ENGINE

Engine Control System (4HK1)

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Specifications

Temperature vs Resistance

Engine Coolant Temperature vs. Resistance

°C	°F	Ω
Temperature vs. Resistance Value (Approximately)		
110	230	160
100	212	200
90	194	260
80	176	350
70	158	470
60	140	640
50	122	880
40	104	1250
30	86	1800
20	68	2650
10	50	4000
0	32	6180
-10	14	9810
-20	-4	16000
-30	-22	27000

Intake Air Temperature vs. Resistance

°C	°F	Ω
Temperature vs. Resistance Value (Approximately)		
90	194	240
80	176	320
70	158	450
60	140	660
50	122	960
40	104	1440
30	86	2300
20	68	3430
10	50	5410
0	32	9770
-10	14	16410
20	-4	28560

Fuel Temperature vs. Resistance

°C	°F	Ω
110	230	140
100	212	180
90	194	240
80	176	310
70	158	420
60	140	580
50	122	810
40	104	1150
30	86	1660
20	68	2450
10	50	3700
0	32	5740
-10	14	9160
-20	-4	15000
-30	-22	25400

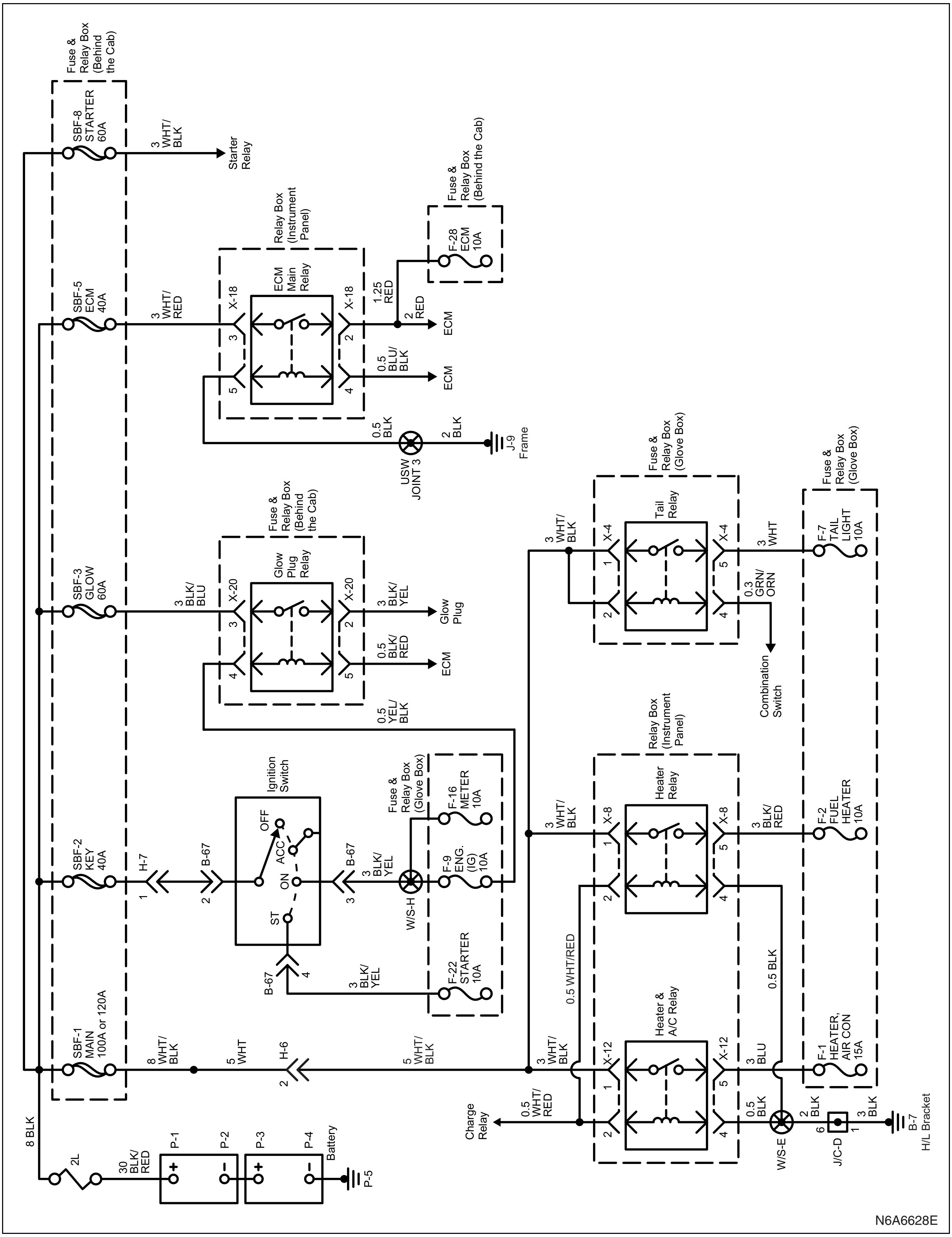
Altitude vs Barometric Pressure

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.		
4267	14000	56-64
3962	13000	58-66
3658	12000	61-69
3353	11000	64-72
3048	10000	66-74
2743	9000	69-77
2438	8000	71-79
2134	7000	74-82
1829	6000	77-85
1524	5000	80-88
1219	4000	83-91
914	3000	87-98
610	2000	90-98
305	1000	94-102
0	0 Sea Level	96-104
-305	-1000	101-105

