVAP Vent Pipe & Mounting Clips
Courtesy of GENERAL MOTORS CORP.

1. Remove the caps from the EVAP vent valve and the EVAP canister.
2. Connect the EVAP vent pipe (2) to the EVAP vent valve.
3. Connect the EVAP vent pipe to the EVAP canister.
4. Install the EVAP vent pipe into the mounting clips (1,3,4, and 5).
5. Lower the vehicle.

EVAPORATIVE EMISSION (EVAP) SYSTEM HOSES/PIPES REPLACEMENT (REAR EVAP FUEL TANK PIPE)

Removal Procedure

IMPORTANT: When replacing the EVAP pipe, always replace the pipe with original equipment or parts that meet the GM specifications for this part. The replacement pipe must have the same type of fittings as the original pipe in order to ensure the integrity of the connection.

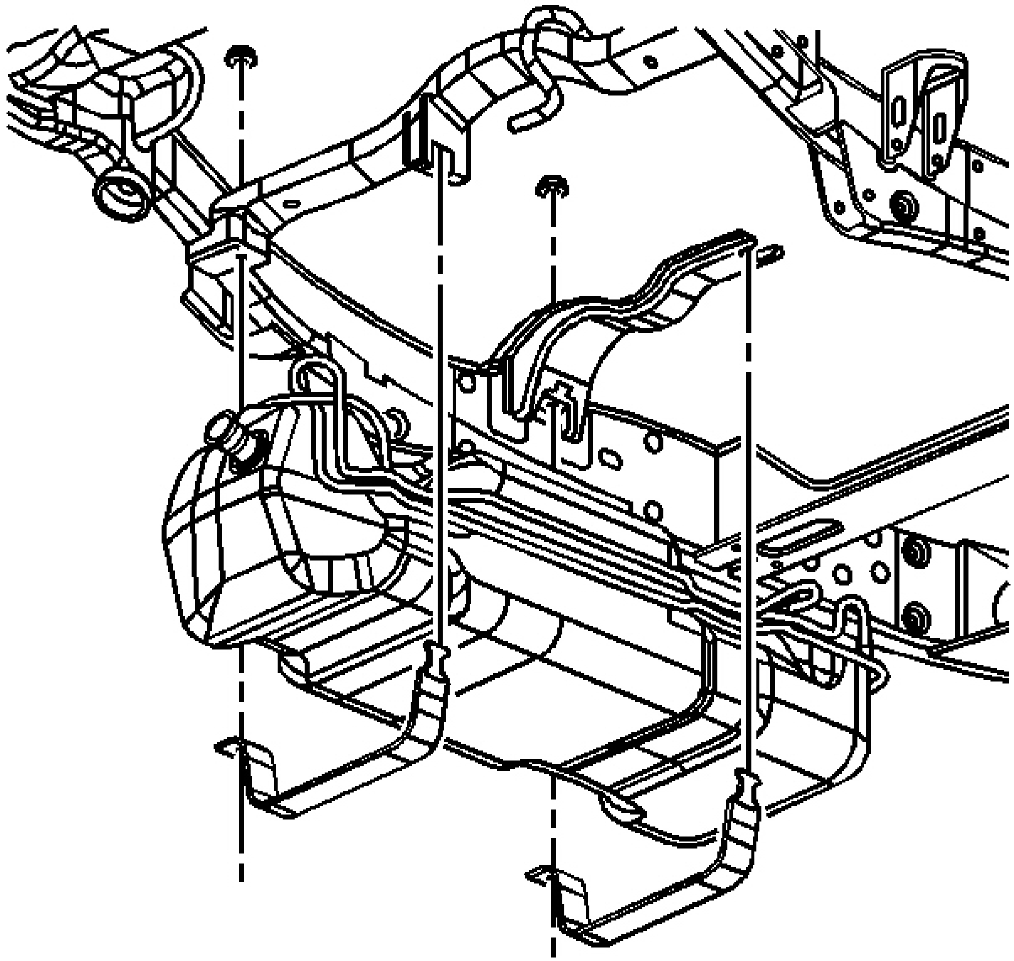


Fig. 146: Fuel Tank Straps & Attaching Bolts
Courtesy of GENERAL MOTORS CORP.

CAUTION: Refer to the Battery Disconnect Caution in Cautions and Notices.

1. Disconnect the negative battery cable.
2. Relieve the fuel system pressure. Refer to **Fuel Pressure Relief Procedure** .
3. Drain the fuel tank. Refer to **Fuel Tank Draining Procedure** .
4. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
5. Clean all fuel and EVAP pipe and hose connections and the surrounding areas before disconnection in

order to avoid possible contamination of the fuel system.

6. Remove the fuel tank. Refer to **Fuel Tank Replacement** .
7. Remove the rear EVAP pipe from the fuel sender, the fuel tank roll over valve and the fuel tank clips.
8. Cap the fuel sender EVAP pipe and the fuel tank roll over valve.

Installation Procedure

1. Remove the caps from the fuel sender EVAP pipe and the fuel tank roll over valve.
2. Connect the rear EVAP pipe to the fuel sender, the fuel tank roll over valve, and the fuel tank clips.

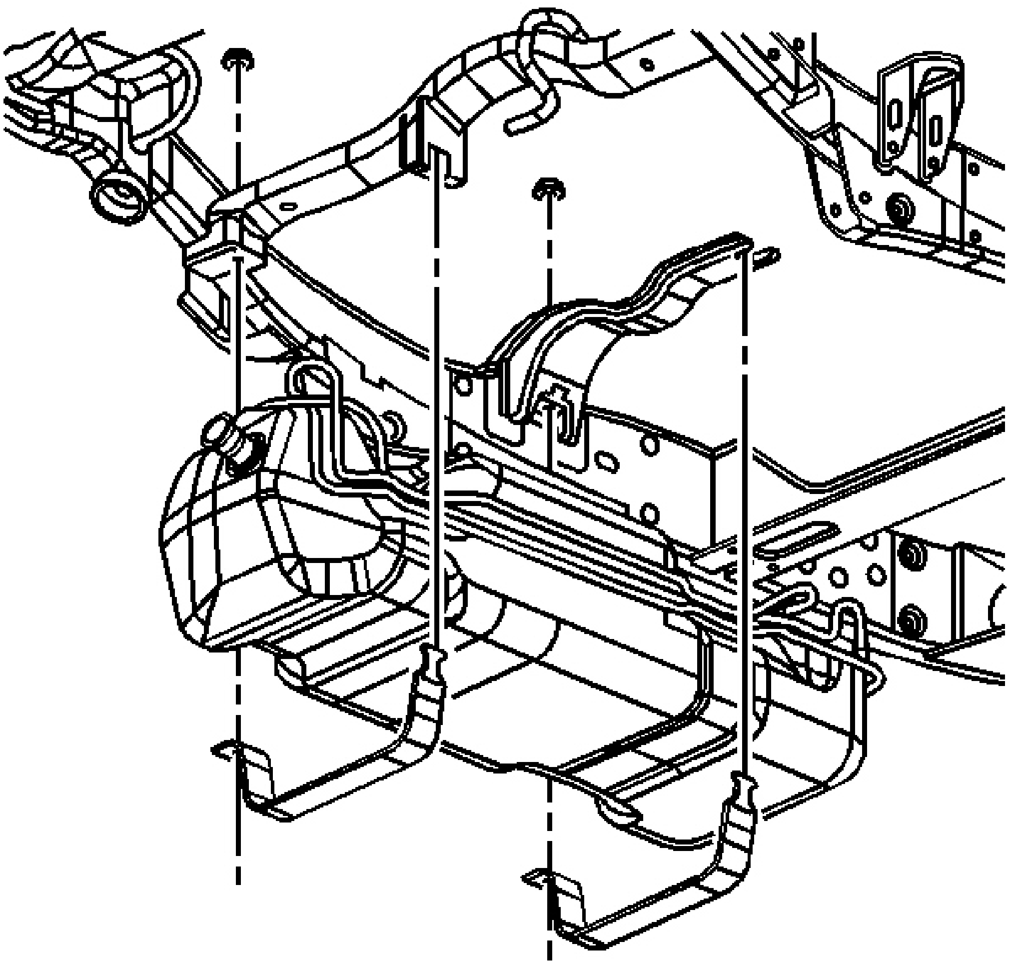


Fig. 147: Fuel Tank Straps & Attaching Bolts
Courtesy of GENERAL MOTORS CORP.

3. Install the fuel tank. Refer to **Fuel Tank Replacement** .
4. Lower the vehicle.
5. Refill the fuel tank.
6. Connect the negative battery cable.
7. Tighten the fuel filler cap.
8. Inspect for leaks.
    1. Turn ON the ignition for 2 seconds.
    2. Turn OFF the ignition for 10 seconds.
    3. Turn ON the ignition.
    4. Inspect for fuel leaks.

EVAPORATIVE EMISSION (EVAP) CANISTER REPLACEMENT

Removal Procedure

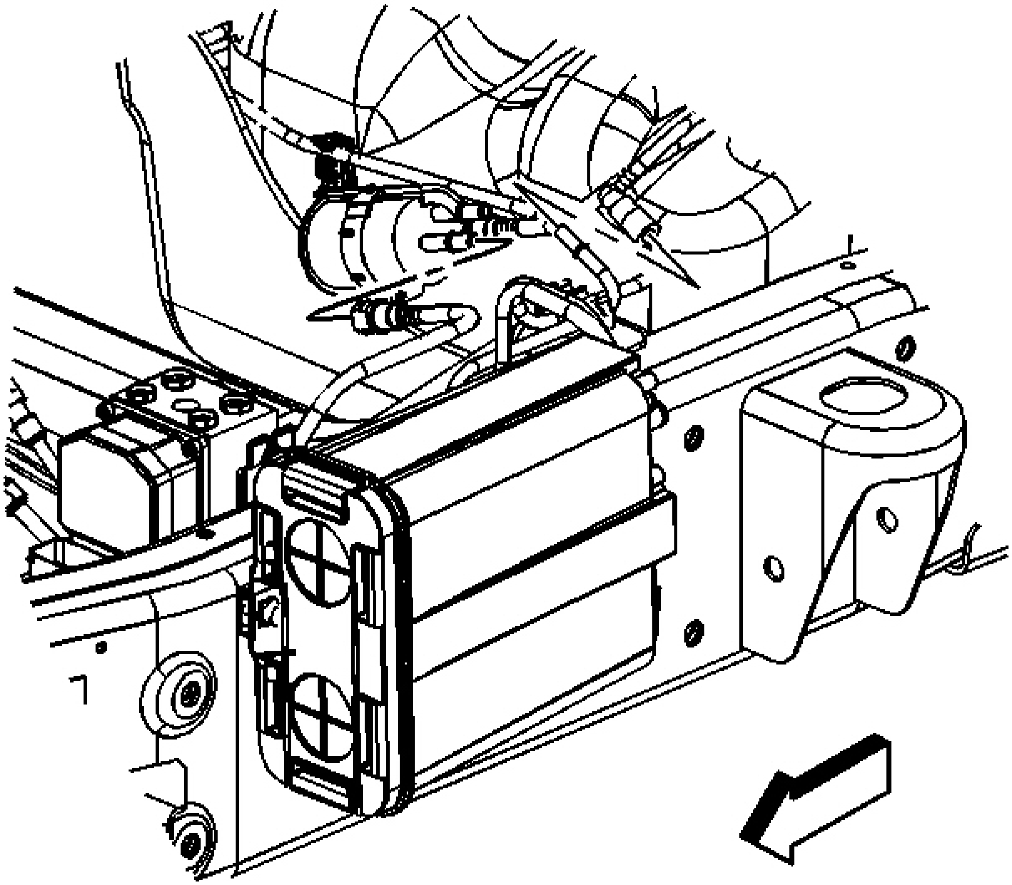


Fig. 148: Chassis Fuel Feed Hose & Fuel Filter
Courtesy of GENERAL MOTORS CORP.

1. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
2. Disconnect EVAP solenoid electrical connector.
3. Remove the evaporative emission (EVAP) canister mount bolts.

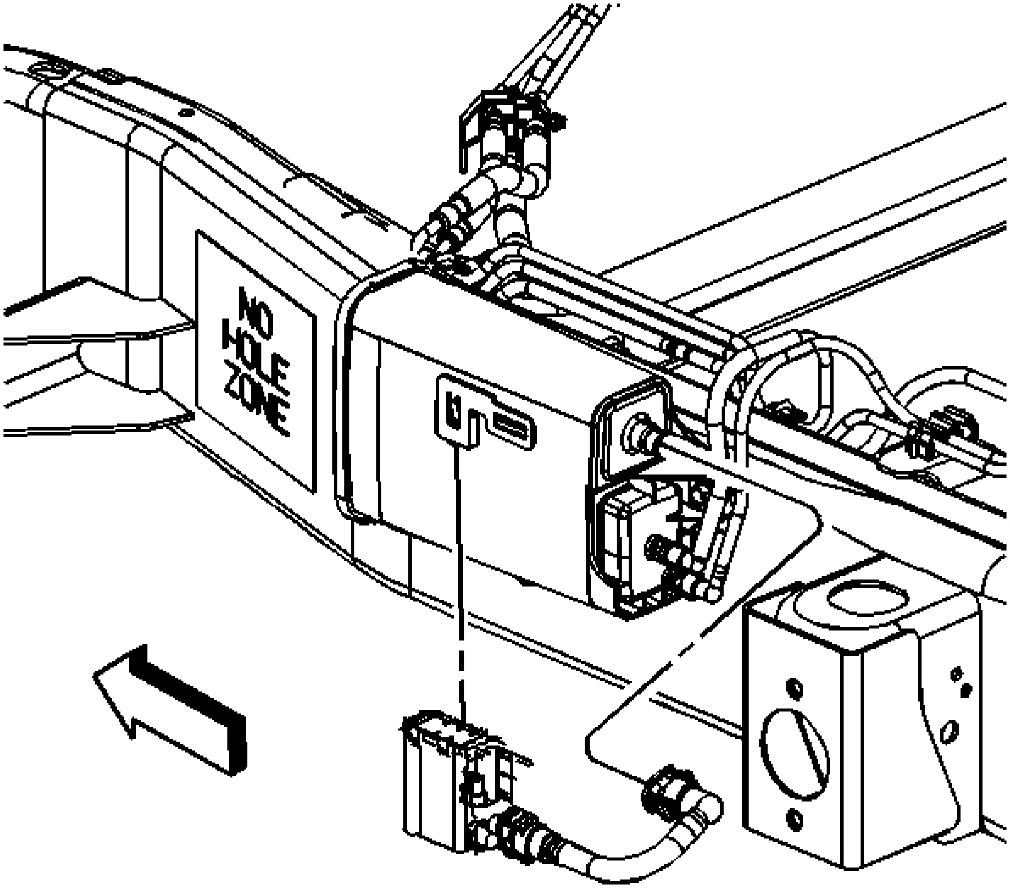


Fig. 149: Vent Pipe & EVAP Canister Vent Valve Electrical Connector
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the pipes at the EVAP canister.
5. Remove the EVAP canister from the vehicle.

Installation Procedure

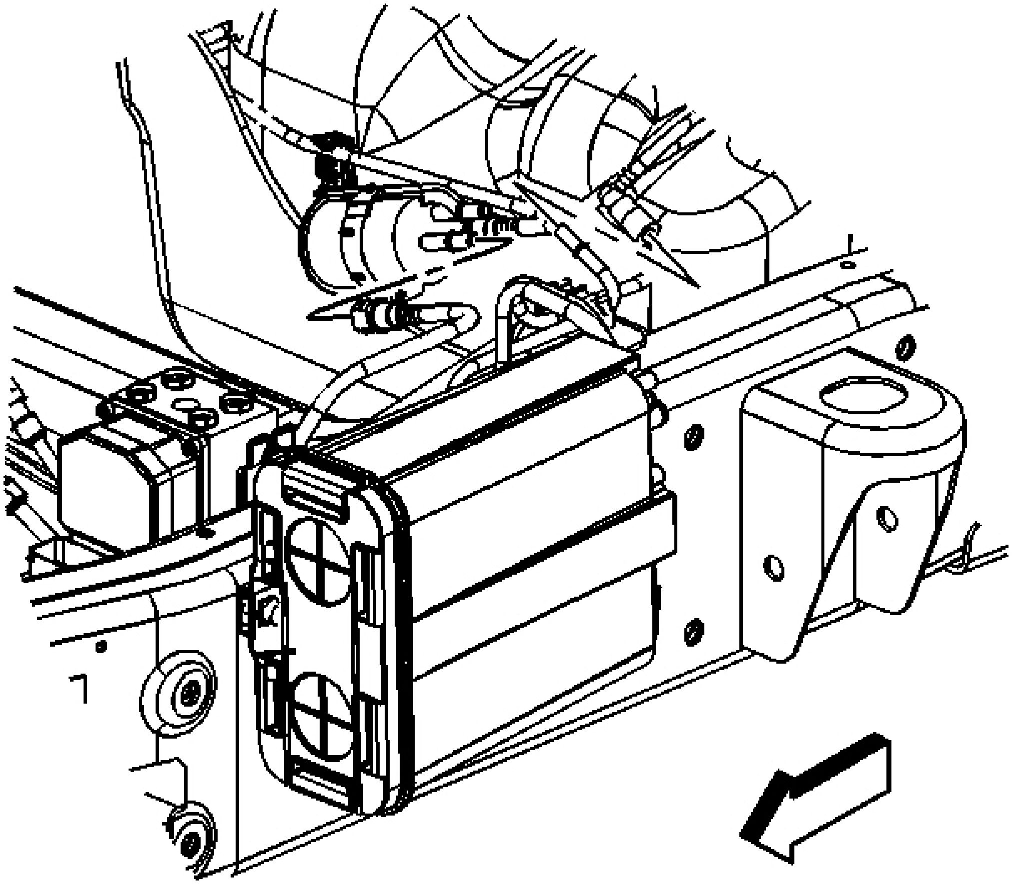


Fig. 150: Chassis Fuel Feed Hose & Fuel Filter
Courtesy of GENERAL MOTORS CORP.

1. Install the EVAP canister to the vehicle.
2. Connect EVAP solenoid electrical connector.

NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Install the EVAP canister mounting bolts.

   Tighten: Tighten the bolts to 25 N.m (18 lb ft).

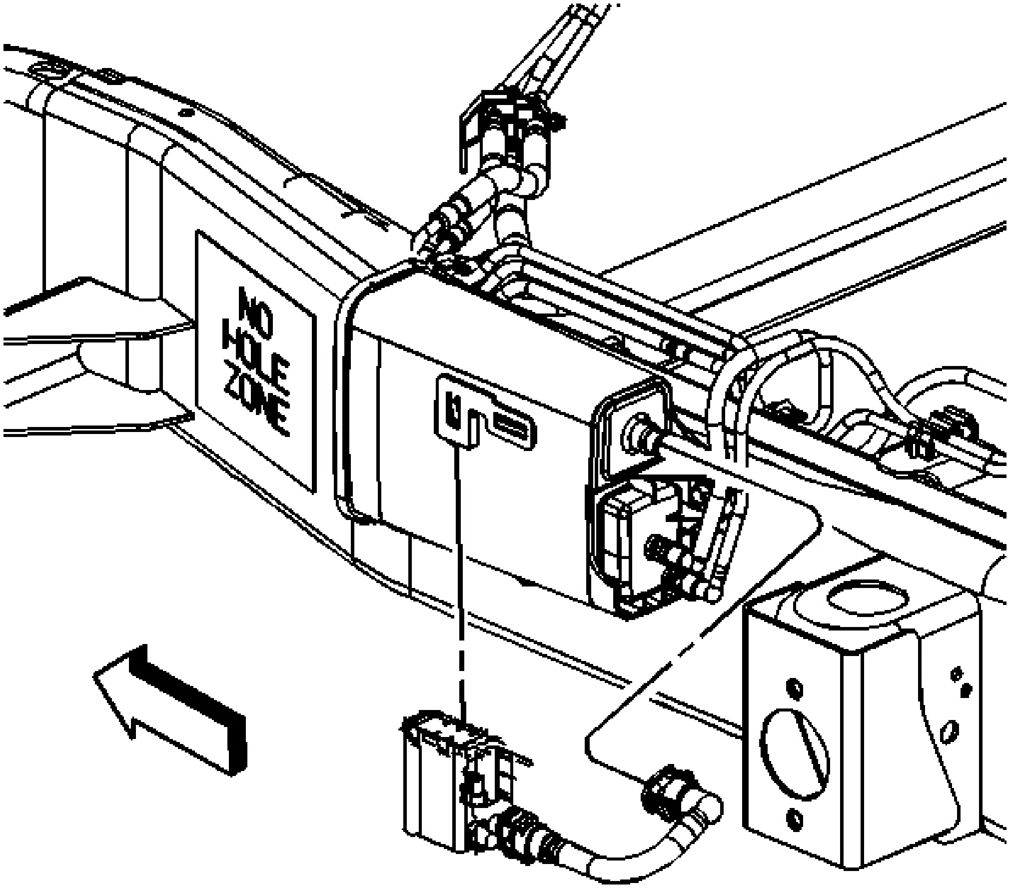


Fig. 151: Vent Pipe & EVAP Canister Vent Valve Electrical Connector
Courtesy of GENERAL MOTORS CORP.

4. Connect the pipes to the EVAP canister.
5. Lower the vehicle.

EVAPORATIVE EMISSION (EVAP) SYSTEM CLEANING

Tools Required

J 41413-200 Evaporative Emission System Tester (EEST). See **Special Tools and Equipment** .

Inspection Procedure

NOTE: Use the Evaporative Emissions System Tester (EEST) J41413-200 in order to

provide a clean, dry, low pressure gas source. Do not substitute any other pressurized gas source. Damage may result to the EVAP system.

IMPORTANT: Do not perform this procedure unless instructed by an EVAP diagnostic.

1. Turn OFF the ignition.
2. Remove the EVAP canister purge solenoid valve. Refer to **Evaporative Emission (EVAP) Canister Purge Solenoid Valve Replacement** .
3. Lightly tap the EVAP canister purge solenoid valve on a clean hard surface.
4. Inspect for carbon particles exiting either of the vacuum ports.
   - If no carbon particles are found reinstall the EVAP canister purge solenoid valve and continue with the EVAP cleaning procedure. Refer to **Evaporative Emission (EVAP) Canister Purge Solenoid Valve Replacement** .
   - If carbon particles are found during the inspection procedure, replace the EVAP canister purge solenoid valve and continue with the EVAP cleaning procedure. Refer to **Evaporative Emission (EVAP) Canister Purge Solenoid Valve Replacement** .
   - If you were instructed to replace the EVAP canister purge solenoid valve, and no carbon particles are found, return to the EVAP diagnostic procedure. Do not perform the EVAP cleaning procedure.

EVAP Cleaning Procedure

1. Remove the EVAP canister. Refer to **Evaporative Emission (EVAP) Canister Replacement** .
2. Turn OFF the main valve on the **J 41413-200** . See **Special Tools and Equipment** .
3. Disconnect the hose from the diagnostic station pressure regulator.
4. Using a section of vacuum hose, connect one end to the diagnostic station pressure regulator.
5. Connect the other end of the vacuum hose to the canister side of the purge pipe.
6. Turn ON the main nitrogen cylinder valve and continue to discharge nitrogen for 15 seconds.
7. If the nitrogen does not dislodge the carbon particles, replace the purge pipe. Refer to **Evaporative Emission (EVAP) System Hoses/Pipes Replacement (Engine Compartment EVAP Pipe)** or **Evaporative Emission (EVAP) System Hoses/Pipes Replacement (Chassis EVAP Pipe)** or **Evaporative Emission (EVAP) System Hoses/Pipes Replacement (EVAP Vent Pipe)** or **Evaporative Emission (EVAP) System Hoses/Pipes Replacement (Rear EVAP Fuel Tank Pipe)** .
8. Return the EVAP pressure/purge diagnostic station to the tools original condition.
9. Install a new EVAP canister. Refer to **Evaporative Emission (EVAP) Canister Replacement** .
10. Connect all previously disconnected EVAP pipe connectors.
11. Lower the vehicle.
12. Continue with the published service manual diagnostic DTC procedure.

IGNITION COIL(S) REPLACEMENT

Removal Procedure

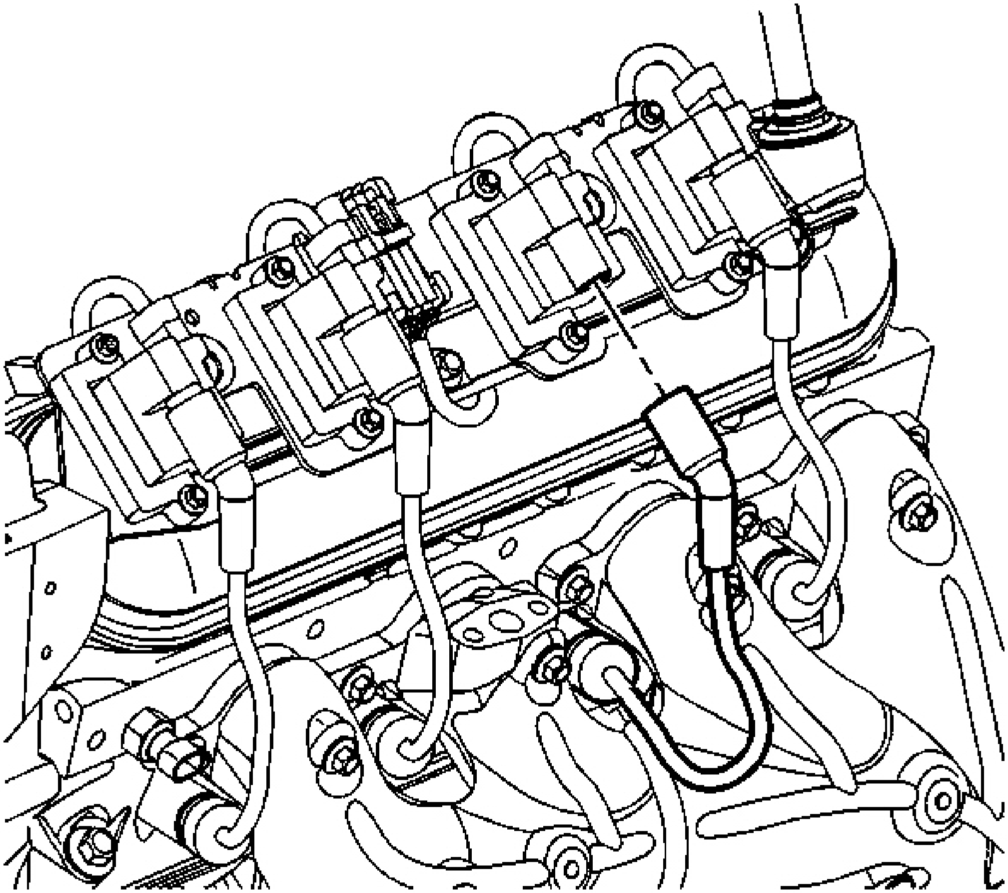


Fig. 152: Spark Plug Wires & Ignition Coils
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the spark plug wires at the ignition coils.

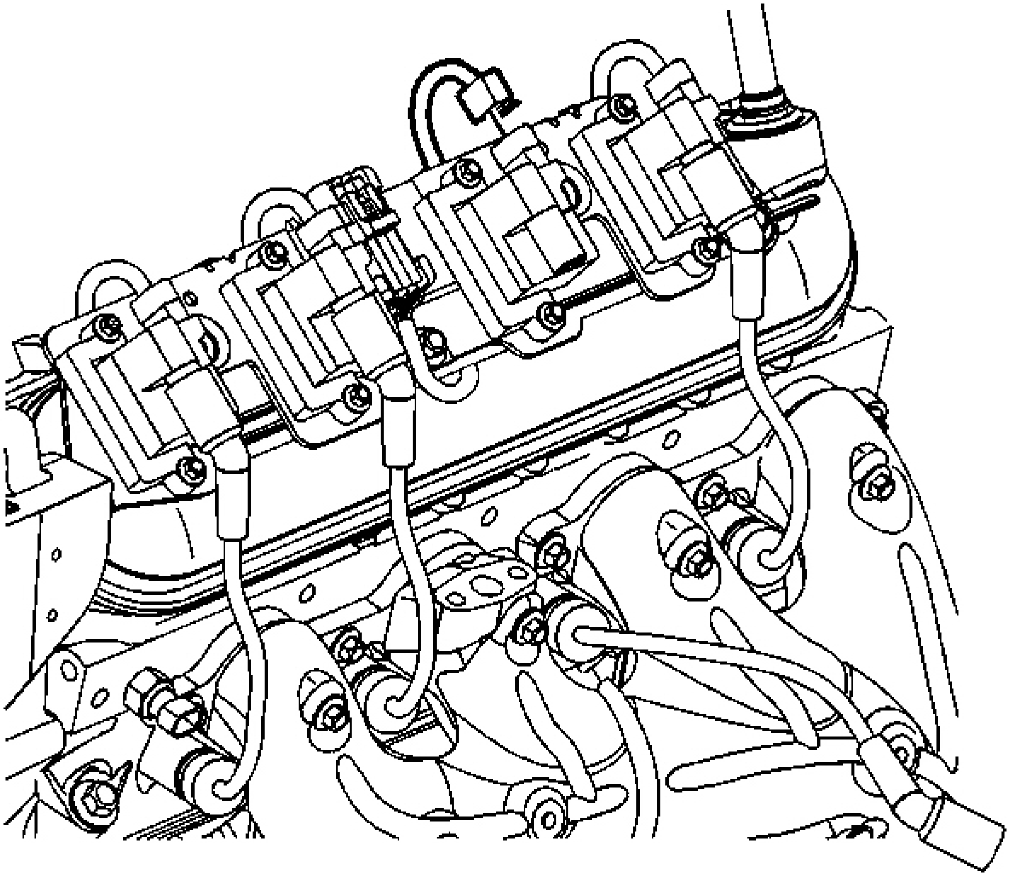


Fig. 153: Ignition Coil Harness Connector
Courtesy of GENERAL MOTORS CORP.

2. Disconnect the ignition coil harness connector.

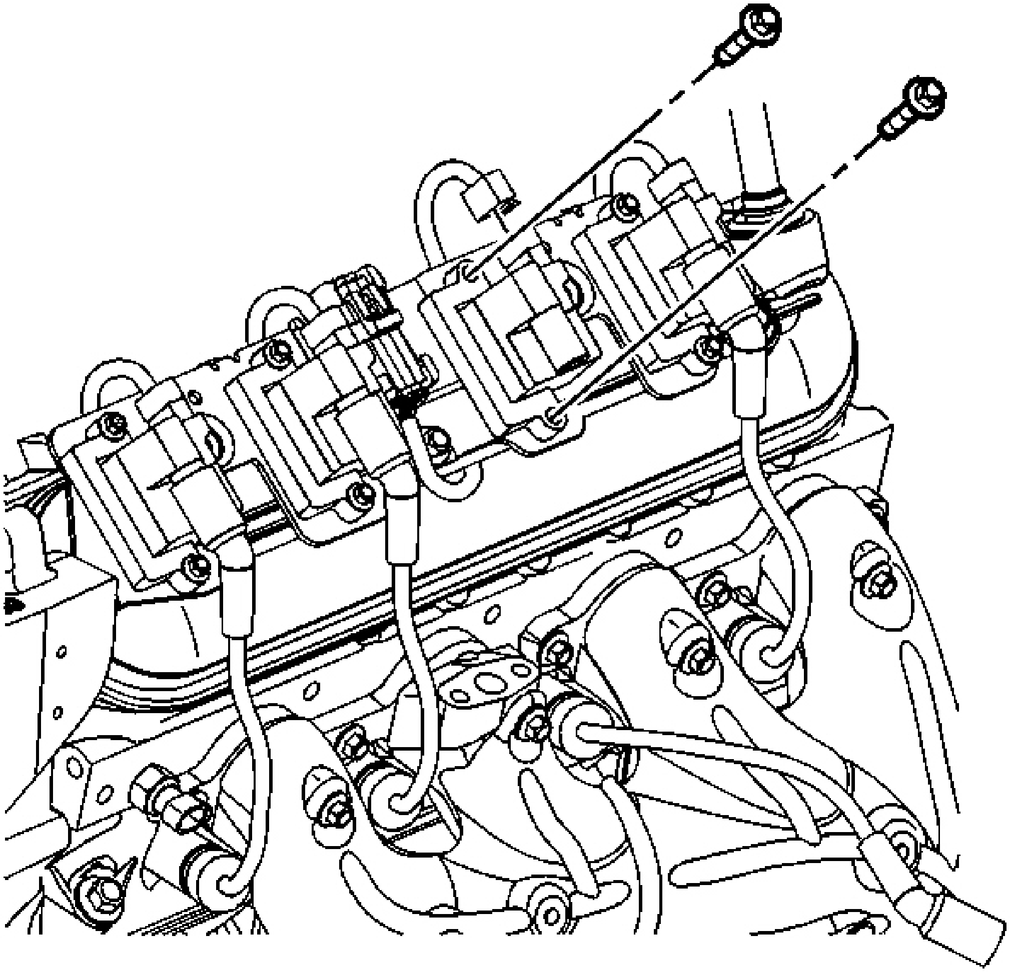


Fig. 154: Ignition Coil Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

3. Remove the ignition coil mounting bolts.

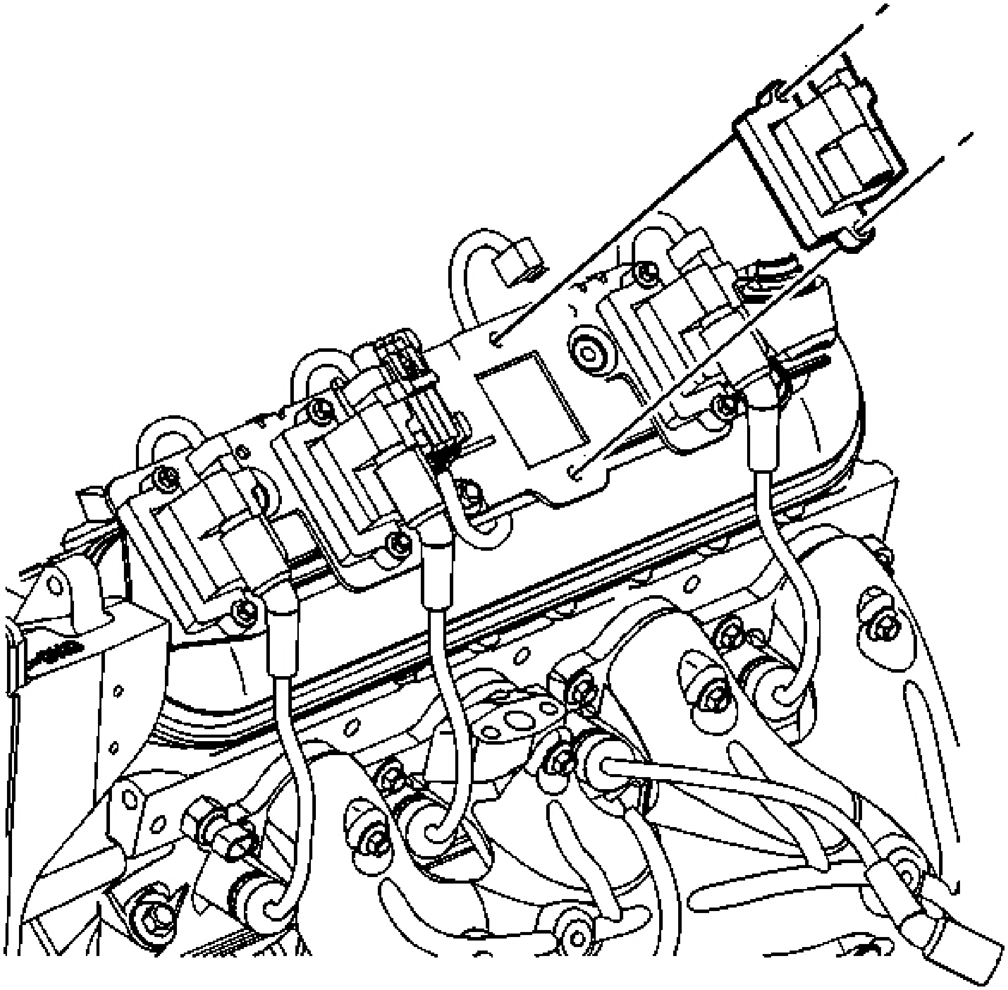


Fig. 155: View Of Ignition Coil
Courtesy of GENERAL MOTORS CORP.

4. Remove the ignition coil.

Installation Procedure

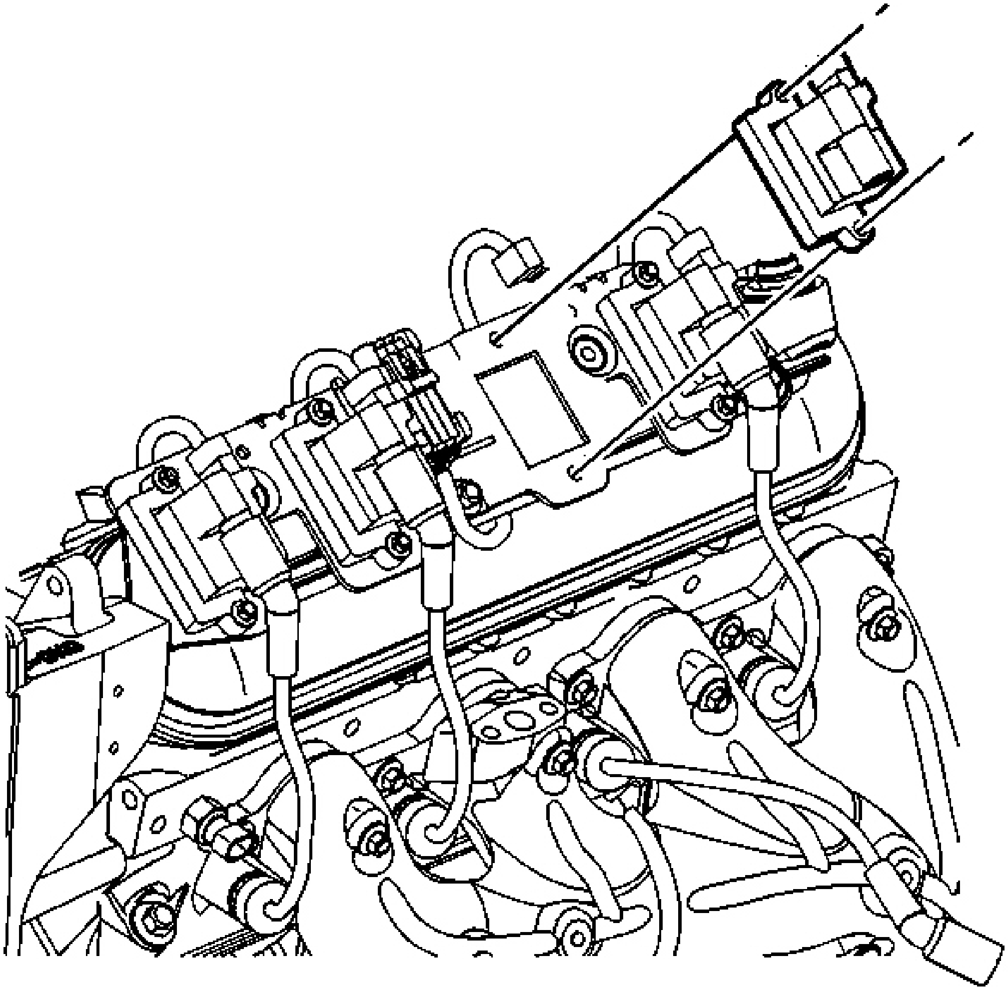


Fig. 156: View Of Ignition Coil
Courtesy of GENERAL MOTORS CORP.

1. Install the ignition coil to the bracket.

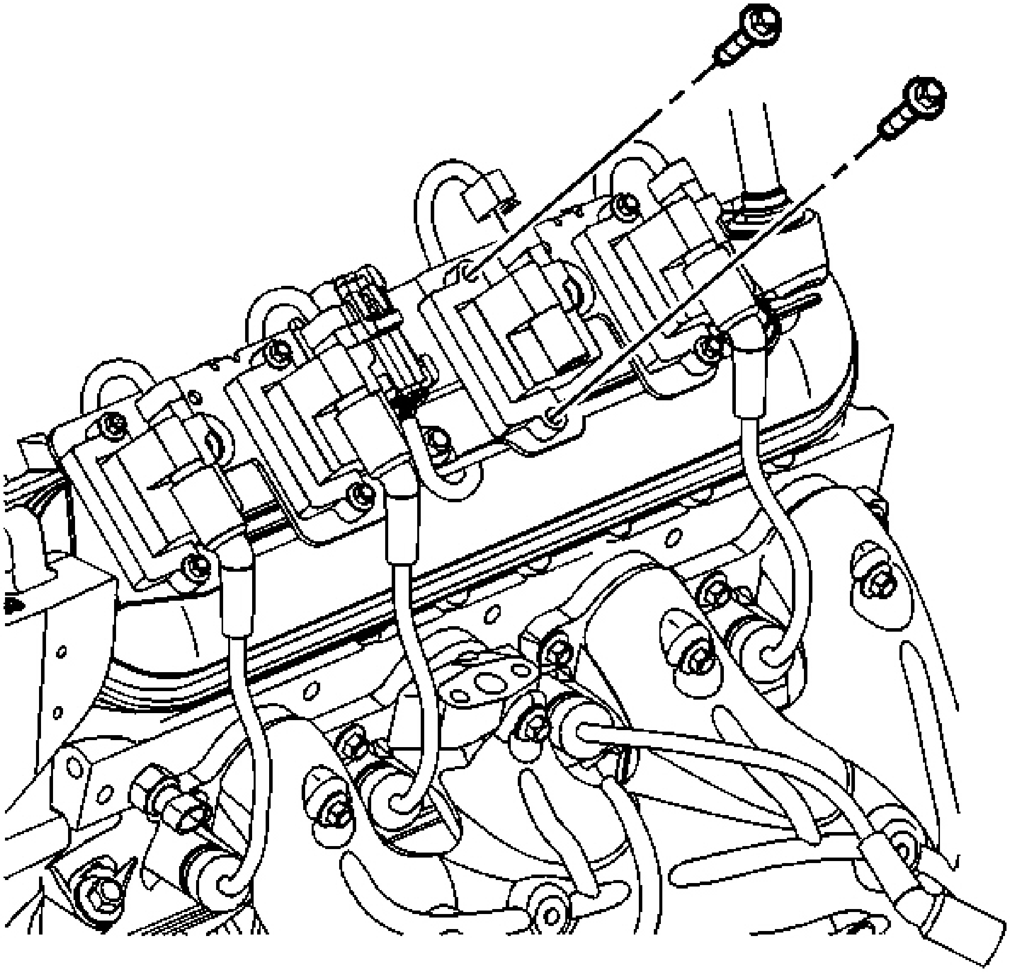


Fig. 157: Ignition Coil Mounting Bolts
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

2. Install the ignition coil mounting bolts.

   Tighten: Tighten the ignition coil mounting bolts to 8 N.m (71 lb in).

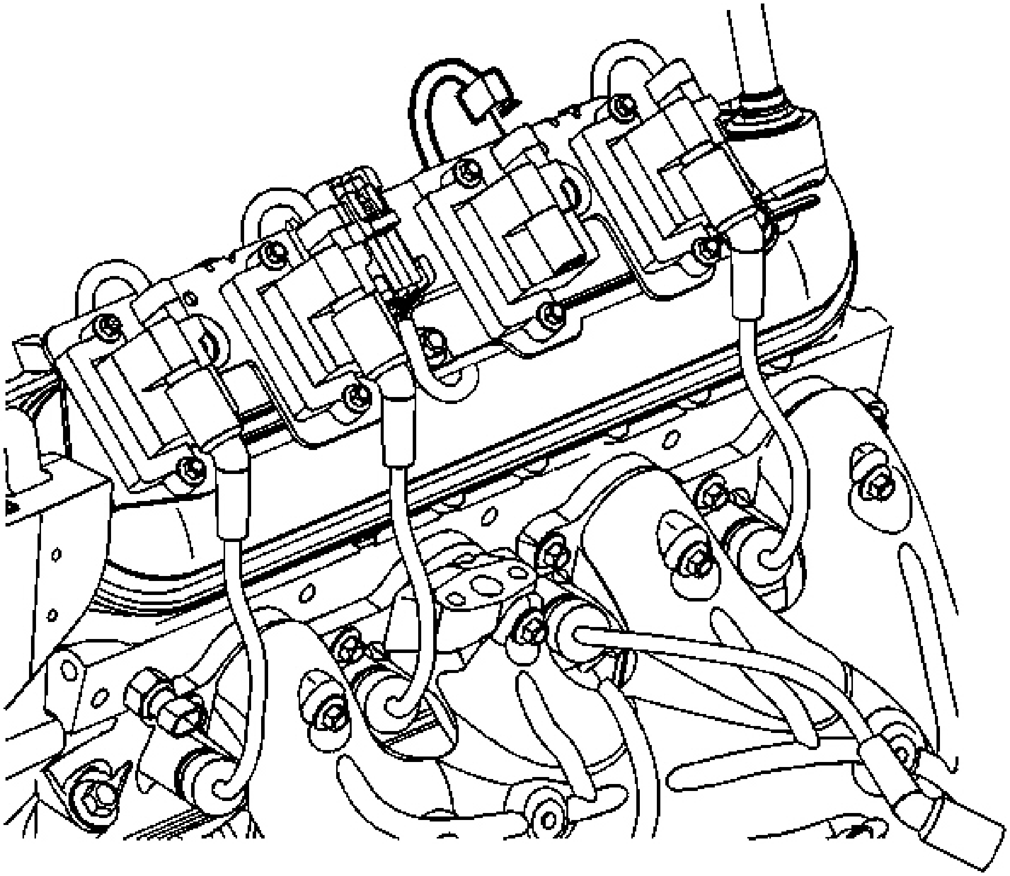


Fig. 158: Ignition Coil Harness Connector
Courtesy of GENERAL MOTORS CORP.

3. Connect the ignition coil harness connector.

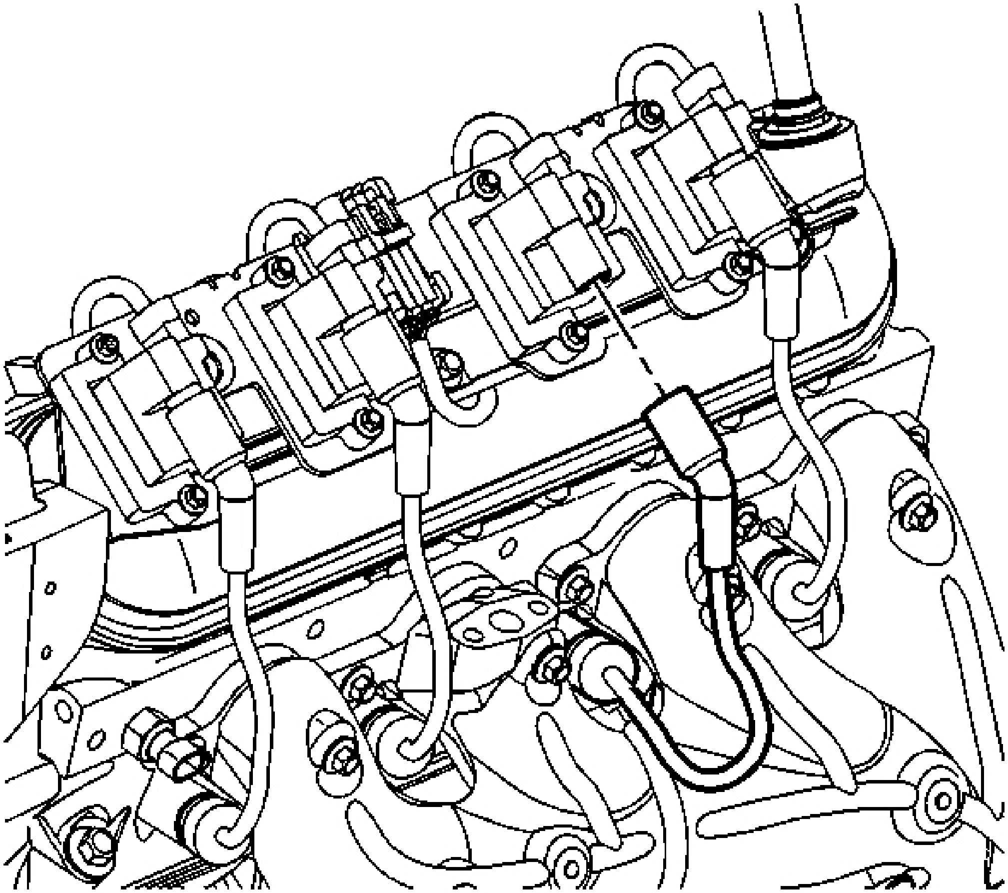


Fig. 159: Spark Plug Wires & Ignition Coils
Courtesy of GENERAL MOTORS CORP.

4. Connect the spark plug wires at the ignition coils.

SPARK PLUG WIRE INSPECTION

Spark plug wire integrity is vital for proper engine operation. A thorough inspection will be necessary to accurately identify conditions that may affect engine operation. Inspect for the following conditions:

- Correct routing of the spark plug wires-Incorrect routing may cause cross-firing.
- Any signs of cracks or splits in the wires.
- Inspect each boot for the following conditions:
  - Tearing

- Piercing
- Arcing
- Carbon tracking
- Corroded terminal

If corrosion, carbon tracking or arcing are indicated on a spark plug wire boot or on a terminal, replace the wire and the component connected to the wire.

SPARK PLUG WIRE REPLACEMENT

Removal Procedure

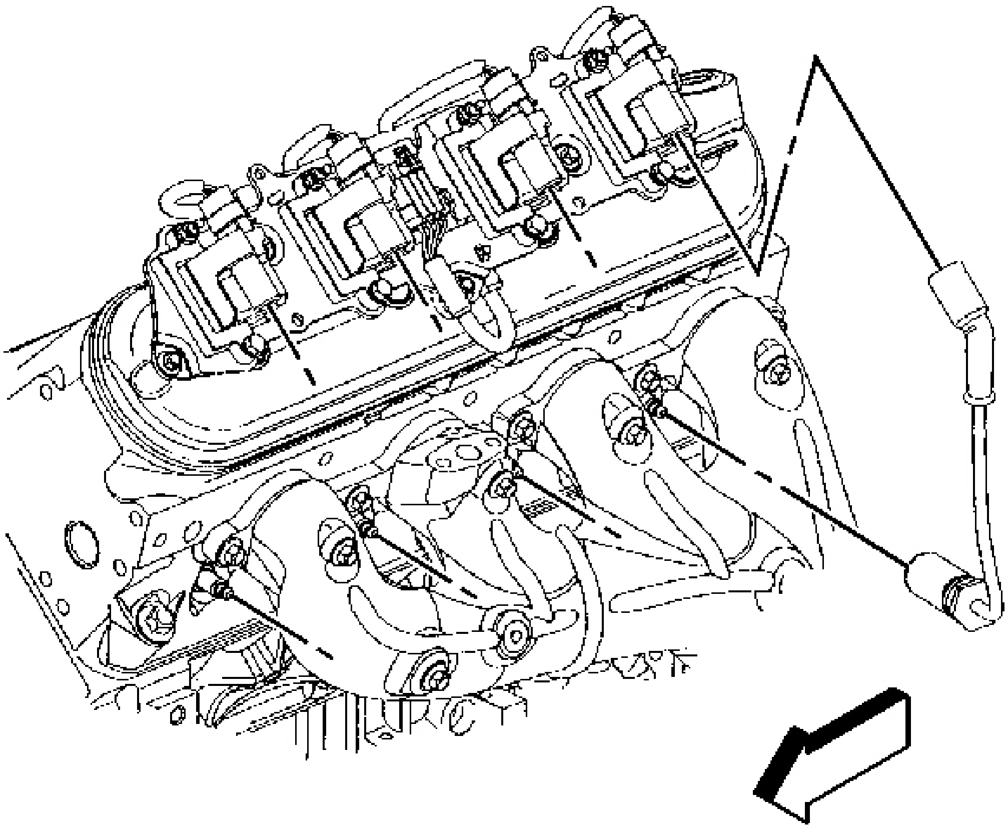


Fig. 160: Spark Plug Wire & Boot
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the spark plug wire at each spark plug.

- Twist each spark plug 1/2 turn.
- Pull only on the boot in order to remove the wire from each spark plug.

2. Disconnect the spark plug wire from the ignition coil.
    - Twist each spark plug boot 1/2 turn.
    - Pull only on the boot in order to remove the wires from the ignition coil.

Spark Plug Wire Length V8

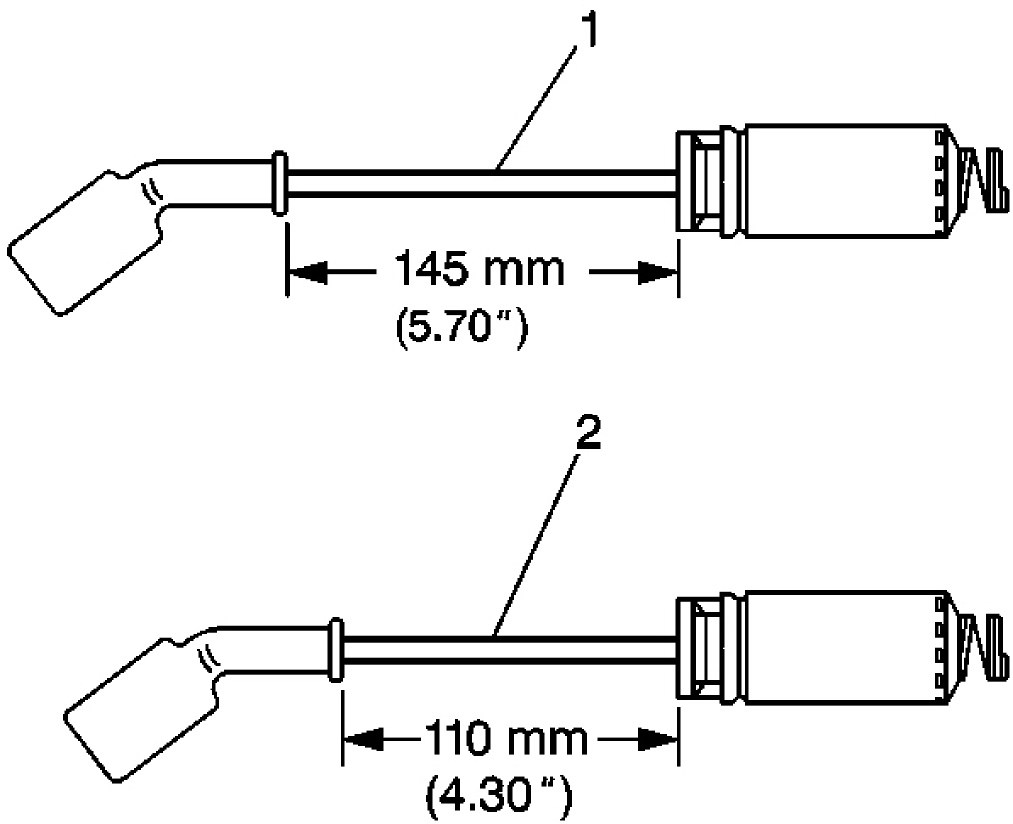


Fig. 161: Spark Plug Wires
Courtesy of GENERAL MOTORS CORP.

- The Melco(R), square design, uses a spark plug wire (1) that is 145 mm (5.70 in) length cable seal to cable seal.
- The Delphi(R), round design uses a spark plug wire (2) that is 110 mm (4.30 in) length cable seal to cable seal.

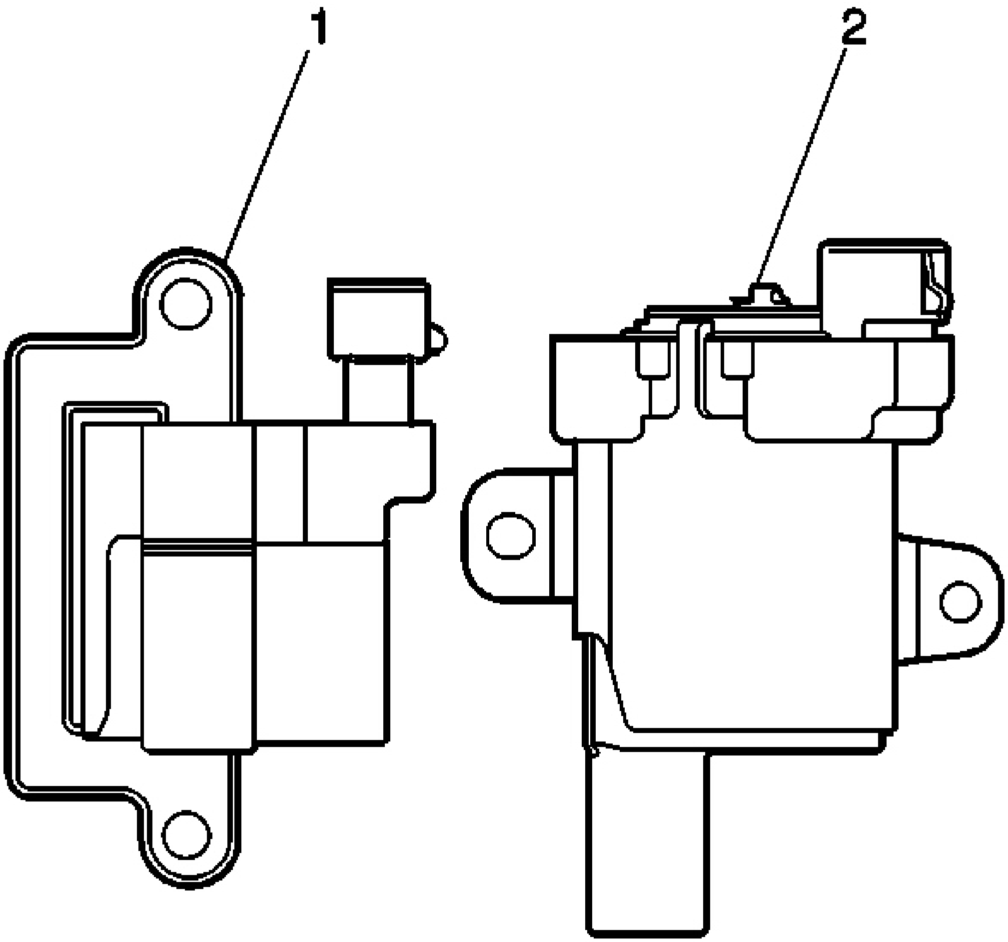


Fig. 162: Melco(R) Square Design & Delphi(R) Round Design
Courtesy of GENERAL MOTORS CORP.

- There are 2 different manufacturers for the ignition coils. the Melco(R) (1) square design, and the Delphi (R) (2) round design. These 2 coils use 2 different spark plug wire, and mounting brackets.

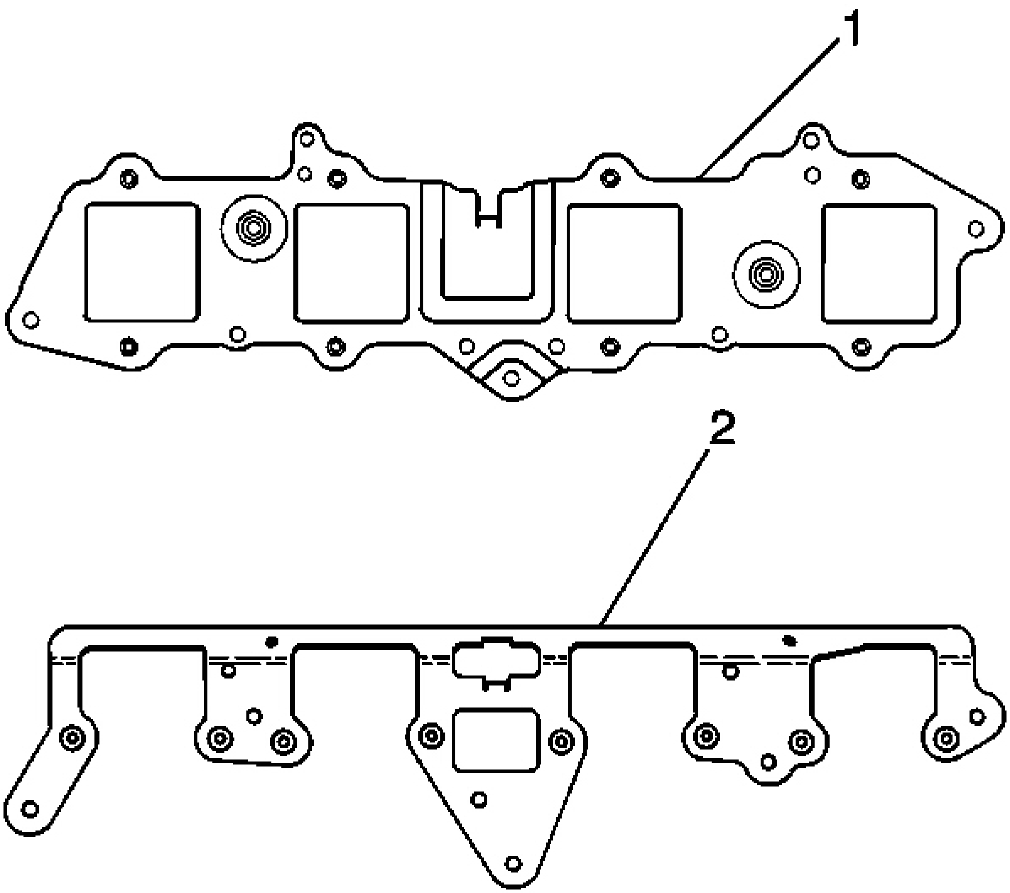


Fig. 163: Melco(R) & Delphi(R) Coil Mounting Brackets
Courtesy of GENERAL MOTORS CORP.

- Melco(R), square design, coil mounting bracket (1).
- Delphi(R), round design, coil mounting bracket (2).

Installation Procedure

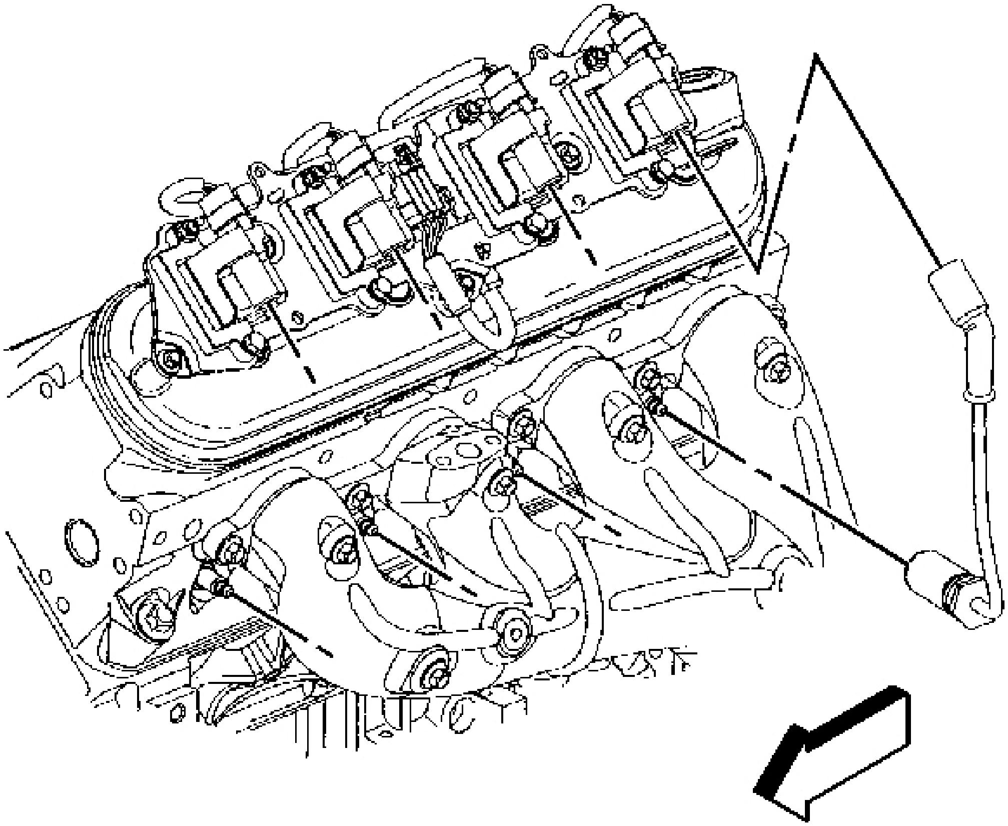


Fig. 164: Spark Plug Wire & Boot
Courtesy of GENERAL MOTORS CORP.

1. Install the spark plug wires at the ignition coil.
2. Install the spark plug wire to each spark plug.
3. Inspect the wires for proper installation:
    - Push sideways on each boot in order to inspect the seating.
    - Reinstall any loose boot.

SPARK PLUG INSPECTION

Spark Plug Usage

- Verify that the correct spark plug is installed. An incorrect spark plug causes driveability conditions. Refer to **Ignition System Specifications** for the correct spark plug.

- Ensure that the spark plug has the correct heat range. An incorrect heat range causes the following conditions:
    - Spark plug fouling-Colder plug
    - Pre-ignition causing spark plug and/or engine damage-Hotter plug

Spark Plug Inspection

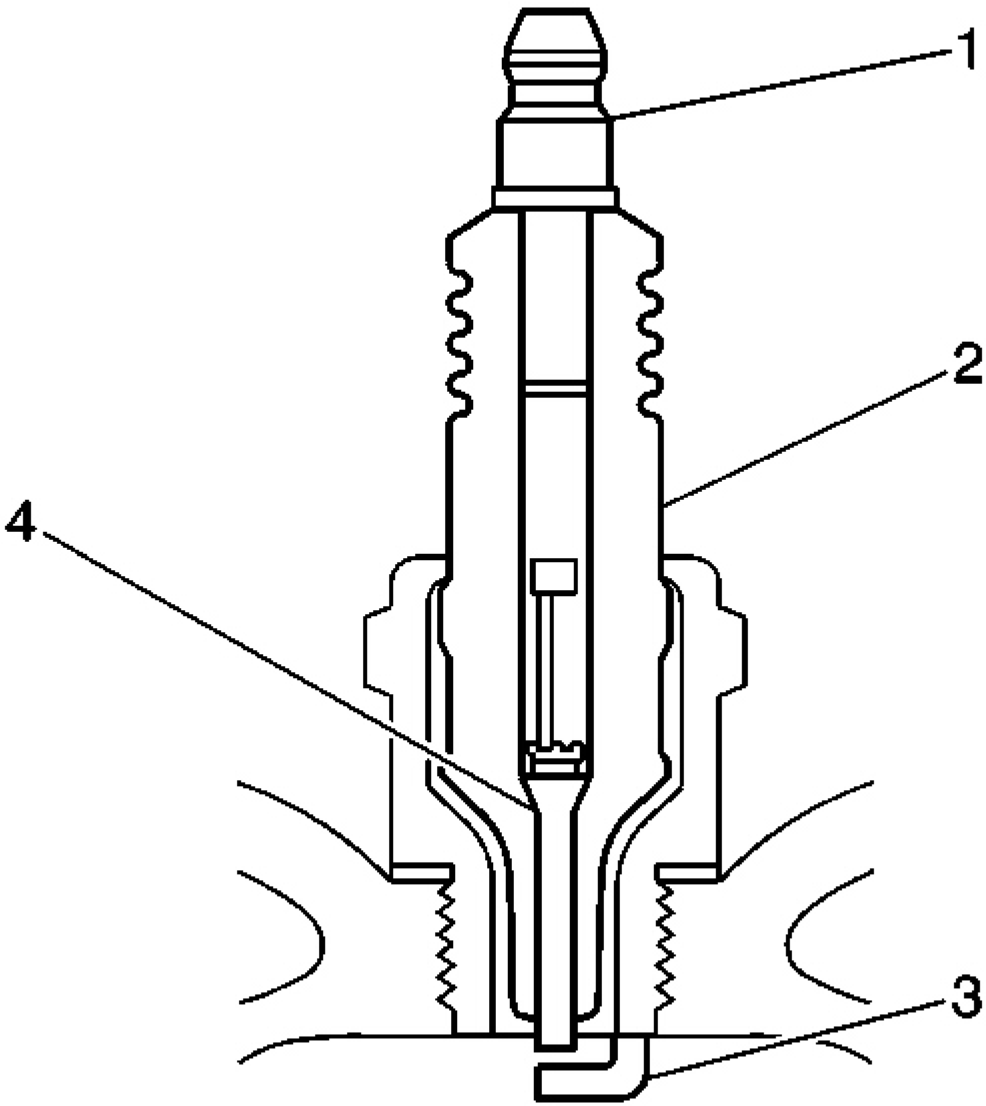


Fig. 165: Inspecting Spark Plug Components
Courtesy of GENERAL MOTORS CORP.

- Inspect the terminal post (1) for damage.
  - Inspect for a bent or broken terminal post (1).
  - Test for a loose terminal post (1) by twisting and pulling the post. The terminal post (1) should NOT move.

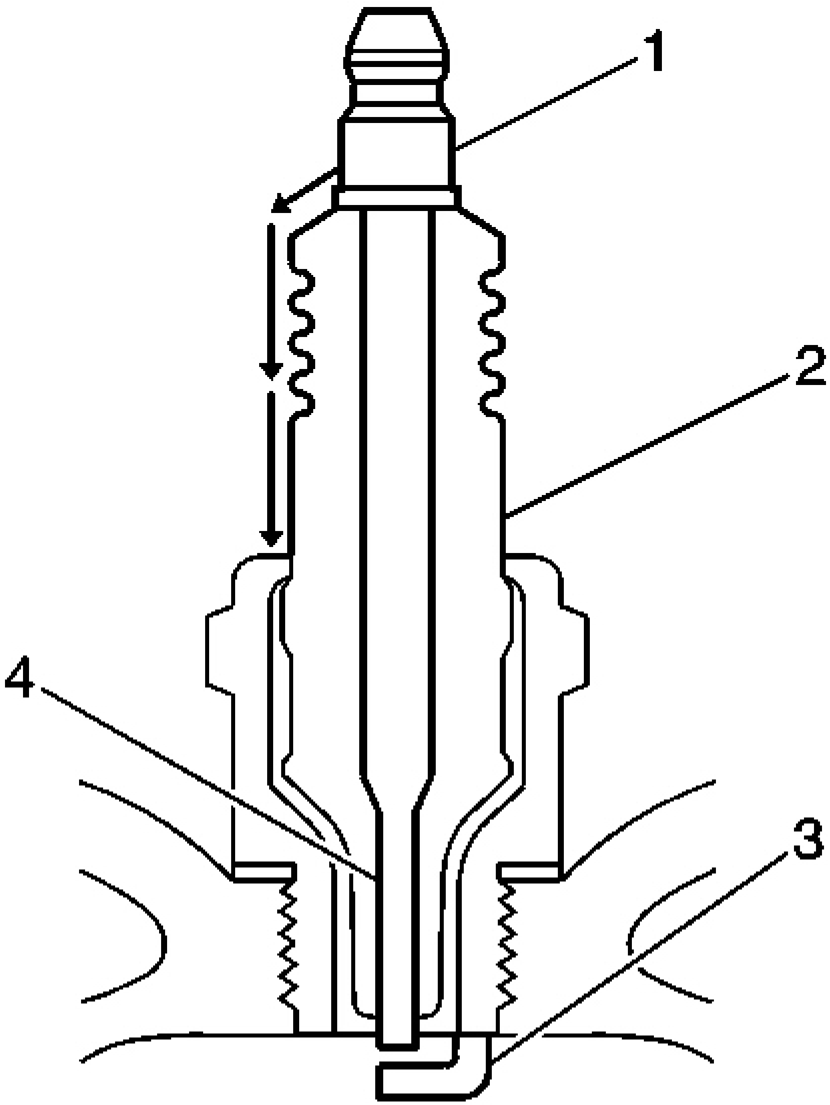


Fig. 166: Inspecting Spark Plug Insulator For Soot
Courtesy of GENERAL MOTORS CORP.

- Inspect the insulator (2) for flashover or carbon tracking, soot. This is caused by the electrical charge traveling across the insulator (2) between the terminal post (1) and ground. Inspect for the following conditions:
  - Inspect the spark plug boot for damage.
  - Inspect the spark plug recess area of the cylinder head for moisture, such as oil, coolant, or water. A spark plug boot that is saturated causes arcing to ground.

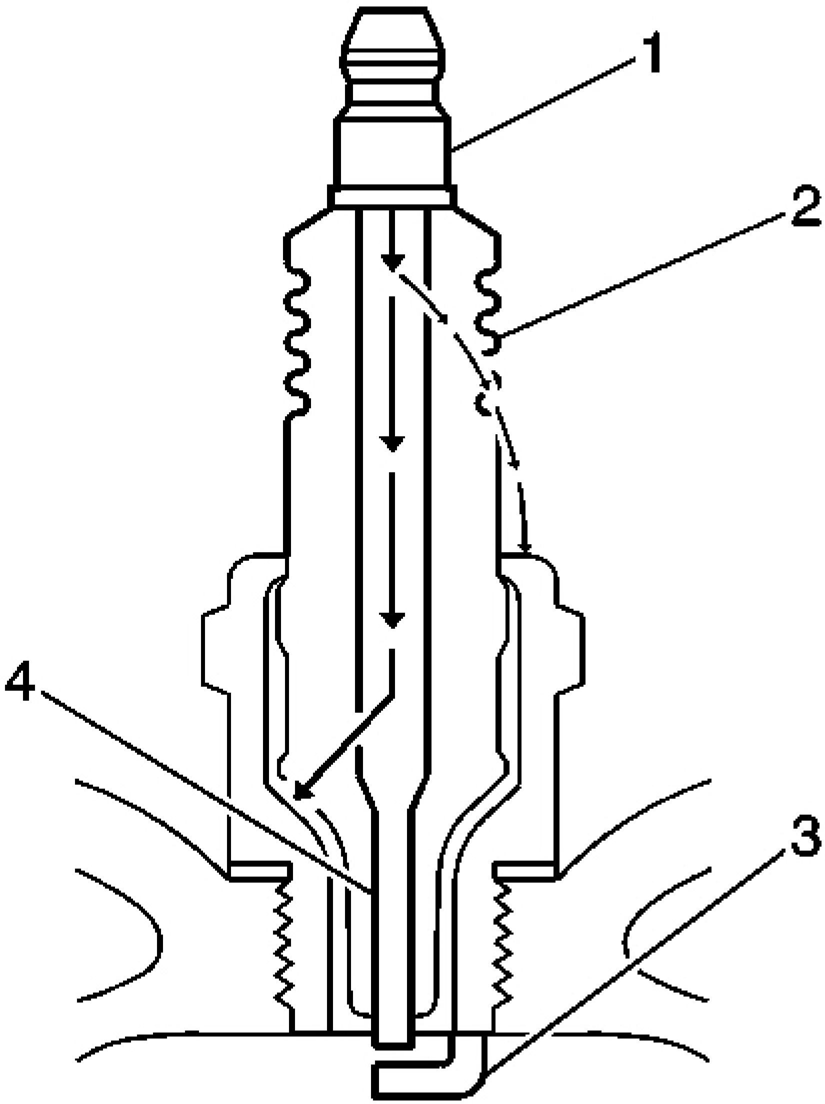


Fig. 167: Inspecting Spark Plug Insulator
Courtesy of GENERAL MOTORS CORP.

- Inspect the insulator (2) for cracks. All or part of the electrical charge may arc through the crack instead of the electrodes (3, 4).

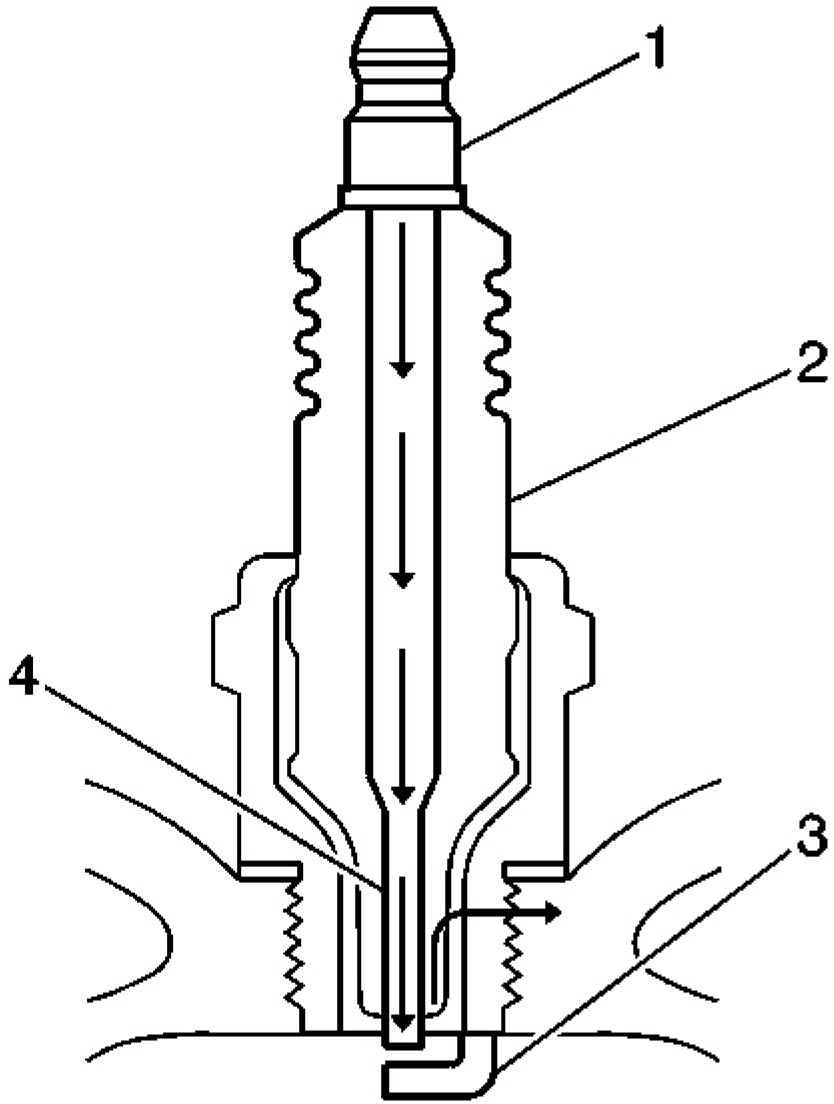


Fig. 168: Inspecting Spark Plug For Improper Arcing
Courtesy of GENERAL MOTORS CORP.

- Inspect for evidence of improper arcing.
  - Measure the gap between the center electrode (4) and the side electrode (3) terminals. Refer to **Ignition System Specifications** . An excessively wide electrode gap can prevent correct spark plug operation.

- Inspect for the correct spark plug torque. Refer to **Ignition System Specifications** . Insufficient torque can prevent correct spark plug operation. An over torqued spark plug, causes the insulator (2) to crack.
- Inspect for signs of tracking that occurred near the insulator tip instead of the center electrode (4).
- Inspect for a broken or worn side electrode (3).
- Inspect for a broken, worn, or loose center electrode (4) by shaking the spark plug.
  - A rattling sound indicates internal damage.
  - A loose center electrode (4) reduces the spark intensity.
- Inspect for bridged electrodes (3, 4). Deposits on the electrodes (3, 4) reduce or eliminates the gap.
- Inspect for worn or missing platinum pads on the electrodes (3, 4), if equipped.
- Inspect for excessive fouling.

- Inspect the spark plug recess area of the cylinder head for debris. Dirty or damaged threads can cause the spark plug not to seat correctly during installation.

Spark Plug Visual Inspection

- Normal operation-Brown to grayish-tan with small amounts of white powdery deposits are normal combustion by-products from fuels with additives.
- Carbon fouled-Dry, fluffy black carbon, or soot caused by the following conditions:
  - Rich fuel mixtures
    - Leaking fuel injectors
    - Excessive fuel pressure
    - Restricted air filter element
    - Incorrect combustion
  - Reduced ignition system voltage output
    - Weak coils
    - Worn ignition wires
    - Incorrect spark plug gap
  - Excessive idling or slow speeds under light loads can keep spark plug temperatures so low that normal combustion deposits may not burn off.
- Deposit fouling-Oil, coolant, or additives that include substances such as silicone, very white coating, reduces the spark intensity. Most powdery deposits will not effect spark intensity unless they form into a glazing over the electrode.

SPARK PLUG REPLACEMENT

Removal Procedure

1. Remove the spark plug wires. Refer to **Spark Plug Wire Replacement** .

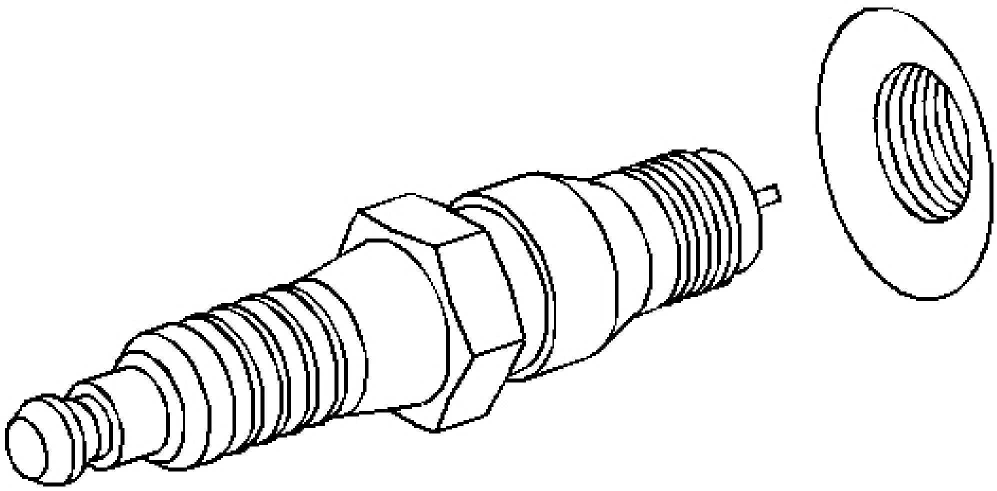


Fig. 169: View Of Spark Plug
Courtesy of GENERAL MOTORS CORP.

2. Loosen each spark plug 1 or 2 turns.
3. Brush or air blast away any dirt from around the spark plugs.
4. Remove the spark plugs 1 at a time. Place each plug in a tray marked with the corresponding cylinder numbers.

Installation Procedure

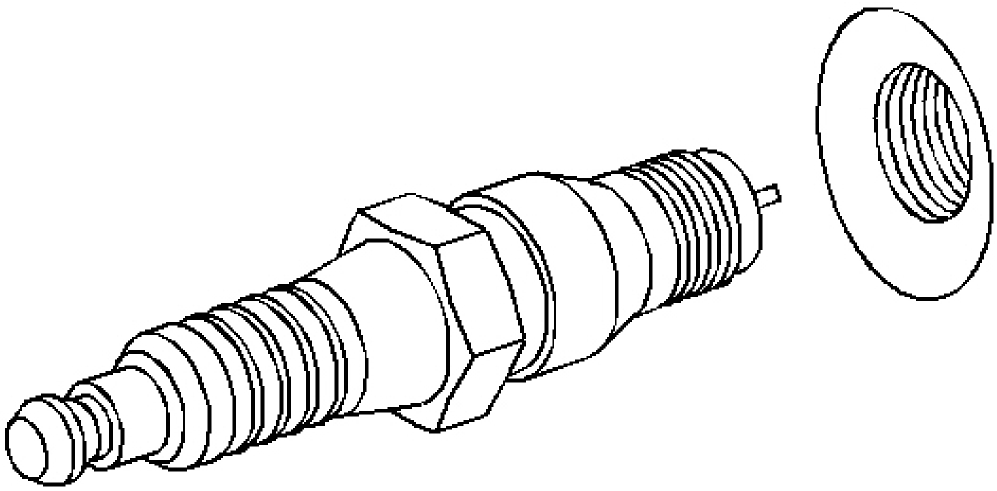


Fig. 170: View Of Spark Plug
Courtesy of GENERAL MOTORS CORP.

1. Properly position each spark plug washer.
2. Inspect each spark plug gap. Adjust each plug as needed.

   Specification: Spark plug gap: 1.524 mm (0.060 in)

   NOTE: Refer to Fastener Notice in Cautions and Notices.

3. Hand start the spark plugs in the corresponding cylinders.
4. Tighten the spark plugs.

   Tighten:
   - For used heads tighten the spark plugs to 15 N.m (11 lb ft).
   - For new aluminum heads tighten the spark plugs to 20 N.m (15 lb ft).
   - For new iron heads, tighten the spark plugs to 30 N.m (22 lb ft).

5. Install the spark plug wires. Refer to **Spark Plug Wire Replacement** .

CRANKSHAFT POSITION (CKP) SENSOR REPLACEMENT

Removal Procedure

IMPORTANT: **Perform the CKP System Variation Learn Procedure when the crankshaft position sensor is removed or replaced.**

CAUTION: **Refer to Battery Disconnect Caution in Cautions and Notices.**

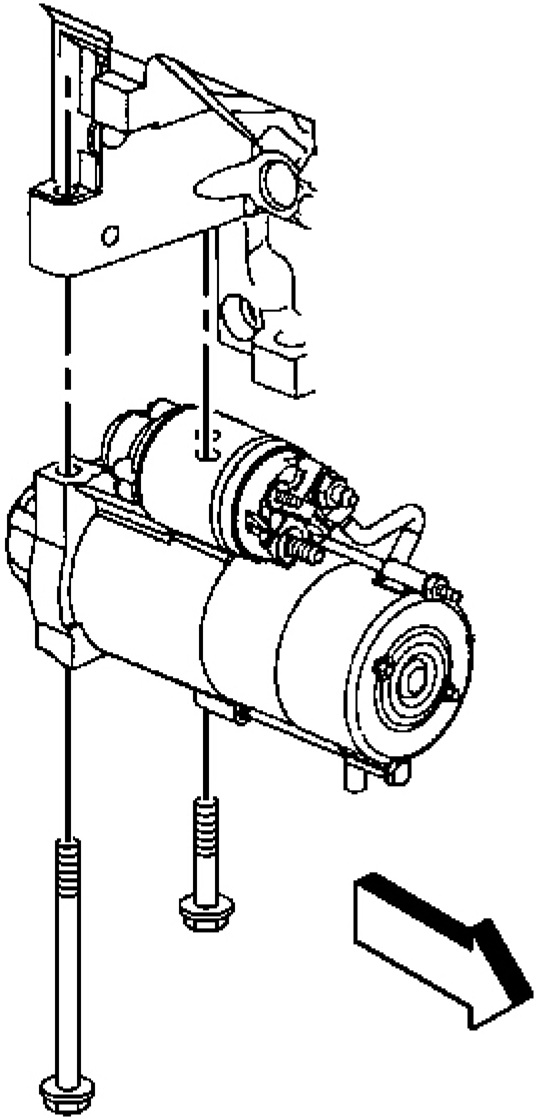


Fig. 171: View Of Starter
Courtesy of GENERAL MOTORS CORP.

1. Disconnect the negative battery cable.
2. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information.
3. Remove the starter. Refer to **Starter Motor Replacement** in Engine Electrical.

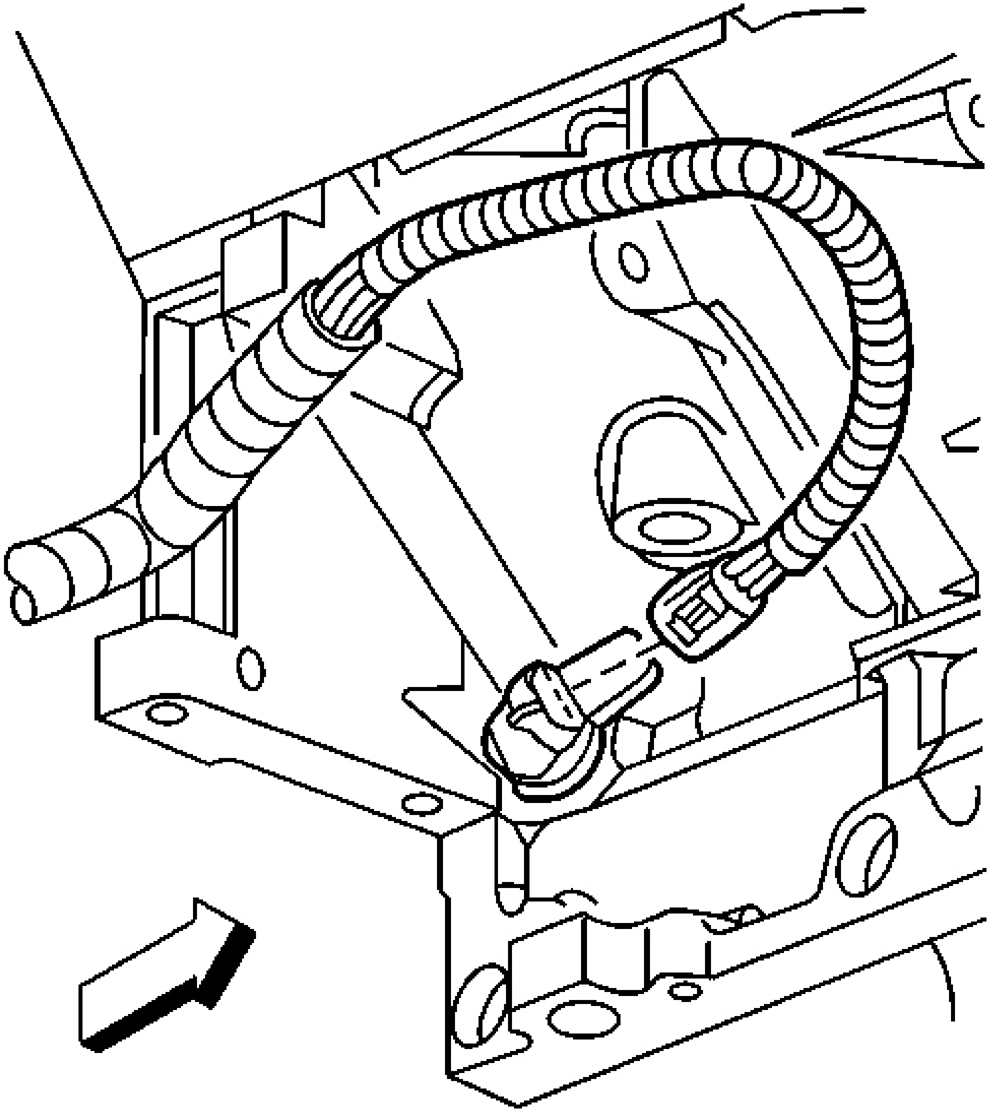


Fig. 172: Crankshaft Position (CKP) Sensor
Courtesy of GENERAL MOTORS CORP.