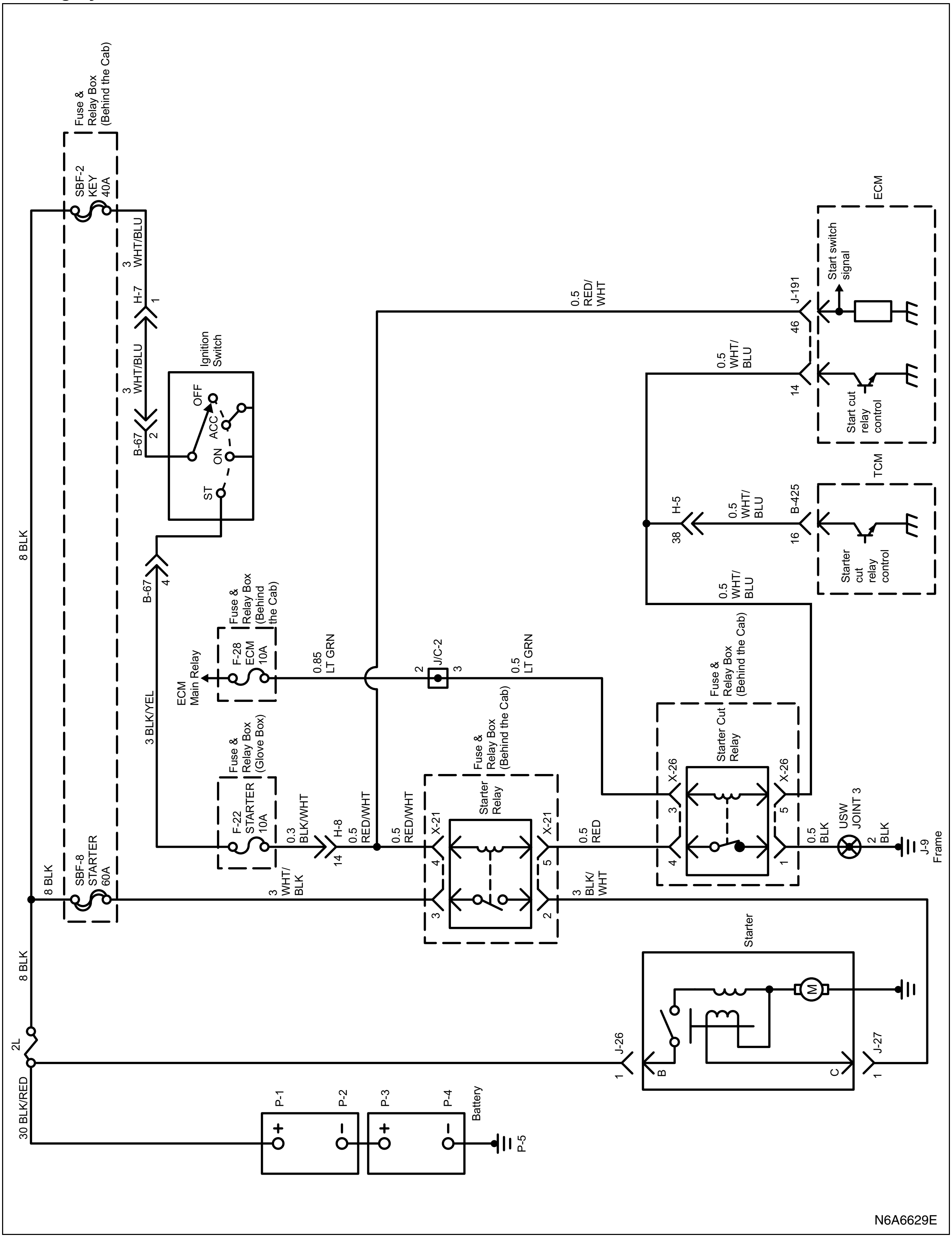
Schematic and Routine Diagrams

Engine Controls Schematics

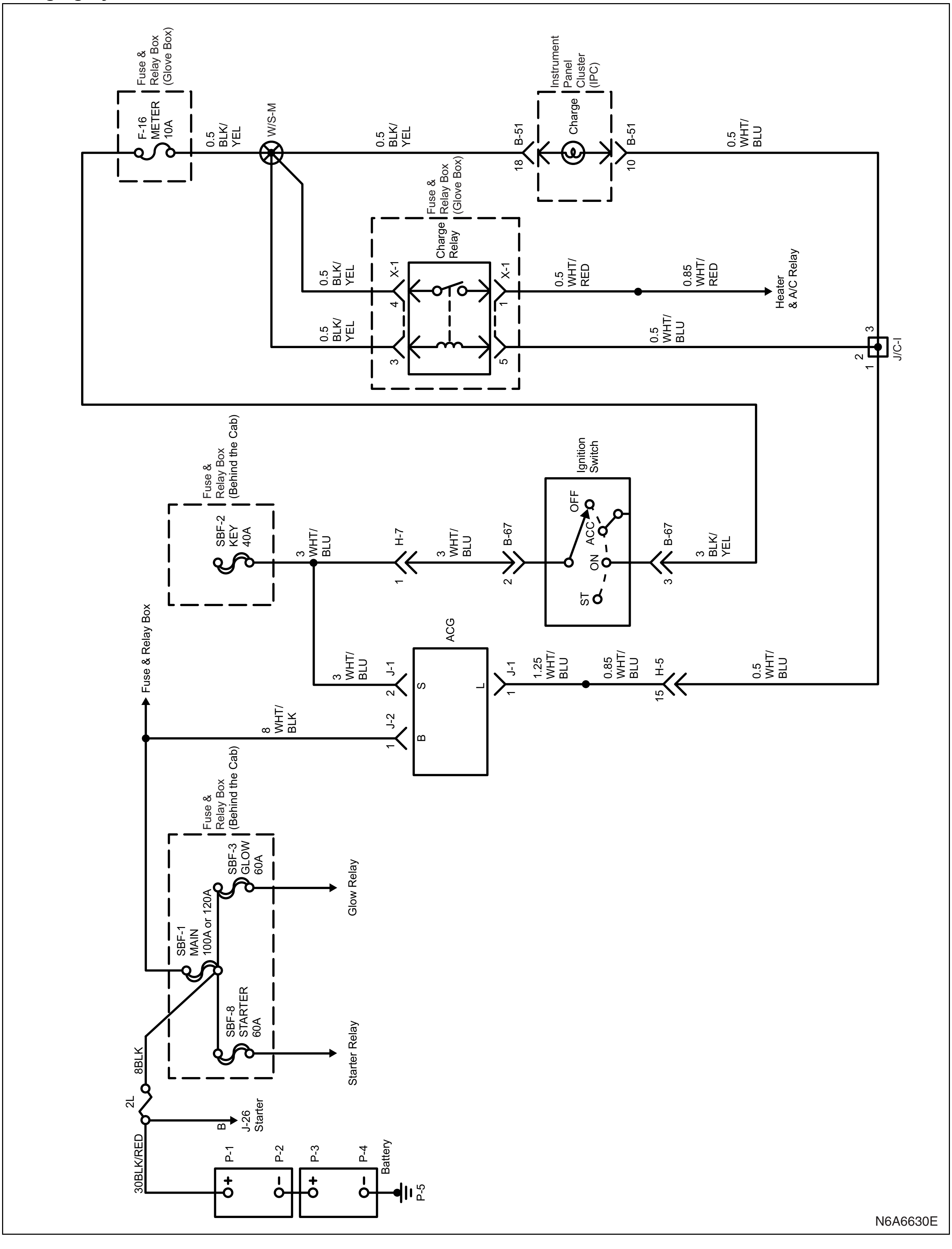
Power Distribution



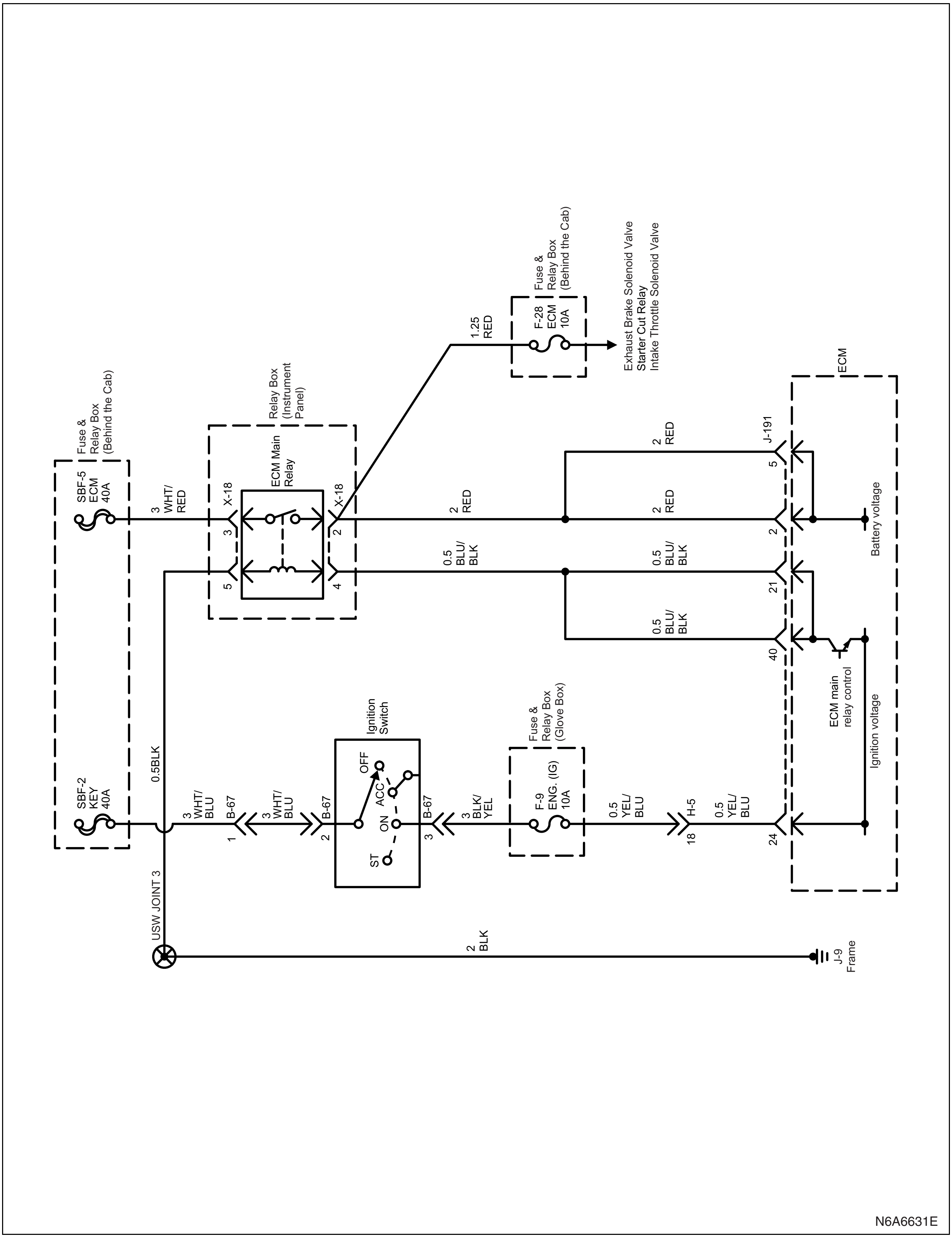
Starting System



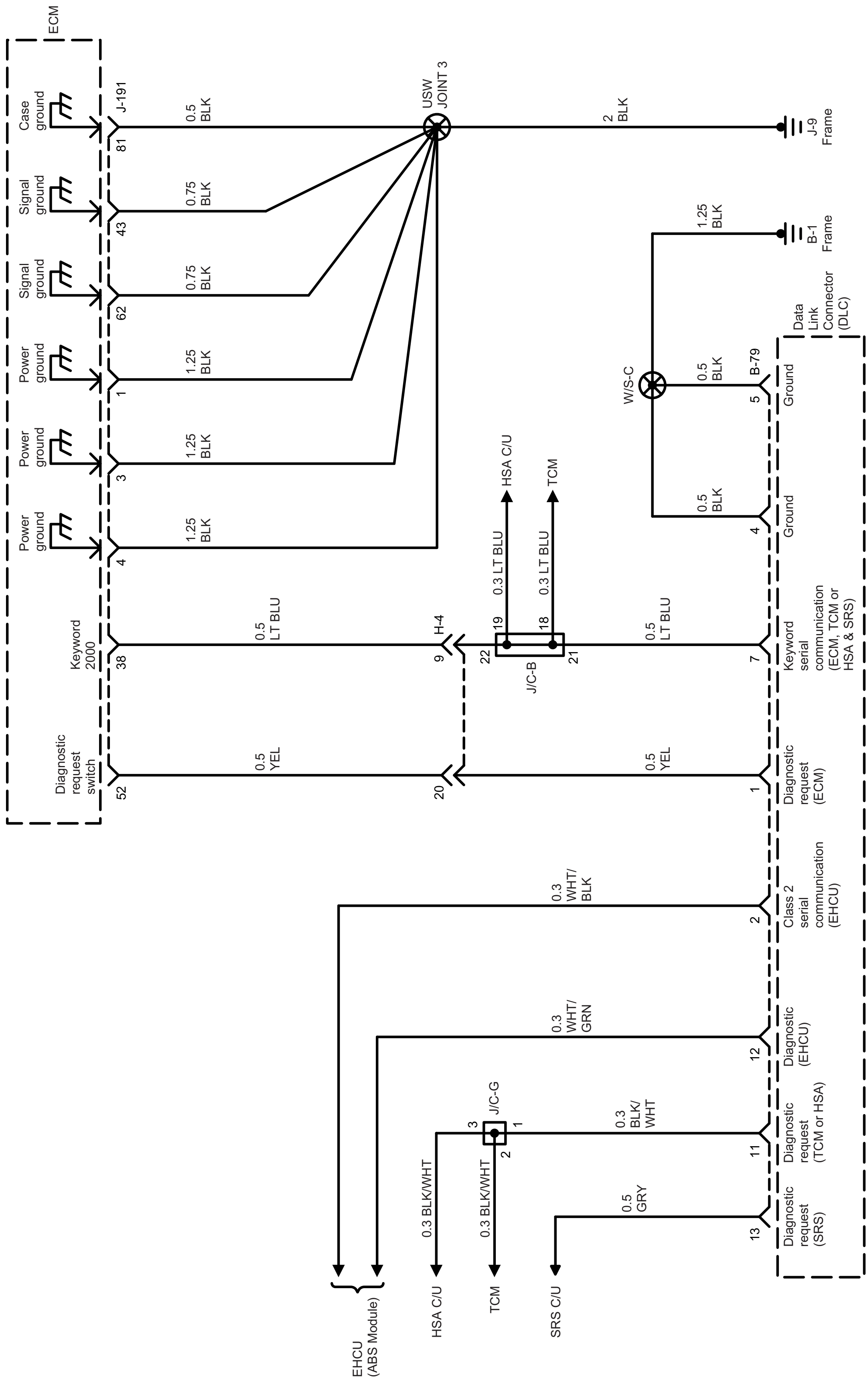
Charging System



ECM Power

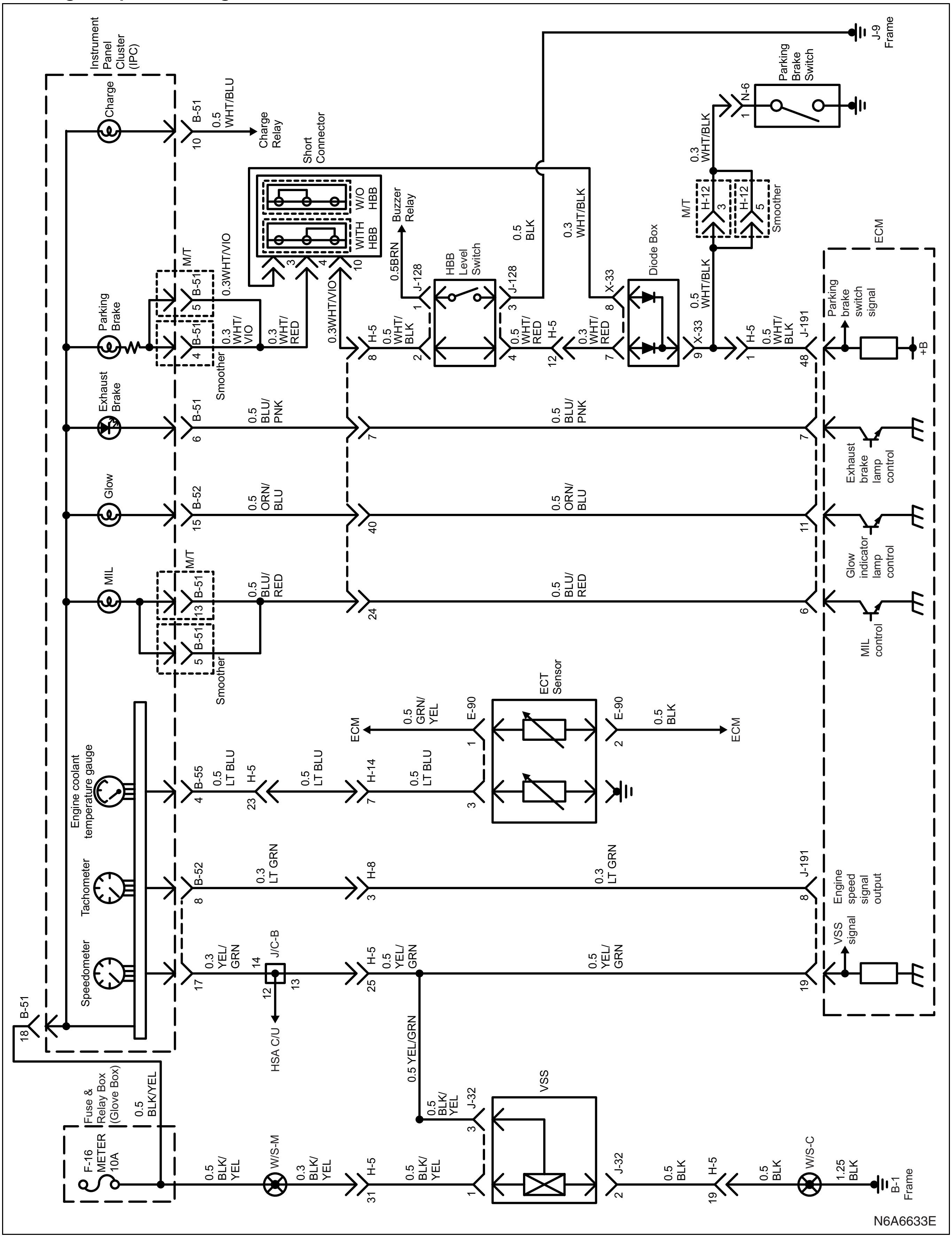

Fuse & Relay Box (Behind the Cab)
SBF-5 ECM 40A
SBF-2 KEY 40A
3 WHT/RED
Relay Box (Instrument Panel)
ECM Main Relay
X-18
1.25 RED
Fuse & Relay Box (Behind the Cab)
F-28 ECM 10A
Exhaust Brake Solenoid Valve
Starter Cut Relay
Intake Throttle Solenoid Valve
ECM
J-191
2 RED
0.5 BLU/BLK
Battery voltage
ECM main relay control
Ignition voltage
0.5BLK
3 WHT/BLU
B-67
Ignition Switch
OFF
ACC
ON
ST
3 BLK/YEL
Fuse & Relay Box (Glove Box)
F-9 ENG. (IG) 10A
0.5 YEL/BLU
H-5
USW JOINT 3
2 BLK
J-9 Frame
N6A6631E