4. Disconnect the crankshaft position (CKP) sensor electrical connector.

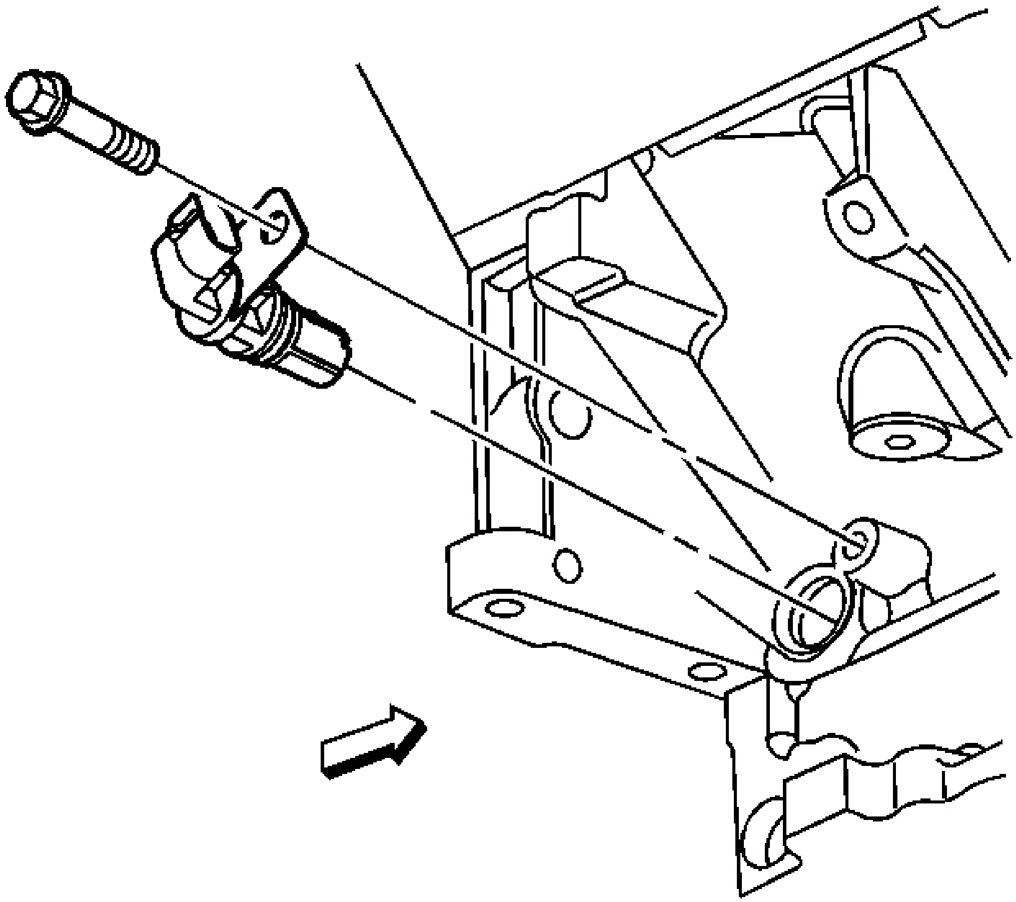


Fig. 173: View Of CKP Sensor & Bolt
Courtesy of GENERAL MOTORS CORP.

5. Clean the area around the CKP sensor before removal in order to avoid debris from entering the engine.
6. Remove the CKP sensor retaining bolt.
7. Remove the CKP sensor.

Installation Procedure

1. Install the CKP sensor.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

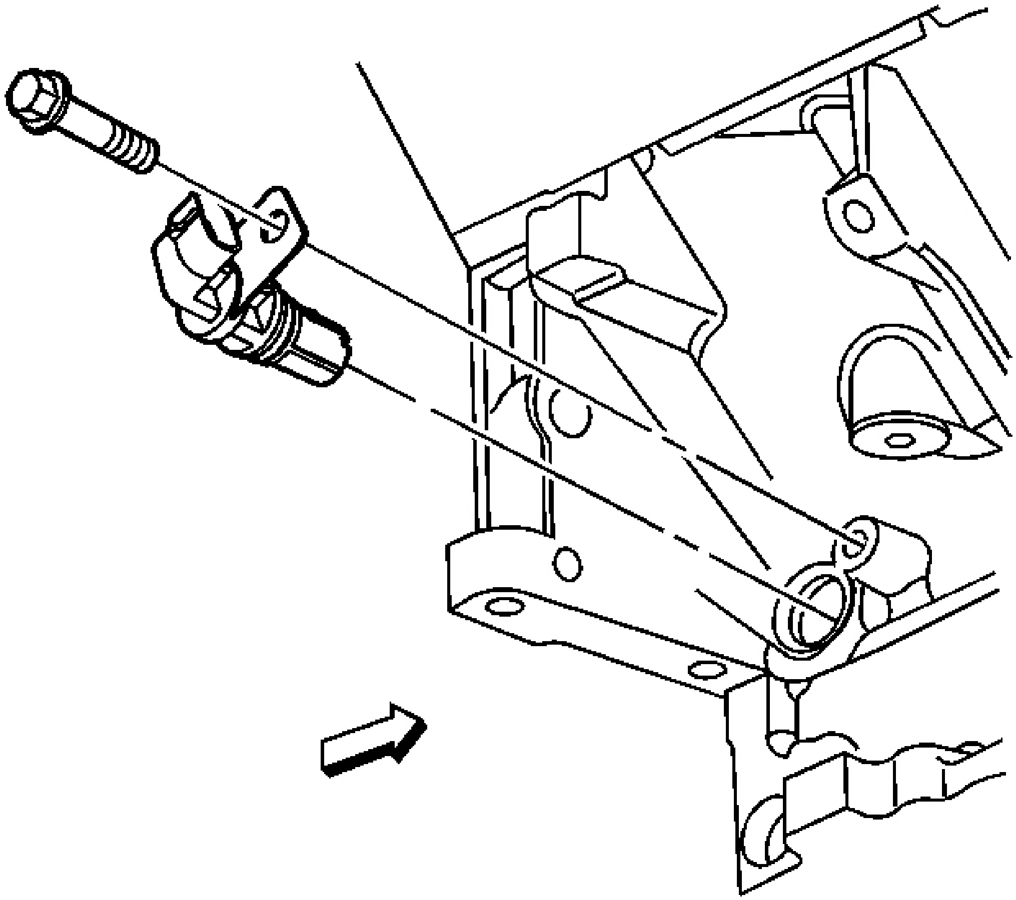


Fig. 174: View Of CKP Sensor & Bolt
Courtesy of GENERAL MOTORS CORP.

2. Install the CKP sensor retaining fastener.

   Tighten: Tighten the bolt to 25 N.m (18 lb ft).

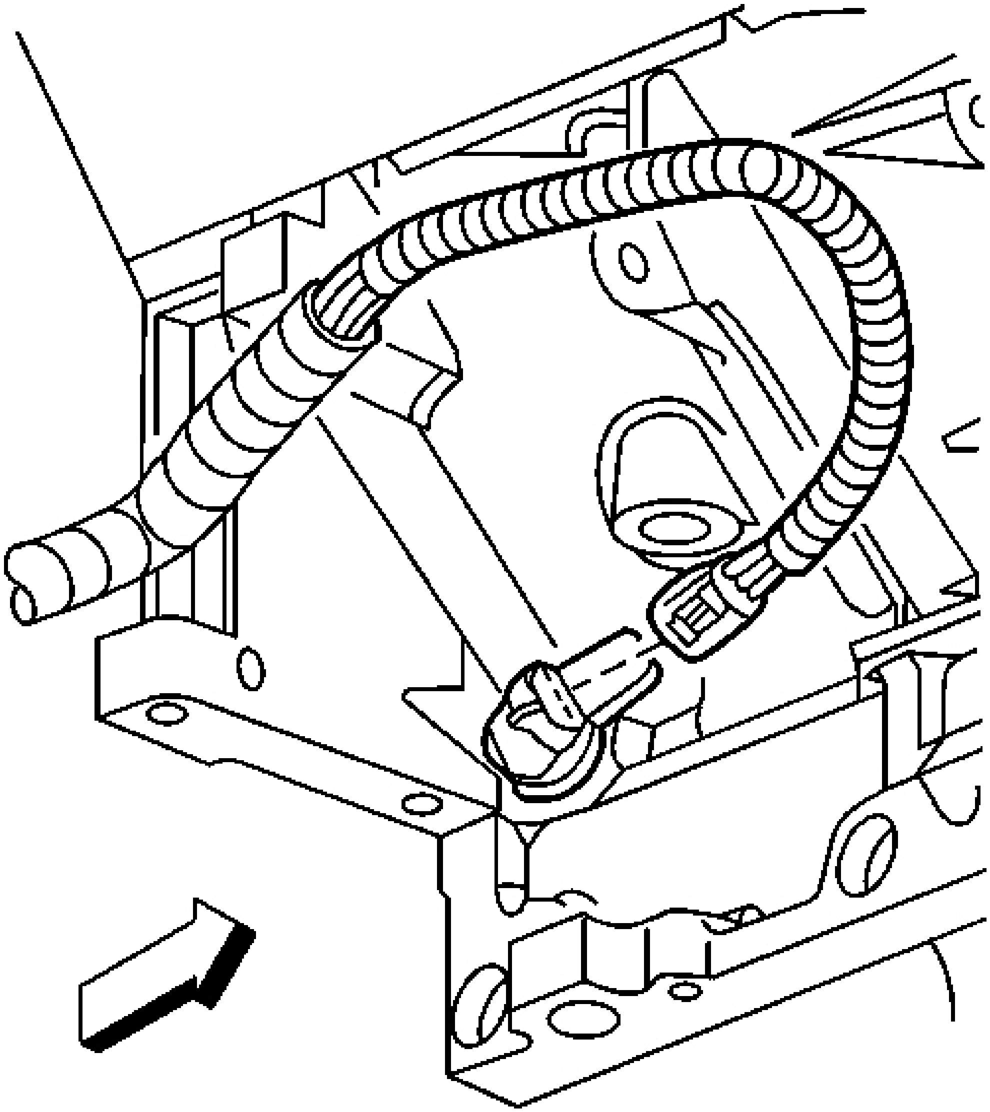


Fig. 175: Crankshaft Position (CKP) Sensor
Courtesy of GENERAL MOTORS CORP.

3. Connect the CKP sensor electrical connector.

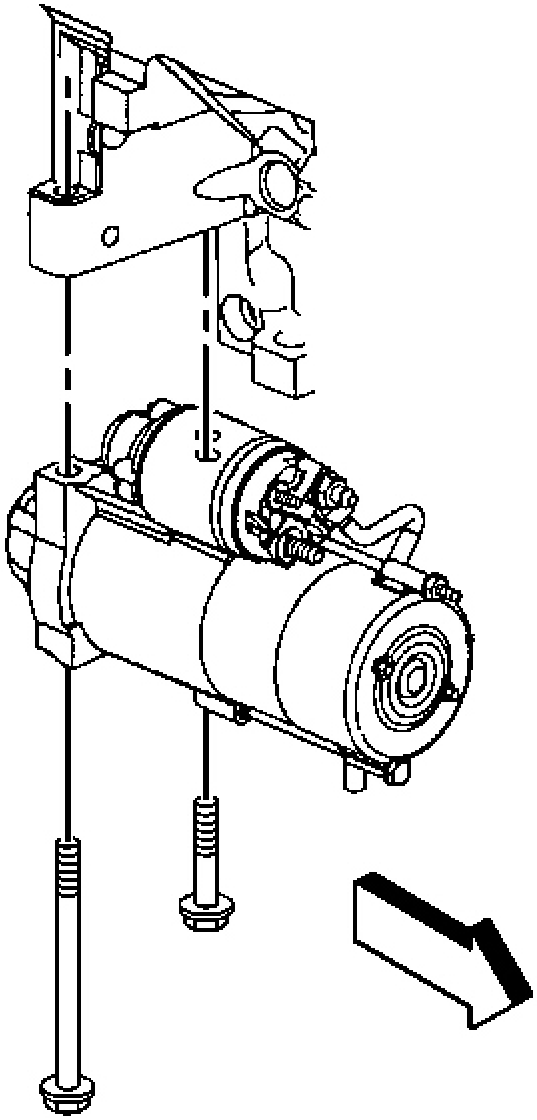


Fig. 176: View Of Starter
Courtesy of GENERAL MOTORS CORP.

4. Install the starter. Refer to **Starter Motor Replacement** in Engine Electrical.
5. Lower the vehicle.
6. Connect the negative battery cable.
7. Perform the CKP system variation learn procedure. Refer to **CKP System Variation Learn Procedure** .

CAMSHAFT POSITION (CMP) SENSOR REPLACEMENT

Removal Procedure

IMPORTANT: Clean the area around the camshaft position (CMP) sensor before removal in order to prevent debris from entering the engine.

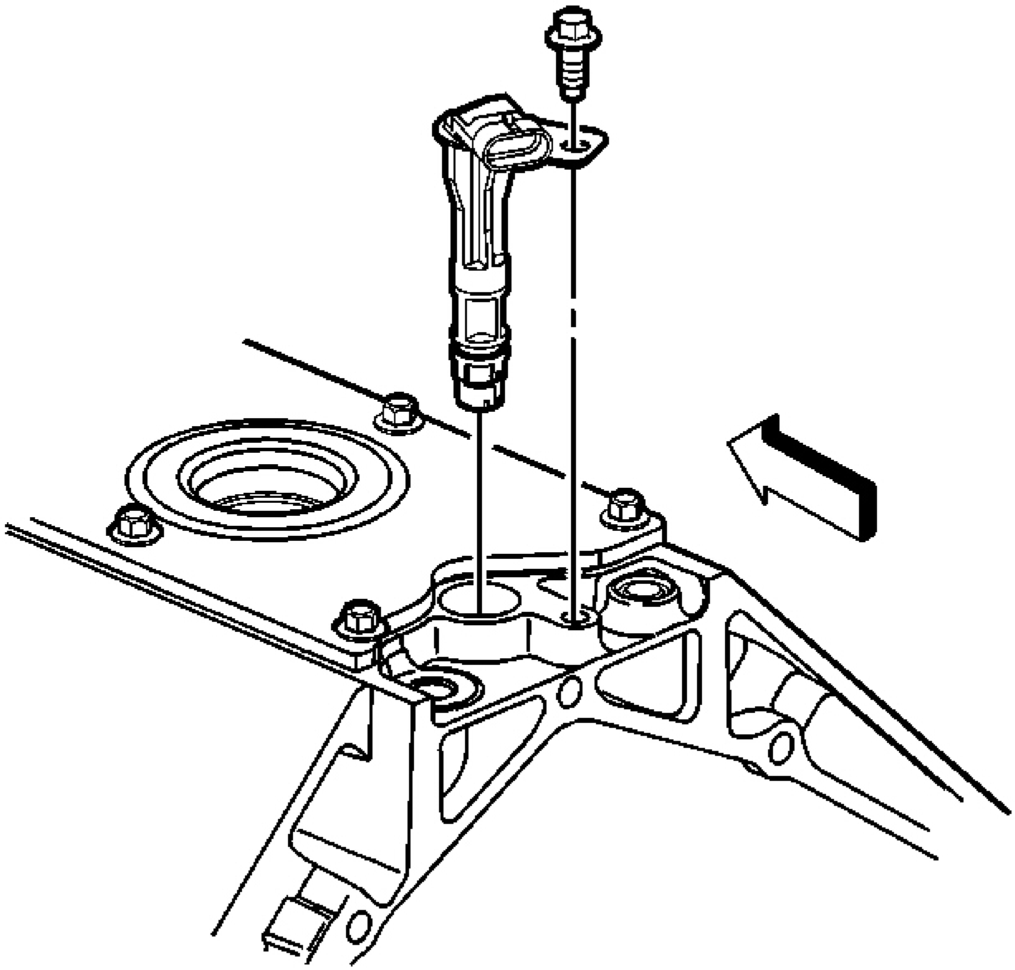


Fig. 177: View Of Camshaft Sensor & Bolt
Courtesy of GENERAL MOTORS CORP.

1. Remove the engine sight shield. Refer to **Engine Sight Shield Replacement (6.0L (LQ4))** in Engine Mechanical 6.0L.
2. Disconnect the CMP sensor electrical connector.

3. Remove the CMP sensor bolt.
4. Remove the CMP sensor.

Installation Procedure

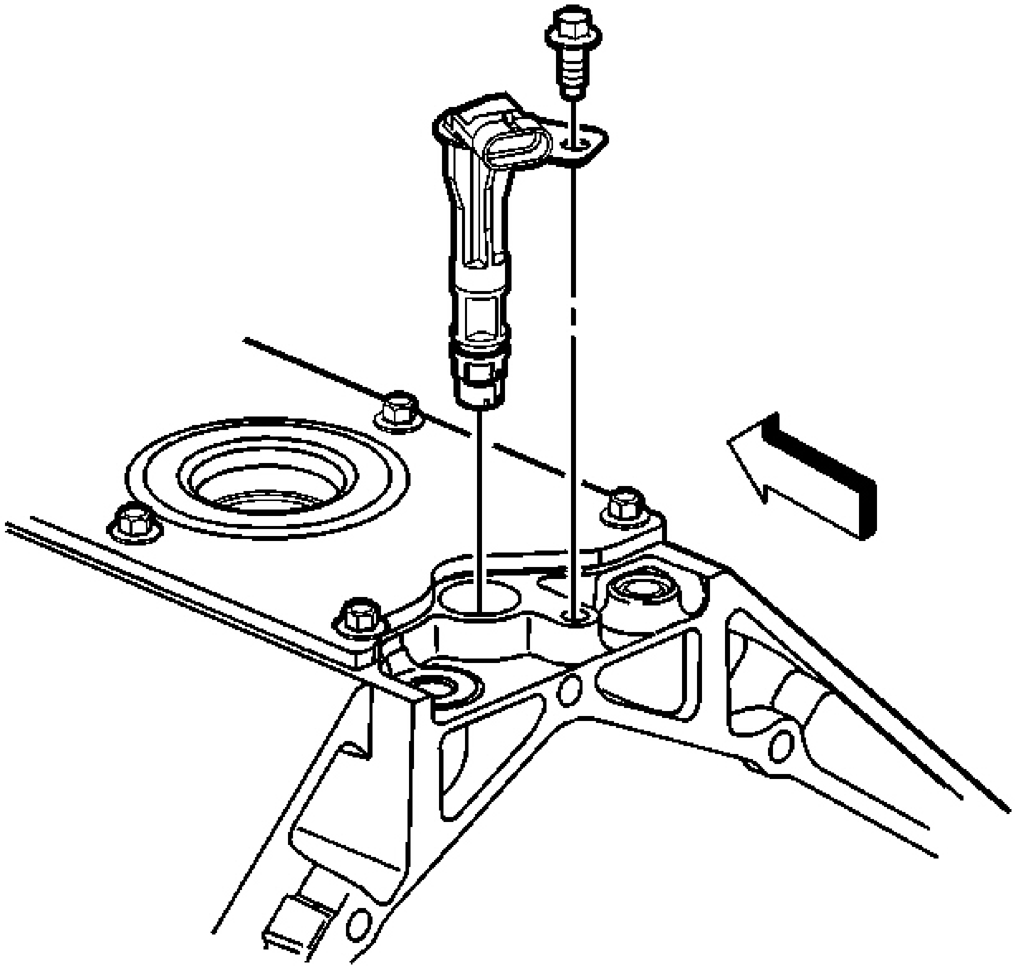


Fig. 178: View Of Camshaft Sensor & Bolt
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

1. Install the CMP sensor.
2. Install the CMP sensor bolt.

Tighten: Tighten the bolt to 25 N.m (18 lb ft).

3. Connect the CMP sensor electrical connector.
4. Install the engine sight shield. Refer to **Engine Sight Shield Replacement (6.0L (LQ4))** in Engine Mechanical 6.0L.

KNOCK SENSOR (KS) REPLACEMENT

Removal Procedure

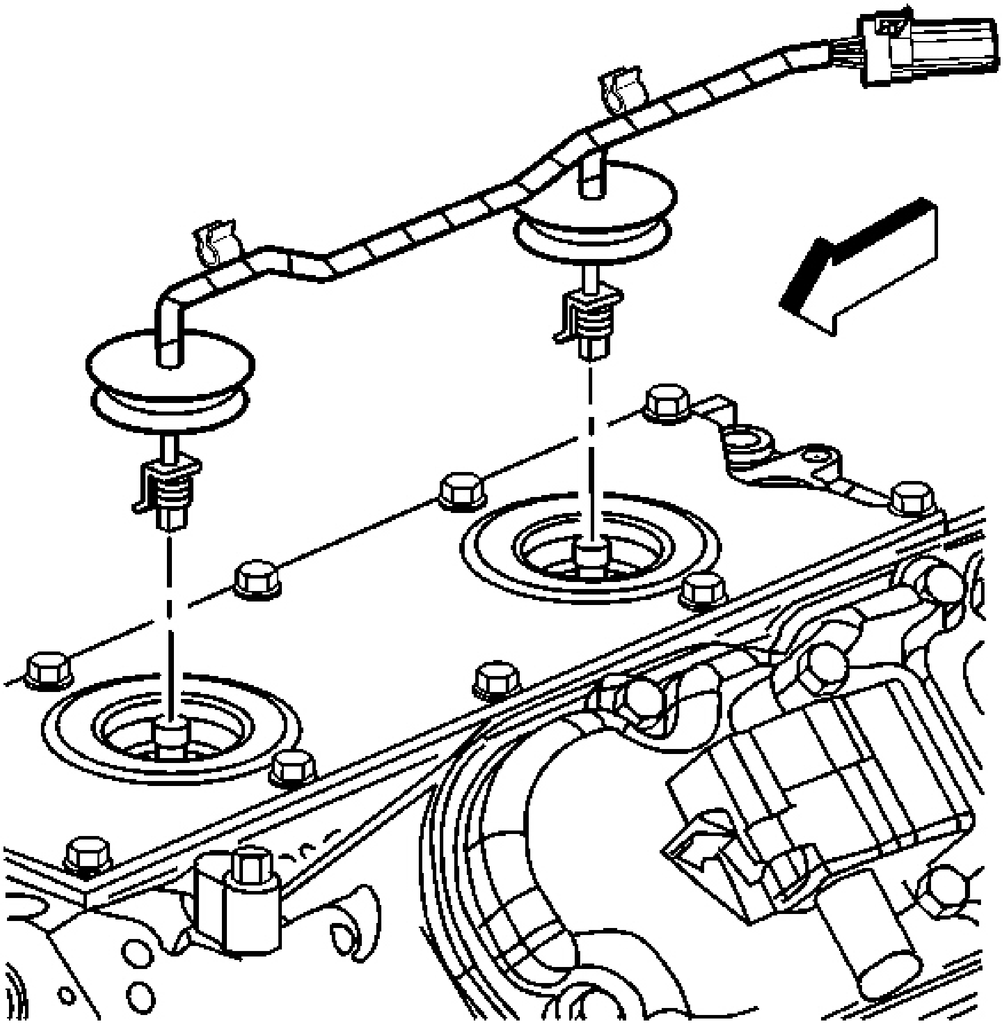


Fig. 179: Knock Sensor Wiring Harness Assembly

Courtesy of GENERAL MOTORS CORP.

1. Remove the intake manifold. Refer to **Intake Manifold Replacement** in Engine Mechanical.
2. Remove the knock sensor wiring harness assembly.

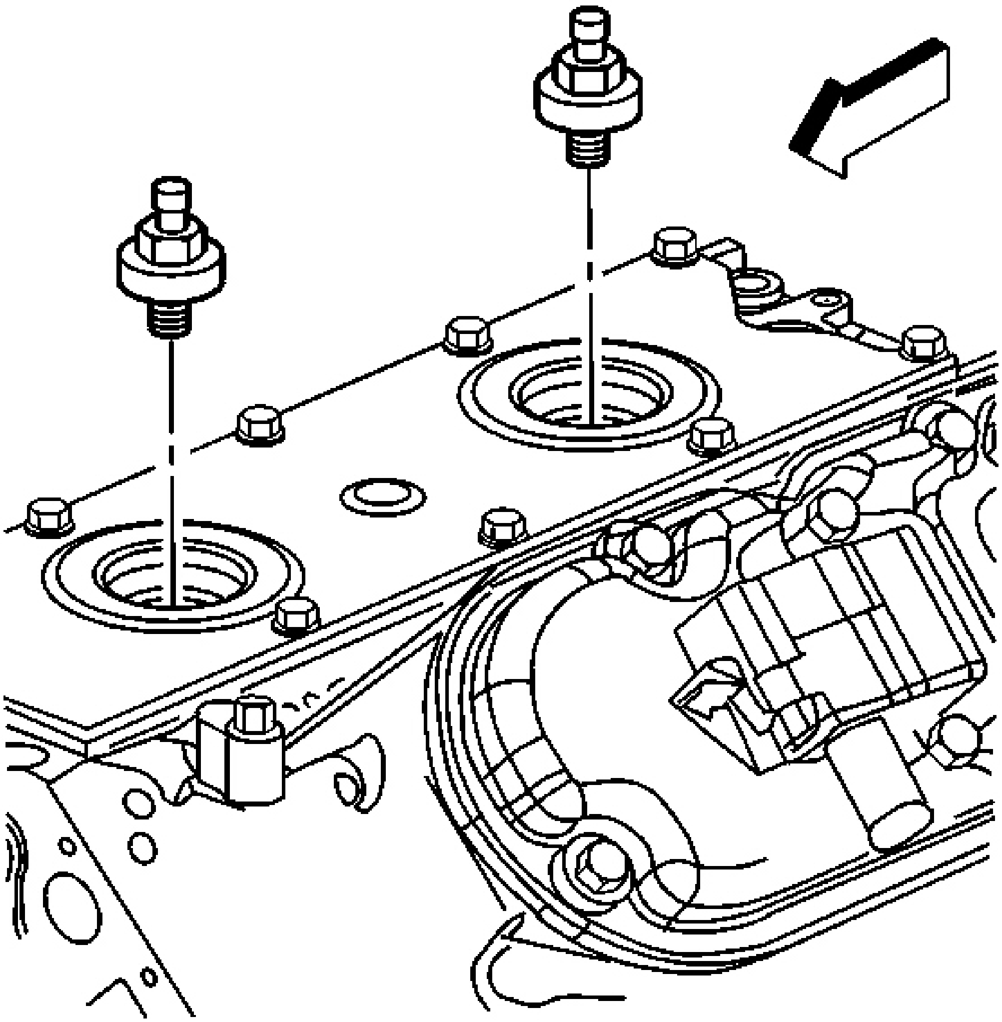


Fig. 180: Identifying Knock Sensors
Courtesy of GENERAL MOTORS CORP.

3. Remove the knock sensor (KS).

Installation Procedure

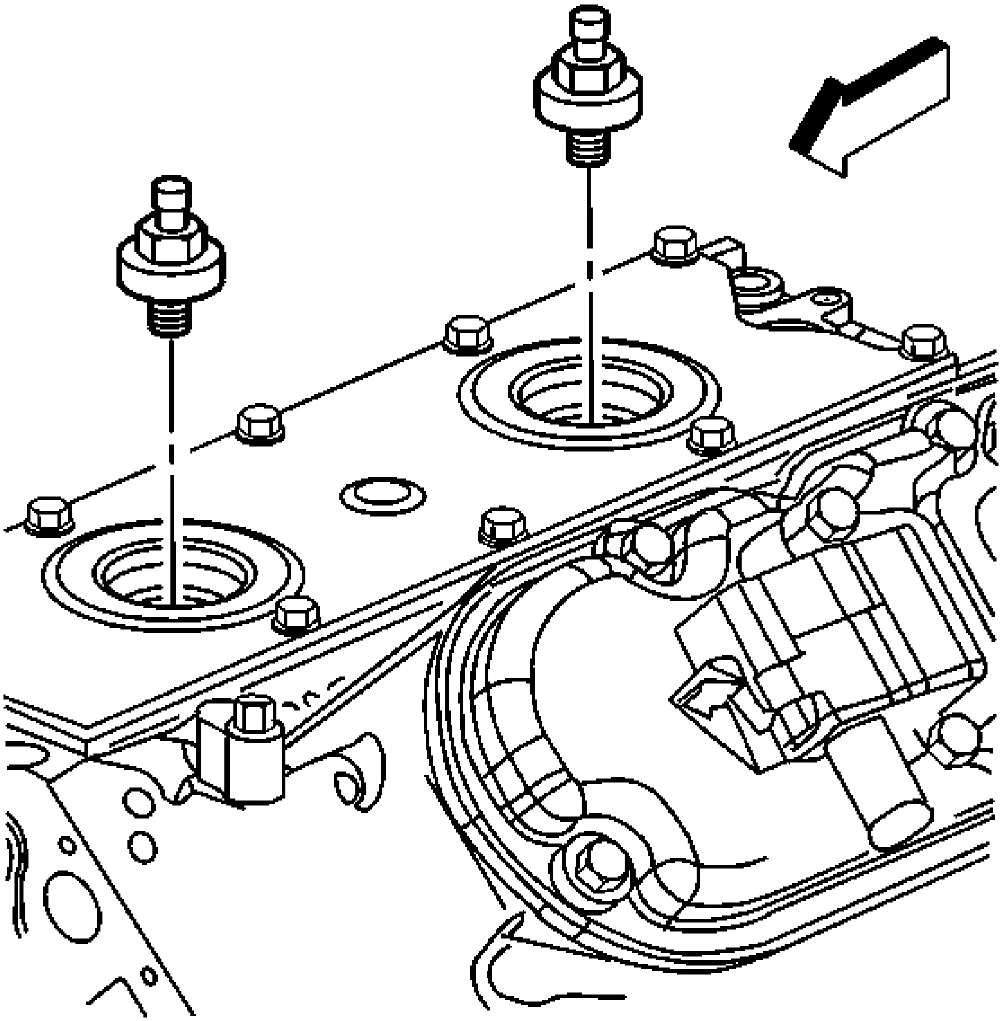


Fig. 181: Identifying Knock Sensors
Courtesy of GENERAL MOTORS CORP.

NOTE: Refer to Fastener Notice in Cautions and Notices.

1. Install the knock sensor.

   Tighten: Torque the sensor to 20 N.m (15 lb ft).

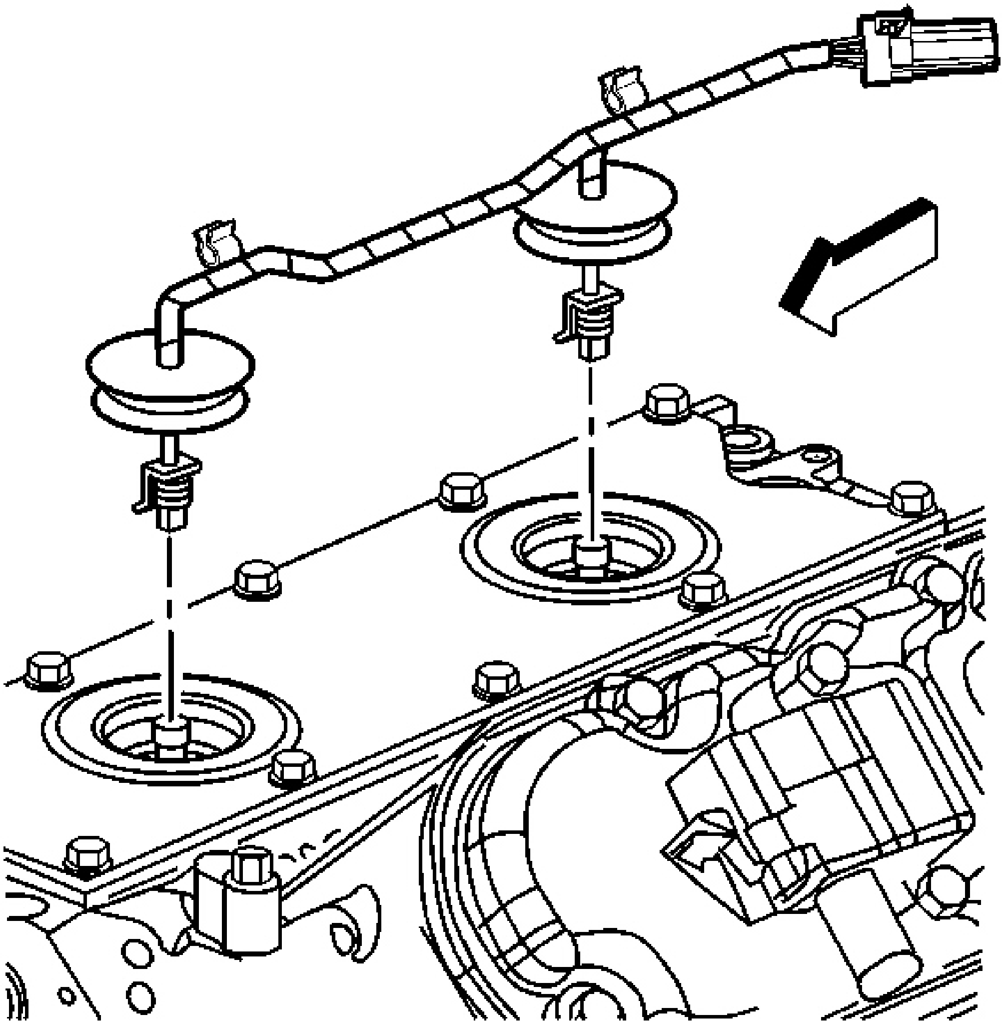


Fig. 182: Knock Sensor Wiring Harness Assembly
Courtesy of GENERAL MOTORS CORP.

2. Install the knock sensor wiring harness assembly.
3. Install the intake manifold. Refer to **Intake Manifold Replacement** in Engine Mechanical.

AIR CLEANER ELEMENT REPLACEMENT

Removal Procedure

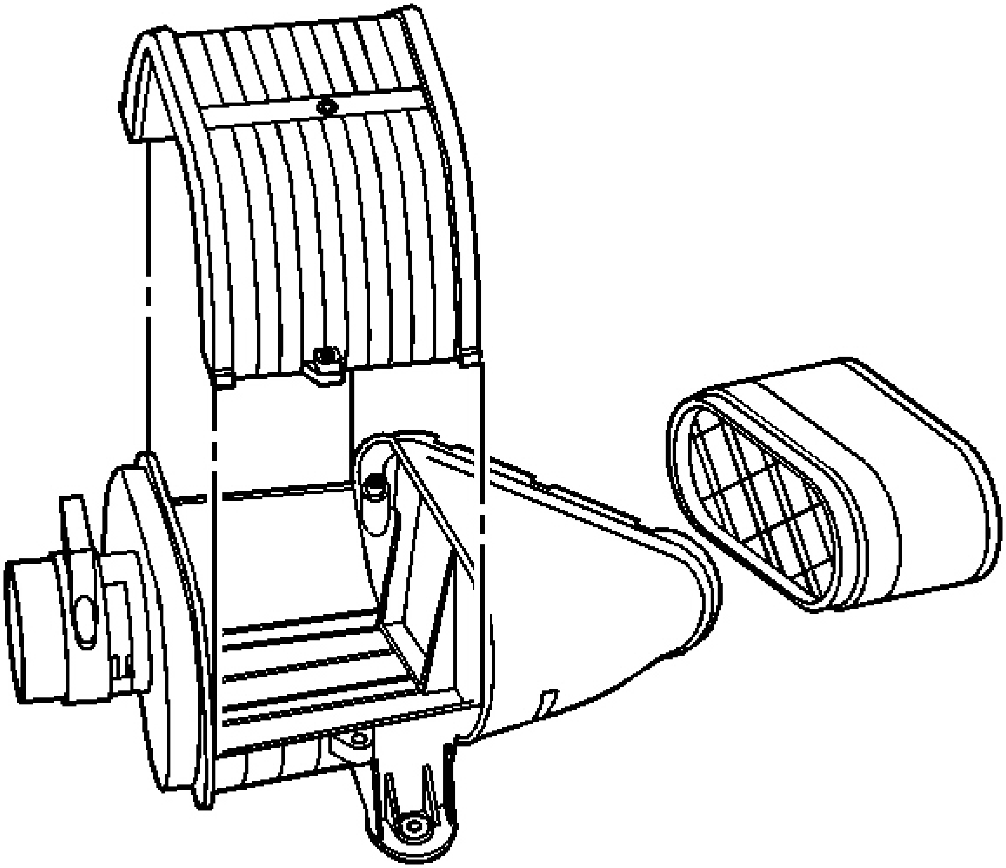


Fig. 183: Air Filter/Cleaner Element
Courtesy of GENERAL MOTORS CORP.

1. Loosen the 2 fasteners securing the air cleaner housing top cover.
2. Lift and rotate the top cover of the air cleaner housing to gain access to the air filter element.
3. Lift out the air filter element.
4. Inspect the air filter element for dust, dirt, or water. Clean or replace the air filter element if required.

Installation Procedure

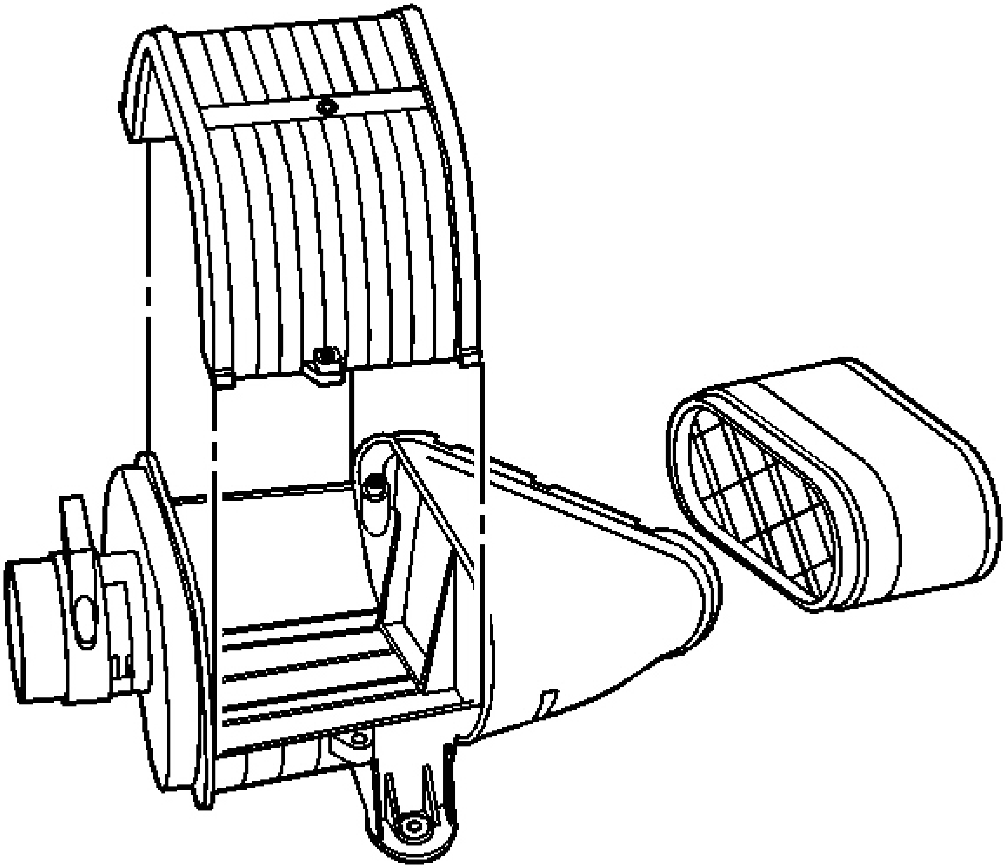


Fig. 184: Air Filter/Cleaner Element
Courtesy of GENERAL MOTORS CORP.

1. Install the air filter element into the air cleaner housing.
2. Rotate and install the top cover to the air cleaner housing.
3. Insert the fasteners to secure the top cover.

AIR CLEANER ASSEMBLY REPLACEMENT

Removal Procedure

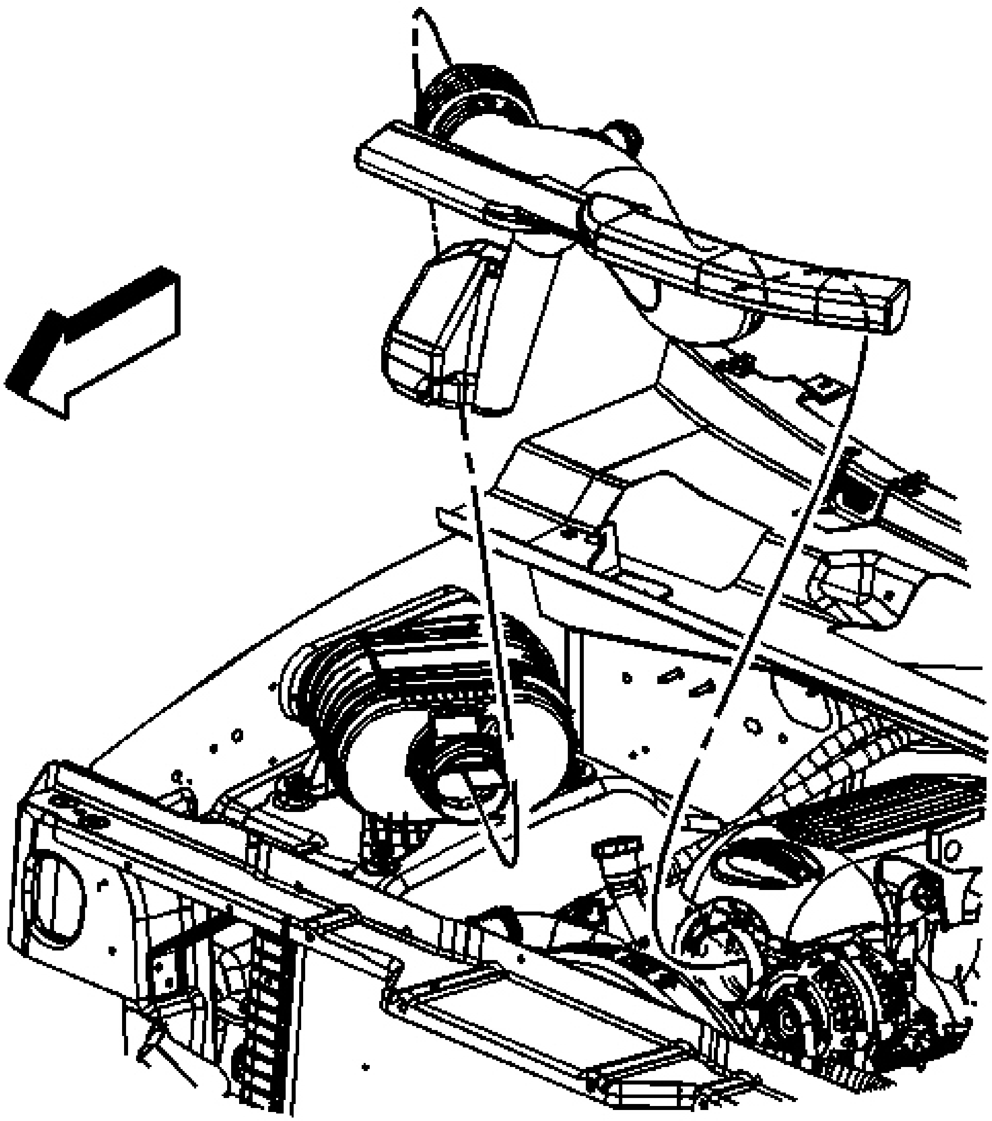


Fig. 185: MAF/IAT Sensor & Air Cleaner Assembly
Courtesy of GENERAL MOTORS CORP.

1. Remove the air intake duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** .
2. Disconnect the mass air flow/intake air temperature (MAF/IAT) sensor connector.
3. Loosen the clamp securing the MAF/IAT sensor to the air cleaner assembly.
4. Remove the MAF/IAT sensor.

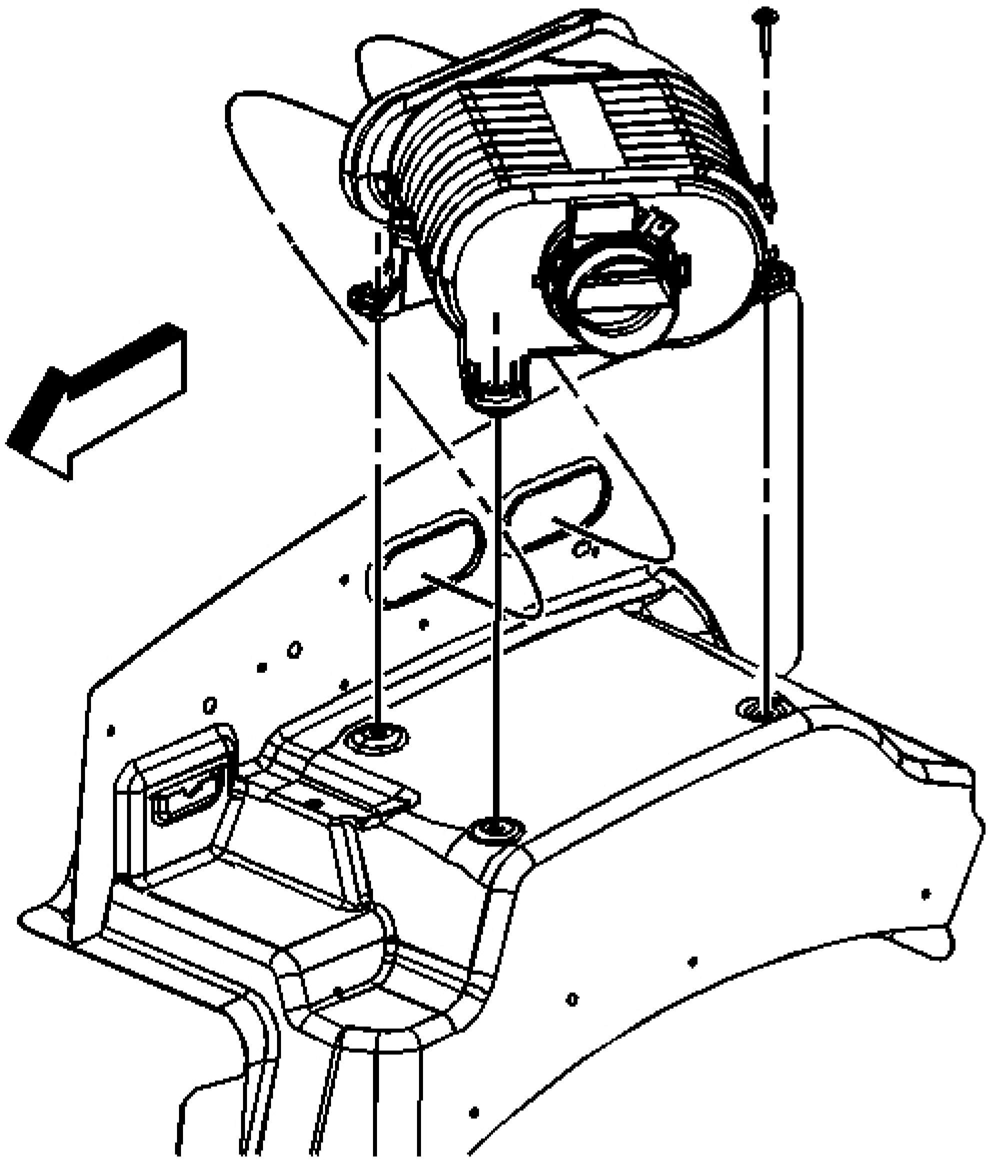


Fig. 186: Air Cleaner Assembly
Courtesy of GENERAL MOTORS CORP.

5. Remove the air cleaner housing fasteners.
6. Remove the air cleaner assembly.

Installation Procedure

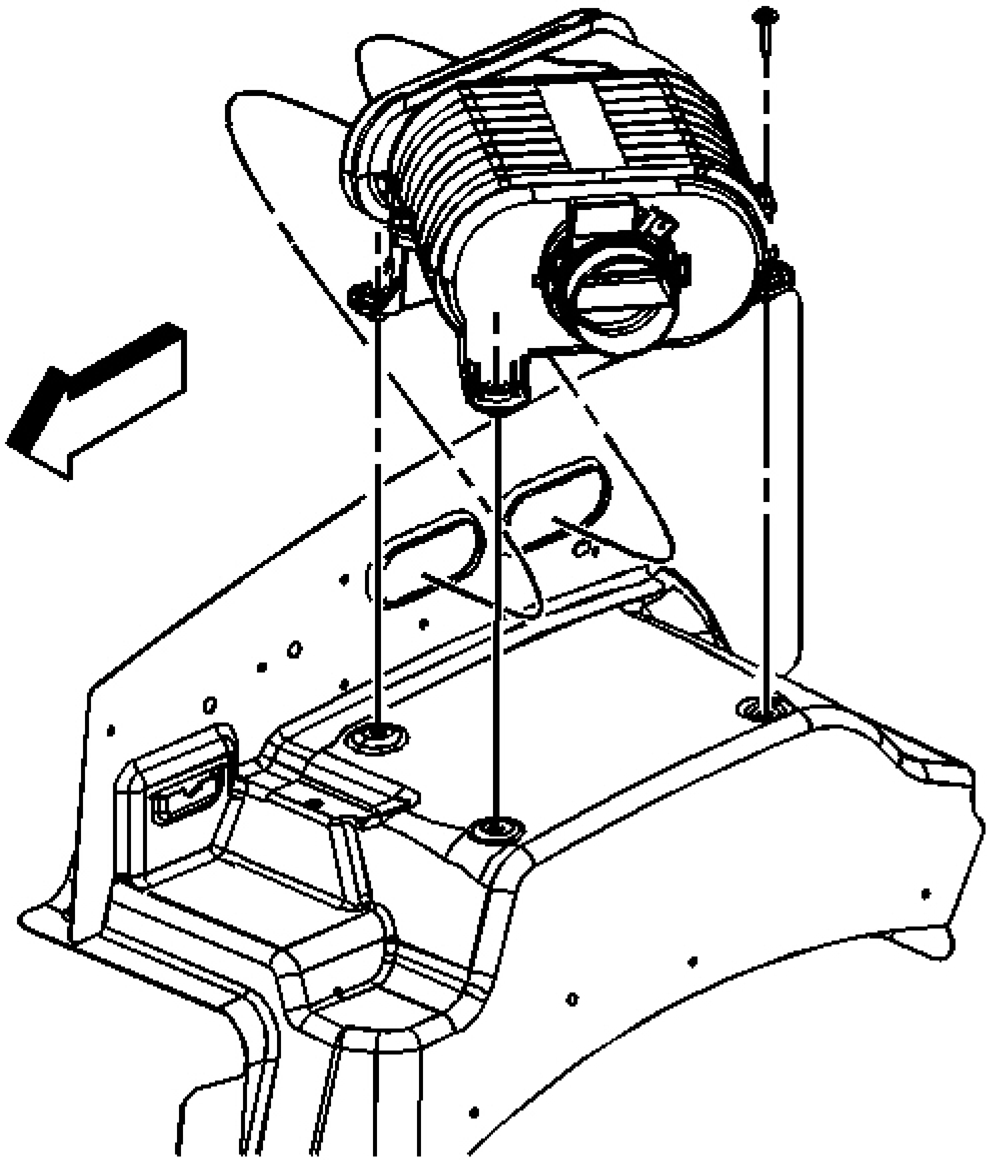


Fig. 187: Air Cleaner Assembly
Courtesy of GENERAL MOTORS CORP.

1. Position the air cleaner assembly onto the air cleaner adaptor.

NOTE: **Refer to Fastener Notice in Cautions and Notices.**

2. Install the fasteners.

   Tighten: Tighten the air cleaner housing fasteners to 10 N.m (89 lb in).

3. Secure the air cleaner assembly onto the air cleaner adaptor.

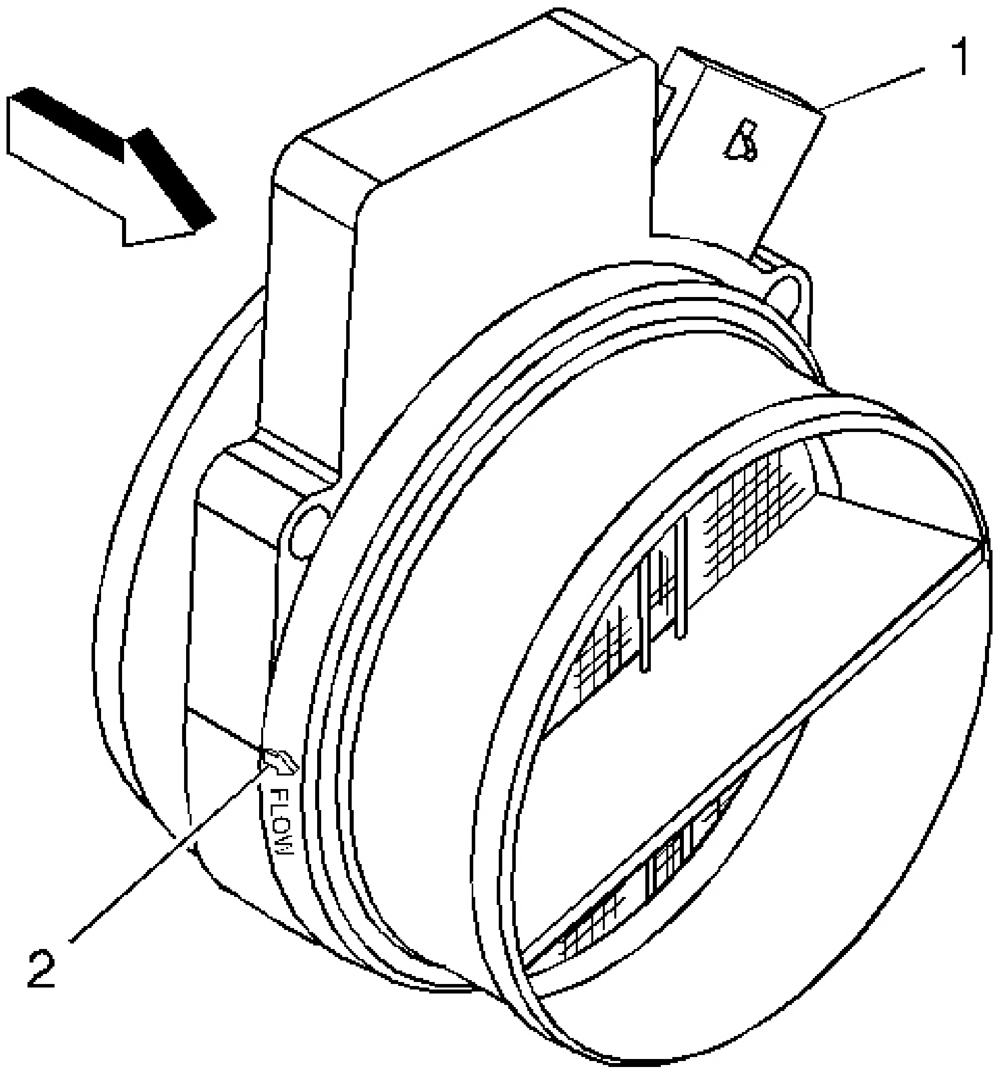


Fig. 188: Locating Air Flow Direction Arrow On MAF/IAT Sensor

Courtesy of GENERAL MOTORS CORP.

IMPORTANT: If the MAF/IAT sensor is installed backwards, the fuel system goes rich. An arrow (2) cast into the plastic portion of the sensor indicates proper air flow direction. The arrow must point toward the engine.

4. Install the MAF/IAT sensor to the air cleaner assembly.

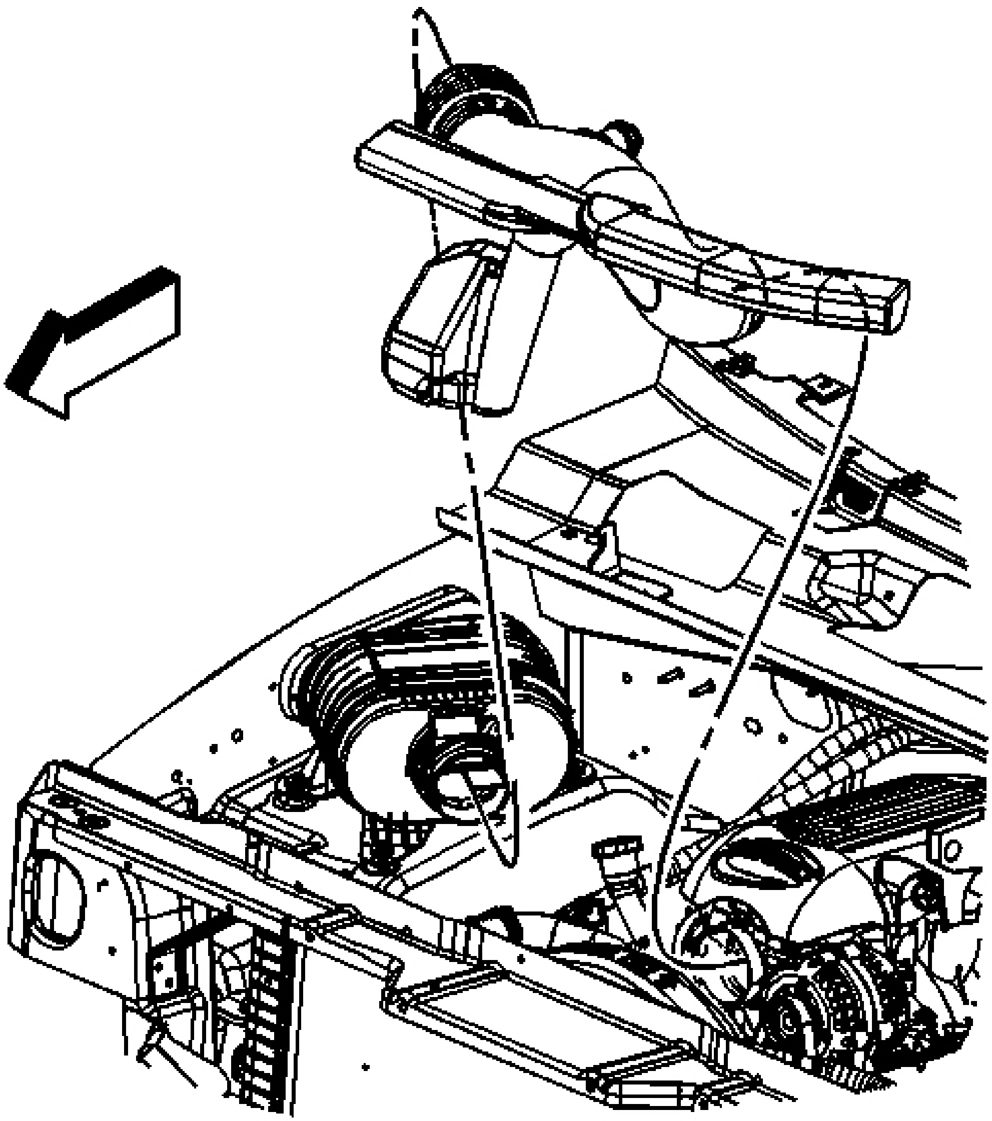
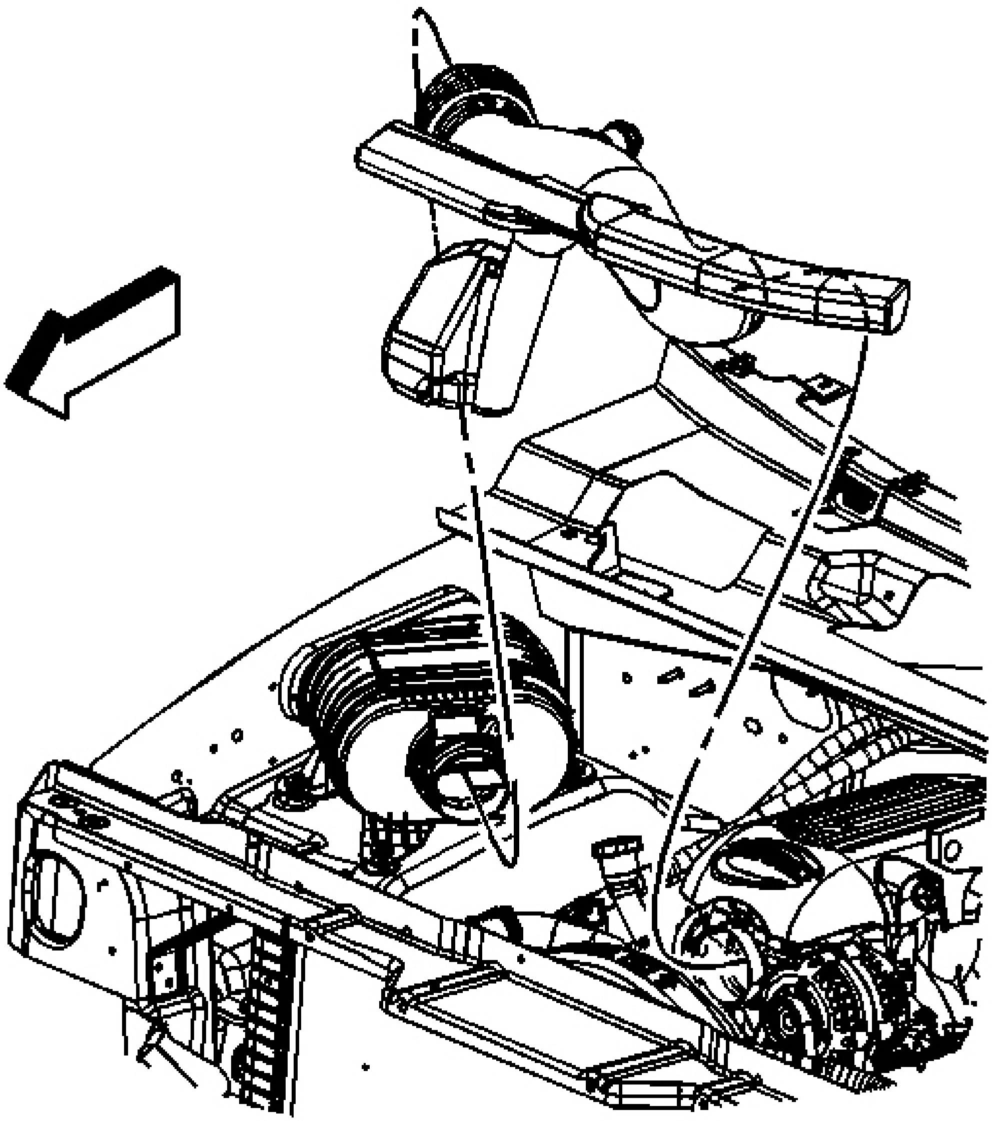


Fig. 189: MAF/IAT Sensor & Air Cleaner Assembly
Courtesy of GENERAL MOTORS CORP.

5. Secure the clamps at the MAF/IAT sensor and the air cleaner assembly.
6. Connect the MAF/IAT connector.
7. Install the air intake duct. Refer to **Air Cleaner Resonator Outlet Duct Replacement** .

AIR CLEANER RESONATOR OUTLET DUCT REPLACEMENT

Removal Procedure



<u>Fig. 190: MAF/IAT Sensor & Air Cleaner Assembly</u>
Courtesy of GENERAL MOTORS CORP.

1. Loosen the clamp and separate the air cleaner resonator outlet duct from the mass air flow/intake air temperature (MAF/IAT) sensor assembly.
2. Loosen the clamp and separate the air cleaner resonator outlet duct from the throttle body assembly.
3. Remove the air cleaner resonator outlet duct.

Installation Procedure

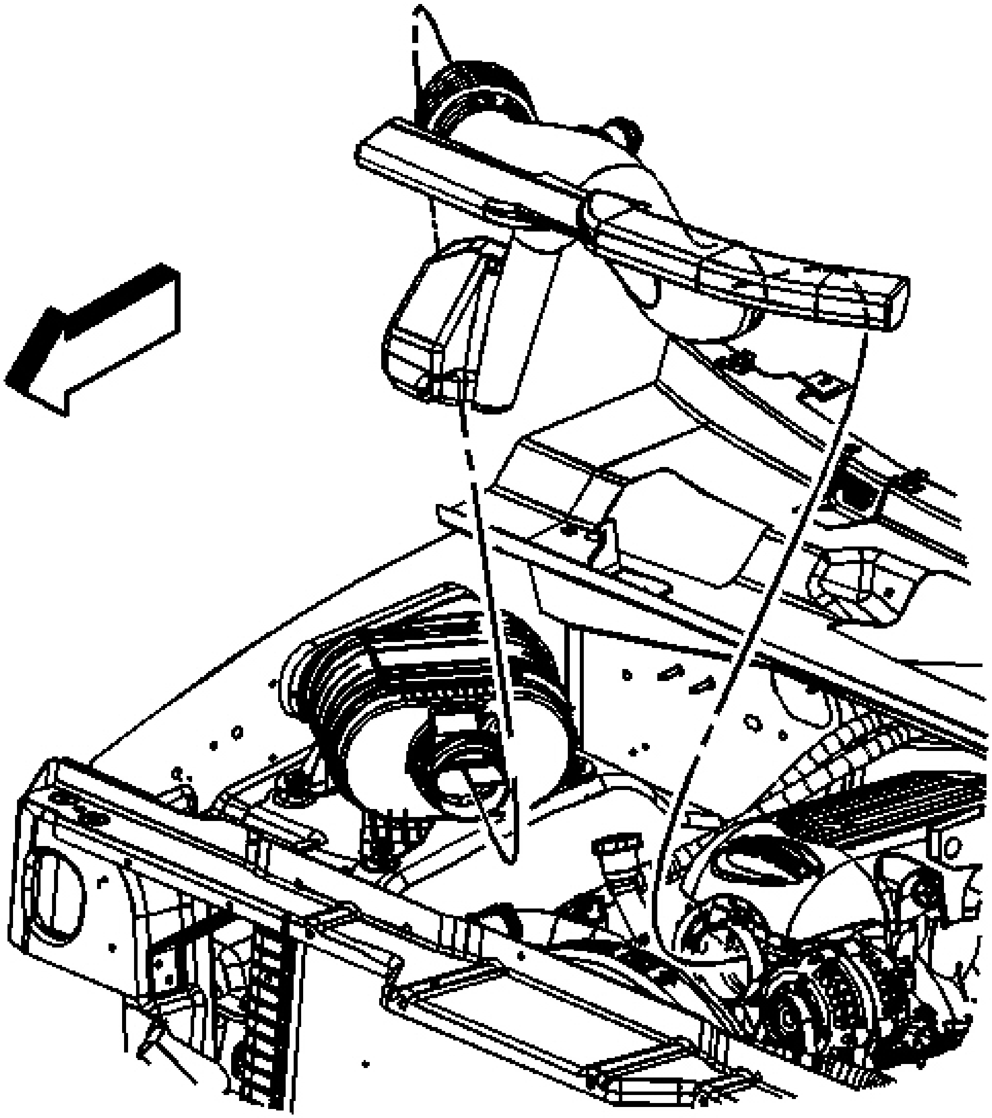


Fig. 191: MAF/IAT Sensor & Air Cleaner Assembly
Courtesy of GENERAL MOTORS CORP.

1. Install the air cleaner resonator outlet duct to the throttle body assembly and the MAF/IAT sensor assembly.
2. Tighten the clamps at the throttle body assembly and the MAF/IAT sensor assembly.

DESCRIPTION AND OPERATION

POWERTRAIN CONTROL MODULE (PCM) DESCRIPTION

Powertrain

The powertrain has electronic controls to reduce exhaust emissions while maintaining excellent driveability and fuel economy. The powertrain control module (PCM) is the control center of this system. The PCM monitors numerous engine and vehicle functions. The PCM constantly looks at the information from various sensors and other inputs, and controls the systems that affect vehicle performance and emissions. The PCM also performs the diagnostic tests on various parts of the system. The PCM can recognize operational problems and alert the driver via the malfunction indicator lamp (MIL). When the PCM detects a malfunction, the PCM stores a diagnostic trouble code (DTC). The problem area is identified by the particular DTC that is set. The control module supplies a buffered voltage to various sensors and switches. Review the components and wiring diagrams in order to determine which systems are controlled by the PCM.

The following are some of the functions that the PCM controls:

- The engine fueling
- The ignition control (IC)
- The knock sensor (KS) system
- The evaporative emissions (EVAP) system
- The secondary air injection (AIR) system (if equipped)
- The exhaust gas recirculation (EGR) system
- The automatic transmission functions
- The generator
- The A/C clutch control
- The cooling fan control

Powertrain Control Module Function

The powertrain control module (PCM) constantly looks at the information from various sensors and other inputs and controls systems that affect vehicle performance and emissions. The PCM also performs diagnostic tests on various parts of the system. The PCM can recognize operational problems and alert the driver via the malfunction indicator lamp (MIL). When the PCM detects a malfunction, the PCM stores a diagnostic trouble code (DTC). The problem area is identified by the particular DTC that is set. The control module supplies a buffered voltage to various sensors and switches. The input and output devices in the PCM include analog-to-digital converters, signal buffers, counters, and output drivers. The output drivers are electronic switches that complete a ground or voltage circuit when turned on. Most PCM controlled components are operated via output drivers. The PCM monitors these driver circuits for proper operation and, in most cases, can set a DTC corresponding to the controlled device if a problem is detected.

Malfunction Indicator Lamp (MIL) Operation

The malfunction indicator lamp (MIL) is located in the instrument panel cluster. The MIL will display as either

SERVICE ENGINE SOON or one of the following symbols when commanded ON:

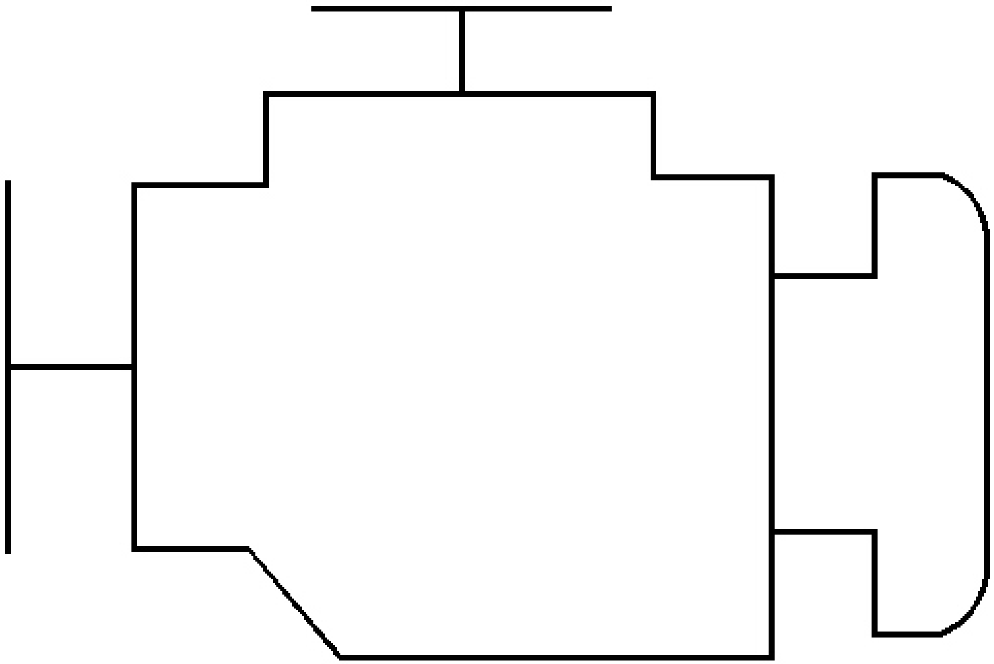


Fig. 192: Identifying MIL Symbol
Courtesy of GENERAL MOTORS CORP.

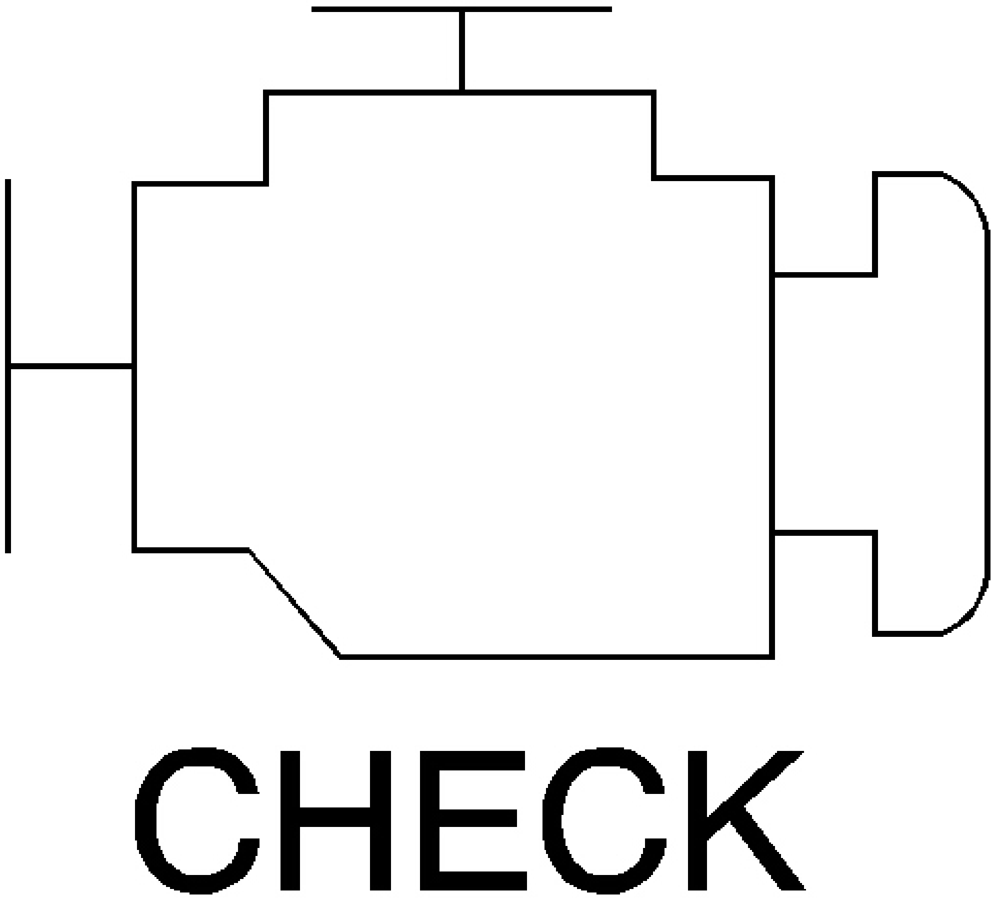


Fig. 193: MIL ON (Check)
Courtesy of GENERAL MOTORS CORP.

The MIL indicates that an emissions related fault has occurred and vehicle service is required.

The following is a list of the modes of operation for the MIL:

- The MIL illuminates when the ignition is turned ON, with the engine OFF. This is a bulb test to ensure the MIL is able to illuminate.
- The MIL turns OFF after the engine is started if a diagnostic fault is not present.
- The MIL remains illuminated after the engine is started if the control module detects a fault. A diagnostic trouble code (DTC) is stored any time the control module illuminates the MIL due to an emissions related fault. The MIL turns OFF after three consecutive ignition cycles in which a Test Passed has been reported

for the diagnostic test that originally caused the MIL to illuminate.

- The MIL flashes if the control module detects a misfire condition which could damage the catalytic converter.
- When the MIL is illuminated and the engine stalls, the MIL will remain illuminated as long as the ignition is ON.
- When the MIL is not illuminated and the engine stalls, the MIL will not illuminate until the ignition is cycled OFF and then ON.

Trip

A trip is an interval of time during which the diagnostic test runs. A trip may consist of only a key cycle to power up the powertrain control module (PCM), allow the diagnostic to run, then cycle the key off to power down the PCM. A trip may also involve a PCM power up, meeting specific conditions to run the diagnostic test, then powering down the PCM. The definition of a trip depends upon the diagnostic. Some diagnostic tests run only once per trip (i.e., catalyst monitor) while other tests run continuously during each trip (i.e., misfire).

Warm-Up Cycle

The powertrain control module (PCM) uses warm-up cycles to run some diagnostics and to clear any diagnostic trouble codes (DTCs). A warm-up cycle occurs when the engine coolant temperature increases 22° C (40° F) from the start-up temperature. The engine coolant must also achieve a minimum temperature of 71° C (160° F). The PCM counts the number of warm-up cycles in order to clear the malfunction indicator lamp (MIL). The PCM will clear the DTCs when 40 consecutive warm-up cycles occur without a malfunction.

Diagnostic Trouble Codes (DTCs)

The powertrain control module (PCM) is programmed with test routines that test the operation of the various systems the PCM controls. Some tests monitor internal PCM functions. Many tests are run continuously. Other tests run only under specific conditions, referred to as Conditions for Running the DTC. When the vehicle is operating within the conditions for running a particular test, the PCM monitors certain parameters and determines if the values are within an expected range. The parameters and values considered outside the range of normal operation are listed as Conditions for Setting the DTC. When the Conditions for Setting the DTC occur, the PCM executes the Action Taken When the DTC Sets. Some DTCs alert the driver via the malfunction indicator lamp (MIL) or a message. Other DTCs do not trigger a driver warning, but are stored in memory. The PCM also saves data and input parameters when most DTCs are set. This data is stored in the Freeze Frame and/or Failure Records.

The DTCs are categorized by type. The DTC type is determined by the MIL operation and the manner in which the fault data is stored when a particular DTC fails. In some cases there may be exceptions to this structure. Therefore, when diagnosing the system it is important to read the Action Taken When the DTC Sets and the Conditions for Clearing the DTC in the supporting text.

There are different types of DTCs and different actions taken when the DTCs set. Refer to Diagnostic Trouble Code (DTC) Type Definitions for a description of the general characteristics of each DTC type.

DTC Status

When the scan tool displays a DTC, the status of the DTC is also displayed. The following DTC statuses are indicated only when they apply to the DTC that is set.

Fail This Ign. (Fail This Ignition)

Indicates that this DTC failed during the present ignition cycle.

Last Test Fail

Indicates that this DTC failed the last time the test ran.

MIL Request

Indicates that this DTC is currently requesting the malfunction indicator lamp (MIL). This selection will report type B DTCs only when they have requested the MIL (failed twice).

Test Fail SCC (Test Failed Since Code Clear)

Indicates that this DTC that has reported a failure since the last time DTCs were cleared.

History

Indicates that the DTC is stored in the powertrain control module (PCM) History memory. Type B DTCs will not appear in History until they have requested the MIL (failed twice). History will be displayed for all type A DTCs and type B DTCs (which have requested the MIL) that have failed within the last 40 warm-up cycles. Type C DTCs that have failed within the last 40 warm-up cycles will also appear in History.

Not Run SCC (Not Run Since Code Clear)

DTCs will be listed in this category if the diagnostic has not run since DTCs were last cleared. This status is not included with the DTC display since the DTC can not be set if the diagnostic has not run. This information is displayed when DTC Info is requested using the scan tool.

THROTTLE ACTUATOR CONTROL (TAC) SYSTEM DESCRIPTION

The throttle actuator control (TAC) system delivers improved throttle response and greater reliability and eliminates the need for mechanical cable. The TAC system performs the following functions:

- Accelerator pedal position (APP) sensing
- Throttle positioning to meet driver and engine demands
- Throttle position sensing
- Internal diagnostics
- Cruise control functions
- Manage TAC electrical power consumption

The TAC system components include the following:

- The APP sensors
- The throttle body assembly
- The TAC module
- The powertrain control module (PCM)

Accelerator Pedal Position (APP) Sensor

The accelerator pedal assembly contains 2 individual APP sensors within the assembly. The APP sensors 1 and 2 are potentiometer type sensors, each with the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The APP sensors are used to determine the pedal angle. The control module provides each APP sensor a 5-volt reference circuit and a low reference circuit. The APP sensors then provide the control module with signal voltage proportional to pedal movement. Both APP sensor signal voltages are low at rest position and increase as the pedal is applied.

Throttle Body Assembly

The throttle body assembly consists of the throttle body, the throttle position (TP) sensors, and the throttle actuator motor. The throttle body functions similar to a similar to a conventional throttle body with the following exceptions:

- An electric motor opens and closes the throttle valve.
- The throttle blade is spring loaded in both directions and the default position is slightly open.
- There are 2 individual TP sensors within the throttle body assembly.

The TP sensors 1 and 2 are potentiometer type sensors, each with the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The TP sensors are used to determine the throttle plate angle. The control module provides each TP sensor a 5-volt reference circuit and a low reference circuit. The TP sensors then provide the control module with signal voltage proportional to throttle plate movement. Both TP sensor signal voltages are low at closed throttle and increase as the throttle opens.

Throttle Actuator Control Module

The throttle actuator control (TAC) module is the control center for the throttle actuator control system. The

TAC system is self-diagnosing and provides diagnostic information to the powertrain control module (PCM) through a dedicated serial data line. The TAC achieves throttle positioning by providing a pulse width modulated voltage to the TAC, as directed by the PCM.

Powertrain Control Module

The powertrain control module (PCM) determines the driver's intent, then calculates the appropriate throttle response. This information is sent to the throttle actuator control (TAC) module through a dedicated serial data line.

Modes of Operation

Normal Mode

During the operation of the throttle actuator control (TAC) system, several modes or functions are considered normal. The following modes may be entered during normal operation:

- Minimum pedal value-At key-up the powertrain control module (PCM) updates the learned minimum pedal value.
- Minimum throttle position (TP) values-At key-up the PCM updates the learned minimum TP value. In order to learn the minimum TP value, the throttle blade is moved to the closed position.
- Ice break mode-If the throttle is not able to reach a predetermined minimum throttle position, the ice break mode is entered. During the ice break mode, the control module commands the maximum pulse width several times to the throttle actuator motor in the closing direction.
- Battery saver mode-After a predetermined time without engine RPM, the control module commands the battery saver mode. During the battery saver mode, the TAC module removes the voltage from the motor control circuits, which removes the current draw used to maintain the idle position and allows the throttle to return to the spring loaded default position.

Reduced Engine Power Mode

When the PCM detects a condition with the TAC system, the PCM may enter a reduced engine power mode. Reduced engine power may cause one or more of the following conditions:

- Acceleration limiting-The control module will continue to use the accelerator pedal for throttle control; however, the vehicle acceleration is limited.
- Limited throttle mode-The control module will continue to use the accelerator pedal for throttle control; however, the maximum throttle opening is limited.
- Throttle default mode-The control module will turn off the throttle actuator motor and the throttle will return to the spring loaded default position.
- Forced idle mode-The control module will perform the following actions:
  - Limit engine speed to idle by positioning throttle position, or by controlling fuel and spark if throttle is turned off.
  - Ignore accelerator pedal input.
- Engine shutdown mode-The control module will disable fuel and de-energize the throttle actuator.

FUEL SYSTEM DESCRIPTION

Fuel System Overview

The Fuel System is a returnless on-demand design. The fuel pressure regulator is a part of the fuel sender assembly, eliminating the need for a return pipe from the engine. A returnless fuel system reduces the internal temperature of the fuel tank by not returning hot fuel from the engine to the fuel tank. Reducing the internal temperature of the fuel tank results in lower evaporative emissions.

An electric turbine style fuel pump attaches to the fuel sender assembly inside the fuel tank. The fuel pump supplies high pressure fuel through the fuel filter and the fuel feed pipe to the fuel injection system. The fuel pump provides fuel at a higher rate of flow than is needed by the fuel injection system. The fuel pump also supplies fuel to a venturi pump located on the bottom of the fuel sender assembly. The function of the venturi pump is to fill the fuel sender assembly reservoir. The fuel pressure regulator, a part of the fuel sender assembly, maintains the correct fuel pressure to the fuel injection system. The fuel pump and sender assembly contains a reverse flow check valve. The check valve and the fuel pressure regulator maintain fuel pressure in the fuel feed pipe and the fuel rail in order to prevent long cranking times.

Fuel Tanks

The fuel tanks store the fuel supply. The fuel tank is held in place by 2 metal straps that attach to the frame. The fuel tank is molded from high density polyethylene.

Fuel Fill Pipe

The fuel fill pipe has a built-in restrictor in order to prevent refueling with leaded fuel. Once the fill vent is obstructed, fuel backs up the fill pipe and trips the dispensing nozzle. The fuel tank vent valves are connected and route to the canister to collect hydrocarbon emissions during operation of the vehicle.

Fuel Filler Cap

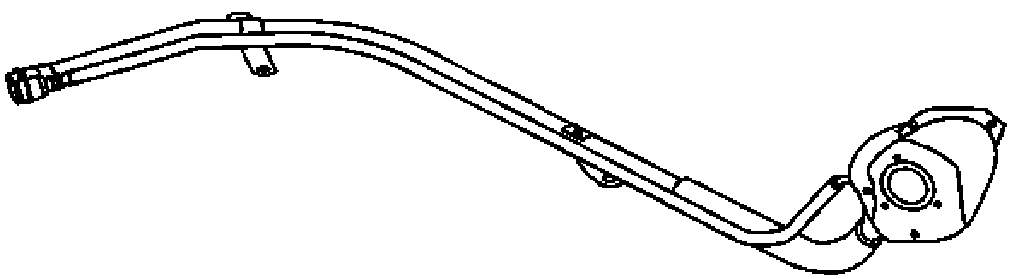


Fig. 194: Fuel Filler Cap
Courtesy of GENERAL MOTORS CORP.

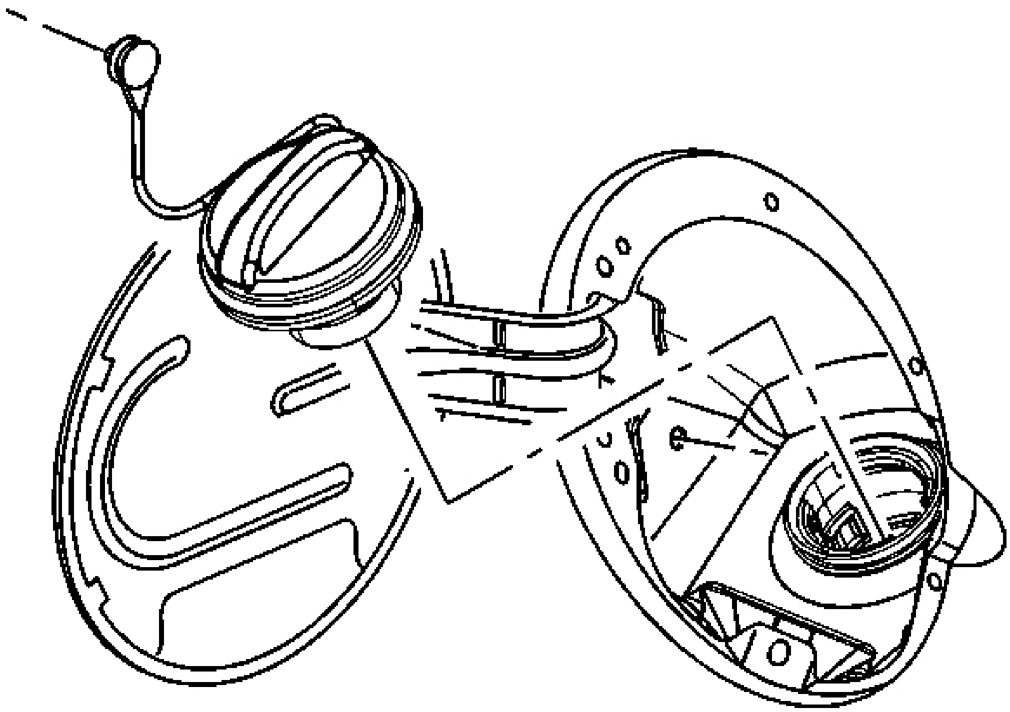


Fig. 195: Fuel Filler Door View
Courtesy of GENERAL MOTORS CORP.

The fuel fill pipe has a tethered fuel filler cap. A torque-limiting device prevents the cap from being over tightened. To install the cap, turn the cap clockwise until you hear clicks. This indicates that the cap is correctly torqued and fully seated. A built-in device indicates that the fuel filler cap is fully seated. A fuel filler cap that is not fully seated may cause a malfunction in the emission system.

Fuel Sender Assembly

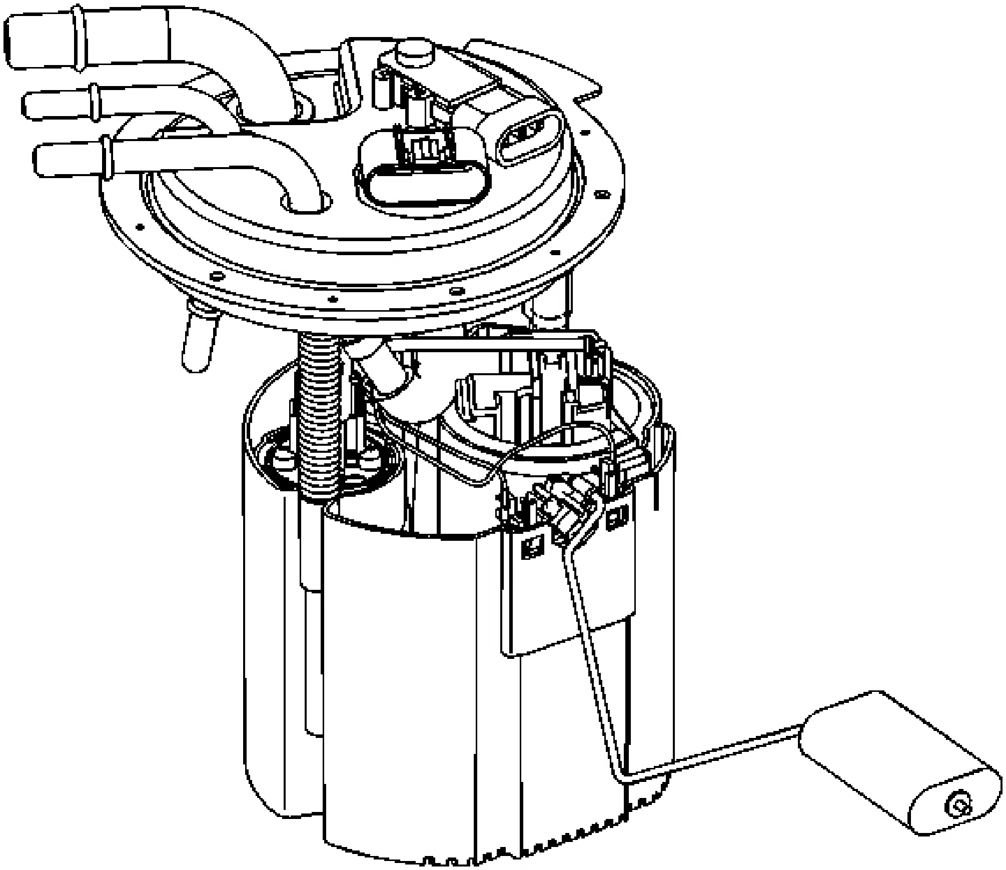


Fig. 196: Fuel Sender Assembly
Courtesy of GENERAL MOTORS CORP.

The fuel sender assembly on single tank applications consists of the following major components:

- The fuel level sensor
- The fuel tank pressure (FTP) sensor
- The fuel tank fuel pump module
- The fuel strainer
- The fuel filter

Fuel Level Sensor

The fuel level sensor consists of a float, a wire float arm, and a ceramic resistor cord. The position of the float arm indicates the fuel level. The fuel level sensor contains a variable resistor, which changes resistance in correspondence to the amount of fuel in the fuel tank. The powertrain control module (PCM) sends the fuel level information via the class 2 circuit to the instrument panel (I/P) cluster. This information is used for the I/P fuel gauge and the low fuel warning indicator, if applicable. The PCM also monitors the fuel level input for various diagnostics.

Fuel Pump

The fuel pump is mounted in the fuel sender assembly reservoir. The fuel pump is an electric high pressure pump. Fuel is pumped to the fuel rail at a specified flow and pressure. The fuel pump delivers a constant flow of fuel to the engine during low fuel conditions and aggressive vehicle maneuvers. The powertrain control module (PCM) controls the electric fuel pump operation through a fuel pump relay. The fuel pump flex pipe acts to dampen the fuel pulses and noise generated by the fuel pump.

Fuel Strainer

The fuel strainer attaches to the lower end of the fuel sender. The fuel strainer is made of woven plastic. The functions of the fuel strainer are to filter contaminants and to wick fuel. Fuel stoppage at this point indicates that the fuel tank contains an abnormal amount of sediment.

Fuel Filter

The fuel filter is contained in the fuel sender assembly inside the fuel tank. the paper filter element of the fuel filter traps particles in the fuel that may damage the fuel injection system. The fuel filter housing is made to withstand maximum fuel system pressure, exposure to fuel additives, and changes in temperature. There is no service interval for fuel filter replacement.

Nylon Fuel Pipes

CAUTION: Refer to Fuel and EVAP Pipe Caution in Cautions and Notices.