ECM Grounding and DLC



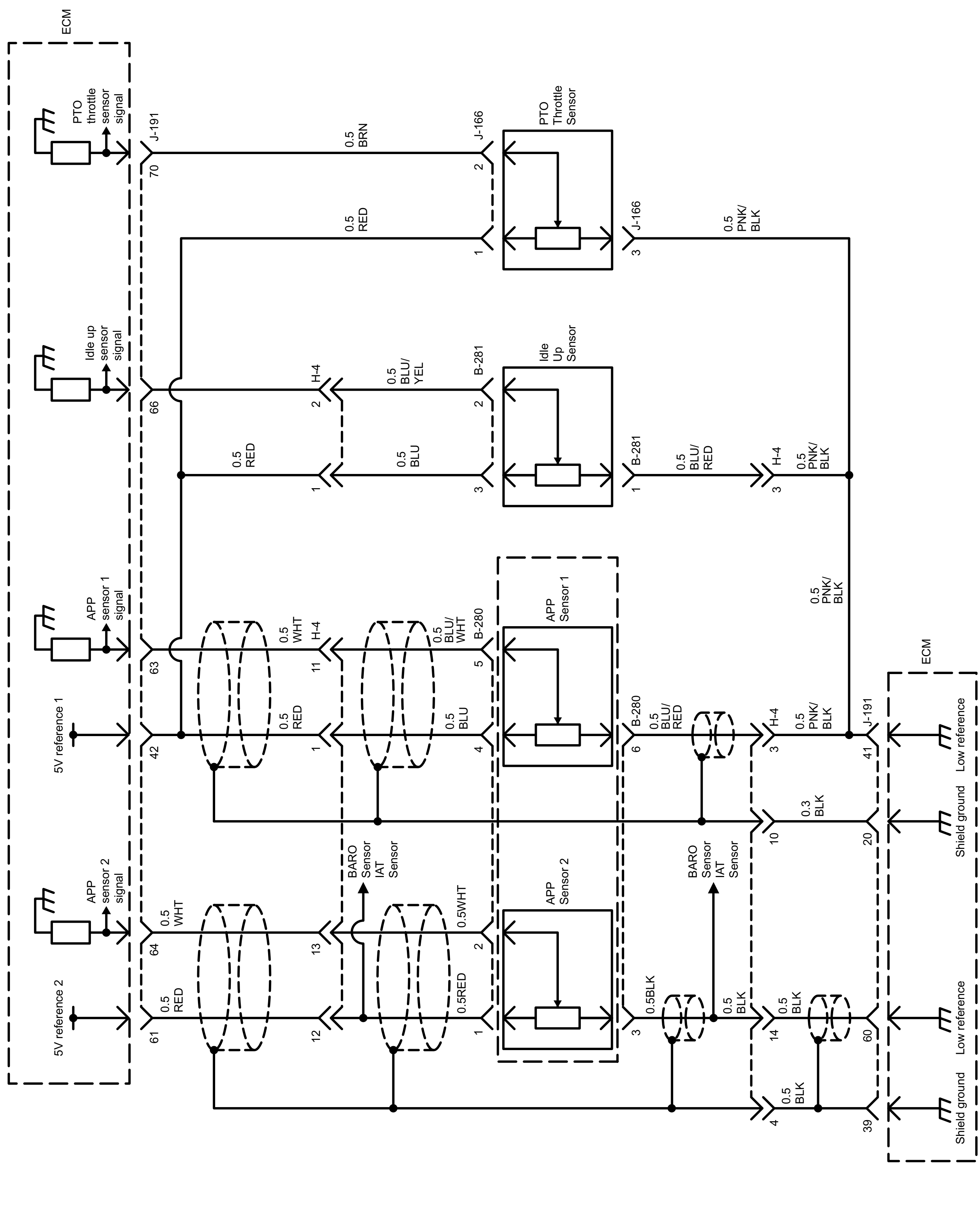
N6A6632E

Warning Lamps and Gauges



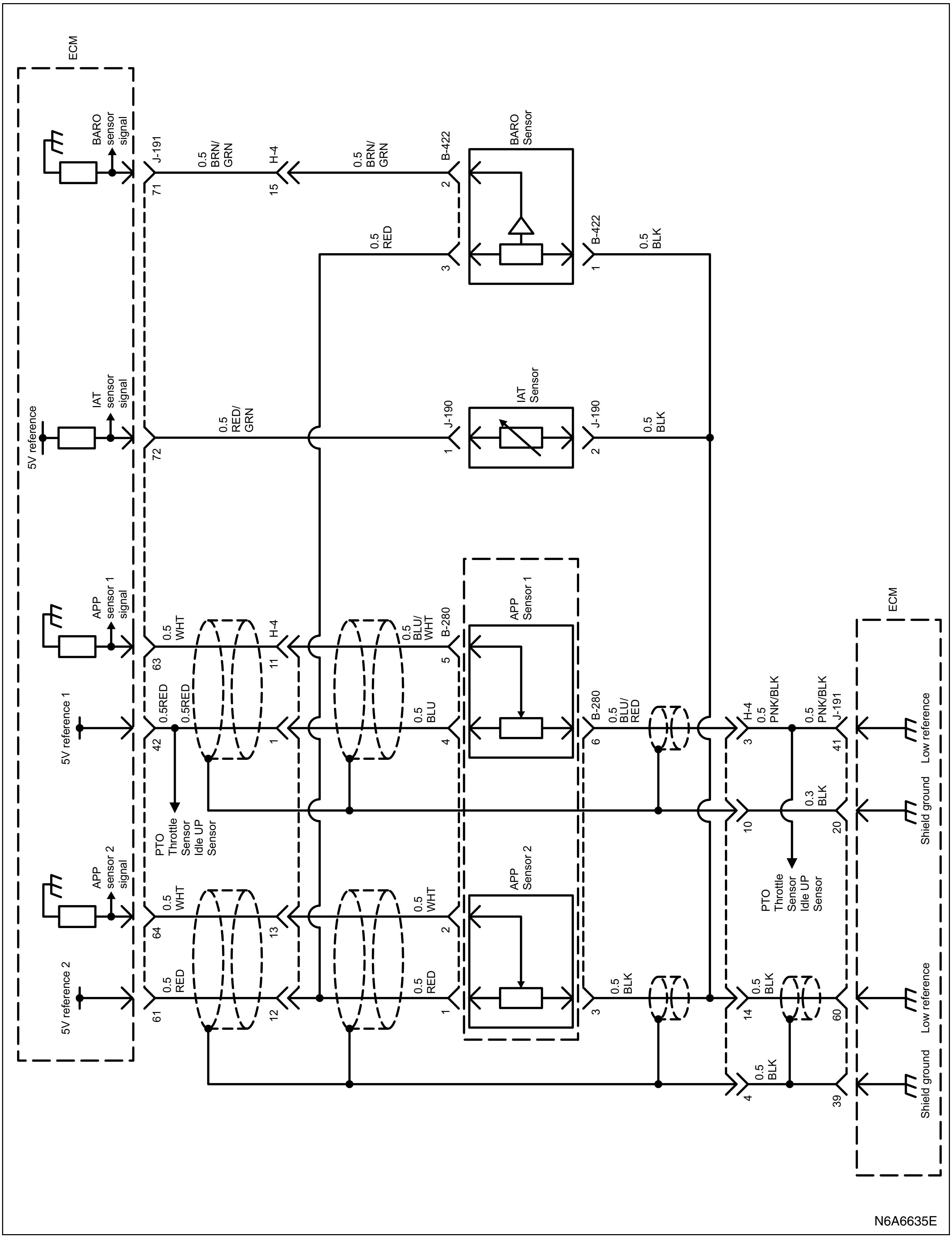
N6A6633E

Idle Up Sensor and PTO Throttle Sensor