Nylon pipes are constructed to withstand maximum fuel system pressure, exposure to fuel additives, and changes in temperature. There are 3 sizes of nylon pipes used: 9.5 mm (3/8 in) ID for the fuel supply, 7.6 mm (5/16 in) ID for the fuel return, and 12.7 mm (1/2 in) ID for the vent. Heat resistant rubber hose or corrugated plastic conduit protects the sections of the pipes that are exposed to chafing, to high temperatures, or to vibration.

Nylon fuel pipes are somewhat flexible and can be formed around gradual turns under the vehicle. However, if nylon fuel pipes are forced into sharp bends, the pipes kink and restrict the fuel flow. Also, once exposed to fuel, nylon pipes may become stiffer and are more likely to kink if bent too far. Take special care when working on a vehicle with nylon fuel pipes.

Quick-Connect Fittings

Quick-connect fittings provide a simplified means of installing and connecting fuel system components. The fittings consist of a unique female connector and a compatible male pipe end. O-rings, located inside the female connector, provide the fuel seal. Integral locking tabs inside the female connector hold the fittings together.

On-Board Refueling Vapor Recovery System (ORVR)

The On-Board Refueling Vapor Recovery System (ORVR) is an on-board vehicle system designed to recover fuel vapors during the vehicle refueling operation. The flow of liquid fuel down the fuel filler pipe provides a liquid seal which prevents vapor from leaving the fuel filler pipe. An EVAP pipe transports the fuel vapor to the EVAP canister for use by the engine.

Fuel Pipe O-Rings

O-rings seal the threaded connections in the fuel system. Fuel system O-ring seals are made of special material. Service the O-ring seals with the correct service part.

Fuel Rail Assembly

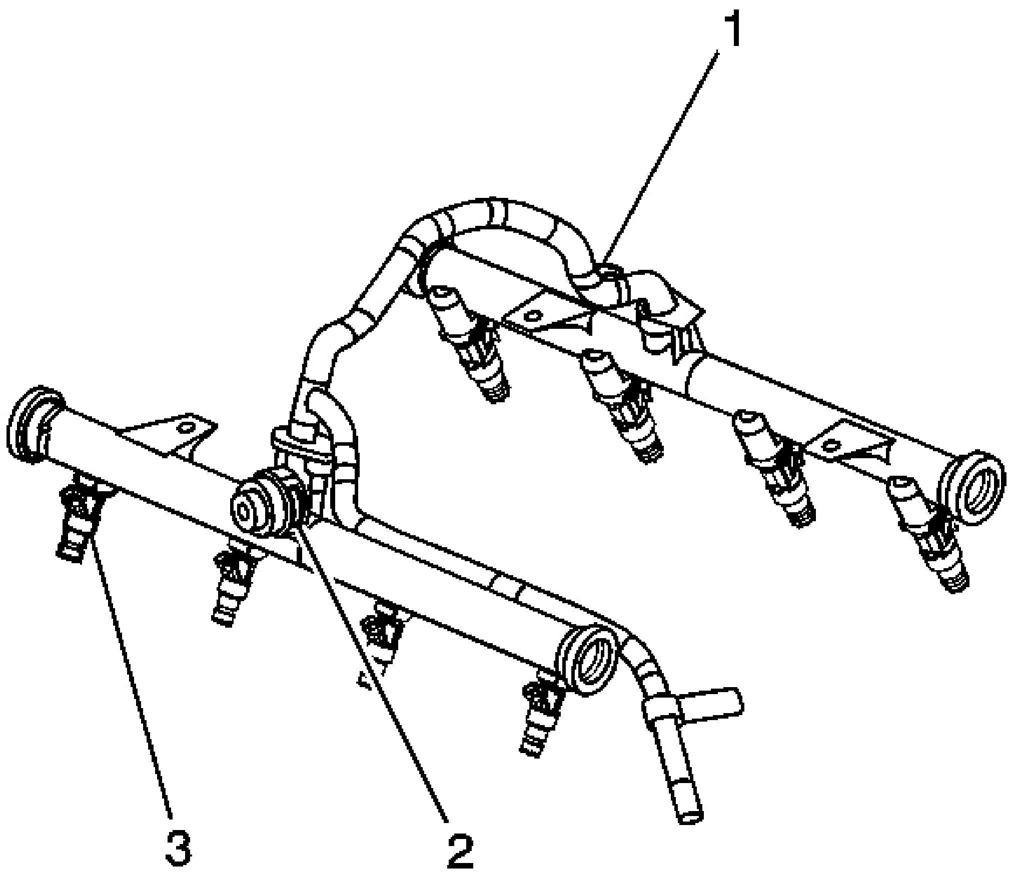


Fig. 197: Injectors & Fuel Dampener
Courtesy of GENERAL MOTORS CORP.

The fuel rail assembly attaches to the engine intake manifold. The fuel rail assembly performs the following functions:

- Positions the injectors (3) in the intake manifold
- Distributes fuel evenly to the injectors
- Integrates the fuel dampener (2) into the fuel metering system

Fuel Injectors

The fuel injector assembly is a solenoid device controlled by the PCM that meters pressurized fuel to a single engine cylinder. The PCM energizes the injector solenoid to open a normally closed ball valve. This allows the fuel to flow into the top of the injector, past the ball valve, and through a director plate at the injector outlet. The director plate has machined holes that control the fuel flow, generating a spray of finely atomized fuel at the injector tip. Fuel from the injector tip is directed at the intake valve, causing the fuel to become further atomized and vaporized before entering the combustion chamber. This fine atomization improves fuel economy and emissions.

Fuel Pressure Regulator

The fuel pressure regulator is contained in the left fuel sender assembly.

Fuel Metering Modes of Operation

The PCM monitors voltages from several sensors in order to determine how much fuel to give the engine. The PCM controls the amount of fuel delivered to the engine by changing the fuel injector pulse width. The fuel is delivered under one of several modes.

Starting Mode

When the ignition is first turned ON, the PCM energizes the fuel pump relay for 2 seconds. This allows the fuel pump to build pressure in the fuel system. The PCM calculates the air/fuel ratio based on inputs from the engine coolant temperature (ECT), mass air flow (MAF), manifold absolute pressure (MAP), and throttle position (TP) sensors. The system stays in starting mode until the engine speed reaches a predetermined RPM.

Clear Flood Mode

If the engine floods, clear the engine by pressing the accelerator pedal down to the floor and then crank the engine. When the TP sensor is at wide open throttle (WOT), the PCM reduces the fuel injector pulse width in order to increase the air to fuel ratio. The PCM holds this injector rate as long as the throttle stays wide open and the engine speed is below a predetermined RPM. If the throttle is not held wide open, the PCM returns to the starting mode.

Run Mode

The run mode has 2 conditions called Open Loop and Closed Loop. When the engine is first started and the engine speed is above a predetermined RPM, the system begins Open Loop operation. The PCM ignores the signal from the heated oxygen sensors (HO2S). The PCM calculates the air/fuel ratio based on inputs from the ECT, MAF, MAP, and TP sensors. The system stays in Open Loop until meeting the following conditions:

- Both front HO2S have varying voltage output, showing that both HO2S are hot enough to operate properly.
- The ECT sensor is above a specified temperature.
- A specific amount of time has elapsed after starting the engine.

Specific values for the above conditions exist for each different engine, and are stored in the electrically erasable programmable read-only memory (EEPROM). The system begins Closed Loop operation after reaching these values. In Closed Loop, the PCM calculates the air/fuel ratio, injector ON time, based upon the signal from various sensors, but mainly from the HO2S. This allows the air/fuel ratio to stay very close to 14.7:1.

Acceleration Mode

When the driver pushes on the accelerator pedal, air flow into the cylinders increases rapidly. To prevent possible hesitation, the PCM increases the pulse width to the injectors to provide extra fuel during acceleration. This is also known as power enrichment. The PCM determines the amount of fuel required based upon the TP, the ECT, the MAP, the MAF, and the engine speed.

Deceleration Mode

When the driver releases the accelerator pedal, air flow into the engine is reduced. The PCM monitors the corresponding changes in the TP, the MAP, and the MAF. The PCM shuts OFF fuel completely if the deceleration is very rapid, or for long periods, such as long, closed-throttle coast-down. The fuel shuts OFF in order to prevent damage to the catalytic converters.

Battery Voltage Correction Mode

When the battery voltage is low, the PCM compensates for the weak spark delivered by the ignition system in the following ways:

- Increasing the amount of fuel delivered
- Increasing the idle RPM
- Increasing the ignition dwell time

Fuel Cutoff Mode

The PCM cuts OFF fuel from the fuel injectors when the following conditions are met in order to protect the powertrain from damage and improve driveability:

- The ignition is OFF. This prevents engine run-on.
- The ignition is ON but there is no ignition reference signal. This prevents flooding or backfiring.

- The engine speed is too high, above red line.
- The vehicle speed is too high, above rated tire speed.
- During an extended, high speed, closed throttle coast down-This reduces emissions and increases engine braking.
- During extended deceleration, in order to prevent damage to the catalytic converters

Fuel Trim

The powertrain control module (PCM) controls the air/fuel metering system in order to provide the best possible combination of driveability, fuel economy, and emission control. The PCM monitors the HO2S signal voltage while in Closed Loop and regulates the fuel delivery by adjusting the pulse width of the fuel injectors based on this signal. The ideal fuel trim values are around 0 percent for both short term and long term fuel trim. A positive fuel trim value indicates the PCM is adding fuel in order to compensate for a lean condition by increasing the pulse width. A negative fuel trim value indicates that the PCM is reducing the amount of fuel in order to compensate for a rich condition by decreasing the pulse width. A change made to the fuel delivery changes the short term and long term fuel trim values. The short term fuel trim values change rapidly in response to the HO2S signal voltage. These changes fine tune the engine fueling. The long term fuel trim makes coarse adjustments to the fueling in order to re-center and restore control to short term fuel trim. A scan tool can be used to monitor the short term and long term fuel trim values. The long term fuel trim diagnostic is based on an average of several of the long term speed load learn cells. The PCM selects the cells based on the engine speed and engine load. If the PCM detects an excessive lean or rich condition, the PCM will set a fuel trim diagnostic trouble code (DTC).

EVAPORATIVE EMISSION (EVAP) CONTROL SYSTEM DESCRIPTION

EVAP System Operation

The evaporative emission (EVAP) control system limits fuel vapors from escaping into the atmosphere. Fuel tank vapors are allowed to move from the fuel tank, due to pressure in the tank, through the vapor pipe, into the EVAP canister. Carbon in the canister absorbs and stores the fuel vapors. Excess pressure is vented through the vent line and EVAP vent solenoid valve to the atmosphere. The EVAP canister stores the fuel vapors until the engine is able to use them. At an appropriate time, the control module will command the EVAP purge solenoid valve ON, allowing engine vacuum to be applied to the EVAP canister. With the EVAP vent solenoid valve OFF, fresh air is drawn through the vent solenoid valve and the vent line to the EVAP canister. Fresh air is drawn through the canister, pulling fuel vapors from the carbon. The air/fuel vapor mixture continues through the EVAP purge pipe and EVAP purge solenoid valve into the intake manifold to be consumed during normal combustion. The control module uses several tests to determine if the EVAP system is leaking.

Large Leak Test

This tests for large leaks and blockages in the evaporative emission (EVAP) system. The control module commands the EVAP vent solenoid valve ON and commands the EVAP purge solenoid valve ON, with the engine running, allowing engine vacuum into the EVAP system. The control module monitors the fuel tank pressure (FTP) sensor voltage to verify that the system is able to reach a predetermined level of vacuum within a set amount of time. The control module then commands the EVAP purge solenoid valve OFF, sealing the system, and monitors the vacuum level for decay. If the control module does not detect that the predetermined vacuum level was achieved, or the vacuum decay rate is more than a calibrated level on 2 consecutive tests, DTC P0455 will set.

Small Leak Test

The engine off natural vacuum (EONV) diagnostic is the small-leak detection diagnostic for the evaporative emission (EVAP) system. While previous leak detection methods were performed with the engine running, the EONV diagnostic monitors the EVAP system pressure or vacuum with the ignition OFF. Because of this, it may be normal for the control module to remain active for up to 40 minutes after the ignition is turned OFF. This is important to remember when performing a parasitic draw test on vehicles equipped with EONV.

The EONV utilizes the temperature changes in the fuel tank immediately following a drive cycle to use the naturally occurring vacuum or pressure in the fuel tank. When the vehicle is driven, the temperature rises in the tank. After the vehicle is parked, the temperature in the tank continues to rise for a period of time, then starts to drop. The EONV diagnostic relies on this temperature change and the corresponding pressure change in a sealed system, to determine if an EVAP system leak is present.

The EONV diagnostic is designed to detect leaks as small as 0.51 mm (0.020 in). The diagnostic can determine if a small leak is present based on vacuum or pressure readings in the EVAP system. When the system is sealed, a finite amount of pressure or vacuum will be observed. When a 0.51 mm (0.020 in) leak is present, often little or no pressure or vacuum is observed. If the test reports a failing value, DTC P0442 will set.

Canister Vent Restriction Test

If the evaporative emission (EVAP) vent system is restricted, fuel vapors will not be properly purged from the EVAP canister. The control module tests this by commanding the EVAP purge solenoid valve ON, commanding the EVAP vent solenoid valve OFF, and monitoring the fuel tank pressure (FTP) sensor for an increase in vacuum. If the vacuum increases more than a calibrated value, DTC P0446 will set.

Purge Solenoid Valve Leak Test

If the evaporative emission (EVAP) purge solenoid valve does not seal properly fuel vapors could enter the engine at an undesired time, causing driveability concerns. The control module tests for this by commanding the EVAP purge solenoid valve OFF and the vent solenoid valve ON, sealing the system, and monitors the fuel tank pressure (FTP) for an increase in vacuum. If the control module detects that the EVAP system vacuum increases above a calibrated value, DTC P0496 will set.

Check Gas Cap Message

The powertrain control module (PCM) sends a class 2 message to the driver information center (DIC) illuminating the Check Gas Cap message when any of the following occur:

- A malfunction in the evaporative emission (EVAP) system and a large leak test fails
- A malfunction in the EVAP system and a small leak test fails

EVAP System Components

The evaporative emission (EVAP) system consists of the following components:

EVAP Canister

The canister is filled with carbon pellets used to absorb and store fuel vapors. Fuel vapor is stored in the canister until the control module determines that the vapor can be consumed in the normal combustion process.

EVAP Purge Solenoid Valve

The EVAP purge solenoid valve controls the flow of vapors from the EVAP system to the intake manifold. The purge solenoid valve opens when commanded ON by the control module. This normally closed valve is pulse width modulated (PWM) by the control module to precisely control the flow of fuel vapor to the engine. The valve will also be opened during some portions of the EVAP testing, allowing engine vacuum to enter the EVAP system.

EVAP Vent Solenoid Valve

The EVAP vent solenoid valve controls fresh airflow into the EVAP canister. The valve is normally open. The control module commands the valve ON, closing the valve during some EVAP tests, allowing the system to be tested for leaks.

Fuel Tank Pressure Sensor

The fuel tank pressure (FTP) sensor measures the difference between the pressure or vacuum in the fuel tank and outside air pressure. The control module provides a 5-volt reference and a ground to the FTP sensor. The FTP sensor provides a signal voltage back to the control module that can vary between 0.1-4.9 volts. A high FTP sensor voltage indicates a low fuel tank pressure or vacuum. A low FTP sensor voltage indicates a high fuel tank pressure.

EVAP Service Port

The EVAP service port is located in the EVAP purge pipe between the EVAP purge solenoid valve and the EVAP canister. The service port is identified by a green colored cap.

ELECTRONIC IGNITION (EI) SYSTEM DESCRIPTION

The electronic ignition (EI) system is responsible for producing and controlling a high energy secondary spark. This spark is used to ignite the compressed air/fuel mixture at precisely the correct time. This provides optimal performance, fuel economy, and control of exhaust emissions. This ignition system consists of a separate ignition coil connected to each spark plug by a short secondary wire. The driver modules within each coil assembly are commanded ON/OFF by the powertrain control module (PCM). The PCM primarily uses engine speed and position information from the crankshaft and camshaft position (CMP) sensors to control the sequence, dwell, and timing of the spark. The EI system consists of the following components:

Crankshaft Position (CKP) Sensor

The crankshaft position (CKP) sensor is a three wire sensor based on the magneto resistive principle. A magneto resistive sensor uses two magnetic pickups between a permanent magnet. As an element such as a reluctor wheel passes the magnets the resulting change in the magnetic field is used by the sensor electronics to produce a digital output pulse. The PCM supplies a 12-volt, low reference, and signal circuit to the CKP sensor. The sensor returns a digital ON/OFF pulse 24 times per crankshaft revolution.

Crankshaft Reluctor Wheel

The crankshaft reluctor wheel is mounted on the rear of the crankshaft. The wheel is comprised of four 90 degree segments. Each segment represents a pair of cylinders at TDC, and is further divided into six 15 degree segments. Within each 15 degree segment is a notch of 1 of 2 different sizes. Each 90 degree segment has a unique pattern of notches. This is known as pulse width encoding. This pulse width encoded pattern allows the PCM to quickly recognize which pair of cylinders are at top dead center (TDC). The reluctor wheel is also a dual track-or mirror image-design. This means there is an additional wheel pressed against the first, with a gap of equal size to each notch of the mating wheel. When one sensing element of the CKP sensor is reading a notch, the other is reading a set of teeth. The resulting signals are then converted into a digital square wave output by the circuitry within the CKP sensor.

Camshaft Position (CMP) Sensor

The CMP sensor is also a magneto resistive sensor, with the same type of circuits as the CKP sensor. The CMP sensor signal is a digital ON/OFF pulse, output once per revolution of the camshaft. The CMP sensor information is used by the PCM to determine the position of the valve train relative to the CKP.

Camshaft Reluctor Wheel

The camshaft reluctor wheel is either pressed onto the camshaft or part of the timing gear depending on the application. The feature-or target- is read in a radial or axial fashion respectively. The wheel is a smooth track, half of which is of a lower profile than the other half. This feature allows the CMP sensor to supply a signal as soon as the key is turned ON, since the CMP sensor reads the track profile, instead of a notch.

Ignition Coils

Each ignition coil has an ignition 1 feed and a ground. The PCM supplies a low reference and an ignition control (IC) circuit. Each ignition coil contains a solid state driver module. The PCM will command the IC circuit ON, this allows the current to flow through the primary coil windings for the appropriate time or dwell. When the PCM commands the IC circuit OFF, this will interrupt current flow through the primary coil windings. The magnetic field created by the primary coil windings will collapse across the secondary coil windings, which induces a high voltage across the spark plug electrodes. The coils are current limited to prevent overloading if the IC current is held high too long. The spark plugs are connected to their respective coils by a short secondary wire. The spark plugs are tipped with iridium for long life and efficiency.

Powertrain Control Module (PCM)

The PCM controls all ignition system functions, and constantly corrects the basic spark timing. The PCM monitors information from various sensor inputs that include the following:

- The throttle position (TP) sensor
- The engine coolant temperature (ECT) sensor

- The mass air flow (MAF) sensor
- The intake air temperature (IAT) sensor
- The vehicle speed sensor (VSS)
- The transmission gear position or range information sensors
- The engine knock sensors (KS)

Modes of Operation

There is one normal mode of operation, with the spark under PCM control. If the CKP pulses are lost the engine will not run. The loss of a CMP signal may result in a longer crank time since the PCM cannot determine which stroke the pistons are on. Diagnostic trouble codes are available to accurately diagnose the ignition system with a scan tool.

KNOCK SENSOR (KS) SYSTEM DESCRIPTION

Purpose

The knock sensor (KS) system enables the control module to control the ignition timing for the best possible performance while protecting the engine from potentially damaging levels of detonation. The control module uses the KS system to test for abnormal engine noise that may indicate detonation, also known as spark knock.

Sensor Description

This knock sensor (KS) system uses one or 2 broadband one-wire sensors. The sensor uses piezo-electric crystal technology that produces an AC voltage signal of varying amplitude and frequency based on the engine vibration, or noise, level. The amplitude and frequency are dependant upon the level of knock that the KS detects. The control module receives the KS signal through a signal circuit. The KS ground is supplied by the engine block through the sensor housing.

One way the control module monitors the system is by output of a bias voltage on the KS signal wire. The bias voltage creates a voltage drop that the control module monitors and uses to help diagnose KS faults. The KS noise signal rides along this bias voltage, and due to the constantly fluctuating frequency and amplitude of the signal, will always be outside of the bias voltage parameters.

Another way the control module monitors the system is by learning the average normal noise output from the KS. The control module learns a minimum noise level, or background noise, at idle from the KS and uses calibrated values for the rest of the RPM range. The control module uses the minimum noise level to calculate a noise channel. The control module uses this noise channel, and the KS signal that rides along the noise channel, in much the same way as the bias voltage type does. As engine speed and load change, the noise channel upper and lower parameters will change to accommodate the normal KS signal.

In order to determine which cylinders are knocking, the control module only uses KS signal information when each cylinder is near top dead center (TDC) of the firing stroke. If the control module has determined that knock is present, it will retard the ignition timing to attempt to eliminate the knock. The control module will always try to work back to a zero compensation level, or no spark retard. An abnormal KS signal will fall within the noise channel or will not be present. KS diagnostics are calibrated to detect faults with the KS circuitry inside the control module, the KS wiring, or the KS voltage output.

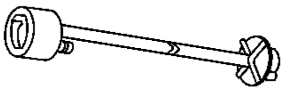
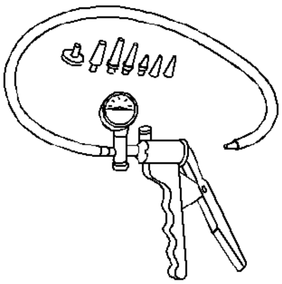
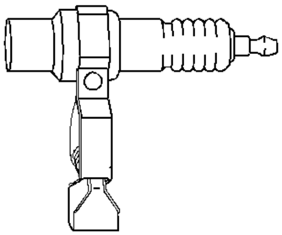
AIR INTAKE SYSTEM DESCRIPTION

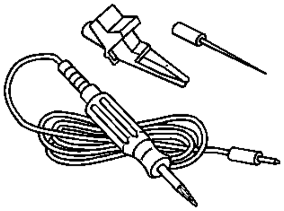
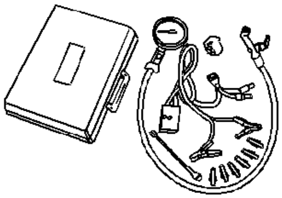
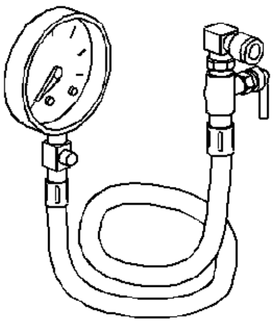
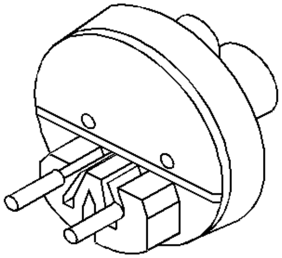
The primary function of the air intake system is to provide filtered air to the engine. The system uses a cleaner element mounted in a housing. The cleaner housing is remotely mounted and uses intake ducts to route the incoming air into the throttle body. The secondary function of the air intake system is to muffle air induction noise. This is achieved through the use of resonators attached to the air intake ducts. the resonators are tuned to the specific powertrain. The mass air flow (MAF) sensor is attached to the outlet of the air cleaner housing. The air cleaner life indicator is located on an intake duct between the air cleaner housing and the throttle plate.

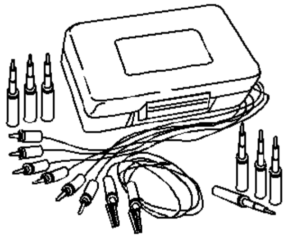
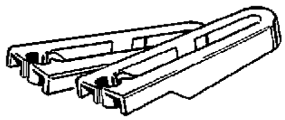
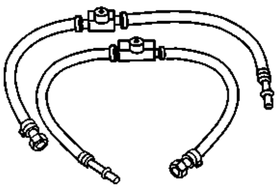
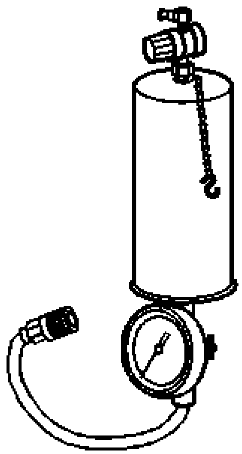
SPECIAL TOOLS AND EQUIPMENT

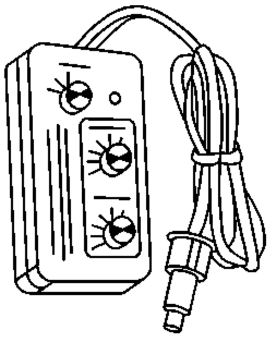
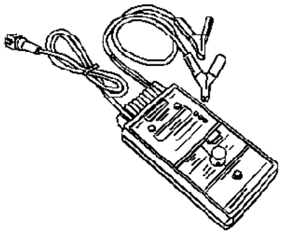
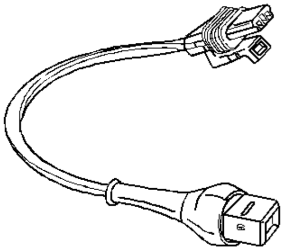
SPECIAL TOOLS

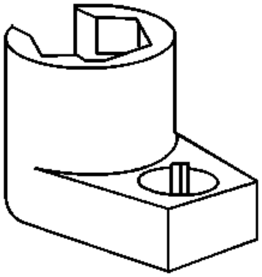
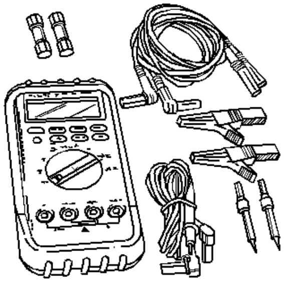
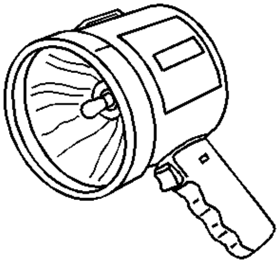
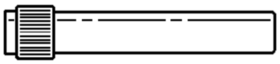
Special Tools

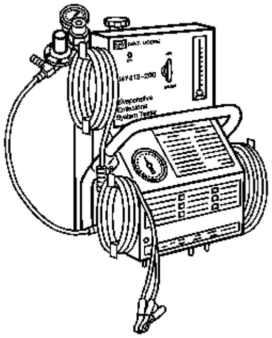
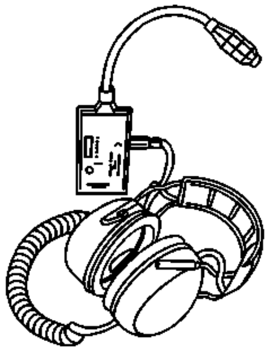
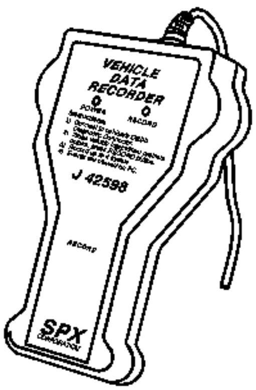
Illustration	Tool Number/Description
	GE 41415-50 Fuel Tank Cap Adapter
	J 23738-A Vacuum Pump
	J 26792 Spark Tester

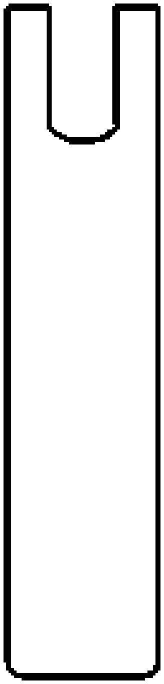
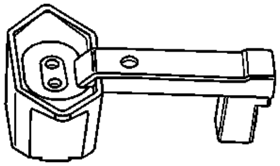
	J 34142-B Test Lamp
	J 34730-E Fuel Pressure Gauge Kit
	J 34730-1A Fuel Pressure Gauge
	J 34730-405 Injector Test Lamp

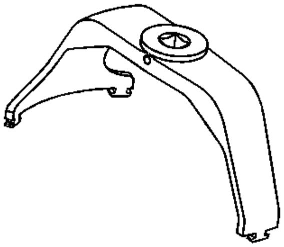
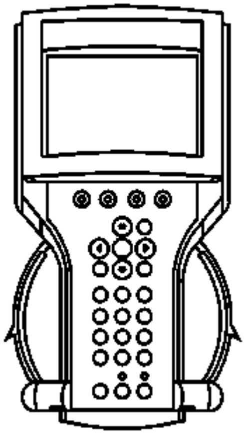
	J 35616-A Connector Test Adapter Kit
	J 37088-A Fuel Line Quick Connect Separator
	J 37287 Inlet and Return Fuel Line Shut-off Adapters
	J 38500-A Fuel Injector Cleaner

	J 38522 Variable Signal Generator
	J 39021 Fuel Injector Coil and Balance Tester
	J 39021-380 Fuel Injector Test Harness
	J 39194-B Oxygen Sensor Wrench

	
	J 39200 Digital Multimeter
	J 41413-SPT High Intensity White Light
	J 41413-VLV EVAP Service Port Vent Fitting

	J 41413-200 Evaporative Emissions System Tester
	J 41416 Ultrasonic Leak Detector
	J 42598 Vehicle Data Recorder

	J 43013 Fuel Injector Assembly Removal Tool
	J 44175 Fuel Composition Tester
	J 45722 Fuel Sender Lock Ring Wrench

	
	Tech 2 Kit 7000081

ENGINE CONTROLS (TROUBLESHOOTING)

SYMPTOMS - ENGINE CONTROLS

Important Preliminary Inspections Before Starting

Perform **Diagnostic System Check - Engine Controls** before using the symptom tables, and verify that all of the following are true:

- The powertrain control module (PCM) and malfunction indicator lamp (MIL) are operating correctly.
- There are no DTCs stored.
- The scan tool data is within the normal operating range, refer to **Scan Tool Data List** .
- Verify the customer concern and locate the correct symptom in the table of contents. Inspect the items indicated under that symptom.

Visual/Physical Inspection

Several of the symptom procedures ask for a careful visual and physical inspection. This step is extremely important. The visual and physical inspection can lead to correcting a problem without further inspections, and can save valuable time. Ensure that:

- The PCM grounds are clean, tight, and in the proper location.
- The vacuum hoses are not split or kinked, and properly connected, as shown on the Vehicle Emission Control Information label. Inspect thoroughly for any type of leak or restriction.
- The mass air flow (MAF) sensor is properly installed. The arrows on the plastic portion of the sensor must point toward the engine.
- The air intake ducts are not collapsed or damaged.
- There are no leaks at the throttle body mounting area, the MAF sensor, or the intake manifold sealing surfaces.
- The ignition wires are not cracked, brittle, or carbon tracked.
- The engine harness wiring and terminals are properly connected and are not pinched or cut.

Intermittent

IMPORTANT: Inspect for improper installation of electrical components if an intermittent condition exists. Inspect for aftermarket theft deterrent devices, lights, and cellular phones. Verify that no aftermarket equipment is connected to the class 2 circuit. If you can not locate an intermittent condition, a cellular phone communication signal may cause the condition.

IMPORTANT: The problem may or may not turn ON the malfunction indicator lamp (MIL) or store a DTC.

Faulty electrical connections or wiring cause most intermittent problems. Perform a careful visual and physical inspection of the suspect connectors for the following conditions:

- Improperly mated connector halves
- Terminals that are not seated
- Terminals that are damaged or improperly formed

Reform or replace connector terminals in the problem circuit in order to ensure proper contact tension. Refer to **Connector Repairs** in Wiring Systems. Remove the terminal from the connector body in order to inspect for poor terminal wire connection. Refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems.

Road test the vehicle with the DMM connected to the suspected circuit. An abnormal reading that occurs when the malfunction occurs is a good indication that there is a malfunction in the circuit being monitored.

Use a scan tool in order to help detect intermittent conditions. Useful features of the GM Techline scan tool include the following:

- Trigger the Snapshot feature in order to capture and store engine parameters when the malfunction occurs. Review this stored information in order to see the specific running conditions that caused the malfunction.
- Freeze Frame/Failure Records can also aid in locating an intermittent condition. Review and capture the information in the Freeze Frame/Failure Record associated with the intermittent DTC being diagnosed. Drive the vehicle within the conditions that were present when the DTC originally set.
- Use the Plot Function on the scan tool in order to plot selected data parameters. Review this stored information to aid in locating an intermittent problem. Refer to the scan tool Users Guide for more information.

IMPORTANT: If the intermittent condition exists as a start and then stall, test for DTCs relating to the vehicle theft deterrent system. Test for improper installation of electrical options such as lights, cellular phones, etc.

Any of the following may cause an intermittent malfunction indicator lamp (MIL) with no stored DTC:

- The ignition coils are shorted to a ground or arcing at the ignition wires or the spark plugs.
- The PCM grounds are loose or dirty. Refer to **Engine Controls Schematics** .
- The ignition control (IC) wires are routed too close to the secondary ignition wires, coils, or the generator. Ensure that all of the circuits from the PCM to the ignition coils have good connections.
- There is an open diode across the A/C compressor clutch or any other open diodes.

Use the following tables when diagnosing a symptom complaint:

- **Intermittent Conditions**
- **Hard Start**
- **Surges/Chuggles**
- **Lack of Power, Sluggishness, or Sponginess**
- **Detonation/Spark Knock**
- **Hesitation, Sag, Stumble**
- **Cuts Out, Misses**
- **Poor Fuel Economy**
- **Poor Fuel Fill Quality**
- **Rough, Unstable, or Incorrect Idle and Stalling**
- **Dieseling, Run-On**
- **Backfire**

INTERMITTENT CONDITIONS

Intermittent Conditions

Inspection/Test	Action
DEFINITION: The problem is not currently present but is indicated in DTC History. OR There is a customer complaint, but the symptom can not currently be duplicated, if the problem is not DTC related.	
Preliminary	Refer to **Symptoms - Engine Controls** before starting.
Harness/Connector	Many intermittent open or shorted circuits are affected by harness/connector movement that is caused by vibration, engine torque, bumps/rough pavement, etc. Test for this type of condition by performing the applicable procedure from the following list: • Move related connectors and wiring while monitoring the appropriate scan tool data. • Move related connectors and wiring with the component commanded ON, and OFF, with the scan tool. Observe the component operation. • With the engine running, move related connectors and wiring while monitoring engine operation. If harness or connector movement affects the data displayed, component/system operation, or engine operation, inspect and repair the harness/connections as necessary. Refer to Electrical Connections or Wiring.
Electrical Connections or Wiring	Poor electrical connections, terminal tension or wiring problems cause most intermittents. Refer to **Testing for Intermittent Conditions and Poor Connections** , **Circuit Testing** , **Connector Repairs** , or **Wiring Repairs** in

	Wiring Systems to perform the following inspections: • Inspect for poor mating of the connector halves, or terminals improperly seated in the connector body. • Inspect for improperly formed or damaged terminals. Test for poor terminal tension. • Inspect for poor terminal to wire connections including terminals crimped over insulation. This requires removing the terminal from the connector body. • Inspect for corrosion/water intrusion. Pierced or damaged insulation can allow moisture to enter the wiring. The conductor can corrode inside the insulation, with little visible evidence. Look for swollen and stiff sections of wire in the suspect circuits. • Inspect for wires that are broken inside the insulation. • Inspect the harness for pinched, cut or rubbed through wiring. • Ensure that the wiring does not come in contact with hot exhaust components.
Control Module Power and Grounds Component Power and Grounds	Poor power or ground connections can cause widely varying symptoms. • Test all control module power supply circuits. Many vehicles have multiple circuits supplying power to the control module. Other components in the system may have separate power supply circuits that may also need to be tested. Inspect connections at the module/component connectors, fuses, and any intermediate connections between the power source and the module/component. A test lamp or a DMM may indicate that voltage is present, but neither tests the ability of the circuit to carry sufficient current. Ensure that the circuit can carry the current necessary to operate the component. Refer to **Circuit Testing** and **Power Distribution Schematics** in Wiring Systems. • Test all control module ground and system ground circuits. The control module may have multiple ground circuits. Other components in the system may have separate grounds that may also need to be tested. Inspect grounds for clean and tight connections at the grounding point. Inspect the connections at the component and in splice packs, where applicable. Ensure that the circuit can carry the current necessary to operate the component. Refer to **Circuit Testing** and **Ground Distribution Schematics** in Wiring Systems.
Temperature Sensitivity	• An intermittent condition may occur when a component/connection reaches normal operating temperature. The condition may occur only when the component/connection is cold, or only when the component/connection is hot. • Freeze Frame, Failure Records, Snapshot, or Vehicle Data Recorder data may help with this type of intermittent condition, where applicable. • If the intermittent is related to heat, review the data for a relationship with

<table>
<tr>
<td></td>
<td>the following:
High ambient temperatures
Underhood/engine generated heat
Circuit generated heat due to a poor connection, or high electrical load
Higher than normal load conditions, towing, etc.
If the intermittent is related to cold, review the data for the following:
Low ambient temperatures - In extremely low temperatures, ice may form in a connection or component. Test for water intrusion.
The condition only occurs on a cold start.
The condition goes away when the vehicle warms up.
Information from the customer may help to determine if the trouble follows a pattern that is temperature related.</td>
</tr>
<tr>
<td>Electromagnetic Interference (EMI) and Electrical Noise</td>
<td>Some electrical components/circuits are sensitive to EMI or other types of electrical noise. Inspect for the following conditions:
A misrouted harness that is too close to high voltage/high current devices such as secondary ignition components, motors, generator etc. These components may induce electrical noise on a circuit that could interfere with normal circuit operation.
Electrical system interference caused by a malfunctioning relay, or a powertrain control module (PCM) driven solenoid or switch. These conditions can cause a sharp electrical surge. Normally, the problem will occur when the malfunctioning component is operating.
Improper installation of non-factory or aftermarket add on accessories such as lights, 2-way radios, amplifiers, electric motors, remote starters, alarm systems, cell phones, etc. These accessories may lead to an emission related OBD II failure while in use, but do not fail when the accessories are not in use. Refer to <u>Checking Aftermarket Accessories</u> in Wiring Systems.
Test for an open diode across the A/C compressor clutch and for other open diodes. Some relays may contain a clamping diode.
Test the generator for a bad rectifier bridge that may be allowing AC noise into the electrical system. Refer to <u>Diagnostic System Check - Engine Electrical</u> in Engine Electrical.</td>
</tr>
<tr>
<td>Incorrect PCM Programming</td>
<td>There are only a few situations where reprogramming a PCM is appropriate:
A new service PCM is installed.
A PCM from another vehicle is installed.
Revised software/calibration files have been released for this vehicle.
IMPORTANT:
DO NOT re-program the PCM with the SAME software/calibration files</td>
</tr>
</table>

	that are already present in the PCM. This is not an effective repair for any type of driveability problem. • Verify that the PCM contains the correct software/calibration. If incorrect programming is found, reprogram the PCM with the most current software/calibration. Refer to **Service Programming System (SPS)** in Programming.
Duplicating Failure Conditions	• If none of the previous tests are successful, attempt to duplicate and/or capture the failure conditions. • Freeze Frame/Failure Records data, where applicable, contains the conditions that were present when the DTC set. 1. Review and record Freeze Frame/Failure Records data 2. Clear the DTCs using the scan tool. 3. Turn the key to OFF and wait 15 seconds. 4. Operate the vehicle under the same conditions that were noted in Freeze Frame/Failure Records data, as closely as possible. The vehicle must also be operating within the Conditions for Running the DTC. Refer to Conditions for Running the DTC in the supporting text of the DTC being diagnosed. 5. Monitor DTC Status for the DTC being tested. The scan tool will indicate Ran, when the enabling conditions have been satisfied long enough for the DTC to run. The scan tool will also indicate whether the DTC passed or failed. • An alternate method is to drive the vehicle with the DMM connected to a suspected circuit. An abnormal reading on the DMM when the problem occurs, may help you locate the problem.
Scan Tool Snapshot	The scan tool can be set up to take a Snapshot of the parameters available via serial data. The Snapshot function records live data over a period of time. The recorded data can be played back and analyzed. The scan tool can also graph parameters singly or in combinations of parameters for comparison. The Snapshot can be triggered manually at the time the symptom is noticed, or set up in advance to trigger when a DTC sets. An abnormal value captured in the recorded data may point to a system or component that needs to be investigated further. Refer to the scan tool user instructions for more information on the Snapshot function.
Vehicle Data Recorder	The **J 42598** Vehicle Data Recorder is connected to the data link connector (DLC) and sent with the customer. The **J 42598** captures data for later retrieval and analysis by the technician. Refer to the vehicle data recorder user instructions for more information.

HARD START

Hard Start

Inspection/Test	Action
DEFINITION: Engine cranks OK, but does not start for a long time. Does eventually run, or may start but immediately dies.	
Preliminary	• Refer to Important Preliminary Inspections Before Starting in **Symptoms - Engine Controls** . • Verify that the powertrain control module (PCM) grounds are clean, tight, and in the proper locations. Refer to **Power and Grounding Component Views** in Wiring Systems, and **Engine Controls Schematics** . • Search for bulletins.
Sensor/System	• Verify that the engine coolant temperature (ECT) sensor is not shifted in value. Connect a scan tool. Compare the engine coolant temperature to the intake air temperature (IAT) on a cold engine. The ECT and IAT sensor values should be within +/- 3°C (5°F) of each other. If the ECT sensor is out of range with the IAT sensor, measure the resistance of the ECT sensor. Refer to **Temperature vs Resistance** for resistance specifications. **IMPORTANT:** **The embossed arrows on the MAF sensor indicate the direction of the intake air flow. The arrows must point toward the engine.** • Inspect the mass air flow (MAF) sensor installation. A MAF sensor that is incorrectly installed may cause a hard start. Install the MAF in the proper direction. Refer to **Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor Replacement** . • Inspect the camshaft position (CMP) sensor for proper mounting and/or a bad connection. An extended crank occurs if the PCM does not receive a CMP signal.
Fuel System	• Inspect the fuel pump relay operation. The fuel pump should turn ON for 2 seconds when you turn ON the ignition. Refer to **Fuel Pump Electrical Circuit Diagnosis** . • Verify that both fuel injector fuses are not open. An open fuel injector fuse causes 4 injectors and 4 ignition coils not to operate. Inspect the injector circuits and the ignition coil circuits for an intermittent short to ground. Replace the fuse. Refer to **Circuit Testing** in Wiring Systems. • Inspect for incorrect fuel pressure. Refer to **Fuel System Diagnosis** . • Inspect for a contaminated fuel condition. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (without Special Tool and E85)** or **Alcohol/Contaminants-in-Fuel Diagnosis (with Special Tool)** .
Ignition System	• Verify that both fuel injector fuses are not open. An open fuel injector fuse causes 4 ignition coils and 4 fuel injectors not to operate. Inspect the ignition coil circuits and the fuel injector circuits for an intermittent short to ground. Refer to **Circuit Testing** in Wiring Systems. Replace the fuse. • Inspect for proper ignition voltage output with the **J 26792** Spark Tester. Refer to

	Electronic Ignition (EI) System Diagnosis .
	• Remove the spark plugs and inspect for the following:
	  ◦ Correct heat range
	  ◦ Wet plugs
	  ◦ Cracks
	  ◦ Wear
	  ◦ Improper gap
	  ◦ Burned electrodes
	  ◦ Heavy deposits
	
	Refer to **Spark Plug Inspection** .
	
	• Determine the cause of the conditions before replacing the spark plugs.
	• Inspect for bare or shorted ignition wires. Refer to **Spark Plug Wire Inspection** .
	• Inspect for loose ignition coil grounds. Refer to **Electronic Ignition (EI) System Diagnosis** .

Engine Mechanical	Inspect for the following conditions:
	
	• Excessive oil in combustion chamber or leaking valve seals - Refer to **Oil Consumption Diagnosis** in Engine Mechanical.
	• Low cylinder compression - Refer to **Engine Compression Test** in Engine Mechanical.
	• Combustion chambers for excessive carbon buildup - Clean the chambers using top engine cleaner. Follow the instructions on the can.
	• Incorrect basic engine parts - Inspect the following:
	  ◦ Cylinder heads - Refer to **Cylinder Head Cleaning and Inspection** in Engine Mechanical.
	  ◦ Camshaft - Refer to **Camshaft and Bearings Cleaning and Inspection** in Engine Mechanical.
	  ◦ Pistons, etc. - Refer to **Piston, Connecting Rod, and Bearings Cleaning and Inspection** in Engine Mechanical.
	• Inspect for excessive crankshaft endplay that will cause the crankshaft position (CKP) sensor reluctor wheel to move out of alignment with the CKP sensor. Refer to **Crankshaft and Bearings Cleaning and Inspection** in Engine Mechanical. This could result in any of the following conditions:
	  ◦ A no start
	  ◦ A start and stall
	  ◦ Erratic performance

SURGES/CHUGGLES

Surges/Chuggles

Inspection/Tests	Action
DEFINITION: Engine power variation under steady throttle or cruise. Feels like the vehicle speeds up and slows down with no change in the accelerator pedal position.	
Preliminary	• Refer to Important Preliminary Inspections Before Starting in **Symptoms - Engine Controls** . • Search for bulletins. • Inspect the powertrain control module (PCM) grounds for being clean, tight, and in the proper locations. Refer to **Power and Grounding Component Views** in Wiring Systems and **Engine Controls Schematics** . • Verify the driver understands the operation of the transmission torque converter clutch (TCC) and A/C compressor operation as explained in the owners manual. Inform the customer how the TCC and the A/C clutch operates.
Sensor/System	• Inspect the heated oxygen sensors (HO2S). The HO2S should respond quickly to different throttle positions. If they do not, inspect the HO2S for silicon or other contaminates from fuel or the use of improper RTV sealant. The sensors may have a white, powdery coating and result in a high but false signal voltage rich exhaust indication. The PCM will then reduce the amount of fuel delivered to the engine causing a severe driveability problem. • Inspect the mass air flow (MAF) sensor connections. Repair or replace damaged terminals. Refer to **Connector Repairs** in Wiring Systems.
Fuel System	• Test for incorrect fuel pressure. Refer to **Fuel System Diagnosis** . • Inspect for a contaminated fuel condition. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (without Special Tool and E85)** or **Alcohol/Contaminants-in-Fuel Diagnosis (with Special Tool)** . • Verify that each injector harness is connected to the correct injector or cylinder. Relocate injector harnesses as necessary. • Inspect for the following that may cause the engine to run rich: **NOTE:** **Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.** ○ Water intrusion in the HO2S connector ○ Engine oil contaminated by fuel ○ An evaporative emission (EVAP) canister purge condition ○ Incorrect fuel pressure - Refer to **Fuel System Diagnosis** . ○ Leaking fuel injectors - Refer to **Fuel System Diagnosis** . ○ An inaccurate MAF sensor ○ Blockage on the inlet screen of the MAF sensor - Refer to **Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor Replacement** . ○ Vacuum hoses that are split, kinked, or improperly connected

	- An air intake duct that is collapsed or restricted - Refer **Air Cleaner Resonator Outlet Duct Replacement** . - An air filter that is dirty or restricted-Refer to **Air Cleaner Element Replacement** . • Inspect for the following conditions that may cause the engine to run lean: **NOTE:** **Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.** - Water intrusion in the HO2S connector - An exhaust leak between the HO2S and the engine - Refer to **Exhaust Leakage** in Engine Exhaust. - Vacuum leaks - Incorrect fuel pressure - Refer to **Fuel System Diagnosis** . - Restricted fuel injectors - Refer to **Fuel Injector Balance Test with Special Tool** or **Fuel Injector Balance Test with Tech 2** . - An inaccurate MAF sensor - Fuel contamination - Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (without Special Tool and E85)** or **Alcohol/Contaminants-in-Fuel Diagnosis (with Special Tool)** . - Vacuum hoses that are split, kinked, or improperly connected
Ignition System	• Soak the secondary ignition system with water from a spray bottle. Soaking the secondary ignition system may help locate damaged or deteriorated components. Look and listen for arcing or misfiring as you apply the water. • Test for proper ignition voltage output with the **J 26792** Spark Tester. Refer to **Electronic Ignition (EI) System Diagnosis** . • Remove the spark plugs and inspect for the following: - Correct heat range - Wet plugs - Cracks - Wear - Improper gap - Burned electrodes - Heavy deposits Refer to **Spark Plug Inspection** . • An improper spark plug gap will cause a driveability problem. Gap the spark plugs using a wire gauge gap tool. Refer to **Spark Plug Replacement** . • Determine the cause of the fouling before replacing the spark plugs.

	• Monitor the Misfire Current Counters while driving the vehicle within the conditions that the misfire occurred. If a misfiring cylinder can be located, use the DTC P0300 table for diagnosis. Refer to **DTC P0300** . • Inspect for loose ignition coil grounds. Refer to **Electronic Ignition (EI) System Diagnosis** .

Engine Mechanical	• Verify that the engine coolant temperature (ECT) is not above 130°C (266°F). This condition causes the PCM to operate in Engine Coolant Over Temperature-Fuel Disabled Mode. While in Engine Coolant Over Temperature-Fuel Disabled Mode, the PCM turns fuel OFF to 4 cylinders at a time to keep engine temperatures from reaching damaging levels. The driver may perceive Engine Coolant Over Temperature-Fuel Disabled Mode as a lack of power, miss, or rough idle. If the vehicle operates in Engine Coolant Over Temperature-Fuel Disabled Mode, refer to **Engine Overheating** in Engine Cooling for diagnosis.
	• Inspect for excessive crankshaft endplay that will cause the crankshaft position (CKP) sensor reluctor wheel to move out of alignment with the CKP sensor. Refer to **Crankshaft and Bearings Cleaning and Inspection** in Engine Mechanical. This could result in any of the following conditions:
	    ○ A no start
	    ○ A start and stall
	    ○ Erratic performance

Additional Inspections	• Visually and physically inspect vacuum hoses for splits, kinks, and proper connections and routing as shown on the Vehicle Emission Control Information label. • Inspect the transmission torque converter clutch (TCC) operation. A TCC applying too soon can cause the engine to spark knock. Refer to **Diagnostic Starting Point - Automatic Transmission** in Automatic Transmission - 4L60-E.

LACK OF POWER, SLUGGISHNESS, OR SPONGINESS

Lack of Power, Sluggishness, or Sponginess

Inspection/Tests	Action
DEFINITION: Engine delivers less than expected power. Little or no increase in speed when the accelerator pedal is pushed down part way.	
Preliminary Inspections	• Refer to Important Preliminary Inspections Before Starting in **Symptoms - Engine Controls** . • Search for bulletins. • Verify that the powertrain control module (PCM) grounds are clean, tight, and in the proper locations. Refer to **Power and Grounding Component Views** in Wiring Systems and **Engine Controls Schematics** . • Remove the air filter element and inspect for dirt or for restrictions. Refer to **Air Cleaner Element Replacement** and replace as necessary.

Fuel System	• Inspect both injector fuses for being open. An open injector fuse causes 4 ignition coils and 4 injectors not to operate. Replace the fuse. Inspect the ignition coil circuits and the injector circuits for an intermittent short to ground. • Inspect for incorrect fuel pressure. Refer to **Fuel System Diagnosis** . • Inspect for a contaminated fuel condition. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (without Special Tool and E85)** or **Alcohol/Contaminants-in-Fuel Diagnosis (with Special Tool)** . • Inspect the fuel injectors. Refer to **Fuel Injector Coil Test** . • Inspect for the following that may cause the engine to run rich: **NOTE:** **Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.** ○ Water intrusion in the heated oxygen sensor (HO2S) connector ○ Engine oil contaminated by fuel ○ An evaporative emission (EVAP) canister purge condition ○ Incorrect fuel pressure - Refer to **Fuel System Diagnosis** . ○ Leaking fuel injectors - Refer to **Fuel System Diagnosis** . ○ An inaccurate mass air flow (MAF) sensor ○ Blockage on the inlet screen of the MAF sensor - Refer to **Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor Replacement** . ○ Vacuum hoses that are split, kinked, or improperly connected ○ An air intake duct that is collapsed or restricted - Refer to **Air Cleaner Resonator Outlet Duct Replacement** . ○ An air filter that is dirty or restricted - Refer to **Air Cleaner Element Replacement** . • Inspect for the following conditions that may cause the engine to run lean: **NOTE:** **Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.** ○ Water intrusion in the HO2S connector ○ An exhaust leak between the HO2S and the engine - Refer to **Exhaust Leakage** in Engine Exhaust. ○ Vacuum leaks ○ Incorrect fuel pressure - Refer to **Fuel System Diagnosis** . ○ Restricted fuel injectors - Refer to **Fuel Injector Balance Test with Special Tool** or **Fuel Injector Balance Test with Tech 2** . ○ An inaccurate MAF sensor

	- Fuel contamination - Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (without Special Tool and E85)** or **Alcohol/Contaminants-in-Fuel Diagnosis (with Special Tool)** . - Vacuum hoses that are split, kinked, or improperly connected
Sensor/System	Use a scan tool in order to monitor the knock sensor (KS) system for excessive spark retard activity. Refer to **Knock Sensor (KS) System Description** .
Ignition System	• Verify that both fuel injector fuses are not open. An open fuel injector fuse causes 4 ignition coils and 4 fuel injectors not to operate. Inspect the ignition coil circuit and the injector circuits for an intermittent short to ground. Refer to **Circuit Testing** in Wiring Systems. Replace the fuse. • Soak the secondary ignition system with water from a spray bottle. Soaking the secondary ignition system may help locate damaged or deteriorated components. Look and listen for arcing or misfiring as water is applied. • Inspect for proper ignition voltage output with the **J 26792** Spark Tester. • Remove the spark plugs and inspect for the following: ○ Correct heat range ○ Wet plugs ○ Cracks ○ Wear ○ Improper gap ○ Burned electrodes ○ Heavy deposits Refer to **Spark Plug Inspection** . • An improper spark plug gap will cause a driveability problem. Gap the spark plugs using a wire gauge gap tool. Refer to **Spark Plug Replacement** . • Determine the cause of the fouling before replacing the spark plugs. • Monitor the Misfire Current Counters while driving the vehicle within the conditions that the misfire occurred. If a misfiring cylinder can be located with a misfire, use the DTC P0300 table for diagnosis. Refer to **DTC P0300** . • Inspect for loose ignition coil grounds. Refer to **Electronic Ignition (EI) System Diagnosis** .
Engine Mechanical	• Verify that the engine coolant temperature (ECT) is not above 130°C (266°F). This condition causes the PCM to operate in Engine Coolant Over Temperature-Fuel Disabled Mode. While in Engine Coolant Over Temperature-Fuel Disabled Mode, the PCM will disable the fuel injectors to 4 cylinders at a time to keep engine temperatures from reaching damaging levels. The driver may perceive the Engine Coolant Over Temperature-Fuel Disabled Mode as a lack of power, miss, or rough idle. If the vehicle operates in Engine Coolant Over Temperature-Fuel Disabled Mode, refer to **Engine Overheating** in Engine Cooling for diagnosis.

	- Inspect for excessive oil in the combustion chambers and leaking valve seals. Refer to **Oil Consumption Diagnosis** in Engine Mechanical. - Test for low cylinder compression. Refer to **Engine Compression Test** in Engine Mechanical. - Inspect for incorrect basic engine parts, including the following: - The camshaft - Refer to **Camshaft and Bearings Cleaning and Inspection** in Engine Mechanical. - The cylinder heads - Refer to **Cylinder Head Cleaning and Inspection** in Engine Mechanical. - The pistons, etc. - Refer to **Piston, Connecting Rod, and Bearings Cleaning and Inspection** in Engine Mechanical. - Inspect for excessive crankshaft endplay that will cause the crankshaft position (CKP) sensor reluctor wheel to move out of alignment with the CKP sensor. Refer to **Crankshaft and Bearings Cleaning and Inspection** in Engine Mechanical. This could result in any of the following conditions: - A no start - A start and stall - Erratic performance
Additional Inspections	- Inspect the exhaust system for possible restrictions. Perform the following: - Inspect the exhaust system for damaged or collapsed pipes. - Inspect the mufflers for heat distress or internal failure. - Inspect for plugged catalytic converters. Refer to **Restricted Exhaust** in Engine Exhaust. - Inspect the transmission torque converter clutch (TCC) for proper operation. Refer to **Diagnostic Starting Point - Automatic Transmission** in Automatic Transmission - 4L60-E.

DETONATION/SPARK KNOCK

Detonation/Spark Knock

Inspection/Tests	Action
DEFINITION: A mild to severe ping, usually worse under acceleration. The engine makes sharp metallic knocks that change with throttle opening.	
Preliminary Inspections	- Refer to Important Preliminary Inspections Before Starting in **Symptoms - Engine Controls** . - Search for bulletins. - Verify that the powertrain control module (PCM) grounds are clean, tight, and in the proper locations. Refer to **Power and Grounding Component Views** in Wiring Systems and **Engine Controls Schematics** . - If there are no engine mechanical faults, fill the fuel tank with a known high quality fuel that meets the vehicles minimum octane requirements. Road test

<table>
<tr><td></td><td>the vehicle and re-evaluate the vehicles performance.</td></tr>
<tr><td>Fuel System</td><td>Inspect for incorrect fuel pressure. Refer to Fuel System Diagnosis .
Inspect for a contaminated fuel condition. Refer to Alcohol/Contaminants-in-Fuel Diagnosis (without Special Tool and E85) or Alcohol/Contaminants-in-Fuel Diagnosis (with Special Tool) .
Inspect for the following conditions that may cause the engine to run lean:
NOTE:
Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.
Water intrusion in the heated oxygen sensor (HO2S) connector
An exhaust leak between the HO2S and the engine - Refer to Exhaust Leakage in Engine Exhaust.
Vacuum leaks
Incorrect fuel pressure - Refer to Fuel System Diagnosis .
Restricted fuel injectors - Refer to Fuel Injector Balance Test with Special Tool or Fuel Injector Balance Test with Tech 2 .
An inaccurate mass air flow (MAF) sensor
Fuel contamination - Refer to Alcohol/Contaminants-in-Fuel Diagnosis (without Special Tool and E85) or Alcohol/Contaminants-in-Fuel Diagnosis (with Special Tool) .
Vacuum hoses that are split, kinked, or improperly connected</td></tr>
<tr><td>Ignition System</td><td>Verify that the spark plugs are of the proper heat range. Refer to Spark Plug Inspection .</td></tr>
<tr><td>Engine Cooling System</td><td>Inspect for obvious overheating problems:
Low engine coolant - Refer to Loss of Coolant in Engine Cooling for the type and amount of engine coolant to be used.
Restricted air flow to the radiator or restricted coolant flow through the radiator.
Inoperative cooling fan - Refer to Fan Clutch Diagnosis in Engine Cooling.</td></tr>
<tr><td>Engine Mechanical</td><td>Inspect for the following engine mechanical problems:
Excessive oil in combustion chamber - Leaking valve seals. Refer to Oil Consumption Diagnosis in Engine Mechanical.
Low cylinder compression - Refer to Engine Compression Test in Engine Mechanical.
Combustion chambers for excessive carbon buildup - Clean the combustion chamber by using top engine cleaner. Follow the instructions on the can.
Inspect for incorrect basic engine parts. Inspect the following:
The camshaft - Refer to Camshaft and Bearings Cleaning and</td></tr>
</table>

	Inspection in Engine Mechanical. - The cylinder heads - Refer to **Cylinder Head Cleaning and Inspection** in Engine Mechanical. - The pistons, etc. - Refer to **Piston, Connecting Rod, and Bearings Cleaning and Inspection** in Engine Mechanical. - Refer to **Symptoms - Engine Mechanical** in Engine Mechanical.
Additional Inspections	- Inspect the park/neutral position (PNP) switch operation. Refer to **Diagnostic System Check - Automatic Transmission** in Automatic Transmission - 4L60-E. - Inspect the transmission torque converter clutch (TCC) operation. The TCC applying too soon can cause the engine to spark knock. Refer to **Diagnostic System Check - Automatic Transmission** in Automatic Transmission - 4L60-E.

HESITATION, SAG, STUMBLE

Hesitation, Sag, Stumble

Inspection/Tests	Action
DEFINITION: Momentary lack of response as the accelerator is pushed down. Can occur at any vehicle speed. Usually more pronounced when first trying to make the vehicle move, as from a stop. May cause the engine to stall if severe enough.	
Preliminary	- Refer to Important Preliminary Inspections Before Starting in **Symptoms - Engine Controls** . - Search for bulletins. - Verify that the powertrain control module (PCM) grounds are clean, tight, and in the proper locations. Refer to **Engine Controls Schematics** .
Sensor/System	Inspect the manifold absolute pressure (MAP) sensor operation.
Fuel System	- Inspect for incorrect fuel pressure. Refer to **Fuel System Diagnosis** . - Inspect for a contaminated fuel condition. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (without Special Tool and E85)** or **Alcohol/Contaminants-in-Fuel Diagnosis (with Special Tool)** . - Verify that both fuel injector fuses are not open. An open fuel injector fuse causes 4 ignition coils and 4 fuel injectors not to operate. Inspect the ignition coil circuits and the fuel injector circuits for an intermittent short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Replace the fuse. - Inspect for the following that may cause the engine to run rich: **NOTE:** **Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.**

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Water intrusion in the heated oxygen sensor (HO2S) connector
Engine oil contaminated by fuel
An evaporative emission (EVAP) canister purge condition
Incorrect fuel pressure - Refer to <u>Fuel System Diagnosis</u> .
Leaking fuel injectors - Refer to <u>Fuel System Diagnosis</u> .
An inaccurate mass air flow (MAF) sensor
Blockage on the inlet screen of the MAF sensor - Refer to <u>Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor Replacement</u> .
Vacuum hoses that are split, kinked, or improperly connected
An air intake duct that is collapsed or restricted-Refer to <u>Air Cleaner Resonator Outlet Duct Replacement</u> .
An air filter that is dirty or restricted - Refer to <u>Air Cleaner Element Replacement</u> .

Inspect for the following conditions that may cause the engine to run lean:
NOTE:
Refer to <u>Heated Oxygen and Oxygen Sensor Notice</u> in Cautions and Notices.

Water intrusion in the HO2S connector
An exhaust leak between the HO2S and the engine-Refer to <u>Exhaust Leakage</u> in Engine Exhaust.
Vacuum leaks
Incorrect fuel pressure - Refer to <u>Fuel System Diagnosis</u> .
Restricted fuel injectors - Refer to <u>Fuel Injector Balance Test with Special Tool</u> or <u>Fuel Injector Balance Test with Tech 2</u> .
An inaccurate MAF sensor
Fuel contamination - Refer to <u>Alcohol/Contaminants-in-Fuel Diagnosis (without Special Tool and E85)</u> or <u>Alcohol/Contaminants-in-Fuel Diagnosis (with Special Tool)</u> .
Vacuum hoses that are split, kinked, or improperly connected

</td>
</tr>
<tr>
<td>Ignition System</td>
<td>

Soak the secondary ignition system with water from a spray bottle. Soaking the secondary ignition system may help locate damaged or deteriorated components. Look and listen for arcing or misfiring as you apply water.
Test for proper ignition voltage output with the J 26792 Spark Tester. Refer to <u>Electronic Ignition (EI) System Diagnosis</u> for the procedure.
Remove the spark plugs and check for the following:

Correct heat range
Wet plugs
Cracks

</td>
</tr>
</table>

	◦ Wear ◦ Improper gap ◦ Burned electrodes ◦ Heavy deposits Refer to **Spark Plug Inspection** . • An improper spark plug gap will cause a driveability problem. Gap the spark plugs using a wire gauge gap tool. Refer to **Spark Plug Replacement** . • Determine the cause of the fouling before replacing the spark plugs. • Monitor the Misfire Current Counters while driving the vehicle in the conditions that the misfire occurred. If a misfiring cylinder can be located, use the DTC P0300 table for diagnosis. Refer to **DTC P0300** . • Inspect for loose ignition coil grounds. Refer to **Electronic Ignition (EI) System Diagnosis** .
Engine Cooling System	Inspect the engine thermostat for proper operation and for proper heat range. Refer to **Thermostat Diagnosis** in Engine Cooling.
Engine Mechanical	Inspect for excessive crankshaft endplay that will cause the crankshaft position (CKP) sensor reluctor wheel to move out of alignment with the CKP sensor. Refer to **Crankshaft and Bearings Cleaning and Inspection** in Engine Mechanical. This could result in any of the following conditions: • A no start • A start and stall • Erratic performance
Additional Inspections	Inspect the generator output voltage. Refer to **Diagnostic System Check - Engine Electrical** in Engine Electrical for the procedure. Repair the charging system if the generator output voltage is less than 9 volts or more than 16 volts.

CUTS OUT, MISSES

Cuts Out, Misses

Inspections	Action
DEFINITION: Steady pulsation or jerking that follows engine speed, usually more pronounced as engine load increases. This condition is not normally felt above 1,500 RPM or 48 km/h (30 mph). The exhaust has a steady spitting sound at idle or low speed.	
Preliminary	• Refer to Important Preliminary Inspections Before Starting in **Symptoms - Engine Controls** . • Search for bulletins. • Verify that the powertrain control module (PCM) grounds are clean, tight, and in the proper locations. Refer to **Power and Grounding Component Views** in Wiring Systems and **Engine Controls Schematics** .

	• Remove the air filter element and inspect for dirt and for restrictions. Refer to **Air Cleaner Element Replacement** . Replace as necessary.
Fuel System	• Inspect the fuel injectors. Refer to **Fuel Injector Coil Test** . • Inspect for incorrect fuel pressure. Refer to **Fuel System Diagnosis** . • Inspect for a restricted fuel filter. Refer to **Fuel System Diagnosis** . • Inspect for a contaminated fuel condition. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (without Special Tool and E85)** or **Alcohol/Contaminants-in-Fuel Diagnosis (with Special Tool)** . • Inspect for the following that may cause the engine to run rich: **NOTE:** **Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.** ○ Water intrusion in the heated oxygen sensor (HO2S) connector ○ Engine oil contaminated by fuel ○ An evaporative emission (EVAP) canister purge condition ○ Incorrect fuel pressure - Refer to **Fuel System Diagnosis** . ○ A leaking fuel pressure regulator - Refer to **Fuel System Diagnosis** . ○ Leaking fuel injectors - Refer to **Fuel System Diagnosis** . ○ An inaccurate mass air flow (MAF) sensor ○ Blockage on the inlet screen of the MAF sensor - Refer to **Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor Replacement** . ○ Vacuum hoses that are split, kinked, or improperly connected ○ An air intake duct that is collapsed or restricted - Refer to **Air Cleaner Resonator Outlet Duct Replacement** . ○ An air filter that is dirty or restricted - Refer to **Air Cleaner Element Replacement** . • Inspect for the following conditions that may cause the engine to run lean: **NOTE:** **Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.** ○ Water intrusion in the HO2S connector ○ An exhaust leak between the HO2S and the engine - Refer to **Exhaust Leakage** in Engine Exhaust. ○ Vacuum leaks ○ Incorrect fuel pressure - Refer to **Fuel System Diagnosis** . ○ Restricted fuel injectors - Refer to **Fuel Injector Balance Test with Special Tool** or **Fuel Injector Balance Test with Tech 2** .

<table>
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An inaccurate MAF sensor
Fuel contamination - Refer to Alcohol/Contaminants-in-Fuel Diagnosis (without Special Tool and E85) or Alcohol/Contaminants-in-Fuel Diagnosis (with Special Tool) .
Vacuum hoses that are split, kinked, or improperly connected

</td></tr>
<tr><td>Sensor/System</td><td>Use a scan tool in order to monitor the knock sensor (KS) system for excessive spark retard activity.</td></tr>
<tr><td>Ignition System</td><td>

Soak the secondary ignition system with water from a spray bottle. Soaking the secondary ignition system may help locate damaged or deteriorated components. Look and listen for arcing or misfiring as you apply water.
Test for proper ignition voltage output with the J 26792 Spark Tester.
Remove the spark plugs and inspect for the following:

Correct heat range
Wet plugs
Cracks
Wear
Improper gap
Burned electrodes
Heavy deposits

Refer to Spark Plug Inspection .

An improper spark plug gap will cause a driveability problem. Refer to Spark Plug Inspection . Gap the spark plugs using a wire gauge gap tool. Refer to Spark Plug Replacement .
Determine the cause of the fouling before replacing the spark plugs.
Visually and physically inspect the secondary ignition for the following:

The ignition wires arcing to ground
The ignition wires for proper engagement to spark plug
The ignition coils for cracks or carbon tracking

Monitor the Misfire Current Counters while driving the vehicle in the conditions that the misfire occurred. If a misfiring cylinder can be located, use the DTC P0300 table for diagnosis. Refer to DTC P0300 .

</td></tr>
<tr><td>Engine Mechanical</td><td>

Inspect engine mechanical for the following:

Inspect compression - Refer to Engine Compression Test in Engine Mechanical.
Sticking or leaking valves
Worn camshaft lobes
Valve timing
Bent push rods

</td></tr>
</table>

	- Worn rocker arms
	- Broken valve springs
	- Excessive oil in combustion chamber-Leaking valve seals. Refer to **Oil Consumption Diagnosis** in Engine Mechanical.
	
	• For incorrect basic engine parts inspect the following:
	  - The camshaft - Refer to **Camshaft and Bearings Cleaning and Inspection** in Engine Mechanical.
	  - The cylinder heads - Refer to **Cylinder Head Cleaning and Inspection** in Engine Mechanical.
	  - The pistons, etc.-Refer to **Piston, Connecting Rod, and Bearings Cleaning and Inspection** in Engine Mechanical.
	
	• Inspect for excessive crankshaft endplay that will cause the crankshaft position (CKP) sensor reluctor wheel to move out of alignment with the CKP sensor. Refer to **Crankshaft and Bearings Cleaning and Inspection** in Engine Mechanical. This could result in any of the following conditions:
	  - A no start
	  - A start and stall
	  - Erratic performance
	
	Refer to **Symptoms - Engine Mechanical** in Engine Mechanical for diagnostic procedures.

Additional Inspections	• Inspect the exhaust system for possible restrictions. Inspect for the following:
	  - Inspect the exhaust system for damaged or collapsed pipes.
	  - Inspect the mufflers for heat distress or possible internal failure.
	  - Inspect for possible plugged catalytic converters. Refer to **Restricted Exhaust** in Engine Exhaust.
	
	• Electromagnetic interference (EMI) on the reference circuit can cause an engine misfire condition. A sudden increase in indicated RPM with little change in actual engine RPM change indicates EMI is present. Inspect for high voltage components near ignition control circuits if a condition exists.
	• Inspect the intake manifold and the exhaust manifold passages for casting flash.

POOR FUEL ECONOMY

Poor Fuel Economy

Inspections	Action
DEFINITION: Fuel economy, as measured by an actual road test, is noticeably lower than expected. Also, fuel economy is noticeably lower than the economy was on this vehicle at one time, as previously shown by an actual road test.	
Preliminary	• Refer to Important Preliminary Inspections Before Starting in **Symptoms - Engine Controls** .

	• Search for bulletins.
	• Verify that the powertrain control module (PCM) grounds are clean, tight, and in the proper locations. Refer to **Power and Grounding Component Views** in Wiring Systems and **Engine Controls Schematics** .
	• Inspect the owners driving habits.
	  ◦ Is the A/C ON or the Defroster mode ON full time?
	  ◦ Are the tires at the correct pressure?
	  ◦ Are the wheels and tires the correct size?
	  ◦ Are there excessively heavy loads being carried?
	  ◦ Is the acceleration rate too much, too often?
	• Remove the air filter element and inspect for dirt or for restrictions. Refer to **Air Cleaner Element Replacement** . Replace as necessary.

Fuel System	• Inspect the type, quality, and alcohol content of the fuel. Oxygenated fuels have lower energy and may deliver reduced fuel economy. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (without Special Tool and E85)** or **Alcohol/Contaminants-in-Fuel Diagnosis (with Special Tool)** .
	• Inspect the fuel injectors. Refer to **Fuel Injector Coil Test** , **Fuel Injector Balance Test with Special Tool** or **Fuel Injector Balance Test with Tech 2** .
	• Inspect for incorrect fuel pressure. Refer to **Fuel System Diagnosis** .
	• Inspect for a contaminated fuel condition. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (without Special Tool and E85)** or **Alcohol/Contaminants-in-Fuel Diagnosis (with Special Tool)** .
	• Inspect that each fuel injector harness is connected to the correct injector and cylinder. Relocate the injector harnesses as necessary.
	• Inspect for foreign material accumulation in the throttle bore, coking on the throttle valve, or on the throttle shaft.
	• Inspect for the following that may cause the engine to run rich:
	NOTE:
	Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.
	  ◦ Water intrusion in the heated oxygen sensor (HO2S) connector
	  ◦ Engine oil contaminated by fuel
	  ◦ An evaporative emissions (EVAP) canister purge condition
	  ◦ Incorrect fuel pressure-Refer to **Fuel System Diagnosis** .
	  ◦ Leaking fuel injectors-Refer to **Fuel System Diagnosis** .
	  ◦ An inaccurate mass air flow (MAF) sensor
	  ◦ Blockage on the inlet screen of the MAF sensor-Refer to **Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor Replacement** .

<table>
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Vacuum hoses that are split, kinked, or improperly connected
An air intake duct that is collapsed or restricted-Refer to Air Cleaner Resonator Outlet Duct Replacement .
An air filter that is dirty or restricted-Refer to Air Cleaner Element Replacement .

</td></tr>
<tr><td>Sensor/System</td><td>

Inspect the air intake system and crankcase for air leaks.
Inspect the crankcase ventilation valve for proper operation. Refer to Crankcase Ventilation System Inspection/Diagnosis in Engine Mechanical.
Inspect for an inaccurate speedometer. Refer to Symptoms - Instrument Panel, Gauges and Console in Instrument Panel, Gauges, and Console.
Use a scan tool in order to monitor the knock sensor (KS) system for excessive spark retard activity. Refer to Knock Sensor (KS) System Description .

</td></tr>
<tr><td>Ignition System</td><td>

Inspect for proper ignition voltage output with the J 26792 Spark Tester.
Remove the spark plugs and inspect for the following:

Wet plugs
Cracks
Wear
Improper gap
Burned electrodes
Heavy deposits

Refer to Spark Plug Inspection .

An improper spark plug gap will cause a driveability problem. Refer to Spark Plug Inspection . Gap the spark plugs using a wire gauge gap tool. Refer to Spark Plug Replacement .
Determine the cause of the fouling before replacing the spark plugs. Refer to Spark Plug Inspection .
Visually and physically inspect the secondary ignition for the following:

Ignition wires arcing to ground
Ignition wires for proper routing

Soaking the secondary ignition system with water from a spray bottle may help locate damaged or deteriorated components. Look and listen for arcing or misfiring as you apply water.
Inspect for loose ignition coil grounds. Refer to Electronic Ignition (EI) System Diagnosis .

</td></tr>
<tr><td>Engine Cooling System</td><td>

Inspect the engine coolant level for being low. Refer to Loss of Coolant in Engine Cooling.
Inspect the engine thermostat for proper operation and for the correct heat range. Refer to Thermostat Diagnosis in Engine Cooling.

</td></tr>
</table>

Engine Mechanical	• Inspect engine mechanical for the following:
	  ○ Compression-Refer to **Engine Compression Test** in Engine Mechanical.
	  ○ Sticking or leaking valves
	  ○ Worn camshaft lobes
	  ○ Valve timing
	  ○ Bent push rods
	  ○ Worn rocker arms
	  ○ Broken valve springs
	  ○ Excessive oil in combustion chamber-Leaking valve seals. Refer to **Oil Consumption Diagnosis** in Engine Mechanical.
	• For incorrect basic engine parts inspect for the following:
	  ○ The camshaft - Refer to **Camshaft and Bearings Cleaning and Inspection** in Engine Mechanical.
	  ○ The cylinder heads - Refer to **Cylinder Head Cleaning and Inspection** in Engine Mechanical.
	  ○ The pistons, etc. - Refer to **Piston, Connecting Rod, and Bearings Cleaning and Inspection** in Engine Mechanical.
	
	Refer to **Symptoms - Engine Mechanical** in Engine Mechanical for diagnostic procedures.

Additional Inspections	• Visually and physically check the vacuum hoses for splits, kinks, and proper connections and routing as shown on Vehicle Emission Control Information label.
	• Inspect the transmission torque converter clutch (TCC) operation. The scan tool should indicate a RPM drop, when the system commands the TCC ON. Refer to **Diagnostic System Check - Automatic Transmission** in Automatic Transmission - 4L60-E.
	• Inspect the exhaust system for a possible restriction. Inspect for the following:
	  ○ Inspect the exhaust system for damaged or collapsed pipes.
	  ○ Inspect the mufflers for heat distress or possible internal failure.
	  ○ Inspect for possible plugged catalytic converters. Refer to **Restricted Exhaust** in Engine Exhaust.
	
	• Electromagnetic interference (EMI) on the reference circuit can cause an engine miss condition. A scan tool can usually detect EMI by monitoring the engine RPM. A sudden increase in RPM with little change in actual engine RPM change indicates EMI is present. Inspect for high voltage components, near ignition control circuits, if a condition exists.
	• Inspect the park neutral position (PNP) switch circuit. Refer to **Park/Neutral Position Switch Adjustment** in Automatic Transmission - 4L60-E.
	• Inspect the intake and the exhaust manifold passages for casting flash.

	• Inspect the brake system for dragging or improper operation. Refer to **Brakes Drag** in Hydraulic Brakes. Verify that the vehicle operator does not drive with a foot on the brake pedal.

POOR FUEL FILL QUALITY

Poor Fuel Fill Quality

Problem	Causes
DEFINITION: Difficulty when refueling the vehicle.	
Difficult to fill	• The check valve is stuck closed. • The fill limiter vent valve is stuck closed. • The evaporative emission (EVAP) canister is restricted. • The EVAP canister vent solenoid is stuck closed. • Restricted EVAP pipes • High Reid vapor pressure • High fuel temperature • The fuel filler hose/pipe is pinched, kinked or blocked. • The fuel feed hose, or crossover hose, is pinched, kinked or blocked. • The ignition switch is ON.
Over fill	• The pressure relief valve in the fill limiter vent valve is stuck open. • The pressure relief valve in the fill limiter vent is valve leaking. • The fill limiter vent valve is stuck open. • The fill limiter vent valve is leaking.
Premature shut-off of the fuel dispensing nozzle	• The check valve is stuck closed. • The fill limiter vent valve is stuck closed. • The EVAP canister is restricted. • The EVAP canister vent solenoid is stuck closed. • Restricted EVAP pipes • High Reid vapor pressure • High fuel temperature • The fuel filler hose/pipe is pinched, kinked or blocked. • The fuel feed hose, or crossover hose, is pinched, kinked or blocked. • The ignition switch is ON.
Fuel spit back	• The check valve is stuck open.

	• The check valve is stuck closed. • The check valve is leaking. • High Reid vapor pressure • High fuel temperature
Liquid fuel in the EVAP canister	• The fill limiter vent valve is stuck open. • The fill limiter vent valve is leaking.
Liquid fuel leak	• The pressure relief valve in the fill limiter vent valve is stuck open. • The pressure relief valve in the fill limiter vent valve is leaking. • The fuel filler hose is loose or torn. • The fuel feed hose, or crossover hose, is loose or torn. • The fill limiter vent valve is stuck open.
Fuel odor	• The pressure relief valve in the fill limiter vent valve is stuck open. • The pressure relief valve in the fill limiter vent valve is leaking. • The EVAP canister is saturated.

ROUGH, UNSTABLE, OR INCORRECT IDLE AND STALLING

Rough, Unstable, or Incorrect Idle and Stalling

Inspections	Action
DEFINITION: Engine runs unevenly at idle. If severe, the engine or vehicle may shake. Engine idle speed may vary in RPM. Either condition may be severe enough to stall the engine.	
Preliminary Inspections	• Refer to Important Preliminary Inspections Before Starting in **Symptoms - Engine Controls** . • Search for bulletins. • Verify that the powertrain control module (PCM) grounds are clean, tight, and in the proper locations. Refer to **Power and Grounding Component Views** in Wiring Systems and **Engine Controls Schematics** . • Remove and inspect the air filter element for dirt or for restrictions. Refer to **Air Cleaner Element Replacement** . Replace as necessary.
Fuel System	• Inspect the fuel injectors. Refer to **Fuel Injector Coil Test** , **Fuel Injector Balance Test with Special Tool** or **Fuel Injector Balance Test with Tech 2** . • Inspect for incorrect fuel pressure. Refer to **Fuel System Diagnosis** . • Inspect for a contaminated fuel condition. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (without Special Tool and E85)** or **Alcohol/Contaminants-in-Fuel Diagnosis (with Special Tool)** . • Inspect that each fuel injector harness is connected to the correct

	injector/cylinder. Relocate fuel injector harnesses as necessary. • Inspect for the following that may cause the engine to run rich: **NOTE:** **Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.** ◦ Water intrusion in the heated oxygen sensor (HO2S) connector ◦ Engine oil contaminated by fuel ◦ An evaporative emissions (EVAP) canister purge condition ◦ Incorrect fuel pressure - Refer to **Fuel System Diagnosis** . ◦ Leaking fuel injectors - Refer to **Fuel System Diagnosis** . ◦ An inaccurate mass air flow (MAF) sensor ◦ Blockage on the inlet screen of the MAF sensor - Refer to **Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor Replacement** . ◦ Vacuum hoses that are split, kinked, or improperly connected ◦ An air intake duct that is collapsed or restricted-Refer to **Air Cleaner Resonator Outlet Duct Replacement** . ◦ An air filter that is dirty or restricted - Refer to **Air Cleaner Element Replacement** . • Inspect for the following conditions that may cause the engine to run lean: **NOTE:** **Refer to Heated Oxygen and Oxygen Sensor Notice in Cautions and Notices.** ◦ Water intrusion in the HO2S connector ◦ An exhaust leak between the HO2S and the engine-Refer to **Exhaust Leakage** in Engine Exhaust. ◦ Vacuum leaks ◦ Incorrect fuel pressure - Refer to **Fuel System Diagnosis** . ◦ Restricted fuel injectors - Refer to **Fuel Injector Balance Test with Special Tool** or **Fuel Injector Balance Test with Tech 2** . ◦ An inaccurate MAF sensor ◦ Fuel contamination - Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (without Special Tool and E85)** or **Alcohol/Contaminants-in-Fuel Diagnosis (with Special Tool)** . ◦ Vacuum hoses that are split, kinked, or improperly connected
Sensor/System	• Inspect the crankcase ventilation valve for proper operation. Refer to **Crankcase Ventilation System Inspection/Diagnosis** in Engine Mechanical. • Use a scan tool in order to monitor the knock sensor (KS) system for excessive

	spark retard activity.
Ignition System	- Inspect for proper ignition voltage output with the **J 26792** Spark Tester. Refer to **Electronic Ignition (EI) System Diagnosis** for procedure. - Remove spark plugs and check for the following: - Wet plugs - Cracks - Wear - Improper gap - Burned electrodes - Heavy deposits Refer to **Spark Plug Inspection** . - An improper spark plug gap will cause a driveability problem. Refer to **Spark Plug Inspection** . Gap the spark plugs using a wire gauge gap tool. Refer to **Spark Plug Replacement** . - Determine the cause of the fouling before replacing the spark plugs. - Visually and physically inspect secondary ignition for the following: - Ignition wires arcing to ground - Ignition wires for proper routing - Soak the secondary ignition system with water from a spray bottle. Soaking the secondary ignition system may help locate damaged or deteriorated components. Look and listen for arcing or misfiring as you apply water. - Monitor the Misfire Current Counters while driving the vehicle in the conditions that the misfire occurred. If a misfiring cylinder can be located, use the DTC P0300 table for diagnosis. Refer to **DTC P0300** . - Inspect for loose ignition coil grounds. Refer to **Electronic Ignition (EI) System Diagnosis** .
Engine Mechanical	- Inspect engine mechanical for the following: - Compression - Refer to **Engine Compression Test** in Engine Mechanical. - Sticking or leaking valves - Worn camshaft lobes - Valve timing - Bent push rods - Worn rocker arms - Broken valve springs - Excessive oil in combustion chamber or leaking valve seals - Refer to **Oil Consumption Diagnosis** in Engine Mechanical. - For incorrect basic engine parts. Inspect the following: - The camshaft - Refer to **Camshaft and Bearings Cleaning and**

<table>
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Inspection in Engine Mechanical.
The cylinder heads - Refer to Cylinder Head Cleaning and Inspection in Engine Mechanical.
The pistons, etc. - Refer to Piston, Connecting Rod, and Bearings Cleaning and Inspection in Engine Mechanical.

Inspect for excessive crankshaft endplay that will cause the crankshaft position (CKP) sensor reluctor wheel to move out of alignment with the CKP sensor. Refer to Crankshaft and Bearings Cleaning and Inspection in Engine Mechanical. This could result in any of the following conditions:

A no start
A start and stall
Erratic performance

Refer to Symptoms - Engine Mechanical in Engine Mechanical for diagnosis procedures.</td></tr>
<tr><td>Additional Inspections</td><td>

Inspect the exhaust system for possible restrictions. Inspect for the following:

Inspect the exhaust system for damaged or collapsed pipes.
Inspect the mufflers for heat distress or possible internal failure.
Inspect for possible plugged catalytic converters. Refer to Restricted Exhaust in Engine Exhaust.

Electromagnetic interference (EMI) on the reference circuit can cause an engine miss condition. A scan tool can usually detect EMI by monitoring the engine RPM. A sudden increase in RPM with little change in actual engine RPM change indicates that EMI is present. If a problem exists, inspect routing of secondary ignition wires or high voltage components near the ignition control circuits.
Inspect the park neutral position (PNP) switch circuit. Refer to Park/Neutral Position Switch Adjustment in Automatic Transmission - 4L60-E/4L65-E.
Inspect for faulty motor mounts. Refer to Engine Mount Inspection in Engine Mechanical.
Inspect the intake manifold and the exhaust manifold passages for casting flash.

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DIESELING, RUN-ON

Dieseling, Run-On

<table>
<tr><th>Inspections</th><th>Action</th></tr>
<tr><td colspan="2">DEFINITION: Engine continues to run after key is turned OFF, but runs very rough. If the engine runs smooth, inspect the ignition switch and the ignition switch adjustment.</td></tr>
<tr><td>Preliminary Inspections</td><td>

Refer to Important Preliminary Inspections Before Starting in Symptoms - Engine Controls .
Search for bulletins.
Verify that the powertrain control module (PCM) grounds are clean, tight, and in

</td></tr>
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	the proper locations. Refer to **Power and Grounding Component Views** in Wiring Systems and **Engine Controls Schematics** .
Fuel System	Inspect the fuel injectors for a leaking condition. Refer to **Fuel System Diagnosis** for the proper procedure.

BACKFIRE

Backfire

Inspections	Actions
DEFINITION: Fuel ignites in the intake manifold or in the exhaust system, making a loud popping noise.	
Preliminary Inspections	• Refer to Important Preliminary Inspections Before Starting in **Symptoms - Engine Controls** . • Search for bulletins. • Verify that the powertrain control module (PCM) grounds are clean, tight, and in the proper locations. Refer to **Power and Grounding Component Views** in Wiring Systems and **Engine Controls Schematics** .
Fuel System	• Inspect for incorrect fuel pressure. Refer to **Fuel System Diagnosis** . • Inspect for a contaminated fuel condition. Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (without Special Tool and E85)** or **Alcohol/Contaminants-in-Fuel Diagnosis (with Special Tool)** . • Inspect the fuel injectors. Refer to **Fuel Injector Coil Test** , **Fuel Injector Balance Test with Special Tool** or **Fuel Injector Balance Test with Tech 2** . • Verify that each injector harness is connected to the correct injector or cylinder. Relocate injector harnesses as necessary.
Sensor/System	• Inspect the air intake system and crankcase for air leaks. • Inspect the crankcase ventilation valve for proper operation. Refer to **Crankcase Ventilation System Inspection/Diagnosis** in Engine Mechanical. • Inspect for an inaccurate speedometer. Refer to **Symptoms - Instrument Panel, Gauges and Console** in Instrument Panel, Gauges, and Console. • Use a scan tool in order to monitor the knock sensor (KS) system for excessive spark retard activity. Refer to **Knock Sensor (KS) System Description** .

Ignition System	• Inspect for proper ignition voltage output with **J 26792** Spark Tester.
	• Remove spark plugs and inspect for the following:
	  ○ Wet plugs
	  ○ Cracks
	  ○ Wear
	  ○ Improper gap
	  ○ Burned electrodes
	  ○ Heavy deposits

	Refer to **Spark Plug Inspection** .
	
	• An improper spark plug gap will cause a driveability problem. Refer to **Spark Plug Inspection** . Gap the spark plugs using a wire gauge gap tool. Refer to **Spark Plug Replacement** .
	• Determine the cause of the fouling before replacing the spark plugs. Refer to **Spark Plug Inspection** for diagnosis.
	• Visually and physically inspect secondary ignition for the following:
	  ○ Ignition wires arcing to ground
	  ○ Ignition coils arcing to ground
	• Soak the secondary ignition system with water from a spray bottle. Soaking the secondary ignition system may help locate damaged or deteriorated components. Look and listen for arcing or misfiring as you apply the water.
	• Monitor the Misfire Current Counters while driving the vehicle in the conditions that the misfire occurred. If a misfiring cylinder can be located, use the DTC P0300 table for diagnosis. Refer to **DTC P0300**
	• Inspect for loose ignition coil grounds. Refer to **Electronic Ignition (EI) System Diagnosis** .

Engine Cooling System	• Inspect the engine coolant level for being low. Refer to **Loss of Coolant** in Engine Cooling. • Inspect the engine thermostat for proper operation and for the correct heat range. Refer to **Thermostat Diagnosis** in Engine Cooling.

Engine Mechanical	• Inspect engine mechanical for the following:
	  ○ Compression - Refer to **Engine Compression Test** in Engine Mechanical.
	  ○ Sticking or leaking valves
	  ○ Worn camshaft lobes
	  ○ Valve timing
	  ○ Bent push rods
	  ○ Worn rocker arms
	  ○ Broken valve springs
	  ○ Excessive oil in combustion chamber or leaking valve seals - Refer to **Oil Consumption Diagnosis** in Engine Mechanical.
	• For incorrect basic engine parts. Inspect the following:
	  ○ The camshaft - Refer to **Camshaft and Bearings Cleaning and Inspection** in Engine Mechanical.
	  ○ The cylinder heads - Refer to **Cylinder Head Cleaning and Inspection** in Engine Mechanical.
	  ○ The pistons, etc. - Refer to **Piston, Connecting Rod, and Bearings Cleaning and Inspection** in Engine Mechanical.
	• Refer to **Symptoms - Engine Mechanical** in Engine Mechanical for diagnosis

	procedures.
Additional Inspections	• Visually and physically inspect the vacuum hoses for splits, kinks, and proper connections and routing as shown on the Vehicle Emission Control Information label. • Inspect the intake manifold and the exhaust manifold passages for casting flash. • Inspect the transmission torque converter clutch (TCC) operation. The scan tool should indicate an RPM drop when the TCC is commanded ON. Refer to **Diagnostic System Check - Automatic Transmission** in Automatic Transmission - 4L60-E. • Inspect the exhaust system for possible restrictions. Inspect the following: ○ Inspect the exhaust system for damaged or collapsed pipes. ○ Inspect the mufflers for heat distress or possible internal failure. ○ Inspect for possible plugged catalytic converters. Refer to **Restricted Exhaust** in Engine Exhaust. • Electromagnetic interference (EMI) on the reference circuit can cause an engine miss condition. A scan tool can usually detect EMI by monitoring the engine RPM. A sudden increase in RPM with little change in actual engine RPM change may indicate that EMI is present. If a problem exists, inspect for high voltage components near the ignition control circuits. • Inspect the park/neutral position (PNP) switch operation. Refer to **Park/Neutral Position Switch Adjustment** in Automatic Transmission - 4L60-E. • Inspect for faulty motor mounts. Refer to **Engine Mount Inspection** in Engine Mechanical. • Inspect the intake manifold and the exhaust manifold passages for casting flash

MALFUNCTION INDICATOR LAMP (MIL) INOPERATIVE

Circuit Description

Voltage is supplied directly to the malfunction indicator lamp (MIL). The powertrain control module (PCM) turns the MIL ON by grounding the MIL control circuit. There should be a steady MIL with the ignition ON and the engine OFF.