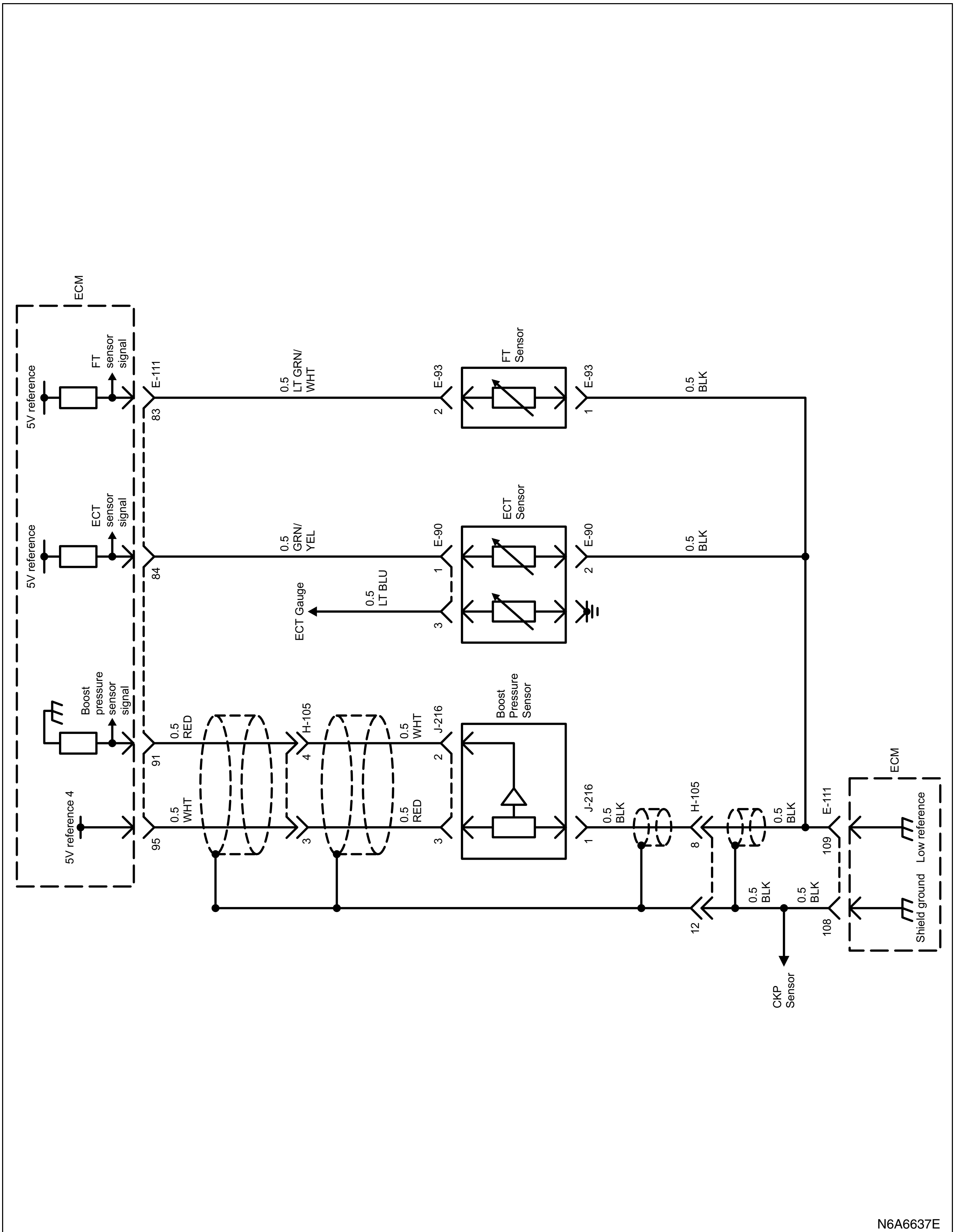


N6A6657E

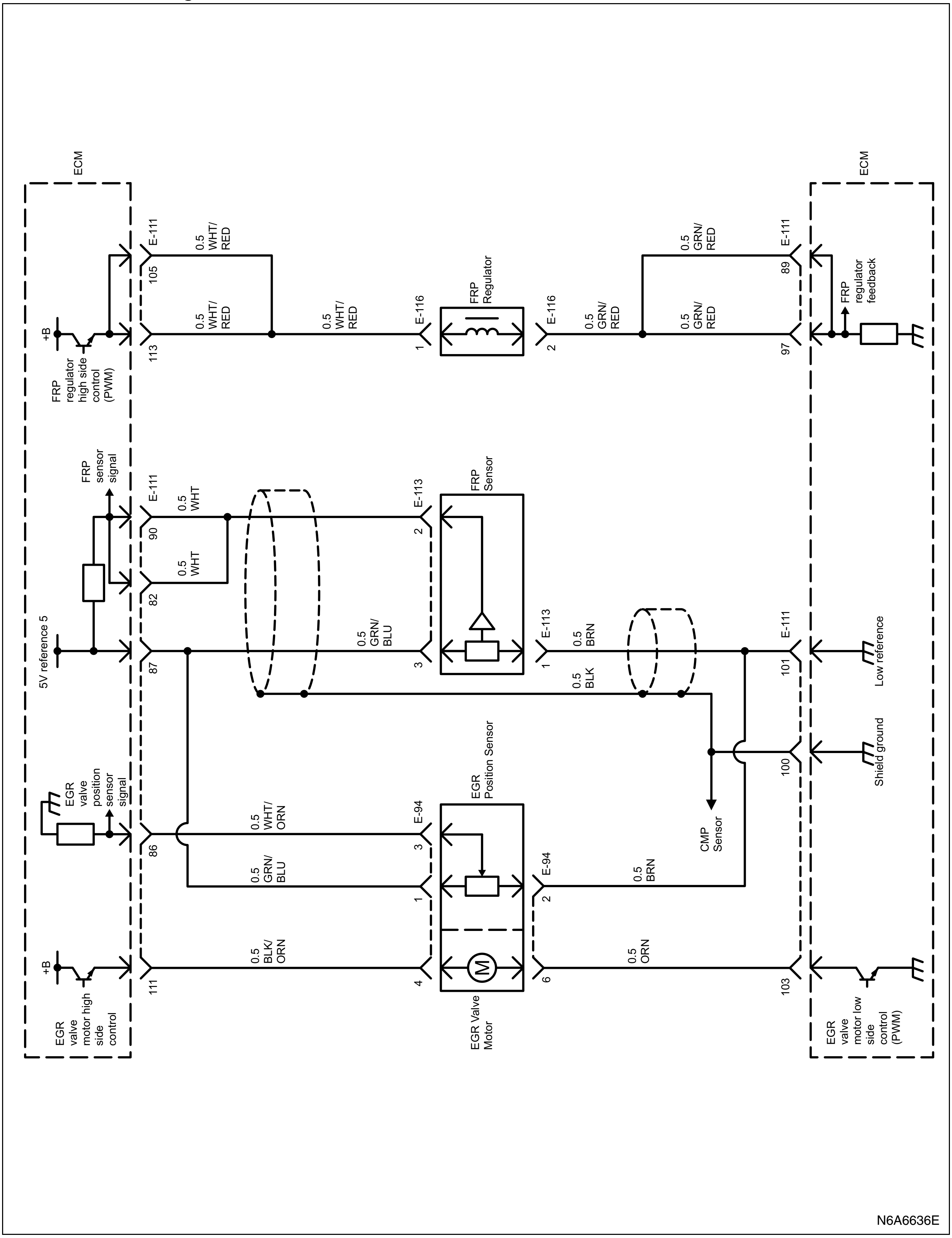
APP, IAT and BARO Sensors



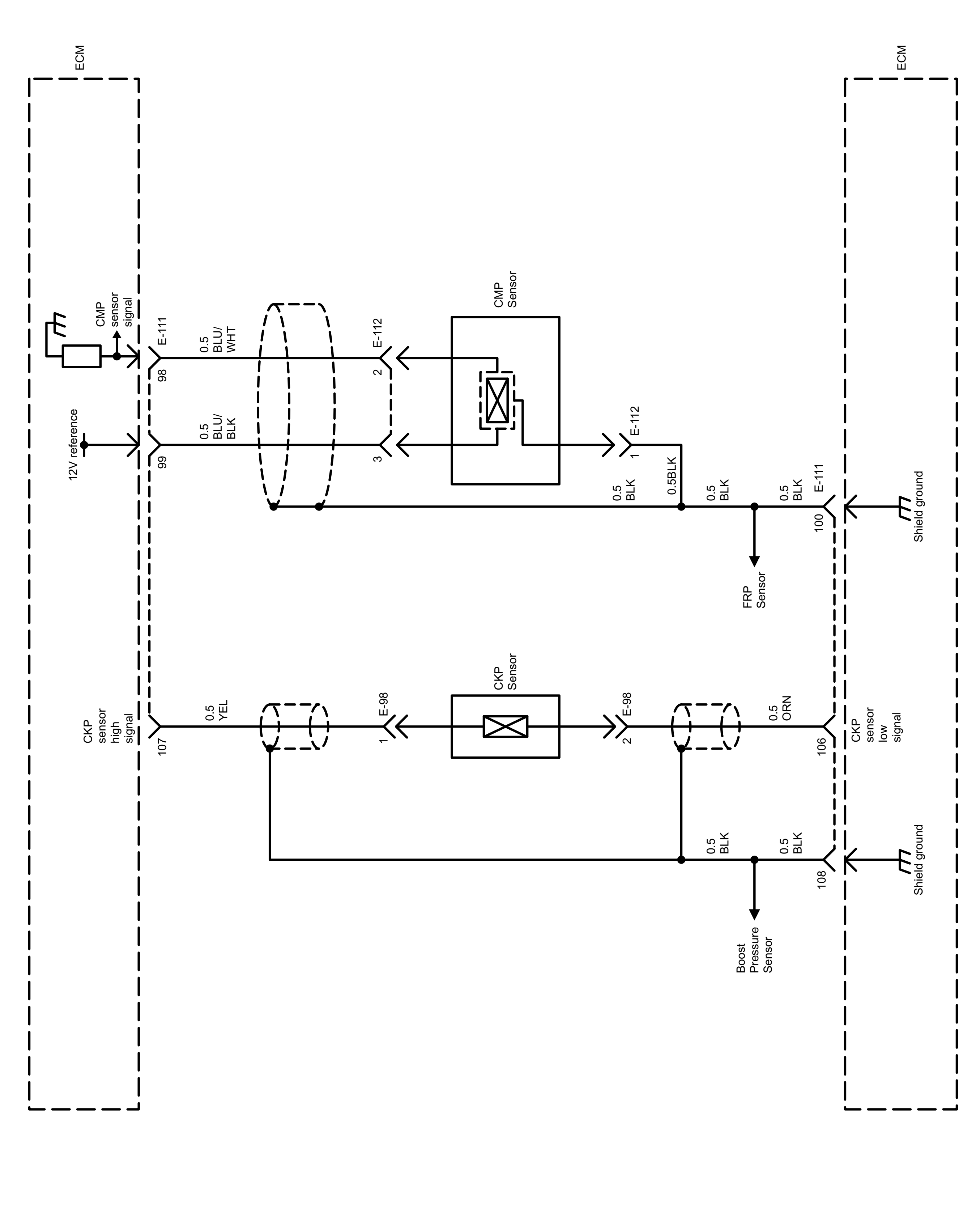
Boost Pressure Sensor, ECT Sensor and FT Sensor



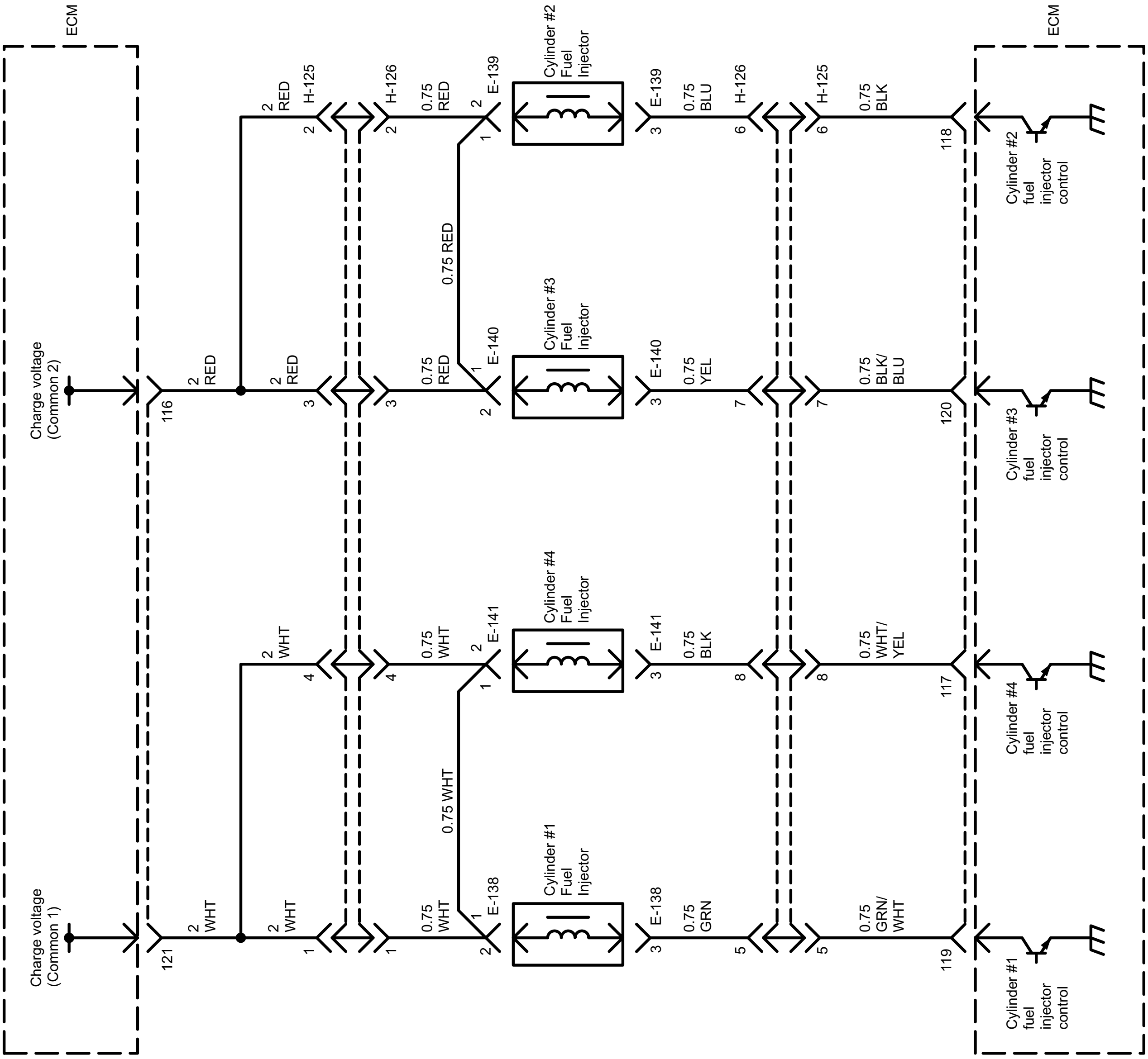
FRP Sensor, FRP Regulator and EGR Valve



CKP and CMP Sensors

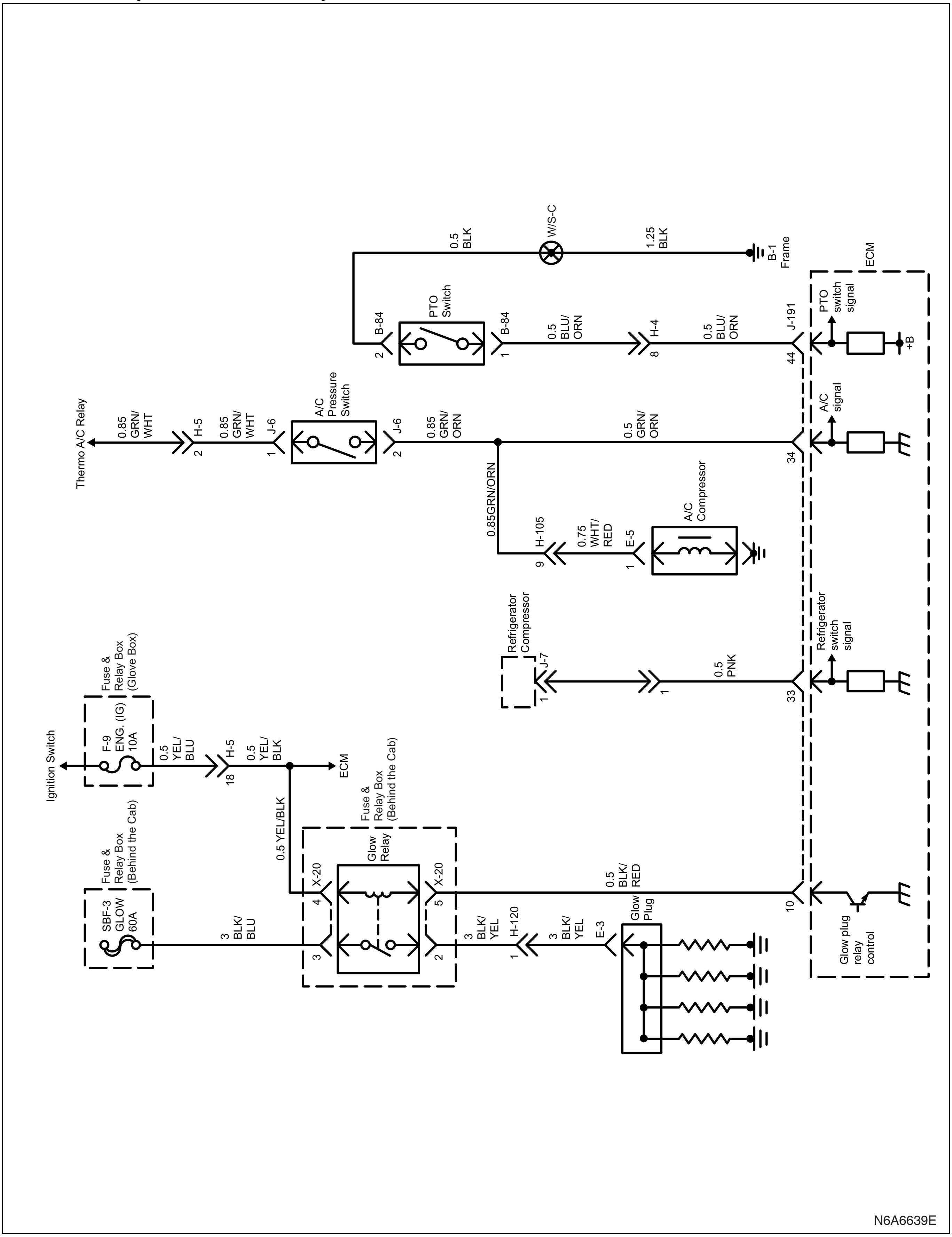


Injectors

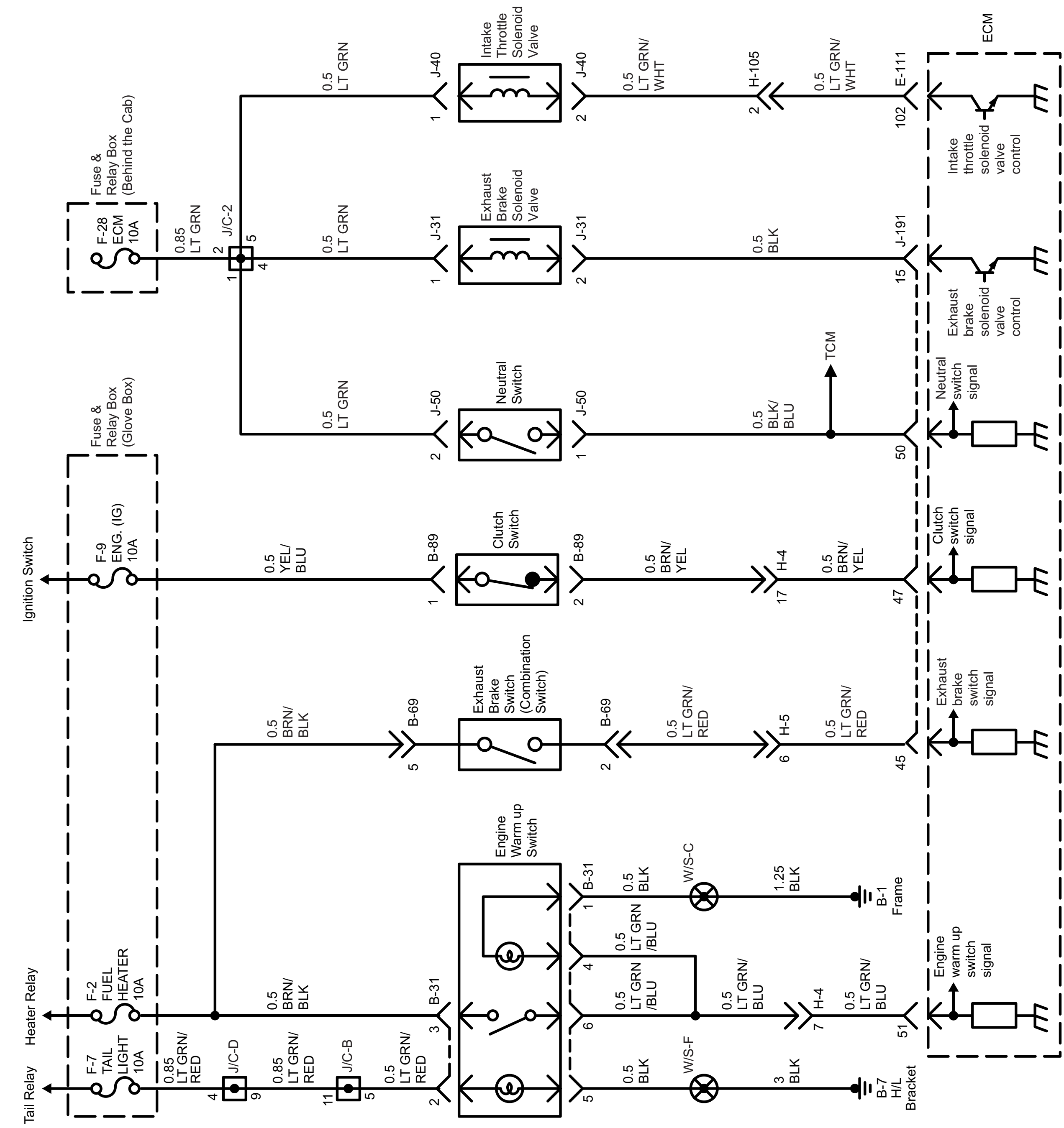


N6A6638E

Glow Control System, A/C Control System, PTO Switch

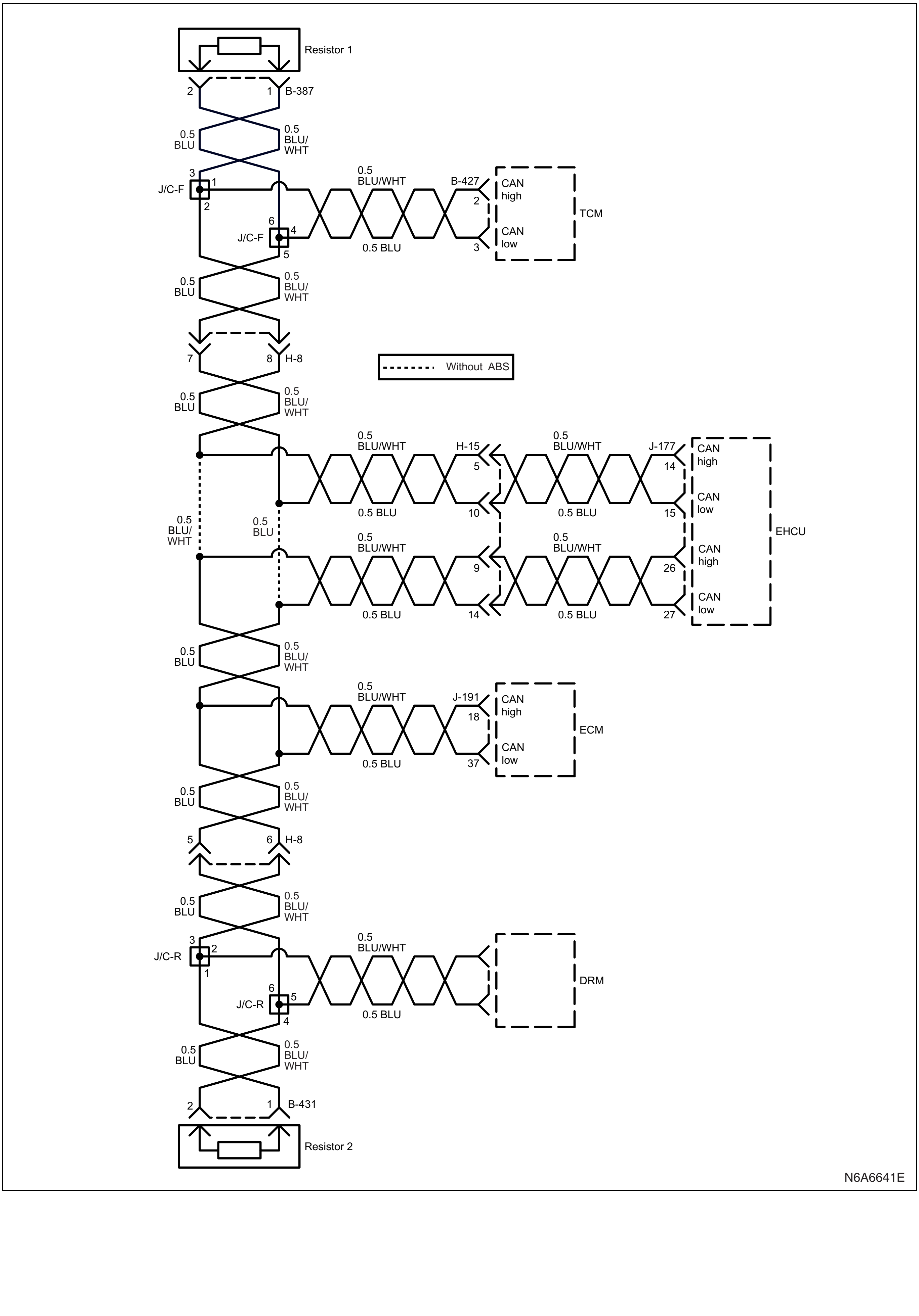


Clutch Switch, Neutral Switch, Exhaust Brake Switch, Engine Warm Up Switch, Exhaust Brake Solenoid Valve, Intake Throttle Solenoid Valve