MIL Operation

The MIL is located on the instrument panel cluster (IPC).

MIL Function

- The MIL informs the driver that a malfunction has occurred and the vehicle should be taken in for service as soon as possible.
- The MIL illuminates during a bulb test and a system test.

- A DTC will be stored if a MIL is requested by the PCM.

MIL Illumination

- The MIL will illuminate with ignition switch ON and the engine not running.
- The MIL will turn OFF when the engine is started.
- The MIL will remain ON if the self-diagnostic system has detected a malfunction.
- The MIL may turn OFF if the malfunction is not present.
- If the MIL is illuminated and then the engine stalls, the MIL will remain illuminated so long as the ignition switch is ON.
- If the MIL is not illuminated and the engine stalls, the MIL will not illuminate until the ignition switch is cycled OFF, then ON.

Test Description

The number below refers to the step number on the diagnostic table.

> **4:** This step tests for a short to voltage on the MIL control circuit. With the fuse removed there should be no voltage on the MIL control circuit.

Malfunction Indicator Lamp (MIL) Inoperative

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Component Views or Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Verify whether the instrument cluster is operational. If the instrument panel (IP) is completely inoperative, refer to **Diagnostic System Check - Instrument Cluster** in Instrument Panel, Gauges and Console. 2. Command the MIL ON and OFF with a scan tool. Does the MIL turn ON and OFF when commanded with a scan tool?	-	Go to **Intermittent Conditions**	Go to **Step 3**
3	Inspect the fuse that supplies voltage to the MIL. Is the fuse open?	-	Go to **Step 10**	Go to **Step 4**
	1. Turn OFF the ignition. 2. Remove the fuse that supplies voltage to the MIL.			

4	3. Disconnect the powertrain control module (PCM). 4. Turn ON the ignition with the engine OFF. 5. Measure the voltage from the MIL control circuit in the PCM harness connector to a good ground. Is the voltage less than the specified value?	0.3 V	Go to **Step 5**	Go to **Step 11**
5	1. Turn OFF the ignition. 2. Install the fuse that supplies voltage to the MIL. 3. Turn ON the ignition with the engine OFF. 4. Connect a 3-amp fused jumper wire between the MIL control circuit in the PCM harness connector and a good ground. Is the MIL illuminated?	-	Go to **Step 9**	Go to **Step 6**
6	1. Turn OFF the ignition. 2. Remove the instrument panel cluster (IPC). Refer to **Instrument Panel Cluster (IPC) Replacement** in Instrument Panel, Gauges, and Console. 3. Turn ON the ignition, with the engine OFF. 4. Probe the MIL voltage supply circuit of the IPC harness connector with a test lamp that is connected to a good ground. Does the test lamp illuminate?	-	Go to **Step 7**	Go to **Step 12**
7	Test the MIL control circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct a condition?	-	Go to **Step 15**	Go to **Step 8**
8	Test for an intermittent and for a poor connection at the IPC. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 13**
9	Test for an intermittent and for a poor connection at the PCM. Refer to Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 14**
	Repair the short to ground in the voltage supply			

10	circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 15**	-
11	Repair the short to voltage in the MIL control circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 15**	-
12	Repair the open in the MIL voltage supply circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 15**	-
13	Replace the IPC. Refer to **Instrument Panel Cluster (IPC) Replacement** in Instrument Panel, Gauges, and Console. Did you complete the replacement?	-	Go to **Step 15**	-
14	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
15	1. Turn OFF the ignition for 30 seconds. 2. Start the engine. 3. Observe the MIL. Does the MIL operate correctly?	-	Go to **Step 16**	Go to **Step 2**
16	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

MALFUNCTION INDICATOR LAMP (MIL) ALWAYS ON

Circuit Description

Voltage is supplied directly to the malfunction indicator lamp (MIL). The powertrain control module (PCM) turns the MIL ON by grounding the MIL control circuit.

MIL Operation

The MIL is located on the instrument panel (IPC).

MIL Function

- The MIL informs the driver that a malfunction has occurred and the vehicle should be taken in for service as soon as possible.
- The MIL illuminates during a bulb test and a system test.
- A DTC will be stored if a MIL is requested by the diagnostic.

MIL Illumination

- The MIL will illuminate with ignition switch ON and the engine not running.
- The MIL will turn OFF when the engine is started.
- The MIL will remain ON if the self-diagnostic system has detected a malfunction.
- The MIL may turn OFF if the malfunction is not present.
- If the MIL is illuminated and then the engine stalls, the MIL will remain illuminated so long as the ignition switch is ON.
- If the MIL is not illuminated and the engine stalls, the MIL will not illuminate until the ignition switch is cycled OFF, then ON.

Diagnostic Aids

If the problem is intermittent, refer to **Intermittent Conditions** .

Test Description

The number below refers to the step number on the diagnostic table.

2: This step determines if the condition is with the MIL control circuit or the PCM.

Malfunction Indicator Lamp (MIL) Always On

Step	Action	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Component Views or Powertrain Control Module (PCM) Connector End Views**			
1	Did you perform the Diagnostic System Check - Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn OFF the ignition. 2. Disconnect the PCM. 3. Turn ON the ignition, with the engine OFF. 4. Observe the MIL. Is the MIL illuminated?	Go to **Step 3**	Go to **Step 5**
3	1. Remove the instrument panel cluster (IPC). Refer to **Instrument Panel Cluster (IPC) Replacement** in Instrument Panel, Gauges, and Console. 2. Test the MIL control circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 6**	Go to **Step 4**
	Replace the IPC. Refer to **Instrument Panel Cluster**		

4	**(IPC) Replacement** in Instrument Panel, Gauges, and Console. Did you complete the replacement?	Go to **Step 6**	-
5	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	Go to **Step 6**	-
6	1. Turn the ignition OFF for 30 seconds. 2. Start the engine. 3. Observe the MIL. Does the MIL operate correctly?	Go to **Step 7**	Go to **Step 2**
7	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

ENGINE CRANKS BUT DOES NOT RUN

Description

The Engine Cranks but Does Not Run diagnostic table is an organized approach to identifying a condition that causes an engine to not start. The diagnostic table directs the service technician to the appropriate system diagnosis. The diagnostic table assumes the following conditions are met:

- The battery is completely charged. Refer to **Battery Inspection/Test (Non-HP2)** in Engine Electrical.
- The engine cranking speed is acceptable. Refer to **Engine Cranks Slowly** in Engine Electrical.
- There is adequate fuel in the fuel tank.

Engine Cranks but Does Not Run

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Crank the engine for the specified amount of time. Does the scan tool display any DTCs that failed this ignition?	15 seconds	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**
3	Does the scan tool display any body control module (BCM) vehicle theft deterrent (VTD) DTCs?	-	Go to **Diagnostic System Check -**	

			Theft Deterrent in Theft Deterrent	Go to **Step 4**
4	1. Turn ON the ignition, with the engine OFF. 2. Probe both sides of the powertrain control module (PCM) 1 fuse located in the underhood electrical center with a test lamp connected to a good ground. Does the test lamp illuminate on at least one side of the fuse?	-	Go to **Step 5**	Go to **Ignition Relay Diagnosis**
5	Monitor the ignition 1 signal parameter with a scan tool. Is the ignition 1 signal parameter at the specified value?	B+	Go to **Step 6**	Go to **Step 10**
6	Command the fuel pump ON with a scan tool. Does the fuel pump operate?	-	Go to **Step 7**	Go to **Fuel Pump Electrical Circuit Diagnosis**
7	1. Turn OFF the ignition. 2. Disconnect a spark plug wire. 3. Install the **J 26792** Spark Tester. 4. Attempt to start the engine. 5. Repeat test for remaining cylinders. Does the spark tester spark for all cylinders?	-	Go to **Step 8**	Go to **Electronic Ignition (EI) System Diagnosis**
8	1. Turn OFF the ignition. 2. Install a fuel pressure gauge. Refer to **Fuel System Diagnosis** . **IMPORTANT:** **The fuel pump operates for about 2 seconds when the ignition is turned ON. The fuel pressure must be observed when the fuel pump is operating.** 3. Turn ON the ignition, with the engine OFF. 4. Observe the fuel pressure while the fuel pump is operating. Is the fuel pressure within the specified range?	VIN V, T, U Gasoline: 385-425 kPa (55-62 psi) VIN Z Ethanol: 335-375 kPa (48-54 psi)	Go to **Step 9**	Go to **Fuel System Diagnosis**
	Inspect for the following conditions:			

9	• The engine coolant temperature (ECT) sensor is not close to the actual engine temperature. Refer to **DTC P0125** . • The duct work between the mass air flow (MAF) sensor and the throttle body for air leaks • A restricted exhaust system-Refer to **Restricted Exhaust** in Engine Exhaust. • A malfunctioning MAF sensor may cause a no start or a stall after a start. If you suspect this, disconnect the MAF sensor. The PCM will default to the speed density in order to calculate the engine load and the intake air flow. If disconnecting the MAF sensor corrects the condition and the connections are OK. Refer to **DTC P0102** . • The spark plugs for being gas fouled-Refer to **Spark Plug Inspection** . • An engine mechanical failure that causes an engine not to start such as timing chain, low compression-Refer to **Engine Compression Test** and **Symptoms - Engine Mechanical** in Engine Mechanical - 4.8L, 5.3L, and 6.0L. • Compare the MAP/BARO parameters to another vehicle. The parameter values should be close to each other. Did you complete the action?	-	Go to **Step 13**	-
10	1. Test the ignition 1 voltage circuits that are supplied by the PCM 1 fuse for an open or for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. 2. Replace the fuse if necessary. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 11**
11	Inspect for poor connections at the harness connector of the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 12**
12	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** .	-		

	Did you complete the replacement?		Go to **Step 13**	-
13	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Attempt to start the engine. Does the engine start the continue to run?	-	Go to **Step 14**	Go to **Step 2**
14	1. Allow the engine to reach operating temperature. 2. Observe the DTC information with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

IGNITION RELAY DIAGNOSIS

Circuit Description

The ignition relay is a normally open relay. The relay armature is held in the open position by spring tension. When the ignition switch is turned to the run or start position, current will flow through the relay coil. A wire connected to the other end of the relay coil completes the path to ground. The electromagnetic field created by the relay coil, overcomes the spring tension and moves the armature allowing the relay contacts to close. The closed relay contacts allow current to flow from the battery to the following fuses:

- PCM 1
- ETC/ECM
- INJ 1
- INJ 2
- SBA, if equipped.

When the ignition switch is turned to the OFF position, the electromagnetic field collapses. This action allows the spring tension to move the armature away from the relay contacts, which interrupts current flow to the fuses.

If the ignition relay fails to close, the engine will crank, but will not run. The class 2 communications will be available with the use of a scan tool.

The ignition relay table assumes that the vehicle battery is fully charged. Refer to **Battery Inspection/Test (Non-HP2)** in Engine Electrical.

Ignition Relay Diagnosis

Step	Action	Yes	No
Schematic Reference: Power Distribution Schematics and Ground Distribution Schematics in Wiring Systems and Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Powertrain Control**			

Module (PCM) Connector End Views

<table>
<tr><td>1</td><td>Did you perform the Diagnostic System Check - Engine Controls?</td><td>Go to Step 2</td><td>Go to Diagnostic System Check - Engine Controls</td></tr>
<tr><td>2</td><td>Turn ON the ignition, with the engine OFF.
Remove the underhood junction block cover.
Probe the following fuses with a test lamp that is connected to a good ground:
PCM 1
ETC/ECM
INJ 1
INJ 2
SBA, if equipped.
Refer to Probing Electrical Connectors and Troubleshooting with a Test Lamp in Wiring Systems.
Does the test lamp illuminate on at least one test point of each fuse?</td><td>Go to Step 3</td><td>Go to Step 10</td></tr>
<tr><td>3</td><td>Turn OFF the ignition.
Probe both test points of the PCM 1 fuse with a test lamp that is connected to a good ground. Refer to Probing Electrical Connectors and Troubleshooting with a Test Lamp in Wiring Systems.
Does the test lamp illuminate on either test point of the fuse?</td><td>Go to Step 4</td><td>Go to Step 30</td></tr>
<tr><td>4</td><td>Turn OFF the ignition.
Remove the ignition relay from the underhood junction block with the J 43244 Relay Puller Pliers. Refer to Relay Replacement (Within an Electrical Center) or Relay Replacement (Attached to Wire Harness) in Wiring Systems.

NOTE:
Refer to Test Probe Notice in Cautions and Notices.
Probe the ignition 1 voltage circuit of the ignition relay at the underhood junction block with a test lamp that is connected to a good ground. Refer to</td><td></td><td></td></tr>
</table>

	Probing Electrical Connectors and **Troubleshooting with a Test Lamp** in Wiring Systems. Does the test lamp illuminate?	Go to **Step 7**	Go to **Step 5**
5	Test the relay load bus bar of the underhood junction block between the ignition relay and the fuses to the circuit components for a short to battery positive voltage. Refer to **Circuit Testing** in Wiring Systems. Did you find a condition?	Go to **Step 29**	Go to **Step 6**
6	1. Turn OFF the ignition. 2. Remove the following fuses from the underhood junction block: • PCM 1 • ETC/ECM • INJ 1 • INJ 2 • SBA, if equipped. 3. Probe the above fuse terminals in the underhood junction block with a test lamp that is connected to a good ground. Refer to **Probing Electrical Connectors** and **Troubleshooting with a Test Lamp** in Wiring Systems. Does the test lamp illuminate at any of the fuse terminals?	Go to **Diagnostic System Check - Engine Electrical** in Engine Electrical	Go to **Step 27**
7	1. Turn OFF the ignition. 2. Disconnect the negative battery cable at the battery. Refer to **Battery Negative Cable Disconnect/Connect Procedure (Single Battery)** in Engine Electrical. 3. Disconnect the underhood junction block electrical connector that contains the ignition 1 voltage circuit for the ignition relay. 4. Disconnect the ignition switch electrical connector that contains the ignition 1 voltage circuit for the ignition relay. 5. Connect the negative battery cable to the battery. 6. Test the ignition 1 voltage circuit for a short to battery positive voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 30**	Go to **Step 8**

8	1. Turn OFF the ignition. 2. Probe the ignition 1 voltage terminal on the ignition switch side of the ignition switch electrical connector with a test lamp that is connected to a good ground. Refer to **Probing Electrical Connectors** and **Troubleshooting with a Test Lamp** in Wiring Systems. Does the test lamp illuminate?	Go to **Step 28**	Go to **Step 9**
9	Test the ignition 1 voltage bus bar circuit in the underhood junction block for a short to battery positive voltage. Refer to **Circuit Testing** in Wiring Systems. Did you find a condition?	Go to **Step 29**	Go to **Step 27**
10	1. Turn OFF the ignition. 2. Inspect the 40-amp IGN B fuse in the underhood junction block. Refer to **Circuit Protection - Fuses** in Wiring Systems. Is the fuse open?	Go to **Step 11**	Go to **Step 18**
11	1. Remove the 40-amp IGN B fuse from the underhood junction block. **NOTE:** **Refer to Test Probe Notice in Cautions and Notices.** 2. Probe both fuse terminals in the underhood junction block with a test lamp that is connected to a good ground. Refer to **Probing Electrical Connectors** and **Troubleshooting with a Test Lamp** in Wiring Systems. Does the test lamp illuminate on at least one fuse terminal?	Go to **Step 12**	Go to **Step 17**
12	Test the ignition 1 voltage circuit between the ignition switch and the underhood junction block for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 30**	Go to **Step 13**
13	Test the ignition switch assembly for a short to ground. Refer to **Circuit Testing** in Wiring Systems. Did you find a condition?	Go to **Step 28**	Go to **Step 14**
14	Test the battery positive voltage circuit between the underhood junction block and the ignition switch for a short to ground. Refer to **Circuit Testing** and **Wiring**		

	Repairs in Wiring Systems. Did you find and correct the condition?	Go to **Step 30**	Go to **Step 15**
15	Test the battery positive voltage bus bar circuit of the underhood junction block between the 40-amp IGN B fuse and the ignition switch for a short to ground. Did you find a condition?	Go to **Step 29**	Go to **Step 16**
16	Test the ignition 1 voltage bus bar circuit of the underhood junction block that contains the ignition relay for a short to ground. Did you find a condition?	Go to **Step 29**	Go to **Step 27**
17	1. Turn OFF the ignition. 2. Probe the mounting stud for the battery positive cable at the underhood junction block with a test lamp that is connected to a good ground. Refer to **Probing Electrical Connectors** and **Troubleshooting with a Test Lamp** in Wiring Systems. Does the test lamp illuminate?	Go to **Step 29**	Go to **Diagnostic System Check - Engine Electrical** in Engine Electrical
18	1. Turn OFF the ignition. 2. Remove the ignition relay with the **J 43244** from the underhood junction block. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** in Wiring Systems. **NOTE:** **Refer to Test Probe Notice in Cautions and Notices.** 3. Probe the battery positive voltage circuit of the ignition relay at the underhood junction block with a test lamp that is connected to a good ground. Refer to **Probing Electrical Connectors** and **Troubleshooting with a Test Lamp** in Wiring Systems. Does the test lamp illuminate?	Go to **Step 19**	Go to **Step 29**
19	1. Turn ON the ignition, with the engine OFF. 2. Probe the ignition 1 voltage circuit of the ignition relay at the underhood junction block with a test lamp that is connected to a good ground. Refer to **Probing Electrical Connectors** and **Troubleshooting with a Test Lamp** in Wiring Systems.		

	Does the test lamp illuminate?	Go to **Step 23**	Go to **Step 20**
20	1. Turn OFF the ignition. 2. Test the ignition 1 voltage circuit between the ignition switch and the underhood junction block for a high resistance or for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 30**	Go to **Step 21**
21	Test the ignition switch assembly for a high resistance or for an open. Refer to **Circuit Testing** in Wiring Systems. Did you find a condition?	Go to **Step 28**	Go to **Step 22**
22	Test the battery positive voltage circuit between the ignition switch and the underhood junction block for a high resistance or for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 30**	Go to **Step 29**
23	1. Turn ON the ignition, with the engine OFF. 2. Probe the coil ground circuit of the ignition relay at the underhood junction block with a test lamp that is connected to battery voltage. Refer to **Probing Electrical Connectors** and **Troubleshooting with a Test Lamp** in Wiring Systems. Does the test lamp illuminate?	Go to **Step 25**	Go to **Step 24**
24	1. Turn OFF the ignition. 2. Disconnect the negative battery cable at the battery. Refer to **Battery Negative Cable Disconnect/Connect Procedure (Single Battery)** in Engine Electrical. 3. Disconnect the underhood junction block electrical connectors. 4. Test the coil ground circuit of the ignition relay at the underhood junction block electrical connector for a high resistance or for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 30**	Go to **Step 29**
	1. Turn OFF the ignition. 2. Jumper the ignition relay battery positive voltage circuit and the ignition relay load circuit together at the underhood junction block with a 20-amp fused jumper wire. Refer to **Using Fused Jumper Wires** in Wiring Systems.		

25	3. Probe the following fuses with a test lamp that is connected to a good ground: • PCM 1 • ETC/ECM • INJ 1 • INJ 2 • SBA, if equipped. Refer to **Probing Electrical Connectors** and **Troubleshooting with a Test Lamp** in Wiring Systems. Does the test lamp illuminate on at least one test point of each fuse?	Go to **Step 26**	Go to **Step 29**
26	Test for an intermittent and for a poor connection at the underhood junction block, ignition relay connector location. Refer to **Testing for Intermittent Conditions and Poor Connections** in Wiring Systems. Did you find a condition?	Go to **Step 29**	Go to **Step 27**
27	Replace the ignition relay. Refer to **Relay Replacement (Within an Electrical Center)** or **Relay Replacement (Attached to Wire Harness)** in Wiring Systems. Did you complete the replacement?	Go to **Step 30**	-
28	Replace the ignition switch. Refer to **Ignition Switch Replacement** in Steering Wheel and Column. Did you complete the replacement?	Go to **Step 30**	-
29	Replace the underhood electrical center. Refer to **Underhood Electrical Center or Junction Block Replacement** in Wiring Systems. Did you complete the replacement?	Go to **Step 30**	-
30	1. Replace any open fuses. 2. Turn OFF the ignition for 30 seconds. 3. Attempt to start the engine. Does the engine start and run?	Go to **Step 31**	Go to **Engine Cranks but Does Not Run**
31	1. Clear the DTCs with a scan tool. 2. Operate the vehicle for 5 minutes. Does a DTC set during this ignition cycle?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

FUEL PUMP ELECTRICAL CIRCUIT DIAGNOSIS

Circuit Description

The control module enables the fuel pump relay when the ignition switch is turned ON. The control module will disable the fuel pump relay within two seconds unless the control module detects ignition reference pulses. The control module continues to enable the fuel pump relay as long as ignition reference pulses are detected. The control module disables the fuel pump relay within two seconds if ignition reference pulses cease to be detected and the ignition remains ON.

Diagnostic Aids

A fuel pump prime terminal is located at the underhood bussed electrical center (UBEC). Refer to the UBEC cover for terminal location.

The following conditions may have caused the fuel pump fuse to open:

- A faulty fuse
- An intermittent short in the fuel pump power supply circuit
- An intermittent internal component failure

For an intermittent condition, refer to **Intermittent Conditions** .

Test Description

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

> **3:** This step determines if the condition is located on the coil side or on the switch side of the fuel pump relay.
>
> **4:** This step verifies that the powertrain control module (PCM) is providing voltage to the fuel pump relay.
>
> **5:** This step tests for an open in the ground circuit to the fuel pump relay.
>
> **6:** This step determines if a voltage is constantly being applied to the fuel pump relay.
>
> **13:** This step determines if the condition with the circuit is intermittent.

Fuel Pump Electrical Circuit Diagnosis

Step	Action	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views**			
1	Did you perform the Diagnostic System Check - Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Command the fuel pump relay ON and OFF with a scan tool. Does the fuel pump turn ON and OFF when commanded with a	Go to Diagnostic	

	scan tool?	Aids	Go to **Step 3**
3	Command the fuel pump relay ON and OFF with a scan tool. Does the fuel pump relay turn ON and OFF when commanded with a scan tool?	Go to **Step 9**	Go to **Step 4**
4	1. Turn OFF the ignition. 2. Remove the fuel pump relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the control circuit of the fuel pump relay with a test lamp that is connected to a good ground. Refer to **Probing Electrical Connectors** in Wiring Systems. 5. Command the fuel pump relay ON and OFF with a scan tool. Does the test lamp turn ON and OFF when commanded with a scan tool?	Go to **Step 5**	Go to **Step 6**
5	1. Connect a test lamp between the control circuit of the fuel pump relay and the ground circuit of the fuel pump relay. 2. Command the fuel pump relay ON and OFF with a scan tool. Does the test lamp turn ON and OFF when commanded with a scan tool?	Go to **Step 19**	Go to **Step 22**
6	Does the test lamp remain illuminated?	Go to **Step 7**	Go to **Step 8**
7	Test the control circuit of the fuel pump relay for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 28**	Go to **Step 27**
8	Test the control circuit of the fuel pump relay for a short to ground or for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 28**	Go to **Step 20**
9	Turn ON the ignition, with the engine OFF. Does the fuel pump operate continuously?	Go to **Step 10**	Go to **Step 11**
10	1. Turn OFF the ignition. 2. Remove the fuel pump relay. 3. Turn ON the ignition, with the engine OFF. Does the fuel pump operate continuously?	Go to **Step 21**	Go to **Step 26**
11	Inspect the fuel pump fuse. Is the fuel pump fuse open?	Go to **Step 12**	Go to **Step 14**
	1. Test the supply voltage circuit of the fuel pump, between		

12	the fuel pump fuse and the fuel pump for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. 2. Replace the fuel pump fuse if necessary. Did you find and correct the condition?	Go to **Step 28**	Go to **Step 13**
13	1. Install all removed electrical components. 2. Install a new fuel pump fuse. 3. Command the fuel pump relay ON with a scan tool. 4. Inspect the fuel pump fuse. Is the fuel pump fuse open?	Go to **Step 24**	Go to **Intermittent Conditions**
14	1. Turn OFF the ignition. 2. Remove the fuel pump relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the battery voltage circuit of the fuel pump relay switch with a test lamp that is connected to a good ground. Does the test lamp illuminate?	Go to **Step 15**	Go to **Step 23**
15	Connect a 20-amp fused jumper wire between the battery voltage circuit of the fuel pump relay switch and the supply voltage circuit of the fuel pump. Does the fuel pump operate?	Go to **Step 19**	Go to **Step 16**
16	Test the supply voltage circuit of the fuel pump, between the fuel pump relay and the fuel pump for an open or for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 28**	Go to **Step 17**
17	**IMPORTANT:** **Inspect the ground circuit for being tight, corrosion on terminals, or damage to the wiring harness.** Test the ground circuit of the fuel pump for an open or for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct the condition?	Go to **Step 28**	Go to **Step 18**
18	Test for an intermittent or for a poor connection at the fuel pump sender assembly connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 28**	Go to **Step 24**
19	Test for an intermittent or for a poor connection at the fuel pump relay. Refer to **Testing for Intermittent Conditions and**		

	Poor Connections and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 28**	Go to **Step 26**
20	Test for an intermittent and for a poor connection at the harness connector of the powertrain control module (PCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 28**	Go to **Step 27**
21	Repair the short to voltage in the supply voltage circuit of the fuel pump. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 28**	-
22	Repair the open in the fuel pump relay ground circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 28**	-
23	Repair the open in the battery voltage circuit of the fuel pump relay. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 28**	-
24	Test for an intermittent and for a poor connection at the fuel pump sender assembly connector within the fuel tank. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the conditions?	Go to **Step 28**	Go to **Step 25**
25	1. Replace the fuel pump sender assembly. Refer to **Fuel Sender Assembly Replacement** . 2. Replace the fuel pump fuse if necessary. Did you complete the replacement?	Go to **Step 28**	-
26	Replace the fuel pump relay. Did you complete the replacement?	Go to **Step 28**	-
27	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	Go to **Step 28**	-
28	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

FUEL SYSTEM DIAGNOSIS

System Description

The control module enables the fuel pump relay when the ignition switch is turned ON. The control module will disable the fuel pump relay within two seconds unless the control module detects ignition reference pulses. The control module continues to enable the fuel pump relay as long as ignition reference pulses are detected. The control module disables the fuel pump relay within two seconds if ignition reference pulses cease to be detected and the ignition remains ON.

The Fuel System is a returnless on-demand design. The fuel pressure regulator is a part of the fuel sender assembly, eliminating the need for a return pipe from the engine. A returnless fuel system reduces the internal temperature of the fuel tank by not returning hot fuel from the engine to the fuel tank. Reducing the internal temperature of the fuel tank results in lower evaporative emissions.

The fuel tank stores the fuel supply. An electric turbine style fuel pump attaches to the fuel sender assembly inside the fuel tank. The fuel pump supplies high pressure fuel through the fuel filter and the fuel feed pipe to the fuel injection system. The fuel pump provides fuel at a higher rate of flow than is needed by the fuel injection system. The fuel pump also supplies fuel to a venturi pump located on the bottom of the fuel sender assembly. The function of the venturi pump is to fill the fuel sender assembly reservoir. The fuel pressure regulator, a part of the fuel sender assembly, maintains the correct fuel pressure to the fuel injection system. The fuel pump and sender assembly contains a reverse flow check valve. The check valve and the fuel pressure regulator maintain fuel pressure in the fuel feed pipe and the fuel rail in order to prevent long cranking times.

Fuel System Diagnosis

Step	Action	Values	Yes	No
Schematic Reference: Fuel Hose/Pipes Routing Diagram (Single Fuel Tank)				
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **Inspect the fuel system for external leaks before proceeding with this diagnostic.** 1. Turn ON the ignition, with the engine OFF. 2. Command the fuel pump relay ON with a scan tool. Does the fuel pump operate?	-	Go to **Step 3**	Go to **Fuel Pump Electrical Circuit Diagnosis**
3	**IMPORTANT:** **Verify that adequate fuel is in the fuel tank before proceeding with this diagnostic.** 1. Turn OFF the ignition. 2. Turn OFF all accessories. **CAUTION:** **Wrap a shop towel around the fuel pressure connection in order to reduce the risk of fire and personal injury. The towel will absorb any fuel leakage that occurs during the connection of the fuel pressure gauge. Place the towel in an approved container when the connection of the fuel pressure gauge is complete.** 3. Install a fuel pressure gauge. Refer to **Fuel Pressure**	385-425 kPa (55-62 psi) VIN Z :		

	Gauge Installation and Removal . 4. Turn ON the ignition, with the engine OFF. **IMPORTANT:** • **The fuel pump relay may need to be commanded ON a few times in order to obtain the highest possible fuel pressure.** • **DO NOT start the engine.** 5. Command the fuel pump relay ON with a scan tool. 6. Observe the fuel pressure gauge with the fuel pump commanded ON. Is the fuel pressure within the specified range?	335-375 kPa (48-54 psi)	Go to **Step 4**	Go to **Step 8**
4	**IMPORTANT:** **The fuel pressure may vary slightly when the fuel pump stops operating. After the fuel pump stops operating, the fuel pressure should stabilize and remain constant.** Monitor the fuel pressure gauge for 1 minute.Does the fuel pressure decrease by more than the specified value?	34 kPa (5 psi)	Go to **Step 7**	Go to **Step 5**
5	1. Relieve the fuel pressure to the first specified value. 2. Monitor the fuel pressure gauge for 5 minutes. Does the fuel pressure decrease by more than the second specified value?	69 kPa (10 psi) 14 kPa (2 psi)	Go to **Step 12**	Go to **Step 6**
6	1. Operate the vehicle within the conditions to reproduce the original symptoms. 2. Monitor the O2 and the Fuel Trim parameters with a scan tool. Does the scan tool parameters indicate a lean condition?	-	Go to **Step 9**	Go to **Symptoms - Engine Controls**
7	1. Turn OFF the ignition. 2. Relieve the fuel pressure. Refer to **Fuel Pressure Relief Procedure** . 3. Disconnect the chassis fuel hose from the engine compartment fuel pipe. Refer to **Quick Connect Fitting (s) Service (Metal Collar)** . 4. Install the **J 37287** Fuel Line Shut-off Adapter between the chassis fuel hose and the engine compartment fuel pipe. 5. Open the valve on the fuel pipe shut-off adapter.	-		

	6. Turn ON the ignition, with the engine OFF. 7. Command the fuel pump relay ON with a scan tool. 8. Bleed the air from the fuel pressure gauge. 9. Command the fuel pump relay ON and then OFF with a scan tool. 10. Close the fuel feed pipe shut-off valve. 11. Monitor the fuel pressure gauge for 1 minute. Does the fuel pressure remain constant?		Go to **Step 12**	Go to **Step 11**
8	Is the fuel pressure more than the specified value?	427 kPa (62 psi) VIN Z: 375 kPa (54 psi)	Go to **Step 12**	Go to **Step 9**
9	Inspect the fuel feed pipe for a restriction. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 10**
10	Inspect the harness connectors and the ground circuits of the fuel pump for poor connections. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 12**
11	1. Turn OFF the ignition. 2. Raise the fuel rail, with the fuel lines connected. Refer to **Fuel Rail Assembly Replacement** . 3. Turn ON the ignition, with the engine OFF. 4. Command the fuel pump relay ON with a scan tool. 5. Replace any leaking fuel injectors. Refer to **Fuel Injector Replacement** . Did you complete the replacement?	-	Go to **Step 13**	-
12	Replace the fuel sender. Refer to **Fuel Sender Assembly Replacement** . Did you complete the replacement?	-	Go to **Step 13**	-
13	Operate the system in order to verify the repair. Did you correct the condition?	-	System OK	Go to **Step 3**

FUEL INJECTOR COIL TEST

Circuit Description

The control module enables the appropriate fuel injector pulse for each cylinder. Ignition voltage is supplied directly to the fuel injectors. The control module controls each fuel injector by grounding the control circuit via a solid state device called a driver. A fuel injector coil winding resistance that is too high or too low will affect engine driveability. A fuel injector control circuit DTC may not set, but a misfire may be apparent. The fuel injector coil windings are affected by temperature. The resistance of the fuel injector coil windings will increase as the temperature of the fuel injector increases.

Diagnostic Aids

- The use of Dielectric compound GM P/N 12377900 (Canadian P/N 10953529) in the fuel injector electrical connector may eliminate a corrosion condition.
- Monitoring the misfire current counters, or misfire graph, may help isolate the fuel injector that is causing the condition.
- Operating the vehicle over a wide temperature range may help isolate the fuel injector that is causing the condition.
- Perform the fuel injector coil test within the conditions of the customers concern. A fuel injector condition may only be apparent at a certain temperature, or under certain conditions.
- If the fuel injector coil test does not isolate the condition perform the fuel injector balance test. Refer to **Fuel Injector Balance Test with Special Tool** or **Fuel Injector Balance Test with Tech 2** .

Fuel Injector Coil Test

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Observe the ECT sensor parameter with a scan tool. Is the ECT sensor parameter within the specified range?	10-32°C (50-90° F)	Go to **Step 3**	Go to **Step 4**
3	Measure the resistance of each fuel injector with a DMM. Refer to **Testing for Continuity** in Wiring Systems. Do any of the fuel injectors display a resistance outside the specified range?	11-14 ohm	Go to **Step 6**	Go to Diagnostic Aids
4	1. Measure the resistance of each fuel injector with a DMM. Refer to **Testing for Continuity** in Wiring Systems. 2. Record each fuel injector value. 3. Subtract the lowest resistance value from the highest resistance value. Is the difference equal to, or less than, the specified value?	3 ohm	Go to **Fuel Injector Balance Test with Special Tool** or **Fuel Injector Balance Test with Tech 2**	Go to **Step 5**

5	1. Add all of the fuel injector resistance values, to obtain a total resistance value. 2. Divide the total resistance value by the number of fuel injectors, to obtain an average resistance value. 3. Subtract the lowest individual fuel injector resistance value from the average resistance value. 4. Compute the difference between the highest individual fuel injector resistance value and the average resistance value. 5. Replace the fuel injector that displays the greatest resistance difference, above or below the average. Refer to **Fuel Injector Replacement** . Did you complete the replacement?	-	Go to **Step 7**	-
6	Replace the fuel injector or fuel injectors that are out of the specified range. Refer to **Fuel Injector Replacement** . Did you complete the replacement?	11-14 ohm	Go to **Step 7**	-
7	Operate the system in order to verify the repair. Did you correct the condition?	-	System OK	Go to **Step 2**

FUEL INJECTOR BALANCE TEST WITH SPECIAL TOOL

Description

The scan tool is first used to energize the fuel pump. The fuel injector tester is then used to pulse each injector for a precise amount of time, allowing a measured amount of fuel into the manifold. This causes a drop in system fuel pressure that can be recorded and used to compare each injector.

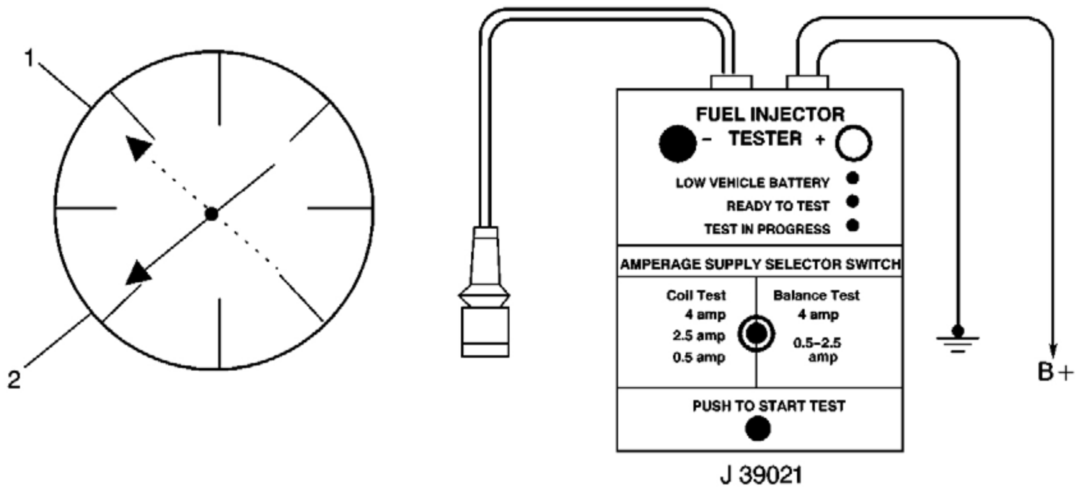

Fig. 1: Fuel Injector Balance Test & Special Tool
Courtesy of GENERAL MOTORS CORP.

Callouts For Fig. 27

Callout	Component Name
1	First Fuel Pressure Gauge Reading
2	Second Fuel Pressure Gauge Reading

Fuel Injector Balance Test Example (Typical)

Cylinder	1	2	3	4
1st Reading	296 kPa (43 psi)	296 kPa (43 psi)	296 kPa (43 psi)	296 kPa (43 psi)
2nd Reading	131 kPa (19 psi)	117 kPa (17 psi)	124 kPa (18 psi)	145 kPa (21 psi)
Amount of Drop	165 kPa (24 psi)	179 kPa (26 psi)	172 kPa (25 psi)	151 kPa (22 psi)
Average Range: 156-176 kPa (22.5-25.5 psi)	Injector OK	Replace fuel injector - too much fuel pressure drop	Injector OK	Replace fuel injector - too little fuel pressure drop

Test Description

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

> **6:** If the pressure drop value for each fuel injector is within 10 kPa (1.5 psi) of the average pressure drop value, the fuel injectors are flowing properly. Calculate the pressure drop value for each fuel injector by subtracting the second pressure reading from the first pressure reading. Refer to the illustration above.

Fuel Injector Balance Test with Special Tool

<table>
<tr><th>Step</th><th>Action</th><th>Values</th><th>Yes</th><th>No</th></tr>
<tr><td colspan="5">Schematic Reference: <u>Engine Controls Schematics</u>
Connector End View Reference: <u>Engine Controls Connector End Views</u> or <u>Powertrain Control Module (PCM) Connector End Views</u></td></tr>
<tr><td>1</td><td>Did you perform the Diagnostic System Check - Engine Controls?</td><td>-</td><td>Go to Step 2</td><td>Go to <u>Diagnostic System Check - Engine Controls</u></td></tr>
<tr><td>2</td><td>Did you perform the Fuel Injector Coil Test?</td><td>-</td><td>Go to Step 3</td><td>Go to <u>Fuel Injector Coil Test</u></td></tr>
<tr><td>3</td><td>IMPORTANT:
Do not perform this test if the engine coolant temperature (ECT) is above 94°C (201°F).

Observe the ECT Sensor parameter with a scan tool.Is the ECT Sensor parameter less than the specified value?</td><td>94°C (201°F)</td><td>Go to Step 4</td><td>-</td></tr>
<tr><td>4</td><td>IMPORTANT:
Verify there is adequate fuel in the fuel tank before proceeding with this diagnostic.

1. Turn OFF the ignition.
2. Install the fuel pressure gauge. Refer to <u>Fuel Pressure Gauge Installation and Removal</u> .
3. Turn ON the ignition, with the engine OFF.
4. Command the fuel pump ON with a scan tool.

IMPORTANT:
• You may need to command the fuel pump ON a few times, in order to obtain the highest possible fuel pressure.
• Do not start the engine.

5. Observe the fuel pressure gauge, with the fuel pump commanded ON.

Is the fuel pressure within the specified range?</td><td>385-425 kPa (55-62 psi) VIN: (V, T, U) Gasoline 335-375 kPa (48-54 psi) VIN Z Ethanol</td><td>Go to Step 5</td><td>Go to <u>Fuel System Diagnosis</u></td></tr>
<tr><td></td><td>IMPORTANT:
The fuel pressure may vary slightly when the</td><td></td><td></td><td></td></tr>
</table>

5	**fuel pump stops operating. After the fuel pump stops operating, the fuel pressure should stabilize and remain constant.** Monitor the fuel pressure gauge for 1 minute.Does the fuel pressure drop more than the specified value?	34 kPa (5 psi)	Go to **Fuel System Diagnosis**	Go to **Step 6**
6	**NOTE:** **Do Not repeat any portion of this test before running the engine in order to prevent the engine from flooding.** **IMPORTANT:** **Refer to the illustration in the supporting text when performing the following steps.** 1. Connect the **J 39021** Fuel Injector Coil and Balance Tester and the **J 39021-380** Fuel Injector Test Harness to a fuel injector. 2. Set the amperage supply selector switch on the fuel injector tester to the Balance Test 0.5-2.5 amp position. 3. Command the fuel pump ON and OFF with a scan tool. **IMPORTANT:** **Record the fuel pressure value immediately after the fuel injector stops pulsing. The fuel pressure may rise after the fuel injector stops pulsing. Do not record the higher fuel pressure value.** 4. Record the fuel pressure indicated by the fuel pressure gauge after the fuel pressure stabilizes. This is the first pressure reading. 5. Energize the fuel injector by depressing the Push to Start Test button on the fuel injector tester. 6. Record the fuel pressure indicated by the fuel pressure gauge. This is the second fuel pressure reading. 7. Repeat steps 1-6 for each fuel injector. 8. Subtract the second pressure reading from the first pressure reading for one fuel injector. The result is the pressure drop	10 kPa (1.5 psi)		

	value. 9. Obtain a pressure drop value for each fuel injector. 10. Add all of the individual pressure drop values. This is the total pressure drop. 11. Divide the total pressure drop by the number of fuel injectors. This is the average pressure drop. Does any fuel injector have a pressure drop value that is more than the average pressure drop or less than the average pressure drop by the specified value?		Go to **Step 7**	Go to **Symptoms - Engine Controls**
7	Perform the **Fuel Injector Cleaning Procedure** . Did you complete the procedure?	-	Go to **Step 8**	-
8	Operate the vehicle in order to verify the repair. Does a driveability condition still exist?	-	Go to **Symptoms - Engine Controls**	System OK

FUEL INJECTOR BALANCE TEST WITH TECH 2

Description

The scan tool is first used to energize the fuel pump. The scan tool is then used to pulse each injector for a precise amount of time, allowing a measured amount of fuel into the manifold. This causes a drop in system fuel pressure that can be recorded and used to compare the flow through each injector.

Fuel Injector Balance Test Example (Typical)

Cylinder	1	2	3	4
1st Reading	296 kPa (43 psi)	296 kPa (43 psi)	296 kPa (43 psi)	296 kPa (43 psi)
2nd Reading	131 kPa (19 psi)	117 kPa (17 psi)	124 kPa (18 psi)	145 kPa (21 psi)
Amount of Drop	165 kPa (24 psi)	179 kPa (26 psi)	172 kPa (25 psi)	151 kPa (22 psi)
Average Range: 156-176 kPa (22.5-25.5 psi)	Injector OK	Replace fuel injector - too much fuel pressure drop	Injector OK	Replace fuel injector - too little fuel pressure drop

Test Description

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

5: If the pressure drop value for each fuel injector is within 10 kPa (1.5 psi) of the average pressure drop value, the fuel injectors are flowing properly. Calculate the pressure drop value for each fuel injector by subtracting the second pressure reading from the first pressure reading.

Fuel Injector Balance Test with Tech 2

Step	Action	Values	Yes	No
Schematic Reference:Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Did you perform the Fuel Injector Coil Test?	-	Go to **Step 3**	Go to **Fuel Injector Coil Test**
3	**IMPORTANT:** **Do not perform this test if the engine coolant temperature (ECT) is above 94°C (201°F).** **IMPORTANT:** **Verify there is adequate fuel in the fuel tank before proceeding with this diagnostic.** 1. Turn OFF the ignition. 2. Turn OFF all accessories. 3. Install the fuel pressure gauge. Refer to **Fuel Pressure Gauge Installation and Removal** . 4. Turn ON the ignition, with the engine OFF. 5. Command the fuel pump ON with a scan tool. **IMPORTANT:** • **You may need to command the fuel pump ON a few times in order to obtain the highest possible fuel pressure.** • **Do not start the engine.** 6. Observe the fuel pressure gauge, with the fuel pump commanded ON. Is the fuel pressure within the specified value?	385-425 kPa (55-62 psi) VIN: (V, T, U) Gasoline 335-375 kPa (48-54 psi) VIN: Z Ethanol	Go to **Step 4**	Go to **Fuel System Diagnosis**
	IMPORTANT:			

4	**The fuel pressure may vary slightly when the fuel pump stops operating. After the fuel pump stops operating, the fuel pressure should stabilize and remain constant.** Observe the fuel pressure gauge for 1 minute.Does the fuel pressure drop more than the specified value?	34 kPa (5 psi)	Go to **Fuel System Diagnosis**	Go to **Step 5**
5	**NOTE:** **Refer to Fuel Injector Balance Test Notice in Cautions and Notices.** 1. Select the Fuel Injector Balance Test function with a scan tool. 2. Select an injector to be tested. 3. Press Enter. This will prime the fuel system. **IMPORTANT:** **Record the fuel pressure value immediately after the fuel injector stops pulsing. The fuel pressure may rise after the fuel injector stops pulsing. Do not record the higher fuel pressure value.** 4. Record the fuel pressure indicated by the fuel pressure gauge after the fuel pressure stabilizes. This is the 1st pressure reading. 5. Energize the fuel injector by depressing the Pulse Injector button on the scan tool. This will energize the injector and decrease the fuel pressure. 6. Record the fuel pressure indicated by the fuel pressure gauge after the fuel injector has stopped pulsing. This is the 2nd pressure reading. 7. Press Enter again to bring you back to the Select Injector screen. 8. Repeat for each fuel injector. 9. Subtract the 2nd pressure reading from the 1st pressure reading for one fuel injector. The result is the pressure drop value. 10. Obtain a pressure drop value for each fuel injector.	10 kPa (1.5 psi)		

	11. Add all of the individual pressure drop values. This is the total pressure drop. 12. Divide the total pressure drop by the number of fuel injectors. This is the average pressure drop. Does any fuel injector have a pressure drop value that is either higher than the average pressure drop or lower than the average pressure drop by the specified value?		Go to **Step 6**	Go to **Symptoms - Engine Controls**
6	Perform the **Fuel Injector Cleaning Procedure** . Did you complete the procedure?	-	Go to **Step 7**	-
7	Operate the vehicle in order to verify the repair. Does a driveability condition still exist?	-	Go to **Symptoms - Engine Controls**	System OK

FUEL TANK LEAK TEST

Description

The fuel tank leak test is used to locate any fuel or fuel vapor escaping the fuel tank area. Fuel vapors escaping above the fuel level will be detected when the evaporative emission (EVAP) diagnostics complete one test cycle. The malfunction indicator lamp (MIL) will illuminate after the EVAP diagnostics have failed two test cycles.

Diagnostic Aids

- Operate the vehicle under the condition of the customers concern. Under high temperature conditions fuel vapors may increase to the point of EVAP canister vapor saturation. Fuel vapors would then be released into the atmosphere. Once the engine is running and EVAP purge is enabled, all fuel vapor release would be eliminated.
- Movement of the EVAP pipes or fuel pipes may help find an intermittent condition.
- If the fuel level is low, a leak may not be evident.

Test Description

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

4: This step tests for fuel leaks below the fuel tank fuel level.

5: This step tests for fuel vapors escaping above the fuel level in the fuel tank.

Fuel Tank Leak Test

Step	Action	Yes	No
	Did you perform the Diagnostic System Check - Engine Controls?		Go to

1		Go to **Step 2**	**Diagnostic System Check - Engine Controls**
2	**CAUTION:** **Gasoline or gasoline vapors are highly flammable. A fire could occur if an ignition source is present. Never drain or store gasoline or diesel fuel in an open container, due to the possibility of fire or explosion. Have a dry chemical (Class B) fire extinguisher nearby.** 1. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information. 2. Inspect the fuel tank and fuel pipes for damage or external leaks. Did you find fuel leaking from the fuel tank?	Go to **Step 6**	Go to **Step 3**
3	1. Turn ON the ignition, with the engine OFF. 2. Command the fuel pump relay ON with a scan tool. 3. Inspect for fuel leaking from the fuel pipes. Did fuel leak from the fuel pipes?	Go to **Step 7**	Go to **Step 4**
4	1. Turn OFF the ignition. 2. Install the **J 41413-200** Evaporative Emissions System Tester (EEST) and the J 41415-40 Fuel Tank Cap Adaptor or the GE-41415-50 Interrupted Thread Fuel Tank Cap Adapter. 3. Test for a fuel tank leak referring to the J 41413-210 Operation Manual. **IMPORTANT:** **If the floating indicator registers any flow after stabilizing, a leak is evident.** 4. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information. 5. Inspect for a fuel leak while the system is under pressure. Did fuel leak from the fuel tank?	Go to **Step 6**	Go to **Step 5**
	1. Using the **J 41413-200** and the J 41413-210 Operation Manual, introduce smoke into the evaporative emission (EVAP) system. **IMPORTANT:** **It may be necessary to partially lower the fuel tank. Refer to Fuel Tank Replacement .**		

5	2. Inspect for leaks in any of the following locations: • The fuel tank, fill limiter vent valve, pressure relief valve, and the grade vent valves-Refer to **Fuel Tank Replacement** . • The fuel sender housing and the fuel sender seal - Refer to **Fuel Sender Assembly Replacement** . • The fuel tank pressure (FTP) sensor seal - Refer to **Fuel Tank Pressure Sensor Replacement** . • The EVAP vapor pipes - Refer to **Evaporative Emission (EVAP) System Hoses/Pipes Replacement (Engine Compartment EVAP Pipe)** or **Evaporative Emission (EVAP) System Hoses/Pipes Replacement (Chassis EVAP Pipe)** or **Evaporative Emission (EVAP) System Hoses/Pipes Replacement (EVAP Vent Pipe)** or **Evaporative Emission (EVAP) System Hoses/Pipes Replacement (Rear EVAP Fuel Tank Pipe)** and **Evaporative Emission (EVAP) Canister Replacement** . • The fuel fill pipe and hose - Refer to **Filler Tube Replacement** . Did you find and correct the condition?	Go to **Step 8**	Go to Diagnostic Aids
6	Replace the fuel tank. Refer to **Fuel Tank Replacement** . Did you complete the repair?	Go to **Step 8**	-
7	Replace the leaking fuel pipe. Refer to **Fuel Hose/Pipes Assembly Replacement** . Did you complete the replacement?	Go to **Step 8**	-
8	Operate the system in order to verify the repair. Did you correct the condition?	System OK	Go to **Step 2**

ALCOHOL/CONTAMINANTS-IN-FUEL DIAGNOSIS (WITHOUT SPECIAL TOOL AND E85)

Description

Water contamination in the fuel system may cause driveability conditions such as hesitation, stalling, no start, or misfires in one or more cylinders. Water may collect near a single fuel injector at the lowest point in the fuel injection system, and cause a misfire in that cylinder. If the fuel system is contaminated with water, inspect the fuel system components for rust, or deterioration.

Alcohol concentrations of 10 percent or greater in fuel can be detrimental to fuel system components. Alcohol contamination may cause fuel system corrosion, deterioration of rubber components, and subsequent fuel filter restriction. Some types of alcohol are more detrimental to fuel system components than others. Ethanol is commonly used in gasoline, but in concentrations of no more than 10 percent. Some fuels, such as E85, contain a very high percentage of ethanol. Fuel with more than 10 percent ethanol may cause driveability conditions such as hesitation, lack or power, stalling, or no start.

Alcohol in Fuel Testing Procedure

The fuel sample should be drawn from the bottom of the tank so that any water present in the tank will be detected. The sample should be bright and clear. If alcohol contamination is suspected then use the following procedure to test the fuel quality.

1. Using a 100 ml specified cylinder with 1 ml graduation marks, fill the cylinder with fuel to the 90 ml mark.
2. Add 10 ml of water in order to bring the total fluid volume to 100 ml and install a stopper.
3. Shake the cylinder vigorously for 10-15 seconds.
4. Carefully loosen the stopper in order to release the pressure.
5. Re-install the stopper and shake the cylinder vigorously again for 10-15 seconds.
6. Put the cylinder on a level surface for approximately 5 minutes in order to allow adequate liquid separation.

If alcohol is present in the fuel, the volume of the lower layer, which would now contain both alcohol and water, will be more than 10 ml. For example, if the volume of the lower layer is increased to 15 ml, this indicates at least 5 percent alcohol in the fuel. The actual amount of alcohol may be somewhat more because this procedure does not extract all of the alcohol from the fuel.

Particulate Contaminants in Fuel Testing Procedure

The fuel sample should be drawn from the bottom of the tank so that any water present in the tank will be detected. The sample should be bright and clear. If the sample appears cloudy, or contaminated with water, as indicated by a water layer at the bottom of the sample, use the following procedure to diagnose the fuel.

1. Using an approved fuel container, draw approximately 0.5 liter of fuel.
2. Place the cylinder on a level surface for approximately 5 minutes in order to allow settling of the particulate contamination.

Particulate contamination will show up in various shapes and colors. Sand will typically be identified by a white or light brown crystals. Rubber will appear as black and irregular particles. If particles are found clean the entire fuel system thoroughly. Refer to **Fuel System Cleaning** .

ALCOHOL/CONTAMINANTS-IN-FUEL DIAGNOSIS (WITH SPECIAL TOOL)

Description

Water contamination in the fuel system may cause driveability conditions such as hesitation, stalling, no start, or misfires in one or more cylinders. Water may collect near a single fuel injector at the lowest point in the fuel injection system, and cause a misfire in that cylinder. If the fuel system is contaminated with water, inspect the fuel system components for rust or deterioration.

Ethanol concentrations of greater than 10 percent in non-blended gasoline, or greater than 85 percent with E85 blended gasoline for flexible fuel applications, can cause driveability conditions and may contribute to fuel system deterioration. Excessive ethanol concentrations can result in driveability conditions such as hesitation, lack of power, stalling, or a no start, and may contribute to fuel system corrosion, deterioration of fuel system components, and a restricted fuel filter.

Test Procedure

1. Test the fuel composition using **J 44175** Fuel Composition Tester and J 44175-3 Instruction Manual.
2. If water appears in the fuel sample, perform the following steps:
    1. Clean the fuel system. Refer to **Fuel System Cleaning** .
    2. Replace the fuel filter if the vehicle is equipped with a serviceable fuel filter.
3. Subtract 50 from the reading on the DMM in order to obtain the percentage of alcohol in the fuel sample. Refer to the examples in the Fuel Composition Test Examples table.
4. If the non-blended gasoline fuel sample contains more than 15 percent ethanol, or if the E85 blended gasoline fuel sample contains more than 85 percent ethanol, add fresh, regular gasoline to the vehicle's fuel tank.
5. Test the fuel composition.
6. If additional testing indicates that the ethanol percentage is still more above 15 percent for a non-blended gasoline sample, drain and replace the vehicle's fuel. Refer to **Fuel System Cleaning** . If additional testing indicates that the E85 blended gasoline sample is still above 85 percent, continue adding fresh, regular gasoline until the ethanol content is 85 percent or less.

Fuel Composition Test Examples

-	Frequency (Hz)	Subtract 50	Ethanol Percent
Example A	50 Hz	-50	0
Example B	65 Hz	-50	15
Example C	129 Hz	-50	79
Example D	135 Hz	-50	85

ELECTRONIC IGNITION (EI) SYSTEM DIAGNOSIS

Circuit Description

The electronic ignition system uses an individual ignition coil for each cylinder. The powertrain control module (PCM) controls the ignition operation through eight individual ignition control (IC) circuits. Each bank of four ignition coils is connected to the PCM, power, or ground by the following circuits:

- Low reference
- Chassis ground
- Ignition 1 voltage
- The appropriate IC circuit

The PCM triggers an ignition coil by grounding the appropriate IC circuit using information from the crankshaft position (CKP) and camshaft position (CMP) sensors.

Diagnostic Aids

IMPORTANT: A missing CMP sensor signal may cause a long crank condition.

The CKP signal must be available for the engine to start. The CMP signal is not needed to start and operate the engine. The PCM can determine when a cylinder is on either the firing or exhaust stroke by the 24X signal.
Remove any debris from the PCM connector surfaces before servicing the PCM. Inspect the PCM connector gaskets when diagnosing or replacing the PCM. Ensure that the gaskets are installed correctly. The gaskets prevent water intrusion into the PCM.

For an intermittent condition, refer to **Intermittent Conditions** .

Test Description

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

5: Monitoring the misfire current counters determines if a fault is present.

12: A good indication that the fuse is open is all off the misfire current counters are incrementing on one side of the engine. Inspect the ignition positive voltage circuit for a grounded circuit. If the fuse is open and the ignition coil circuits are OK, inspect the injector circuits for being grounded.

Electronic Ignition (EI) System Diagnosis

Step	Action	Value (s)	Yes	No
Schematic Reference:Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Attempt to start the engine. Does the engine start and run?	-	Go to **Step 5**	Go to **Step 3**
3	1. Observe the Engine Speed parameter with a scan tool. 2. Crank the engine. Does the scan tool indicate RPM is present?	-	Go to **Step 7**	Go to **Step 4**
4	Is DTC P0335, P0336, or P0351-P0358 also set?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 16**
5	1. Idle the engine. 2. Observe the misfire current counters on the scan tool. Does the scan tool display any misfire current counters incrementing?	-	Go to **Step 6**	Go to Diagnostic Aids

6	Do the misfire current counters increment for most cylinders on one bank of the engine?	-	Go to **Step 12**	Go to **Step 7**
7	1. Inspect the spark plug wire for open circuits, cracks, or improper seating of terminals at the spark plug or coil before proceeding with test. Refer to **Spark Plug Wire Inspection** . 2. Inspect for spark at the plug with the **J 26792** Spark Tester or equivalent while cranking. A few sparks, then nothing is considered no spark. Is adequate spark present?	-	Go to **Step 33**	Go to **Step 8**
8	Measure the spark plug wire resistance. Refer to **Spark Plug Wire Inspection** . Is the resistance more than the specified value?	1,000 ohm/ft	Go to **Step 32**	Go to **Step 9**
9	1. Turn OFF the ignition. 2. Disconnect the inoperative ignition coil. 3. Turn ON the ignition, with the engine OFF. 4. Probe the ignition 1 voltage circuit of the ignition coil with a test lamp connected to a good ground. Refer to **Probing Electrical Connectors** in Wiring Systems. Does the test lamp illuminate?	-	Go to **Step 10**	Go to **Step 13**
10	Probe the ignition 1 voltage circuit at the ignition coil with a test lamp connected to the ground circuit of the ignition coil. Refer to **Probing Electrical Connectors** in Wiring Systems. Does the test lamp illuminate?	-	Go to **Step 11**	Go to **Step 14**
11	Probe the ignition 1 voltage circuit at the ignition coil with a test lamp connected to the low reference circuit of the ignition coil. Refer to **Probing Electrical Connectors** in Wiring Systems. Does the test lamp illuminate?	-	Go to **Step 20**	Go to **Step 15**
12	Inspect for an open INJ 1 or INJ 2 fuse. Is the fuse open?	-	Go to **Step 29**	Go to **Step 23**
13	1. Disconnect the main ignition coil 8-way connector. 2. Probe the ignition 1 voltage circuit at the ignition coil main 8-way connector using the test lamp connected to battery ground. Refer to **Probing Electrical Connectors** in Wiring Systems.	-		

	Does the test lamp illuminate?		Go to **Step 24**	Go to **Step 23**
14	1. Disconnect the main ignition coil 8-way connector. 2. Probe the ignition 1 voltage circuit on the harness side with a test lamp connected to the ground circuit of the ignition coil. Refer to **Probing Electrical Connectors** in Wiring Systems. Does the test lamp illuminate?	-	Go to **Step 18**	Go to **Step 26**
15	1. Disconnect the main ignition coil 8-way connector. 2. Probe the ignition 1 voltage circuit on the harness side with a test lamp connected to the low reference circuit of the ignition coil. Refer to **Probing Electrical Connectors** in Wiring Systems. Does the test lamp illuminate?	-	Go to **Step 19**	Go to **Step 28**
16	1. Turn ON the ignition, with the engine OFF. 2. Disconnect the crankshaft position (CKP) sensor. 3. Measure the voltage from the CKP sensor 12-volt reference circuit and a good ground with the DMM. 4. Compare the measured voltage with the system voltage. Is the difference in the voltage more than the specified value?	0.5 V	Go to **Step 17**	Go to **Step 30**
17	Test for a short to ground in the CKP 12-volt reference circuit or the camshaft position (CMP) sensor 12-volt reference circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 22**
18	Test for an intermittent and for a poor connection at the ignition coil 8-way connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 25**
	Test for an intermittent and for a poor connection at the ignition coil 8-way connector. Refer to **Testing for Intermittent Conditions and Poor**			

19	**Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 27**
20	Test for an intermittent and for a poor connection at the ignition coil. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 31**
21	Test for an intermittent and for a poor connection at the CKP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 30**
22	Test for an intermittent and for a poor connection at the powertrain control module (PCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 35**	Go to **Step 34**
23	Repair the open or high resistance in the ignition 1 voltage circuit between the fuse block and the splice. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 35**	-
24	Repair the open or high resistance in the ignition 1 voltage circuit between the splice and the ignition coil connector. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 35**	-
25	Repair the open in the ground circuit between the main 8-way connector and the ignition coil. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 35**	-
26	Repair the open in the ground circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 35**	-
27	Repair the open in the low reference circuit between the main 8-way connector and the ignition coil. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 35**	-
28	Repair the open in the low reference circuit between the PCM and the splice. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 35**	-
	1. Repair the ignition 1 voltage for a short to ground. Refer to **Wiring Repairs** in Wiring			

29	Systems. 2. Replace the fuse. Did you complete the repair?	-	Go to **Step 35**	-
30	Replace the CKP sensor. Refer to **Crankshaft Position (CKP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 35**	-
31	Replace the ignition coil. Refer to **Ignition Coil(s) Replacement** . Did you complete the replacement?	-	Go to **Step 35**	-
32	Replace the spark plug wire. Refer to **Spark Plug Wire Replacement** . Did you complete the replacement?	-	Go to **Step 35**	-
33	Replace the spark plug. Refer to **Spark Plug Replacement** . Did you complete the replacement?	-	Go to **Step 35**	-
34	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 35**	-
35	Attempt to start the engine. Does the engine start and continue to run?	-	Go to **Step 36**	Go to **Step 3**
36	1. Clear the DTCs with a scan tool. 2. Turn OFF the engine for 30 seconds. 3. Start the engine. 4. Allow the engine to reach operating temperature. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

INSPECTION/MAINTENANCE (I/M) SYSTEM CHECK

Description

Several states require that a vehicle pass on-board diagnostic (OBD) system tests and the inspection/maintenance (I/M) emission inspection in order to renew license plates. This is accomplished by viewing the I/M System Status display on a scan tool. Using a scan tool, the technician can observe the I/M System Status in order to verify that the vehicle meets the criteria that comply with the local area requirements.

Conditions for Updating the I/M System Status

Each system monitor requires at least one, and sometimes several diagnostic tests. The result of each test is reported by a diagnostic trouble code (DTC). A system monitor is complete when either all of the DTCs comprising the monitor have Run and Passed, or when any one of the DTCs comprising the monitor has illuminated the malfunction indicator lamp (MIL). Once the system monitor is complete, the I/M System Status display will indicate YES in the Completed column.

For example, when the HO2S Heater Status indicates YES, either all of the oxygen sensor heater tests have passed or one of the tests has illuminated the MIL. If the vehicle has four heated oxygen sensors, either all four heater circuit tests have passed or one of the heater circuit tests has illuminated the MIL. The I/M System Status will indicate NO under the Completed column when any of the required tests for that system have not run. The following is a list of conditions that would set the I/M System Status indicator to NO:

- The vehicle is new from the factory and has not yet been driven through the necessary drive conditions to complete the tests.
- The battery has been disconnected or discharged below operating voltage.
- The control module power or ground has been interrupted.
- The control module has been reprogrammed.
- The control module DTCs have been cleared.

Monitored Emission Control Systems

The OBD II System monitors all emission control systems that are on-board. Not all vehicles have a full complement of emission control systems. For example, a vehicle may not be equipped with secondary air injection (AIR) or exhaust gas recirculation (EGR). The OBD II regulations require monitoring of the following:

- The air conditioning system
- The catalytic converter efficiency
- Comprehensive component monitoring-Emission related inputs and outputs
- The evaporative emissions (EVAP) system
- The EGR System
- The fuel delivery system
- Heated catalyst monitoring
- Misfire monitoring
- The oxygen sensor system (O2S or HO2S)
- The oxygen sensor heater system (HO2S heater)
- The AIR system

For the specific DTCs required for each system, refer to **Inspection/Maintenance (I/M) System DTC Table** . Systems such as fuel delivery, misfire, and comprehensive components may not be listed in a system status list. These tests run continuously and do not require an I/M System Status indicator.

Inspection/Maintenance (I/M) System Check

Step	Action	Value (s)	Yes	No
	1. Perform **Diagnostic System Check - Engine Controls** .			

1	**IMPORTANT:** **Many DTC related repairs will instruct the technician to clear the DTC information. This procedure will reset ALL of the I/M System Status indicators to NO, and require performing the I/M Complete System Set Procedure.** 2. Repair any DTCs or driveability concerns that would prevent the I/M System Status tests from completing. Did you find and repair a DTC or driveability concern?	-	Go to **Step 3**	Go to **Step 2**
2	1. Review any service bulletins for software updates that may prevent inspection/maintenance (I/M) readiness. 2. Perform any reprogramming or repairs indicated by the service bulletins. Was a reprogramming or repair service required?	-	Go to **Inspection/Maintenance (I/M) Complete System Set Procedure**	Go to **Step 3**
3	Observe the I/M System Status display with a scan tool. Is more than one test indicating a NO status?	-	Go to **Inspection/Maintenance (I/M) Complete System Set Procedure**	Go to the I/M System Set Procedure for the indicated systems that have not updated

INSPECTION/MAINTENANCE (I/M) COMPLETE SYSTEM SET PROCEDURE

Description

The purpose of the inspection maintenance (I/M) Complete System Set Procedure is to satisfy the enable criteria necessary to execute all of the I/M readiness diagnostics, and to complete the trips for those particular diagnostics. When all diagnostic tests are completed, the I/M System Status indicators are set to YES. Perform this test when more than one or all of the I/M System Status indicators are set to NO.

Conditions for Running

Cold Start

- The barometric pressure (BARO) is more than 75 kPa.

- The engine coolant temperature (ECT) is between 4-30°C (39-86°F).
- The intake air temperature (IAT) is between 4-30°C (39-86°F).
- The difference between the IAT and the ECT is 8°C (14°F) or less.
- The battery voltage is between 10-18 volts.
- The fuel level is between 15-85 percent.

Diagnostic Aids

Rough road conditions may prevent some of the tests from running. Extreme high or low ambient temperatures may prevent tests such as for the heated oxygen sensor (HO2S) heater and the evaporative emission (EVAP) system from initiating. If a step is interrupted before completion, perform the remaining portion of the set procedures. Any portion of the set procedure that requires the engine at operating temperature may be repeated. This allows most of the diagnostics to run and the remaining tests can be performed using the individual System Set Procedures.

The scan tool can be used in order to monitor each of the I/M System Status indicators during the I/M Complete System Set Procedure. When all of the indicators for a test step have updated to YES, testing can move on to the next step even if the remaining portion of the test is not complete. For example, step 3 is designed to run the EVAP, AIR, and HO2S tests. The procedure instructs the technician to operate the vehicle in the enable conditions for 6 minutes. If all 3 tests have updated to YES within 4 minutes, you do not need to continue with the enable conditions and testing can advance to the next step.

Test Description

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

2: This step is to run the HO2S heater tests and initiate the EVAP System Test. Preprogramming the scan tool will reduce the amount of time the oxygen sensor heaters operate while verifying the enable criteria.

3: This step is to run the EVAP, the AIR and the oxygen sensor tests. The EVAP test begins once the engine coolant reaches a calibrated temperature. The AIR test, if equipped, begins shortly after Closed Loop and the indicated speed is achieved. The oxygen sensor tests begin once the engine is at operating temperature, in Closed Loop Fuel Control, and a calibrated amount of time has elapsed.

4: This step is to run the Catalyst Tests. This test runs during the idle period immediately following a cruise period that meets a minimum calibrated RPM and time period.

Inspection/Maintenance (I/M) Complete System Set Procedure

Step	Action	Value (s)	Yes	No
CAUTION: **Refer to Road Test Caution in Cautions and Notices.**				
1	Did you perform the Inspection/Maintenance (I/M) System Check?	-	Go to **Step 2**	Go to **Inspection/Maintenance (I/M) System Check**
	IMPORTANT:			

2	**Whenever the ignition is turned ON, ignition positive voltage is supplied to the heated oxygen sensor (HO2S) heaters. After verifying the enable criteria, turn OFF the ignition for approximately 5 minutes in order to allow the sensors to cool before continuing with the test. Once the engine is started, DO NOT turn the engine OFF for the remaining portion of the set procedure.** 1. Preprogram the scan tool with the vehicle information before the ignition is turned ON. 2. Ensure that the vehicle is within the Conditions for Running specified in the supporting text. 3. Turn OFF all of the accessories, including the A/C, and blower fan. 4. Set the vehicle parking brake. 5. Verify the transmission is in Park for automatic transmissions and Neutral for manual transmissions. 6. Start the engine and allow it to idle for the specified time. Is the action complete?	2 minutes	Go to **Step 3**	-
3	In order for the next group of tests to run, the vehicle must operate in the following conditions: 1. Acceleration at part throttle to 90 km/h (55 mph), with this speed maintained until the engine reaches operating temperature. This may be up to 10 minutes depending on the start up coolant temperature. 2. Continue operation under these conditions for an additional 6 minutes. Is the action complete?	-	Go to **Step 4**	-
	In order for the next group of tests to run, the vehicle must operate in the following conditions:			

4	1. Acceleration at part throttle to 75-89 km/h (45-55 mph) with this speed maintained for 2 minutes. 2. Deceleration to 0 km/h (0 mph). 3. Engine idling for 2 minutes while the following criteria are maintained: • Service brake depressed • Automatic transmission in drive • Manual transmission in neutral with the clutch pedal depressed Is the action complete?	-	Go to **Step 5**	-
5	Observe the I/M System Status display with a scan tool. Did all of the I/M System Status indicators update to YES?	-	Go to **Step 6**	Go to the I/M System Set Procedure for the systems that have not updated
6	Observe the emission related DTC portion of the I/M System Status display with a scan tool. Does the scan tool indicate any emission related DTCs set?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

INSPECTION/MAINTENANCE (I/M) SYSTEM DTC TABLE

Inspection/Maintenance (I/M) System DTC Table

System	DTCs Required to Set System Status to YES
Catalyst	**DTC P0420 or P0430**
EVAP	**DTC P0455** **DTC P0442** **DTC P0446** **DTC P0496**
Oxygen Sensor	**DTC P0133 or P0153** **DTC P0140 or P0160** **DTC P1133 or P1153** **DTC P1134 or P1154** **DTC P0136 or P0156**
Oxygen Sensor Heater	**DTC P0135 or P0155**

INSPECTION/MAINTENANCE (I/M) CATALYST SYSTEM SET PROCEDURE (WITHOUT HP2)

Description

The purpose of this test is to satisfy the enable criteria necessary to execute inspection/maintenance (I/M) readiness diagnostics for the catalyst system. The test may be used to set the I/M System Status indicators to YES. The I/M System Status display on the scan tool provides an indication of whether the control module has completed the required tests. The I/M System Status does not indicate that the tests have passed or failed. When all of the diagnostics for a specific system have run and passed, the I/M System Status will update to YES. If a test for a specific system has failed, the I/M System Status will update to YES, indicating a determination was made even if all of the other tests for that system have not run.

Conditions for Running

- The engine load must be stable.
- DTCs P0420 and P0430 are not set.
- The barometric pressure is more than 74 kPa.
- The engine coolant temperature (ECT) is between 70-120°C (158-248°F).
- The engine has been running for more than 10 minutes.
- The engine is in Closed Loop fuel control.
- The battery voltage is more than 10-18 volts.
- The intake air temperature (IAT) is between -7 and +85°C (+20 and +185°F).
- The difference between the engine speed and the desired engine speed is less than 200 RPM.

Diagnostic Aids

The control module runs a calibrated number of catalyst tests per trip until the Catalyst System Status updates to YES. If the status does not update, the test outlined in this procedure can be repeated until the I/M System Status updates to YES.

If there is an impending failure, the system may require more time to run the diagnostic than was allotted in the set procedure. If the test does not run after numerous attempts and no DTC is set, review the appropriate scan tool data list and the service information for an indication of why the test does not complete. Some tests may abort due to changes in the conditions while the test is running. For example, changes in engine load such as a cooling fan or A/C compressor clutch turning ON may cause the test to abort.

Inspection/Maintenance (I/M) Catalyst System Set Procedure (Without HP2)

Step	Action	Yes	No
1	Did you perform the Inspection/Maintenance (I/M) System Check?	Go to **Step 2**	Go to **Inspection/Maintenance (I/M) System Check**
	1. Ensure the vehicle is within the Conditions for Running specified in the supporting text. 2. Turn OFF all of the accessories, e.g., A/C, blower fan, etc. 3. Start the engine and allow it to idle for 2 minutes.		

2	**CAUTION:** **Refer to Road Test Caution in Cautions and Notices.** **IMPORTANT:** **In order for this test to run, the vehicle must operate in the following conditions:** • **Acceleration at part throttle to 90 km/h (55 mph) with this speed maintained for 8 minutes** • **Deceleration to 0 km/h (0 mph)** • **Engine idling for 2 minutes while the following criteria is maintained:** ○ **Service brake depressed** ○ **Automatic transmission in Drive** 4. Observe the I/M System Status display with a scan tool. Did the catalyst System Status update to YES?	Go to **Step 5**	Go to **Step 3**
3	Observe the DTC Information with a scan tool. Does the scan tool indicate any failed DTCs?	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 4**
4	1. Refer to the **Inspection/Maintenance (I/M) System DTC Table** to determine which DTCs are required to run in order to complete this test. 2. Observe the Not Ran Since Code Cleared display with a scan tool. 3. Determine which of the DTCs required for a YES status has not run. 4. Enter the DTC number in the specific DTC menu of the scan tool. 5. Operate the vehicle within the Conditions for Running the DTC, located in the supporting text for the diagnostic table of the DTC. 6. Repeat the procedure until the scan tool indicates the diagnostic test has run. 7. Repeat steps 4-6 for any additional required DTCs that have not run.		

	8. Observe the I/M System Status display with a scan tool. Did the catalyst System Status update to YES?	Go to **Step 5**	Go to Diagnostic Aids
5	Observe the emission related DTC portion of the I/M System Status display with a scan tool. Does the scan tool indicate any emission related DTCs set?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

INSPECTION/MAINTENANCE (I/M) EVAPORATIVE EMISSION (EVAP) SYSTEM SET PROCEDURE

Description

The purpose of this test is to satisfy the enable criteria necessary in order to execute the inspection/maintenance (I/M) readiness diagnostics for the evaporative emission (EVAP) system. The test may be used in order to set the I/M System Status indicators to YES. The I/M System Status Display on the scan tool provides an indication of when the control module has completed the required tests. The I/M System Status does not indicate that the tests have passed or failed. When all of the diagnostics for a specific system have run and passed and I/M System Status will update to YES. If a test for a specific system has failed, the I/M System Status will update to YES, indicating a determination was made, even if all of the other tests for that system have not run. Performing a visual inspection prior to running the EVAP test may prevent having to repeat the test. A failed or aborted test will require the vehicle to cool down in order to meet the enable criteria to run another test.

Conditions for Running

- DTCs P0442, P0446, P0455, P0496 are not set.
- The barometric pressure (BARO) is more than 75 kPa.
- The fuel level is between 1/4 and 3/4.
- The battery voltage is between 10-18 volts.
- The engine coolant temperature (ECT) is between 3.75-30°C (39-86°F).
- The intake air temperature (IAT) is between 3.75-30°C (39-86°F).
- The difference between the ECT and the IAT is less than 8°C (14°F).

Diagnostic Aids

If there is an impending failure, the system may require more time to run the diagnostic than was allotted in the set procedure. If the test does not run after numerous attempts and no DTC is set, review the appropriate scan tool data list and the service information for an indication of why the test does not complete. Some tests may abort due to changes in the conditions while the test is running. For example, changes in engine load such as cooling fan or an A/C compressor clutch turning ON may cause the test to abort.

Inspection/Maintenance (I/M) Evaporative Emission (EVAP) System Set Procedure

Step	Action	Yes	No

1	Did you perform the Inspection/Maintenance (I/M) System Check?	Go to **Step 2**	Go to **Inspection/Maintenance (I/M) System Check**
2	1. Ensure the vehicle is within the Conditions for Running specified in the supporting text. 2. Turn OFF all of the accessories, including the A/C and the blower fan. **IMPORTANT:** **Once the engine is started, DO NOT turn the engine OFF for the remainder of the procedure until the test is complete.** 3. Start and idle the engine. **CAUTION:** **Refer to Road Test Caution in Cautions and Notices.** **IMPORTANT:** **In order for this test to run, the vehicle must operate in the following conditions:** 4. Acceleration at part throttle to 72 km/h (45 mph) with this speed maintained until the engine reaches operating temperature. This may be up to 8-10 minutes, depending on the startup coolant temperature. 5. Continue the operating conditions for an additional 3 minutes after the engine reaches the operating temperature. 6. Decelerate to 0 km/h (0 mph). 7. Idle the engine for 2 minutes. 8. Turn OFF the ignition for 1 hour. 9. After 1 hour, turn ON the ignition. 10. Observe the EVAP System Status with a scan tool. Did the EVAP System Status update to YES?	Go to **Step 5**	Go to **Step 3**
3	Observe the DTC Information with a scan tool. Does the scan tool indicate any failed DTCs?	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 4**

4	1. Refer to **Inspection/Maintenance (I/M) System DTC Table** to determine which DTCs are required to run in order to complete this test. 2. Observe the Not Ran Since Code Cleared display with a scan tool. 3. Determine which of the DTCs required for a YES status has not run. 4. Enter the DTC number in the Specific DTC menu of the scan tool. 5. Operate the vehicle within the Conditions for Running the DTC, located in the supporting text for the diagnostic table of the DTC. 6. Repeat the procedure until the scan tool indicates the diagnostic test has run. 7. Repeat steps 4-6 for any additional required DTCs that have not run. 8. Observe the I/M System Status display with a scan tool. Did the EVAP System Status update to YES?	Go to **Step 5**	Go to Diagnostic Aids
5	Observe the Emission Related DTC portion of the I/M System Status display with a scan tool. Does the scan tool indicate any Emission Related DTCs set?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

INSPECTION/MAINTENANCE (I/M) HEATED OXYGEN SENSOR/OXYGEN SENSOR (HO2S/O2S) SYSTEM SET PROCEDURE

Description

The purpose of this test is to satisfy the enable criteria necessary to execute inspection/maintenance (I/M) readiness diagnostics for the oxygen sensor (O2S, HO2S) system. The test may be used to set the I/M System Status to YES. The I/M System Status display on the scan tool provides an indication of whether the control module has completed the required tests. The I/M System Status does not indicate that the tests have passed or failed. When all of the diagnostics for a specific system have run and passed, the I/M System Status will update to YES. If a test for a specific system has failed, the I/M System Status will update to YES, indicating a determination was made, even if all of the other tests for that system have not run.

Conditions for Running

- DTCs P0133, P0135, P0136, P0140, P0141, P0153, P0155, P0156, P0160, P0161, P1133, P1134, P1153, P1154 are not set.
- The fuel level is more than 10 percent.

- The engine coolant temperature (ECT) is more than 60°C (140°F).
- The engine is running in Closed Loop fuel control.
- The engine has been running for more than 3 minutes.
- The battery voltage is between 10-18 volts.
- The mass air flow (MAF) is between 20-55 grams per second.
- The engine speed is between 1,200-3,000 RPM.
- The throttle position (TP) sensor is more than 5 percent.

Diagnostic Aids

If there is an impending failure, the system may require more time to run the diagnostic than was allotted in the set procedure. If the test does not run after numerous attempts and no DTC is set, review the appropriate scan tool data list and the service information for an indication of why the test does not complete. Some tests may abort due to changes in the conditions while the test is running. For example, changes in engine load such as a cooling fan or A/C compressor clutch turning ON may cause the test to abort.

Inspection/Maintenance (I/M) Heated Oxygen Sensor/Oxygen Sensor (HO2S/O2S) System Set Procedure

Step	Action	Yes	No
1	Did you perform the Inspection/Maintenance (I/M) System Check?	Go to **Step 2**	Go to **Inspection/Maintenance (I/M) System Check**
2	1. Ensure the vehicle is within the Conditions for Running specified in the supporting text. 2. Turn OFF all of the accessories, e.g., A/C, blower fan, etc. 3. Start the engine and allow it to idle for 1 minute. **CAUTION:** **Refer to Road Test Caution in Cautions and Notices.** **IMPORTANT:** **In order for this test to run, the vehicle must operate in the following conditions:** 4. Acceleration at part throttle to 75-90 km/h (45-55 mph) with this speed maintained for 6 minutes or until the I/M System Status updates to YES. Manual transmissions, either 5 or 6 speed, may require operation in 4th or 5th gear		

	respectively, in order for this test to run. 5. Review the I/M System Status display with a scan tool. Did the HO2S/O2S System Status update to YES?	Go to **Step 5**	Go to **Step 3**
3	Observe the DTC Information with a scan tool. Does the scan tool indicate any failed DTCs?	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 4**
4	1. Refer to the **Inspection/Maintenance (I/M) System DTC Table** to determine which DTCs are required to run in order to complete this test. 2. Observe the Not Ran Since Code Cleared display with a scan tool. 3. Determine which of the DTCs required for a YES status has not run. 4. Enter the DTC number in the Specific DTC menu of the scan tool. 5. Operate the vehicle within the Conditions for Running the DTC, located in the supporting text for the diagnostic table of the DTC. 6. Repeat the procedure until the scan tool indicates the diagnostic test has run. 7. Repeat steps 4-6 for any additional required DTCs that have not run. 8. Observe the I/M System Status display with a scan tool. Did the HO2S/O2S System Status update to YES?	Go to **Step 5**	Go to Diagnostic Aids
5	Observe the Emission Related DTC portion of the I/M System Status display with a scan tool. Does the scan tool indicate any Emission Related DTCs set?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

INSPECTION/MAINTENANCE (I/M) HEATED OXYGEN SENSOR (HO2S) HEATER SYSTEM SET PROCEDURE

Description

The purpose of this test is to satisfy the enable criteria necessary to execute inspection/maintenance (I/M) readiness diagnostics for the heated oxygen sensor (HO2S) heater system. The test may be used to set the I/M

System Status to YES. The I/M System Status display on the scan tool provides an indication of whether the control module has completed the required tests. The I/M System Status does not indicate that the tests have passed or failed. When all of the diagnostics for a specific system have run and passed, the I/M System Status will update to YES. If a test for a specific system has failed, the I/M System Status will update to YES, indicating a determination was made, even if all of the other tests for that system have not run.

Conditions for Running

- DTCs P0135, P0141, P0155, P0161 are not set.
- The engine has been running for more than 2 minutes.
- The engine coolant temperature (ECT) is more than 50°C (122°F).
- The engine speed is between 500-3,000 RPM.
- The battery voltage is between 10-18 volts.
- The mass air flow (MAF) is between 3-40 grams per second.

Diagnostic Aids

The HO2S Heater Tests will normally run within the 2 minutes allotted in the procedure. If there is an indeterminate condition, the test may take up to 8 minutes on some vehicles before a decision of pass or fail is made. If the test does not update to YES, it may have failed or aborted due to the loss of enabling conditions. Extremely high ambient temperatures may prevent the HO2S Heater Test from initiating.

If there is an impending failure, the system may require more time to run the diagnostic than was allotted in the set procedure. If the test does not run after numerous attempts and no DTC is set, review the appropriate scan tool data list and the service information for an indication of why the test does not complete. Some tests may abort due to changes in the conditions while the test is running. For example, changes in engine load such as a cooling fan or A/C compressor clutch turning ON may cause the test to abort.

Inspection/Maintenance (I/M) Heated Oxygen Sensor (HO2S) Heater System Set Procedure

Step	Action	Value (s)	Yes	No
1	Did you perform the Inspection/Maintenance (I/M) System Check?	-	Go to **Step 2**	Go to **Inspection/Maintenance (I/M) System Check**
	IMPORTANT: **Whenever the ignition is turned ON, ignition positive voltage is supplied to the heated oxygen sensor (HO2S) heaters. After verifying the enable criteria, turn OFF the ignition for approximately 5 minutes to allow the sensors to cool before continuing with the test.** 1. Preprogram the scan tool with the vehicle information before the ignition is turned			

2	ON. 2. Ensure the vehicle is within the Conditions for Running as specified in the supporting text. 3. Set the vehicle parking brake. 4. Verify the transmission is in Park for automatic transmissions and Neutral for manual transmissions. 5. Turn OFF all of the accessories, e.g., A/C, blower fan, etc. 6. Start the engine and allow it to idle for the specified time or until the I/M System Status indicator updates to YES. Did the HO2S Heater System Status update to YES?	2 minutes	Go to **Step 5**	Go to **Step 3**
3	Observe the DTC information with a scan tool. Does the scan tool indicate any failed DTCs?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 4**
4	1. Refer to the **Inspection/Maintenance (I/M) System DTC Table** to determine which DTCs are required to run in order to complete this test. 2. Observe the Not Ran Since Code Cleared display with a scan tool. 3. Determine which of the DTCs required for a YES status has not run. 4. Enter the DTC number in the Specific DTC menu of the scan tool. 5. Operate the vehicle within the Conditions for Running the DTC, located in the supporting text for the diagnostic table of the DTC. 6. Repeat the procedure until the scan tool indicates the diagnostic test has run. 7. Repeat steps 4-6 for any additional required DTCs that have not run. 8. Observe the I/M System Status display with a scan tool. Did the HO2S Heater System Status update to	-		

	YES?		Go to **Step 5**	Go to Diagnostic Aids
5	Observe the Emission Related DTC portion of the I/M System Status display with a scan tool. Does the scan tool indicate any Emission Related DTCs set?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DIAGNOSTIC STARTING POINT - ENGINE CONTROLS

Begin the system diagnosis with **Diagnostic System Check - Engine Controls** . The Diagnostic System Check-Engine Controls will provide the following information:

- The identification of the control modules which command the system
- The ability of the control modules to communicate through the serial data circuit
- The identification of any stored diagnostic trouble codes (DTCs) and the codes' statuses

The use of the Diagnostic System Check-Engine Controls will identify the correct procedure for diagnosing the system and where the procedure is located.

DIAGNOSTIC SYSTEM CHECK - ENGINE CONTROLS

DESCRIPTION

The Diagnostic System Check is an organized approach to identifying a condition created by an electronic engine control system malfunction. The Diagnostic System Check must be the starting point for any driveability concern. The Diagnostic System Check directs the service technician to the next logical step in diagnosing the concern. Understanding the table and using the table correctly reduces diagnostic time and prevents the replacement of good parts.

Diagnostic System Check - Engine Controls

Step	Action	Yes	No
1	Perform the following preliminary inspections: 1. Ensure that the battery is fully charged. Refer to **Battery Inspection/Test (Non-HP2)** in Engine Electrical. 2. Ensure that the battery cables are clean and tight. 3. Inspect the easily accessible systems or the visible system components for obvious damage or conditions that could cause the symptom. Refer to **Strategy Based Diagnosis** in General Information 4. Ensure that the engine and control module grounds are clean, tight,		

	and in the correct location. 5. Inspect for aftermarket devices that could affect the operation of the system. Refer to **Checking Aftermarket Accessories** in Wiring Systems. Did you find and correct the condition?	System OK	Go to **Step 2**
2	1. Install a scan tool. 2. Turn ON the scan tool. Does the scan tool turn ON?	Go to **Step 3**	Go to **Scan Tool Does Not Power Up** in Data Link Communications
3	1. Turn ON the ignition, with the engine OFF. 2. Attempt to establish communication with the listed control modules. If you are using a Tech 2, obtain the information using the Class 2 Message Monitor feature: • Powertrain control module (PCM) • Electronic brake control module (EBCM) • Body control module (BCM) Does the scan tool communicate with all the listed modules?	Go to **Step 4**	Go to **Scan Tool Does Not Communicate with Class 2 Device** in Data Link Communications
4	**IMPORTANT:** **The engine may start during the following step. Turn OFF the engine as soon as you have observed the Crank power mode.** 1. Access the Class 2 Power Mode in the Diagnostic Circuit Check on the scan tool. 2. Rotate the ignition switch through all positions while observing the ignition switch power mode parameter. Refer to the **Body Control System**		

	Description and Operation in Body Control Systems, for a list of the power mode states that correspond to each ignition switch position. Does the ignition switch parameter reading match the ignition switch position for all switch positions?	Go to **Step 5**	Go to **Power Mode Mismatch** in Body Control System
5	Attempt to start the engine. Does the engine crank?	Go to **Step 6**	Go to **Symptoms - Engine Electrical** in Engine Electrical
6	Did the engine start and idle?	Go to **Step 7**	Go to **Engine Cranks but Does Not Run**
7	**IMPORTANT:** **Do NOT clear the DTCs unless instructed by a diagnostic procedure.** 1. Select the DTC display function for the following control modules and record the DTCs: • PCM • EBCM • BCM 2. If multiple powertrain DTCs are stored, diagnose the DTCs in the following order: 1. Component level DTCs. For example, sensor DTCs, solenoid DTCs, and relay DTCs. Begin with the lowest number DTC unless the diagnostic table directs you otherwise. 2. System level DTCs. For example, misfire DTCs, EVAP system DTCs, fuel trim DTCs, and system voltage DTCs.		

	3. Search for applicable service bulletins. Does the scan tool display any DTCs?	Go to **Step 8**	Go to **Step 9**
8	If there are any powertrain DTCs, select Capture Info to store the powertrain DTC information with a scan tool. Did you complete the action?	Go to **Diagnostic Trouble Code (DTC) List** for applicable diagnostic procedure	-
9	Is the customer's concern with Inspection/Maintenance (I/M) testing?	Go to **Inspection/Maintenance (I/M) System Check**	Go to **Step 10**
10	Are there any driveability symptoms observed?	Go to **Symptoms - Engine Controls**	System OK

SCAN TOOL DATA LIST

The Engine Scan Tool Data List contains all engine related parameters that are available on the scan tool. The list is arranged in alphabetical order. A given parameter may appear in any one of the data lists, and in some cases may appear more than once, or in more than one data list in order to group certain related parameters together.

Use the Engine Scan Tool Data List only after the following is determined:

- The Diagnostic System Check - Engine Controls is completed.
- No diagnostic trouble codes (DTCs)
- On-board diagnostics are functioning properly.

Scan tool values from a properly running engine may be used for comparison with the engine you are diagnosing. The Engine Scan Tool Data List represents values that would be seen on a normal running engine.

IMPORTANT: A scan tool that displays faulty data should not be used. The scan tool problem should be reported to the manufacturer. Use of a faulty scan tool can result in misdiagnosis and unnecessary parts replacement.

Only the parameters listed below are referenced in this service manual for use in diagnosis. If all values are within the typical range described below, refer to **Symptoms - Engine Controls** for diagnosis.

The column labeled Data List indicates where a parameter can be located on the scan tool. Refer to the scan tool operating manual for the exact locations of the data lists. The following is a description of each term listed:

All

The Parameter is in all of the data lists indicated below.

Eng 1

Engine Data 1 List

Eng 2

Engine Data 2 List

EE

Enhanced Evaporative Emission (EVAP) Data

FF/FR

Freeze Frame/Failure Records

FT

Fuel Trim Data List

MF

Misfire Data List

TAC

Throttle Actuator Control (TAC) Data List

CC

Cruise Control Data List

HO2S Data

Heated Oxygen Sensor (HO2S) Data List

Scan Tool Data List

Scan Tool Parameter	Data List	Parameter Range/Units	Typical Data Values
Engine Idling/Radiator Hose Hot/Closed Throttle/Park or Neutral/Closed Loop/Accessories OFF			
4WD Signal	Eng 2	Enabled/Disabled	Disabled
4WD Low Signal	Eng 2	Enabled/Disabled	Disabled
A/C Pressure Sensor	Eng 2	Volts	0.98 Volts/Varies
A/C Pressure Sensor	Eng 2	PSI	90 PSI/Varies
A/C Relay Command	Eng 1, 2, MF	On/Off	Off
A/C Request Signal	Eng 2	Yes/No	No

APP Average	TAC	0-100%	0%
APP Indicated Angle	Eng 1, Eng 2, EE, CC, FT, TAC, HO2S	Counts	0
APP Sensor 1	TAC	0-5.0 Volts	0.4-0.9 Volts
APP Sensor 2	TAC	5.0-0 Volts	4.5-4.1 Volts
APP Sensor 1	TAC	0-100%	0%
APP Sensor 2	TAC	0-100%	0%
APP Sensor 1 and 2	TAC	Agree/Disagree	Agree
BARO	Eng 1, EE, FT	kPa	50-104 kPa/Varies w/Altitude
CMP Sensor - High to Low	Eng 2	Counts	Varies
CMP Sensor - Low to High	Eng 2	Counts	Varies
Clutch Pedal Switch	Eng 2	Released/Applied	Released
Coolant Level Switch	Eng 2	OK/Low	OK
Cruise Control Active	Eng 1, TAC, CC	Yes/No	No
Cruise Disengage 1 History	CC	Varies	Varies
Cruise Disengage 2 History	CC	Varies	Varies
Cruise Disengage 3 History	CC	Varies	Varies
Cruise Disengage 4 History	CC	Varies	Varies
Cruise Disengage 5 History	CC	Varies	Varies
Cruise Disengage 6 History	CC	Varies	Varies
Cruise Disengage 7 History	CC	Varies	Varies
Cruise Disengage 8 History	CC	Varies	Varies
Cruise Inhibit Signal Command	Eng 1	On/Off	On
Cruise On/Off Switch	CC, TAC	On/Off	Off
Cruise Release Brake Pedal Switch	CC	Released/Applied	Released
Cruise Resume/Accel Switch	CC, TAC	On/Off	Off
Cruise Set/Coast Switch	CC, TAC	On/Off	Off
Current Gear	Eng 1, 2, FT	0-4	1

Cycles of Misfire Data	MF	0-100 Counts	Varies
Decel Fuel Cutoff	HO2S	Active/Inactive	Inactive
Desired IAC Airflow	Eng 1	0-64 g/s	Varies
Desired Idle Speed	Eng 1, Eng 2, TAC, EE	RPM	PCM Controlled
DTC Set This Ignition	Eng 1, 2, CC, EE, FT, HO2S	Yes/No	No
ECT Sensor	Eng 1, Eng 2, EE, FT, MF, HO2S	-39 to +140°C (-38 to +284°F)	88-105°C (190-221°F)
Engine Load	All	0-100%	1-4% @ Idle 7-9% @ 2500 RPM
Engine Oil Level Switch	Eng 2	OK/Low	OK
Engine Oil Life Remaining	Eng 2	0-100%	Varies
Engine Oil Pressure Sensor	Eng 2	Volts	1.5 Volts/Varies
Engine Run Time	All	Hrs, Min, Sec	Varies
Engine Speed	All	0-10,000 RPM	500-700 RPM
EVAP Purge Solenoid Command	Eng 1, EE, FT	0-100%	10-25%
EVAP Test Result	EE	Test Result	Varies
EVAP Test State	EE	Test State	Varies
EVAP Vent Solenoid Command	Eng 1, EE, FT	Not Venting/Venting	Venting
Fail Counter	FF	Counts	Varies
Fuel Alcohol Content	Eng 2	%	Varies
Fuel Comp. Sensor Frequency	Eng 2	Hz	Varies
Fuel Comp. Sensor On Time	Eng 2	mS	Varies
Fuel Level Sensor	Eng 1, EE	0-5 Volts	0.7-2.5 Volts
Fuel Level Sensor Rear Tank, if equipped	Eng 1, EE	0-5 Volts	0.7-2.5 Volts
Fuel Tank Level Remaining	EE	Gallon/Liter	Varies
Fuel Tank Level Remaining	EE	0-100%	Varies
Fuel Tank Pressure Sensor	Eng 1, EE	-32.7 to +14.0 mm/Hg (-17.5 to +7.5 in/H2O)	Varies
Fuel Tank Pressure Sensor	EE	0-5.0 volts	Varies
Fuel Tank Rated Capacity	EE	98 Liters (25.9 Gallons) or 129 Liters (34 Gallons)	Varies with Fuel Tank Option

Fuel Temperature	Eng 2	°C/°F	Varies
Fuel Trim Cell	Eng 1, EE, FT	0-23	19
Fuel Trim Learn	Eng 1, EE, FT	Enabled/Disabled	Enabled, May Toggle
Generator F Terminal Signal	Eng 2	Percent	Varies
Generator L Terminal Signal Command	Eng 2	Off/On	On
HO2S Bank 1 Sensor 1	Eng 1, EE, FT, HO2S	Millivolts	10-1,000 mV and Varying
HO2S Bank 1 Sensor 2	Eng 1, FT, HO2S	Millivolts	10-1,000 mV and Varying
HO2S Bank 2 Sensor 1	Eng 1, EE, FT, HO2S	Millivolts	10-1,000 mV and Varying
HO2S Bank 2 Sensor 2	Eng 1, FT, HO2S	Millivolts	10-1,000 mV and Varying
HO2S Heater BN 1 Sensor 1	HO2S	Amps	Varies
HO2S Heater BN 1 Sensor 2	HO2S	Amps	Varies
HO2S Heater BN 2 Sensor 1	HO2S	Amps	Varies
HO2S Heater BN 2 Sensor 2	HO2S	Amps	Varies
Hot Run Counter	FF	Counts	Varies
IAT Sensor	Eng 1, Eng 2, EE, FT, HO2S	-39 to +140°C (-38 to +284°F)	35°C (91°F) Depends on Ambient Temperature
Ignition 1 Signal	Eng 1, Eng 2, CC, EE, FT, TAC	0-25 Volts	11.5-14.5 Volts
Inj. PWM Bank 1 Average	Eng 2, FT, MF	Milliseconds	2-6
Inj. PWM Bank 2 Average	Eng 2, FT, MF	Milliseconds	2-6
Knock Retard	Eng 1	0.0-16°	0°
Long Term FT Avg. Bn1	FT	Percentage	Near 0%
Long Term FT Avg. Bn2	FT	Percentage	Near 0%
Long Term FT Bank 1	Eng 1, Eng 2, EE, FT, HO2S	Percentage	Near 0%
Long Term FT Bank 2	Eng 1, Eng 2, EE, FT, HO2S	Percentage	Near 0%
Loop Status	Eng 1, 2, EE, FT, HO2S	Open/Closed	Closed
Low Oil Lamp Command	Eng 2	On/Off	Off
MAF Sensor	Eng 1, Eng 2, EE, MF, FT, TAC,	Grams Per Seconds (g/s)	1-9 g/s @ Idle, Depends on Altitude

	HO2S		15-26 g/s @ 2,500 RPM, Depends on Altitude
MAF Sensor	Eng 2	0-31,999 Hz	2,000-3,000 Hz
MAP Sensor	Eng 1, Eng 2, EE, FT, MF, TAC, HO2S	kPa	20-48 kPa
MAP Sensor	Eng 1, Eng 2, FF/FR	Volts	1.0-2.0 Volts Varies with Altitude
MIL Command	Eng 2	Off/On	Off
Mileage Since DTC Cleared	Eng 2	kilometers/miles	Varies
Mileage Since First Failure	FF	Counts	Varies
Mileage Since Last Failure	FF	Counts	Varies
Misfire Counter Status	MF	Normal/Invalid	Normal
Misfire Current Cyl. 1-8	MF	0-200 Counts	0
Misfire History Cyl. 1-8	MF	0-65,535 Counts	0
Pass Counter	FF	Counts	Varies
PCM Reset	Eng 1, Eng 2, EE, FT	Yes/No	No
PCM/VCM in VTD Fail Enable	Eng 1	Yes/No	No
Power Enrichment	Eng 1, HO2S	Active/Inactive	Inactive
Reduced Engine Power	Eng 1, CC, TAC	Active/Inactive	Inactive
Short Term FT Avg Bn1	FT	Percentage	Near 0%
Short Term FT Avg Bn2	FT	Percentage	Near 0%
Short Term FT Bank 1	Eng 1, Eng 2, EE, FT, HO2S	Percentage	Near 0%
Short Term FT Bank 2	Eng 1, Eng 2, EE, FT, HO2S	Percentage	Near 0%
Spark	Eng 1, Eng 2, FT, MF, HO2S	Degrees	15-20°
Start Up ECT	Eng 2, EE, FT	C°/F°	Varies
Stop Lamp Pedal Switch	CC, TAC	Applied/Released	Released
TAC/PCM Comm Signal	TAC, CC	OK/Fault	OK
TCC Enable Solenoid Command	Eng 1, Eng 2	On/Off	Off
TCC PWM Solenoid Command	Eng 2	On/Off	Off
TFP Switch	Eng 2, CC, FT	Transmission Gear Position	Varies
Torque Delivered Signal	Eng 2, TAC	N.m lb ft	Varies
Torque Request Signal	Eng 2, TAC	N.m lb ft	406 N.m 299 lb ft

TP Desired Angle	Eng 1, Eng 2, EE, TAC, CC	0-100%	5.5%
TP Indicated Angle	All	0-100%	5.5%
TP Sensor 1	TAC	0-5.0 Volts	0.4-0.9 Volts
TP Sensor 1	TAC	0-100%	Varies near 0%
TP Sensor 2	TAC	5.0-0 Volts	Volts
TP Sensor 2	TAC	100-0%	Varies
TP Sensors 1 and 2	TAC	Agree/Disagree	Agree
TR Switch	CC, FT	Transmission Gear	Varies
Traction Control Signal	Eng 2, CC, TAC	Active/Inactive	Inactive
Vehicle Speed Sensor	All	km/h mph	0
VTD Auto Learn Timer	Eng 1	Active/Inactive	Inactive
VTD Fuel Disable	Eng 1	Active/Inactive	Inactive
VTD Fuel Disable Until Ign. Off	Eng 1	Yes/No	No
Warm-Ups w/o Emission Faults	Eng 2	0-255 Counts	Varies
Warm-Ups w/o Non-Emission Faults	Eng 2	0-255 Counts	Varies

SCAN TOOL DATA DEFINITIONS

The Engine Scan Tool Data Definitions contains a brief description of all engine related parameters available on the scan tool. The list is in alphabetical order. A given parameter may appear in any one of the data lists. In some cases, the parameter may appear more than once or in more than one data list in order to group certain related parameters together.

4WD Signal

This parameter displays the state of the transfer case based on the signal from the front axle indicator switch. The scan tool will display Enabled or Disabled. Enabled indicates the front axle is locked in four wheel drive and the front axle indicator switch is closed, supplying voltage to the controller on the axle switch signal circuit. Disabled indicates the transfer case is not in four wheel drive and the front axle indicator switch is open.

4WD Low Signal

This parameter displays the state of the transfer case based on the signal from the four wheel drive (4WD) low switch. The scan tool will display Enabled or Disabled. Enabled indicates the transfer case is in 4WD low gear and the 4WD low switch is closed, completing the low signal circuit. Disabled indicates the transfer case is not in 4WD low gear and the 4WD low switch is open.

A/C Relay Command

This parameter displays the commanded state of the air conditioning (A/C) clutch relay control circuit. The scan tool will display ON or OFF. ON indicates the A/C clutch relay control circuit is being grounded by the control module, allowing voltage to the A/C compressor clutch. OFF indicates the A/C clutch relay is not being commanded on by the control module.

A/C Request Signal

This parameter displays the state of the air conditioning (A/C) request input to the control module from the heating, ventilation, and air conditioning (HVAC) controls. The scan tool will display Yes or No. Yes indicates the control module is receiving a request from the HVAC system to ground the A/C clutch relay control circuit, engaging the A/C compressor clutch. No indicates the control module is not receiving a request from the HVAC system to ground the A/C clutch relay control circuit.

APP Average

This parameter displays the average of the 3 accelerator pedal position (APP) sensors as calculated by the throttle actuator control (TAC) module. The APP average is a range of values indicating a low number when the accelerator pedal is not pressed to a high number when the accelerator pedal is fully pressed. This value is listed in counts.

APP Indicated Angle

This parameter displays the angle of the accelerator pedal as calculated by the control module using the signals from the accelerator pedal position sensors. The APP indicated angle is a range of values indicating a low percentage when the accelerator pedal is not pressed to a high percentage when the accelerator pedal is fully pressed.

APP Sensor 1

This parameter displays the voltage signal sent to the control module from accelerator pedal position (APP) sensor 1 of the APP sensor assembly. APP sensor 1 is a range of values indicating a low voltage when the accelerator pedal is not pressed to a high voltage when the accelerator pedal is fully pressed.

APP Sensor 1

This parameter displays the angle of the accelerator pedal position (APP) sensor 1 as calculated by the control module using the signal from the APP sensor 1. APP sensor 1 is a range of values indicating a low percentage when the accelerator pedal is not pressed to a high percentage when the accelerator pedal is fully pressed.

APP Sensor 1 and 2

This parameter displays the results of a control module test that compares the signals from the accelerator pedal position (APP) sensors 1 and 2. The scan tool will display Agree or Disagree. Agree indicates that APP sensor 1 and APP sensor 2 voltages correspond to the same accelerator pedal position. Disagree indicates that APP sensor 1 and APP sensor 2 voltages correspond to different accelerator pedal positions.

APP Sensor 2

This parameter displays the voltage signal sent to the control module from accelerator pedal position (APP) sensor 2 of the APP sensor assembly. APP sensor 2 is a range of values indicating a low voltage when the accelerator pedal is not pressed to a high voltage when the accelerator pedal is fully pressed.

APP Sensor 2

This parameter displays the angle of the accelerator pedal position (APP) sensor 2 as calculated by the control module using the signal from the APP sensor 2. APP sensor 2 is a range of values indicating a low percentage when the accelerator pedal is not pressed to a high percentage when the accelerator pedal is fully pressed.

BARO

This parameter displays the barometric pressure as calculated by the control module using the signal from the manifold absolute pressure (MAP) sensor measured when the ignition is turned on with the engine not running. The control module will update the barometric pressure during wide-open throttle (WOT) conditions.

Clutch Pedal Switch

This parameter displays the current state of the clutch pedal as determined by the control module.

CMP Sensor - High To Low

This parameter displays the number of times the signal voltage from the camshaft position (CMP) sensor changes from high to low. The scan tool will display these transitions as counts.

CMP Sensor - Low To High

This parameter displays the number of times the signal voltage from the camshaft position (CMP) sensor changes from low to high. The scan tool will display these transitions as counts.

Coolant Level Switch

This parameter displays the level of engine coolant as determined by the control module. The control module determines the level of the coolant using the signal from a switch used to monitor the engine coolant level. The scan tool will display low when the engine coolant level is low. The scan tool will display OK when the coolant level is correct.

Cruise Control Active

This parameter displays the status of the cruise control system as determined by the control module. The scan tool will display Yes when the cruise control system is in control of vehicle speed. The scan tool will display No when the cruise control system is not operating.

Cruise Disengage 1-8 History

The scan tool indicates the last 8 cruise control disengages in order, from 1 to 8. There are 20 possible causes for the cruise control to disengage.

Cruise Inhibit Signal Command

This parameter displays the commanded state of the cruise inhibit signal circuit. The scan tool will display On when the control module is inhibiting cruise control operation. The scan tool will display OFF when the control module is allowing cruise control operation.

Cruise On/Off Switch

This parameter displays the state of the On/Off switch input to the control module. The scan tool will display ON when the cruise switch is ON.

Cruise Release Brake Pedal Switch

This parameter displays the state of the Cruise Release Brake Pedal Switch as determined by the control module. The scan tool will display Released or Applied. Released indicates the brake pedal is not being pushed down, allowing the cruise control to be enabled. Applied indicates the brake switch is being applied, disabling cruise control operation.

Cruise Resume/Accel Switch

This parameter displays the state of the Resume/Accel switch input to the control module when the cruise control switch is in the on position and the Resume/Accel switch is activated, the scan tool displays On. When the Resume/Accel switch is released the scan tool displays OFF.

Cruise Set/Coast Switch

This parameter displays the state of the Set/Coast switch input to the control module from the cruise control system. When the cruise control switch is in the on position and the Set/Coast switch is activated, the scan tool displays On. When the Set/Coast switch is released the scan tool displays OFF.

Current Gear

This parameter displays the transmission gear commanded by the control module. The scan tool will display 1 when the control module has commanded first gear regardless of the gear selector position. The scan tool will display up to 6 depending upon which gear is commanded and what transmission is in the vehicle. The scan tool will display 9 if the transmission gear is not known.

Cycles Of Misfire Data

This parameter displays the number of cylinder firing events that were recorded as misfires as determined by the control module.

Decel. Fuel Cutoff

This parameter displays the status of the operating mode used to turn OFF the fuel injectors during certain deceleration conditions. When the scan tool displays Active, the control module has turned OFF the fuel injectors. When the scan tool displays Inactive, the fuel system is operating normally.

Desired IAC Airflow

This parameter displays the desired airflow in the idle air control (IAC) passage as calculated by the control module.

Desired Idle Speed

This parameter displays the engine idle speed in RPM commanded by the control module. The control module compensates for various engine loads in order to maintain the desired engine RPM at idle. This parameter is not valid unless the engine is running.

DTC Set This Ignition

This parameter displays if a diagnostic trouble code (DTC) set during the current ignition cycle. The scan tool will display YES if a DTC is stored this ignition cycle.

ECT Sensor

This parameter displays the temperature of the engine coolant based on a voltage input from the engine coolant temperature (ECT) sensor to the control module. The scan tool will display a low value when coolant temperature is low, and a high value when the coolant temperature is high.

Engine Load

This parameter displays the engine load in percent based on inputs to the control module from various engine sensors. The scan tool will display a low percentage when the engine is at idle with little or no load. The scan tool will display a high percentage when the engine is running at a high RPM under a heavy load.

Engine Oil Level Switch

This parameter displays the state of the engine oil level switch as determined by the control module. The scan tool will display OK or Low. OK indicates that the engine oil level is not too low for safe operation of the engine. Low indicates the engine oil level is abnormally low and has closed the engine oil level switch.

Engine Oil Life Remaining

This parameter displays the amount of engine oil life remaining before requiring an oil change. This number is calculated by the control module based on many inputs and is displayed as a percent. The lower the percentage, the sooner the next oil change will be required.

Engine Run Time

This parameter displays the time elapsed since the engine was started. The scan tool will display the time in hours, minutes and seconds. The engine run time will reset to zero as soon as the engine stops running.

Engine Speed

This parameter displays the speed of the crankshaft as calculated by the control module based on inputs from the crankshaft position (CKP) sensor. The scan tool will display the engine speed in revolutions per minute (RPM).

EVAP Purge Solenoid Command

This parameter displays the on-time or duty cycle of the evaporative emission (EVAP) purge solenoid commanded by the control module expressed as a percent. The scan tool will display a high percentage when the control module is commanding the EVAP purge solenoid to be open a large amount. The scan tool will display a low percentage when the control module is commanding the EVAP purge solenoid to be open a small amount. The scan tool will display 0 when the control module is commanding the EVAP purge solenoid closed.

EVAP Test Result

The scan tool displays No Result, Passed, Aborted, Fail-DTC P0440, Fail-DTC P0442, Fail-DTC P0446, or Fail-DTC P1441. The scan tool displays PASS if the control module determines that the EVAP test has passed.

EVAP Test State

The scan tool displays Waiting For Purge, Test Running, or Test Completed. This parameter indicates the state of the EVAP service bay test.

EVAP Vent Solenoid Command

This parameter displays the commanded state of the EVAP vent solenoid control circuit. The scan tool will display Venting or Not Venting. Venting indicates the EVAP vent solenoid is not being commanded on by the control module. Not Venting indicates the EVAP vent solenoid is being commanded ON by the control module.

Fail Counter

The scan tool displays the number of times that a diagnostic has failed.

Fuel Alcohol Content

This parameter displays the percentage of alcohol in the fuel. This value is calculated by the control module using the frequency signal from the fuel composition sensor. The scan tool will display a low percentage when there is very little alcohol in the fuel. The scan tool will display a high percentage when the alcohol content of the fuel is high.

Fuel Composition Sensor Frequency

This parameter displays the frequency from the sensor used to monitor the concentration of alcohol in the fuel. The fuel composition sensor measures the fuel capacitance, temperature, and fuel conductance to determine the amount of alcohol contained in the fuel. The scan tool will display a low frequency reading when the alcohol concentration of the fuel is low. The scan tool will display a high frequency reading when the alcohol concentration of the fuel is high.

Fuel Composition Sensor On Time

This parameter displays the pulse width signal of the fuel composition sensor as received by the control module. The scan tool will display a lower value at colder fuel temperatures. The scan tool will display a higher value at higher fuel temperatures.

Fuel Level Sensor

This parameter displays the voltage from the signal produced by the sensor used to monitor the fuel level inside the fuel tank. The scan tool will display a low voltage reading when the fuel level in the tank is low or near empty. The scan tool will display a high voltage reading when the fuel level in the tank is high or near full.

Fuel Level Sensor Rear Tank

This parameter displays the voltage from the signal produced by the sensor used to monitor the fuel level inside the rear fuel tank. The scan tool will display a low voltage reading when the fuel level in the rear tank is low or near empty. The scan tool will display a high voltage reading when the fuel level in the tank is high or near full.

Fuel Tank Level Remaining

This parameter displays the amount of fuel remaining in all fuel tanks of the vehicle as measured in liters or gallons. The control module calculates the amount of fuel remaining in the tank by using information from the fuel level sensors.

Fuel Tank Level Remaining

This parameter displays the amount of fuel remaining in tall of the fuel tanks of the vehicle as a percentage. The control module calculates this level using the signals from the sensors used to monitor the fuel level in the fuel tanks. The scan tool will display a low reading when the total fuel level in the vehicle is low or near empty. The scan tool will display a high reading when the fuel level in the tank is high or near full.

Fuel Tank Pressure Sensor

This parameter indicates the pressure or vacuum in the fuel tanks as determined by the control module based on inputs from the fuel tank pressure sensor. The scan tool displays in mm/Hg or in H2O. The scan tool indicates a negative value if there is a vacuum in the fuel tank, and a positive value if there is pressure in the fuel tank.

Fuel Tank Pressure Sensor

This parameter displays the voltage signal sent to the control module from the sensor used to monitor the pressure inside the fuel tank. The scan tool will display a low voltage when the pressure in the fuel tank is high. The scan tool will display a high voltage when the pressure in the fuel tank is low or in a vacuum.

Fuel Tank Rated Capacity

The scan tool displays liters or gallons. This parameter displays the fuel tank capacity as determined by the calibrations of the vehicle.

Fuel Temperature

This parameter displays the current fuel temperature as calculated by the control module based on input from the fuel composition sensor. The scan tool will display a higher value at higher fuel temperatures. The scan tool will display a lower value at lower fuel temperatures.

Fuel Trim Cell

This parameter displays the fuel trim cell as calculated by the control module based on many sensor inputs. The fuel trim cell indicates which cell is currently active.

Fuel Trim Learn

The scan tool displays Enabled or Disabled. When conditions are appropriate for enabling long term fuel trim corrections, the scan tool displays Enabled. If the scan tool displays Disabled, then long term fuel trim will not respond to changes in short term fuel trim.

Generator F-Terminal Signal

This parameter displays the commanded state of the generator by the control module. A high value indicates a high charging command, and a low value indicates a low charging command.

Generator L-Terminal Signal Command

This parameter displays if the control module is allowing the generator to operate. The scan tool displays ON if the generator is allowed to operate. The scan tool displays OFF if the control module is disabling the generator.

HO2S Bank 1 Sensor 1

This parameter displays the voltage from the signal produced by the heated oxygen sensor used to monitor fuel trim for cylinder bank 1. The scan tool will display a low voltage reading when that cylinder bank is running lean. The scan tool will display a high voltage reading when that cylinder bank is running rich.

HO2S Bank 1 Sensor 2

This parameter displays the voltage from the signal produced by the heated oxygen sensor used to monitor catalyst efficiency for cylinder bank 1. The scan tool will display a low voltage reading when that cylinder bank is running lean. The scan tool will display a high voltage reading when that cylinder bank is running rich.

HO2S Bank 2 Sensor 1

This parameter displays the voltage from the signal produced by the heated oxygen sensor used to monitor fuel trim for cylinder bank 2. The scan tool will display a low voltage reading when that cylinder bank is running lean. The scan tool will display a high voltage reading when that cylinder bank is running rich.

HO2S Bank 2 Sensor 2

This parameter displays the voltage from the signal produced by the heated oxygen sensor used to catalyst efficiency for cylinder bank 2. The scan tool will display a low voltage reading when that cylinder bank is running lean. The scan tool will display a high voltage reading when that cylinder bank is running rich.

HO2S Heater Bank 1 Sensor 1

This parameter displays the current through the control module when the bank 1 sensor 1 HO2S heater is commanded ON by the control module. HO2S Heater Bank 1 Sensor 1 is a range of values indicating a low current when the heater circuit resistance is high to a high current when the heater circuit resistance is low.

HO2S Heater Bank 1 Sensor 2

This parameter displays the current through the control module when the bank 1 sensor 2 HO2S heater is commanded ON by the control module. HO2S Heater Bank 1 Sensor 2 is a range of values indicating a low current when the heater circuit resistance is high to a high current when the heater circuit resistance is low.

HO2S Heater Bank 2 Sensor 1

This parameter displays the current through the control module when the bank 2 sensor 1 HO2S heater is commanded ON by the control module. HO2S Heater Bank 2 Sensor 1 is a range of values indicating a low current when the heater circuit resistance is high to a high current when the heater circuit resistance is low.

HO2S Heater Bank 2 Sensor 2

This parameter displays the current through the control module when the bank 2 sensor 2 HO2S heater is commanded ON by the control module. HO2S Heater Bank 2 Sensor 2 is a range of values indicating a low current when the heater circuit resistance is high to a high current when the heater circuit resistance is low.

IAT Sensor

This parameter displays the temperature of the intake air calculated by the control module based on the input from the intake air temperature (IAT). The scan tool will display a low value for a low intake air temperature, and a high value for a high intake air temperature.

Ignition 1 Signal

This parameter displays the voltage measured at the ignition 1 circuit of the control module. Voltage is applied to the control module when the ignition switch is in the ignition 1 position.

Injector PWM Bank 1 Average

The scan tool displays milliseconds. This parameter is the average time the control module turns on each fuel injector on that bank. The scan tool will display a higher value with a longer pulse width, or a lower value with a shorter pulse width.

Injector PWM Bank 2 Average

The scan tool displays milliseconds. This parameter is the average time the control module turns on each fuel injector on that bank. The scan tool will display a higher value with a longer pulse width, or a lower value with a shorter pulse width.

Knock Retard

The scan tool displays in degrees. This parameter indicates the amount of timing retard commanded by the control module. The scan tool will display a lower value if no knock is detected, and a higher value as more knock is detected and the control module retards the ignition timing.

Long Term FT Avg. Bn1

The scan tool displays %. This parameter is the average long term fuel trim for this bank as calculated by the control module. The scan tool will display a value of more than 0 percent indicating that time is being added to the injector pulse width, increasing the amount of fuel to this bank of the engine. The scan tool will display a value of less than 0 indicating time is being subtracted from the injector pulse width, reducing the amount of fuel to this bank of the engine. A value of 0 percent indicates no compensation is required to operate the engine at the desired air/fuel ratio.

Long Term FT Avg. Bn2

The scan tool displays %. This parameter is the average long term fuel trim for this bank as calculated by the control module. The scan tool will display a value of more than 0 percent indicating that time is being added to the injector pulse width, increasing the amount of fuel to this bank of the engine. The scan tool will display a value of less than 0 indicating time is being subtracted from the injector pulse width, reducing the amount of fuel to this bank of the engine. A value of 0 percent indicates no compensation is required to operate the engine at the desired air/fuel ratio.

Long Term FT Bank 1

The scan tool displays %. This parameter is the long term fuel trim for this bank as calculated by the control module. The scan tool will display a value of more than 0 percent indicating that time is being added to the injector pulse width, increasing the amount of fuel to this bank of the engine. The scan tool will display a value of less than 0 indicating time is being subtracted from the injector pulse width, reducing the amount of fuel to this bank of the engine. A value of 0 percent indicates no compensation is required to operate the engine at the desired air/fuel ratio.

Long Term FT Bank 2

The scan tool displays %. This parameter is the long term fuel trim for this bank as calculated by the control module. The scan tool will display a value of more than 0 percent indicating that time is being added to the injector pulse width, increasing the amount of fuel to this bank of the engine. The scan tool will display a value of less than 0 indicating time is being subtracted from the injector pulse width, reducing the amount of fuel to this bank of the engine. A value of 0 percent indicates no compensation is required to operate the engine at the desired air/fuel ratio.

Loop Status

The scan tool displays Open or Closed. The scan tool displays Closed Loop if the control module is controlling the fuel delivery according to the heated oxygen sensor (HO2S) voltages. The scan tool displays open loop if the control module is not adjusting for HO2S inputs. In open loop the control module bases fuel deliver on throttle position, engine coolant temperature, and mass airflow sensor inputs.

Low Oil Lamp Command

This parameter displays the commanded state of the low oil lamp control circuit by the control module. The scan tool will display ON if the lamp is commanded ON by the control module. The scan tool will display OFF if the lamp is not being commanded by the control module.

MAF Sensor

The scan tool displays g/s. This parameter indicates the airflow into the engine as calculated by the control module based on mass airflow (MAF) sensor inputs. The scan tool will display a high value at higher engine speeds, and a low value at idle.

MAF Sensor

The scan tool displays in Hz. This parameter indicates the frequency signal sent from the MAF sensor to the control module. the scan tool will display a high value indicates a higher engine speed. The scan tool will display a low value at idle.

MAP Sensor

The scan tool displays kPa. This parameter displays the pressure inside of the intake manifold as calculated by the control module based on the input from the MAP sensor. The scan tool will display a high value at wide open throttle (WOT). The scan tool will display a low value at idle speed.

MAP Sensor

This parameter displays the voltage signal from the MAP sensor to the control module. The scan tool will display a high value at wide open throttle (WOT). The scan tool will display a low value at idle speed.

MIL Command

This parameter displays the commanded state of the malfunction indicator lamp (MIL) control circuit. The malfunction indicator lamp should be ON when the scan tool indicates the MIL Command is ON. The malfunction indicator lamp should be OFF when the scan tool indicates the MIL Command is OFF. The control module will command the MIL ON when the ignition is ON with the engine OFF in order to perform a bulb check.

Mileage Since DTC Cleared

The scan tool displays km or miles. This parameter indicates the mileage accumulated since an emission diagnostic trouble code cleared.

Mileage Since First Failure

The scan tool will display in km or miles. This parameter indicates the difference in mileage between when the DTC first set and the current vehicle mileage as calculated by the control module.

Mileage Since Last Failure

The scan tool will display in km or miles. This parameter indicates the difference in mileage between when the DTC last set and the current vehicle mileage as calculated by the control module.

Misfire Counter Status

The misfire counter shows the relative number of failed misfire tests since the misfire DTC P0300 became active.

Misfire Current Cyl. #1 - #8

The scan tool will display in counts. This parameter indicates the number of cylinder firing events detected as possible misfires on each cylinder during the last 200 crankshaft revolutions as calculated by the control module. The scan tool will display a low number for a low number of cylinder misfire events. The scan tool will display a high number for a high number of cylinder misfire events.

Misfire History Cyl. #1 - #8

The scan tool displays in counts. This parameter displays the total level of cylinder misfires that have been calculated for each cylinder by the control module. This parameter will not update or show activity until a misfire DTC has become active. The misfire history counters will update every 200 cylinder firing events.

Not Run Counter

The scan tool displays the number of times a DTC diagnostic has not reached the predetermined criteria in order to run since the first DTC run failure.

Pass Counter

The scan tool displays the number of times a DTC has run and passed.

PCM Reset

The scan tool displays Yes or No. This parameter indicates when the internal PCM resets. The scan tool displays YES when an internal PCM reset occurred. The scan tool displays NO under the normal operating conditions.

PCM/VCM in VTD Fail Enable

The scan tool displays Yes or No. The scan tool displays Yes if the body control module (BCM) and the control module lose communications with each other after the BCM sends the correct password. The scan tool displays No if the BCM is communicating the correct password to the PCM.

Power Enrichment

Scan tool displays ACTIVE or INACTIVE. ACTIVE displayed indicates that the control module has detected conditions appropriate to operate in Power Enrichment mode. The control module commands Power Enrichment mode when a large increase in throttle position and load is detected. While in Power Enrichment, the control module will increase the amount of fuel delivered by entering Open Loop and increasing the injector pulse width.

Reduced Engine Power

The scan tool displays Active or Inactive. The scan tool displays Active when the control module receives a signal from the TAC module that a throttle actuator control system fault is occurring. The scan tool displays inactive when the engine is operating normally.

Short Term FT Avg. Bn1

The scan tool displays %. This parameter indicates the average short term fuel trim for this bank. The scan tool will display a value more than 0 if the time is being added to the injector pulse width, increasing the amount of fuel to that bank of the engine to compensate for a lean condition sensed by the oxygen sensors on that bank. The scan tool will display a value less than 0 if time is being subtracted from the injector pulse width, reducing the amount of fuel to the engine to compensate for a rich condition sensed by the oxygen sensors on that bank. A value of 0 percent indicates no compensation is required to operate the engine at the desired air/fuel ratio.

Short Term FT Avg. Bn2

The scan tool displays %. This parameter indicates the average short term fuel trim for this bank. The scan tool will display a value more than 0 if the time is being added to the injector pulse width, increasing the amount of fuel to that bank of the engine to compensate for a lean condition sensed by the oxygen sensors on that bank. The scan tool will display a value less than 0 if time is being subtracted from the injector pulse width, reducing the amount of fuel to the engine to compensate for a rich condition sensed by the oxygen sensors on that bank. A value of 0 percent indicates no compensation is required to operate the engine at the desired air/fuel ratio.

Short Term FT Bank 1

The scan tool displays %. This parameter indicates the current short term fuel trim for this bank. The scan tool will display a value more than 0 if the time is being added to the injector pulse width, increasing the amount of fuel to that bank of the engine to compensate for a lean condition sensed by the oxygen sensors on that bank. The scan tool will display a value less than 0 if time is being subtracted from the injector pulse width, reducing the amount of fuel to the engine to compensate for a rich condition sensed by the oxygen sensors on that bank. A value of 0 percent indicates no compensation is required to operate the engine at the desired air/fuel ratio.

Short Term FT Bank 2

The scan tool displays %. This parameter indicates the current short term fuel trim for this bank. The scan tool will display a value more than 0 if the time is being added to the injector pulse width, increasing the amount of fuel to that bank of the engine to compensate for a lean condition sensed by the oxygen sensors on that bank. The scan tool will display a value less than 0 if time is being subtracted from the injector pulse width, reducing the amount of fuel to the engine to compensate for a rich condition sensed by the oxygen sensors on that bank. A value of 0 percent indicates no compensation is required to operate the engine at the desired air/fuel ratio.

Spark

This parameter is the desired spark advance calculated by the control module based on many sensor inputs. The scan tool will display a lower value at idle speed, and a higher value under heavy acceleration and load conditions.

Start Up ECT

This parameter indicates the engine coolant temperature at startup, as calculated by the control module based on the input from the engine coolant temperature sensor. The scan tool will display a higher value at higher engine startup temperatures, and a lower value at lower startup temperatures.

Stop Lamp Pedal Switch

This parameter displays the state of the brake pedal as determined by the control module based on an input from the stop lamp pedal switch. This switch turns ON the stop lamps when the brake pedal is pressed. The scan tool will display Applied when the brake pedal is pressed.

TAC/PCM Communication Signal

This parameter indicates the status of the communication between the TAC module and the control module. The scan tool will display OK if the circuits are operating normally. The scan tool will display Fault if there is an interrupt in the communication.

TCC Enable Solenoid Command

This parameter displays the commanded state of the torque converter clutch (TCC) solenoid control circuit. The scan tool will display ON or OFF. ON indicates the TCC solenoid control circuit is being grounded by the control module, operating the torque converter. OFF indicates the TCC solenoid is not being commanded ON by the control module.

TCC PWM Solenoid Command

This parameter indicates the commanded state of the TCC PWM Solenoid by the control module. The scan tool displays ON or OFF. The scan tool displays ON when the commanded state of the solenoid is ON. The scan tool displays OFF when the solenoid is OFF.

TFP Switch

The scan tool displays Park/Neutral, Reverse, Drive, or Invalid. This display indicates the decoded status of the two A/B inputs from the automatic transmission fluid pressure manual valve position switch.

Torque Delivered Signal

The scan tool displays ft-lbs or N.m. This parameter represents the pulse width modulation (PWM) signal which indicates the percent of available torque the engine is delivering to the drive wheels. The electronic brake/traction control module (EBCM) monitors the Traction Control Torque signal to ensure that the powertrain control module (PCM) is responding properly to the Traction Control Desired Torque signal.

Torque Request Signal

The scan tool displays ft-lbs or N.m. Represents the pulse width modulation (PWM) signal from the electronic brake and traction control module. The electronic brake/traction control module (EBCM) reduces the traction control desired torque signal pulse width when a drive wheel slippage situation is detected. The powertrain control module (PCM) monitors the traction control desired torque signal and reduces drive wheel slippage as necessary by retarding spark timing, decreasing boost solenoid PWM, or increasing air/fuel ratio. The PCM can also turn OFF up to three fuel injectors if the traction control desired torque signal indicates a large enough amount of drive wheel slippage.

TP Desired Angle

This parameter indicates the TP angle commanded by the control module. The scan tool will display a low value at idle, and a high value at wide open throttle (WOT).

TP Indicated Angle

This parameter displays the angle of the throttle position (TP) in percent. This information is calculated by the control module using the signals from the throttle position sensors. The scan tool will display a low percentage when the throttle plates are closed. The scan tool will display a high percentage when the throttle plates are fully open.

TP Sensor 1

This parameter displays the voltage signal sent to the control module from the sensor used to monitor the position of the throttle plates. This parameter is for sensor 1 of the throttle position (TP) sensor assembly. The scan tool will display a low voltage when the throttle plates are at rest. The scan tool will display a high voltage when the throttle plates are fully open.

TP Sensor 1

This parameter displays the angle of the throttle position (TP) sensor 1 in percent. This information is calculated by the control module using the signal from the throttle position sensor 1. The scan tool will display a low percentage when the throttle plates are closed. The scan tool will display a high percentage when the throttle plates are fully open.

TP Sensor 2

This parameter displays the voltage signal sent to the control module from the sensor used to monitor the position of the throttle plates. This parameter is for sensor 2 of the throttle position (TP) sensor assembly. The scan tool will display a high voltage when the throttle plates are at rest. The scan tool will display a low voltage when the throttle plates are fully open.

TP Sensor 2

This parameter displays the angle of the throttle position (TP) sensor 2 in percent. This information is calculated by the control module using the signal from the throttle position sensor 2. The scan tool will display a low percentage when the throttle plates are closed. The scan tool will display a high percentage when the throttle plates are fully open.

TP Sensors 1 and 2

This parameter displays the results of a control module test that compares signals from the throttle position (TP) sensors 1 and 2. The scan tool will display Agree when the signal from TP sensor 1 corresponds with the signal from TP sensor 2. The scan tool will display Disagree when the signal from TP sensor 1 conflicts with the signal from TP sensor 2.

TR Switch

This parameter indicates the current state of the gear select switch on the transmission/transaxle as calculated by the control module based on the TR switch. The scan tool status will switch from High to Low as different combinations are met. On the scan tool in Park, the PRNDL would read P and A will be Low, and B and C will be High.

Traction Control Signal

This parameter displays the current status of the traction control system. The scan tool will display ACTIVE if the traction control system is operating. The scan tool will display INACTIVE if the traction control system is not requested because of a wheel slippage condition.

Vehicle Speed Sensor

This parameter indicates the vehicle speed calculated by the control module based on an input from the vehicle speed sensor (VSS). The scan tool will display a high value at higher vehicle speeds, and a low value at lower vehicle speeds.

VTD Auto Learn Timer

The scan tool displays Active/Inactive. This parameter indicates if the control module is ready to learn the theft deterrent password. The scan tool will display active if the system is ready to learn. The scan tool will display inactive if the system has timed out or is not ready to learn the password.

VTD Fuel Disable

This parameter Indicates if the VTD module has received proper information to enable or disable fuel. The scan tool will display Active or Inactive. The scan tool will display Active if the control module does not receive the correct password from the BCM. The scan tool will display Inactive if the control module receives the correct password from the BCM. If the system is Active, the engine will not start.

VTD Fuel Disable Until Ignition Off

The scan tool displays Yes or No. With the ignition ON and a VTD code present, the scan tool displays Yes.

Warm-ups w/o Emission Faults

The scan tool displays in counts. This parameter counts the number of warm up cycles without an emission fault present. The parameter increments until a fault occurs. If a fault occurs, the counter reverts to 0 until the fault is corrected. Clearing information with a scan tool or a loss of power to the PCM also resets the counter to 0.

Warm-ups w/o Non-Emission Faults

The scan tool displays in counts. This parameter counts the number of warm up cycles without a non-emission fault present. The parameter increments until a fault occurs. If a fault occurs, the counter reverts to 0 until the fault is corrected. Clearing information with a scan tool or a loss of power to the PCM also resets the counter to 0.

SCAN TOOL OUTPUT CONTROLS

Scan Tool Output Controls

Scan Tool Output Control	Additional Menu Selection (s)	Description
Crankshaft Position Variation Learn	-	Enables the powertrain control module (PCM) to learn the variations in the crankshaft position (CKP) system. The PCM will learn the variations once the following conditions are met: • Engine coolant temperature (ECT) is more than a specified value. • All instructions on the scan tool have been completed. • The accelerator pedal is smoothly applied until the fuel cut-OFF, as specified on the scan tool, is achieved, and then immediately released. The PCM learns the variation values on the deceleration from fuel cut-OFF.
Cylinder Power Balance	Fuel System	Enables/Disables a cylinder by turning OFF the fuel injector to the cylinder. The fuel injector is normally enabled. The PCM disables the fuel injector when the following conditions are met: • All instruction on the scan tool are completed • Stabilized engine speed • The fuel injector is selected When Disable is selected the PCM turns the injector OFF for 30 seconds. During this period, the engine operates with a misfire.
Engine Speed Control	TAC System	Activates the throttle activation control (TAC) system to change engine RPM. The normal commanded state is None. To enable the RPM control, all instruction on the scan tool must be completed. The system will increase or decrease the RPM within a range of 350-2000 RPM. The set step value changes the RPM by increments of 25 RPM, 100 RPM, and 500 RPM. The system remains in the commanded state until cancelled by the scan tool.
EVAP Purge	Engine Output	Activates the evaporative emission (EVAP) purge valve. The normal commanded state is None. The system will increase or decrease the amount of EVAP purge valve opening by 10 percent increments within

Solenoid	Controls/EVAP System	a range of 0-100 percent. The system remains in the commanded state until cancelled by the tool or the fuel tank pressure (FTP) exceeds 32 mm Hg (17 in H20).
EVAP Purge/Seal	Engine Output Controls/EVAP System	This control enables two functions. One function increases or decreases the amount of purge by changing the duty cycle of the purge valve and commanding the vent ON, non-venting. The normal commanded state of both valves is None. The system will increase or decrease the amount of EVAP purge valve opening by 10 percent increments within a range of 0-100 percent. The second function seals the system after using the purge function to obtain a specific amount of FTP. When activated the purge valve is commanded to 0 percent and the vent valve is commanded ON, non-venting. Both functions remain in the commanded state until one of the following conditions occurs: • Cancelled by the tool • The FTP exceeds 32 mm Hg (17 in H20)
EVAP Vent Solenoid	Engine Output Controls/EVAP System	Activates the EVAP vent solenoid. The normal commanded state is None. When commanded ON, the vent valve switches to non-venting. The system remains in the commanded state until one of the following conditions occurs: • Cancelled by the tool • Purge is greater than 0 percent, and the fuel tank pressure exceeds 32 mm Hg (17 in H20)
Fuel Injector Balance	Fuel System	Enables the fuel injector in order to verify proper fuel injector flow. The PCM will pulse the selected injector when the following conditions are met: • All instruction on the scan tool completed • Fuel injector selected • Key ON, engine OFF The selected fuel injector can only be flowed/pulsed once per ignition cycle.
Fuel Pump	Engine Output Controls	Controls the fuel pump relay. The normal commanded state is None. When commanded ON/OFF, the PCM turns the fuel pump ON/OFF. If the engine is running, and the fuel pump is commanded OFF, the engine will stall. The system remains in the commanded state until cancelled by the scan tool.
Fuel Trim Enable	Fuel System	Disables the PCMs ability to learn new fuel trim parameters. The system remains in the commanded state until cancelled by the scan tool.
Fuel Trim Reset	Fuel System	Activates the reset of fuel trim data in all of the fuel trim cells.

Loop Status	Engine Output Controls	Controls the system loop status. The commanded states include None, Open, or Closed. The normal commanded state is None. When commanded Open or Closed, the system remains in the commanded state until cancelled by the scan tool.
Malfunction Indicator Lamp	Engine Output Controls	Controls the malfunction indicator lamp (MIL). The commanded states include None, ON, and OFF. When commanded ON or OFF, the system remains in the commanded state until cancelled by the scan tool.
Misfire Graphic	-	Graphs the accumulated misfires occurring in each cylinder. The scan tool allows for a reset of the misfire graph.
O2S Heater Control	Engine Output Controls	Activates the HO2S Heater. The commanded states include None, ON, and OFF. The normal commanded state is None. On a cold engine, with the key ON, engine OFF, the HO2S signal will continue to drop below bias when commanded ON. The system remains in the commanded state until cancelled by the tool.

DIAGNOSTIC TROUBLE CODE (DTC) LIST

Diagnostic Trouble Code (DTC) List

DTC	Diagnostic Procedure	Module(s)
P0068	**DTC P0068**	PCM
P0101	**DTC P0101 (With Throttle Actuator Control)**	PCM
P0102	**DTC P0102**	PCM
P0103	**DTC P0103**	PCM
P0106	**DTC P0106 (With Throttle Actuator Control)**	PCM
P0107	**DTC P0107**	PCM
P0108	**DTC P0108**	PCM
P0112	**DTC P0112**	PCM
P0113	**DTC P0113**	PCM
P0116	**DTC P0116**	PCM
P0117	**DTC P0117**	PCM
P0118	**DTC P0118**	PCM
P0120	**DTC P0120**	PCM
P0125	**DTC P0125**	PCM
P0128	**DTC P0128**	PCM
P0131	**DTC P0131 or P0151**	PCM
P0132	**DTC P0132 or P0152**	PCM
P0133	**DTC P0133 or P0153**	PCM
P0134	**DTC P0134 or P0154**	PCM
P0135	**DTC P0135 or P0155**	PCM
P0136	**DTC P0136 or P0156**	PCM
P0137	**DTC P0137 or P0157**	PCM

P0138	**DTC P0138 or P0158**	PCM
P0140	**DTC P0140 or P0160**	PCM
P0141	**DTC P0141 or P0161**	PCM
P0151	**DTC P0131 or P0151**	PCM
P0152	**DTC P0132 or P0152**	PCM
P0153	**DTC P0133 or P0153**	PCM
P0154	**DTC P0134 or P0154**	PCM
P0155	**DTC P0135 or P0155**	PCM
P0156	**DTC P0136 or P0156**	PCM
P0157	**DTC P0137 or P0157**	PCM
P0158	**DTC P0138 or P0158**	PCM
P0160	**DTC P0140 or P0160**	PCM
P0161	**DTC P0141 or P0161**	PCM
P0171	**DTC P0171 or P0174**	PCM
P0172	**DTC P0172 or P0175**	PCM
P0174	**DTC P0171 or P0174**	PCM
P0175	**DTC P0172 or P0175**	PCM
P0200	**DTC P0200**	PCM
P0218	**DTC P0218** in Automatic Transmission - 4L60-E	PCM
P0220	**DTC P0220**	PCM
P0230	**DTC P0230**	PCM
P0300	**DTC P0300**	PCM
P0315	**DTC P0315**	PCM
P0325	**DTC P0325**	PCM
P0327	**DTC P0327 or P0332**	PCM
P0332	**DTC P0327 or P0332**	PCM
P0335	**DTC P0335**	PCM
P0336	**DTC P0336**	PCM
P0341	**DTC P0341**	PCM
P0342	**DTC P0342**	PCM
P0343	**DTC P0343**	PCM
P0351	**DTC P0351-P0358**	PCM
P0352	**DTC P0351-P0358**	PCM
P0353	**DTC P0351-P0358**	PCM
P0354	**DTC P0351-P0358**	PCM
P0355	**DTC P0351-P0358**	PCM
P0356	**DTC P0351-P0358**	PCM
P0357	**DTC P0351-P0358**	PCM
P0358	**DTC P0351-P0358**	PCM
P0420	**DTC P0420 or P0430**	PCM
P0430	**DTC P0420 or P0430**	PCM

P0442	**DTC P0442**	PCM
P0443	**DTC P0443**	PCM
P0446	**DTC P0446**	PCM
P0449	**DTC P0449**	PCM
P0452	**DTC P0452**	PCM
P0453	**DTC P0453**	PCM
P0455	**DTC P0455**	PCM
P0461	**DTC P0461** in Instrument Panel, Gauges, and Console	PCM, IPC
P0462	**DTC P0462** in Instrument Panel, Gauges, and Console	PCM, IPC
P0463	**DTC P0463** in Instrument Panel, Gauges, and Console	PCM, IPC
P0496	**DTC P0496**	PCM
P0502	**DTC P0502** in Automatic Transmission - 4L60-E	PCM
P0503	**DTC P0503** in Automatic Transmission - 4L60-E	PCM
P0506	**DTC P0506 (TAC)**	PCM
P0507	**DTC P0507 (TAC)**	PCM
P0522	**DTC P0522** in Instrument Panel, Gauges, and Console	IPC
P0523	**DTC P0523** in Instrument Panel, Gauges, and Console	IPC
P0530	**DTC P0530** in HVAC	PCM
P0562	**DTC P0562** in Engine Electrical	PCM
P0563	**DTC P0563** in Engine Electrical	PCM
P0567	**DTC P0567** in Cruise Control	PCM
P0568	**DTC P0568** in Cruise Control	PCM
P0601	**DTC P0601-P0607, P1600, P1621, P1627, P1680, P1681, P1683, or P2610**	PCM
P0602	**DTC P0601-P0607, P1600, P1621, P1627, P1680, P1681, P1683, or P2610**	PCM
P0604	**DTC P0601-P0607, P1600, P1621, P1627, P1680, P1681, P1683, or P2610**	PCM
P0606	**DTC P0601-P0607, P1600, P1621, P1627, P1680, P1681, P1683, or P2610**	PCM
P0608	**DTC P0608** in Instrument Panel, Gauges, and Console	PCM, IPC
P0641	**DTC P0641**	PCM
P0650	**DTC P0650**	PCM
P0651	**DTC P0651**	PCM
P0654	**DTC P0654** in Instrument Panel, Gauges, and Console	PCM, IPC
P0706	**DTC P0706** in Automatic Transmission - 4L60-E	PCM, IPC
P0711	**DTC P0711** in Automatic Transmission - 4L60-E	PCM
P0712	**DTC P0712** in Automatic Transmission - 4L60-E	PCM
P0713	**DTC P0713** in Automatic Transmission - 4L60-E	PCM
P0719	**DTC P0719** in Automatic Transmission - 4l60-E	PCM
P0724	**DTC P0724** in Automatic Transmission - 4L60-E	PCM

P0740	**DTC P0740** in Automatic Transmission - 4L60-E	PCM
P0741	**DTC P0741** in Automatic Transmission - 4L60-E	PCM
P0742	**DTC P0742** in Automatic Transmission - 4L60-E	PCM
P0748	**DTC P0748** in Automatic Transmission - 4L60-E	PCM
P0751	**DTC P0751** in Automatic Transmission - 4L60-E	PCM
P0752	**DTC P0752** in Automatic Transmission - 4L60-E	PCM
P0753	**DTC P0753** in Automatic Transmission - 4L60-E	PCM
P0756	**DTC P0756** in Automatic Transmission - 4L60-E	PCM
P0757	**DTC P0757** in Automatic Transmission - 4L60-E	PCM
P0758	**DTC P0758** in Automatic Transmission - 4L60-E	PCM
P0785	**DTC P0785** in Automatic Transmission - 4L60-E	PCM
P0894	**DTC P0894** in Automatic Transmission - 4L60-E	PCM
P1106	**DTC P1106**	PCM
P1107	**DTC P1107**	PCM
P1111	**DTC P1111**	PCM
P1112	**DTC P1112**	PCM
P1114	**DTC P1114**	PCM
P1115	**DTC P1115**	PCM
P1125	**DTC P1125**	PCM
P1133	**DTC P1133 or P1153**	PCM
P1134	**DTC P1134 or P1154**	PCM
P1153	**DTC P1133 or P1153**	PCM
P1154	**DTC P1134 or P1154**	PCM
P1258	**DTC P1258** in Engine Cooling	PCM
P1380	**DTC P1380**	PCM
P1381	**DTC P1381**	PCM
P1516	**DTC P1516**	PCM
P1574	**DTC P1574** in Cruise Control	PCM
P1626	**DTC P1626** in Theft Deterrent	PCM
P1631	**DTC P1631** in Theft Deterrent	PCM
P1637	**DTC P1637** in Engine Electrical	PCM
P1810	**DTC P1810** in Automatic Transmission - 4L60-E	PCM
P2101	**DTC P2101**	PCM
P2108	**DTC P2108**	PCM
P2120	**DTC P2120**	PCM
P2121	**DTC P2121**	PCM
P2125	**DTC P2125**	PCM
P2135	**DTC P2135**	PCM
P2610	**DTC P0601-P0607, P1600, P1621, P1627, P1680, P1681, P1683, or P2610**	PCM
P2761	**DTC P2761** in Automatic Transmission - 4L60-E/4L65-E	PCM

P2771	**DTC P2771** in Automatic Transmission - 4L60-E/4L65-E	PCM
U0107	**DTC U0107**	PCM
UXXXX	**Scan Tool Does Not Communicate with Class 2 Device** in Data Link Communications.	PCM, BCM, IPC, VTD, EBCM

ENGINE CONTROLS DIAGNOSIS (DTC P0068 TO DTC P0141/P0161)

DTC P0068

Circuit Description

The powertrain control module (PCM) uses the following readings to calculate the predicted mass air flow (MAF) rate:

- The throttle position (TP)
- The barometric pressure (BARO)
- The intake air temperature (IAT)
- The engine RPM

The PCM compares the predicted MAF value to the actual MAF value, and to the speed density calculation, in order to verify the proper throttle operation.

Conditions for Running the DTC

- DTCs P0601, P0602, P0604, P0606, P1516, P2101, P2108, U0107 are not set.
- DTCs P0120 and P0220 are not active at the same time.

  or

- The engine operates longer than 1 second.
- The engine speed is more than 500 RPM.

Conditions for Setting the DTC

- The PCM detects that the difference between the actual air flow and the speed density calculated air flow is more than expected.
- The above condition is met for less than 1 second.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame and/or the Failure Records.
- The control module commands the TAC system to operate in the Reduced Engine Power mode.

- A message center or an indicator displays Reduced Engine Power.
- Under certain conditions the control module commands the engine OFF.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Inspect the throttle blade for being broken, bent, or missing.
- Inspect the TP sensor for proper installation. A sensor that is mis-aligned could set this DTC.
- Inspect the throttle actuator control (TAC) module connectors for signs of water intrusion. If water intrusion occurs, multiple DTCs may set without any circuit or component conditions found during diagnostic testing.
- Physically and visually inspect the throttle body assembly and correct any problems that you observe. Manually move the throttle blade from closed to wide open throttle (WOT). You should not need to use excess force. The throttle blade should move smoothly through the full range, then should independently return to a slightly open position.
- When the TAC module detects a condition within the TAC system, more than one TAC system related DTC may set. This is due to the many redundant tests run continuously on this system. Locating and repairing one individual condition may correct more than one DTC. Disconnecting components during testing may set additional DTCs. Remember this if you review the stored information in Capture Info.
- For an intermittent condition, refer to **Intermittent Conditions** .

Test Description

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

> **5:** This step will determine if the manifold absolute pressure (MAP) sensor voltage is within the proper range at idle.
>
> **6:** This step will determine if the MAP sensor responds properly to the change in manifold pressure.
>
> **7:** A throttle blade that sticks or binds may set this code. Opening the throttle through the entire range will indicate problems such as these.
>
> **9:** When the PCM detects a condition within the ETC system other DTCs may set due to the many redundant tests run continuously on this system. Locating and repairing one individual condition may correct more than one DTC. Keep this in mind when reviewing captured DTC info.

DTC P0068

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Are any other DTCs set?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to Diagnostic Aids
4	Inspect for the following conditions: • Vacuum hoses for splits, kinks, and proper connections as shown on Vehicle Emission Control Information label-Inspect thoroughly for any type of leak or restriction. • Air leaks at throttle body mounting area and intake manifold sealing surfaces Did you find and correct the condition?	-	Go to **Step 8**	Go to **Step 5**
5	1. Allow the engine to reach operating temperature. 2. Observe the MAP sensor voltage parameter with a scan tool. Is the manifold absolute pressure (MAP) sensor voltage within the specified range?	0.8-2.0 V	Go to **Step 6**	Go to **DTC P0106 (With Throttle Actuator Control)**
	1. Idle the engine. 2. Observe the MAP sensor kPa parameter with a scan tool.			

6	3. Increase the engine speed slowly and then back to idle. Does the MAP sensor kPa change smoothly and gradually as engine speed is increased and returned to idle?	-	Go to **Step 7**	Go to **DTC P0106 (With Throttle Actuator Control)**
7	**CAUTION:** **Turn OFF the ignition before inserting fingers into the throttle bore. Unexpected movement of the throttle blade could cause personal injury.** 1. Inspect the throttle body for the following conditions while modulating the throttle through the entire range using the scan tool: • Loose or damaged throttle blade • Broken throttle shaft • Drive mechanism damage 2. If any of the above conditions exist, replace the throttle body assembly. Refer to **Throttle Body Assembly Replacement** . Did you find and correct the condition?	-	Go to **Step 6**	Go to Diagnostic Aids
8	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 7**
9	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0101 (WITH THROTTLE ACTUATOR CONTROL)

Circuit Description

The mass air flow (MAF) sensor is an air flow meter that measures the amount of air entering the engine. The powertrain control module (PCM) uses the MAF sensor signal to provide the correct fuel delivery for all engine speeds and loads. A small quantity of air entering the engine indicates a deceleration or idle condition. A large quantity of air entering the engine indicates an acceleration or high load condition. The MAF sensor has the following circuits:

- An ignition 1 voltage circuit
- A ground circuit
- A signal circuit

The PCM applies a voltage to the sensor on the signal circuit. The sensor uses the voltage to produce a frequency based on the inlet air flow through the sensor bore. The frequency varies within a range of near 2,000 Hertz at idle to near 10,000 Hertz at maximum engine load. The PCM uses the following sensor inputs to calculate a predicted MAF value:

- The manifold absolute pressure (MAP) sensor
- The intake air temperature (IAT) sensor
- The engine coolant temperature (ECT) sensor
- The engine speed in revolutions per minute (RPM)

The PCM compares the actual MAF sensor frequency signal to the predicted MAF value. This comparison will determine if the signal is stuck based on a lack of variation, or is too low or too high for a given operating condition. If the PCM detects the actual MAF sensor frequency signal is not within a predetermined range of the calculated MAF value DTC P0101 sets.

Conditions for Running the DTC

- DTCs P0102, P0103, P0106, P0107, P0108, P0120, P0220, P0442, P0443, P0446, P0449, P0455, P0496, P2135 are not set.
- The engine is cranking or running.
- The ignition 1 signal is between 11-18 volts.
- The throttle position (TP) indicated angle is less than 95 percent.
- The change in the TP indicated angle is less than 5 percent.
- The MAP sensor is more than 17 kPa.
- The change in the MAP sensor is less than 3 kPa.
- The above conditions are met for 1.5 seconds.

Conditions for Setting the DTC

The PCM detects that the actual MAF sensor frequency signal is not within a predetermined range of the calculated MAF value for more than 4 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.

- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Inspect the harness of the MAF sensor to verify that it is not routed too close to the following components:
  - The secondary ignition wires or coils
  - Any solenoids
  - Any relays
  - Any motors
- A low minimum air rate through the sensor bore at idle or during deceleration may cause this DTC to set. Inspect for any vacuum leak downstream of the MAF sensor.
- Inspect for any contamination or debris on the sensing elements of the MAF sensor.
- Inspect the air induction system for any water intrusion. Any water that reaches the MAF sensor will skew the sensor and may cause this DTC to set.
- A wide open throttle acceleration from a stop should cause the MAF sensor parameter on the scan tool to increase rapidly. This increase should be from 3-10 g/s at idle to 170 g/s or more at the time of the 1-2 shift. If the increase is not observed, inspect for a restriction in the induction system or the exhaust system.
- A high resistance of 15 ohms or more on the ignition 1 voltage circuit may cause this DTC to set. A high resistance may cause a driveability concern before this DTC sets.
- The barometric pressure (BARO) that is used to calculate the predicted mass air flow value is initially based on the MAP sensor at key ON. When the engine is running the BARO value is continually updated near wide open throttle. A skewed MAP sensor will cause the calculated mass air flow value to be inaccurate and may result in a no start condition. The value shown for the MAP sensor parameter varies with the altitude. With the ignition ON and the engine OFF, 101 kPa is the approximate value near sea level. This value will decrease by approximately 3 kPa for every 305 meters (1,000 feet) of altitude.
- A high resistance on the 5-volt reference circuit of the MAP sensor may cause this DTC to set.
- A high resistance on the low reference circuit of the MAP sensor may cause this DTC to set.
- If the condition is intermittent, refer to **Intermittent Conditions** .

Test Description

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

5: This step will determine if the MAP sensor pressure is within the proper range for a given altitude.
6: This step will determine if the MAP sensor voltage is within the proper range at idle.
7: This step will determine if the MAP sensor responds properly to the change in manifold pressure.
8: This step will determine if the TP sensors are operating properly.
9: This step will determine if any mechanical faults have caused this DTC to set.
10: This voltage drop test will determine if high resistance has caused this DTC to set.

DTC P0101 (With Throttle Actuator Control)

Step	Action	Values	Yes	No
Schematic Reference:Engine Controls Schematics **Connector End View Reference:Powertrain Control Module (PCM) Connector End Views** or **Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Attempt to start the engine. Does the engine start?	-	Go to **Step 3**	Go to **Step 5**
3	Observe the Diagnostic Trouble Code (DTC) Information with the scan tool. Does the scan tool display any other DTCs set?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 4**
4	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 5**	Go to Diagnostic Aids
	IMPORTANT: **The Altitude vs. Barometric Pressure table indicates a pressure range for a given altitude under normal weather conditions. Weather conditions consisting of very low**			

5	**or very high pressure and/or temperature may cause a reading to be slightly out of range.** 1. Turn ON the ignition, with the engine OFF. 2. Observe the MAP sensor kPa parameter with a scan tool. 3. The manifold absolute pressure (MAP) sensor pressure should be within the specified range for your altitude. Refer to **Altitude vs Barometric Pressure** . Is the MAP sensor pressure within the specified range as indicated on the Altitude Vs. Barometric Pressure table?	-	Go to **Step 6**		Go to **DTC P0106 (With Throttle Actuator Control)**
6	1. Start the engine. 2. Turn OFF all accessories. 3. Allow the engine to reach operating temperature. 4. Observe the MAP sensor parameter with a scan tool. Is the MAP sensor parameter within the specified range?	0.8-2.0 V	Go to **Step 7**	Go to **DTC P0106 (With Throttle Actuator Control)**	
7	1. Idle the engine. 2. Observe the MAP sensor parameter with a scan tool. 3. Increase the engine speed slowly to 3,000 RPM and then back to idle. Does the MAP sensor parameter change smoothly and gradually through the specified range of the test?	-	Go to **Step 8**	Go to **DTC P0106 (With Throttle Actuator Control)**	
8	1. Turn OFF the ignition for 30 seconds. 2. Turn ON the ignition with the engine OFF. 3. Observe the throttle position (TP) indicated angle parameter with a scan tool. 4. Depress the accelerator pedal completely.	98-100%			

	Is the TP indicated angle parameter within the specified range?		Go to **Step 9**	Go to **DTC P0120**	
9	1. Turn OFF the ignition. 2. Inspect for the following conditions: • A restricted or collapsed air intake duct • A misaligned air intake duct • A dirty or deteriorating air filter element • Any objects blocking the air inlet screen of the mass air flow (MAF) sensor, if equipped • Any contamination or debris on the sensing elements of the MAF sensor • Any water intrusion in the induction system • Any vacuum leak downstream of the MAF sensor • A MAF sensor wiring harness that is routed too close to any aftermarket accessories-Refer to **Checking Aftermarket Accessories** in Wiring Systems. • Any type of restriction in the exhaust system Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 10**	
10	1. Disconnect the harness connector of the MAF sensor. 2. Measure the battery voltage with a DMM. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the ignition 1 voltage circuit of the MAF sensor and a good ground. Refer to **Circuit Testing** in Wiring Systems. 5. Connect a DMM to the probe of the test lamp and a good ground. Refer to **Measuring Voltage Drop** in Wiring Systems.	B+			

	Is the voltage within 0.50 volts of the specified value?		Go to **Step 11**	Go to **Step 12**
11	Test for an intermittent and for a poor connection at the MAF sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 13**
12	Repair the high resistance in the ignition 1 voltage circuit of the MAF sensor. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 14**	-
13	Replace the MAF/intake air temperature (IAT) sensor. Refer to **Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 14**	-
14	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 15**
15	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0102

Circuit Description

The mass air flow (MAF) sensor is an air flow meter that measures the amount of air entering the engine. The powertrain control module (PCM) uses the MAF sensor signal to provide the correct fuel delivery for all engine speeds and loads. A small quantity of air entering the engine indicates a deceleration or idle condition. A large quantity of air entering the engine indicates an acceleration or high load condition. The MAF sensor has the following circuits:

- An ignition 1 voltage circuit
- A ground circuit

- A signal circuit

The PCM applies a voltage to the sensor on the signal circuit. The sensor uses the voltage to produce a frequency based on the inlet air flow through the sensor bore. The frequency varies within a range of near 2,000 Hertz at idle to near 10,000 Hertz at maximum engine load. If the PCM detects the frequency signal is less than the possible range of a correctly operating MAF sensor DTC P0102 sets.

Conditions for Running the DTC

- The engine is running for more than 2 seconds.
- The engine speed is more than 400 RPM.
- The ignition 1 signal is more than 8 volts.
- The MAF sensor frequency is stable for more than 1 second.

Conditions for Setting the DTC

The PCM detects that the MAF sensor frequency signal is less than 1,200 Hz for more than 0.6 second.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Inspect the harness of the MAF sensor to verify that it is not routed too close to the following components:
  - The secondary ignition wires or coils
  - Any solenoids
  - Any relays

    - Any motors
- A low minimum air rate through the sensor bore at idle or during deceleration may cause this DTC to set. Inspect for any vacuum leak downstream of the MAF sensor.
- Inspect for any contamination or debris on the sensing elements of the MAF sensor.
- A wide open throttle acceleration from a stop should cause the MAF sensor parameter on the scan tool to increase rapidly. This increase should be from 3-10 g/s at idle to 170 g/s or more at the time of the 1-2 shift. If the increase is not observed, inspect for a restriction in the induction system or the exhaust system.
- A high resistance of 15 ohms or more on the ground circuit of the MAF sensor may cause this DTC to set. A high resistance may cause a driveability concern before this DTC sets.
- A high resistance of 15 ohms or more on the ignition 1 voltage circuit can cause this DTC to set. A high resistance may cause a driveability concern before this DTC sets.
- If the condition is intermittent, refer to **Intermittent Conditions** .

Test Description

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

5: This step will determine if any mechanical faults have caused this DTC to set.

7: This voltage drop test will determine if high resistance has caused this DTC to set.

9: This step verifies the voltage signal from the PCM to the MAF sensor connector.

10: This step tests the signal circuit of the MAF sensor for a short to another 5-volt reference circuit.

11: This step will determine if the PCM is able to process the frequency signal that it receives from the MAF sensor.

14: This step will determine which portion of the circuit or which component is shorted to ground.

17: This step verifies that the signal circuit is not shorted to any other PCM circuit.

DTC P0102

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Start the engine. 2. Observe the MAF Sensor parameter with a scan tool. Is the MAF Sensor parameter less than the specified value?	1,200 Hz	Go to **Step 4**	Go to **Step 3**
	1. Observe the Freeze Frame/Failure Records for			

3	this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to Diagnostic Aids
4	1. Observe the MAF Sensor parameter with a scan tool. 2. Move the harness and the connector of the mass air flow (MAF)/intake air temperature (IAT) sensor. Does the movement of the harness or the connector affect the MAF Sensor parameter?	-	Go to **Step 20**	Go to **Step 5**
5	1. Turn OFF the ignition. 2. Inspect for the following conditions: • A restricted or collapsed air intake duct • A misaligned air intake duct • A dirty or deteriorating air filter element • Any objects blocking the air inlet screen of the MAF/IAT sensor • Any water intrusion in the Induction System • Any contamination or debris on the sensing elements of the MAF sensor Did you find and correct the condition?	-	Go to **Step 28**	Go to **Step 6**
6	Inspect the fuse in the ignition 1 voltage circuit of the MAF sensor. Is the fuse open?	-	Go to **Step 14**	Go to **Step 7**
7	1. Turn ON the ignition, with the engine OFF. 2. Measure the battery voltage with a DMM. 3. Disconnect the MAF/IAT sensor. 4. Connect a test lamp between the ignition 1 voltage circuit of the MAF sensor and a good ground. Refer to **Probing Electrical Connectors** in Wiring Systems.	B+		

	5. Connect the DMM to the probe of the test lamp and a good ground. Refer to **Measuring Voltage Drop** and **Circuit Testing** in Wiring Systems. Is the voltage within 0.50 volts of the specified value?		Go to **Step 8**	Go to **Step 21**
8	**IMPORTANT:** **All electrical components and accessories must be turned OFF.** 1. Turn OFF the ignition for 60 seconds to allow the control modules to power down. 2. Measure the resistance from the ground circuit of the MAF sensor to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the resistance less than the specified value?	5 ohm	Go to **Step 9**	Go to **Step 22**
9	1. Turn ON the ignition, with the engine OFF. 2. Measure the voltage from the signal circuit of the MAF sensor to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the voltage within the specified range?	4.8-5.2 V	Go to **Step 10**	Go to **Step 13**
10	1. Connect a 3-amp fused jumper wire between the signal circuit of the MAF sensor and a good ground. Refer to **Circuit Testing** in Wiring Systems. 2. Start the engine. 3. Observe the DTC Information with a scan tool. Do any additional DTCs set?	-	Go to **Step 24**	Go to **Step 11**
	1. Turn OFF the ignition. 2. Connect the voltage supply and the ground lead of the **J 38522** Variable Signal Generator to the vehicle. 3. Connect the red lead of the **J 38522** to the signal circuit of the MAF sensor. Refer to **Probing Electrical Connectors** in Wiring Systems. 4. Set the Duty Cycle switch of the **J 38522** to	4,950-		

11	Normal. 5. Set the Frequency switch of the **J 38522** to 5 K. 6. Set the Signal switch of the **J 38522** to 5 V. 7. Start the engine and allow it to idle. 8. Observe the MAF Sensor parameter with a scan tool. Is the MAF Sensor parameter within the specified range?	5,025 Hz	Go to **Step 12**	Go to **Step 15**
12	**IMPORTANT:** **An abnormal resistance on the signal circuit will disable the MAF sensor frequency before the voltage starts to drop out of the correct parameter of 4.8-5.2 volts.** 1. Turn OFF the ignition. 2. Disconnect the powertrain control module (PCM). 3. Test the MAF sensor signal circuit for a high resistance and for a short to the IAT signal circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 28**	Go to **Step 18**
13	Is the voltage less than the specified value?	4.8 V	Go to **Step 15**	Go to **Step 16**
14	**IMPORTANT:** **The ignition 1 voltage circuit of the MAF sensor is spliced to other components of the vehicle.** Test the ignition 1 voltage circuit for a short to ground. Refer to **Testing for Short to Ground** and **Wiring Repairs** in Wiring Systems.Did you find and correct the condition?	-	Go to **Step 28**	-
15	1. Turn OFF the ignition. 2. Disconnect the PCM. 3. Test the signal circuit between the PCM and the MAF sensor for the following conditions: • A high resistance • An open circuit • A short to ground Refer to **Circuit Testing** and **Wiring Repairs** in	-		

	Wiring Systems.Did you find and correct the condition?		Go to **Step 28**	Go to **Step 17**
16	**IMPORTANT:** **Disconnecting the PCM connectors may eliminate the short to voltage if the signal circuit is shorted to another PCM circuit.** 1. Turn OFF the ignition. 2. Disconnect the PCM. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the signal circuit of the MAF sensor to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the voltage more than the specified value?	0 V	Go to **Step 23**	Go to **Step 17**
17	Measure the resistance from the signal circuit of the MAF sensor to all other circuits at both PCM connectors with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the resistance less than the specified value?	infinity ohm	Go to **Step 25**	Go to **Step 19**
18	Test for an intermittent and for a poor connection at the MAF sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 28**	Go to **Step 26**
19	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 28**	Go to **Step 27**
20	Repair the wiring or the connector as needed. Refer to **Wiring Repairs** and **Connector Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 28**	-
21	Repair the high resistance or the open in the MAF sensor ignition 1 voltage circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 28**	-
22	Repair the high resistance or the open in the MAF sensor ground circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 28**	-
23	Repair the short to voltage in the MAF sensor signal circuit. Refer to **Wiring Repairs** in Wiring Systems.	-		

	Did you complete the repair?		Go to **Step 28**	-
24	Repair the short between the MAF sensor signal circuit and the 5-volt reference circuit for which the DTC set. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 28**	-
25	Repair the circuits that are shorted together. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 28**	-
26	Replace the MAF/IAT sensor. Refer to **Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 28**	-
27	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 28**	-
28	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 29**
29	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0103

Circuit Description

The mass air flow (MAF) sensor is an airflow meter that measures the amount of air entering the engine. The powertrain control module (PCM) uses the MAF sensor signal to provide the correct fuel delivery for all engine speeds and loads. A small quantity of air entering the engine indicates a deceleration or idle condition. A large quantity of air entering the engine indicates an acceleration or high load condition. The MAF sensor has the following circuits:

- An ignition 1 voltage circuit
- A ground circuit
- A signal circuit

The PCM applies a voltage to the sensor on the signal circuit. The sensor uses the voltage to produce a frequency based on the inlet airflow through the sensor bore. The frequency varies within a range of near 2,000 Hertz at idle to near 10,000 Hertz at maximum engine load. If the PCM detects the frequency signal is more than the possible range of a correctly operating MAF sensor DTC P0103 sets.

Conditions for Running the DTC

- The engine is running for more than 2 seconds.
- The Engine Speed parameter is more than 400 RPM.
- The Ignition 1 Signal parameter is more than 8 volts.
- The MAF Sensor parameter is stable for more than 1 second.

Conditions for Setting the DTC

The PCM detects that the MAF sensor frequency signal is more than 13,500 Hertz for more than 1.2 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Inspect the air induction system for any water intrusion. The water rapidly cools the hot sensing elements in the sensor causing a false indication of excessive airflow. Any water that reaches the MAF sensor will skew the sensor and may cause this DTC to set.
- A poor connection in the ignition 1 voltage circuit of the MAF sensor may cause this DTC to set.

If the condition is intermittent, refer to **Intermittent Conditions** .

Test Description

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

3: This step tests for electromagnetic interference (EMI) on the signal circuit of the MAF sensor. A frequency reading with the MAF sensor disconnected indicates an EMI related fault or a poor connection at the PCM. Disconnecting the MAF sensor may set additional related DTCs.

4: This step will determine if incorrect harness routing has caused this DTC to set.

5: This step will determine if water intrusion has caused this DTC to set.

DTC P0103

Step	Action	Values	Yes	No
Schematic Reference:Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 3**	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the mass air flow (MAF) sensor. 3. Start the engine. 4. Observe the MAF Sensor parameter with a scan tool. Is the MAF Sensor parameter more than the specified value?	0 Hz	Go to **Step 4**	Go to **Step 5**
4	1. Turn OFF the ignition. 2. Inspect the harness of the MAF sensor for incorrect routing that is too close to the following components: • Any aftermarket accessories-Refer to **Checking Aftermarket Accessories** in Wiring Systems. • The secondary ignition wires or the coils	-		

	• Any solenoids • Any relays • Any motors Did you find and correct the condition?		Go to **Step 10**	Go to **Step 7**
5	1. Turn OFF the ignition. 2. Inspect the air induction system for any water intrusion. Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 6**
6	Test for an intermittent and for a poor connection at the MAF sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 8**
7	Test for an intermittent and for a poor connection at the powertrain control module (PCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 9**
8	Replace the MAF/intake air temperature (IAT) sensor. Refer to **Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 10**	-
9	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 10**	-
10	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 11**
11	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0106 (WITH THROTTLE ACTUATOR CONTROL)

Circuit Description

The manifold absolute pressure (MAP) sensor responds to pressure changes in the intake manifold. The pressure changes occur based on the engine load. The MAP sensor has the following circuits:

- 5-volt reference circuit
- Low reference circuit
- MAP sensor signal circuit

The powertrain control module (PCM) supplies 5 volts to the MAP sensor on the 5-volt reference circuit. The PCM also provides a ground on the low reference circuit. The MAP sensor provides a signal to the PCM on the MAP sensor signal circuit which is relative to the pressure changes in the manifold. The PCM should detect a low signal voltage at a low MAP, such as during an idle or a deceleration. The PCM should detect a high signal voltage at a high MAP, such as the ignition is ON, with the engine OFF, or at a wide open throttle (WOT). The MAP sensor is also used in order to determine the barometric pressure (BARO). This occurs when the ignition switch is turned ON, with the engine OFF. The BARO reading may also be updated whenever the engine is operated at WOT. The PCM monitors the MAP sensor signal for voltage outside of the normal range.

The PCM calculates a predicted value for the MAP sensor based on the throttle position (TP) and the engine speed. The PCM then compares the predicted value to the actual MAP sensor signal. If the PCM detects that the MAP sensor signal is not within the predicted range, DTC P0106 sets.

Conditions for Running the DTC

- DTCs P0068, P0101, P0102, P0103, P0107, P0108, P0120, P0220, P0442, P0443, P0446, P0455, P1125, P1516, P2101, P2108, P2120, P2121, P2125, P2135 are not set.
- The engine is running.
- The engine speed is between 400-5,000 RPM.
- Any change in the engine speed is less than 125 RPM.
- The traction control, if equipped, is not active.
- The power take-off (PTO), if equipped, is not active.
- The A/C compressor clutch state does not change.
- The clutch switch state does not change, if equipped with a manual transmission.
- The power steering load is stable.
- The brake switch state does not change.
- The above conditions are met for 1 second.

Conditions for Setting the DTC

The PCM detects that the actual MAP sensor signal is not within the predicted range for 2 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition

cycle that the diagnostic runs and fails.

- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

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

4: This step tests the ability of the MAP sensor to correctly indicate barometric pressure.

6: This step tests the ability of the MAP sensor to respond to an increase in engine vacuum.

8: This step tests for a proper MAP sensor pressure with an applied vacuum.

13: This step calculates the resistance in the 5-volt reference circuit.

14: This step calculates the resistance in the low reference circuit.

DTC P0106 (With Throttle Actuator Control)

Step	Action	Values	Yes	No
Schematic Reference:Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Inspect for the following conditions: • A disconnected, damaged, or incorrectly routed vacuum hose • A missing or damaged manifold absolute pressure (MAP) sensor seal • Any restrictions in the MAP sensor vacuum source • Any vacuum leaks in the intake manifold	-		

	Did you find and correct the condition?		Go to **Step 21**	Go to **Step 3**
3	**IMPORTANT:** **The vehicle used for the comparison is not limited to the same type of vehicle as is being serviced. A vehicle known to provide an accurate reading is acceptable.** Do you have access to another vehicle in which the MAP sensor pressure can be observed with a scan tool?	-	Go to **Step 4**	Go to **Step 5**
4	1. Turn ON the ignition, with the engine OFF. 2. Observe the MAP sensor pressure with the scan tool. 3. Observe the MAP sensor pressure in the known good vehicle with the scan tool. 4. Compare the values. Is the difference between the values less than the specified value?	3 kPa	Go to **Step 6**	Go to **Step 11**
5	**IMPORTANT:** **The Altitude vs. Barometric Pressure table indicates a pressure range for a given altitude under normal weather conditions. Weather conditions consisting of very low or very high pressure and/or very low or very high temperature may cause a reading to be slightly out of range.** 1. Turn ON the ignition, with the engine OFF. 2. Observe the MAP sensor pressure with the scan tool. Refer to **Altitude vs Barometric Pressure** . 3. The MAP sensor pressure should be within the range specified for your altitude. Does the MAP sensor indicate the correct barometric pressure?	-	Go to **Step 6**	Go to **Step 11**
6	1. Observe the MAP sensor pressure with the scan tool. 2. Start the engine. Does the MAP sensor pressure change?	-	Go to **Step 7**	Go to **Step 11**
	1. Turn OFF the ignition. 2. Remove the MAP sensor from the intake manifold. Leave the MAP sensor connected to the electrical harness.			

7	3. Connect a **J 23738-A** Mityvac to the MAP sensor port. 4. Turn ON the ignition, with the engine OFF. 5. Observe the MAP sensor pressure with the scan tool. 6. Apply vacuum to the MAP sensor with the **J 23738-A** in 1 inch Hg increments until 15 inch Hg is reached. Each 1 inch Hg should decrease the MAP sensor pressure by 3-4 kPa. Is the decrease in MAP sensor pressure consistent?	-	Go to **Step 8**	Go to **Step 11**
8	1. Observe the MAP sensor pressure with the scan tool. 2. Apply vacuum with the **J 23738-A** until 20 inches Hg is reached. Is the MAP sensor pressure less than the specified value?	34 kPa	Go to **Step 9**	Go to **Step 11**
9	1. Observe the MAP sensor pressure with the scan tool. 2. Disconnect the **J 23738-A** from the MAP sensor. Does the MAP sensor pressure return to the original reading observed in Step 4 or Step 5?	-	Go to **Step 10**	Go to **Step 11**
10	Inspect for the following engine conditions: • Incorrect cam timing-Refer to **Timing Chain and Sprockets Replacement** in Engine Mechanical for the correct timing. • A restricted exhaust flow-Refer to **Restricted Exhaust** in Engine Exhaust. • Any worn piston rings-Refer to **Engine Compression Test** in Engine Mechanical. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Intermittent Conditions**
11	Test for an intermittent and for a poor connection at the MAP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 12**
	1. Disconnect the MAP sensor harness connector. 2. Measure the voltage from the 5-volt reference circuit of the MAP sensor to a good ground with a			

12	DMM. Note the measurement as "Supply voltage". 3. Connect a test lamp and a DMM in series between the 5-volt reference circuit and the low reference circuit of the MAP sensor at the harness connector. 4. Measure the amperage with the DMM. Note the measurement as "Amperage". Is the amperage equal to the specified value?	0 mA	Go to **Step 16**	Go to **Step 13**
13	1. Remove the DMM from the circuit. 2. Connect the test lamp between the 5-volt reference circuit and the low reference circuit of the MAP sensor, at the harness connector. 3. Measure the voltage from the 5-volt reference circuit at the test lamp to a good ground, with the DMM. Note the measurement as "Load voltage drop". **IMPORTANT:** **Before any calculations are performed, ensure that all measurements are converted to like units, for example, volts/amps or millivolts/milliamps.** 4. Subtract the "Load voltage drop" from the "Supply voltage". Note the result as "Supply voltage drop". 5. Divide the "Supply voltage drop" by the "Amperage". Is the result more than the specified value?	5 ohm	Go to **Step 15**	Go to **Step 14**
14	1. Measure the voltage from the low reference circuit of the MAP sensor at the test lamp to a good ground, with the DMM. Note the result as "Low reference voltage drop". **IMPORTANT:** **Before any calculations are performed, ensure that all measurements are converted to like units, for example, volts/amps or millivolts/milliamps.** 2. Divide the "Low reference voltage drop" by the "Amperage". Is the result more than the specified value?	5 ohm	Go to **Step 17**	Go to **Step 19**

15	Test the 5-volt reference circuit between the powertrain control module (PCM) and the MAP sensor for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 18**
16	Test the low reference circuit between the PCM and the MAP sensor for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 18**
17	Test the low reference circuit between the PCM and the MAP sensor for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 18**
18	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 21**	Go to **Step 20**
19	Replace the MAP sensor. Refer to **Manifold Absolute Pressure (MAP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 21**	-
20	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 21**	-
21	1. Clear the DTCs with the scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 22**
22	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0107

Circuit Description

The manifold absolute pressure (MAP) sensor responds to pressure changes in the intake manifold. The pressure changes occur based on the engine load. The MAP sensor has the following circuits:

- 5-volt reference circuit
- Low reference circuit
- MAP sensor signal circuit

The powertrain control module (PCM) supplies 5 volts to the MAP sensor on the 5-volt reference circuit. The PCM also provides a ground on the low reference circuit. The MAP sensor provides a signal to the PCM on the MAP sensor signal circuit which is relative to the pressure changes in the manifold. The PCM should detect a low signal voltage at a low MAP, such as during an idle or a deceleration. The PCM should detect a high signal voltage at a high MAP, such as the ignition is ON, with the engine OFF, or at a wide open throttle (WOT). The MAP sensor is also used in order to determine the barometric pressure (BARO). This occurs when the ignition switch is turned ON, with the engine OFF. The BARO reading may also be updated whenever the engine is operated at WOT. The PCM monitors the MAP sensor signal for voltage outside of the normal range.

If the PCM detects a MAP sensor signal voltage that is excessively low, DTC P0107 sets.

Conditions for Running the DTC

- The ignition is ON.
- DTCs P0068, P0120, P0220, P1125, P1516, P2101, P2108, P2120, P2121, P2125, P2135 are not set.
- The throttle angle is more than 0 percent when the engine speed is less than 800 RPM.

  OR

- The throttle angle is more than 12.5 percent when the engine speed is more than 800 RPM.

Conditions for Setting the DTC

The PCM detects that the MAP sensor voltage is less than 0.10 volt for more than 4 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other

emission related diagnostic.

- Clear the MIL and the DTC with a scan tool.

DTC P0107

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Monitor the Diagnostic Trouble Code (DTC) Information with the scan tool. Is DTC P0641 also set?	-	Go to **DTC P0641**	Go to **Step 3**
3	Observe the MAP sensor parameter with the scan tool. Is the voltage is less than the specified value?	0.1 V	Go to **Step 5**	Go to **Step 4**
4	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Does the DTC fail this ignition?	-	Go to **Step 5**	Go to **Intermittent Conditions**
5	Test for an intermittent and for a poor connection at the manifold absolute pressure (MAP) sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 6**
6	1. Turn OFF the ignition. 2. Disconnect the MAP sensor electrical connector. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the 5-volt reference circuit of the MAP sensor to a good ground, with a DMM.	4.8 V		

	Is the voltage more than the specified value?		Go to **Step 7**	Go to **Step 8**
7	1. Connect a 3-amp fused jumper wire between the 5-volt reference circuit of the MAP sensor and the signal circuit of the MAP sensor. 2. Observe the MAP sensor parameter with the scan tool. Is the voltage more than the specified value?	4.9 V	Go to **Step 11**	Go to **Step 9**
8	Test the 5-volt reference circuit between the powertrain control module (PCM) and the MAP sensor for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 10**
9	Test the MAP sensor signal circuit between the PCM and the MAP sensor for a short to ground or an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 10**
10	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 12**
11	Replace the MAP sensor. Refer to **Manifold Absolute Pressure (MAP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 13**	-
12	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 13**	-
13	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 14**
14	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0108

Circuit Description

The manifold absolute pressure (MAP) sensor responds to pressure changes in the intake manifold. The pressure changes occur based on the engine load. The MAP sensor has the following circuits:

- 5-volt reference circuit
- Low reference circuit
- MAP sensor signal circuit

The powertrain control module (PCM) supplies 5 volts to the MAP sensor on the 5-volt reference circuit. The PCM also provides a ground on the low reference circuit. The MAP sensor provides a signal to the PCM on the MAP sensor signal circuit which is relative to the pressure changes in the manifold. The PCM should detect a low signal voltage at a low MAP, such as during an idle or a deceleration. The PCM should detect a high signal voltage at a high MAP, such as the ignition is ON, with the engine OFF, or at a wide open throttle (WOT). The MAP sensor is also used in order to determine the barometric pressure (BARO). This occurs when the ignition switch is turned ON, with the engine OFF. The BARO reading may also be updated whenever the engine is operated at WOT. The PCM monitors the MAP sensor signal for voltage outside of the normal range.

If the PCM detects a MAP sensor signal voltage that is excessively high, DTC P0108 sets.

Conditions for Running the DTC

- DTCs P0068, P0120, P0220, P1125, P1516, P2101, P2108, P2120, P2121, P2125, P2135 are not set.
- The engine is running.
- The throttle angle is less than 1 percent when the engine speed is less than 1,200 RPM.

  OR

- The throttle angle is more than 20 percent when the engine speed is more than 1,200 RPM.

Conditions for Setting the DTC

The PCM detects that the MAP sensor voltage is more than 4.9 volts for more than 4 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P0108

Step	Action	Values	Yes	No
Schematic Reference:Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Start the engine. 2. Observe the MAP sensor parameter with the scan tool. Is the voltage more than the specified value?	4.9 V	Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure Records data for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	Inspect the manifold absolute pressure (MAP) sensor vacuum source for the following conditions: • A leak • A restriction • A faulty connection Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 5**
	Monitor the DTC Information with the scan tool.			

5	Is DTC P0641 also set?	-	Go to **Step 9**	Go to **Step 6**
6	Test for an intermittent and for a poor connection at the MAP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 7**
7	1. Turn OFF the ignition. 2. Disconnect the MAP sensor electrical connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the MAP sensor parameter with the scan tool. Is the voltage less than the specified value?	0.1 V	Go to **Step 8**	Go to **Step 10**
8	1. Turn OFF the ignition. 2. Connect a jumper wire between each of the terminals in the MAP sensor harness connector and the corresponding terminal at the MAP sensor. Refer to **Using Connector Test Adapters** in Wiring Systems. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the low reference circuit of the MAP sensor at the jumper wire terminal to a good ground with the DMM. Refer to **Measuring Voltage Drop** in Wiring Systems. Is the voltage more than the specified value?	0.2 V	Go to **Step 11**	Go to **Step 13**
9	1. Turn OFF the ignition. 2. Disconnect the MAP sensor electrical connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the MAP sensor parameter with the scan tool. Is the voltage less than the specified value?	0.1 V	Go to **DTC P0641**	Go to **Step 10**
10	Test the MAP sensor signal circuit between the powertrain control module (PCM) and the MAP sensor for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 14**
	Test the low reference circuit between the PCM and the MAP sensor for an open or for high resistance.			