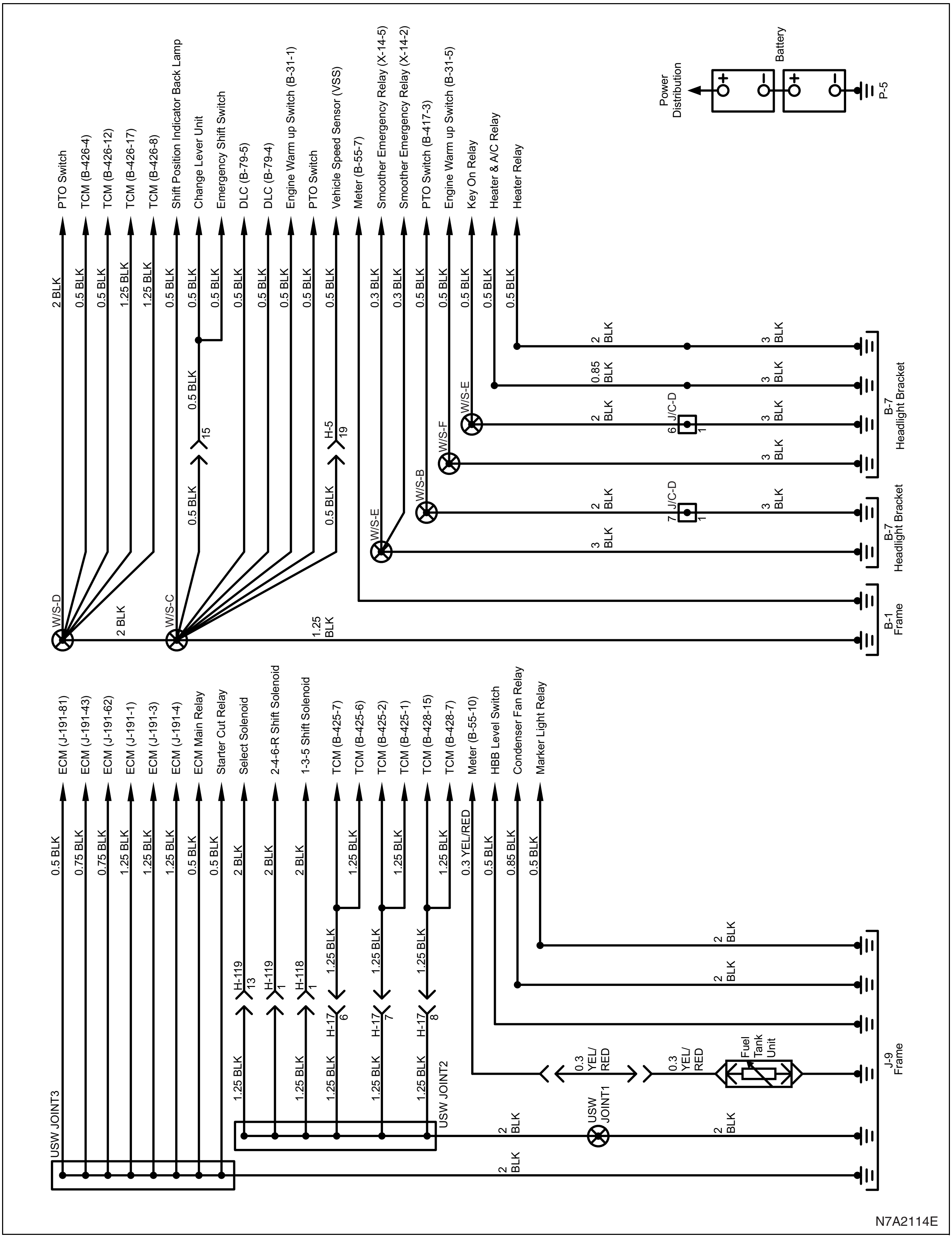


N6A6640E

CAN


Resistor 1
2
1
B-387
0.5
BLU
0.5
BLU/
WHT
3
J/C-F
1
2
0.5
BLU/WHT
B-427
CAN
high
2
TCM
6
J/C-F
4
5
CAN
low
0.5 BLU
3
0.5
BLU
0.5
BLU/
WHT
7
8
H-8
Without ABS
0.5
BLU
0.5
BLU/
WHT
0.5
BLU/WHT
H-15
5
0.5
BLU/WHT
J-177
14
CAN
high
CAN
low
0.5 BLU
10
0.5 BLU
15
0.5
BLU/
WHT
0.5
BLU
EHCU
0.5
BLU/WHT
9
0.5
BLU/WHT
26
CAN
high
CAN
low
0.5 BLU
14
0.5 BLU
27
0.5
BLU
0.5
BLU/
WHT
0.5
BLU/WHT
J-191
18
CAN
high
ECM
CAN
low
0.5 BLU
37
0.5
BLU
0.5
BLU/
WHT
5
6
H-8
0.5
BLU
0.5
BLU/
WHT
3
J/C-R
2
1
0.5
BLU/WHT
DRM
6
J/C-R
5
4
0.5 BLU
0.5
BLU
0.5
BLU/
WHT
2
1
B-431
Resistor 2
N6A6641E