11	Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 12**
12	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 14**
13	Replace the MAP sensor. Refer to **Manifold Absolute Pressure (MAP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
14	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
15	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 16**
16	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0112

Circuit Description

The intake air temperature (IAT) sensor is a variable resistor. The IAT sensor has a signal circuit and a low reference circuit. The IAT sensor measures the temperature of the air entering the engine. The powertrain control module (PCM) supplies 5 volts to the IAT signal circuit and a ground for the IAT low reference circuit. When the IAT sensor is cold, the sensor resistance is high. When the air temperature increases, the sensor resistance decreases. With high sensor resistance, the PCM detects a high voltage on the IAT signal circuit. With lower sensor resistance, the PCM detects a lower voltage on the IAT signal circuit. If the PCM detects an excessively low IAT signal voltage, indicating a high temperature, DTC P0112 sets.

Conditions for Running the DTC

- DTCs P0502, P0503 are not set.
- The engine run time is more than 45 seconds.

- The vehicle speed sensor (VSS) indicates that the vehicle speed is more than 40 km/h (25 mph).

Conditions for Setting the DTC

The PCM detects that the IAT Sensor parameter is more than 128°C (262°F) for 5 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- When the vehicle is at ambient temperature the IAT sensor and the ECT sensor temperatures should be relatively close to each other. Refer to **Temperature vs Resistance** .
- If an intermittent condition is suspected, refer to **Intermittent Conditions** .

DTC P0112

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Observe the intake air temperature (IAT) sensor parameter with a scan tool. Is the IAT sensor parameter more than the specified value?	128°C (262°F)	Go to **Step 4**	Go to **Step 3**
	1. Observe the Freeze Frame/Failure Records for this DTC.			

3	2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Fame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to Diagnostic Aids
4	1. Disconnect the IAT sensor. 2. Observe the IAT sensor parameter with a scan tool. Is the IAT sensor parameter less than the specified value?	-38°C (-36°F)	Go to **Step 6**	Go to **Step 5**
5	Test the signal circuit of the IAT sensor for a short to ground or a short to the IAT low reference circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 8**
6	Test for an intermittent and for a poor connection at the IAT sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 7**
7	Replace the IAT sensor. Refer to **Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 10**	-
8	1. Turn OFF the ignition. 2. Disconnect the powertrain control module (PCM). 3. Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 9**
9	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 10**	-
	1. Clear the DTCs with a scan tool.			

10	2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 11**
11	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0113

Circuit Description

The intake air temperature (IAT) sensor is a variable resistor. The IAT sensor has a signal circuit and a low reference circuit. The IAT sensor measures the temperature of the air entering the engine. The powertrain control module (PCM) supplies 5 volts to the IAT signal circuit and a ground for the IAT low reference circuit. When the IAT sensor is cold, the sensor resistance is high. When the air temperature increases, the sensor resistance decreases. With high sensor resistance, the PCM detects a high voltage on the IAT signal circuit. With lower sensor resistance, the PCM detects a lower voltage on the IAT signal circuit. If the PCM detects an excessively high IAT signal voltage, indicating a low temperature, DTC P0113 sets.

Conditions for Running the DTC

- DTCs P0101, P0102, P0103, P0116, P0117, P0118, P0125, P0128, P0502, P0503 are not set.
- The engine run time is more than 120 seconds.
- The vehicle speed sensor (VSS) indicates that the vehicle speed is less than 11 km/h (7 mph).
- The engine coolant temperature (ECT) is more than 60°C (140°F).
- The mass air flow (MAF) is less than 15 g/s.

Conditions for Setting the DTC

The PCM detects that the IAT Sensor parameter is less than -38°C (-36°F) for more than 5 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze

Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- When the vehicle is at ambient temperature the IAT sensor and the ECT sensor temperatures should be relatively close to each other. Refer to **Temperature vs Resistance** .
- If a short to a separate 5-volt source occurs this DTC may set.
- If an intermittent condition is suspected, refer to **Intermittent Conditions** .

Test Description

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

6: This step tests for the proper operation of the circuit in the low voltage range.

DTC P0113

Step	Action	Values	Yes	No
Schematic Reference:Engine Controls Schematics **Connector End View Reference:Powertrain Control Module (PCM) Connector End Views** or **Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Observe the IAT sensor parameter with a scan tool. Is the IAT sensor parameter less than the specified value?	-38°C (-36°F)	Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure Records data for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records.	-		Go to Diagnostic

	Did the DTC fail this ignition?		Go to **Step 4**	Aids
4	1. Disconnect the mass air flow (MAF)/intake air temperature (IAT) sensor. 2. Connect a DMM between the signal circuit of the IAT sensor and a good ground. Is the voltage more than the specified value?	5.2 V	Go to **Step 5**	Go to **Step 6**
5	**IMPORTANT:** **The sensor may be damaged if the circuit is shorted to a voltage source.** Test the signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 12**
6	1. Connect a 3-amp fused jumper wire between the signal circuit of the IAT sensor and the low reference circuit of the IAT sensor. Refer to **Using Fused Jumper Wires** in Wiring Systems. 2. Observe the IAT sensor parameter with a scan tool. Is the IAT sensor parameter more than the specified value?	128°C (262°F)	Go to **Step 10**	Go to **Step 7**
7	1. Connect a 3-amp fused jumper wire between the signal circuit of the IAT sensor and a good ground. Refer to **Using Fused Jumper Wires** in Wiring Systems. 2. Observe the IAT sensor parameter with a scan tool. Is the IAT sensor parameter more than the specified value?	128°C (262°F)	Go to **Step 9**	Go to **Step 8**
8	Test the signal circuit of the IAT sensor for an open circuit or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 12**
9	Test the IAT sensor low reference circuit for high resistance or an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 12**
10	Test the IAT signal circuit for a short to any 5-volt reference circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.	-		

	Did you find and correct the condition?		Go to **Step 15**	Go to **Step 11**
11	**IMPORTANT:** **The sensor may be damaged if the circuit is shorted to a voltage source.** Test for an intermittent and for a poor connection at the IAT sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring SystemsDid you find and correct the condition?	-	Go to **Step 15**	Go to **Step 13**
12	Test for an intermittent and for a poor connection at the powertrain control module (PCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 14**
13	Replace the IAT sensor. Refer to **Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
14	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
15	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 16**
16	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0116

Circuit Description

The engine coolant temperature (ECT) sensor is a variable resistor that measures the temperature of the engine coolant. The powertrain control module (PCM) supplies 5 volts to the signal circuit and a ground for the ECT low reference circuit. When the ECT is low, the sensor resistance is high. When the ECT is high, the sensor resistance is low. The PCM uses this high side coolant rationality test to determine if the ECT input is skewed high. The internal clock of the PCM will record the amount of time the ignition is OFF. At restart the PCM will compare the temperature difference between the ECT and the intake air temperature (IAT). Before failing this test the PCM will perform a calculation to determine the presence of a block heater. If the PCM detects that the temperature difference is not within the calibrated range after the ignition OFF time, DTC P0116 sets.

Conditions for Running the DTC

- The ignition is ON.
- DTCs P0112, P0113, P0117, P0118, P0125, P0128, P0601, P0602, P1621, P1683 are not set.
- The start-up IAT is more than 15°C (59°F).
- The vehicle has a minimum ignition OFF time of 10 hours.
- This DTC will only run once during the ignition cycle within the enabling conditions.

Conditions for Setting the DTC

If the PCM detects a temperature difference between the ECT sensor and the IAT sensor of more than 15°C (27°F), then the vehicle must be driven for more than 400 seconds over 24 km/h (15 mph). If the IAT sensor temperature decreases more than 3°C (5°F), a block heater is detected and the test is aborted. If the IAT sensor temperature does not decrease, a block heater was not detected and DTC P0116 sets.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

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

7: A snapshot is the quickest method to capture the data before it changes.

8: An IAT sensor that is skewed low can cause this DTC to set.

10: This step will determine if high resistance has caused this DTC to set.

12: A high resistance short from the signal circuit to the low reference circuit can cause this DTC to set.

DTC P0116

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Inspect the cooling system coolant level. Is the cooling system coolant low?	-	Go to **Draining and Filling Cooling System** in Engine Cooling	Go to **Step 3**
3	Observe and record the ambient air temperature of the vehicle environment using an accurate thermometer. Did you complete the action?	-	Go to **Step 4**	-
4	**IMPORTANT:** **The vehicle needs to have been OFF for at least 10 hours for the ECT and the intake air temperature (IAT) to be at ambient temperature. The vehicle should not have changed environments during this time.** Has the engine been OFF for the specified amount of time?	10 hrs	Go to **Step 7**	Go to **Step 5**
5	1. Remove the mass air flow/intake air temperature (MAF/IAT) sensor. Refer to **Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor Replacement** . 2. Remove the ECT sensor. Refer to **Engine Coolant Temperature (ECT) Sensor Replacement** . 3. Place the sensors on a work surface away from any heat source. 4. Allow the sensors to reach the ambient air temperature for 30-60 minutes. Are the sensors at the ambient temperature?	-	Go to **Step 6**	-
	1. Connect the MAF/IAT sensor to the electrical connector, but DO NOT install it.			

6	2. Insulate the sensor from any engine heat source. 3. Connect the ECT sensor to the electrical connector, but DO NOT install it. 4. Insulate the sensor from any engine heat source. Are the sensors connected?	-	Go to **Step 7**	-
7	**IMPORTANT:** **The IAT sensor will start to warm-up as soon as the ignition is turned ON.** 1. Turn ON the ignition. 2. Take a snapshot of the Engine Data List with a scan tool. 3. Review the snapshot data that was taken with the scan tool. 4. Observe the ECT Sensor parameter with a scan tool. 5. Observe the IAT Sensor parameter with a scan tool. Is the difference between the ECT Sensor parameter and the IAT Sensor parameter more than the specified value?	15°C (27°F)	Go to **Step 8**	Go to **Intermittent Conditions**
8	Observe the recorded IAT Sensor parameter. Is the difference between the IAT Sensor parameter and the ambient air temperature less than the specified value?	8°C (14°F)	Go to **Step 9**	Go to **Step 10**
9	Observe the recorded ECT Sensor parameter. Is the difference between the ECT Sensor parameter and the ambient air temperature less than the specified value?	8°C (14°F)	Go to **Intermittent Conditions**	Go to **Step 12**
10	1. Disconnect the MAF/IAT sensor. 2. Test for an intermittent and for a poor connection at the IAT sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 11**
	1. At the sensor, measure the resistance between the IAT signal and the IAT low			

11	reference terminals with a DMM and record the value. Refer to **Circuit Testing** in Wiring Systems. 2. Observe the recorded ambient air temperature. 3. Compare the resistance measurement of the IAT sensor to the ambient air temperature using the Temperature vs. Resistance table. Refer to **Temperature vs Resistance** . Is the resistance measurement of the IAT sensor within the specified range?	-	Go to **Step 14**	Go to **Step 22**
12	1. Disconnect the ECT sensor. 2. Inspect for the following conditions: • An ECT sensor leaking engine coolant internally through the sensor • Corrosion on the ECT sensor terminals • Corrosion on the ECT harness connector terminals Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 13**
13	1. At the sensor, measure the resistance between the ECT signal and the ECT low reference terminals with a DMM and record the value. Refer to **Circuit Testing** in Wiring Systems. 2. Observe the recorded ambient air temperature. 3. Compare the resistance measurement of the ECT sensor to the ambient air temperature using the Temperature vs. Resistance table. Refer to **Temperature vs Resistance** . Is the resistance measurement of the ECT sensor within the specified range?	-	Go to **Step 15**	Go to **Step 23**
14	Measure the voltage from the IAT signal circuit to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the voltage within the specified range?	4.8-5.2 V	Go to **Step 16**	Go to **Step 17**
15	Measure the voltage from the ECT signal circuit to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the voltage within the specified range?	4.8-5.2 V	Go to **Intermittent Conditions**	Go to **Step 19**

16	**IMPORTANT:** **All electrical components and accessories must be turned OFF. Performing this step will disable the diagnostic for 10 hours.** 1. Turn OFF the ignition for 90 seconds to allow the control modules to power down. 2. Measure the resistance from the low reference circuit of the IAT sensor to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the resistance less than the specified value?	5 ohm	Go to **Intermittent Conditions**	Go to **Step 18**
17	Test the IAT signal circuit for a high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 20**
18	Test the IAT low reference circuit for a high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 20**
19	Test the ECT signal circuit for a high resistance short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 21**
20	Test for an intermittent and for a poor connection at the powertrain control module (PCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 24**
21	Test for shorted terminals and poor connections at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** , **Connector Repairs** in Wiring Systems, and **Intermittent Conditions** . Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 24**
22	Replace the MAF/IAT sensor. Refer to **Mass Air Flow (MAF)/Intake Air Temperature (IAT) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 25**	-
23	Replace the ECT sensor. Refer to **Engine Coolant Temperature (ECT) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 25**	-

24	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 25**	-
25	Reassemble the vehicle as necessary. Did you complete the action?	-	Go to **Step 26**	-
26	**IMPORTANT:** **This DTC will not run without the ignition being OFF for at least 10 hours.** 1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 10 hours. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running in the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 27**
27	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0117

Circuit Description

The engine coolant temperature (ECT) sensor is a variable resistor, that measures the temperature of the engine coolant. The powertrain control module (PCM) supplies 5 volts to the ECT signal circuit and a ground for the ECT low reference circuit. When the ECT is cold, the sensor resistance is high. When the ECT increases, the sensor resistance decreases. With high sensor resistance, the PCM detects a high voltage on the ECT signal circuit. With lower sensor resistance, the PCM detects a lower voltage on the ECT signal circuit. If the PCM detects an excessively low ECT signal voltage, which is a high temperature indication, DTC P0117 sets.

Conditions for Running the DTC

- The engine run time is more than 10 seconds.

  OR

- The engine run time is less than 10 seconds when the intake air temperature (IAT) is less than 50°C (122° F).

Conditions for Setting the DTC

The PCM detects that the ECT sensor parameter is more than 138°C (280°F) for more than 20 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- An overheating condition may cause this DTC to set.
- After starting the engine, the ECT should rise steadily to about 90°C (194°F) then stabilize when the thermostat opens.
- Use the Temperature vs. Resistance table to test the ECT sensor at various temperature levels to evaluate the possibility of a skewed sensor. A skewed sensor could result in poor driveability concerns. Refer to **Temperature vs Resistance** .
- If the condition is suspected of being an intermittent, refer to **Intermittent Conditions** .

DTC P0117 - ECT Sensor Circuit Low Voltage

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Observe the engine coolant temperature (ECT) sensor parameter with a scan tool. Is the ECT sensor parameter more than the specified value?	138°C (280°F)	Go to **Step 4**	Go to **Step 3**
	1. Observe the Freeze Frame/Failure Records for			

3	this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to Diagnostic Aids
4	1. Disconnect the ECT sensor. 2. Observe the ECT sensor parameter with a scan tool. Is the ECT sensor parameter less than the specified value?	-38°C (-36°F)	Go to **Step 6**	Go to **Step 5**
5	Test the signal circuit of the ECT sensor for a short to ground or a short to the ECT low reference circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 8**
6	Test for an intermittent and for a poor connection at the ECT sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 7**
7	Replace the ECT sensor. Refer to **Engine Coolant Temperature (ECT) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 10**	-
8	Test for an intermittent and for a poor connection at the powertrain control module (PCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 9**
9	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 10**	-
10	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the	-		

	vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?		Go to **Step 2**	Go to **Step 11**
11	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0118

Circuit Description

The engine coolant temperature (ECT) sensor is a variable resistor, that measures the temperature of the engine coolant. The ECT sensor has a signal circuit and a low reference circuit. The powertrain control module (PCM) supplies 5 volts to the ECT signal circuit and a ground for the ECT low reference circuit. When the ECT is cold, the sensor resistance is high. When the ECT increases, the sensor resistance decreases. With high sensor resistance, the PCM detects a high voltage on the ECT signal circuit. With lower sensor resistance, the PCM detects a lower voltage on the ECT signal circuit. If the PCM detects an excessively high ECT signal voltage, which is a low temperature indication, DTC P0118 sets.

Conditions for Running the DTC

The engine has been running for more than 60 seconds.

OR

The engine run time is less than 60 seconds when the intake air temperature (IAT) is more than 0°C (32°F)

Conditions for Setting the DTC

The PCM detects that the ECT sensor parameter is less than -38°C (-36°F) for 20 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles

that the diagnostic runs and does not fail.

- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- If a short to a separate 5-volt source occurs, this DTC may set.
- After starting the engine, the ECT should rise steadily, then stabilize when the thermostat opens.
- Use the Temperature vs. Resistance table in order to test the ECT sensor. A skewed sensor could result in poor driveability conditions. Refer to **Temperature vs Resistance** .
- If the condition is suspected of being intermittent, refer to **Intermittent Conditions** .

DTC P0118

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Observe the ECT sensor parameter with a scan tool. Is the ECT sensor parameter less than the specified value?	-38°C (-36°F)	Go to **Step 4**	Go to **Step 3**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to Diagnostic Aids
4	1. Disconnect the ECT sensor. 2. Measure the voltage from the signal circuit of the ECT sensor to a good ground with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.	5.2 V		

	Is the voltage more than the specified value?		Go to **Step 5**	Go to **Step 6**
5	**IMPORTANT:** **If a short to voltage occurs, the ECT sensor may be damaged.** Test the ECT signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 12**
6	1. Connect a 3-amp fused jumper between the signal circuit of the ECT sensor and the low reference circuit. Refer to **Using Fused Jumper Wires** in Wiring Systems. 2. Observe the ECT sensor parameter with the scan tool. Is the ECT sensor parameter more than the specified value?	138°C (280°F)	Go to **Step 10**	Go to **Step 7**
7	1. Connect a 3-amp fused jumper between the signal circuit of the ECT sensor and a good ground. 2. Observe the ECT sensor parameter with a scan tool. Is the ECT sensor parameter more than the specified value?	138°C (280°F)	Go to **Step 9**	Go to **Step 8**
8	Test the signal circuit of the ECT sensor for a high resistance or an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 12**
9	Test the low reference circuit of the ECT sensor for a high resistance or an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 12**
10	Test the ECT signal circuit for a short to any 5-volt reference circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 11**
11	Test for an intermittent and for a poor connection at the ECT sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 13**
	Test for an intermittent and for a poor connection at			

12	the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 14**
13	Replace the ECT sensor. Refer to **Engine Coolant Temperature (ECT) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
14	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
15	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 16**
16	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0120

Circuit Description

The throttle position (TP) sensor 1 is a potentiometer type sensor with the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The TP sensor is used to determine the throttle plate angle for various engine management systems. The control module provides the TP sensor a 5-volt reference circuit and a low reference circuit. The TP sensor then provides the control module a signal voltage proportional to throttle plate movement. TP sensor 1 signal voltage is low at closed throttle and increases as the throttle opens. When the control module detects that the TP sensor 1 signal or TP sensor 5-volt reference voltage is outside the predetermined range, this DTC sets.

Conditions for Running the DTC

- DTCs P2108 or U0107 are not set.
- The ignition switch is in the Crank or Run position.

- The ignition voltage is more than 5.23 volts.

Conditions for Setting the DTC

- The TP sensor 1 signal voltage is less than 0.37 volt or more than 4.51 volts.
- The above condition is present for more than 1 second.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame and/or the Failure Records.
- The control module commands the TAC system to operate in the Reduced Engine Power mode.
- A message center or an indicator displays Reduced Engine Power.
- Under certain conditions the control module commands the engine OFF.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Inspect the TAC module connectors for signs of water intrusion. When this occurs, multiple DTCs could be set with no circuit or component conditions found during diagnostic testing.
- When the TAC module detects a condition within the TAC system, more than one TAC system related DTC may set. This is due to the many redundant tests run continuously on this system. Locating and repairing one individual condition may correct more than one DTC. Disconnecting components during testing may set additional DTCs. Keep this in mind when reviewing the stored information, Capture Info.
- If this DTC is determined to be intermittent, refer to **Intermittent Conditions** .

Test Description

The number below refers to the step number on the diagnostic table.

> **33:** When the TAC module detects a condition within the TAC system, more than one TAC system related DTC may set. This is due to the many redundant tests run continuously on this system. Locating and repairing one individual condition may correct more than one DTC. Disconnecting components during testing may set additional DTCs. Keep this in mind when reviewing the stored information, Capture Info.

DTC P0120

Step	Action	Values	Yes	No
Schematic Reference:Engine Controls Schematics **Connector End View Reference:Engine Controls Component Views** or **Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn OFF the ignition. 2. Remove the air inlet duct from the throttle body. 3. Disconnect the throttle body harness connector. 4. Connect the jumper wires between the throttle position (TP) sensor 1 terminals of the throttle body harness connector and the corresponding TP sensor 1 terminals of the throttle body. 5. Turn ON the ignition, with the engine OFF. 6. Close the throttle blade by hand. 7. Observe the TP sensor 1 voltage with a scan tool. Is the TP sensor 1 voltage within the specified range?	0.37-0.71 V	Go to **Step 5**	Go to **Step 3**
3	1. Turn OFF the ignition. 2. Connect jumper wires between the TP sensor 2 terminals of the throttle body harness connector and the corresponding TP sensor 2 terminals of the throttle body. 3. Turn ON the ignition, with the engine OFF. 4. Close the throttle blade by hand. 5. Observe the TP sensor 2 voltage with a scan tool. Is the TP sensor 2 voltage within the specified range?	0.28-0.81 V	Go to **Step 9**	Go to **Step 4**
4	Is DTC U0107 also set?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 9**
5	1. Open the throttle blade to wide open throttle (WOT) by hand. 2. Observe the TP sensor 1 voltage parameter on the scan tool. Is the TP sensor 1 voltage parameter more than the specified value?	4.51 V	Go to **Step 9**	Go to **Step 6**

6	1. Disconnect the TP sensor harness connector. 2. Disconnect the throttle actuator control (TAC) module harness connector containing the TP sensor circuits. 3. Test the TP sensor low-reference circuit for a short to ground with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 32**	Go to **Step 7**
7	1. Turn OFF the ignition for 15 seconds. 2. Connect the TAC module harness connector. 3. Connect the throttle body harness connector. 4. Install the air inlet duct. 5. Turn ON the ignition, with the engine OFF. 6. Select the DTC Info option on the scan tool. 7. Lightly touch and move the related engine wiring harnesses and connectors for the TP sensor while observing the DTC Info. The DTC will set if an intermittent condition is present. Refer to **Connector Repairs** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 32**	Go to **Step 8**
8	1. Continue to observe the DTC Info. 2. Slowly depress the accelerator pedal to WOT, then slowly return the pedal to the released position 3 times. Does the scan tool indicate this DTC failed this ignition?	-	Go to **Step 27**	Go to Diagnostic Aids
9	1. Disconnect the TP sensor harness connector. 2. Measure the voltage at the TP sensor 1 signal circuit with a DMM connected to ground. Is the voltage within the specified range?	3.94-6.06 V	Go to **Step 14**	Go to **Step 10**
10	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the TP sensor circuits. 3. Turn ON the ignition, with the engine OFF. 4. Test the TP sensor 1 signal circuit for a short to voltage with a DMM. Refer to **Circuit Testing**	-		

	and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?		Go to **Step 32**	Go to **Step 11**
11	Test the TP sensor 1 signal circuit for an open or high resistance with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 32**	Go to **Step 12**
12	Test the TP sensor 1 signal circuit for a short to ground with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 32**	Go to **Step 13**
13	1. Disconnect the other TAC module harness connector. 2. Test for a short between the TP sensor 1 signal circuit and all other TAC module circuits with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 32**	Go to **Step 28**
14	Measure the voltage from the TP sensor 1 5-volt reference circuit to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the voltage within the specified range?	4.54-5.21 V	Go to **Step 24**	Go to **Step 15**
15	Is the voltage more than the specified value?	5.21 V	Go to **Step 16**	Go to **Step 18**
16	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the TP sensor circuits. 3. Turn ON the ignition, with the engine OFF. 4. Test the TP sensor 1 5-volt reference circuit for a short to voltage with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 32**	Go to **Step 17**
17	1. Turn OFF the ignition. 2. Disconnect the accelerator pedal position (APP) sensor harness connector. 3. Disconnect the other TAC module harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Test the APP sensor 1 5-volt reference circuit for a short to voltage with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.	-		

	Did you find and correct the condition?		Go to **Step 32**	Go to **Step 22**
18	Disconnect the APP sensor. Is the voltage less than the specified value?	4.54 V	Go to **Step 19**	Go to **Step 30**
19	1. Disconnect the TAC module harness connector containing the TP sensor circuits. 2. Test the TP sensor 1 5-volt reference circuit for an open or high resistance with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 32**	Go to **Step 20**
20	Test the TP sensor 1 5-volt reference circuit for a short to ground with a DMM. Did you find and correct the condition?	-	Go to **Step 32**	Go to **Step 21**
21	Test the APP sensor 1 5-volt reference circuit for a short to ground with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 32**	Go to **Step 22**
22	Test for a short between the TP sensor 1 5-volt reference circuit and all other TAC module circuits with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 32**	Go to **Step 23**
23	Test for a short between the APP sensor 1 5-volt reference circuit and all other TAC module circuits with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 32**	Go to **Step 28**
24	1. Connect a fused jumper between the TP sensor 1 low reference circuit and the TP sensor 1 signal circuit. 2. Observe the TP sensor 1 voltage parameter with a scan tool. Is the TP sensor 1 parameter near the specified value?	0 V	Go to **Step 26**	Go to **Step 25**
25	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the TP sensor circuits. 3. Test the TP sensor 1 low-reference circuit for an open or high resistance with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 32**	Go to **Step 28**

26	Inspect for an intermittent and for a poor connection at the throttle body harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Repairing Connector Terminals** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 32**	Go to **Step 29**
27	Inspect for an intermittent and for a poor connection at the APP sensor harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Repairing Connector Terminals** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 32**	Go to **Step 30**
28	Inspect for an intermittent and for a poor connection at the TAC module harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Repairing Connector Terminals** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 32**	Go to **Step 31**
29	Replace the throttle body assembly. Refer to **Throttle Body Assembly Replacement** . Did you complete the replacement?	-	Go to **Step 32**	-
30	Replace the APP sensor. Refer to **Accelerator Pedal Position (APP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 32**	-
31	Replace the TAC module. Refer to **Throttle Actuator Control (TAC) Module Replacement** . Did you complete the replacement?	-	Go to **Step 32**	-
32	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 33**
33	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0125

Circuit Description

The engine coolant temperature (ECT) sensor monitors the temperature of the coolant. This input is used by the powertrain control module (PCM) for engine control, and as an enabling criteria for some diagnostics.

The air flow coming into the engine is accumulated and used to determine if the vehicle has been driven within conditions that would allow the engine coolant to heat up normally to the Closed Loop temperature. If the coolant temperature does not increase normally or does not reach the Closed Loop temperature, the diagnostics that use engine coolant temperature as enabling criteria may not run when expected.

This DTC will only run once per ignition cycle within the enabling conditions. If the PCM detects the calibrated amount of air flow and engine run time have been met and the ECT has not met the Closed Loop temperature, DTC P0125 sets.

Conditions for Running the DTC

- DTCs P0101, P0102, P0103, P0112, P0113, P0116, P0117, P0118, P0500, P0502, P0503 are not present.
- The engine run time is between 120-1,600 seconds.
- The minimum air temperature is between -7 and +55°C (+19 and +131°F).
- The start-up coolant temperature is less than 28.5°C (83°F).
- The mass air flow (MAF) is between 20-75 g/s with the average more than 15 g/s.
- The vehicle speed is more than 8 km/h (5 mph) for more than 0.5 miles.
- This diagnostic has not previously run this ignition cycle.

Conditions for Setting the DTC

The PCM detects all of the following conditions:

- The calibrated amount of engine run time has been met.
- The calibrated amount of engine air flow has been met.
- The calibrated vehicle speed and distance have been met.
- The engine coolant temperature for Closed Loop of 34°C (93°F) has not been met.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.

- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P0125

<table>
<tr><th>Step</th><th>Action</th><th>Values</th><th>Yes</th><th>No</th></tr>
<tr><td colspan="5">Schematic Reference: <u>Engine Controls Schematics</u>
Connector End View Reference: <u>Engine Controls Connector End Views</u> or <u>Powertrain Control Module (PCM) Connector End Views</u></td></tr>
<tr><td>1</td><td>Did you perform the Diagnostic System Check-Engine Controls?</td><td>-</td><td>Go to Step 2</td><td>Go to <u>Diagnostic System Check - Engine Controls</u></td></tr>
<tr><td>2</td><td>Is the cooling system coolant low?</td><td>-</td><td>Go to <u>Draining and Filling Cooling System</u> in Engine Cooling</td><td>Go to Step 3</td></tr>
<tr><td>3</td><td>Test and verify the proper operation of the thermostat. Refer to <u>Thermostat Diagnosis</u> in Engine Cooling.
Did you find and correct the condition?</td><td>-</td><td>Go to Step 14</td><td>Go to Step 4</td></tr>
<tr><td>4</td><td>1. Disconnect the engine coolant temperature (ECT) sensor.
2. Inspect for the following conditions:
• Corrosion on the ECT sensor terminals
• Improper or corroded terminals at the ECT harness connector
• Loose terminals in the ECT harness connector-Refer to <u>Testing for Intermittent Conditions and Poor Connections</u> and <u>Connector Repairs</u> in Wiring Systems.

Did you find and correct the condition?</td><td>-</td><td>Go to Step 14</td><td>Go to Step 5</td></tr>
<tr><td>5</td><td>Measure the voltage from the signal circuit of the ECT sensor to a good ground with a DMM. Refer to <u>Circuit Testing</u> in Wiring Systems.
Is the voltage within the specified range?</td><td>4.8-5.2 V</td><td>Go to Step 6</td><td>Go to Step 8</td></tr>
<tr><td>6</td><td>Measure the voltage from the signal circuit of the ECT sensor to the low reference circuit of the ECT sensor with a DMM. Refer to <u>Circuit Testing</u> in Wiring Systems.</td><td>4.8-5.2 V</td><td></td><td></td></tr>
</table>

	Is the voltage within the specified range?		Go to **Step 9**	Go to **Step 7**
7	Test the ECT sensor low reference circuit for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 11**
8	Test the ECT sensor signal circuit for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 11**
9	1. Turn OFF the ignition. 2. Remove the ECT sensor. Refer to **Engine Coolant Temperature (ECT) Sensor Replacement** . 3. Place the sensor on a work surface away from any heat source. 4. Allow the sensor to reach the ambient air temperature for 30-60 minutes. 5. Observe and record the ambient air temperature of the vehicle environment using an accurate thermometer. **IMPORTANT:** **Do not hold the ECT sensor by the probe.** 6. Measure the resistance of the ECT sensor and record the value. 7. Compare the resistance measurement of the ECT sensor to the ambient air temperature on the Temperature vs. Resistance table. Refer to **Temperature vs Resistance** . Is the resistance measurement of the ECT sensor within the specified range?	-	Go to **Step 10**	Go to **Step 12**
10	Install the ECT sensor. Refer to **Engine Coolant Temperature (ECT) Sensor Replacement** . Is the action complete?	-	Go to **Intermittent Conditions**	-
11	Test for an intermittent and for a poor connection at the powertrain control module (PCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 13**
12	Replace the ECT sensor. Refer to **Engine Coolant Temperature (ECT) Sensor Replacement** .	-		

	Did you complete the replacement?		Go to **Step 14**	-
13	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	or	Go to **Step 14**	-
14	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 15**
15	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0128

Circuit Description

An engine coolant temperature (ECT) sensor monitors the temperature of the coolant. This input is used by the powertrain control module (PCM) for engine control, and as an enabling criteria for some diagnostics.

The air flow coming into the engine is accumulated and used to determine if the vehicle has been driven within conditions that would allow the engine coolant to heat up normally to the thermostat regulating temperature. If the coolant temperature does not increase normally or does not reach the regulating temperature of the thermostat, diagnostics that use ECT as enabling criteria, may not run when expected.

This DTC will only run once per ignition cycle within the enabling condition. If the PCM detects the calibrated amount of air flow and engine run time have been met and the ECT has not met the minimum thermostat regulating temperature, DTC P0128 sets.

Conditions for Running the DTC

- DTCs P0101, P0102, P0103, P0112, P0113, P0116, P0117, P0118, P0125, P0500, P0502, P0503 are not present.
- The start up engine coolant temperature is less than 70°C (158°F).
- The intake air temperature (IAT) sensor parameter is between -7 and +55°C (+19 and +131°F).
- The engine is running between 120-1,600 seconds.
- The vehicle speed is more than 8 km/h (5 mph) for more than 2.5 km (1.5 miles).
- The mass air flow (MAF) is between 20-75 g/s with the average more than 15 g/s.
- This diagnostic has not previously run this ignition cycle.

Conditions for Setting the DTC

The PCM detects all of the following conditions:

- The calibrated amount of engine run time has been met.
- The calibrated amount of engine air flow has been met.
- The calibrated vehicle speed and distance have been met.
- The calibrated minimum engine coolant temperature of 75°C (167°F) has not been met.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P0128

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Is the cooling system coolant low?	-	Go to **Draining and Filling Cooling System** in Engine Cooling	Go to **Step 3**
3	Test and verify the proper operation of the thermostat. Refer to **Thermostat Diagnosis** in Engine Cooling.	-		

	Did you find and correct the condition?		Go to **Step 14**	Go to **Step 4**
4	1. Disconnect the engine coolant temperature (ECT) sensor. 2. Inspect for the following conditions: • Corrosion on the ECT sensor terminals • Improper or corroded terminals at the ECT harness connector • Loose terminals in the ECT harness connector-Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 5**
5	Measure the voltage from the signal circuit of the ECT sensor to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the voltage within the specified range?	4.8-5.2 V	Go to **Step 6**	Go to **Step 8**
6	Measure the voltage from the signal circuit of the ECT sensor to the low reference circuit of the ECT sensor with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the voltage within the specified range?	4.8-5.2 V	Go to **Step 9**	Go to **Step 7**
7	Test the ECT sensor low reference circuit for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 11**
8	Test the ECT sensor signal circuit for high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 11**
9	1. Turn OFF the ignition. 2. Remove the ECT sensor. Refer to **Engine Coolant Temperature (ECT) Sensor Replacement** . 3. Place the sensor on a work surface away from any heat source. 4. Allow the sensor to reach the ambient air temperature for 30-60 minutes. 5. Observe and record the ambient air temperature of the vehicle environment using an accurate thermometer.	-		

	IMPORTANT: **Do not hold the ECT sensor by the probe.** 6. Measure the resistance of the ECT sensor and record the value. 7. Compare the resistance measurement of the ECT sensor to the ambient air temperature on the Temperature vs. Resistance table. Refer to **Temperature vs Resistance** . Is the resistance measurement of the ECT sensor within the specified range?		Go to **Step 10**	Go to **Step 12**
10	Install the ECT sensor. Refer to **Engine Coolant Temperature (ECT) Sensor Replacement** . Is the action complete?	-	Go to **Intermittent Conditions**	-
11	Test for an intermittent and for a poor connection at the powertrain control module (PCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 13**
12	Replace the ECT sensor. Refer to **Engine Coolant Temperature (ECT) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 14**	-
13	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 14**	-
14	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 15**
15	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0131 OR P0151

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The powertrain control module (PCM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the PCM operates in open loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and closed loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream; low HO2S voltage indicates a lean exhaust stream. If the PCM detects an HO2S voltage that stays below a specified value, DTC P0131 sets for HO2S bank 1 sensor 1, or DTC P0151 sets for HO2S bank 2 sensor 1.

Conditions for Running the DTC

Lean Test Enable:

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0200, P0220, P0300, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The Loop Status parameter is closed.
- The Ignition 1 Signal parameter is between 10-18 volts.
- The Fuel Tank Level Remaining parameter is more than 10 percent.
- The TP Indicated Angle parameter is between 3-70 percent more than the value observed at idle.

OR

Power Enrichment Test Enable:

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0200, P0220, P0300, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The Loop Status parameter is closed.
- The Ignition 1 Signal parameter is between 10-18 volts.
- The Fuel Tank Level Remaining parameter is more than 10 percent.
- The Engine Run Time parameter is more than 30 seconds.
- The Power Enrichment parameter is active for more than 1 second.

Conditions for Setting the DTC

Lean Test:

The PCM detects that the affected HO2S voltage parameter is less than 200 mV for 165 seconds.

OR

Power Enrichment Test:

The PCM detects that the affected HO2S voltage parameter is less than 360 mV for 10 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.
- The control module commands the Loop Status open.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

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

2: If the voltage is varying above and below the specified range, the condition is not present.

DTC P0131 or P0151

Step	Action	Value (s)	Yes	No
Schematic Reference:Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to **Scan Tool Data List** . 3. Observe the affected HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter varying above and	300-600 mV		

	below the specified range?		Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the affected heated oxygen sensor (HO2S). 3. Turn ON the ignition, with the engine OFF. 4. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to **Step 6**	Go to **Step 5**
5	1. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and a good ground. 2. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to **Step 7**	Go to **Step 8**
6	Test the HO2S high signal circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 9**
7	Test the HO2S low signal circuit for a short to the HO2S heater low control circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 10**
8	Test the HO2S high signal circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 12**
	Test the HO2S high signal circuit for a short to the following circuits:			

9	• HO2S low signal circuit • HO2S heater low control circuit Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 12**
10	1. The HO2S may be detecting a lean exhaust condition or may be contaminated. Inspect for the following conditions: **NOTE:** **Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices.** • A silicon contaminated HO2S • Any water intrusion into the HO2S connector • An exhaust leak between the HO2S and the engine • Any vacuum leaks • An incorrect fuel pressure-Refer to **Fuel System Diagnosis** . • Any lean fuel injectors-Refer to **Fuel Injector Balance Test with Tech 2** . • An inaccurate mass air flow (MAF) sensor-Refer to **Scan Tool Data List** . 2. Repair any of the above or similar engine conditions as necessary. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 11**
11	Test for shorted terminals and for poor connections at the HO2S. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 13**
12	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 14**

13	Replace the affected HO2S. Refer to **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1** or **Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1** . Did you complete the replacement?	-	Go to **Step 15**	-
14	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
15	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 16**
16	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0132 OR P0152

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The powertrain control module (PCM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the PCM operates in open loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and closed loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream; low HO2S voltage indicates a lean exhaust stream. If the PCM detects an HO2S voltage that stays above a specified value, DTC P0132 sets for HO2S bank 1 sensor 1, or DTC P0152 sets for HO2S bank 2 sensor 1.

Conditions for Running the DTC

Rich Test Enable:

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0200, P0220, P0300, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The Loop Status parameter is closed.

- The Ignition 1 Signal parameter is between 10-18 volts.
- The Fuel Tank Level Remaining parameter is more than 10 percent.
- The TP Indicated Angle parameter is between 3-70 percent more than the value observed at idle.

OR

Decel. Fuel Cutoff Test Enable:

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0200, P0220, P0300, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0170 are not set.
- The Loop Status parameter is closed.
- The Ignition 1 Signal parameter is between 10-18 volts.
- The Fuel Tank Level Remaining parameter is more than 10 percent.
- The Engine Run Time parameter is more than 30 seconds.
- The Decel. Fuel Cutoff parameter is active for more than 2 seconds.

Conditions for Setting the DTC

Rich Test:

The PCM detects that the affected HO2S voltage parameter is more than 900 mV for 165 seconds.

OR

Decel. Fuel Cutoff Test:

The PCM detects that the affected HO2S voltage parameter is more than 540 mV for 5 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.
- The control module commands the Loop Status open.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.

- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

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

2: If the voltage is varying above and below the specified range, the condition is not present.

DTC P0132 or P0152

Step	Action	Value (s)	Yes	No
Schematic Reference:Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to **Scan Tool Data List** . 3. Observe the affected HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter varying above and below the specified range?	300-600 mV	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the affected heated oxygen sensor (HO2S). 3. Turn ON the ignition, with the engine OFF.	400-500		

	4. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter within the specified range?	mV	Go to **Step 5**	Go to **Step 6**
5	1. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and a good ground. 2. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to **Step 7**	Go to **Step 8**
6	Test the HO2S high signal circuit for a short to the HO2S heater low control circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 10**
7	1. Remove the jumper wire from the previous step. 2. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and the low signal circuit of the HO2S harness connector on the engine harness side. 3. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to **Step 9**	Go to **Step 11**
8	Test the HO2S high signal circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 14**
9	Test the HO2S low signal circuit for a short to the HO2S heater low control circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 12**
10	**IMPORTANT:** **The sensor may be damaged if the circuit is shorted to a voltage source.** Test the HO2S high signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct the	-		

	condition?		Go to **Step 17**	Go to **Step 14**
11	Test the HO2S low signal circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 14**
12	1. The HO2S may be detecting a rich exhaust condition or may be contaminated. Inspect for the following conditions: **NOTE:** **Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices.** • A silicon contaminated HO2S • Any water intrusion into the HO2S connector • Engine oil contaminated with fuel • An evaporative emission (EVAP) canister purge condition • An incorrect fuel pressure-Refer to **Fuel System Diagnosis** . • Any rich fuel injectors-Refer to **Fuel Injector Balance Test with Tech 2** . • An inaccurate mass air flow (MAF) sensor-Refer to **Scan Tool Data List** . • An air intake restriction or collapsed air intake duct 2. Repair any of the above or similar engine conditions as necessary. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 13**
13	Test for shorted terminals and for poor connections at the HO2S. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 15**
14	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 16**
	Replace the affected HO2S. Refer to **Heated Oxygen**			

15	**Sensor (HO2S) Replacement Bank 1 Sensor 1** or **Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1** . Did you complete the replacement?	-	Go to **Step 17**	-
16	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 17**	-
17	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 18**
18	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0133 OR P0153

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The powertrain control module (PCM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the PCM operates in open loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and closed loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream; low HO2S voltage indicates a lean exhaust stream. This diagnostic will only run once per ignition cycle. The PCM monitors the rich-to-lean and lean-to-rich transition time. A transition is defined as, the HO2S voltage changes from above 625 mV to below 250 mV or from below 250 mV to above 625 mV. If the PCM detects that the transition time is too long, DTC P0133 sets for HO2S bank 1 sensor 1, or DTC P0153 sets for HO2S bank 2 sensor 1.

Conditions for Running the DTC

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0131, P0132, P0134, P0135, P0151, P0152, P0154, P0155, P0200, P0220, P0300, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258,P1516, P2101, P2108, P2135, U0107 are not set.
- The ECT Sensor parameter is more than 60°C (140°F).
- The EVAP Purge Solenoid Command parameter is more than 1 percent.

- The MAF Sensor parameter is between 20-55 g/s.
- The Engine Speed parameter is between 1,200-3,000 RPM.
- The TP Indicated Angle parameter is 5 percent more than the value observed at idle.
- The Loop Status parameter is closed.
- The Ignition 1 Signal parameter is between 10-18 volts.
- The Fuel Tank Level Remaining parameter is more than 10 percent.
- The Engine Run Time parameter is more than 160 seconds.
- The above conditions are met for 100 seconds.

Conditions for Setting the DTC

The PCM detects that the affected HO2S rich-to-lean or lean-to-rich average response time is more than a calibrated value.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

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

2: If the voltage is varying above and below the specified value, the condition is not present.

DTC P0133 or P0153

Step	Action	Value (s)	Yes	No
Schematic Reference:Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Powertrain Control**				

Module (PCM) Connector End Views

1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to **Scan Tool Data List** . 3. Operate the engine at 1,500 RPM for 30 seconds. 4. Observe the affected HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter varying above and below the specified range?	250-625 mV	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the affected heated oxygen sensor (HO2S). 3. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and a good ground. 4. Turn ON the ignition, with the engine OFF. 5. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to **Step 6**	Go to **Step 5**
5	Test the HO2S high signal circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 9**
	1. Remove the jumper wire from the previous step. 2. Connect a 3-amp fused jumper wire between the			

6	high signal circuit of the HO2S harness connector on the engine harness side and the low signal circuit of the HO2S harness connector on the engine harness side. 3. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to **Step 8**	Go to **Step 7**
7	Test the HO2S low signal circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 9**
8	Test for shorted terminals and for poor connections at the HO2S. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 10**
9	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 11**
10	**NOTE:** **Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices.** **IMPORTANT:** **The HO2S may be damaged due to contamination. Prior to replacing the HO2S inspect for the following sources of contamination:** • A silicon contaminated HO2S • Fuel contamination-Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (without Special Tool and E85)** or **Alcohol/Contaminants-in-Fuel Diagnosis (with Special Tool)** . • Engine oil consumption-Refer to **Oil Consumption Diagnosis** in Engine Mechanical. • Engine coolant consumption-Refer to **Loss of Coolant** in Engine Cooling. Replace the affected HO2S. Refer to **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1** or	-		

	Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1 .Did you complete the replacement?		Go to **Step 12**	-
11	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
12	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 13**
13	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0134 OR P0154

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The powertrain control module (PCM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the PCM operates in open loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and closed loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream; low HO2S voltage indicates a lean exhaust stream. If the PCM detects that the HO2S voltage remains within the bias voltage range, DTC P0134 sets for HO2S bank 1 sensor 1, or DTC P0154 sets for HO2S bank 2 sensor 1.

Conditions for Running the DTC

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0200, P0220, P0300, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The Engine Run Time parameter is more than 300 seconds.
- The Ignition 1 Signal parameter is between 10-18 volts.

Conditions for Setting the DTC

The PCM detects that the affected HO2S voltage parameter is between 350-550 mV for 60 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.
- The control module commands the Loop Status open.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The number below refers to the step number on the diagnostic table.

3: If the voltage is varying above and below the specified value, the condition is not present.

DTC P0134 or P0154

Step	Action	Value (s)	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **Whenever the HO2S heaters are commanded ON with a scan tool, they will continue to be pulsed ON once per second until the ignition is turned OFF for 30 seconds.** 1. Turn ON the ignition, with the engine OFF. 2. Command the HO2S heaters ON with a scan tool. 3. Wait 15 seconds to allow the HO2S heater	0.25-3.125 A		

	current to stabilize. 4. Observe the affected HO2S heater current parameter with a scan tool. Is the HO2S heater current parameter within the specified range?		Go to **Step 3**	Go to **DTC P0135 or P0155**
3	1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to **Scan Tool Data List** . 3. Operate the engine at 1,500 RPM for 30 seconds. 4. Observe the affected HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter varying above and below the specified range?	300-600 mV	Go to **Step 4**	Go to **Step 5**
4	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 5**	Go to **Intermittent Conditions**
5	1. Turn OFF the ignition. 2. Disconnect the affected HO2S. 3. Turn ON the ignition, with the engine OFF. 4. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter more than the specified value?	800 mV	Go to **Step 7**	Go to **Step 6**
6	Measure the voltage from the high signal circuit of the HO2S harness connector on the engine harness side to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the voltage more than the specified value?	0.2 V	Go to **Step 8**	Go to **Step 9**
	IMPORTANT: **The sensor may be damaged if the circuit is**			

	shorted to a voltage source.			
7	Test the HO2S high signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 14**
8	Measure the voltage from the low signal circuit of the HO2S harness connector on the engine harness side to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the voltage more than the specified value?	2 V	Go to **Step 12**	Go to **Step 10**
9	Test the HO2S high signal circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 14**
10	1. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and the low signal circuit of the HO2S harness connector on the engine harness side. 2. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to **Step 13**	Go to **Step 11**
11	Test the HO2S low signal circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 14**
12	Test the HO2S low signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 14**
13	Test for shorted terminals and for poor connections at the HO2S. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 15**
14	Test for shorted terminals and for poor connections at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 16**
	Replace the affected HO2S. Refer to **Heated Oxygen Sensor (HO2S) Replacement Bank 1**			

15	**Sensor 1** or **Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1** . Did you complete the replacement?	-	Go to **Step 17**	-
16	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 17**	-
17	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 18**
18	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0135 OR P0155

Circuit Description

The heated oxygen sensor (HO2S) must reach operating temperature to provide an accurate voltage signal. A heating element inside the HO2S minimizes the time required for the sensor to reach operating temperature. Voltage is provided to the heater by the ignition 1 voltage circuit through a fuse. With the engine running, ground is provided to the heater by the HO2S heater low control circuit, through a low side driver within the powertrain control module (PCM). The PCM commands the heater ON or OFF to maintain a specific HO2S operating temperature range. The PCM determines the temperature by measuring the current flow through the heater. When the heater is in the ON state, the PCM will pulse the heater OFF for a duration of 50 ms, once per second. When the heater is in the OFF state, the PCM will pulse the heater ON for a duration of 50 ms, once per second. The PCM monitors the heater current with the engine running. The PCM also calculates the heater resistance on a cold start. Both diagnostics will only run once per ignition cycle. If the PCM detects that the heater current or the heater calculated resistance is not within an expected range, DTC P0135 sets for HO2S bank 1 sensor 1 or DTC P0155 sets for HO2S bank 2 sensor 1.

Conditions for Running the DTC

Heater Current Test

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0200, P0220, P0300, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.

- The ECT Sensor parameter is more than 50°C (122°F).
- The Ignition 1 Signal parameter is between 10-18 volts.
- The MAF Sensor parameter is between 3-40 g/s.
- The Engine Speed parameter is between 500-3,000 RPM.
- The Engine Run Time parameter is more than 120 seconds.

OR

Heater Resistance Test

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0200, P0220, P0300, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The ignition is OFF for more than 10 hours.
- The ECT Sensor parameter is between -30 to +45°C (-22 to +113°F) at engine start-up.
- The ECT Sensor parameter minus the IAT Sensor parameter is less than 8°C (14°F) at engine start-up.
- The engine is running.

Conditions for Setting the DTC

Heater Current Test

- The PCM detects that the affected HO2S heater current parameter is more than 3.125 amps or less than 0.25 amps.
- The above condition is met for 10 seconds.

OR

Heater Resistance Test

The PCM detects that the affected HO2S heater calculated resistance is not within an expected range at engine start-up.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The number below refers to the step number on the diagnostic table.

9: With no fault present, the test lamp will blink once per second.

DTC P0135 or P0155

Step	Action	Value (s)	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Component Views or Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **Whenever the HO2S heaters are commanded ON with a scan tool, they will continue to be pulsed ON once per second until the ignition is turned OFF for 30 seconds.** 1. Turn ON the ignition, with the engine OFF. 2. Command the HO2S heaters ON with a scan tool. 3. Wait 15 seconds to allow the HO2S heater current to stabilize. 4. Observe the affected HO2S heater current parameter with a scan tool. Is the HO2S heater current parameter within the specified range?	0.25-3.125 A	Go to **Step 3**	Go to **Step 6**
3	Observe the Freeze Frame/Failure Records for this DTC. Did the DTC fail with an engine run time of less that 10 seconds?	-	Go to **Step 4**	Go to **Step 5**
	1. Operate the vehicle within the Conditions for Running the Heater Resistance Test.			

4	2. Start the engine. Did the DTC fail this ignition?	-	Go to **Step 6**	Go to **Intermittent Conditions**
5	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the Heater Current Test. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 6**	Go to **Intermittent Conditions**
6	Inspect the O2A fuse. Is the O2A fuse open?	-	Go to **Step 7**	Go to **Step 8**
7	Test the ignition 1 voltage circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 10**
8	1. Disconnect the affected HO2S. 2. Turn ON the ignition, with the engine OFF. 3. Probe the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side with a test lamp that is connected to a good ground. Refer to **Probing Electrical Connectors** in Wiring Systems. Does the test lamp illuminate?	-	Go to **Step 9**	Go to **Step 19**
9	**IMPORTANT:** **The test lamp may blink prior to commanding the heaters ON. This is because the heaters were commanded ON in a previous step. To command the heaters OFF, turn OFF the ignition for 30 seconds.** 1. Connect a test lamp between the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side and the HO2S heater low control circuit of the HO2S harness connector on the engine harness side. 2. Command the HO2S heaters ON with a scan tool.	-		

	Does the test lamp blink once per second?		Go to **Step 11**	Go to **Step 12**
10	**IMPORTANT:** **Perform the following test on all HO2S' which are supplied voltage by the suspect circuit.** Test the ignition 1 voltage circuit on the sensor side of the HO2S connector for a short to ground. Refer to **Circuit Testing** in Wiring Systems.Is any sensor shorted to ground?	-	Go to **Step 20**	Go to **Intermittent Conditions**
11	Measure the resistance of the following circuits with a DMM: • HO2S heater low control circuit • Ignition 1 voltage circuit Refer to **Circuit Testing** in Wiring Systems. Is the resistance of either circuit more than the specified value?	3 ohm	Go to **Step 18**	Go to **Step 16**
12	Is the test lamp on steady?	-	Go to **Step 13**	Go to **Step 14**
13	Test the HO2S heater low control circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 17**
14	Test the HO2S heater low control circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 15**
15	Test the HO2S heater low control circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 17**
16	Test for shorted terminals and for poor connections at the HO2S. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 20**
17	Test for shorted terminals and for poor connections at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 21**
18	Repair the circuit with high resistance. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 22**	-

19	Repair the open or high resistance in the ignition 1 voltage circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 22**	-
20	Replace the affected HO2S. Refer to **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1** or **Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1** . Did you complete the replacement?	-	Go to **Step 22**	-
21	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 22**	-
22	Were you sent to this diagnostic from DTC P0134 or P0154?	-	Go to Step 17 in **DTC P0134 or P0154**	Go to **Step 23**
23	1. Replace the O2A fuse if necessary. 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 24**
24	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0136 OR P0156

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The powertrain control module (PCM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the PCM operates in open loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and closed loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream; low HO2S voltage indicates a lean exhaust stream.

The HO2S bank 1 sensor 2 and HO2S bank 2 sensor 2 are used for catalyst monitoring. This diagnostic runs once per ignition cycle. This diagnostic consists of two tests, a passive test and an intrusive test. During the passive test, if the HO2S bank 1 sensor 2 or HO2S bank 2 sensor 2 voltage transitions below 350 mV and above 709 mV, the DTC will pass for this ignition cycle. If the DTC does not pass during the passive test, the intrusive test will begin. During the intrusive test, the control module will force the air-to-fuel ratio rich and/or lean. The control module then waits for a predicted response from the HO2S. If the HO2S voltage transitions below 350 mV and/or above 709 mV, the DTC will pass for this ignition cycle. If the control module does not receive the expected response from the HO2S, DTC P0136 will set for HO2S bank 1 sensor 2 or DTC P0156 will set for HO2S bank 2 sensor 2.

Conditions for Running the DTC

DTCs P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0125, P0131, P0132, P0133, P0134, P0135, P0137, P0138, P0140, P0141, P0151, P0152, P0153, P0154, P0155, P0157, P0158, P0160, P0161, P0200, P0442, P0443, P0446, P0449, P0455, P0496, P1133, P1134, P1153, P1154 are not set.

Passive Test

- The engine is running.
- The Engine Run Time parameter is less than 13.5 minutes.

Intrusive Test

- The Engine Run Time parameter is more than 13.5 minutes.
- The Ignition 1 Signal parameter is between 10-18 volts.
- The Engine Speed parameter is between 900-5,000 RPM.
- The MAF Sensor parameter is between 5-55 g/s.
- The Vehicle Speed parameter is between 24-131 km/h (15-82 mph).
- The Short Term FT Bank 1 and Bank 2 parameter is between -10 and +10 percent.
- The maximum number of intrusive attempts is less than 13.

Conditions for Setting the DTC

1. The PCM detects that the HO2S bank 1 sensor 2 or HO2S bank 2 sensor 2 did not transition below 350 mV and above 709 mV during the passive test.
2. One of the following tests fail:
   - Lean Intrusive Test
     - The PCM detects that the HO2S bank 1 sensor 2 or HO2S bank 2 sensor 2 is more than 350 mV for 25.4 seconds.
     - The HO2S bank 1 sensor 1 and HO2S bank 2 sensor 1 is less than 300 mV.

       OR
   - Rich Intrusive Test
     - The PCM detects that the HO2S bank 1 sensor 2 or HO2S bank 2 sensor 2 is less than 709 mV for 25.4 seconds.

- The HO2S bank 1 sensor 1 and HO2S bank 2 sensor 1 is more than 600 mV.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

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

2: If the voltage does not change more than the specified value, the condition is present.

DTC P0136 or P0156

Step	Action	Value (s)	Yes	No
Schematic Reference:Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to **Scan Tool Data List** . 3. Operate the engine at 1,500 RPM for 30 seconds. 4. While observing the affected HO2S voltage parameter with a scan tool, quickly cycle the throttle from closed throttle to wide open throttle, 3 times.	200 mV		

	Did the HO2S voltage parameter change more than the specified value?		Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the affected heated oxygen sensor (HO2S). 3. Turn ON the ignition, with the engine OFF. 4. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to **Step 6**	Go to **Step 5**
5	Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter more than the specified value?	800 mV	Go to **Step 7**	Go to **Step 8**
6	Test the HO2S high signal circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 9**
7	**IMPORTANT:** **The sensor may be damaged if the circuit is shorted to a voltage source.** Test the HO2S high signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 17**
8	Measure the voltage from the low signal circuit of the HO2S harness connector on the engine harness side to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the voltage more than the specified value?	2 V	Go to **Step 10**	Go to **Step 11**
9	Test the HO2S high signal circuit for a short to the HO2S low signal circuit. Refer to **Circuit Testing** and	-		

	Wiring Repairs in Wiring Systems. Did you find and correct the condition?		Go to **Step 20**	Go to **Step 17**
10	Test the HO2S low signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 17**
11	1. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and a good ground. 2. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to **Step 12**	Go to **Step 14**
12	1. Remove the jumper wire from the previous step. 2. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and the low signal circuit of the HO2S harness connector on the engine harness side. 3. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to **Step 15**	Go to **Step 13**
13	Test the HO2S low signal circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 17**
14	Test the HO2S high signal circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 17**
	1. The HO2S may be detecting a rich exhaust condition, a lean exhaust condition, or the HO2S may be contaminated. Inspect for the following conditions: **NOTE:** **Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices.**			

15	- A silicon contaminated HO2S - Any water intrusion into the HO2S connector - An exhaust leak between the HO2S and the engine - Any vacuum leaks - Engine oil contaminated with fuel - An incorrect fuel pressure-Refer to **Fuel System Diagnosis** . - Any lean or rich fuel injectors-Refer to **Fuel Injector Balance Test with Tech 2** . - An inaccurate mass air flow (MAF) sensor-Refer to **Scan Tool Data List** . 2. Repair any of the above or similar engine conditions as necessary. Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 16**
16	Test for shorted terminals and for poor connections at the HO2S. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 18**
17	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 19**
18	Replace the affected HO2S. Refer to **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 2** or **Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 2** . Did you complete the replacement?	-	Go to **Step 20**	-
19	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 20**	-
20	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records.	-		

	Did the DTC fail this ignition?		Go to **Step 2**	Go to **Step 21**
21	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0137 OR P0157

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The powertrain control module (PCM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the PCM operates in open loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and closed loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream; low HO2S voltage indicates a lean exhaust stream. If the PCM detects an HO2S voltage that stays below a specified value, DTC P0137 sets for HO2S bank 1 sensor 2 or DTC P0157 sets for HO2S bank 2 sensor 2.

Conditions for Running the DTC

Lean Test Enable:

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0200, P0220, P0300, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The Loop Status parameter is closed.
- The Ignition 1 Signal parameter is between 10-18 volts.
- The Fuel Tank Level Remaining parameter is more than 10 percent.
- The TP Indicated Angle parameter is between 3-70 percent more than the value observed at idle.

OR

Power Enrichment Test Enable:

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0200, P0220, P0300, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The Loop Status parameter is closed.
- The Ignition 1 Signal parameter is between 10-18 volts.
- The Fuel Tank Level Remaining parameter is more than 10 percent.
- The Engine Run Time parameter is more than 30 seconds.

- The Power Enrichment parameter is active for more than 2 seconds.

Conditions for Setting the DTC

Lean Test

The PCM detects that the affected HO2S voltage parameter is less than 80 mV for 200 seconds.

OR

Power Enrichment Test

The PCM detects that the affected HO2S voltage parameter is less than 420 mV for 10 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

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

2: If the voltage does not change more than the specified value, the condition is present.

DTC P0137 or P0157

Step	Action	Value (s)	Yes	No
Schematic Reference:Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Powertrain Control Module (PCM) Connector End Views**				

1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **With the engine running, observe the HO2S Bank 1 Sensor 1 and HO2S Bank 2 Sensor 1 voltage parameters with a scan tool. The voltage should vary from below 300 mV to above 600 mV. If the voltage is not varying, refer to DTC P0132 or P0152 .** 1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to **Scan Tool Data List** . 3. Operate the engine at 1,500 RPM for 30 seconds. 4. While observing the affected HO2S voltage parameter with a scan tool, quickly cycle the throttle from closed throttle to wide open throttle, 3 times. Did the HO2S voltage parameter change more than the specified value?	200 mV	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the affected heated oxygen sensor (HO2S). 3. Turn ON the ignition, with the engine OFF. 4. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to **Step 6**	Go to **Step 5**
5	Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter more than the specified value?	800 mV	Go to **Step 7**	Go to **Step 8**

6	Test the HO2S high signal circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 9**
7	**IMPORTANT:** **The sensor may be damaged if the circuit is shorted to a voltage source.** Test the HO2S high signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 17**
8	Measure the voltage from the low signal circuit of the HO2S harness connector on the engine harness side to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the voltage more than the specified value?	2 V	Go to **Step 10**	Go to **Step 11**
9	Test the HO2S high signal circuit for a short to the HO2S low signal circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 17**
10	Test the HO2S low signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 17**
11	1. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and a good ground. 2. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to **Step 12**	Go to **Step 14**
12	1. Remove the jumper wire from the previous step. 2. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and the low signal circuit of the HO2S harness connector on the engine harness side. 3. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to **Step 15**	Go to **Step 13**
	Test the HO2S low signal circuit for an open or high			

13	resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 17**
14	Test the HO2S high signal circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 17**
15	1. The HO2S may be detecting a lean exhaust condition or may be contaminated. Inspect for the following conditions: **NOTE:** **Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices.** • A silicon contaminated HO2S • Any water intrusion into the HO2S connector • An exhaust leak between the HO2S and the engine • Any vacuum leaks • An incorrect fuel pressure-Refer to **Fuel System Diagnosis** . • Any lean fuel injectors-Refer to **Fuel Injector Balance Test with Tech 2** . • An inaccurate mass air flow (MAF) sensor-Refer to **Scan Tool Data List** . 2. Repair any of the above or similar engine conditions as necessary. Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 16**
16	Test for shorted terminals and for poor connections at the HO2S. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 18**
17	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 20**	Go to **Step 19**
	Replace the affected HO2S. Refer to **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 2** or			

18	**Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 2** . Did you complete the replacement?	-	Go to **Step 20**	-
19	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 20**	-
20	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 21**
21	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0138 OR P0158

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The powertrain control module (PCM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the PCM operates in open loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and closed loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream; low HO2S voltage indicates a lean exhaust stream. If the PCM detects an HO2S voltage that stays above a specified value, DTC P0138 sets for HO2S bank 1 sensor 2 or DTC P0158 sets for HO2S bank 2 sensor 2.

Conditions for Running the DTC

Rich Test Enable:

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0200, P0220, P0300, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The Loop Status parameter is closed.
- The Ignition 1 Signal parameter is between 10-18 volts.
- The Fuel Tank Level Remaining parameter is more than 10 percent.

- The TP Indicated Angle parameter is between 3-70 percent more than the value observed at idle.

OR

Decel. Fuel Cutoff Test Enable:

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0200, P0220, P0300, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The Loop Status parameter is closed.
- The Ignition 1 Signal parameter is between 10-18 volts.
- The Fuel Tank Level Remaining parameter is more than 10 percent.
- The Engine Run Time parameter is more than 30 seconds.
- The Decel. Fuel Cutoff parameter is active for more than 4 seconds.

Conditions for Setting the DTC

Rich Test

The PCM detects that the affected HO2S voltage parameter is more than 950 mV for 200 seconds.

OR

Decel. Fuel Cutoff Test

The PCM detects that the affected HO2S voltage parameter is more than 480 mV for 5 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

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

2: If the voltage does not change more than the specified value, the condition is present.

DTC P0138 or P0158

Step	Action	Value (s)	Yes	No
Schematic Reference:Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **With the engine running, observe the HO2S Bank 1 Sensor 1 and HO2S Bank 2 Sensor 1 voltage parameters with a scan tool. The voltage should vary from below 300 mV to above 600 mV. If the voltage is not varying, refer to DTC P0131 or P0151 .** 1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to **Scan Tool Data List** . 3. Operate the engine at 1,500 RPM for 30 seconds. 4. While observing the affected HO2S voltage parameter with a scan tool, quickly cycle the throttle from closed throttle to wide open throttle, 3 times. Did the HO2S voltage parameter change more than the specified value?	200 mV	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
	1. Turn OFF the ignition.			

4	2. Disconnect the affected heated oxygen sensor (HO2S). 3. Turn ON the ignition, with the engine OFF. 4. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter more than the specified value?	800 mV	Go to **Step 6**	Go to **Step 5**
5	Measure the voltage from the low signal circuit of the HO2S harness connector on the engine harness side to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the voltage more than the specified value?	2 V	Go to **Step 7**	Go to **Step 8**
6	**IMPORTANT:** **The sensor may be damaged if the circuit is shorted to a voltage source.** Test the HO2S high signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 14**
7	Test the HO2S low signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 14**
8	1. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and a good ground. 2. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to **Step 9**	Go to **Step 11**
9	1. Remove the jumper wire from the previous step. 2. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and the low signal circuit of the HO2S harness connector on the engine harness side. 3. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to **Step 12**	Go to **Step 10**
	Test the HO2S low signal circuit for an open or high			

10	resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 14**
11	Test the HO2S high signal circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 14**
12	1. The HO2S may be detecting a rich exhaust condition or may be contaminated. Inspect for the following conditions: **NOTE:** **Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices.** • A silicon contaminated HO2S • Any water intrusion into the HO2S connector • Engine oil contaminated with fuel • An evaporative emission (EVAP) canister purge condition • An incorrect fuel pressure-Refer to **Fuel System Diagnosis** . • Any rich fuel injectors-Refer to **Fuel Injector Balance Test with Tech 2** . • An inaccurate mass air flow (MAF) sensor-Refer to **Scan Tool Data List** . • An air intake restriction or collapsed air intake duct 2. Repair any of the above or similar engine conditions as necessary. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 13**
13	Test for shorted terminals and for poor connections at the HO2S. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 15**
14	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 16**

15	Replace the affected HO2S. Refer to **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 2** or **Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 2** . Did you complete the replacement?	-	Go to **Step 17**	-
16	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 17**	-
17	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 18**
18	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0140 OR P0160

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The powertrain control module (PCM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the PCM operates in open loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and closed loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream; low HO2S voltage indicates a lean exhaust stream. This diagnostic will only run once per ignition cycle. If the PCM detects that the HO2S voltage remains within the bias voltage range, DTC P0140 sets for HO2S bank 1 sensor 2 or DTC P0160 sets for HO2S bank 2 sensor 2.

Conditions for Running the DTC

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0141, P0161, P0200, P0220, P0300, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The Engine Run Time parameter is more than 300 seconds.
- The Loop Status is closed.

- The Ignition 1 Signal parameter is between 10-18 volts.

Conditions for Setting the DTC

- The PCM detects that the affected HO2S voltage parameter is between 410-490 mV for 150 seconds.
- The TP Indicated Angle parameter changes more than 5 percent within 1 second, 6 times.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The number below refers to the step number on the diagnostic table.

3: If the voltage is varying above and below the specified value, the condition is not present.

DTC P0140 or P0160

Step	Action	Value (s)	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check- Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
	IMPORTANT: **Whenever the HO2S heaters are commanded ON with a scan tool, they will continue to be pulsed ON once per second until the ignition is turned**			

	OFF for 30 seconds.			
2	1. Turn ON the ignition, with the engine OFF. 2. Command the HO2S heaters ON with a scan tool. 3. Wait 15 seconds to allow the HO2S heater current to stabilize. 4. Observe the affected HO2S heater current parameter with a scan tool. Is the HO2S heater current parameter within the specified range?	0.25-1.375 A	Go to **Step 3**	Go to **DTC P0141 or P0161**
3	1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to **Scan Tool Data List** . 3. Operate the engine at 1,500 RPM for 30 seconds. 4. While observing the affected HO2S voltage parameter with a scan tool, quickly cycle the throttle from closed throttle to wide open throttle, 3 times. Did the HO2S voltage parameter change more than the specified value?	200 mV	Go to **Step 4**	Go to **Step 5**
4	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 5**	Go to **Intermittent Conditions**
5	1. Turn OFF the ignition. 2. Disconnect the affected HO2S. 3. Turn ON the ignition, with the engine OFF. 4. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter more than the	800 mV		

	specified value?		Go to **Step 7**	Go to **Step 6**
6	Measure the voltage from the high signal circuit of the HO2S harness connector on the engine harness side to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the voltage more than the specified value?	0.2 V	Go to **Step 8**	Go to **Step 9**
7	**IMPORTANT:** **The sensor may be damaged if the circuit is shorted to a voltage source.** Test the HO2S high signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 14**
8	Measure the voltage from the low signal circuit of the HO2S harness connector on the engine harness side to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the voltage more than the specified value?	2 V	Go to **Step 12**	Go to **Step 10**
9	Test the HO2S high signal circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 14**
10	1. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and the low signal circuit of the HO2S harness connector on the engine harness side. 2. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to **Step 13**	Go to **Step 11**
11	Test the HO2S low signal circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 14**
12	Test the HO2S low signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 14**
13	Test for shorted terminals and for poor connections at the HO2S. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems.	-		

	Did you find and correct the condition?		Go to **Step 17**	Go to **Step 15**
14	Test for shorted terminals and for poor connections at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 16**
15	Replace the affected HO2S. Refer to **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 2** or **Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 2** . Did you complete the replacement?	-	Go to **Step 17**	-
16	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 17**	-
17	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 18**
18	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0141 OR P0161

Circuit Description

The heated oxygen sensor (HO2S) must reach operating temperature to provide an accurate voltage signal. A heating element inside the HO2S minimizes the time required for the sensor to reach operating temperature. Voltage is provided to the heater by the ignition 1 voltage circuit through a fuse. With the engine running, ground is provided to the heater by the HO2S heater low control circuit, through a low side driver within the powertrain control module (PCM). The PCM commands the heater ON or OFF to maintain a specific HO2S operating temperature range. The PCM determines the temperature by measuring the current flow through the heater. When the heater is in the ON state, the PCM will pulse the heater OFF for a duration of 50 ms, once per second. When the heater is in the OFF state, the PCM will pulse the heater ON for a duration of 50 ms, once per second. The PCM monitors the heater current with the engine running. The PCM also calculates the heater resistance on a cold start. Both diagnostics will only run once per ignition cycle. If the PCM detects that the heater current or the heater calculated resistance is not within an expected range, DTC P0141 sets for HO2S bank 1 sensor 2, or DTC P0161 sets for HO2S bank 2 sensor 2.

Conditions for Running the DTC

Heater Current Test

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0200, P0220, P0300, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The ECT Sensor parameter is more than 50°C (122°F).
- The Ignition 1 Signal parameter is between 10-18 volts.
- The MAF Sensor parameter is between 3-40 g/s.
- The Engine Speed parameter is between 500-3,000 RPM.
- The Engine Run Time parameter is more than 120 seconds.

OR

Heater Resistance Test

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0200, P0220, P0300, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The ignition is OFF for more than 10 hours.
- The ECT Sensor parameter is between -30 to +45°C (-22 to +113°F) at engine start-up.
- The ECT Sensor parameter minus the IAT Sensor parameter is less than 8°C (14°F) at engine start-up.
- The engine is running.

Conditions for Setting the DTC

Heater Current Test

- The PCM detects that the affected HO2S heater current parameter is more than 1.375 amps or less than 0.25 amps.
- The above condition is met for 10 seconds.

OR

Heater Resistance Test

The PCM detects that the affected HO2S heater calculated resistance is not within an expected range at engine start-up.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.

- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The number below refers to the step number on the diagnostic table.

9: With no fault present, the test lamp will blink once per second.

DTC P0141 or P0161

Step	Action	Value (s)	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Component Views or Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **Whenever the HO2S heaters are commanded ON with a scan tool, they will continue to be pulsed ON once per second until the ignition is turned OFF for 30 seconds.** 1. Turn ON the ignition, with the engine OFF. 2. Command the HO2S heaters ON with a scan tool. 3. Wait 15 seconds to allow the HO2S heater current to stabilize. 4. Observe the affected HO2S heater current parameter with a scan tool. Is the HO2S heater current parameter within the	0.25-1.375 A		

	specified range?		Go to **Step 3**	Go to **Step 6**
3	observe the Freeze Frame/Failure Records for this DTC. Did the DTC fail with an engine run time of less than 10 seconds?	-	Go to **Step 4**	Go to **Step 5**
4	1. Operate the vehicle within the Conditions for Running the Heater Resistance Test. 2. Start the engine. Did the DTC fail this ignition?	-	Go to **Step 6**	Go to **Intermittent Conditions**
5	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the Heater Current Test. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 6**	Go to **Intermittent Conditions**
6	Inspect the O2B fuse. Is the O2B fuse open?	-	Go to **Step 7**	Go to **Step 8**
7	Test the ignition 1 voltage circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 10**
8	1. Disconnect the affected HO2S. 2. Turn ON the ignition, with the engine OFF. 3. Probe the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side with a test lamp that is connected to a good ground. Refer to **Probing Electrical Connectors** in Wiring Systems. Does the test lamp illuminate?	-	Go to **Step 9**	Go to **Step 19**
	IMPORTANT: **The test lamp may blink prior to commanding the heaters ON. This is because the heaters were commanded ON in a previous step. To command the heaters OFF, turn OFF the ignition for 30 seconds.**			

9	1. Connect a test lamp between the ignition 1 voltage circuit of the HO2S harness connector on the engine harness side and the HO2S heater low control circuit of the HO2S harness connector on the engine harness side. 2. Command the HO2S heaters ON with a scan tool. Does the test lamp blink once per second?	-	Go to **Step 11**	Go to **Step 12**
10	**IMPORTANT:** **Perform the following test on all HO2S' which are supplied voltage by the suspect circuit.** Test the ignition 1 voltage circuit on the sensor side of the HO2S connector for a short to ground. Refer to **Circuit Testing** in Wiring Systems.Is any sensor shorted to ground?	-	Go to **Step 20**	Go to **Intermittent Conditions**
11	Measure the resistance of the following circuits with a DMM: • HO2S heater low control circuit • Ignition 1 voltage circuit Refer to **Circuit Testing** in Wiring Systems. Is the resistance of either circuit more than the specified value?	3 ohm	Go to **Step 18**	Go to **Step 16**
12	Is the test lamp on steady?	-	Go to **Step 13**	Go to **Step 14**
13	Test the HO2S heater low control circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 17**
14	Test the HO2S heater low control circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 15**
15	Test the HO2S heater low control circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 17**
16	Test for shorted terminals and for poor connections at the HO2S. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 20**

17	Test for shorted terminals and for poor connections at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 22**	Go to **Step 21**
18	Repair the circuit with high resistance. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 22**	-
19	Repair the open or high resistance in the ignition 1 voltage circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 22**	-
20	Replace the affected HO2S. Refer to **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 2** or **Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 2** . Did you complete the replacement?	-	Go to **Step 22**	-
21	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 22**	-
22	Were you sent to this diagnostic from DTC P0140 or P0160?	-	Go to Step 17 in **DTC P0140 or P0160**	Go to **Step 23**
23	1. Replace the O2B fuse if necessary. 2. Clear the DTCs with a scan tool. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 24**
24	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

ENGINE CONTROLS DIAGNOSIS (DTC P0171/P0174 TO DTC P0507 (TAC))

DTC P0171 OR P0174

Circuit Description

The powertrain control module (PCM) controls the air/fuel metering system in order to provide the best possible combination of driveability, fuel economy and emission control. Fuel delivery is controlled differently during Open and Closed Loop. During Open Loop the PCM determines fuel delivery based on sensor signals without oxygen sensor input. During Closed Loop the PCM adds oxygen sensor inputs and level of purge to calculate Short and Long Term fuel trim adjustments. If the oxygen sensors indicate a lean condition, fuel trim values will be above 0 percent. If the oxygen sensors indicate a rich condition, fuel trim values will be below 0 percent. The values for the Short Term fuel trim change rapidly in response to the heated oxygen sensor (HO2S) voltage signals. Long Term fuel trim makes coarse adjustments in order to maintain an Air/Fuel Ratio of 14.7:1. A block of cells contain information arranged in combinations of engine RPM and engine load for a full range of vehicle operating conditions. The long term fuel trim diagnostic is based on an average of cells currently being used. The PCM selects the cells based on the engine speed and engine load. If the PCM detects an excessively lean condition, DTC P0171 or P0174 sets.

Conditions for Running the DTC

- DTCs P0101, P0103, P0108, P0135, P0137, P0141, P0200, P0300, P0410, P0420, P0430, P0440, P0442, P0443, P0446, P0449, P0506, P0507 or P1441 are not set.
- The engine coolant temperature (ECT) is between 75-115°C (167-239°F).
- The intake air temperature (IAT) is between -20 to +90°C (+4 and +194°F).
- The manifold absolute pressure (MAP) is between 26-90 kPa (3.7-13 psi).
- The vehicle speed is less than 137 km/h (85 mph).
- The engine speed is between 400-3,000 RPM.
- The barometric pressure (BARO) is more than 74 kPa (10.7 psi).
- The mass air flow (MAF) is between 5-90 g/s.
- The fuel level is more than 10 percent.
- The throttle position (TP) is less than 90 percent.

Conditions for Setting the DTC

- The average long term fuel trim cell value is above 23 percent.
- All of the above conditions are present for 6 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- The system will go lean if an injector is not supplying enough fuel.
- A lean condition could be present during high fuel demand.
- Use a scan tool in order to review the Failure Records. If an intermittent condition is suspected, refer to Intermittent Conditions.

Test Description

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

5: If conditions were not corrected, refer to Fuel System Diagnosis for a possible fuel problem.

6: If conditions were not corrected, a worn cam, worn intake or exhaust valves, or other engine mechanical failure may be the problem.

DTC P0171 or P0174

Step	Action	Values	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
	IMPORTANT: **If any DTCs other than P0171 or P0174 are set, refer to those DTCs before continuing.** 1. Install the scan tool. 2. Start and idle the engine at the normal operating temperature in Closed Loop.			

2	3. Record the long term fuel trim. 4. Turn OFF the engine. 5. Turn ON ignition, with engine OFF. 6. Review the Freeze Frame/Failure Records and record the displayed data for this DTC. Does the scan tool indicate that the long term fuel trim is greater than the specified value?	23%	Go to **Step 3**	Go to Diagnostic Aids
3	1. Operate engine at idle. 2. Observe the HO2S parameters with a scan tool. Does the scan tool indicate that the parameter is within the specified range and fluctuating?	200-800 mV	Go to **Step 4**	Go to **Step 5**
4	1. Turn OFF the engine. 2. Visually and physically inspect the following items: • The vacuum hoses for splits, kinks, and proper connections - Refer to **Emission Hose Routing Diagram** . • Ensure that the vehicle has sufficient fuel in tank. If fuel pressure is too low this DTC may set. Refer to **Fuel System Diagnosis** . • Fuel contamination - Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (without Special Tool and E85)** or **Alcohol/Contaminants-in-Fuel Diagnosis (with Special Tool)** . Did you find and correct the condition?	-	Go to **Step 7**	Go to **Step 6**
5	1. Turn OFF the engine. 2. Inspect the heated oxygen sensor (HO2S) for proper installation. 3. Verify the electrical connectors and the wires are secure, and not contacting the exhaust system. 4. Test for continuity between the HO2S signal circuit and the low reference circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 7**	Go to **Fuel System Diagnosis**

6	1. Operate the engine at idle. 2. Inspect for any missing, loose, or leaking exhaust components forward of the HO2S. 3. Inspect for vacuum leaks at the intake manifold, throttle body, and injector O-rings. 4. Inspect the air induction system and the air intake ducts for leaks. 5. Inspect the secondary air injection (AIR) system for leaks, improper air delivery, and for the shut-off valves not closing. 6. Inspect the crankcase ventilation system for leaks. Refer to **Crankcase Ventilation System Inspection/Diagnosis** in Engine Mechanical - 4.8L, 5.3L, and 6.0L. Did you find and correct the condition?	-	Go to **Step 7**	Go to **Symptoms - Engine Mechanical** in Engine Mechanical - 4.8L, 5.3L, and 6.0L
7	**IMPORTANT:** **After repairs, use the scan tool Fuel Trim Reset function in order to reset the Long Term Fuel Trim.** 1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 8**
8	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0172 OR P0175

Circuit Description

The powertrain control module (PCM) controls the air/fuel metering system in order to provide the best possible combination of driveability, fuel economy and emission control. Fuel delivery is controlled differently during Open and Closed Loop. During Open Loop the PCM determines fuel delivery based on sensor signals, without oxygen sensor input. During Closed Loop the PCM adds oxygen sensor inputs and level of purge to calculate Short and Long Term fuel trim adjustments. If the oxygen sensors indicate a lean condition, fuel trim values will be above 0 percent. If the oxygen sensors indicate a rich condition, fuel trim values will be below 0 percent. The values for the Short Term fuel trim change rapidly in response to the heated oxygen sensor (HO2S) voltage signals. Long Term fuel trim makes coarse adjustments in order to maintain an Air/Fuel Ratio of 14.7:1. A block of cells contain information arranged in combinations of engine RPM and engine load for a full range of vehicle operating conditions. The long term fuel trim diagnostic is based on an average of cells currently being used. The PCM selects the cells based on the engine speed and engine load. The fuel trim diagnostic will conduct a test to determine if a rich failure actually exists or if excessive vapor from the evaporative emission (EVAP) canister is causing a rich condition. If the PCM detects an excessively rich condition, DTC P0172 or P0175 sets.

Conditions for Running the DTC

- DTCs P0101, P0103, P0108, P0135, P0137, P0141, P0200, P0300, P0410, P0420, P0430, P0440, P0442, P0443, P0446, P0449, P0506, P0507 or P1441 are not set.
- The engine coolant temperature (ECT) is between 75-115°C (167-239°F).
- The intake air temperature (IAT) is between -20 to +90°C (+4 and +194°F).
- The manifold absolute pressure (MAP) is between 26-90 kPa (3.7-13 psi).
- The vehicle speed is less than 137 km/h (85 mph).
- The engine speed is between 400-3,000 RPM.
- The barometric pressure (BARO) is more than 74 kPa (10.7 psi).
- The mass air flow (MAF) is between 5-90 g/s.
- The fuel level is more than 10 percent.
- The throttle position (TP) is less than 90 percent.

Conditions for Setting the DTC

- The average long term fuel trim value is below -13 percent.
- All of the above conditions are present for 40 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other

emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Fuel contamination, such as water or alcohol will effect fuel trim.
- A malfunctioning mass air flow sensor can cause a rich condition and set this DTC. Refer to **DTC P0101 (With Throttle Actuator Control)** .
- Use a scan tool in order to review Failure Records. If an intermittent condition is suspected, refer to **Intermittent Conditions** .

Test Description

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

5: If conditions were not corrected, refer to Fuel System Diagnosis for a possible fuel problem.

6: An EVAP canister that is saturated will cause a rich condition. If the conditions were not corrected, a worn cam, worn intake or exhaust valves, or other engine mechanical failure may be the problem.

DTC P0172 or P0175

Step	Action	Values	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **If any DTCs other than P0172 are set, refer to those DTCs before continuing.** 1. Install scan tool. 2. Start and idle the engine at the normal operating temperature in Closed Loop. 3. Record the long term fuel trim data. 4. Turn OFF the engine. 5. Turn ON ignition, with the engine OFF. 6. Review the Freeze Frame/Failure Records, and record the displayed data for this DTC. Does the scan tool indicate that the long term fuel trim is less than the specified value?	-13%	Go to **Step 3**	Go to Diagnostic Aids
3	1. Operate engine at idle. 2. Observe HO2S parameters with a scan tool.	200-800 mV		

	Does the scan tool indicate that the values are within the specified range and fluctuating?		Go to **Step 4**	Go to **Step 5**
4	1. Turn OFF engine. 2. Visually and physically inspect the following items: • The evaporative emissions (EVAP) lines and components for damage or blockage-Refer to **Evaporative Emissions (EVAP) Hose Routing Diagram** . • The inlet screen of the mass air flow (MAF) sensor for blockage. • The vacuum hoses for splits, kinks, and proper connections-Refer to **Emission Hose Routing Diagram** . • The air intake duct for being collapsed or restricted. • The air filter for being dirty or restricted. • Check for objects blocking the throttle body. Did you find and correct the condition?	-	Go to **Step 7**	Go to **Step 6**
5	1. Turn OFF engine. 2. Inspect the heated oxygen sensor (HO2S) for proper installation. 3. Inspect to ensure that the electrical connectors and the wires are secure and not contacting the exhaust system. 4. Test for continuity between the signal circuit and the low reference circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 7**	Go to **Fuel System Diagnosis**
6	Inspect for the following: • Excessive fuel in the crankcase. • Proper operation of the fuel pressure regulator - Refer to **Fuel System Diagnosis** . • All injectors are functioning properly - Refer to **Fuel Injector Coil Test** .	-		Go to **Symptoms -**

	Did you find and correct the condition?		Go to **Step 7**	**Engine Mechanical** in Engine Mechanical - 4.8L, 5.3L, and 6.0L
7	**IMPORTANT:** **After repairs, use the scan tool Fuel Trim Reset function in order to reset the Long Term Fuel Trim.** 1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 8**
8	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0200

Circuit Description

The control module enables the appropriate fuel injector pulse for each cylinder. Ignition voltage is supplied to the fuel injectors. The control module controls each fuel injector by grounding the control circuit via a solid state device called a driver. The control module monitors the status of each driver. If the control module detects an incorrect voltage for the commanded state of the driver, DTC P0200 sets.

Conditions for Running the DTC

- The engine speed is more than 400 RPM.
- The ignition voltage is between 6-18 volts.

Conditions for Setting the DTC

- The powertrain control module (PCM) detects an incorrect voltage on a fuel injector control circuit.
- The condition exists for 5 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition

cycle that the diagnostic runs and fails.

- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Performing the Fuel Injector Coil Test may help to isolate an intermittent condition. Refer to **Fuel Injector Coil Test** .
- For an intermittent condition, refer to **Intermittent Conditions** .

Test Description

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

5: This step verifies that the PCM is able to control the fuel injector.

7: This step tests if a ground is constantly being applied to the fuel injector.

DTC P0200

Step	Action	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views**			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Clear the DTCs with a scan tool. 2. Idle the engine at the normal operating temperature. 3. Monitor the misfire current counters with a scan tool. Are any of the misfire current counters incrementing?	Go to **Step 4**	Go to **Step 3**
	1. Observe the Freeze Frame/Failure Records for this		

3	DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to **Step 4**	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the injector which displays the highest number of misfire current counters. 3. Turn ON the ignition, with the engine OFF. 4. Probe the ignition 1 voltage circuit of the fuel injector with a test lamp that is connected to a good ground. Does the test lamp illuminate?	Go to **Step 5**	Go to **Step 13**
5	1. Connect the **J 34730-405** Injector Test Lamp between the control circuit of the fuel injector and the ignition voltage circuit of the fuel injector. 2. Start the engine. Does the test lamp flash?	Go to **Step 6**	Go to **Step 7**
6	Did the DTC fail this ignition?	Go to **Step 12**	Go to **Step 10**
7	Does the test lamp remain illuminated?	Go to **Step 9**	Go to **Step 8**
8	Test the fuel injector control circuit for a short to voltage or for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 16**	Go to **Step 12**
9	Test the fuel injector control circuit for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 16**	Go to **Step 15**
10	Test for an intermittent and for a poor connection at the fuel injector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Repairing Connector Terminals** in Wiring Systems. Did you find and correct the condition?	Go to **Step 16**	Go to **Step 11**
	1. Apply Dielectric compound GM P/N 12377900 (Canadian P/N 10953529) to the fuel injector electrical connector. 2. Reconnect the fuel injector connector.		

11	3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to **Step 14**	Go to **Step 16**
12	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Repairing Connector Terminals** in Wiring Systems. Did you find and correct the condition?	Go to **Step 16**	Go to **Step 15**
13	**IMPORTANT:** **The INJ fuse also supplies voltage to the ignition coil modules. If the fuse is open, inspect all related circuits and components for a short to ground. Refer to Circuit Testing in Wiring Systems.** Repair the open or short to ground in the ignition 1 voltage circuit of the fuel injector.Is the repair complete?	Go to **Step 16**	-
14	Replace the fuel injector. Refer to **Fuel Injector Replacement** . Did you complete the replacement?	Go to **Step 16**	-
15	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	Go to **Step 16**	-
16	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 17**
17	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0220

Circuit Description

The throttle position (TP) sensor 2 is a potentiometer type sensor with the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The TP sensor is used to determine the throttle plate angle for various engine management systems. The control module provides the TP sensor a 5-volt reference circuit and a low reference circuit. The TP sensor then provides the control module a signal voltage proportional to throttle plate movement. The TP sensor 1 signal voltage is low at closed throttle and increases as the throttle opens. When the control module detects that the TP sensor 2 signal or the TP sensor 5-volt reference voltage is outside the predetermined range, this DTC sets.

Conditions for Running the DTC

- DTCs P2108 or U0107 are not set.
- The ignition switch is in the Crank or Run position.
- The ignition voltage is more than 5.23 volts.

Conditions for Setting the DTC

- The TP sensor 2 voltage is less than 0.28 volt or greater than 4.60 volts.
- The above condition is present for more than 1 second.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame and/or the Failure Records.
- The control module commands the TAC system to operate in the Reduced Engine Power mode.
- A message center or an indicator displays Reduced Engine Power.
- Under certain conditions the control module commands the engine OFF.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Inspect the TAC module connectors for signs of water intrusion. If water intrusion occurs, multiple DTCs may set without any circuit or component conditions found during diagnostic testing.
- When the TAC module detects a condition within the TAC system, more than one TAC system related

DTC may set. This is due to the many redundant tests run continuously on this system. Locating and repairing one individual condition may correct more than one DTC. Disconnecting components during testing may set additional DTCs. Remember this if you review the stored information in Capture Info.

- If this DTC is determined to be intermittent, refer to **Intermittent Conditions** .

Test Description

The number below refers to the step number on the diagnostic table.

31: When the TAC module detects a condition within the TAC system, more than one TAC system related DTC may set. This is due to the many redundant tests run continuously on this system. Locating and repairing one individual condition may correct more than one DTC. Disconnecting components during testing may set additional DTCs. Keep this in mind when reviewing the stored information, Capture Info.

DTC P0220

<table>
<tr><th>Step</th><th>Action</th><th>Values</th><th>Yes</th><th>No</th></tr>
<tr><td colspan="5">Schematic Reference:Engine Controls Schematics
Connector End View Reference:Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views</td></tr>
<tr><td>1</td><td>Did you perform the Diagnostic System Check - Engine Controls?</td><td>-</td><td>Go to Step 2</td><td>Go to Diagnostic System Check - Engine Controls</td></tr>
<tr><td>2</td><td>1. Turn OFF the ignition.
2. Remove the air inlet duct from the throttle body.
3. Disconnect the throttle body harness connector.
4. Connect jumper wires between the throttle position (TP) sensor 2 terminals of the throttle body harness connector and the corresponding TP sensor 2 terminals of the throttle body.
5. Turn ON the ignition, with the engine OFF.
6. Close the throttle blade by hand.
7. Observe the TP sensor 2 voltage with a scan tool.

Is the TP sensor 2 voltage within the specified range?</td><td>0.28-0.81 V</td><td>Go to Step 3</td><td>Go to Step 7</td></tr>
<tr><td>3</td><td>1. Open the throttle blade to wide open throttle (WOT) by hand.
2. Observe the TP sensor 2 voltage parameter on the scan tool.

Is the TP sensor 2 voltage parameter more than the specified value?</td><td>4.60 V</td><td>Go to Step 7</td><td>Go to Step 4</td></tr>
</table>

4	1. Disconnect the TP sensor harness connector. 2. Disconnect the throttle actuator control (TAC) module harness connector containing the TP sensor circuits. 3. Test the TP sensor low-reference circuit for a short to ground with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 30**	Go to **Step 5**
5	1. Turn OFF the ignition for 15 seconds. 2. Connect the TAC module harness connector. 3. Connect the throttle body harness connector. 4. Install the air inlet duct. 5. Turn ON the ignition, with the engine OFF. 6. Select the DTC Info option on the scan tool. 7. Lightly touch and move the related engine wiring harnesses and connectors for the TP sensor while observing the DTC Info. The DTC will set if an intermittent condition is present. Refer to **Connector Repairs** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 30**	Go to **Step 6**
6	1. Continue to observe the DTC Info. 2. Slowly depress the accelerator pedal to WOT, then slowly return the pedal to the released position 3 times. Does the scan tool indicate this DTC failed this ignition?	-	Go to **Step 25**	Go to Diagnostic Aids
7	1. Disconnect the TP sensor harness connector. 2. Measure the voltage at the TP sensor 2 signal circuit with a DMM connected to ground. Is the voltage within the specified range?	3.94-6.06 V	Go to **Step 12**	Go to **Step 8**
8	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the TP sensor circuits. 3. Turn ON the ignition, with the engine OFF. 4. Test the TP sensor 2 signal circuit for a short to voltage with a DMM. Refer to **Circuit Testing**	-		

	and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?		Go to **Step 30**	Go to **Step 9**
9	Test the TP sensor 2 signal circuit for an open or high resistance with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 30**	Go to **Step 10**
10	Test the TP sensor 2 signal circuit for a short to ground with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 30**	Go to **Step 11**
11	1. Disconnect the other TAC module harness connector. 2. Test for a short between the TP sensor 2 signal circuit and all other TAC module circuits with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 30**	Go to **Step 26**
12	Measure the voltage from the TP sensor 2 5-volt reference circuit to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the voltage within the specified range?	4.54-5.21 V	Go to **Step 22**	Go to **Step 13**
13	Is the voltage more than the specified value?	5.21 V	Go to **Step 14**	Go to **Step 16**
14	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the TP sensor circuits. 3. Turn ON the ignition, with the engine OFF. 4. Test the TP sensor 2 5-volt reference circuit for a short to voltage with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 30**	Go to **Step 15**
15	1. Turn OFF the ignition. 2. Disconnect the accelerator pedal position (APP) sensor harness connector. 3. Disconnect the other TAC module harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Test the APP sensor 2 5-volt reference circuit for a short to voltage with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.	-		

	Did you find and correct the condition?		Go to **Step 30**	Go to **Step 20**
16	Disconnect the APP sensor. Is the voltage less than the specified value?	4.54 V	Go to **Step 17**	Go to **Step 28**
17	1. Disconnect the TAC module harness connector containing the TP sensor circuits. 2. Test the TP sensor 2 5-volt reference circuit for an open or high resistance with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 30**	Go to **Step 18**
18	Test the TP sensor 2 5-volt reference circuit for a short to ground with a DMM. Did you find and correct the condition?	-	Go to **Step 30**	Go to **Step 19**
19	Test the APP sensor 2 5-volt reference circuit for a short to ground with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 30**	Go to **Step 20**
20	Test for a short between the TP sensor 2 5-volt reference circuit and all other TAC module circuits with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 30**	Go to **Step 21**
21	Test for a short between the APP sensor 2 5-volt reference circuit and all other TAC module circuits with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 30**	Go to **Step 26**
22	1. Connect a fused jumper between the TP sensor 2 low-reference circuit and the TP sensor 2 signal circuit. 2. Observe the TP sensor 2 voltage parameter with a scan tool. Is the TP sensor 2 parameter near the specified value?	0 V	Go to **Step 24**	Go to **Step 23**
23	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the TP sensor circuits. 3. Test the TP sensor 2 low-reference circuit for an open or high resistance with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 30**	Go to **Step 26**

24	Inspect for an intermittent and for a poor connection at the throttle body harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Repairing Connector Terminals** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 30**	Go to **Step 27**
25	Inspect for an intermittent and for a poor connection at the APP sensor harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Repairing Connector Terminals** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 30**	Go to **Step 28**
26	Inspect for an intermittent and for a poor connection at the TAC module harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Repairing Connector Terminals** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 30**	Go to **Step 29**
27	Replace the throttle body assembly. Refer to **Throttle Body Assembly Replacement** . Did you complete the replacement?	-	Go to **Step 30**	-
28	Replace the APP sensor. Refer to **Accelerator Pedal Position (APP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 30**	-
29	Replace the TAC module. Refer to **Throttle Actuator Control (TAC) Module Replacement** . Did you complete the replacement?	-	Go to **Step 30**	-
30	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 31**
31	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0230

Circuit Description

The control module enables the fuel pump relay when the ignition switch is turned ON. The control module will disable the fuel pump relay within two seconds unless the control module detects ignition reference pulses. The control module continues to enable the fuel pump relay as long as ignition reference pulses are detected. The control module disables the fuel pump relay within two seconds if ignition reference pulses cease to be detected and the ignition remains ON.

The control module monitors the voltage on the fuel pump relay control circuit. If the control module detects an incorrect voltage on the fuel pump relay control circuit, a fuel pump relay control DTC sets.

Conditions for Running the DTC

- The engine speed is more than 400 RPM.
- The ignition voltage is between 6-18 volts.

Conditions for Setting the DTC

- The PCM detects that the commanded state of the driver and the actual state of the control circuit do not match.
- The above conditions are present for a minimum of 2.5 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

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

4: This step verifies that the PCM is providing voltage to the fuel pump relay.

5: This step tests for an open in the ground circuit to the fuel pump relay.

6: This step tests if the voltage is constantly being applied to the control circuit of the fuel pump relay.

DTC P0230

Step	Action	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views**			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Command the fuel pump relay ON and OFF with a scan tool. Does the fuel pump relay turn ON and OFF when commanded with a scan tool?	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Remove the fuel pump relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the control circuit of the fuel pump relay with a test lamp that is connected to a good ground. Refer to **Probing Electrical Connectors** in Wiring Systems. 5. Command the fuel pump ON and OFF with a scan tool. Does the test lamp turn ON and OFF when commanded with a scan tool?	Go to **Step 5**	Go to **Step 6**
5	1. Connect a test lamp between the control circuit of the fuel pump relay and the ground circuit of the fuel pump relay. 2. Command the fuel pump relay ON and OFF with a scan tool.		

	Does the test lamp turn ON and OFF when commanded with a scan tool?	Go to **Step 9**	Go to **Step 11**
6	Does the test lamp remain illuminated?	Go to **Step 8**	Go to **Step 7**
7	Test the control circuit of the fuel pump relay for a short to ground or an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 10**
8	Test the control circuit of the fuel pump relay for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 10**
9	Test for an intermittent and for a poor connection at the fuel pump relay. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 12**
10	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 13**
11	Test the ground circuit of the fuel pump relay for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	-
12	Replace the fuel pump relay. Did you complete the replacement?	Go to **Step 14**	-
13	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	Go to **Step 14**	-
14	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 15**
15	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0300

System Description

The powertrain control module (PCM) uses information from the crankshaft position (CKP) sensor and the camshaft position (CMP) sensor in order to determine when an engine misfire is occurring. By monitoring variations in the crankshaft rotation speed for each cylinder, the PCM is able to detect individual misfire events. A misfire rate that is high enough can cause the 3-way catalytic converter (TWC) to overheat under certain driving conditions. The malfunction indicator lamp (MIL) will flash ON and OFF when the conditions for TWC overheating are present. If the PCM detects a misfire rate sufficient to cause emission levels to exceed mandated standards, DTC P0300 will set.

Conditions for Running the DTC

- DTCs P0101, P0102, P0103, P0106, P0107, P0108, P0116, P0117, P0118, P0125, P0128, P0220, P0315, P0335, P0336, P0341, P0342, P0343, P0502, P0503, P1114, P1115, P1120, P1258 are not set.
- The engine speed is between 450-5,000 RPM.
- The ignition voltage is between 10-18 volts.
- The engine coolant temperature (ECT) is between -7 and +130°C (+19 and +266°F).
- The fuel level is more than 10 percent.
- The throttle angle is steady within 1 percent.
- The anti-lock brake system (ABS) and the traction control system are not active.
- The transmission is not changing gears.
- The A/C clutch is not changing states.
- The PCM is not in fuel shut-off or decel fuel cut-off mode.
- The PCM is not receiving a rough road signal.

Conditions for Setting the DTC

The PCM is detecting a crankshaft rotation speed variation indicating a misfire sufficient to cause emission levels to exceed mandated standards.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.

- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Excessive vibration from sources other than the engine could cause DTC P0300 to set. The following are possible sources of vibration:
  - Thickness variation of the brake rotors-Refer to **Symptoms - Hydraulic Brakes** in Hydraulic Brakes.
  - The drive shaft not balanced-Refer to **Vibration Analysis - Driveline** in Vibration Diagnosis and Correction.
  - Worn or damaged accessory drive belt-Refer to **Symptoms - Engine Mechanical** in Engine Mechanical - 4.8L, 5.3L and 6.0L
- There may be more or less cylinders actually misfiring than indicated by the scan tool.
- Spray water on the secondary ignition components using a spray bottle. Look and listen for arcing or misfiring.
- If there are multiple misfires on only one bank, inspect the fuel injector and ignition coil, power and ground circuits for that bank. Refer to **Engine Controls Schematics** .

Test Description

The number below refers to the step number on the diagnostic table.

2: If the actual CKP variation values are not within the learned values, the misfire counters may increment.

DTC P0300

Step	Action	Values	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **You must perform the crankshaft position (CKP) system variation learn procedure before proceeding with this diagnostic table. Refer to CKP System Variation Learn Procedure .** 1. Start the engine. 2. Allow the engine to idle or operate within the conditions listed in the Freeze Frame/Failure Records.	-		

	3. Monitor all of the Misfire counters with the scan tool. Are any of the Misfire current counters incrementing?		Go to **Step 3**	Go to Diagnostic Aids
3	Are any other DTCs set?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 4**
4	Can any abnormal engine noise be heard?	-	Go to **Symptoms - Engine Mechanical** in Engine Mechanical - 4.8L, 5.3L and 6.0L	Go to **Step 5**
5	Does the scan tool indicate that the heated oxygen sensor (HO2S) bank 1 sensor 1 or HO2S bank 2 sensor 1 voltage parameters are below the specified value?	200 mV	Go to **DTC P0131 or P0151**	Go to **Step 6**
6	Does the scan tool indicate that the HO2S bank 1 sensor 1 or HO2S bank 2 sensor 1 voltage parameters are fixed above the specified value?	900 mV	Go to **DTC P0132 or P0152**	Go to **Step 7**
7	Inspect the following components: • The vacuum hoses and seals for splits, restrictions, and improper connections - Refer to **Emission Hose Routing Diagram** . • The throttle body and intake manifold for vacuum leaks • The crankcase ventilation system for vacuum leaks - Refer to **Crankcase Ventilation System Inspection/Diagnosis** in Engine Mechanical - 4.8L, 5.3L and 6.0L. • The powertrain control module (PCM) grounds for corrosion and loose connections - Refer to **Ground Distribution Schematics** in Wiring Systems. • The exhaust system for restrictions - Refer to **Restricted Exhaust** in Engine Exhaust. • The fuel for contamination - Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (without Special Tool and E85)** or **Alcohol/Contaminants-in-Fuel Diagnosis (with Special Tool)** .	-		

	Did you find and correct the condition?		Go to **Step 20**	Go to **Step 8**
8	**IMPORTANT:** **An erratic or inconsistent spark is considered a no spark.** 1. Turn OFF the ignition. 2. Disconnect the spark plug wire from the spark plug that corresponds to the Misfire Current counters that were incrementing. Refer to **Spark Plug Wire Replacement** . 3. Install the **J 26792** Spark Tester. 4. Start the engine. Does the spark jump the tester gap?	-	Go to **Step 10**	Go to **Step 9**
9	1. Remove the spark plug wire for the affected cylinders. Refer to **Spark Plug Wire Replacement** . 2. Inspect the spark plug wire. Refer to **Spark Plug Wire Inspection** . 3. Measure the resistance of the spark plug wire with a DMM. Is the spark plug wire resistance less than the specified value?	700 ohm	Go to **Electronic Ignition (EI) System Diagnosis**	Go to **Step 19**
10	1. Remove the spark plug from the cylinder that indicated a misfire. Refer to **Spark Plug Replacement** . 2. Inspect the spark plug. Refer to **Spark Plug Inspection** . Does the spark plug appear to be OK?	-	Go to **Step 11**	Go to **Step 12**
11	1. Exchange the suspected spark plug with another cylinder that is operating properly. Refer to **Spark Plug Replacement** . 2. Operate the vehicle under the same conditions that the misfire occurred. Did the misfire move with the spark plug?	-	Go to **Step 18**	Go to **Step 15**
	Is the spark plug oil or coolant fouled?		Go to **Symptoms - Engine Mechanical**	

12		-	in Engine Mechanical - 4.8L, 5.3L and 6.0L	Go to **Step 13**
13	Is the spark plug gas fouled?	-	Go to **Step 16**	Go to **Step 14**
14	Did the spark plug show any signs of being cracked, worn, or improperly gapped?	-	Go to **Step 17**	Go to **Step 15**
15	Perform the fuel injector coil test. Refer to **Fuel Injector Coil Test** . Did you find and correct the condition?	-	Go to **Step 20**	Go to **Symptoms - Engine Mechanical** in Engine Mechanical - 4.8L, 5.3L and 6.0L
16	Perform the fuel system diagnosis. Refer to **Fuel System Diagnosis** . Did you find and correct the condition?	-	Go to **Step 20**	Go to **Symptoms - Engine Mechanical** in Engine Mechanical - 4.8L, 5.3L and 6.0L
17	Replace or gap the spark plug. Refer to **Spark Plug Replacement** . Did you complete the action?	-	Go to **Step 20**	-
18	Replace the faulty spark plug. Refer to **Spark Plug Replacement** . Did you complete the replacement?	-	Go to **Step 20**	-
19	Replace the faulty spark plug wires. Refer to **Spark Plug Wire Replacement** . Did you complete the replacement?	-	Go to **Step 20**	-
20	Was the customer concern the malfunction indicator lamp (MIL) flashing?	-	Go to **Step 21**	Go to **Step 22**
21	1. Operate the vehicle at the specified value for 4 minutes. 2. Operate the vehicle within the Conditions for Running the DTC P0420 or P0430 as specified in the supporting text. Refer to **DTC P0420 or P0430** . Does the DTC run and pass?	2,500 RPM	Go to **Step 22**	Go to **DTC P0420 or P0430**
22	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records.	-		

	Did the DTC fail this ignition?		Go to **Step 2**	Go to **Step 23**
23	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0315

Circuit Description

The crankshaft position (CKP) system variation learn feature is used to calculate reference period errors caused by slight tolerance variations in the crankshaft, and the CKP sensor. The calculated error allows the powertrain control module (PCM) to accurately compensate for reference period variations. This enhances the ability of the PCM to detect misfire events over a wide range of engine speed and load. The PCM stores the Crankshaft Position System Variation values after a learn procedure has been performed. If the actual crankshaft position variation is not within the Crankshaft Position System Variation compensating values stored in the PCM, DTC P0300 may set. If the CKP system variation values are not stored in the PCM memory, DTC P0315 sets.

Conditions for Running the DTC

DTCs P0335, P0336, P0341, P0342, or P0343 are not set.

Conditions for Setting the DTC

The CKP system variation values are not stored in the PCM memory.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P0315

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Preform the crankshaft position (CKP) system variation learn procedure. Refer to **CKP System**		

	Variation Learn Procedure . Does the scan tool display Learned this ignition?	Go to **Step 4**	Go to **Step 3**
3	If the CKP system variation learn procedure cannot be performed successfully, check for the following conditions and correct as necessary: • Worn crankshaft main bearings • A damaged reluctor wheel • Excessive crankshaft runout • A damaged crankshaft • Interference in the signal circuit of the CKP sensor • Any foreign material passing between the CKP sensor and the reluctor wheel • A coolant temperature that is not within the Conditions For Running the DTC • The ignition switch is in the ON position until the battery is drained. • A powertrain control module (PCM) power disconnect with the ignition ON may erase the stored value and set the DTC P0315. Did you complete the inspection?	Go to **Step 4**	-
4	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 5**
5	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0325

Circuit Description

The knock sensors (KS) produce an AC signal under all engine operating conditions. When the engine is running, the powertrain control module (PCM) learns a minimum and maximum frequency of normal engine noise. The KS system monitors both knock sensors in order to determine if knock is present. If the KS system determines that excessive knock is present, the PCM retards the spark timing based on the signals from the KS. The PCM continues to retard timing until no knock is present. If the PCM malfunctions in a manner that will not allow proper diagnosis of the KS system this DTC will set

Conditions for Running the DTC

- The engine run time is more than 10 seconds.
- The ignition voltage is more than 10 volts.

Conditions for Setting the DTC

- The PCM malfunctions in a manner that will not allow proper diagnosis of the KS system.
- The above condition is present for 12 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P0325

Step	Action	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views**			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds.		

2	3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to **Step 3**	Go to **Intermittent Conditions**
3	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	Go to **Step 4**	-
4	1. Start the engine. 2. Operate the vehicle within the conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 5**
5	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0327 OR P0332

Circuit Description

The knock sensors (KS) produce an AC signal under all engine operating conditions. When the engine is running, the powertrain control module (PCM) learns a minimum and maximum frequency of normal engine noise. The KS system monitors both knock sensors in order to determine if knock is present. If the KS system determines that excessive knock is present, the PCM retards the spark timing based on the signals from the KS. The PCM continues to retard timing until no knock is present. If the PCM detects that the frequency is out of the normal range, DTC P0327 or P0332 will set.

Conditions for Running the DTC

- DTCs P0116, P0117, P0118, P0122, P0123, P0125, or P0128 are not set.
- The minimum noise level must be learned. The minimum noise level is learned when the following conditions are met:
  - The engine coolant temperature (ECT) is more than 60°C (140°F).
  - The engine RPM is between 475-975 for 10 seconds.
- The engine speed is between 1,500-3,000 RPM.
- The manifold absolute pressure (MAP) is less than 45 kPa.
- The engine run time is more than 10 seconds.
- The ignition voltage is more than 10 volts.

Conditions for Setting the DTC

The PCM detects that the affected KS signal is less than the expected amount for more than 9 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

IMPORTANT: If the KS is dropped, the sensor must be replaced.

- Inspect the KS for proper installation. A knock sensor that is loose or over torqued may cause the DTC to set.
- If DTCs P0327 and P0332 are set at the same time, inspect for poor connections at the KS harness jumper, located at the left rear side of the intake manifold.
- For an intermittent, refer to **Intermittent Conditions** .

DTC P0327 or P0332

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Component Views or Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
	IMPORTANT: **If an engine knock can be heard, repair the engine mechanical condition before proceeding with this diagnostic.**			

2	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the engine within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 3**	Go to Diagnostic Aids
3	1. Turn OFF the ignition 2. Remove the intake manifold sight shield. Refer to **Engine Sight Shield Replacement (6.0L (LQ4))** in Engine Mechanical. 3. Disconnect the knock sensor (KS) inline harness connector. 4. Measure the resistance from the signal circuit of the affected KS to a good ground with a DMM. Is the resistance of the KS within the specified range?	93K-107K ohm	Go to **Step 4**	Go to **Step 6**
4	**IMPORTANT:** **Do not tap on any plastic engine components.** 1. Measure the AC voltage from the signal circuit of the affected KS to a good ground. 2. Tap on the engine block near the affected KS while observing the DMM. Does the voltage change on the DMM while tapping on the engine block near the KS?	-	Go to **Step 5**	Go to **Step 10**
5	Test the affected KS signal circuit between the PCM and the KS inline harness connector for the following conditions: • An open or a high resistance • A short to voltage • A short to ground Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.	-		

	Did you find and correct the condition?		Go to **Step 12**	Go to **Step 8**
6	1. Remove the intake manifold. Refer to **Intake Manifold Replacement** in Engine Mechanical. 2. Test the affected signal circuit between the KS inline harness connector and the affected KS connector for an open, high resistance or short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 7**
7	Test for an intermittent and for a poor connection at the affected KS. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 10**
8	Test for an intermittent and for a poor connection at the KS inline harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 9**
9	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 11**
10	Replace the affected knock sensor. Refer to **Knock Sensor (KS) Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
11	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
12	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC as specified in the supporting text. You may also operate the vehicle within the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 13**
13	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code**	

DTC P0335

Circuit Description

The crankshaft position (CKP) sensor signal indicates the crankshaft speed and position. The CKP sensor circuits are connected directly to the powertrain control module (PCM) and consists of the following circuits:

- The 12-volt reference circuit
- The low reference circuit
- The CKP sensor signal circuit

If the PCM detects there is no signal from the CKP sensor for 8 seconds, DTC P0335 sets.

Conditions for Running the DTC

- DTCs P0101, P0102, P0103, P0341, P0342, or P0343 are not set.
- The camshaft position (CMP) sensor signal is incrementing.
- The mass air flow (MAF) is more than 3 g/s.
- The ignition switch is in the Crank position.

Conditions for Setting the DTC

The PCM detects there is no signal from the CKP sensor for 8 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

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

> **3:** This step determines if the fault is present.
>
> **6:** This step simulates a CKP sensor signal to the PCM. If the PCM receives the signal, the fuel pump will operate for about two seconds.

DTC P0335

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Attempt to start the engine. Does the engine start and continue to run?	-	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn ON the ignition, with the engine OFF. 2. Raise the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information. 3. Disconnect the crankshaft position (CKP) sensor harness connector. 4. Measure the voltage from the 12-volt reference circuit of the CKP sensor to a good ground with a DMM. Is the voltage within the specified value?	B+	Go to **Step 5**	Go to **Step 7**
5	Measure the voltage between the 12-volt reference circuit of the CKP sensor and the low reference circuit of the CKP sensor with a DMM. Is the voltage within the specified value?	B+	Go to **Step 6**	Go to **Step 8**

6	Momentarily connect a test lamp between the CKP sensor signal circuit and the 12-volt reference of the CKP sensor. Does the fuel pump operate when the test lamp is applied to the CKP sensor signal circuit?	-	Go to **Step 10**	Go to **Step 9**
7	Test the 12-volt reference circuit for the following conditions: • An open • High resistance • A short to ground Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct condition?	-	Go to **Step 16**	Go to **Step 12**
8	Test the low reference circuit for the following conditions: • An open • High Resistance • A short to voltage Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 12**
9	Test the CKP sensor signal circuit for the following conditions: • High resistance • An open • A short to ground • A short to voltage Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 12**
	1. Remove the CKP sensor. Refer to **Crankshaft Position (CKP) Sensor Replacement** . 2. Visually inspect the CKP sensor for the following conditions:			

10	• Physical damage • Loose or improper installation • Wiring routed too closely to the secondary ignition components 3. The following conditions may cause this DTC to set: • Excessive air gap between the CKP sensor and the reluctor wheel • The CKP sensor coming in contact with the reluctor wheel • Foreign material passing between the CKP sensor and the reluctor wheel • Insufficient fuel Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 11**
11	Visually inspect the CKP sensor reluctor wheel for the following conditions: • Physical damage • Excessive play or looseness Refer to **Crankshaft and Bearings Cleaning and Inspection** in Engine Mechanical. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 14**
12	Test for poor connections at the CKP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 13**
13	Test for poor connections at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 15**
14	Replace the CKP sensor. Refer to **Crankshaft Position (CKP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 16**	-
15	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 16**	-
	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds.			

16	3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 17**
17	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0336

Circuit Description

The crankshaft position (CKP) sensor signal indicates the crankshaft speed and position. The CKP sensor circuits are connected directly to the powertrain control module (PCM) and consists of the following circuits:

- The 12-volt reference circuit
- The low reference circuit
- The CKP sensor signal circuit

If the PCM detects that the CKP sensor signal is inconsistent for 2 seconds, DTC P0336 sets.

Conditions for Running the DTC

The engine is cranking or running.

Conditions for Setting the DTC

The PCM detects that the CKP sensor signal is inconsistent for 2 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P0336

Step	Action	Yes	No
Schematic Reference:Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Powertrain Control Module (PCM) Connector End Views**			
1	Did you perform the Diagnostic System Check - Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **If DTC P0335 is also set, diagnose DTC P0335 before proceeding with this DTC.** 1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to **Step 3**	Go to **Intermittent Conditions**
3	Inspect all of the crankshaft position sensor (CKP) circuits for the following conditions: • Wiring routed too closely to secondary ignition wires or components • Wiring routed too closely to after-market add-on electrical equipment • Wiring routed to closely to solenoids, relays, and motors • Electromagnetic interference in the CKP sensor circuits Did you find and correct the condition?	Go to **Step 12**	Go to **Step 4**

4	Test the 12-volt reference circuit for an intermittent condition or shorted to other circuits. Refer to **Testing for Electrical Intermittents** and **Inducing Intermittent Fault Conditions** in Wiring Systems. Did you find and correct the condition?	Go to **Step 12**	Go to **Step 5**
5	Test the low reference circuit for an intermittent condition. Refer to **Testing for Electrical Intermittents** and **Inducing Intermittent Fault Conditions** in Wiring Systems. Did you find and correct the condition?	Go to **Step 12**	Go to **Step 6**
6	Test the CKP sensor signal circuit for an intermittent condition. Refer to **Testing for Electrical Intermittents** and **Inducing Intermittent Fault Conditions** in Wiring Systems. Did you find and correct the condition?	Go to **Step 12**	Go to **Step 7**
7	Test for an intermittent and for a poor connection at the CKP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 12**	Go to **Step 8**
8	Test for an intermittent and for a poor connection at the powertrain control module (PCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 12**	Go to **Step 9**
9	1. Remove the CKP sensor. Refer to **Crankshaft Position (CKP) Sensor Replacement** . 2. Inspect the CKP sensor for the following conditions: • Physical damage • Improper installation • Excessive play or looseness • Excessive air gap between the CKP sensor and the reluctor wheel • Foreign material passing between the CKP sensor and the reluctor wheel • Insufficient fuel Did you find and correct the condition?	Go to **Step 12**	Go to **Step 10**
10	Inspect the reluctor wheel for the following conditions: • Physical damage • Improper installation • Excessive endplay or looseness		

	Refer to **Crankshaft and Bearings Cleaning and Inspection** in Engine Mechanical. Did you find and correct the condition?	Go to **Step 12**	Go to **Step 11**
11	Replace the CKP sensor. Refer to **Crankshaft Position (CKP) Sensor Replacement** . Did you complete the replacement?	Go to **Step 12**	-
12	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 13**
13	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0341

Circuit Description

The camshaft position (CMP) sensor works in conjunction with a 1 X reluctor wheel on the camshaft. The powertrain control module (PCM) provides a 12 volt reference to the CMP sensor as well as a low reference and a signal circuit.

As the camshaft rotates, the reluctor wheel interrupts a magnetic field produced by a magnet within the sensor. The sensors internal circuitry detects this and produces a signal which the PCM reads.

The CMP sensor 1 X signal is used by the PCM to determine if the cylinder at top dead center (TDC) is on the firing stroke or the exhaust stroke. The PCM can determine TDC for all cylinders by using the CKP sensor 24 X signal alone. The engine will start without a CMP signal as long as the PCM receives the CKP sensor 24 X signal. A slightly longer cranking time may be a symptom of this condition. The system attempts synchronization and looks for an increase in engine speed indicating that the engine started. If the PCM does not detect an increase in engine speed, the PCM assumes that the PCM incorrectly synchronized to the exhaust stroke and re-syncs to the opposite cam position. If the PCM detects that a CMP to CKP mis-match has occurred DTC P0341 sets.

Conditions for Running the DTC

The engine is running and the engine speed is less than 4,000 RPM.

Conditions for Setting the DTC

The PCM detects that a CMP to CKP mis-match has occurred.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

The following conditions may cause this DTC to set:

- Camshaft reluctor ring damage
- The sensor coming in contact with the reluctor ring
- Foreign material passing between the sensor and the reluctor ring
- Excessive camshaft end-play
- Wiring routed too close to secondary ignition components

If you suspect the condition is intermittent, refer to **Intermittent Conditions** .

Test Description

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

3: This step inspects for electromagnetic interference (EMI) on the CMP sensor circuits.

6: Damage to the face of the sensor could indicate foreign material passing between the CMP sensor and the reluctor wheel. This condition would cause this DTC to set. Damage to the reluctor wheel would affect the CMP sensor output.

DTC P0341

Step	Action	Yes	No

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views

1	Did you perform the Diagnostic System Check - Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to **Step 3**	Go to Diagnostic Aids
3	1. Visually and physically inspect all circuits going to the CMP sensor for the following: • Being routed too close to secondary ignition wires or components • Being routed too close to after-market add-on electrical equipment • Being routed too close to solenoids, relays, and motors 2. If you find incorrect routing, correct the harness routing Did you find and correct the condition?	Go to **Step 9**	Go to **Step 4**
4	Test for an intermittent and for a poor connection at the CMP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 9**	Go to **Step 5**
5	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 9**	Go to **Step 6**
6	1. Remove the CMP sensor. Refer to **Camshaft Position (CMP) Sensor Replacement** . 2. Visually inspect the CMP sensor for the following conditions: • Physical damage		

	• Excessive wear of the sensor • Loose or improper installation Did you find and correct the condition?	Go to **Step 9**	Go to **Step 7**
7	1. Visually inspect the CMP sensor reluctor ring for damage. 2. If the CMP reluctor ring is damaged, Refer to **Camshaft and Bearings Cleaning and Inspection** in Engine Mechanical. Did you find and correct the condition?	Go to **Step 9**	Go to **Step 8**
8	Replace the CMP sensor. Refer to **Camshaft Position (CMP) Sensor Replacement** . Did you complete the replacement?	Go to **Step 9**	-
9	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 10**
10	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0342

Circuit Description

The camshaft position (CMP) sensor works in conjunction with a 1 X reluctor wheel on the camshaft. The powertrain control module (PCM) provides a 12 volt reference to the CMP sensor as well as a low reference and a signal circuit.

As the camshaft rotates, the reluctor wheel interrupts a magnetic field produced by a magnet within the sensor. The sensors internal circuitry detects this and produces a signal which the PCM reads.

The CMP sensor 1 X signal is used by the PCM to determine if the cylinder at top dead center (TDC) is on the firing stroke or the exhaust stroke. The PCM can determine TDC for all cylinders by using the CKP sensor 24 X signal alone. The engine will start without a CMP signal as long as the PCM receives the CKP sensor 24 X signal. A slightly longer cranking time may be a symptom of this condition. The system attempts synchronization and looks for an increase in engine speed indicating that the engine started. If the PCM does not detect an increase in engine speed, the PCM assumes that the PCM incorrectly synchronized to the exhaust stroke and re-syncs to the opposite cam position. If the PCM detects that a CMP signal is constantly low, DTC P0342 sets.

Conditions for Running the DTC

- The engine is running.
- The engine speed is less than 4,000 RPM.

Conditions for Setting the DTC

The PCM detects that the CMP sensor signal is low for 1.5 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

The following conditions may cause this DTC to set:

- Camshaft reluctor ring damage
- The sensor coming in contact with the reluctor ring
- Foreign material passing between the sensor and the reluctor ring
- Excessive camshaft end-play
- Wiring routed too close to secondary ignition components

If the condition is intermittent, refer to **Intermittent Conditions** .

Test Description

The number below refers to the step number on the diagnostic table.

5: This step tests the CMP sensor signal circuit. Applying a voltage causes the CMP sensor high to low and low to high parameter to increase if the circuit and the PCM are operating properly.

DTC P0342

Step	Action	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views**			
1	Did you perform the Diagnostic System Check - Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Start the engine. 2. Observe the camshaft position (CMP) sensor high to low and low to high transition parameter with a scan tool. Does the scan tool parameter increment?	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to **Step 4**	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the CMP sensor. 3. Turn ON the ignition, with the engine OFF. 4. Probe the 12-volt reference circuit of the CMP sensor at the CMP sensor wire harness electrical connector with a test lamp that is connected to a good ground. Refer to **Probing Electrical Connectors** in Wiring Systems. Does the test lamp illuminate?	Go to **Step 5**	Go to **Step 6**
	1. Start the engine. 2. Observe the CMP sensor high to low and low to high transition parameters with the scan tool.		

5	3. Momentarily and repeatedly probe the signal circuit of the CMP sensor at the CMP sensor wire harness electrical connector with a test lamp that is connected to battery positive voltage. Does the CMP sensor high to low and low to high transition counters increment when the test lamp contacts the signal circuit?	Go to **Step 8**	Go to **Step 7**
6	Test the 12-volt reference circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 9**
7	Test the CMP sensor signal circuit for an open or a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 9**
8	Test for an intermittent and for a poor connection at the CMP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 10**
9	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 13**
10	1. Remove the CMP sensor. Refer to **Camshaft Position (CMP) Sensor Replacement** . 2. Visually inspect the CMP sensor for the following conditions: • Physical damage • Loose or improper installation • Wiring routed too close to the secondary ignition components Did you find and correct the condition?	Go to **Step 14**	Go to **Step 11**
11	1. Visually inspect the CMP sensor reluctor ring for damage. 2. If the CMP reluctor ring is damaged, refer to **Camshaft and Bearings Cleaning and Inspection** in Engine Mechanical. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 12**
	Replace the CMP sensor. Refer to **Camshaft Position**		

12	**(CMP) Sensor Replacement** . Did you complete the replacement?	Go to **Step 14**	-
13	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	Go to **Step 14**	-
14	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 15**
15	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0343

Circuit Description

The camshaft position (CMP) sensor works in conjunction with a 1 X reluctor wheel on the camshaft. The powertrain control module (PCM) provides a 12 volt reference to the CMP sensor as well as a low reference and a signal circuit.

As the camshaft rotates, the reluctor wheel interrupts a magnetic field produced by a magnet within the sensor. The sensors internal circuitry detects this and produces a signal which the PCM reads.

The CMP sensor 1 X signal is used by the PCM to determine if the cylinder at top dead center (TDC) is on the firing stroke or the exhaust stroke. The PCM can determine TDC for all cylinders by using the CKP sensor 24 X signal alone. The engine will start without a CMP signal as long as the PCM receives the CKP sensor 24 X signal. A slightly longer cranking time may be a symptom of this condition. The system attempts synchronization and looks for an increase in engine speed indicating that the engine started. If the PCM does not detect an increase in engine speed, the PCM assumes that the PCM incorrectly synchronized to the exhaust stroke and re-syncs to the opposite cam position. If the PCM detects that the CMP signal is constantly high, DTC P0343 sets.

Conditions for Running the DTC

- The engine is running.
- The engine speed is less than 4,000 RPM.

Conditions for Setting the DTC

The PCM detects that the CMP sensor signal is high for 1.5 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

The following conditions may cause this DTC to set:

- Camshaft reluctor ring damage
- The sensor coming in contact with the reluctor ring
- Foreign material passing between the sensor and the reluctor ring
- Excessive camshaft end-play
- Wiring routed too close to secondary ignition components

If the condition is intermittent, refer to **Intermittent Conditions** .

Test Description

The number below refers to the step number on the diagnostic table.

> **5:** This step tests the CMP sensor signal circuit. Applying a voltage causes the CMP sensor high to low and low to high parameter to increase if the circuit and the PCM are operating properly.

DTC P0343

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views**				

1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Start the engine. 2. Observe the camshaft position (CMP) sensor high to low and low to high transition parameter with a scan tool. Does the scan tool parameter increment?	-	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the CMP sensor. 3. Turn ON the ignition, with the engine OFF. 4. Probe the signal circuit of the CMP sensor with a test lamp that is connected to a good ground. Refer to **Probing Electrical Connectors** in Wiring Systems. Does the test lamp illuminate?	-	Go to **Step 7** Go to **Step 5**	
5	1. Start the engine. 2. Observe the CMP sensor high to low and low to high transition parameters with the scan tool. 3. Momentarily and repeatedly probe the signal circuit of the CMP sensor with a test lamp that is connected to battery voltage. Does the CMP sensor high to low and low to high transition counters increment when the test lamp contacts the signal circuit?	-	Go to **Step 6**	Go to **Step 10**
	1. Turn OFF the ignition. 2. Jumper the CMP circuits from the CMP sensor to the CMP sensor harness connector. Refer to **Using Connector Test Adapters** in Wiring			

6	Systems. 3. Turn ON the ignition, with the engine OFF. 4. Measure the Voltage Drop from the low reference circuit of the CMP sensor to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the voltage more than the specified value?	0.2 V	Go to **Step 8**	Go to **Step 9**	
7	Test the CMP sensor signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**		Go to **Step 10**
8	Test the low reference circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**		Go to **Step 10**
9	Test for an intermittent and for a poor connection at the CMP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**		Go to **Step 11**
10	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**		Go to **Step 14**
11	1. Remove the CMP sensor. Refer to **Camshaft Position (CMP) Sensor Replacement** . 2. Visually inspect the CMP sensor for the following conditions: • Physical damage • Loose or improper installation • Wiring routed too close to the secondary ignition components Did you find and correct the condition?	-	Go to **Step 15**		Go to **Step 12**
12	1. Visually inspect the CMP sensor reluctor ring for damage. 2. If the CMP reluctor ring is damaged, refer to **Camshaft and Bearings Cleaning and Inspection** in Engine Mechanical Did you find and correct the condition?	-	Go to **Step 15**		Go to **Step 13**

13	Replace the CMP sensor. Refer to **Camshaft Position (CMP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
14	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
15	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 16**
16	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0351-P0358

Circuit Description

The ignition system on this engine uses an individual ignition coil for each cylinder. The powertrain control module (PCM) controls the ignition system operation. The PCM controls each coil using one of eight ignition control (IC) circuits. The PCM commands the IC circuit low when a spark event is requested. This causes the IC module to energize the ignition coil to create a spark at the spark plug. Each ignition coil has the following circuits:

- An ignition 1 voltage circuit
- A ground circuit
- An ignition control (IC) circuit
- A low reference circuit

Sequencing and timing are PCM controlled. If the PCM detects that the IC circuit is out of range, DTC P0351-P0358 sets.

Conditions for Running the DTC

The engine is operating.

Conditions for Setting the DTC

The PCM detects the IC circuit is grounded, open, or shorted to voltage for less than 1 second.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

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

3: This step verifies the integrity of the IC circuit and the PCM output.

4: This step tests for a short to ground on the IC circuit.

DTC P0351-P0358

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 3**	Go to **Intermittent Conditions**

3	1. Turn OFF the engine. 2. Disconnect the respective ignition coil. 3. Start the engine. 4. Measure the frequency at the IC circuit with the DMM set to DC Hertz. Refer to **Measuring Frequency** in Wiring Systems. Is the frequency within the specified range?	3-20 Hz	Go to **Step 7**	Go to **Step 4**
4	Measure the voltage from the IC circuit of the ignition coil to a good ground with the DMM. Is the voltage more than the specified value?	1 V	Go to **Step 13**	Go to **Step 5**
5	1. Turn OFF the ignition. 2. Disconnect the PCM connector. 3. Test the IC circuit between the ignition coil connector and the PCM connector for continuity with the DMM. Does the DMM indicate continuity?	-	Go to **Step 6**	Go to **Step 14**
6	Test the respective IC circuit for a short to ground. Refer to **Testing for Short to Ground** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 10**
7	1. Turn ON the ignition, with the engine OFF. 2. Probe the ignition 1 voltage circuit of the ignition coil with a test lamp that is connected to battery ground. Refer to **Troubleshooting with a Test Lamp** in Wiring Systems. Does the test lamp illuminate?	-	Go to **Step 8**	Go to **Step 11**
8	Probe the ground circuit of the ignition coil with a test lamp connected to battery voltage. Refer to **Troubleshooting with a Test Lamp** in Wiring Systems. Does the test lamp illuminate?	-	Go to **Step 9**	Go to **Step 12**
9	Test for an intermittent and for a poor connection at the ignition coil. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 17**	Go to **Step 15**
10	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems.	-		

	Did you find and correct the condition?		Go to **Step 17**	Go to **Step 16**
11	Repair the open in the ignition 1 voltage circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 17**	-
12	Repair the open in the ground circuit for the ignition coil. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 17**	-
13	Repair the IC circuit for a short to voltage. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 17**	-
14	Repair open in the IC circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 17**	-
15	Replace the ignition coil. Refer to **Ignition Coil(s) Replacement** . Did you complete the replacement?	-	Go to **Step 17**	-
16	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 17**	-
17	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 18**
18	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0420 OR P0430

Circuit Description

The three-way catalytic converter (TWC) reduces emissions of hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOx). The catalyst within the converter promotes a chemical reaction, which oxidizes the HC and CO that are present in the exhaust gas. This process converts these chemicals into water vapor and carbon dioxide (CO_2), and will reduce the NOx, by converting them into nitrogen. The catalytic converter also stores oxygen. The powertrain control module (PCM) monitors this process using heated oxygen sensor (HO2S) bank 1 sensor 2 and HO2S bank 2 sensor 2, located in the exhaust stream after the TWC. These sensors are referred to as the catalyst monitor sensors. The catalyst monitor sensors produce an output signal the PCM uses to indicate the oxygen storage capacity of the catalyst. This determines the catalysts ability to effectively convert the exhaust emissions.

If the catalyst is functioning correctly, the HO2S bank 1 sensor 2 and HO2S bank 2 sensor 2 signals will be far less active than the signals that are produced by HO2S bank 1 sensor 1 and HO2S bank 2 sensor 1. This indicates that the TWC oxygen storage capacity is at an acceptable threshold. When the response time of the catalyst monitor sensors are close to that of the fuel control sensors, the ability of the catalyst to store oxygen may be below an acceptable threshold.

The PCM performs this diagnostic test at idle. When the conditions for running this DTC are met, the following occurs:

- The air-to-fuel ratio transitions from lean to rich.
- The air-to-fuel ratio transitions from rich to lean, opposite the first air-to-fuel ratio transition.
- The PCM captures the response time of the front and the rear HO2S when the air-to-fuel ratio transitions occur. The HO2S response time changes from less than 350 mV to more than 600 mV, and from more than 600 mV to less than 350 mV.
- The PCM measures the time necessary for the rear HO2S voltage to cross a reference lean-to-rich threshold, and the time necessary for the front HO2S voltage to cross the same lean-to-rich threshold. The difference between the front HO2S time and the rear HO2S time indicates the oxygen storage capacity of the catalyst. If the PCM detects that this time difference is less than a predetermined value, DTC P0420 for bank 1 or DTC P0430 for bank 2 sets.

Conditions for Running the DTC

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0117, P0118, P0120, P0125, P0128, P0131, P0132, P0133, P0134, P0135, P0136, P0137, P0138, P0140, P0141, P0151, P0152, P0153, P0154, P0155, P0156, P0157, P0158, P0160, P0161, P0171, P0172, P0174, P0175, P0200, P0220, P0300, P0325, P0327, P0332, P0335, P0336, P0341, P0342, P0343, P0351-P0358, P0442, P0443, P0446, P0449, P0452, P0453, P0455, P0496, P0502, P0503, P0506, P0507, P1125, P1133, P1134, P1153, P1154, P1516, P2101, P2108, P2120, P2121, P2125, P2135 are not set.
- The engine has been running for more than 10 minutes.
- The intake air temperature (IAT) is between -7 to +85°C (+20 and +185°F).
- The barometric pressure (BARO) is more than 75 kPa.
- The engine coolant temperature (ECT) is more than 70-120°C (158-248°F).
- Since the end of the last idle period, the engine speed has been more than 900 RPM for 46 seconds.
- The engine must be at a stable idle speed, within 200 RPM of desired idle.
- The battery voltage is more than 10.7 volts.
- The Closed Loop fuel control is enabled.

Conditions for Setting the DTC

The PCM determines that the oxygen storage capability of the TWC has degraded to less than a calibrated threshold.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- The catalyst test may abort due to a change in the engine load. Do not change the engine load, ensure the AC is OFF, the coolant fan is not cycling, while a catalyst test is in progress.
- Driving the vehicle under the conditions outlined in the Inspection/Maintenance (I/M) section can verify whether the fault is present.
- These conditions may cause a catalytic converter to degrade. Inspect for the following conditions:
  - An engine misfire
  - High engine oil or high coolant consumption
  - Retarded spark timing
  - A weak or poor spark
  - A lean fuel mixture
  - A rich fuel mixture
  - A damaged oxygen sensor or wiring harness.
  - If an intermittent condition cannot be duplicated, the information included in Freeze Frame data can be useful in determining the vehicle operating conditions when the DTC was set.
- The catalyst may have been temporarily contaminated with a chemical from a fuel additive, fuel contamination or any of the above conditions.

If the condition is determined to be intermittent, refer to **Intermittent Conditions** .

Test Description

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

> **5:** A catalytic converter which has been discolored may be due to an engine running rich, lean or had a previous misfire. Verifying the fuel trim percentages may be of assistance in determining if such a condition exists.

6: This steps inspects for conditions than can cause the TWC efficiency to appear degraded.

DTC P0420 or P0430

Step	Action	Values	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Review the DTC information on the scan tool. Are any other DTCs set?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**
3	1. Start and idle the engine. 2. Allow the engine to reach operating temperature. 3. Increase the engine speed to 1,500 RPM for 1 minute. 4. Ensure Closed Loop operation is enabled. 5. Return the engine to a stabilized idle. 6. Observe the HO2S 2 voltage parameter on the scan tool for the applicable bank. Is the applicable HO2S 2 voltage parameter transitioning below the first specified value and above the second specified value?	350 mV 600 mV	Go to **Step 5**	Go to **Step 4**
4	1. Clear the DTCs with a scan tool. 2. Start the engine. 3. Operate the vehicle within the Conditions For Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did DTC P0420 or P0430 set?	-	Go to **Step 5**	Go to Diagnostic Aids
5	**IMPORTANT:** **Verify that the three-way catalytic converter (TWC) is a high quality part that meets the OEM specifications.** Visually and physically inspect the TWC for the following conditions: • Physical damage • Severe discoloration caused by excessive temperatures	-		

	• Internal rattles caused by loose catalyst substrate • Restrictions-Refer to **Restricted Exhaust** in Engine Exhaust. Did you find and correct the condition?		Go to **Step 10**	Go to **Step 6**
6	Visually inspect the exhaust system for the following conditions: • Leaks - Refer to **Exhaust Leakage** in Engine Exhaust. • Physical damage • Loose or missing hardware • The heated oxygen sensor (HO2S) 2 for the applicable bank for proper torque Did you find and correct the condition?	-	Go to **Step 10**	Go to **Step 7**
7	Visually inspect the HO2S 2 at the applicable bank for the following conditions: • The pigtail and wiring harness contacting the exhaust or any ground. • Road damage Did you find a condition?	-	Go to **Step 8**	Go to **Step 9**
8	Replace the applicable HO2S 2 sensor. Refer to **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 2** or **Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 2** . Did you complete the replacement?	-	Go to **Step 10**	-
9	**NOTE:** **In order to avoid damaging the replacement three-way catalytic converter, correct the engine misfire or mechanical fault before replacing the three-way catalytic converter.** Replace the TWC. Refer to **Catalytic Converter Replacement (Right Hand)** in Engine Exhaust.Did you complete the replacement?	-	Go to **Step 10**	-
	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine.			

10	4. Operate the vehicle within the Conditions For Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 11**
11	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0442

System Description

This diagnostic tests the evaporative emission (EVAP) system for a small leak when the key is turned OFF and the correct conditions are met.

Heat is transferred into a vehicle fuel tank while the vehicle is operating. When the vehicle is turned OFF, a change in the fuel tank vapor temperature occurs, which results in corresponding pressure changes in the fuel tank vapor space. This change is monitored by the control module using the fuel tank pressure sensor input. The control module then makes a judgement on the integrity of the system. With a 0.51 mm (0.020 in) leak in the system, the amount of pressure change observed is significantly less than that of a sealed system.

If the control module detects a pressure change less than a calibrated amount, DTC P0442 sets.

Conditions for Running the DTC

- DTCs P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0125, P0335, P0336, P0443, P0446, P0449, P0452, P0453, P0455, P0496, P0500, P0502, P1106, P1107, P2610 are not set.
- The diagnostic runs once with a 10 hour minimum between tests after a fail.
- DTC P0455 must run and pass.
- The start up intake air temperature (IAT) is between 4-30°C (39-86°F).
- The start up engine coolant temperature (ECT) is less than 30°C (86°F).
- The start up IAT and ECT are within 8°C (15°F).
- The barometric pressure (BARO) is more than 74 kPa.
- The ambient air temperature is between 2-32°C (36-90°F).
- The engine run time minimum is 600 seconds.
- The odometer displays more than 10 miles.
- The vehicle has traveled more than 3 miles this trip.
- The ECT is more than 70°C (158°F).
- The fuel level is between 15-85 percent.

- The ignition is OFF.

Conditions for Setting the DTC

The control module detects a pressure change that is less than a calibrated amount.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame/Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- To help locate intermittent leaks, use the **J 41413-200** Evaporative Emissions System Tester (EEST) to introduce smoke into the EVAP system. Move all EVAP components while observing smoke with the **J 41413-SPT** High Intensity White Light.
- A condition may exist where a leak in the EVAP system only exists under a vacuum condition. By using the scan tool PURGE/SEAL function to create a vacuum, seal the system and observe the FTP parameter for vacuum decay, this type of leak may be detected.
- To improve the visibility of the smoke exiting the EVAP system, observe the suspected leak area from different angles with the **J 41413-SPT** .
- For intermittent conditions, refer to **Intermittent Conditions** .

Test Description

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

3: Introducing smoke in 15 second intervals may allow smaller leak areas to be more noticeable. When the system is less pressurized, the smoke will sometimes escape in a more condensed manner.

5: This step verifies that repairs are complete and that no other condition is present.

DTC P0442

Step	Action	Yes	No
Schematic Reference:Emission Hose Routing Diagram			

1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **Larger volume fuel tanks and/or those with lower fuel levels may require several minutes for the floating indicator to stabilize.** 1. Turn the nitrogen/smoke valve to nitrogen. 2. Connect the nitrogen/smoke hose to the 0.5 mm (0.20 in) test orifice on the bottom-front of the **J 41413-200** Evaporative Emissions System Tester (EEST). 3. Activate the **J 41413-200** with the remote switch. 4. Align the red flag on the flow meter with the floating indicator. De-activate the **J 41413-200** with the remote switch. 5. Install the J 41415-40 Fuel Tank Cap Adapter or **GE-41415-50** Fuel Tank Cap Adapter to the fuel fill pipe. 6. Remove the nitrogen/smoke hose from the test orifice and install the hose onto the J 41415-40 or **GE-41415-50** . 7. Turn ON the ignition, with the engine OFF. 8. Command the evaporative emissions (EVAP) canister vent solenoid valve closed with a scan tool. 9. Introduce nitrogen and fill the EVAP system until the floating stabilizes with the remote switch. 10. Compare the flow meter's stable floating indicator position to the red flag. Is the floating indicator below the red flag?	Go to Diagnostic Aids	Go to **Step 3**
	IMPORTANT: **Ensure that the vehicle underbody temperature is similar to the ambient temperature and allow the surrounding air to stabilize before starting the diagnostic procedure. System flow will be less with higher temperatures.** 1. Turn OFF the ignition. 2. Connect the **J 41413-200** power supply clips to a known good 12-volt source. 3. Install the J 41415-40 or**GE-41415-50** to the fuel fill pipe. 4. Connect the **J 41413-200** nitrogen/smoke supply hose to the J 41415-40 or **GE-41415-50** .		

3	5. Turn ON the ignition, with the engine OFF. 6. Command the EVAP canister vent solenoid valve closed with a scan tool. 7. Turn the nitrogen/smoke valve on the **J 41413-200** control panel to SMOKE. 8. Use the remote switch to introduce smoke into the EVAP system. 9. Use the **J 41413-VLV** EVAP Service Port Vent Fitting to open the EVAP service port. 10. Remove the **J 41413-VLV** once smoke is observed. 11. Continue to introduce smoke into the EVAP system for an additional 60 seconds. 12. Inspect the entire EVAP system for exiting smoke with the **J 41413-SPT** High Intensity White Light. 13. Continue to introduce smoke at 15 second intervals until the leak source has been located. Did you locate and repair a leak source?	Go to **Step 5**	Go to **Step 4**
4	1. Disconnect the J 41415-40 or **GE-41415-50** from the fuel fill pipe. 2. Install the fuel fill cap to the fuel fill pipe. 3. Connect the **J 41413-200** nitrogen/smoke supply hose to the EVAP service port. 4. Use the remote switch to introduce smoke into the EVAP system. 5. Inspect the entire EVAP system for exiting smoke with the **J 41413-SPT** . 6. Continue to introduce smoke at 15 second intervals until the leak source has been located. Did you locate and repair a leak source?	Go to **Step 5**	Go to Diagnostic Aids
	IMPORTANT: **Larger volume fuel tanks and/or those with lower fuel levels may require several minutes for the floating indicator to stabilize.** 1. Turn the nitrogen/smoke valve to nitrogen. 2. Connect the nitrogen/smoke hose to the 0.50 mm (0.20 in) test orifice on the bottom-front of the **J 41413-200** . 3. Use the remote switch to activate the **J 41413-200** . 4. Align the red flag on the flow meter with the floating		

5	indicator. Use the remote switch to de-activate the **J 41413-200** . 5. Install the J 41415-40 or **GE-41415-50** to the fuel fill pipe. 6. Remove the nitrogen/smoke hose from the test orifice and install the hose onto the J 41415-40 or **GE-41415-50** . 7. Turn ON the ignition, with the engine OFF. 8. Command the EVAP canister vent solenoid valve closed with a scan tool. 9. Use the remote switch to introduce nitrogen and fill the EVAP system until the floating stabilizes. 10. Compare the flow meter's stable floating indicator position to the red flag. Is the floating indicator below the red flag?	Go to **Step 6**	Go to **Step 2**
6	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0443

Circuit Description

An ignition voltage is supplied directly to the evaporative emission (EVAP) canister purge solenoid valve. The EVAP canister purge solenoid valve is pulse width modulated (PWM). The scan tool displays the amount of ON time as a percentage. The control module monitors the status of the driver. The control module controls the EVAP canister purge solenoid valve ON time by grounding the control circuit via an internal switch called a driver. If the control module detects an incorrect voltage for the commanded state of the driver, this DTC sets.

Conditions for Running the DTC

- The engine speed is more than 400 RPM.
- The system voltage is between 6-18 volts.

Conditions for Setting the DTC

- The control module detects that the commanded state of the driver and the actual state of the control circuit do not match.
- The above conditions are present for a minimum of 5 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.

- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

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

2: This step tests if the concern is active. The EVAP canister purge solenoid valve is PWM. You should hear a clicking sound when the EVAP canister purge solenoid valve is commanded to 50 percent. The clicking sound should stop when the EVAP canister purge solenoid valve is commanded to 0 percent. The rate at which the valve cycles should increase when the commanded state is increased, and decrease when the commanded state is decreased.

5: This step verifies that the control module is providing ground to the EVAP canister purge solenoid valve.

6: This step tests if a ground is constantly being applied to the EVAP canister purge solenoid valve.

DTC P0443

Step	Action	Yes	No
Schematic Reference:Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Powertrain Control Module (PCM) Connector End Views**			
1	Did you perform the Diagnostic System Check - Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Command the evaporative emission (EVAP) canister purge solenoid valve to 50 percent, then to 0 percent with a scan tool. Does the EVAP canister purge solenoid valve respond to the commanded state?	Go to **Step 3**	Go to **Step 4**
	1. Observe the Freeze Frame/Failure Records for this		

3	DTC. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the EVAP canister purge solenoid valve harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Probe the ignition 1 voltage circuit of the EVAP canister purge solenoid valve with a test lamp that is connected to a good ground. Does the test lamp illuminate?	Go to **Step 5**	Go to **Step 11**
5	1. Connect a test lamp between the control circuit of the EVAP canister purge solenoid valve and the ignition 1 voltage circuit of the EVAP canister purge solenoid valve. 2. Command the EVAP canister purge solenoid valve to 0 percent with a scan tool. Does the test lamp illuminate?	Go to **Step 8**	Go to **Step 6**
6	Command the EVAP canister purge solenoid valve to 50 percent with a scan tool. Does the test lamp illuminate or pulse when the EVAP canister purge solenoid valve is commanded to 50 percent?	Go to **Step 9**	Go to **Step 7**
7	Test the control circuit of the EVAP canister purge solenoid valve for an open or for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 10**
8	Test the control circuit of the EVAP canister purge solenoid valve for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 13**
9	Inspect for poor connections at the harness connector of the EVAP canister purge solenoid valve. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 12**

10	Inspect for poor connections at the harness connector of the control module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 13**
11	Repair the open or short to ground in the ignition 1 voltage circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 14**	-
12	Replace the EVAP canister purge solenoid valve. Refer to **Evaporative Emission (EVAP) Canister Purge Solenoid Valve Replacement** . Did you complete the replacement?	Go to **Step 14**	-
13	Replace the powertrain control module (PCM). Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	Go to **Step 14**	-
14	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 15**
15	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0446

System Description

This DTC tests the evaporative emission (EVAP) system for a restricted or blocked EVAP vent path. The control module commands the EVAP canister purge solenoid valve Open and the EVAP canister vent solenoid valve Closed. This allows vacuum to be applied to the EVAP system. Once a calibrated vacuum level has been reached, the control module commands the EVAP canister purge solenoid valve Closed and the EVAP canister purge solenoid valve Open. The control module monitors the fuel tank pressure (FTP) sensor for a decrease in vacuum. If the vacuum does not decrease to near 0 inches H2O in a calibrated time, this DTC sets.

The following table illustrates the relationship between the ON and OFF states, and the Open or Closed states of the EVAP canister purge and vent solenoid valves.

DTC P0446

Control Module	EVAP Canister Purge Solenoid	EVAP Canister Vent Solenoid

Command	Valve	Valve
ON	Open	Closed
OFF	Closed	Open

Conditions for Running the DTC

- DTCs P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0121, P0122, P0123, P0125, P0131, P0132, P0133, P0134, P0135, P0136, P0137, P0138, P0140, P0141, P0151, P0152, P0153, P0154, P0155, P0156, P0157, P0158, P0160, P0161, P0220, P0442, P0443, P0449, P0452, P0453, P0455, P0502, P0503, P1111, P1112, P1114, P1115, P1121, P1122, P1125, P2135 are not set.
- The ignition voltage is between 10-18 volts.
- The barometric pressure (BARO) is more than 75 kPa.
- The fuel level is between 15-85 percent.
- The engine coolant temperature (ECT) is between 4-30°C (39-86°F).
- The intake air temperature (IAT) is between 4-30°C (39-86°F).
- The start up ECT and IAT are within 9°C (16°F) of each other.

Conditions for Setting the DTC

- The fuel tank pressure sensor is less than - 10 inches H2O.
- The above condition is present for more than 30 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- An intermittent condition could be caused by a damaged EVAP vent housing, a temporary blockage at the

EVAP canister vent solenoid valve inlet, or a pinched vent hose. A blockage in the vent system will also cause a poor fuel fill problem.

- For intermittent conditions, refer to **Intermittent Conditions** .
- An EVAP canister, vent hose or vent solenoid valve that has restricted flow may cause this DTC to set. Using purge solenoid valve command with a scan tool, will allow vacuum to be applied to the system instead of pressure. With the EVAP canister vent solenoid valve open and the EVAP canister purge solenoid valve commanded to 100 percent, vacuum should not increase to more than 9 inches H2O.

DTC P0446

Step or	Action	Values	Yes	No
Schematic Reference:Evaporative Emissions (EVAP) Hose Routing Diagram				
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Inspect the evaporative emission (EVAP) system for the following conditions: • A damaged EVAP canister vent solenoid valve - Refer to **Evaporative Emission (EVAP) Canister Vent Solenoid Valve Replacement** . • A pinched EVAP vent hose • A damaged EVAP canister - Refer to **Evaporative Emission (EVAP) Canister Replacement** . Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 3**
3	1. Turn OFF the ignition. 2. Disconnect the purge line from the EVAP canister purge solenoid valve. Refer to **Evaporative Emission (EVAP) Canister Purge Solenoid Valve Replacement** . 3. Turn ON the ignition, with the engine OFF. Is the fuel tank pressure sensor parameter within the specified range?	-1 to +1 in H2O	Go to **Step 4**	Go to **Step 9**
	IMPORTANT: **DO NOT exceed the specified value in this step. Exceeding the specified value may produce incorrect test results.**			

4	1. Turn OFF the ignition. 2. Connect the EVAP purge pipe. 3. Connect the **J 41413-200** Evaporative Emissions System Tester (EEST) power supply clips to a known good 12-volt source. 4. Install the J 41415-40 Fuel Tank Cap Adapter or **GE-41415-50** Fuel Tank Cap Adapter to the fuel fill pipe. 5. Connect the fuel fill cap to the J 41415-40 or **GE-41415-50** . 6. Connect the **J 41413-200** nitrogen/smoke supply hose to the J 41415-40 or **GE-41415-50** . 7. Turn ON the ignition, with the engine OFF. 8. Command the EVAP canister vent solenoid valve closed with a scan tool. 9. Turn the nitrogen/smoke valve on the **J 41413-200** control panel to NITROGEN. 10. Use the remote switch to pressurize the EVAP system to the first specified value. 11. Observe the fuel tank pressure sensor in H2O with a scan tool. 12. Command the EVAP canister vent solenoid valve open with a scan tool. Is the fuel tank pressure sensor parameter less than the second specified value?	5 in H2O 1 in H2O	Go to **Step 5**	Go to **Step 7**		
5	1. Connect the NITROGEN/SMOKE hose to the EVAP service port. 2. Remove the J 41415-40 or**GE-41415-50** . 3. Install the fuel fill cap to the fuel fill pipe. 4. Start the engine. 5. Allow the engine to idle. 6. Use the PURGE/SEAL function to seal the system, with a scan tool. 7. Command the EVAP canister purge solenoid valve to 30 percent. 8. Observe the VACUUM/PRESSURE gauge on the **J 41413-200** and the FTP parameter on the scan tool.	1 in H2O				

	9. Allow the vacuum to increase on the gauge of the **J 41413-200** , until it reaches approximately 16 inches H2O. 10. Use the PURGE/SEAL function to seal the system, with a scan tool. Is the difference between the FTP parameter on a scan tool and the VACUUM/PRESSURE gauge on the **J 41413-200** within the specified value, until the vacuum reached the abort limit on a scan tool?		Go to **Step 6**	Go to **Step 9**
6	Did the FTP parameter on a scan tool display more than the specified value?	3.2 V	Go to Diagnostic Aids	Go to **Step 12**
7	Disconnect the EVAP vent hose from the EVAP canister vent solenoid valve. Is the fuel tank pressure sensor parameter less than the specified value?	1 in H2O	Go to **Step 13**	Go to **Step 8**
8	Disconnect the EVAP vent hose from the EVAP canister. Is the fuel tank pressure sensor parameter less than the specified value?	1 in H2O	Go to **Step 11**	Go to **Step 14**
9	Test for an intermittent and for a poor connection at the fuel tank pressure (FTP) sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 10**
10	Test the low reference circuit of the FTP sensor for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 15**	Go to **Step 12**
11	Repair the pinched or restricted EVAP vent hose. Did you complete the repair?	-	Go to **Step 15**	-
12	Replace the FTP sensor. Refer to **Fuel Tank Pressure Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
13	Replace the EVAP canister vent solenoid valve. Refer to **Evaporative Emission (EVAP) Canister Vent Solenoid Valve Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
14	Replace the EVAP canister. Refer to **Evaporative Emission (EVAP) Canister Replacement** . Did you complete the replacement?	-	Go to **Step 15**	-
	1. Turn OFF the ignition.			

15	2. Disconnect the purge line from the EVAP canister vent solenoid valve. 3. Turn ON the ignition, with the engine OFF. Is the fuel tank pressure sensor parameter within the specified range?	-1 to +1 in H2O	Go to **Step 16**	Go to **Step 2**
16	**IMPORTANT:** **DO NOT exceed the specified value in this step. Exceeding the specified value may produce incorrect test results.** 1. Turn OFF the ignition. 2. Reconnect all disconnected components. 3. Connect the **J 41413-200** to the fuel fill pipe. 4. Turn ON the ignition, with the engine OFF. 5. Command the EVAP canister vent solenoid valve closed with a scan tool. 6. Turn the nitrogen/smoke valve on the **J 41413-200** control panel to NITROGEN. 7. Use the remote switch to pressurize the EVAP system to the first specified value. 8. Observe the fuel tank pressure sensor in H2O with a scan tool. 9. Command the EVAP canister vent solenoid valve open with a scan tool. Is the fuel tank pressure sensor parameter less than the second specified value?	5 in H2O 1 in H2O	Go to **Step 17**	Go to **Step 2**
17	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0449

Circuit Description

A battery positive is supplied to the evaporative emission (EVAP) canister vent solenoid valve. The control module grounds the EVAP canister vent solenoid valve control circuit to close the valve by means of an internal switch called a driver. The scan tool displays the commanded state of the EVAP canister vent solenoid valve as ON or OFF. The control module monitors the status of the driver. If the control module detects an incorrect voltage for the commanded state of the driver, this DTC sets.

The following table illustrates the relationship between the ON and OFF states, and the OPEN or CLOSED states of the EVAP canister vent solenoid valve.

DTC P0449

Control Module Command	EVAP Canister Vent Solenoid Valve Position
ON	CLOSED
OFF	OPEN

Conditions for Running the DTC

- The engine speed is more than 400 RPM.
- The system voltage is between 6-18 volts.

Conditions for Setting the DTC

- The control module detects that the commanded state of the driver and the actual state of the control circuit do not match.
- The above conditions are present for a minimum of 5 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

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

2: Listen for a click when the valve operates. Verify that both the ON and the OFF states are commanded.

5: This step verifies that the control module is providing ground to the EVAP canister vent solenoid valve.

6: This step tests if the EVAP canister vent solenoid valve control circuit is grounded.

DTC P0449

Step	Action	Yes	No
Schematic Reference:Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Powertrain Control Module (PCM) Connector End Views**			
1	Did you perform the Diagnostic System Check - Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Command the evaporative emission (EVAP) canister vent solenoid valve ON and OFF with the scan tool. Do you hear or feel a click from the EVAP canister vent solenoid valve when the valve is commanded ON and OFF?	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the EVAP canister vent solenoid valve. 3. Turn ON the ignition, with the engine OFF. 4. Probe the batter positive voltage circuit of the EVAP canister vent solenoid valve with a test lamp connected to a good ground. Refer to **Troubleshooting with a Test Lamp** in Wiring Systems. Does the test lamp illuminate?	Go to **Step 5**	Go to **Step 11**
5	1. Connect a test lamp between the control circuit of the EVAP canister vent solenoid valve and battery positive voltage circuit of the EVAP canister vent solenoid valve at the EVAP canister vent solenoid valve harness connector. 2. Command the EVAP canister vent solenoid valve ON		

	and OFF with a scan tool. Does the test lamp turn ON and OFF with each command?	Go to **Step 9**	Go to **Step 6**
6	Does the test lamp remain illuminated with each command?	Go to **Step 8**	Go to **Step 7**
7	Test the control circuit of the EVAP canister vent solenoid valve for a short to voltage or an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 10**
8	Test the control circuit of the EVAP canister vent solenoid valve for a short to ground. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 10**
9	Inspect for poor connections at the harness connector of the EVAP canister vent solenoid valve. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 12**
10	Inspect for poor connections at the harness connector of the control module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 13**
11	**IMPORTANT:** **If the fuse is open, inspect all related circuits for a short to ground.** Repair the open or short to ground in the battery positive voltage circuit. Refer to **Wiring Repairs** in Wiring Systems.Did you complete the repair?	Go to **Step 14**	-
12	Replace the EVAP canister vent solenoid valve. Refer to **Evaporative Emission (EVAP) Canister Vent Solenoid Valve Replacement** . Did you complete the replacement?	Go to **Step 14**	-
13	Replace the control module. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	Go to **Step 14**	-
14	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records.		

	Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 15**
15	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0452

Circuit Description

The fuel tank pressure (FTP) sensor measures the difference between the air pressure or vacuum in the evaporative emission (EVAP) system, and the outside air pressure. The control module supplies a 5-volt reference and a low reference circuit to the FTP sensor. The FTP sensor signal circuit voltage varies depending on EVAP system pressure or vacuum. If the FTP sensor signal voltage goes below a calibrated value, this DTC sets.

The following table illustrates the relationship between the FTP sensor signal voltage and the EVAP system pressure/vacuum.

DTC P0452

FTP Sensor Signal Voltage	Fuel Tank Pressure
High, Approximately 1.5 Volts or More	Negative Pressure/Vacuum
Low, Approximately 1.5 Volts or Less	Positive Pressure

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

- The fuel tank pressure (FTP) sensor voltage is less than 0.1 volts.
- All conditions are present for more than 5 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles

that the diagnostic runs and does not fail.

- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The number below refers to the step number on the diagnostic table.

5: This step tests for the proper operation of the circuit in the high voltage range.

DTC P0452

Step	Action	Value (s)	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Idle the engine for 1 minute. 2. Monitor the diagnostic trouble code (DTC) information with a scan tool. Did DTC P0641 or P0651 fail this ignition?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**
3	Observe the fuel tank pressure sensor parameter with the scan tool. Does the scan tool indicate that fuel tank pressure sensor parameter is less than the specified value?	0.1 V	Go to **Step 5**	Go to **Step 4**
4	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 5**	Go to **Intermittent Conditions**
	1. Turn OFF the ignition. 2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General			

5	Information. 3. Disconnect the fuel tank wiring harness at the fuel tank harness connector. 4. Connect a 3-amp fused jumper wire between the 5-volt reference circuit of the FTP sensor and the signal circuit of the FTP sensor. 5. Turn ON the ignition, with the engine OFF. 6. Observe the fuel tank pressure sensor voltage with a scan tool. Is the fuel tank pressure sensor parameter more than the specified value?	4.8 V	Go to **Step 8**	Go to **Step 6**
6	Test the 5-volt reference circuit of the FTP sensor for an open between the fuel tank harness connector and the control module. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 7**
7	Test the signal circuit of the FTP sensor for a short to ground, or an open between the fuel tank harness connector and the control module. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 9**
8	1. Remove the fuel tank. Refer to **Fuel Tank Replacement** . 2. Inspect the fuel tank wiring harness for the following: • Damaged wiring • Poor connections • Broken wires inside the insulation-Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 10**
9	Inspect for poor connections at the harness connector of the control module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 11**
10	Replace the FTP sensor. Refer to **Fuel Tank Pressure Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
11	Replace the control module. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-

12	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 13**
13	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0453

Circuit Description

The fuel tank pressure (FTP) sensor measures the difference between the air pressure or vacuum in the evaporative emission (EVAP) system, and the outside air pressure. The control module supplies a 5-volt reference and a low reference circuit to the FTP sensor. The FTP sensor signal circuit voltage varies depending on EVAP system pressure or vacuum. If the FTP sensor signal voltage increases above a calibrated value, this DTC sets.

The following table illustrates the relationship between FTP sensor signal voltage and the EVAP system pressure/vacuum.

DTC P0453

FTP Sensor Signal Voltage	Fuel Tank Pressure
High, Approximately 1.5 Volts or More	Negative Pressure/Vacuum
Low, Approximately 1.5 Volts or Less	Positive Pressure

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

- The fuel tank pressure (FTP) sensor voltage is more than 4.9 volts.
- All conditions are present for more than 5 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition

cycle that the diagnostic runs and fails.

- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The number below refers to the step number on the diagnostic table.

2: If DTC P0641 or P0651 is set, the 5-volt reference circuit may be shorted to a voltage.

DTC P0453

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Idle the engine for 1 minute. 2. Monitor the diagnostic trouble code (DTC) information with the scan tool. Did DTC P0641 or P0651 fail this ignition?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**
3	1. Turn ON the ignition, with the engine OFF. 2. Observe the fuel tank pressure sensor voltage with a scan tool. Is the fuel tank pressure sensor parameter more than the specified value?	4.3 V	Go to **Step 5**	Go to **Step 4**
	1. Observe the Freeze Frame/Failure Records for this DTC.			

4	2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 5**	Go to **Intermittent Conditions**
5	1. Turn OFF the ignition. 2. Raise and support the vehicle. Refer to **Lifting and Jacking the Vehicle** in General Information. 3. Disconnect the fuel tank wiring harness at the fuel tank harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Observe the fuel tank pressure sensor voltage with a scan tool. Does the scan tool indicate that the fuel tank pressure sensor parameter is more than the specified value?	1 V	Go to **Step 6**	Go to **Step 7**
6	Test the signal circuit of the FTP for a short to voltage between the fuel tank harness connector and the control module. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 12**
7	Probe the low reference circuit of the FTP sensor at the fuel tank harness connector with a test lamp connected to battery voltage. Refer to **Circuit Testing** in Wiring Systems. Did the test lamp illuminate?	-	Go to **Step 9**	Go to **Step 8**
8	Test the low reference circuit of the FTP sensor for an open between the fuel tank harness connector and the control module. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 10**
9	1. Remove the fuel tank. Refer to **Fuel Tank Replacement** . 2. Disconnect the FTP sensor harness connector. 3. Inspect the fuel tank wiring harness for the following: • Damaged wiring	-		

	• Poor connections • Broken wires inside the insulation - Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?		Go to **Step 13**	Go to **Step 11**
10	Inspect for poor connections at the harness connector of the control module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 12**
11	Replace the FTP sensor. Refer to **Fuel Tank Pressure Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 13**	-
12	Replace the control module. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 13**	-
13	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 14**
14	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0455

System Description

The control module tests the evaporative emission (EVAP) system for a large leak. The control module monitors the fuel tank pressure (FTP) sensor signal to determine the EVAP system vacuum level. When the conditions for running are met, the control module commands the EVAP canister purge solenoid valve open and the EVAP canister vent solenoid valve closed. This allows engine vacuum to enter the EVAP system. At a calibrated time, or vacuum level, the control module commands the EVAP canister purge solenoid valve closed, sealing the system, and monitors the FTP sensor input in order to determine the EVAP system vacuum level. If the system is unable to achieve the calibrated vacuum level, or the vacuum level decreases too rapidly, this DTC sets.

The following table illustrates the relationship between the ON and OFF states, and the OPEN or CLOSED states of the EVAP canister purge and vent solenoid valves.

DTC P0455

Control Module Command	EVAP Canister Purge Solenoid Valve	EVAP Canister Vent Solenoid Valve
ON	Open	Closed
OFF	Closed	Open

Conditions for Running the DTC

- DTC P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0125, P0131, P0132, P0133, P0134, P0135, P0136, P0137, P0138, P0140, P0141, P0151, P0152, P0153, P0154, P0155, P0156, P0157, P0158, P0160, P0161, P0220, P0442, P0443, P0449, P0452, P0453, P1111, P1112, P1114, P1115, P1125, P2135 are not set.
- The engine is running.
- The ignition voltage is between 10-18 volts.
- The barometric pressure (BARO) is more than 75 kPa.
- The fuel level is between 15-85 percent.
- The engine coolant temperature (ECT) is between 4-65°C (39-149°F).
- The intake air temperature (IAT) is between 4-75°C (39-167°F).
- The start-up ECT and IAT are within 9°C (16°F) of each other.

Conditions For Setting the DTC

The EVAP system is not able to achieve or maintain vacuum during the diagnostic test.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.

- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- To help locate intermittent leaks, use the **J 41413-200** Evaporative Emissions System Tester (EEST) to introduce smoke into the EVAP system. Move all EVAP components while observing smoke with the **J 41413-SPT** High Intensity White Light. Introducing smoke in 15 second intervals will allow less pressure into the EVAP system. When the system is less pressurized, the smoke will sometimes escape in a more condensed manner.
- A temporary blockage in the EVAP canister purge solenoid valve, purge pipe or EVAP canister could cause an intermittent condition. Inspect and repair any restriction in the EVAP system.
- To improve the visibility of the smoke exiting the EVAP system, observe the suspected leak area from different angles with the **J 41413-SPT** .
- Reviewing the Failure Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.
- For intermittent conditions, refer to **Intermittent Conditions** .

Test Description

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

3: Introducing smoke in 15 second intervals may allow smaller leak areas to be more noticeable. When the system is less pressurized, the smoke will sometimes escape in a more condensed manner.

5: This step verifies proper operation of the fuel tank pressure (FTP) sensor.

6: A normal operating FTP sensor should increase above 5 inches of H2O and stop between 6 inches of H2O and 7 inches of H2O.

DTC P0455

Step	Action	Values	Yes	No
Schematic Reference: Emission Hose Routing Diagram				
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
	1. Inspect the evaporative emission (EVAP) system for the following conditions: • Loose, missing, or damaged service port schrader valve • Loose, incorrect, missing, or damaged fuel fill cap • A damaged EVAP canister purge solenoid			

2	valve 2. Raise the vehicle on a hoist. Refer to **Lifting and Jacking the Vehicle** in General Information. 3. Inspect the EVAP system for the following conditions: • Disconnected, improperly routed, kinked, or damaged EVAP pipes and hoses • A damaged EVAP canister vent solenoid valve or EVAP canister Did you find and correct the condition?	-	Go to **Step 16**	Go to **Step 3**	
3	**IMPORTANT:** **Ensure that the vehicle underbody temperature is similar to the ambient temperature and allow the surrounding air to stabilize before starting the diagnostic procedure. System flow will be less with higher temperatures.** 1. Turn OFF the ignition. 2. Connect the **J 41413-200** Evaporative Emissions System Tester (EEST) power supply clips to a known good 12-volt source. 3. Install the **GE-41415-50** Fuel Tank Cap Adapter to the fuel fill pipe. 4. Connect the **J 41413-200** nitrogen/smoke supply hose to the **GE-41415-50** . 5. Turn ON the ignition, with the engine OFF. 6. Command the EVAP canister vent solenoid valve closed with a scan tool. 7. Turn the nitrogen/smoke valve on the **J 41413-200** control panel to SMOKE. 8. Use the remote switch to introduce smoke into the EVAP system. 9. Use the **J 41413-VLV** EVAP Service Port Vent Fitting to open the EVAP service port. 10. Remove the **J 41413-VLV** once smoke is observed. 11. Continue to introduce smoke into the EVAP system for an additional 60 seconds. 12. Inspect the entire EVAP system for exiting smoke with the **J 41413-SPT** High Intensity White Light. 13. Continue to introduce smoke at 15 second	-			

	intervals until the leak source has been located. Did you locate and repair a leak source?		Go to **Step 16**	Go to **Step 4**
4	1. Disconnect the **GE-41415-50** from the fuel fill pipe. 2. Install the fuel fill cap to the fuel fill pipe. 3. Connect the **J 41413-200** nitrogen/smoke supply hose to the EVAP service port. 4. Use the remote switch to introduce smoke into the EVAP system. 5. Inspect the entire EVAP system for exiting smoke with the **J 41413-SPT** . 6. Continue to introduce smoke at 15 second intervals until the leak source has been located. Did you locate and repair a leak source?	-	Go to **Step 16**	Go to **Step 5**
5	1. Use the remote switch to stop introducing smoke. 2. Install the **GE-41415-50** to the fuel fill pipe. 3. Connect the **J 41413-200** nitrogen/smoke supply hose and vehicle fuel fill cap to the **GE-41415-50** . 4. Command the EVAP canister vent solenoid valve open with a scan tool. 5. Compare the fuel tank pressure sensor parameter with a scan tool to the**J 41413-200** pressure/vacuum gauge. Is the difference between the two gauges less than the specified value?	1 in H2O	Go to **Step 6**	Go to **Step 12**
6	1. Seal the EVAP system using the EVAP Purge/Seal function with a scan tool. 2. Turn the nitrogen/smoke valve on the **J 41413-200** control panel to NITROGEN. 3. Use the **J 41413-200** to pressurize the EVAP system to the first specified value. Is the fuel tank pressure sensor parameter more than the second specified value?	13 in H2O 5 in H2O	Go to **Step 7**	Go to **Step 12**
7	1. Stop introducing nitrogen into the EVAP system with the remote switch. 2. Increase the EVAP canister purge solenoid valve to 100 percent.	1 in H2O		

	Is the fuel tank pressure sensor parameter less than the specified value?		Go to Diagnostic Aids	Go to **Step 8**
8	Disconnect the EVAP purge pipe from the EVAP canister purge solenoid valve. Is the fuel tank pressure sensor parameter less than the specified value?	1 in H2O	Go to **Step 13**	Go to **Step 9**
9	Disconnect the EVAP purge pipe at the EVAP canister. Is the fuel tank pressure sensor parameter less than the specified value?	1 in H2O	Go to **Step 14**	Go to **Step 10**
10	Disconnect the EVAP vapor pipe at the EVAP canister. Is the fuel tank pressure sensor parameter less than the specified value?	1 in H2O	Go to **Step 15**	Go to **Step 11**
11	Repair the pinched or obstructed EVAP vapor pipe. Did you complete the repair?	-	Go to **Step 16**	-
12	Replace the FTP sensor. Refer to **Fuel Tank Pressure Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 16**	-
13	Replace the EVAP canister purge solenoid valve. Refer to **Evaporative Emission (EVAP) Canister Purge Solenoid Valve Replacement** . Did you complete the replacement?	-	Go to **Step 16**	-
14	Repair the restriction in the EVAP purge pipe. Refer to **Evaporative Emission (EVAP) System Hoses/Pipes Replacement (Engine Compartment EVAP Pipe)** or **Evaporative Emission (EVAP) System Hoses/Pipes Replacement (Chassis EVAP Pipe)** or **Evaporative Emission (EVAP) System Hoses/Pipes Replacement (EVAP Vent Pipe)** or **Evaporative Emission (EVAP) System Hoses/Pipes Replacement (Rear EVAP Fuel Tank Pipe)** . Did you complete the repair?	-	Go to **Step 16**	-
15	Replace the EVAP canister. Refer to **Evaporative Emission (EVAP) Canister Replacement** . Did you complete the replacement?	-	Go to **Step 16**	-
16	**IMPORTANT:** **DO NOT exceed the specified value in this step. Exceeding the specified value may produce incorrect test results.** 1. Connect the **J 41413-200** to the fuel fill pipe. 2. Turn the nitrogen/smoke valve to NITROGEN. 3. Seal the EVAP system using the EVAP Purge/Seal function with a scan tool. 4. Pressurize the EVAP system to the specified	5 in H2O		

	value. 5. Observe the **J 41413-200** pressure/vacuum gauge for 5 minutes. Does the **J 41413-200** pressure/vacuum gauge remain constant?		Go to **Step 17**	Go to **Step 3**	
17	Observe the fuel tank pressure sensor parameter with a scan tool. Is the scan tool fuel tank pressure parameter within the specified value of the **J 41413-200** pressure/vacuum gauge?	1 in H2O	Go to **Step 18**	Go to **Step 5**	
18	1. Observe the **J 41413-200** pressure/vacuum gauge. 2. Increase the EVAP canister purge solenoid valve to 100 percent. Does the pressure decrease?	-	Go to **Step 19**		Go to **Step 8**
19	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK	

DTC P0496

System Description

This DTC tests for undesired intake manifold vacuum flow to the evaporative emission (EVAP) system. The control module seals the EVAP system by commanding the EVAP canister purge solenoid valve Closed and the EVAP canister vent solenoid valve Closed. The control module monitors the fuel tank pressure (FTP) sensor to determine if a vacuum is being drawn on the EVAP system. If vacuum in the EVAP system is more than a predetermined value within a predetermined time, this DTC sets.

The following table illustrates the relationship between the ON and OFF states, and the Open or Closed states of the EVAP canister purge and vent solenoid valves.

DTC P0496

Control Module Command	EVAP Canister Purge Solenoid Valve	EVAP Canister Vent Solenoid Valve
ON	Open	Closed
OFF	Closed	Open

Conditions for Running the DTC

- DTCs P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0121, P0122, P0123, P0125, P0131, P0132, P0133, P0134, P0135, P0136, P0137, P0138, P0140, P0141, P0151, P0152, P0153, P0154, P0155, P0156, P0157, P0158, P0160, P0161, P0220, P0442, P0443, P0449, P0452, P0453, P0455, P0502, P0503, P1111, P1112, P1114, P1115, P1121, P1122, P1125, P2135 are not set.

- The ignition voltage is between 10-18 volts.
- The barometric pressure (BARO) is more than 75 kPa.
- The fuel level is between 15-85 percent.
- The engine coolant temperature (ECT) is between 4-30°C (39-86°F).
- The intake air temperature (IAT) is between 4-30°C (39-86°F).
- The start up ECT and IAT are within 9°C (16°F) of each other.

Conditions for Setting the DTC

- A continuous open purge flow condition is detected during the diagnostic test.
- The fuel tank pressure decreases to less than -11 inches H_2O.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P0496

Step	Action	Values	Yes	No
Schematic Reference: Emission Hose Routing Diagram				
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
	1. Start the engine. 2. Seal the evaporative emission (EVAP) system using the Purge/Seal function			

2	with a scan tool. 3. Increase the engine idle to 1,200-1,500 RPM. 4. Observe the fuel tank pressure sensor in H2O with a scan tool. Is the fuel tank pressure sensor parameter within the specified value?	-1 to +1 in H2O	Go to **Intermittent Conditions**	Go to **Step 3**
3	1. Turn OFF the ignition. 2. Disconnect the EVAP purge pipe from the EVAP purge solenoid valve. 3. Turn ON the ignition, with the engine OFF. 4. Observe the fuel tank pressure sensor in H2O with a scan tool. Is the fuel tank pressure sensor parameter within the specified range?	-1 to +1 in H2O	Go to **Step 4**	Go to **Step 5**
4	Replace the EVAP purge solenoid valve. Refer to **Evaporative Emission (EVAP) Canister Purge Solenoid Valve Replacement** . Did you complete the replacement?	-	Go to **Step 6**	-
5	Replace the fuel tank pressure (FTP) sensor. Refer to **Fuel Tank Pressure Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 6**	-
6	1. Connect all EVAP hardware that was previously disconnected. 2. Seal the EVAP system using the Purge/Seal function with a scan tool. 3. Start the engine and idle at 1,200-1,500 RPM. 4. Observe the fuel tank pressure sensor parameter with a scan tool. Is the fuel tank pressure sensor parameter within the specified range?	-1 to +1 in H2O	Go to **Step 7**	Go to **Step 2**
7	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0506 (TAC)

Circuit Description

The electronic throttle control (ETC) system uses various inputs from the powertrain control module (PCM). This system uses the inputs to control the idle speed through serial data circuits to the throttle actuator control (TAC) module. The DC motor, which is located on the throttle body, activates the throttle plate. In order to decrease idle speed, the TAC module commands the throttle closed, reducing air flow into the engine, and the idle speed decreases. In order to increase the idle speed, the TAC module commands the throttle plate open, allowing more air in order to bypass the throttle plate. If the actual idle RPM does not match the desired idle RPM within a calibrated time, this DTC will set.

Conditions for Running the DTC

- DTCs P0101-P0103, P0107, P0108, P0112, P0113, P0117, P0118, P0125, P0171, P0172, P0174, P0175, P0200, P0300, P0440, P0442, P0443, P0500, P0502, P0503, P1120, P1220, P1221, P1441 are not set.
- The engine is running for greater than 60 seconds.
- The engine coolant temperature (ECT) is greater than 60°C (140°F).
- The intake air temperature (IAT) is greater than -10°C (+14°F).
- The barometric pressure (BARO) is greater than 65 kPa.
- The system voltage is between 9-18 volts.
- The vehicle speed is less than 1.7 km/h (1 mph).
- The accelerator pedal position (APP) sensor is at 0 percent.

Conditions for Setting the DTC

- The actual idle speed is 100 RPM less than the desired idle speed.
- The above condition is present for 5 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.

- Clear the MIL and the DTC with a scan tool.

Test Description

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

2: This test determines if the engine can achieve the commanded RPM.

DTC P0506 (TAC)

<table>
<tr><th>Step</th><th>Action</th><th>Yes</th><th>No</th></tr>
<tr><td colspan="4">Schematic Reference:<u>Engine Controls Schematics</u>
Connector End View Reference:<u>Engine Controls Component Views</u> or <u>Powertrain Control Module (PCM) Connector End Views</u></td></tr>
<tr><td>1</td><td>Did you perform the Diagnostic System Check - Engine Controls?</td><td>Go to Step 2</td><td>Go to <u>Diagnostic System Check - Engine Controls</u></td></tr>
<tr><td>2</td><td>1. Set the park brake and block the drive wheels.
2. Start the engine.
3. Turn OFF all accessories.
4. Command the engine RPM to 1,500 RPM, to 500 RPM, and back to 1,500 RPM with the RPM control function of the scan tool.
5. Exit the RPM Control function.

Did the engine speed stay within 100 RPM of the commanded RPM during the above test?</td><td>Go to Step 3</td><td>Go to Step 4</td></tr>
<tr><td>3</td><td>1. Observe the Freeze Frame/Failure Records for this DTC.
2. Turn OFF the ignition for 30 seconds.
3. Use the following information to operate the vehicle under the conditions which set the DTC:
• The data in the Freeze Frame/Failure Records
• The parameters listed in the Conditions for Running in the DTC

Does the DTC set?</td><td>Go to Step 4</td><td>Go to <u>Intermittent Conditions</u></td></tr>
<tr><td>4</td><td>Inspect for the following conditions:

• Deposits in the throttle body
• Objects which are blocking the air intake system
• Energy-draining load on the engine, such as transmission conditions</td><td></td><td></td></tr>
</table>

	Did you find and correct the condition?	Go to **Step 5**	-
5	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 6**
6	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

ENGINE CONTROLS DIAGNOSIS (DTC P0507 (TAC) TO DTC U0107)

DTC P0507 (TAC)

Circuit Description

The electronic throttle control (ETC) system uses various inputs from the powertrain control module (PCM). This system uses these inputs to control the idle speed through serial data circuits to the throttle actuator control (TAC) module. The DC motor, which is located on the throttle body, activates the throttle plate. In order to decrease idle speed, the TAC module commands the throttle closed, reducing air flow into the engine, and the idle speed decreases. In order to increase the idle speed, the TAC module commands the throttle plate open, allowing more air in order to bypass the throttle plate. If the actual idle RPM does not match the desired idle RPM within a calibrated time, this DTC will set.

Conditions for Running the DTC

- DTCs P0101, P0102, P0103, P0107, P0108, P0112, P0113, P0117, P0118, P0125, P0171, P0172, P0174, P0175, P0200, P0300, P0440, P0442, P0443, P0500, P0502, P0503, P1120, P1220, P1221, P1441 are not set.
- The engine is running for greater than 60 seconds.
- The engine coolant temperature (ECT) is greater than 60°C (140°F).
- The intake air temperature (IAT) is greater than -10°C (+14°F).
- The barometric pressure (BARO) is greater than 65 kPa.
- The system voltage is between 9-18 volts.
- The vehicle speed is less than 1.7 km/h (1 mph).
- The accelerator pedal position (APP) sensor is at 0 percent.

Conditions for Setting the DTC

- The actual idle speed is 200 RPM greater than the desired idle speed.
- The above condition is present for 5 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze

Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

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

2: This test determines if the engine can achieve the commanded RPM.

DTC P0507 (TAC)

Step	Action	Yes	No
Schematic Reference:Engine Controls Schematics **Connector End View Reference:Engine Controls Component Views** or **Powertrain Control Module (PCM) Connector End Views**			
1	Did you perform the Diagnostic System Check-Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Set the park brake and block the drive wheels. 2. Start the engine. 3. Turn OFF all accessories. 4. Command the engine RPM to 1,500 RPM, to 500 RPM, and back to 1,500 RPM with the RPM control function of the scan tool. 5. Exit the RPM control function. Did the engine speed stay within 200 RPM of the commanded RPM during the above test?	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Use the following information to operate the vehicle under the conditions which set the DTC: • The data in the Freeze Frame/Failure Records • The parameters listed in the Conditions for Running in the DTC		

	Does the DTC set?	Go to **Step 4**	Go to **Intermittent Conditions**
4	Inspect for the following conditions: • Deposits in the throttle body • A faulty positive crankcase ventilation (PCV) valve Did you find and correct the condition?	Go to **Step 5**	-
5	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 6**
6	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0601-P0607, P1600, P1621, P1627, P1680, P1681, P1683, OR P2610

Description

This diagnostic applies to internal microprocessor integrity conditions within the powertrain control module (PCM). This diagnostic also addresses if the PCM is not programmed.

Test Description

The number below refers to the step number on the diagnostic table.

2: A DTC P0602 indicates the PCM is not programmed.

DTC P0601-P0607, P1600, P1621, P1627, P1680, P1681, P1683, or P2610

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Is DTC P0602 set?	Go to **Step 3**	Go to **Step 5**
3	Program the PCM. Refer to **Service Programming System (SPS)** in Programming. Does DTC P0602 reset?	Go to **Step 4**	Go to **Step 6**

4	1. Ensure that all tool connections are secure. 2. Ensure that the programming equipment is operating correctly. 3. Ensure that the correct software/calibration package is used. 4. Attempt to program the PCM. Refer to **Service Programming System (SPS)** in Programming. Does DTC P0602 reset?	Go to **Step 5**	Go to **Step 6**
5	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	Go to **Step 6**	-
6	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 7**
7	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0641

Circuit Description

The powertrain control module (PCM) provides 5 volts to the following sensors:

- The engine oil pressure (EOP) sensor
- The manifold absolute pressure (MAP) sensor

These 5-volt reference circuits are independent of each other outside the PCM, but are bussed together inside the PCM. Therefore a circuit condition on one sensor 5-volt reference circuit may affect the other sensor 5-volt reference circuits. The PCM monitors the voltage on the 5-volt reference circuit. If the PCM detects that the voltage is out of tolerance, DTC P0641 sets.

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

- The PCM detects a voltage out of tolerance condition on the 5-volt reference circuit.
- The above condition is present for longer than 2 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The number below refers to the step number on the diagnostic table.

9: A short to voltage on the signal circuit of the manifold absolute pressure (MAP) sensor will backfeed through the sensor into the 5-volt reference circuit and set this DTC.

DTC P0641

Step	Action	Values	Yes	No
Schematic Reference:Engine Controls Schematics Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views				
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records.	-		Go to **Intermittent**

	Does the DTC fail this ignition?		Go to **Step 3**	**Conditions**
3	1. Turn OFF the ignition. 2. Disconnect the engine oil pressure (EOP) sensor. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the 5-volt reference circuit of the EOP sensor to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the voltage within the specified range?	4.8-5.2 V	Go to **Step 4**	Go to **Step 5**
4	1. Connect the EOP sensor. 2. Disconnect the manifold absolute pressure (MAP) sensor. 3. Measure the voltage from the 5-volt reference circuit of the MAP sensor to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the voltage within the specified range?	4.8-5.2 V	Go to **Intermittent Conditions**	Go to **Step 11**
5	Is the voltage measured in step 3 more than the specified value?	5.2 V	Go to **Step 8**	Go to **Step 6**
6	Monitor the DMM while disconnecting the MAP sensor. Does the voltage return to within the specified range when the MAP sensor is disconnected?	4.8-5.2 V	Go to **Step 10**	Go to **Step 7**
7	1. Turn OFF the ignition. 2. Disconnect the powertrain control module (PCM). 3. Test the 5-volt reference circuit for a short to ground or any sensor low reference circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 12**
8	Test all 5-volt reference circuits for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 9**
9	Test the MAP sensor signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 12**

10	Replace the MAP sensor. Refer to **Manifold Absolute Pressure (MAP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 13**	-
11	Replace the EOP sensor. Refer to **Engine Oil Pressure Sensor and/or Switch Replacement** in Engine Mechanical. Did you complete the replacement?	-	Go to **Step 13**	-
12	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 13**	-
13	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 14**
14	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0650

Circuit Description

The malfunction indicator lamp (MIL) is located on the instrument panel cluster (IPC). The MIL informs the driver that an emission system fault has occurred and that the engine control system requires service. The control module monitors the MIL control circuit for conditions that are incorrect for the commanded state of the MIL. For example, a failure condition exists if the control module detects low voltage when the MIL is commanded OFF, or high voltage when the MIL is commanded ON. If the control module detects an improper voltage on the MIL control circuit, DTC P0650 will set.

Conditions for Running the DTC

- The engine speed is more than 400 RPM.
- The ignition voltage is between 6-18 volts.

Conditions for Setting the DTC

- The control module detects that the commanded state of the MIL driver and the actual state of the control circuit do not match.

- The conditions are present for a minimum of 5 seconds.

Action Taken When the DTC Sets

The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

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

> **5:** This step tests for a short to ground in the MIL control circuit. With the powertrain control module (PCM) disconnected and the ignition ON, the MIL should be OFF.
>
> **6:** This step tests for a short to voltage on the MIL control circuit. With the fuse removed, there should be no voltage on the MIL control circuit.

DTC P0650

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Component Views or Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Verify whether the instrument cluster is operational. If the instrument panel (I/P) is completely inoperative, refer to **Diagnostic System Check - Instrument Cluster** in Instrument Panel, Gauges and Console. 2. Command the MIL ON and OFF with a scan tool. Does the MIL turn ON and OFF when commanded with a scan tool?	-	Go to **Step 3**	Go to **Step 4**

3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Does the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	Inspect the fuse that supplies voltage to the MIL. Is the fuse open?	-	Go to **Step 12**	Go to **Step 5**
5	1. Turn OFF the ignition. 2. Disconnect the powertrain control module (PCM). 3. Turn ON the ignition. Is the MIL OFF?	-	Go to **Step 6**	Go to **Step 13**
6	1. Turn OFF the ignition. 2. Remove the fuse that supplies voltage to the MIL. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the MIL control circuit in the PCM to a good ground. Is the voltage less than the specified value?	0.3 V	Go to **Step 7**	Go to **Step 14**
7	1. Turn OFF the ignition. 2. Install the fuse that supplies voltage to the MIL. 3. Turn ON the ignition, with the engine OFF. 4. Connect a 3-amp fused jumper wire between the MIL control circuit of the PCM and a good ground. Is the MIL illuminated?	-	Go to **Step 11**	Go to **Step 8**
	1. Turn OFF the ignition. 2. Remove the instrument panel cluster (IPC). Refer to **Instrument Panel Cluster (IPC) Replacement** in Instrument Panel, Gauges, and Console.			

8	3. Turn ON the ignition, with the engine OFF. 4. Probe the MIL voltage supply circuit of the IPC harness connector with a test lamp that is connected to a good ground. Does the test lamp illuminate?	-	Go to **Step 9**	Go to **Step 15**
9	Test the MIL control circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct a condition?	-	Go to **Step 18**	Go to **Step 10**
10	Test for an intermittent and for a poor connection at the IPC. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 16**
11	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 17**
12	Repair the short to ground in the voltage supply circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 18**	-
13	Repair the short to ground in the MIL control circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 18**	-
14	Repair the short to voltage in the MIL control circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 18**	-
15	Repair the open in the MIL voltage supply circuit. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	-	Go to **Step 18**	-
16	Replace the IPC. Refer to **Instrument Panel Cluster (IPC) Replacement** in Instrument Panel, Gauges, and Console. Did you complete the replacement?	-	Go to **Step 18**	-
17	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 18**	-
18	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the	-		

	vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?		Go to **Step 2**	Go to **Step 19**
19	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P0651

Circuit Description

The powertrain control module (PCM) provides 5 volts to the following sensors:

- The air conditioning (A/C) pressure sensor.
- The fuel tank pressure (FTP) sensor

These 5-volt reference circuits are independent of each other outside the PCM, but are bussed together inside the PCM. Therefore a circuit condition on one sensor 5-volt reference circuit may affect the other sensor 5-volt reference circuits. The PCM monitors the voltage on the 5-volt reference circuit. If the PCM detects that the voltage is out of tolerance, DTC P0651 sets.

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

- The PCM detects a voltage out of tolerance condition on the 5-volt reference circuit.
- The above condition is present for longer than 10 seconds.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles

that the diagnostic runs and does not fail.

- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

The number below refers to the step number on the diagnostic table.

9: A short to voltage on the signal circuit of the fuel tank pressure (FTP) sensor will backfeed through the sensor into the 5-volt reference circuit and set this DTC.

DTC P0651

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Component Views or Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Does the DTC fail this ignition?	-	Go to **Step 3**	Go to **Intermittent Conditions**
3	1. Turn OFF the ignition. 2. Disconnect the air conditioning (A/C) pressure sensor. 3. Turn ON the ignition, with the engine OFF. 4. Measure the voltage from the 5-volt reference circuit of the A/C pressure sensor to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the voltage within the specified range?	4.8-5.2 V	Go to **Step 4**	Go to **Step 5**
	1. Connect the A/C pressure sensor.			

4	2. Disconnect the fuel tank pressure (FTP) sensor. 3. Measure the voltage from the 5-volt reference circuit of the FTP sensor to a good ground with a DMM. Refer to **Circuit Testing** in Wiring Systems. Is the voltage within the specified range?	4.8-5.2 V	Go to **Intermittent Conditions**	Go to **Step 11**
5	Is the voltage measured in step 3 more than the specified value?	5.2 V	Go to **Step 8**	Go to **Step 6**
6	Monitor the DMM while disconnecting the FTP sensor. Does the voltage return to within the specified range when the FTP is disconnected?	4.8-5.2 V	Go to **Step 10**	Go to **Step 7**
7	1. Turn OFF the ignition. 2. Disconnect the powertrain control module (PCM). 3. Test the 5-volt reference circuit for a short to ground or any sensor low reference circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 12**
8	1. Turn OFF the ignition. 2. Disconnect the PCM. 3. Turn ON the ignition, with the engine OFF. 4. Test all 5-volt reference circuits for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 9**
9	Test the FTP sensor signal circuit for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 13**	Go to **Step 12**
10	Replace the FTP sensor. Refer to **Fuel Tank Pressure Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 13**	-
11	Replace the A/C pressure sensor. Refer to **Air Conditioning (A/C) Refrigerant Pressure Sensor Replacement** in HVAC. Did you complete the replacement?	-	Go to **Step 13**	-
	Replace the PCM. Refer to **Powertrain Control**			

12	**Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 13**	-
13	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 14**
14	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P1106

Circuit Description

The manifold absolute pressure (MAP) sensor responds to pressure changes in the intake manifold. The pressure changes occur based on the engine load. The MAP sensor has the following circuits:

- 5-volt reference circuit
- Low reference circuit
- MAP sensor signal circuit

The powertrain control module (PCM) supplies 5 volts to the MAP sensor on the 5-volt reference circuit. The PCM also provides a ground on the low reference circuit. The MAP sensor provides a signal to the PCM on the MAP sensor signal circuit which is relative to the pressure changes in the manifold. The PCM should detect a low signal voltage at a low MAP, such as during an idle or a deceleration. The PCM should detect a high signal voltage at a high MAP, such as the ignition is ON, with the engine OFF, or at a wide open throttle (WOT). The MAP sensor is also used in order to determine the barometric pressure (BARO). This occurs when the ignition switch is turned ON, with the engine OFF. The BARO reading may also be updated whenever the engine is operated at WOT. The PCM monitors the MAP sensor signal for voltage outside of the normal range.

If the PCM detects a MAP sensor signal voltage that is intermittently high, DTC P1106 sets.

Conditions for Running the DTC

- DTCs P0068, P0120, P0220, P1125, P1516, P2101, P2108, P2120, P2121, P2125, P2135 are not set.
- The engine is running.
- The throttle angle is less than 1 percent when the engine speed is less than 1,200 RPM.

OR

- The throttle angle is more than 20 percent when the engine speed is more than 1,200 RPM.

Conditions for Setting the DTC

The PCM detects that the MAP sensor voltage is intermittently more than 4.9 volts.

Action Taken When the DTC Sets

- The control module stores the DTC information into memory when the diagnostic runs and fails.
- The malfunction indicator lamp (MIL) will not illuminate.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Failure Records.
- The driver information center, if equipped, may display a message.

Conditions for Clearing the DTC

- A current DTC Last Test Failed clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- Clear the DTC with a scan tool.

Test Description

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

3: This step attempts to pinpoint the location of the intermittent fault.

DTC P1106

Step	Action	Yes	No
Schematic Reference:Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Powertrain Control Module (PCM) Connector End Views**			
1	Did you perform the Diagnostic System Check - Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Start the engine. 2. Monitor the diagnostic trouble code (DTC) information with the scan tool. Is DTC P0108 or P0641 also set?	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**
	1. Observe the MAP sensor parameter with the scan tool. 2. Attempt to induce the fault that set the DTC by		

3	manipulating the following items: • The manifold absolute pressure (MAP) sensor wiring harness • The MAP sensor electrical connector • The powertrain control module (PCM) connector Refer to **Inducing Intermittent Fault Conditions** in Wiring Systems and **Intermittent Conditions** .Is the MAP sensor voltage affected during any part of the test?	Go to **Step 4**	Go to **Step 8**
4	Test the low reference circuit between the PCM and the MAP sensor for an intermittent open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 8**	Go to **Step 5**
5	**IMPORTANT:** **Disconnecting the PCM may eliminate the short during testing.** Test the MAP sensor signal circuit between the PCM and the MAP sensor for an intermittent short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.Did you find and correct the condition?	Go to **Step 8**	Go to **Step 6**
6	Test for an intermittent and for a poor connection at the MAP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 8**	Go to **Step 7**
7	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you complete the action?	Go to **Step 8**	-
8	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 9**
9	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P1107

Circuit Description

The manifold absolute pressure (MAP) sensor responds to pressure changes in the intake manifold. The pressure changes occur based on the engine load. The MAP sensor has the following circuits:

- 5-volt reference circuit
- Low reference circuit
- MAP sensor signal circuit

The powertrain control module (PCM) supplies 5 volts to the MAP sensor on the 5-volt reference circuit. The PCM also provides a ground on the low reference circuit. The MAP sensor provides a signal to the PCM on the MAP sensor signal circuit which is relative to the pressure changes in the manifold. The PCM should detect a low signal voltage at a low MAP, such as during an idle or a deceleration. The PCM should detect a high signal voltage at a high MAP, such as the ignition is ON, with the engine OFF, or at a wide open throttle (WOT). The MAP sensor is also used in order to determine the barometric pressure (BARO). This occurs when the ignition switch is turned ON, with the engine OFF. The BARO reading may also be updated whenever the engine is operated at WOT. The PCM monitors the MAP sensor signal for voltage outside of the normal range.

If the PCM detects a MAP sensor signal voltage that is intermittently low, DTC P1107 sets.

Conditions for Running the DTC

- The ignition is ON.
- DTCs P0068, P0120, P0220, P1125, P1516, P2101, P2108, P2120, P2121, P2125, P2135 are not set.
- The throttle angle is more than 0 percent when the engine speed is less than 800 RPM.

  OR

- The throttle angle is more than 12.5 percent when the engine speed is more than 800 RPM.

Conditions for Setting the DTC

The PCM detects that the MAP sensor voltage is intermittently less than 0.10 volt.

Action Taken When the DTC Sets

- The control module stores the DTC information into memory when the diagnostic runs and fails.
- The malfunction indicator lamp (MIL) will not illuminate.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Failure Records.
- The driver information center, if equipped, may display a message.

Conditions for Clearing the DTC

- A current DTC Last Test Failed clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- Clear the DTC with a scan tool.

Test Description

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

3: This step attempts to pinpoint the location of the intermittent fault.

DTC P1107

Step	Action	Yes	No
Schematic Reference:Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Powertrain Control Module (PCM) Connector End Views**			
1	Did you perform the Diagnostic System Check - Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Start the engine. 2. Monitor the diagnostic trouble code (DTC) information with the scan tool. Is DTC P0107 or P0641 also set?	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 3**
3	1. Turn OFF the ignition. 2. Turn ON the ignition, with the engine OFF. 3. Observe the MAP sensor parameter with the scan tool. 4. Attempt to induce the fault that set the DTC by manipulating the following items: • The manifold absolute pressure (MAP) sensor wiring harness • The MAP sensor electrical connector • The powertrain control module (PCM) connector Refer to **Inducing Intermittent Fault Conditions** in Wiring Systems and **Intermittent Conditions** .Is the MAP sensor voltage affected during any part of the test?	Go to **Step 4**	Go to **Step 8**
4	Test the 5-volt reference circuit between the PCM and the MAP sensor for an open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 8**	Go to **Step 5**

5	Test the MAP sensor signal circuit between the PCM and the MAP sensor for an intermittent short to ground or open. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 8**	Go to **Step 6**
6	Test for an intermittent and for a poor connection at the MAP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 8**	Go to **Step 7**
7	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you complete the action?	Go to **Step 8**	-
8	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 9**
9	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P1111

Circuit Description

The intake air temperature (IAT) sensor is a variable resistor. The IAT sensor has a signal circuit and a low reference circuit. The IAT sensor measures the temperature of the air entering the engine. The powertrain control module (PCM) supplies 5 volts to the IAT signal circuit and a ground for the IAT low reference circuit. When the IAT sensor is cold, the sensor resistance is high. When the air temperature increases, the sensor resistance decreases. With high sensor resistance, the PCM detects a high voltage on the IAT signal circuit. With lower sensor resistance, the PCM detects a lower voltage on the IAT signal circuit. If the PCM detects an intermittent high IAT signal voltage, indicating a low temperature, DTC P1111 sets.

Conditions for Running the DTC

- DTCs P0101, P0102, P0103, P0113 are not set.
- The engine run time is more than 120 seconds.
- The ECT sensor parameter is more than 60°C (140°F).

- The vehicle speed is less than 11 km/h (7 mph).
- The mass air flow is less than 15 g/s.

Conditions for Setting the DTC

The PCM detects that the IAT sensor parameter is less than -38°C (-36°F) intermittently for a calibrated amount of time.

Action Taken When the DTC Sets

- The control module stores the DTC information into memory when the diagnostic runs and fails.
- The malfunction indicator lamp (MIL) will not illuminate.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Failure Records.
- The driver information center, if equipped, may display a message.

Conditions for Clearing the DTC

- A current DTC Last Test Failed clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- Clear the DTC with a scan tool.

Diagnostic Aids

- An IAT sensor or PCM which is intermittently shorted, open, or skewed is possible, yet very unlikely.
- A skewed sensor could result in poor driveability conditions.
- If an intermittent condition is suspected, refer to **Intermittent Conditions** .

DTC P1111

Step	Action	Value (s)	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Observe the DTC Information with a scan tool. Is DTC P0113 set?	-	Go to **DTC P0113**	Go to **Step 3**
3	Test for an intermittent and for a poor connection at the IAT sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems.	-		

	Did you find and correct the condition?		Go to **Step 8**	Go to **Step 4**
4	Test the IAT signal circuit between the IAT sensor and the PCM for an intermittent open. Refer to **Inducing Intermittent Fault Conditions** , **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 8**	Go to **Step 5**
5	Test the IAT signal circuit between the IAT sensor and the PCM for an intermittent short to voltage. Refer to **Inducing Intermittent Fault Conditions** , **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 8**	Go to **Step 6**
6	Test the low reference circuit for an intermittent open. Refer to **Inducing Intermittent Fault Conditions** , **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 8**	Go to **Step 7**
7	Test for an intermittent and for a poor connection at the PCM. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 8**	Go to Diagnostic Aids
8	1. Clear the DTCs with a scan tool. 2. Turn off the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 9**
9	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P1112

Circuit Description

The intake air temperature (IAT) sensor is a variable resistor. The IAT sensor has a signal circuit and a low reference circuit. The IAT sensor measures the temperature of the air entering the engine. The powertrain control module (PCM) supplies 5 volts to the IAT signal circuit and a ground for the IAT low reference circuit. When the IAT sensor is cold, the sensor resistance is high. When the air temperature increases, the sensor resistance decreases. With high sensor resistance, the PCM detects a high voltage on the IAT signal circuit.

With lower sensor resistance, the PCM detects a lower voltage on the IAT signal circuit. If the PCM detects an intermittent low IAT signal voltage, indicating a high temperature, DTC P1112 sets.

Conditions for Running the DTC

- DTCs P0112, P0500, P0502, and P0503 are not set.
- The engine run time is more than 45 seconds.
- The vehicle speed is more than 40 km/h (25 mph).
- The ECT sensor parameter is less than 125°C (257°F).

Conditions for Setting the DTC

The PCM detects that the IAT sensor parameter is more than 128°C (262°F) intermittently for a calibrated amount of time.

Action Taken When the DTC Sets

- The control module stores the DTC information into memory when the diagnostic runs and fails.
- The malfunction indicator lamp (MIL) will not illuminate.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Failure Records.
- The driver information center, if equipped, may display a message.

Conditions for Clearing the DTC

- A current DTC Last Test Failed clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- Clear the DTC with a scan tool.

Diagnostic Aids

- An IAT sensor or PCM which is intermittently shorted, open, or skewed is possible, yet very unlikely.
- A skewed sensor could result in poor driveability conditions.
- If an intermittent condition is suspected, refer to **Intermittent Conditions** .

DTC P1112

Step	Action	Value (s)	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**				
1	Did you perform the Diagnostic System Check-Engine Controls?	-		Go to **Diagnostic System Check -**

			Go to **Step 2**	**Engine Controls**
2	Observe the DTC information with a scan tool. Is DTC P0112 set?	-	Go to **DTC P0112**	Go to **Step 3**
3	Test for an intermittent and for a poor connection at the IAT sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 5**	Go to **Step 4**
4	Test the IAT signal circuit between the IAT sensor and the PCM for an intermittent short to ground. Refer to **Inducing Intermittent Fault Conditions** , **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 5**	Go to Diagnostic Aids
5	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 6**
6	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P1114

Circuit Description

The engine coolant temperature (ECT) sensor is a variable resistor, that measures the temperature of the engine coolant. The powertrain control module (PCM) supplies 5 volts to the ECT signal circuit and a ground for the ECT low reference circuit. When the ECT is cold, the sensor resistance is high. When the ECT increases, the sensor resistance decreases. With high sensor resistance, the PCM detects a high voltage on the ECT signal circuit. With lower sensor resistance, the PCM detects a lower voltage on the ECT signal circuit. If the PCM detects an excessively low ECT signal voltage, which is a high temperature indication, DTC P1114 sets.

Conditions for Running the DTC

The engine run time is more than 10 seconds.

Conditions for Setting the DTC

The PCM detects that the ECT sensor parameter is more than 138°C (280°F) intermittently for a calibrated amount of time.

Action Taken When the DTC Sets

- The control module stores the DTC information into memory when the diagnostic runs and fails.
- The malfunction indicator lamp (MIL) will not illuminate.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Failure Records.
- The driver information center, if equipped, may display a message.

Conditions for Clearing the DTC

- A current DTC Last Test Failed clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- Clear the DTC with a scan tool.

Diagnostic Aids

- An ECT sensor or PCM which is intermittently shorted, open, or skewed is possible, but very unlikely
- An intermittent short to ground in the ECT sensor signal circuit could result in a DTC P1114.
- Use the Temperature vs. Resistance Value scale to test the coolant sensor at various temperature levels to evaluate the possibility of a skewed sensor. A skewed sensor could result in poor driveability conditions. Refer to **Temperature vs Resistance** .
- For an intermittent condition, refer to **Intermittent Conditions** .

DTC P1114

Step	Action	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**			
1	Did you perform the Diagnostic System Check - Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Observe the DTC information with a scan tool. Is DTC P0117 set?	Go to **DTC P0117**	Go to **Step 3**
3	Observe the engine coolant temperature (ECT) sensor parameter with a scan tool while moving the ECT sensor connector and the powertrain control module (PCM) connector. Refer to **Inducing Intermittent Fault Conditions** in Wiring Systems. Does the scan tool indicate an abrupt change in value?	Go to **Step 6**	Go to **Step 4**
4	Observe the ECT parameter with a scan tool while moving the wiring harness at the ECT sensor and the PCM. Refer to		

	Inducing Intermittent Fault Conditions in Wiring Systems. Does the scan tool indicate an abrupt change in value?	Go to **Step 7**	Go to **Step 5**
5	1. Observe the Freeze Frame/Failure Records for this DTC 2. Turn OFF the ignition for 30 seconds 3. Start the engine 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to **Step 2**	System OK
6	Repair the ECT connector or the terminal as necessary. Refer to **Connector Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 8**	-
7	Repair the ECT wiring or the wiring harness as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 8**	-
8	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 9**
9	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P1115

Circuit Description

The engine coolant temperature (ECT) sensor is a variable resistor, that measures the temperature of the engine coolant. The powertrain control module (PCM) supplies 5 volts to the ECT signal circuit and a ground for the ECT low reference circuit. When the ECT is cold, the sensor resistance is high. When the ECT increases, the sensor resistance decreases. With high sensor resistance, the PCM detects a high voltage on the ECT signal circuit. With lower sensor resistance, the PCM detects a lower voltage on the ECT signal circuit. If the PCM detects an excessively high signal voltage, which is a low temperature indication, DTC P1115 sets.

Conditions for Running the DTC

The engine run time is more than 60 seconds.

Conditions for Setting the DTC

The PCM detects that the ECT sensor parameter is less than -38°C (-36°F) intermittently for a calibrated amount of time.

Action Taken When the DTC Sets

- The control module stores the DTC information into memory when the diagnostic runs and fails.
- The malfunction indicator lamp (MIL) will not illuminate.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Failure Records.
- The driver information center, if equipped, may display a message.

Conditions for Clearing the DTC

- A current DTC Last Test Failed clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- Clear the DTC with a scan tool.

Diagnostic Aids

- An ECT sensor or PCM which is intermittently shorted, open, or skewed is possible, but very unlikely.
- An intermittent open or a short to voltage in the ECT sensor signal circuit could result in DTC P1115 setting. Refer to **Intermittent Conditions** .
- Use the Temperature vs. Resistance Value table to test the coolant sensor at various temperature levels to evaluate the possibility of a skewed sensor. A skewed sensor could result in poor driveability conditions. Refer to **Temperature vs Resistance** .

DTC P1115

Step	Action	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Powertrain Control Module (PCM) Connector End Views or Engine Controls Connector End Views**			
1	Did you perform the Diagnostic System Check - Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Observe the DTC information with a scan tool. Is DTC P0118 set?	Go to **DTC P0118**	Go to **Step 3**
	1. Turn OFF the engine. 2. Turn ON the ignition, with the engine OFF. 3. Observe the engine coolant temperature (ECT) sensor		

3	parameter with a scan tool while moving the ECT sensor connector and the powertrain control module (PCM) connector. Refer to **Inducing Intermittent Fault Conditions** in Wiring Systems. Does the scan tool indicate an abrupt change in value?	Go to **Step 6**	Go to **Step 4**
4	Observe the ECT parameter with a scan tool while moving the wiring harness at the ECT sensor and the PCM. Refer to **Inducing Intermittent Fault Conditions** in Wiring Systems. Does the scan tool indicate an abrupt change in value?	Go to **Step 7**	Go to **Step 5**
5	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to **Step 2**	System OK
6	Repair the ECT connector or the terminal as necessary. Refer to **Connector Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 8**	-
7	Repair the wiring harness or the wiring as necessary. Refer to **Wiring Repairs** in Wiring Systems. Did you complete the repair?	Go to **Step 8**	-
8	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 9**
9	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P1125

Circuit Description

The accelerator pedal position (APP) sensor 1 and the APP sensor 2 are potentiometer type sensors, each with the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The control module provides the APP sensors with a 5-volt reference circuit and a low reference circuit. The APP sensors then provide the control module signal voltages proportional to pedal movement. The APP sensor 1 signal voltage is low at rest and increases as the pedal is depressed. The APP sensor 2 signal voltage is low at rest and increases as the pedal is depressed. When the control module detects that the APP sensor 1 and the APP sensor 2 signal circuits are out of correlation with each other, DTC P1125 sets.

Conditions for Running the DTC

- DTC P1518, P2108 or U0107 is not set.
- The ignition is in the Crank or Run position.
- The ignition voltage is more than 5.23 volts.
- The communication between the throttle actuator control (TAC) module and the powertrain control module (PCM) must be valid.

Conditions for Setting the DTC

The PCM detects that the difference between APP sensor 1 and APP sensor 2 is more than the predicted value.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame and/or the Failure Records.
- The control module commands the TAC system to operate in the Reduced Engine Power mode.
- A message center or an indicator displays Reduced Engine Power.
- Under certain conditions the control module commands the engine OFF.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

DTC P1125

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Record the throttle actuator control (TAC) module calibration with a scan tool. Does the TAC module calibration match the part number of the TAC module?	-	Go to **Step 3**	Go to **Step 11**
3	Observe the DTC Information with a scan tool. Is DTC P2120 or P2125 also set?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 4**
4	1. Turn OFF the ignition for 30 seconds. 2. Turn ON the ignition, with the engine OFF. 3. Observe the APP Sensors 1 and 2 parameter with a scan tool. Does the scan tool indicate that the APP sensors 1 and 2 parameters disagree?	-	Go to **Step 5**	Go to **Intermittent Conditions**
5	1. Turn OFF the ignition. 2. Disconnect the accelerator pedal position (APP) sensor. 3. Disconnect the TAC module. 4. Measure the resistance of the following circuits for each of the APP sensors with a DMM: • The low reference circuit • The signal circuit • The 5-volt reference circuit Is the resistance more than the specified value for any circuit?	5 ohm	Go to **Step 9**	Go to **Step 6**
6	Test the signal circuit of the APP sensor 1 for a short to the signal circuit of the APP sensor 2. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 7**
7	Test for an intermittent and for a poor connection at the TAC module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems.	-		

	Did you find and correct the condition?		Go to **Step 12**	Go to **Step 8**
8	Test for an intermittent and for a poor connection at the APP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 10**
9	Repair the high resistance in the circuit that measured above the specified value. Refer to **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	-
10	Replace the APP sensor. Refer to **Accelerator Pedal Position (APP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
11	Replace the TAC module. Refer to **Throttle Actuator Control (TAC) Module Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
12	1. Assemble the vehicle, as necessary. 2. Clear the DTCs with a scan tool. 3. Start the engine. 4. Operate the system in order to verify the repair. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 13**
13	**IMPORTANT:** **Be aware that repairing one individual condition may correct more than one DTC.** Observe the Capture Info with a scan tool.Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P1133 OR P1153

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The powertrain control module (PCM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the PCM operates in open loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and closed loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream; low HO2S voltage indicates a lean exhaust stream. This diagnostic will only run once per ignition cycle. The PCM monitors the number of rich-to-lean and lean-to-rich transitions. If the PCM detects that the number of transitions were less than a specified value, DTC P1133 sets for HO2S bank 1 sensor 1, or DTC P1153 sets for HO2S bank 2 sensor 1.

Conditions for Running the DTC

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0131, P0132, P0134, P0135, P0151, P0152, P0154, P0155, P0200, P0220, P0300, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The ECT Sensor parameter is more than 60°C (140°F).
- The EVAP Purge Solenoid Command parameter is more than 1 percent.
- The MAF Sensor parameter is between 20-55 g/s.
- The Engine Speed parameter is between 1,200-3,000 RPM.
- The TP Indicated Angle parameter is 5 percent more than the value observed at idle.
- The Loop Status parameter is closed.
- The Ignition 1 Signal parameter is between 10-18 volts.
- The Fuel Tank Level Remaining parameter is more than 10 percent.
- The Engine Run Time parameter is more than 160 seconds.
- The above conditions are met for 100 seconds.

Conditions for Setting the DTC

The PCM detects that the affected HO2S lean-to-rich or rich-to-lean transitions are less than a calibrated value.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

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

2: If the voltage is varying above and below the specified value, the condition is not present.

DTC P1133 or P1153

Step	Action	Value (s)	Yes	No
Schematic Reference:Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to **Scan Tool Data List** . 3. Operate the engine at 1,500 RPM for 30 seconds. 4. Observe the affected heated oxygen sensor (HO2S) voltage parameter with a scan tool. Is the HO2S voltage parameter varying above and below the specified range?	250-625 mV	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the affected HO2S. 3. Turn ON the ignition, with the engine OFF. 4. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to **Step 6**	Go to **Step 5**
5	1. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and a good ground. 2. Observe the HO2S voltage parameter with a scan tool.	100 mV		

	Is the HO2S voltage parameter less than the specified value?		Go to **Step 8**	Go to **Step 7**
6	Test the HO2S high signal circuit for a short to the HO2S low signal circuit. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 11**
7	Test the HO2S high signal circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 11**
8	1. Remove the jumper wire from the previous step. 2. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and the low signal circuit of the HO2S harness connector on the engine harness side. 3. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to **Step 10**	Go to **Step 9**
9	Test the HO2S low signal circuit for an open, or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 11**
10	Test for shorted terminals and for poor connections at the HO2S. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 12**
11	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 14**	Go to **Step 13**
	NOTE: **Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices.** **IMPORTANT:** **The HO2S may be damaged due to contamination. Prior to replacing the HO2S inspect for the following sources of contamination:** • A silicon contaminated HO2S			

12	• Fuel contamination - Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (without Special Tool and E85)** or **Alcohol/Contaminants-in-Fuel Diagnosis (with Special Tool)** . • Engine oil consumption - Refer to **Oil Consumption Diagnosis** in Engine Mechanical. • Engine coolant consumption - Refer to **Loss of Coolant** in Engine Cooling. Replace the affected HO2S. Refer to **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1** or **Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1** .Did you complete the replacement?	-	Go to **Step 14**	-
13	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 14**	-
14	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 15**
15	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P1134 OR P1154

Circuit Description

Heated oxygen sensors (HO2S) are used for fuel control and post catalyst monitoring. Each HO2S compares the oxygen content of the surrounding air with the oxygen content in the exhaust stream. The HO2S must reach operating temperature to provide an accurate voltage signal. Heating elements inside the HO2S minimize the time required for the sensors to reach operating temperature. The powertrain control module (PCM) supplies the HO2S with a reference, or bias, voltage of about 450 mV. When the engine is first started the PCM operates in open loop, ignoring the HO2S voltage signal. Once the HO2S reaches operating temperature and closed loop is achieved, the HO2S generates a voltage within a range of 0-1,000 mV that fluctuates above and below bias voltage. High HO2S voltage indicates a rich exhaust stream; low HO2S voltage indicates a lean exhaust stream. This diagnostic will only run once per ignition cycle. The PCM monitors the rich-to-lean and lean-to-rich transition time. A transition is defined as, the HO2S voltage changes from above 625 mV to below 250 mV or from below 250 mV to above 625 mV. If the PCM detects that the difference between the rich-to-lean average transition time and lean-to-rich average transition time is more than a specified value, DTC P1134 sets for HO2S bank 1 sensor 1, or DTC P1154 sets for HO2S bank 2 sensor 1.

Conditions for Running the DTC

- DTCs P0068, P0101, P0102, P0103, P0106, P0107, P0108, P0112, P0113, P0116, P0117, P0118, P0120, P0131, P0132, P0134, P0135, P0151, P0152, P0154, P0155, P0200, P0220, P0300, P0442, P0446, P0452, P0453, P0455, P0496, P1125, P1258, P1516, P2101, P2108, P2135, U0107 are not set.
- The ECT Sensor parameter is more than 60°C (140°F).
- The EVAP Purge Solenoid Command parameter is more than 1 percent.
- The MAF Sensor parameter is between 20-55 g/s.
- The Engine Speed parameter is between 1,200-3,000 RPM.
- The TP Indicated Angle parameter is 5 percent more than the value observed at idle.
- The Loop Status parameter is closed.
- The Ignition 1 Signal parameter is between 10-18 volts.
- The Fuel Tank Level Remaining parameter is more than 10 percent.
- The Engine Run Time parameter is more than 160 seconds.
- The above conditions are met for 100 seconds.

Conditions for Setting the DTC

The PCM detects that the difference between the HO2S rich-to-lean average transition time and the lean-to-rich average transition time is more than a calibrated value.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) on the second consecutive ignition cycle that the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The first time the diagnostic fails, the control module stores this information in the Failure Records. If the diagnostic reports a failure on the second consecutive ignition cycle, the control module records the operating conditions at the time of the failure. The control module writes the operating conditions to the Freeze Frame and updates the Failure Records.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Test Description

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

2: If the voltage is varying above and below the specified value, the condition is not present.

DTC P1134 or P1154

Step	Action	Value (s)	Yes	No
Schematic Reference:Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Start the engine. 2. Allow the engine to reach operating temperature. Refer to **Scan Tool Data List** . 3. Operate the engine at 1,500 RPM for 30 seconds. 4. Observe the affected heated oxygen sensor (HO2S) voltage parameter with a scan tool. Is the HO2S voltage parameter varying above and below the specified range?	250-625 mV	Go to **Step 3**	Go to **Step 4**
3	1. Observe the Freeze Frame/Failure Records for this DTC. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 4**	Go to **Intermittent Conditions**
4	1. Turn OFF the ignition. 2. Disconnect the affected HO2S. 3. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and a good ground. 4. Turn ON the ignition, with the engine OFF. 5. Observe the HO2S voltage parameter with a scan tool.	100 mV		

	Is the HO2S voltage parameter less than the specified value?		Go to **Step 6**	Go to **Step 5**
5	Test the HO2S high signal circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 9**
6	1. Remove the jumper wire from the previous step. 2. Connect a 3-amp fused jumper wire between the high signal circuit of the HO2S harness connector on the engine harness side and the low signal circuit of the HO2S harness connector on the engine harness side. 3. Observe the HO2S voltage parameter with a scan tool. Is the HO2S voltage parameter less than the specified value?	100 mV	Go to **Step 8**	Go to **Step 7**
7	Test the HO2S low signal circuit for an open or high resistance. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 9**
8	Test for shorted terminals and for poor connections at the HO2S. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 10**
9	Test for shorted terminals and for poor connections at the powertrain control module (PCM). Refer to **Testing for Intermittent Conditions and Poor Connections** and **Connector Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 12**	Go to **Step 11**
10	**NOTE:** **Refer to Silicon Contamination of Heated Oxygen Sensors Notice in Cautions and Notices.** **IMPORTANT:** **The HO2S may be damaged due to contamination. Prior to replacing the HO2S inspect for the following sources of contamination:** • A silicon contaminated HO2S • Fuel contamination - Refer to **Alcohol/Contaminants-in-Fuel Diagnosis (without Special Tool and E85)** or	-		

	Alcohol/Contaminants-in-Fuel Diagnosis (with Special Tool) . • Engine oil consumption - Refer to **Oil Consumption Diagnosis** in Engine Mechanical. • Engine coolant consumption - Refer to **Loss of Coolant** in Engine Cooling. Replace the affected HO2S. Refer to **Heated Oxygen Sensor (HO2S) Replacement Bank 1 Sensor 1** or **Heated Oxygen Sensor (HO2S) Replacement Bank 2 Sensor 1** .Did you complete the replacement?		Go to **Step 12**	-
11	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 12**	-
12	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 13**
13	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P1380

System Description

The powertrain control module (PCM) detects engine misfire events by monitoring variations in the crankshaft rotation speed. Wheel speed changes caused by rough road conditions can cause changes in crankshaft speed. By monitoring the wheel speed sensors, the anti-lock brake system (ABS) can determine if the vehicle is operating on a rough road. If the ABS is detecting a rough road condition severe enough to effect misfire detection, a rough road signal is sent to the PCM on the serial data circuit. If DTC P0300 is set and the rough road information is not available due to an ABS malfunction, DTC P1380 will set.

Conditions for Running the DTC

- DTCs P0101, P0102, P0103, P0120, P0335, P0336, P0742 are not set.
- The vehicle speed is greater than 16 km/h (10 mph).
- The engine load is less than 60 percent.

- The engine misfire is detected-DTC P0300 set.
- The engine speed is less than 3,200 RPM.

Conditions for Setting the DTC

An ABS malfunction exists preventing the PCM from receiving rough road detection data.

Action Taken When the DTC Sets

- The control module stores the DTC information into memory when the diagnostic runs and fails.
- The malfunction indicator lamp (MIL) will not illuminate.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Failure Records.
- The driver information center, if equipped, may display a message.

Conditions for Clearing the DTC

- A current DTC Last Test Failed clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- Clear the DTC with a scan tool.

DTC P1380

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	Go to **Diagnostic System Check - ABS** in Anti-lock Brake System	Go to **Diagnostic System Check - Engine Controls**

DTC P1381

System Description

The powertrain control module (PCM) detects engine misfire events by monitoring variations in the crankshaft rotation speed. Wheel speed changes caused by rough road conditions can cause changes in crankshaft speed. By monitoring the wheel speed sensors, the anti-lock brake system (ABS) can determine if the vehicle is operating on a rough road. If the ABS is detecting a rough road condition severe enough to effect misfire detection, a rough road signal is sent to the PCM on the serial data circuit. If DTC P0300 is set and the rough road information is not available due to an ABS malfunction, DTC P1381 will set.

Conditions for Running the DTC

- The vehicle speed is above 16 km/h (10 mph).
- The engine speed is below 3,200 RPM.
- The engine load is less than 60 percent.
- Engine misfire is detected-DTC P0300 set.

Conditions for Setting the DTC

- A serial data malfunction exists preventing the PCM from receiving rough road detection data.
- The above conditions met for 20 seconds.

Action Taken When the DTC Sets

- The control module stores the DTC information into memory when the diagnostic runs and fails.
- The malfunction indicator lamp (MIL) will not illuminate.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Failure Records.
- The driver information center, if equipped, may display a message.

Conditions for Clearing the DTC

- A current DTC Last Test Failed clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- Clear the DTC with a scan tool.

Test Description

The number below refers to the step number on the diagnostic table.

1: This step will diagnose a malfunction in the serial data circuits.

DTC P1381

Step	Action	Yes	No
1	Did you perform the Diagnostic System Check - Engine Controls?	Go to **Diagnostic System Check - ABS** in Anti-lock Brake System	Go to **Diagnostic System Check - Engine Controls**

DTC P1516

Circuit Description

The predicted throttle position (TP) is compared to the actual throttle position. The two values should be within a calibrated range of each other. Both the powertrain control module (PCM) and the throttle actuator control (TAC) module redundantly monitor the predicted and actual throttle position. This DTC sets if the PCM detects an out of range condition between the predicted and the actual throttle position.

Conditions for Running the DTC

- DTC U0107 is not set.
- The ignition switch is in the Crank or Run position.
- The ignition voltage is more than 5.23 volts.

- The TAC system is not in the battery saver mode.

Conditions for Setting the DTC

- The TAC module detects that the predicted and the actual throttle positions are not within a calibrated range of each other.
- The PCM and the TAC cannot determine the throttle position.
- Both of the TP sensors are invalid.
- All of the above conditions are met for more than 1 second.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame and/or the Failure Records.
- The control module commands the TAC system to operate in the Reduced Engine Power mode.
- A message center or an indicator displays Reduced Engine Power.
- Under certain conditions the control module commands the engine OFF.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Inspect the TAC module connectors for signs of water intrusion. If water intrusion occurs, multiple DTCs may set without any circuit or component conditions found during diagnostic testing.
- Verify that the starting and charging systems are operating properly. Low system voltage can cause this DTC to set.
- When the TAC module detects a condition within the TAC system, more than one TAC system related DTC may set. This is due to the many redundant tests run continuously on this system. Locating and repairing an individual condition may correct more than one DTC. Disconnecting components during testing may set additional DTCs. Remember this if you review the stored information in Capture Info.
- For an intermittent, refer to **Intermittent Conditions** .

Test Description

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

7: If the TP indicated angle does not follow the movement of the throttle blade and no TP sensor DTCs are set, there is a mechanical condition with the throttle shaft or the TP sensor.

18: Locating and repairing an individual condition may correct more than one DTC.

DTC P1516

Step	Action	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views**			
1	Did you perform the Diagnostic System Check - Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Is DTC U0107 set?	Go to **DTC U0107**	Go to **Step 3**
3	Is DTC P2135 set?	Go to **DTC P2135**	Go to **Step 4**
4	**IMPORTANT:** **Low system voltage may cause this DTC to set. Clear DTCs if low system voltage has been experienced.** 1. Turn OFF the ignition for 15 seconds. 2. Turn ON the ignition, with the engine OFF. 3. Observe the throttle position (TP) sensor 1 and TP sensor 2 angle parameters with a scan tool. 4. Slowly depress the accelerator pedal to wide open throttle (WOT) and slowly return it to the released position. Does the scan tool indicate both angle parameters increasing as the pedal is depressed to WOT and decreasing as the pedal is released?	Go to Diagnostic Aids	Go to **Step 5**
5	1. Turn OFF the ignition. 2. Disconnect the throttle actuator motor harness connector. 3. Remove the air inlet duct from the throttle body. 4. Inspect the throttle body and throttle plate for the following conditions which may cause the throttle plate to bind: • Debris - If debris is found, clean the throttle body and repair the source of contamination. • Damage or evidence of tampering-If the throttle body and/or throttle plate is damaged, replace the throttle body. Refer to **Throttle Body**		

	Assembly Replacement . Did you find and correct the condition?	Go to **Step 17**	Go to **Step 6**
6	With your hand, slowly open the throttle plate to WOT and back to the closed position several times. Does the throttle plate move smoothly without binding in both directions?	Go to **Step 7**	Go to **Step 14**
7	1. Turn OFF the ignition. 2. Disconnect the throttle body harness connector. 3. Connect the jumper wires between the TP sensor terminals of the throttle body harness connector and the corresponding TP sensor terminals of the throttle body. 4. Turn ON the ignition, with the engine OFF. 5. Open the throttle blade to WOT, then to the closed position by hand. 6. Observe the TP sensor 1 and TP sensor 2 angle parameters with a scan tool. Does the scan tool indicate both angle parameters increasing as the throttle plate is moved to WOT, and decreasing as the plate is moved to the closed position?	Go to **Step 8**	Go to **Step 15**
8	1. Turn OFF the ignition. 2. Disconnect the throttle actuator control (TAC) module harness connector containing the throttle actuator control motor circuits. 3. Turn ON the ignition, with the engine OFF. 4. Test the TAC motor circuits for a short to voltage with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 17**	Go to **Step 9**
9	Test each TAC motor circuit for an open or high resistance with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 17**	Go to **Step 10**
10	Test each TAC motor circuit for a short to ground with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 17**	Go to **Step 11**
	1. Disconnect the other TAC module harness connector. 2. Test for a short between each TAC motor circuit and all other TAC module circuits with a DMM. Refer to		

11	**Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 17**	Go to **Step 12**
12	1. Turn OFF the ignition. 2. Connect the TAC module. 3. Connect a test lamp between the 2 TAC motor circuits at the TAC motor harness connector. 4. Turn ON the ignition, with the engine OFF, and observe the test lamp. Did the test lamp illuminate briefly when the ignition was turned ON?	Go to **Step 13**	Go to **Step 15**
13	Inspect for poor connections at the TAC motor harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Repairing Connector Terminals** in Wiring Systems. Did you find and correct the condition?	Go to **Step 17**	Go to **Step 14**
14	Replace the throttle body assembly. Refer to **Throttle Body Assembly Replacement** . Did you complete the replacement?	Go to **Step 15**	-
15	Inspect for poor connections at the TAC module harness connectors. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Repairing Connector Terminals** in Wiring Systems. Did you find and correct the condition?	Go to **Step 17**	Go to **Step 16**
16	Replace the TAC module. Refer to **Throttle Actuator Control (TAC) Module Replacement** . Did you complete the replacement?	Go to **Step 17**	-
17	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 18**
18	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2101

Circuit Description

The commanded throttle position (TP), based on accelerator pedal position (APP) and possibly other limiting factors, is compared to the actual TP. The two values should be within a calibrated range of each other. Both the powertrain control module (PCM) and the throttle actuator control (TAC) module redundantly monitor the commanded and actual TP. This DTC sets if the PCM detects an out-of-range condition between the commanded and the actual throttle position.

Conditions for Running the DTC

- DTCs P0601, P0602, P0604, P0606, P1516, P2108, U0107 are not set.
- DTCs P0120 and P0220 are not active at the same time.
- The ignition switch is in the Crank or Run position.
- The ignition voltage is more than 8.5 volts.
- The TAC system is not in the battery saver mode.

Conditions for Setting the DTC

- The PCM detects that the commanded and actual throttle positions are not within a calibrated range of each other.
- The above condition is met for less than 1 second.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame and/or the Failure Records.
- The control module commands the TAC system to operate in the Reduced Engine Power mode.
- A message center or an indicator displays Reduced Engine Power.
- Under certain conditions the control module commands the engine OFF.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Inspect for mechanical concerns or binding that may be temperature related. Components may not move freely in extreme heat or cold due to the presence of contaminants or ice formation.

- Inspect the TAC module connectors for signs of water intrusion. If water intrusion occurs, multiple DTCs may set without any circuit or component conditions found during diagnostic testing.
- When the TAC module detects a condition within the TAC system, more than one TAC system related DTC may set. This is due to the many redundant tests run continuously on this system. Locating and repairing an individual condition may correct more than one DTC. Disconnecting components during testing may set additional DTCs. Remember this if you review the stored information in Capture Info.
- For an intermittent, refer to **Intermittent Conditions** .

Test Description

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

4: If the TP indicated angle does not follow the movement of the throttle blade and no TP sensor DTCs are set, there is a mechanical condition with the throttle shaft or the TP sensor.

15: Locating and repairing an individual condition may correct more than 1 DTC.

DTC P2101

Step	Action	Yes	No
Schematic Reference:Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Powertrain Control Module (PCM) Connector End Views**			
1	Did you perform the Diagnostic System Check - Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Is DTC U0107 also set?	Go to **DTC U0107**	Go to **Step 2**
3	**IMPORTANT:** **The next test must be started within 15 seconds after the ignition is turned ON.** 1. Turn OFF the ignition for 15 seconds. 2. Turn ON the ignition, with the engine OFF. 3. Observe the throttle position (TP) sensor 1 and TP sensor 2 angle parameters with a scan tool. 4. Slowly depress the accelerator pedal to wide open throttle (WOT) and slowly return the pedal to the released position. Does the scan tool indicate both angle parameters increasing as the pedal is depressed to WOT and decreasing as the pedal is moved to the released position?	Go to Diagnostic Aids	Go to **Step 4**
	1. Turn OFF the ignition. 2. Remove the air inlet duct from the throttle body.		

4	3. Disconnect the throttle body harness connector. 4. Connect the jumper wires between the TP sensor terminals of the throttle body harness connector and the corresponding TP sensor terminals of the throttle body. 5. Turn ON the ignition with the engine OFF. 6. Open the throttle blade to WOT, then to the closed position by hand. 7. Observe the TP sensor 1 and the TP sensor 2 angle parameters with a scan tool. Does the scan tool indicate both angle parameters increasing as the throttle plate is moved to WOT, and decreasing as the throttle plate is moved to the closed position?	Go to **Step 5**	Go to **Step 12**
5	1. Turn OFF the ignition. 2. Disconnect the throttle actuator control (TAC) module harness connector containing the TAC motor circuits. 3. Turn ON the ignition, with the engine OFF. 4. Test the TAC motor circuits for a short to voltage with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 6**
6	Test each TAC motor circuit for an open or high resistance with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 7**
7	Test each TAC motor circuit for a short to ground with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 8**
8	1. Disconnect the other TAC module harness connector. 2. Remove all jumper wires. 3. Test for a short between each TAC motor circuit and all other TAC module circuits with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 9**
	1. Turn OFF the ignition.		

9	2. Connect the TAC module. 3. Connect a test lamp between the 2 TAC motor circuits at the TAC motor harness connector. 4. Turn ON the ignition, with the engine OFF, and observe the test lamp. Did the test lamp illuminate briefly when the ignition was turned ON?	Go to **Step 10**	Go to **Step 12**
10	Inspect for poor connections at the TAC motor harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Repairing Connector Terminals** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 11**
11	Replace the throttle body assembly. Refer to **Throttle Body Assembly Replacement** . Did you complete the replacement?	Go to **Step 14**	-
12	Inspect for poor connections at the TAC module harness connectors. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Repairing Connector Terminals** in Wiring Systems. Did you find and correct the condition?	Go to **Step 14**	Go to **Step 13**
13	Replace the TAC module. Refer to **Throttle Actuator Control (TAC) Module Replacement** . Did you complete the replacement?	Go to **Step 14**	-
14	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 15**
15	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2108

Circuit Description

The throttle actuator control (TAC) module contains data which is essential for proper TAC system operation. The TAC module continuously tests the integrity of this data. When the TAC module is unable to write or read data to and from random access memory (RAM), or the TAC module is unable to correctly read data from the flash memory or an internal TAC module processor fault is detected, this DTC sets.

Conditions for Running the DTC

- DTC U0107 is not set.
- The ignition switch is in the Crank or Run position.
- The ignition voltage is greater than 6 volts.

Conditions for Setting the DTC

- The TAC module determines that an internal data test did not pass.
- The above condition is met for more than 1 second.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame and/or the Failure Records.
- The control module commands the TAC system to operate in the Reduced Engine Power mode.
- A message center or an indicator displays Reduced Engine Power.
- Under certain conditions the control module commands the engine OFF.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Verify that the starting and charging systems are operating properly. Low system voltage can cause this DTC to set.
- Inspect the TAC module connectors for signs of water intrusion. If water intrusion occurs, multiple DTCs may set without any circuit or component conditions found during diagnostic testing.
- When the TAC module detects a condition within the TAC system, more than one TAC system related DTC may set. This is due to the many redundant tests run continuously on this system. Locating and repairing an individual condition may correct more than one DTC. Disconnecting components during testing may set additional DTCs. Remember this if you review the stored information in Capture Info.

Test Description

The number below refers to the step number on the diagnostic table.

4: Locating and repairing an individual condition may correct more than one DTC.

DTC P2108

Step	Action	Yes	No
Schematic Reference:Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Powertrain Control Module (PCM) Connector End Views**			
1	Did you perform the Diagnostic System Check - Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Replace the throttle actuator control (TAC) module. Refer to **Throttle Actuator Control (TAC) Module Replacement** . Did you complete the replacement?	Go to **Step 3**	-
3	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 4**
4	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2120

Circuit Description

The accelerator pedal position (APP) sensor 1 is a potentiometer type sensor with the following three circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The control module provides the APP sensor a 5-volt reference circuit and a low reference circuit. The APP sensor then provides the control module a signal voltage proportional to pedal movement. The APP sensor 1 signal voltage is low at rest and increases as the pedal is depressed. When the control module detects that the APP sensor 1 signal or APP sensor 5-volt reference voltage is outside the predetermined range, this DTC sets.

Conditions for Running the DTC

- DTCs P0601, P0602, P0606, P2108, U0107 are not set.
- The ignition switch is in the Crank or Run position.
- The ignition voltage is more than 5.23 volts.

Conditions for Setting the DTC

- The APP sensor 1 voltage is less than 0.24 volts or more than 4.49 volts.

  OR

- The 5-volt reference is less than 4.54 volts or more than 5.21 volts.
- One of the above conditions is present for more than 1 second.

Action Taken When the DTC Sets

- The control module stores the DTC information into memory when the diagnostic runs and fails.
- The malfunction indicator lamp (MIL) will not illuminate.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Failure Records.
- If one or more APP sensor DTCs are set, the following occurs:
  - The control module commands Reduced Engine Power mode.
  - The APP indicated angle is limited to a predetermined value to limit the amount of throttle control.

    OR

  - The APP indicated angle is limited to 0 percent. The control module only allows the engine to idle.
  - The message center displays Reduced Engine Power.

Conditions for Clearing the DTC

- A current DTC Last Test Failed clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- Clear the DTC with a scan tool.

Diagnostic Aids

- Inspect the throttle actuator control (TAC) module connectors for signs of water intrusion. If water intrusion occurs, multiple DTCs may set without any circuit or component conditions found during diagnostic testing.
- When the TAC module detects a condition within the TAC system, more than one TAC system related DTC may set. This is due to the many redundant tests run continuously on this system. Locating and

repairing one individual condition may correct more than one DTC. Disconnecting components during testing may set additional DTCs. Remember this if you review the stored information in Capture Info.

- For an intermittent, refer to **Intermittent Conditions** .

Test Description

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

12: This test isolates whether the short is to another TAC system circuit in the harness or within the TAC module.

26: When the TAC module detects a condition within the TAC system, more than one TAC system related DTC may set. This is due to the many redundant tests run continuously on this system. Locating and repairing one individual condition may correct more than one DTC. Disconnecting components during testing may set additional DTCs. Remember this if you review the stored information in Capture Info.

DTC P2120

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **If DTCs P0120 or U0107 is also set, refer to the appropriate DTC for further diagnosis.** 1. Turn ON the ignition with the engine OFF, and with your foot OFF the accelerator pedal. 2. Observe the accelerator pedal position (APP) sensor 1 voltage with a scan tool. Does the scan tool indicate the APP sensor 1 voltage is within the specified values?	0.24-2.24 V	Go to **Step 3**	Go to **Step 6**
3	Depress the accelerator pedal to the wide open throttle (WOT) position. Does the scan tool indicate APP sensor 1 voltage within the specified values?	0.24-4.49 V	Go to **Step 4**	Go to **Step 6**
4	1. Turn OFF the ignition for 30 seconds. 2. Turn ON the ignition, with the engine OFF. 3. Select the DTC option using the scan tool. 4. Lightly touch and move the related engine wiring harnesses and connectors while	-		

	monitoring the DTC information. Did this DTC fail this ignition during the above test?		Go to **Step 24**	Go to **Step 5**
5	1. Continue to observe the DTC information. 2. Depress the accelerator pedal to WOT, then return the pedal to the rest position. Did this DTC fail this ignition during the above test?	-	Go to **Step 19**	Go to Diagnostic Aids
6	Disconnect the APP sensor harness connector. Does the scan tool indicate the APP sensor 1 voltage is at the specified value?	0 V	Go to **Step 7**	Go to **Step 11**
7	Connect a test lamp between the APP sensor 1 signal circuit and B+. Does the scan tool indicate the APP sensor 1 voltage is at the specified value?	5 V	Go to **Step 8**	Go to **Step 13**
8	Test the APP sensor 1 5-volt reference circuit for voltage with a DMM. Does the DMM indicate voltage within the specified values?	4.54-5.21 V	Go to **Step 10**	Go to **Step 9**
9	1. Turn OFF the ignition. 2. Disconnect the throttle actuator motor harness connector. 3. Remove the air inlet duct from the throttle body assembly. 4. Turn ON the ignition, with the engine OFF, 5. Rotate the throttle blade by hand to WOT and hold. 6. Test the APP sensor 1 5-volt reference circuit for voltage with a DMM. Does the DMM indicate voltage within the specified values?	4.54-5.21 V	Go to **Step 21**	Go to **Step 16**
10	1. Connect a fused jumper between the APP sensor 1 low-reference circuit and the APP sensor 1 5-volt reference circuit. 2. Observe the throttle position (TP) sensor 1 voltage parameter with a scan tool. Does the scan tool indicate TP sensor 1 voltage at the specified value?	0 V	Go to **Step 19**	Go to **Step 17**
	1. Turn OFF the ignition. 2. Disconnect the throttle actuator control (TAC)			

11	module harness connector containing the APP sensor circuits. 3. Turn ON the ignition, with the engine OFF. 4. Test the APP sensor 1 signal circuit for a short to voltage with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 12**
12	1. Turn OFF the ignition. 2. Disconnect the other TAC module harness connector. 3. Test for a short between the APP sensor 1 signal circuit and all other TAC module circuits with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 22**
13	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the APP sensor circuits. 3. Test the APP sensor 1 signal circuit for an open or high resistance with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 14**
14	Test the APP sensor 1 signal circuit for a short to ground with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 15**
15	1. Turn OFF the ignition. 2. Disconnect the other TAC module harness connector. 3. Test for a short between the APP sensor 1 signal circuit and all other TAC module circuits with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 22**
	1. Turn OFF the ignition. 2. Disconnect the TAC module connector containing the APP sensor circuits.			

16	3. Test the APP sensor 1 5-volt reference circuit for the following conditions with a DMM: • An open • A short to ground • High resistance Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 22**
17	1. Disconnect the TAC module connector containing the APP sensor circuits. 2. Test the APP sensor 1 low-reference circuit for an open or high resistance with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 18**
18	Test the TAC module ground circuit for an open or high resistance with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 22**
19	Inspect for poor connections at the harness connector of the APP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Repairing Connector Terminals** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 20**
20	Replace the APP sensor assembly. Refer to **Accelerator Pedal Position (APP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 25**	-
21	Did DTC P0120 set while performing Step 9?	-	Go to **DTC P0120**	Go to **Step 22**
22	Inspect for poor connections at the harness connector of the TAC module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Repairing Connector Terminals** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 23**
23	Replace the TAC module. Refer to **Throttle Actuator Control (TAC) Module Replacement** . Did you complete the replacement?	-	Go to **Step 25**	-
24	Repair the intermittent condition as necessary. Refer to **Connector Repairs** and **Wiring Repairs** in	-		

	Wiring Systems. Did you complete the repair?		Go to **Step 25**	-
25	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 26**
26	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2121

Circuit Description

The accelerator pedal position (APP) sensor 1 and APP sensor 2 are potentiometer type sensors, each with the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The control module provides the APP sensors a 5-volt reference circuit and a low reference circuit. The APP sensors then provide the control module signal voltages proportional to pedal movement. The APP sensor 1 signal voltage is low at rest and increases as the pedal is depressed. The APP sensor 2 signal voltage is also low at rest and increases as the pedal is depressed. When the control module detects that the APP sensor 1 signal and the APP sensor 2 signal circuits are out of correlation, this DTC sets.

Conditions for Running the DTC

- DTCs P0606, P2108, or U0107 are not set.
- The ignition switch is in the Crank or Run position.
- The ignition voltage is more than 5.23 volts.

Conditions for Setting the DTC

- APP sensor 1 disagrees with APP sensor 2 by more than 10.5 percent.
- The above condition is present for more than 1 second.

Action Taken When the DTC Sets

- The control module stores the DTC information into memory when the diagnostic runs and fails.
- The malfunction indicator lamp (MIL) will not illuminate.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Failure Records.
- If one or more APP sensor DTCs are set for a single APP sensor, the following occurs:
  - The control module commands Reduced Engine Power mode.
  - The APP indicated angle is limited to a predetermined value to limit the amount of throttle control.
  - The APP indicated angle is limited to 0 percent. The control module only allows the engine to idle.
  - The message center displays Reduced Engine Power.

Conditions for Clearing the DTC

- A current DTC Last Test Failed clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- Clear the DTC with a scan tool.

Diagnostic Aids

- Inspect the throttle actuator control (TAC) module connectors for signs of water intrusion. If water intrusion occurs, multiple DTCs may set without any circuit or component conditions found during diagnostic testing.
- When the TAC module detects a condition within the TAC system, more than one TAC system related DTC may set. This is due to the many redundant tests run continuously on this system. Locating and repairing one individual condition may correct more than one DTC. Disconnecting components during testing may set additional DTCs. Remember this if you review the stored information in Capture Info.
- For an intermittent, refer to **Intermittent Conditions** .

Test Description

The numbers below refer to the steps numbers in the diagnostic table.

2: This step determines if a communication condition exists.

5: This step isolates an internal APP sensor failure. The condition may only occur at a certain accelerator pedal position. Monitoring the APP angles for sensor 2 and sensor 3 is an accurate way of verifying the actual position of the pedal. The APP angles for all 3 sensors should be within a few percent of each other. If the pedal is at rest, the APP angle for all 3 sensors should be 0 percent. If the pedal is fully depressed, all APP angles should be 100 percent.

6: The APP sensor 1 shares a common 5-volt reference circuit with the throttle position (TP) sensor 1. Monitoring the TP sensor 1 voltage aids in diagnosing the APP sensor 5-volt reference and low reference circuits.

9: With the TAC module still connected, this test will help determine a short to the signal circuit either within the TAC module or the wiring.

10: This step determines whether the TAC module or a shorted circuit is causing the condition.

19: When the TAC module detects a condition within the TAC system, more than one TAC system related DTC may set. This is due to the many redundant tests run continuously on this system. Locating and repairing one individual condition may correct more than one DTC. Disconnecting components during testing may set additional DTCs. Remember this if you review the stored information in Capture Info.

DTC P2121

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Is DTCs U0107 also set?	-	Go to **DTC U0107**	Go to **Step 3**
3	**IMPORTANT:** **DO NOT depress the accelerator pedal.** 1. Start the engine. 2. Observe the DTC information with a scan tool. Did any other throttle actuator control (TAC) module or accelerator pedal position (APP) sensor DTC set except P1125?	-	Go to **Diagnostic Trouble Code (DTC) List**	Go to **Step 4**
4	Observe the APP sensor Agree/Disagree parameters with a scan tool. Does the scan tool indicate Disagree for any of the APP Agree/Disagree parameters?	-	Go to **Step 6**	Go to **Step 5**
5	1. Turn ON the ignition, with the engine OFF. 2. Observe the APP sensor angles for both APP sensors with a scan tool. 3. Slowly depress the accelerator pedal, stopping at 25, 50, 75, and 100 percent. 4. Slowly release the accelerator pedal, stopping at 75, 50, 25, and 0 percent. Does the scan tool indicate APP sensor 1 angle within 10.5 percent of the APP sensor 2 angle during the above test?	-	Go to Diagnostic Aids	Go to **Step 6**
	1. Turn OFF the ignition.			

6	2. Disconnect the APP sensor harness connector. 3. Connect a fused jumper between the APP sensor 1 5-volt reference circuit and ground. 4. Turn ON the ignition, with the engine OFF. 5. Observe the throttle position (TP) sensor 1 voltage parameter with a scan tool. Does the scan tool indicate TP sensor 1 voltage is at the specified value?	0.0 V	Go to **Step 7**	Go to **Step 11**
7	1. Connect a fused jumper between the APP sensor 1 5-volt reference circuit and the APP sensor 1 low reference circuit. 2. Observe the TP sensor 1 voltage parameter with a scan tool. Does the scan tool indicate TP sensor 1 voltage is at specified value?	0.0 V	Go to **Step 8**	Go to **Step 12**
8	1. Connect a fused jumper between the APP sensor 1 signal circuit and the APP sensor 1 5-volt reference circuit. 2. Observe the APP sensor 1 voltage parameter with a scan tool. Does the scan tool indicate APP sensor 1 voltage is near the specified value?	5 V	Go to **Step 14**	Go to **Step 9**
9	Test for a short between the APP sensor 1 signal circuit and all other APP circuits at the APP sensor harness connector with a DMM. Does the DMM indicate a short to another circuit?	-	Go to **Step 10**	Go to **Step 13**
10	1. Turn OFF the ignition. 2. Disconnect both of the TAC module harness connectors. 3. Test for a short between the APP sensor 1 signal circuit and all other APP circuits at the APP sensor harness connector with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 15**
	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the APP circuits.			

11	3. Test the APP sensor 1 5-volt reference circuit for an open or high resistance with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 15**
12	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the APP circuits. 3. Test the APP sensor 1 low-reference circuit for an open or high resistance with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 15**
13	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the APP circuits. 3. Test the APP sensor 1 signal circuit for an open or high resistance with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find an open or high resistance?	-	Go to **Step 18**	Go to **Step 15**
14	Inspect for poor connections at the harness connector of the APP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Repairing Connector Terminals** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 16**
15	Inspect for poor connections at the harness connectors of the TAC module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Repairing Connector Terminals** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 18**	Go to **Step 17**
16	Replace the APP sensor assembly. Refer to **Accelerator Pedal Position (APP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 18**	-
17	Replace the TAC module. Refer to **Throttle Actuator Control (TAC) Module Replacement** . Did you complete the replacement?	-	Go to **Step 18**	-
	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds.			

18	3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 19**
19	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2125

Circuit Description

The accelerator pedal position (APP) sensor 2 is a potentiometer type sensor with the following circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The control module provides the APP sensor a 5-volt reference circuit and a low reference circuit. The APP sensor then provides the control module a signal voltage proportional to pedal movement. The APP sensor 1 signal voltage is low at rest and increases as the pedal is depressed. When the control module detects that the APP sensor 2 signal or the APP sensor 5-volt reference voltage is outside the predetermined range, this DTC sets.

Conditions for Running the DTC

- DTCs P0601, P0602, P0606, P2108, U0107 are not set.
- The ignition switch is in the Crank or Run position.
- The ignition voltage is more than 5.23 volts.

Conditions for Setting the DTC

- The APP sensor 2 voltage is less than 0.24 volt or more than 4.49 volts.

  OR

- The 5-volt reference is less than 4.54 volts or more than 5.21 volts.
- One of the above conditions is present for more than 1 second.

Action Taken When the DTC Sets

- The control module stores the DTC information into memory when the diagnostic runs and fails.
- The malfunction indicator lamp (MIL) will not illuminate.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Failure Records.
- If one or more APP sensor DTCs are set, the following occurs:
  - The control module commands Reduced Engine Power mode.
  - The APP indicated angle is limited to a predetermined value to limit the amount of throttle control.

    OR

  - The APP indicated angle is limited to 0 percent. The control module only allows the engine to idle.
  - The message center displays Reduced Engine Power.

Conditions for Clearing the DTC

- A current DTC Last Test Failed clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other non-emission related diagnostic.
- Clear the DTC with a scan tool.

Diagnostic Aids

- Inspect the throttle actuator control (TAC) module connectors for signs of water intrusion. If water intrusion occurs, multiple DTCs may set without any circuit or component conditions found during diagnostic testing.
- When the TAC module detects a condition within the TAC system, more than one TAC system related DTC may set. This is due to the many redundant tests run continuously on this system. Locating and repairing one individual condition may correct more than one DTC. Disconnecting components during testing may set additional DTCs. Remember this if you review the stored information in Capture Info.
- For an intermittent, refer to **Intermittent Conditions** .

Test Description

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

2: The throttle position (TP) sensor 2 and the APP sensor 2 share a common 5-volt reference source. Diagnose DTC P0220 first if that DTC is also set.

6: Measuring the specified voltage at the APP sensor harness connector verifies the integrity of the APP sensor 2 signal circuit from the TAC module.

18: This test determines whether or not the TAC module can recognize a change in signal voltage.

19: There are 2 separate 5-volt reference sources within the TAC module. The TP sensor 1 and the APP sensor 1 share one 5-volt reference source. The TP sensor 2 and the APP sensor 2 share another common 5-volt reference source. This test determines whether the signal circuit is shorted to any one of the 5-volt reference circuits. If a short exists, the corresponding sensor voltage will be pulled low.

20: The previous step found the signal circuit and a 5-volt reference circuit shorted together. This test isolates whether the short is in the harness or within the TAC module.

26: When the TAC module detects a condition within the TAC system, more than one TAC system related DTC may set. This is due to the many redundant tests run continuously on this system. Locating and repairing one individual condition may correct more than one DTC. Disconnecting components during testing may set additional DTCs. Remember this if you review the stored information in Capture Info.

DTC P2125

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	**IMPORTANT:** **If DTCs P0220 or U0107 is also set, refer to Diagnostic Trouble Code (DTC) List and diagnose the applicable DTC first.** 1. Turn ON the ignition, with the engine OFF, and with your foot OFF of the accelerator pedal. 2. Observe the accelerator pedal position (APP) sensor 2 voltage parameter with a scan tool. Does the scan tool indicate the APP sensor 2 voltage is within the specified values?	0.24-2.24 V	Go to **Step 3**	Go to **Step 6**
3	Fully depress the accelerator pedal to the wide open throttle (WOT) position. Does the scan tool indicate the APP sensor 2 voltage is within the specified values?	0.24-4.49 V	Go to **Step 4**	Go to **Step 6**
4	1. Turn OFF the ignition for 15 seconds. 2. Turn ON the ignition, with the engine OFF. 3. Observe the DTC info with a scan tool. 4. Lightly touch and move the related engine wiring harnesses and connectors for the APP sensor while observing the DTC status. 5. If the scan tool indicates this DTC failed this ignition during the above test, repair the intermittent condition as necessary. Refer to **Wiring Repairs** and **Connector Repairs** in	-		

	Wiring Systems. Did you find and correct the condition?		Go to **Step 25**	Go to **Step 5**
5	Slowly depress the accelerator pedal to WOT, then slowly return the pedal to closed throttle while observing the DTC status. Did the scan tool indicate this DTC failed this ignition during the above test?	-	Go to **Step 21**	Go to Diagnostic Aids
6	1. Disconnect the APP sensor harness connector. 2. Test the APP sensor 2 signal circuit for voltage with a DMM. Does the DMM indicate the APP sensor 2 signal voltage is within the specified values?	3.94-6.06 V	Go to **Step 11**	Go to **Step 7**
7	1. Turn OFF the ignition. 2. Disconnect the throttle actuator control (TAC) module harness connector containing the APP sensor circuits. 3. Turn ON the ignition, with the engine OFF. 4. Test the APP sensor 2 signal circuit for a short to voltage with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 8**
8	Test the APP sensor 2 signal circuit for an open or high resistance with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 9**
9	Test the APP sensor 2 signal circuit for a short to ground with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 10**
10	Test for a short between the APP sensor 2 signal circuit and all other TAC module circuits with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 23**
11	Test the APP sensor 2 5-volt reference circuit for voltage with a DMM. Does the DMM indicate voltage within the specified values?	4.54-5.21 V	Go to **Step 16**	Go to **Step 12**
	1. Turn OFF the ignition. 2. Disconnect the TAC module harness			

12	connector containing the APP sensor circuits. 3. Turn ON the ignition, with the engine OFF. 4. Test the APP sensor 2 5-volt reference circuit for a short to voltage with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 13**
13	Test the APP sensor 2 5-volt reference circuit for an open or high resistance with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 14**
14	Test the APP sensor 2 5-volt reference circuit for a short to ground with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 15**
15	Test for a short between the APP sensor 2 5-volt reference circuit and all other TAC module circuits with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 23**
16	Measure resistance with a DMM connected between the APP sensor 2 low reference circuit and the APP sensor 1 low reference circuit. Does the DMM indicate resistance within the specified values?	0-5 ohm	Go to **Step 18**	Go to **Step 17**
17	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connector containing the APP sensor circuits. 3. Test the APP sensor 2 low reference circuit for an open or high resistance with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 23**
18	1. Connect a fused jumper between the APP sensor 2 signal circuit and the APP sensor 2 low reference circuit at the APP sensor harness connector. 2. Observe the APP sensor 2 voltage parameter with a scan tool. Does the scan tool indicate APP sensor 2 voltage is	0 V		

	at the specified value?		Go to **Step 19**	Go to **Step 23**
19	1. Observe the APP sensor 1, the APP sensor 3, and the TP sensor 2 voltage parameters with a scan tool. 2. Connect a fused jumper between the APP sensor 2 signal circuit and the APP sensor 2 low reference circuit at the APP sensor harness connector. Did the scan tool indicate a change in voltage in any of the parameters observed during the above test?	-	Go to **Step 20**	Go to **Step 21**
20	1. Turn OFF the ignition. 2. Disconnect the TAC module harness connectors. 3. Test for a short between the APP sensor 2 signal circuit and all other TAC module circuits with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 23**
21	Inspect for poor connections at the harness connector of the APP sensor. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Repairing Connector Terminals** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 22**
22	Replace the APP sensor assembly. Refer to **Accelerator Pedal Position (APP) Sensor Replacement** . Did you complete the replacement?	-	Go to **Step 25**	-
23	Inspect for poor connections at the harness connector of the TAC module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Repairing Connector Terminals** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 25**	Go to **Step 24**
24	Replace the TAC module. Refer to **Throttle Actuator Control (TAC) Module Replacement** . Did you complete the replacement?	-	Go to **Step 25**	-
	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine.			

25	4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 26**
26	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC P2135

Circuit Description

The throttle position (TP) sensors 1 and 2 are potentiometer type sensors, each with the following three circuits:

- A 5-volt reference circuit
- A low reference circuit
- A signal circuit

The TP sensors are used to determine the throttle plate angle for various engine management systems. The control module provides each TP sensor a 5-volt reference circuit and a low reference circuit. The TP sensors then provide the control module with signal voltage proportional to throttle plate movement. Both TP sensor signal voltages are low at closed throttle and increase as the throttle opens. When the control module detects that TP sensor 1 signal and the TP sensor 2 signals disagree, or signal voltages are outside the predetermined range, this DTC sets.

Conditions for Running the DTC

- DTCs P2108 or U0107 are not set.
- The ignition switch is in the Crank or Run position.
- The ignition voltage is more than 5.23 volts.

Conditions for Setting the DTC

- The TP sensor 2 disagrees with the TP sensor 1 by more than 7.5 percent.
- The above condition is present for more than 1 second.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame and/or the Failure Records.

- The control module commands the TAC system to operate in the Reduced Engine Power mode.
- A message center or an indicator displays Reduced Engine Power.
- Under certain conditions the control module commands the engine OFF.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

- Inspect the throttle actuator control (TAC) module connectors for signs of water intrusion. If water intrusion occurs, multiple DTCs may set without any circuit or component conditions found during diagnostic testing.
- When the TAC module detects a condition within the TAC system, more than one TAC system related DTC may set. This is due to the many redundant tests run continuously on this system. Locating and repairing one individual condition may correct more than one DTC. Disconnecting components during testing may set additional DTCs. Remember this if you review the stored information in Capture Info.
- If this DTC is determined to be intermittent, refer to **Intermittent Conditions** .

Test Description

The number below refers to the step number on the diagnostic table.

> **21:** When the TAC module detects a condition within the TAC system, more than one TAC system related DTC may set. This is due to the many redundant tests run continuously on this system. Locating and repairing one individual condition may correct more than one DTC. Disconnecting components during testing may set additional DTCs. Remember this if you review the stored information in Capture Info.

DTC P2135

Step	Action	Yes	No
Schematic Reference:Engine Controls Schematics **Connector End View Reference:Engine Controls Connector End Views** or **Powertrain Control Module (PCM) Connector End Views**			
1	Did you perform the Diagnostic System Check - Engine Controls?	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	Is DTC U0107 set?	Go to **Diagnostic Trouble Code**	

		(DTC) List	Go to **Step 3**
3	1. Turn ON the ignition, with the engine OFF. 2. Observe the throttle position (TP) sensor 1 and 2 Agree/Disagree parameter with a scan tool. Does the scan tool TP sensor 1 and 2 Agree/Disagree parameter indicate Disagree?	Go to **Step 5**	Go to **Step 4**
4	1. Remove the air inlet duct from the throttle body. 2. Disconnect the throttle body harness connector. 3. Connect the jumper wires between the TP sensor terminals of the throttle body harness connector and the corresponding TP sensor terminals of the throttle body. 4. Observe the TP sensor 1 and 2 with a scan tool. 5. Slowly open the throttle blade to wide open throttle (WOT) and back to the closed throttle position several times by hand. Does the TP sensor Agree/Disagree parameter change from Agree to Disagree during the above test?	Go to **Step 18**	Go to Diagnostic Aids
5	1. Disconnect the TP sensor harness connector. 2. Disconnect the throttle actuator control (TAC) module harness connectors. 3. Test the TP sensor 1 5-volt reference circuit for resistance with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 20**	Go to **Step 6**
6	Test for a short between the TP sensor 1 5-volt reference circuit and all other TAC module circuits with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 20**	Go to **Step 7**
7	Test the TP sensor 1 signal circuit for resistance with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 20**	Go to **Step 8**
8	Test for a short between the TP sensor 1 signal circuit and all other TAC module circuits with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 20**	Go to **Step 9**
9	Test the TP sensor 1 low reference circuit for resistance with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in		

	Wiring Systems. Did you find and correct the condition?	Go to **Step 20**	Go to **Step 10**
10	Test for a short between the TP sensor 1 low reference circuit and all other TAC module circuits with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 20**	Go to **Step 11**
11	Test the TP sensor 2 5-volt reference circuit for resistance with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 20**	Go to **Step 12**
12	Test for a short between the TP sensor 2 5-volt reference circuit and all other TAC module circuits with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 20**	Go to **Step 13**
13	Test the TP sensor 2 signal circuit for resistance with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 20**	Go to **Step 14**
14	Test for a short between the TP sensor 2 signal circuit and all other TAC module circuits with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 20**	Go to **Step 15**
15	Test the TP sensor 2 low reference circuit for resistance with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 20**	Go to **Step 16**
16	Test for a short between the TP sensor 2 low reference circuit and all other TAC module circuits with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	Go to **Step 20**	Go to **Step 17**
17	Inspect for an intermittent and for a poor connection at the harness connector of the TAC module. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Repairing Connector Terminals** in Wiring Systems. Did you find and correct the condition?	Go to **Step 20**	Go to **Step 18**
18	Inspect for an intermittent and for a poor connection at the harness connector of the throttle body. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Repairing Connector Terminals** in Wiring Systems. Did you find and correct the condition?	Go to **Step 20**	Go to **Step 19**
19	Replace the throttle body assembly. Refer to **Throttle Body Assembly Replacement** . Did you complete the replacement?	Go to **Step 20**	-

20	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	Go to **Step 2**	Go to **Step 21**
21	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	Go to **Diagnostic Trouble Code (DTC) List**	System OK

DTC U0107

Circuit Description

The throttle actuator control (TAC) module and the powertrain control module (PCM) communicate via a dedicated serial data circuit. This serial data circuit is separate from any other serial data circuit on the vehicle. Accurate transmitting and receiving of serial data requires not only good circuit integrity, but also adequate system voltage. This diagnostic test monitors the accuracy of the serial data transmitted between the TAC module and the PCM. If the PCM detects a loss of data or invalid data, this DTC sets.

Conditions for Running the DTC

- The ignition switch is in the Crank or Run position.
- The ignition voltage is more than 5.23 volts.

Conditions for Setting the DTC

- Invalid or missing serial data messages are detected for a predetermined amount of time.
- The above condition is met for more than 1 second.

Action Taken When the DTC Sets

- The control module illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The control module records the operating conditions at the time the diagnostic fails. The control module stores this information in the Freeze Frame and/or the Failure Records.
- The control module commands the TAC system to operate in the Reduced Engine Power mode.
- A message center or an indicator displays Reduced Engine Power.
- Under certain conditions the control module commands the engine OFF.

Conditions for Clearing the MIL/DTC

- The control module turns OFF the malfunction indicator lamp (MIL) after 3 consecutive ignition cycles that the diagnostic runs and does not fail.
- A current DTC, Last Test Failed, clears when the diagnostic runs and passes.
- A history DTC clears after 40 consecutive warm-up cycles, if no failures are reported by this or any other emission related diagnostic.
- Clear the MIL and the DTC with a scan tool.

Diagnostic Aids

IMPORTANT: Reprogramming the PCM may cause a communication error between the PCM and the TAC. If the PCM detects a communication error, DTC U0107 sets. Clear any DTCs from the memory that may have been set by Reprogramming.

- DTC U0107 sets if the battery voltage is low. If the customer's concern is slow cranking or no crank because battery voltage is low, ignore DTC U0107. Clear any DTCs from memory that may have set from the low battery voltage condition.
- DTC U0107 sets when there is a short to B+ on the TAC module ground circuit. Inspect the fuses for the circuits that are in the TAC module harness-i.e. cruise, brake. An inspection of the fuses may lead you to the circuit that is shorted to the TAC module ground circuit.
- DTC U0107 sets if the TAC module ignition feed circuit is shorted to a B+ supply circuit. The TAC module stays powered-up when the ignition switch is turned OFF. When the ignition switch is turned ON, the TAC module is powered-up before the PCM. DTC U0107 sets because no communication is detected by the TAC module from the PCM. Inspect related circuits for being shorted to a B+ supply circuit.
- Inspect the TAC module power and ground circuits and the TAC module/PCM serial data circuits for intermittent connections.
- Inspect the TAC module connectors for signs of water intrusion. If water intrusion occurs, multiple DTCs may set without any circuit or component conditions found during diagnostic testing.
- When the TAC module detects a problem within the TAC system, more than one TAC system related DTC may set. This is due to the many redundant tests run continuously on this system. Locating and repairing an individual condition may correct more than one DTC. Remember this if you review the stored information in Capture Info.
- For an intermittent condition, refer to **Intermittent Conditions** .

Test Description

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

2: This step determines if the ignition relay is supplying a voltage to the ETC fuse.

5: Increasing the engine speed to 3,000 RPM aids in locating a shorted throttle actuator motor control circuit. Depending on the polarity of the throttle actuator motor transistors, this DTC may not set with a fault in the control circuits. The throttle actuator motor is a bi-directional DC motor. Raising the engine speed changes the polarity of the transistors in the throttle actuator motor. This occurs because one set of the transistors is low, 0 volts, and the other set is high, B+. Therefore, if one set of transistors is at a low voltage and the corresponding circuit is shorted low, DTC P1518 will not set. When the polarity of the transistors change, this DTC sets. If this DTC does not fail this ignition, continue to monitor this DTC status while moving related harnesses and connectors.

29: Locating and repairing an individual condition may correct more than one DTC.

DTC U0107

Step	Action	Values	Yes	No
Schematic Reference: Engine Controls Schematics **Connector End View Reference: Engine Controls Connector End Views or Powertrain Control Module (PCM) Connector End Views**				
1	Did you perform the Diagnostic System Check - Engine Controls?	-	Go to **Step 2**	Go to **Diagnostic System Check - Engine Controls**
2	1. Turn ON the ignition, with the engine OFF. 2. Remove the cover from the underhood electrical center. 3. Test both sides of the ETC fuse with a test lamp connected to ground. Does the test lamp illuminate on at least one side of the fuse?	-	Go to **Step 3**	Go to **Ignition Relay Diagnosis**
3	1. Turn OFF the ignition 2. Test for voltage at the ETC fuse with a test lamp connected to ground. Does the test lamp illuminate?	-	Go to **Step 22**	Go to **Step 4**
4	Connect a scan tool. Is DTC P0604 also set?	-	Go to **DTC P0601-P0607, P1600, P1621, P1627, P1680, P1681, P1683, or P2610**	Go to **Step 5**
5	**IMPORTANT:** **If the Driver Information Center is displaying Reduced Engine Power, go to Step 6.** 1. Start the engine. 2. Increase the engine speed to 3,000 RPM, if possible. 3. Monitor the DTC Info option using the scan tool. Does the scan tool indicate this DTC failed this	-		Go to Diagnostic

	ignition?		Go to **Step 6**	Aids
6	1. Turn OFF the ignition. 2. Disconnect the throttle actuator motor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Test for voltage at both throttle actuator motor control circuits with a DMM. Does the DMM indicate voltage on both circuits above the specified value?	1 V	Go to **Step 12**	Go to **Step 7**
7	1. Turn OFF the ignition. 2. Disconnect the throttle actuator control (TAC) module connectors. 3. Test both throttle actuator motor control circuits for continuity to ground with a DMM. Does the DMM indicate continuity to ground?	-	Go to **Step 10**	Go to **Step 8**
8	1. Turn OFF the ignition. 2. Remove the ETC fuse. 3. Test the TAC side of the fuse terminal for continuity to ground with a DMM. Refer to Diagnostic Aids for terminal identification table. Does the DMM indicate continuity to ground?	-	Go to **Step 9**	Go to **Step 11**
9	1. Disconnect the TAC module 16-way harness connector. 2. Test the TAC side of the fuse terminal for a short to ground with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 28**	Go to **Step 24**
10	1. Disconnect the TAC module 16-way harness connector. 2. Test the throttle actuator motor control circuits for a short to ground at the TAC module 16-way harness connector with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems.	-		

	Did you find and correct the condition?		Go to **Step 28**	Go to **Step 24**
11	1. Turn OFF the ignition. 2. Disconnect the TAC module 16-way harness connector. 3. Test the TAC module ignition feed circuit for an open or high resistance with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 28**	Go to **Step 24**
12	1. Turn OFF the ignition. 2. Disconnect the TAC module 16-way connector. 3. Turn ON the ignition, with the engine OFF. 4. Test for a short to voltage at both throttle actuator motor control circuits with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 28**	Go to **Step 13**
13	1. Turn OFF the ignition. 2. Disconnect the TAC module 10-way harness connector. 3. Test for a short between each throttle actuator motor control circuit and all other TAC module circuits with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 28**	Go to **Step 14**
14	Test for an open or high resistance in the TAC module ground circuit with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 28**	Go to **Step 15**
15	Test for voltage on the serial data circuits at the TAC module 16-way harness connector with a DMM. Does the DMM indicate voltage within the specified values for both circuits?	0-4.5 V	Go to **Step 16**	Go to **Step 18**
	1. Turn OFF the ignition. 2. Test both serial data circuits at the TAC module 16-way harness connector for			

16	continuity to ground with a DMM. Does the DMM indicate OL for both circuits?	-	Go to **Step 20**	Go to **Step 17**
17	1. Disconnect the powertrain control module (PCM) connector containing the TAC module serial data circuits. 2. Test both serial data circuits at the TAC module 16-way connector for a short to ground with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 28**	Go to **Step 18**
18	Test for a short between both serial data circuits and all other circuits at the PCM and TAC module harness connectors with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 28**	Go to **Step 19**
19	Test for a short to voltage on both serial data circuits at the TAC module 16-way connector with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 28**	Go to **Step 25**
20	1. Disconnect the PCM connector that contains the TAC module serial data circuits. 2. Test each serial data circuit between the TAC module 16-way harness connector and the PCM harness connector for an open or high resistance with a DMM. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 28**	Go to **Step 21**
21	1. Connect the PCM. 2. Turn ON the ignition. 3. Test for voltage on the serial data circuit at the TAC module 16-way harness connector with a DMM. Does the DMM indicate voltage at the specified value?	0 V	Go to **Step 25**	Go to **Step 24**
	1. Turn OFF the ignition. 2. Disconnect the 16-way TAC module harness			

22	connector. 3. Test the TAC module ignition feed circuit for a short to battery voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 28**	Go to **Step 23**
23	1. Turn ON the ignition. 2. Test both TAC motor circuits for a short to voltage. Refer to **Circuit Testing** and **Wiring Repairs** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 28**	Go to **Step 24**
24	Test for poor connections at the TAC module harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Repairing Connector Terminals** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 28**	Go to **Step 26**
25	Test for poor connections at the PCM harness connector. Refer to **Testing for Intermittent Conditions and Poor Connections** and **Repairing Connector Terminals** in Wiring Systems. Did you find and correct the condition?	-	Go to **Step 28**	Go to **Step 27**
26	Replace the TAC module. Refer to **Throttle Actuator Control (TAC) Module Replacement** . Did you complete the replacement?	-	Go to **Step 28**	-
27	Replace the PCM. Refer to **Powertrain Control Module (PCM) Replacement** . Did you complete the replacement?	-	Go to **Step 28**	-
28	1. Clear the DTCs with a scan tool. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Operate the vehicle within the Conditions for Running the DTC. You may also operate the vehicle within the conditions that you observed from the Freeze Frame/Failure Records. Did the DTC fail this ignition?	-	Go to **Step 2**	Go to **Step 29**
29	Observe the Capture Info with a scan tool. Are there any DTCs that have not been diagnosed?	-	Go to **Diagnostic Trouble Code (DTC) List**	System OK