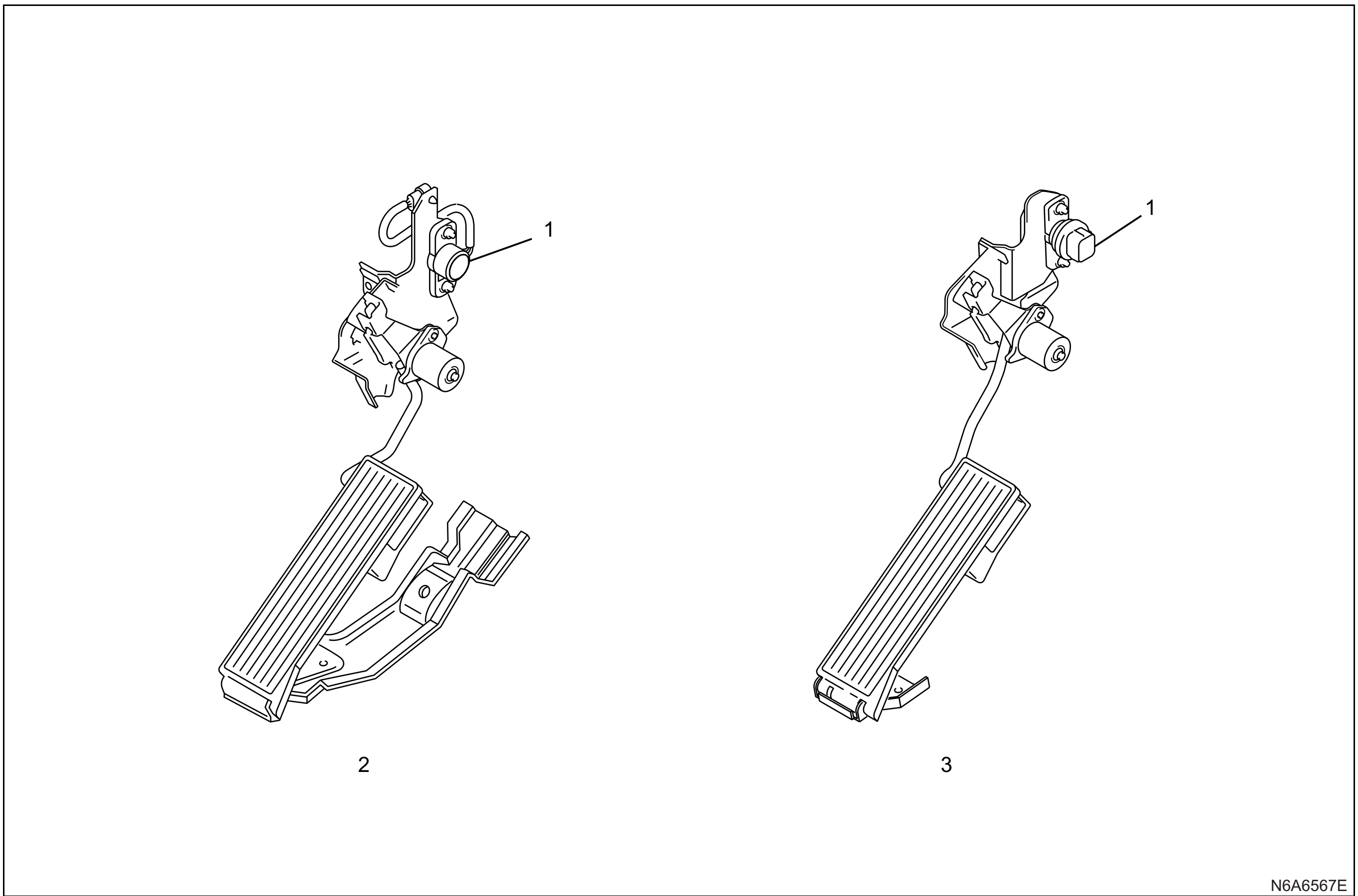
Ground Distributions



Component Locator

Engine Controls Component Views

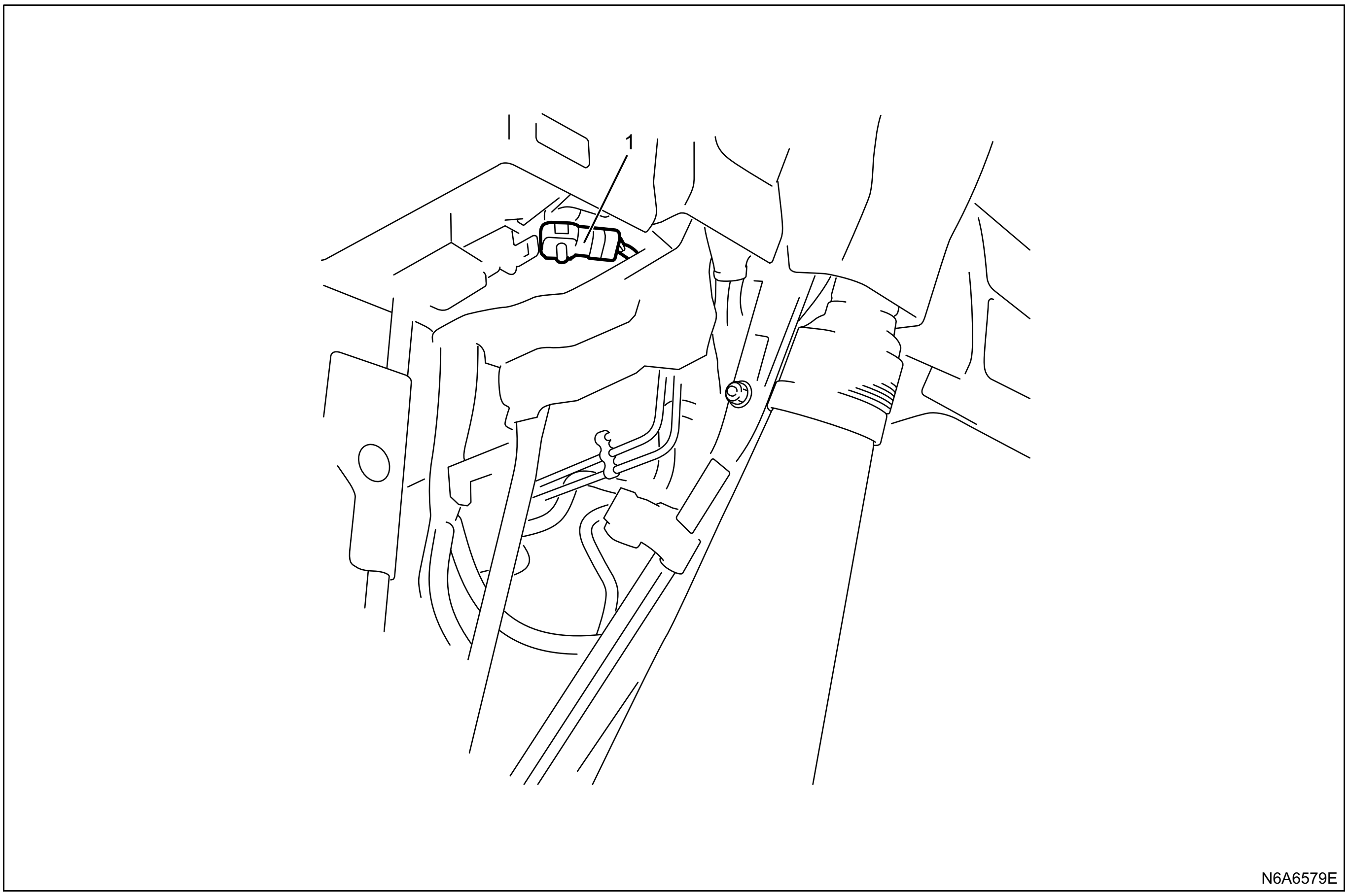
Accelerator Pedal Position (APP) Sensor



Legend

1. Accelerator Pedal Position (APP) Sensor Assembly
2. LHD Model
3. RHD Model

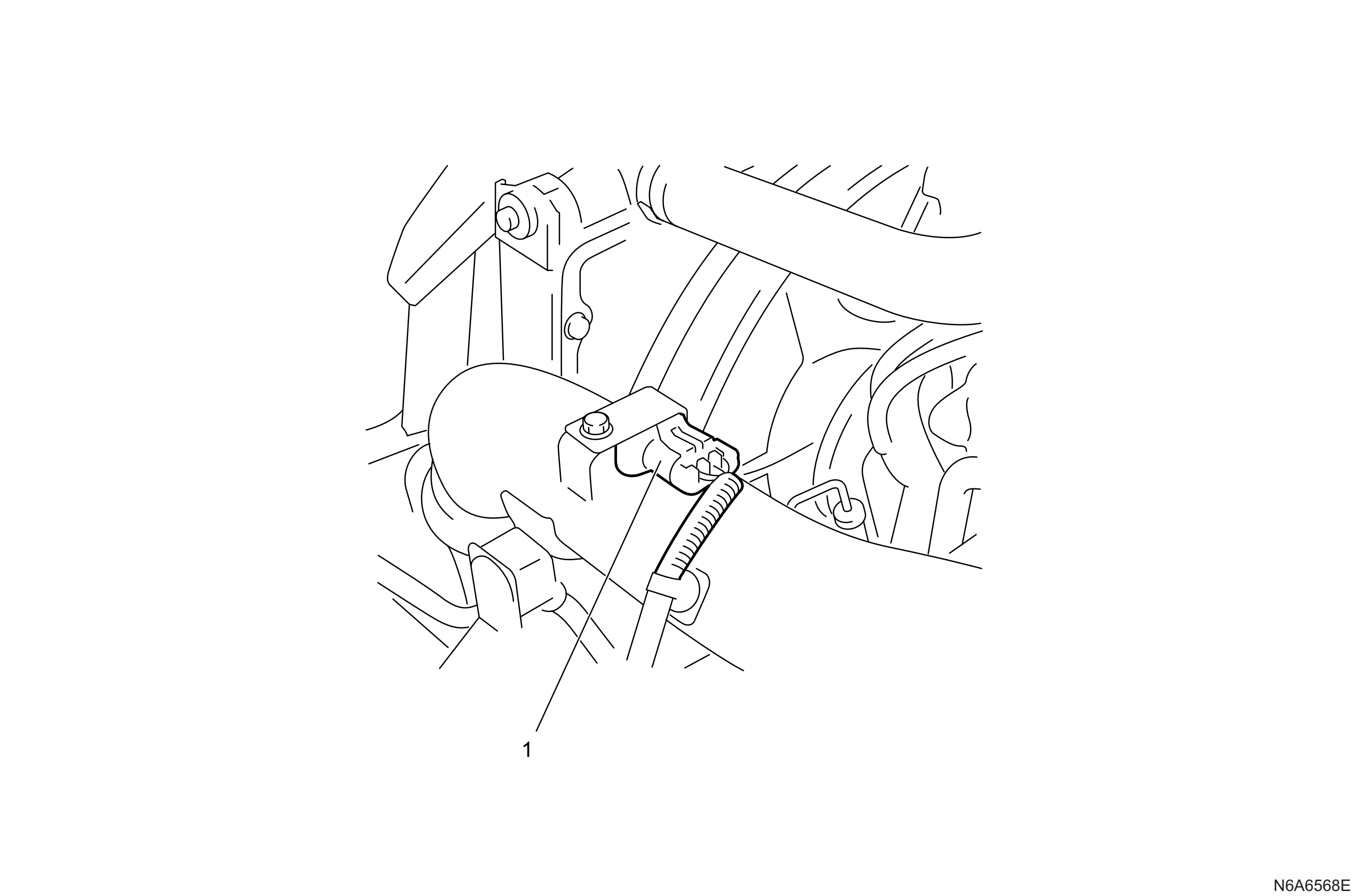
Barometric Pressure (BARO) Sensor



Legend

1. Barometric Pressure (BARO) Sensor

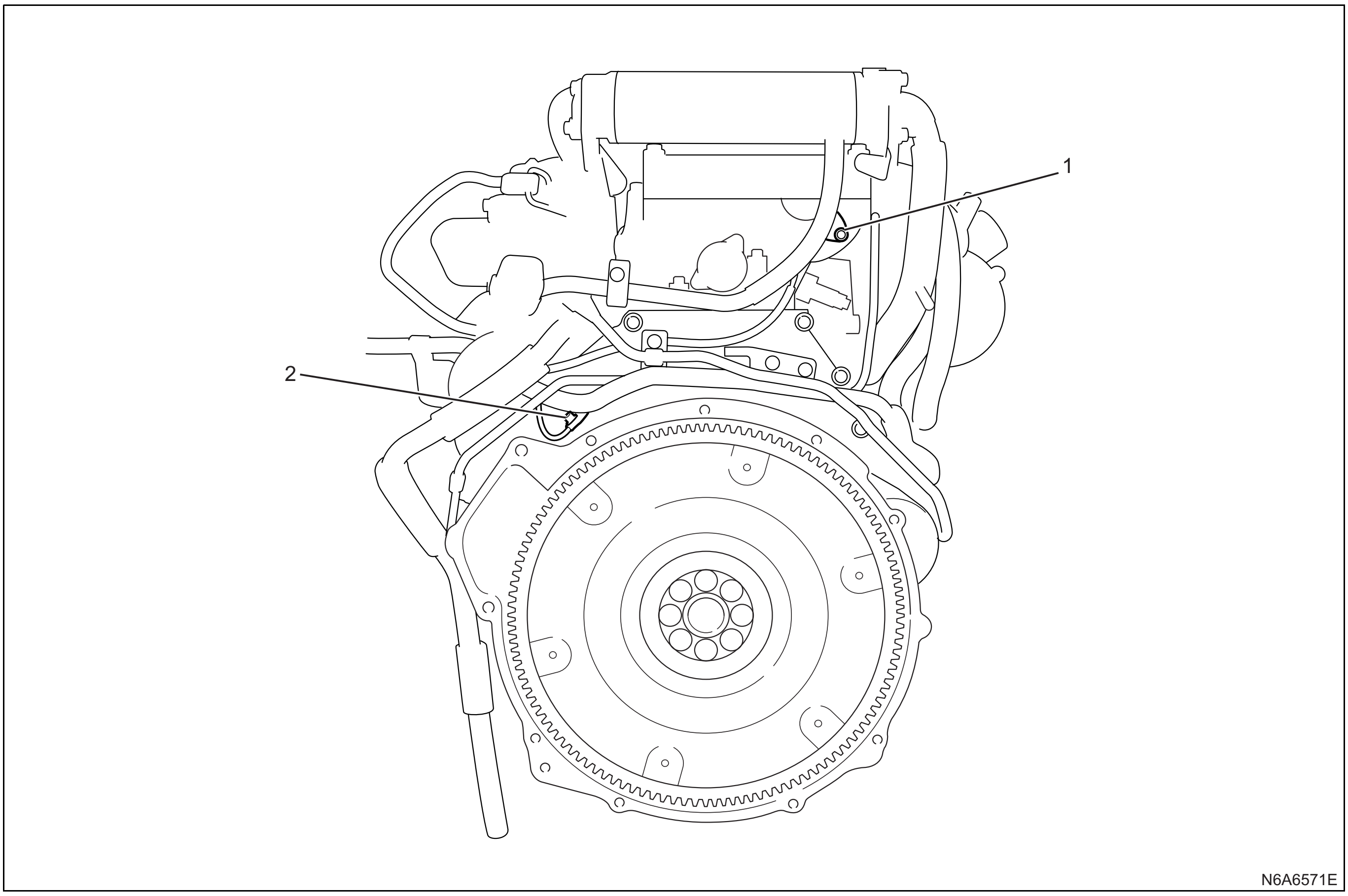
Boost Pressure Sensor



Legend

1. Boost Pressure Sensor

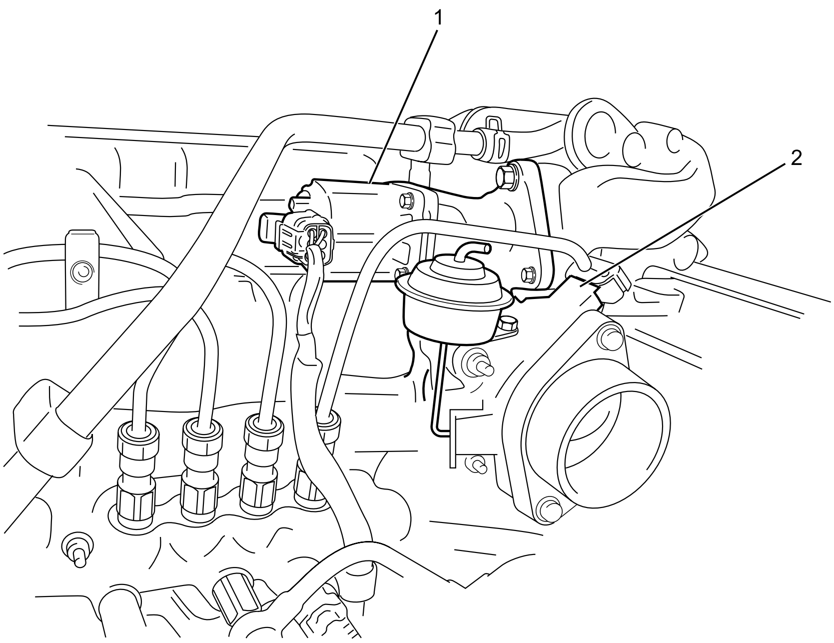
Camshaft Position (CMP), Crankshaft Position (CKP) Sensors



Legend

1. Camshaft Position (CMP) Sensor
2. Crankshaft Position (CKP) Sensor

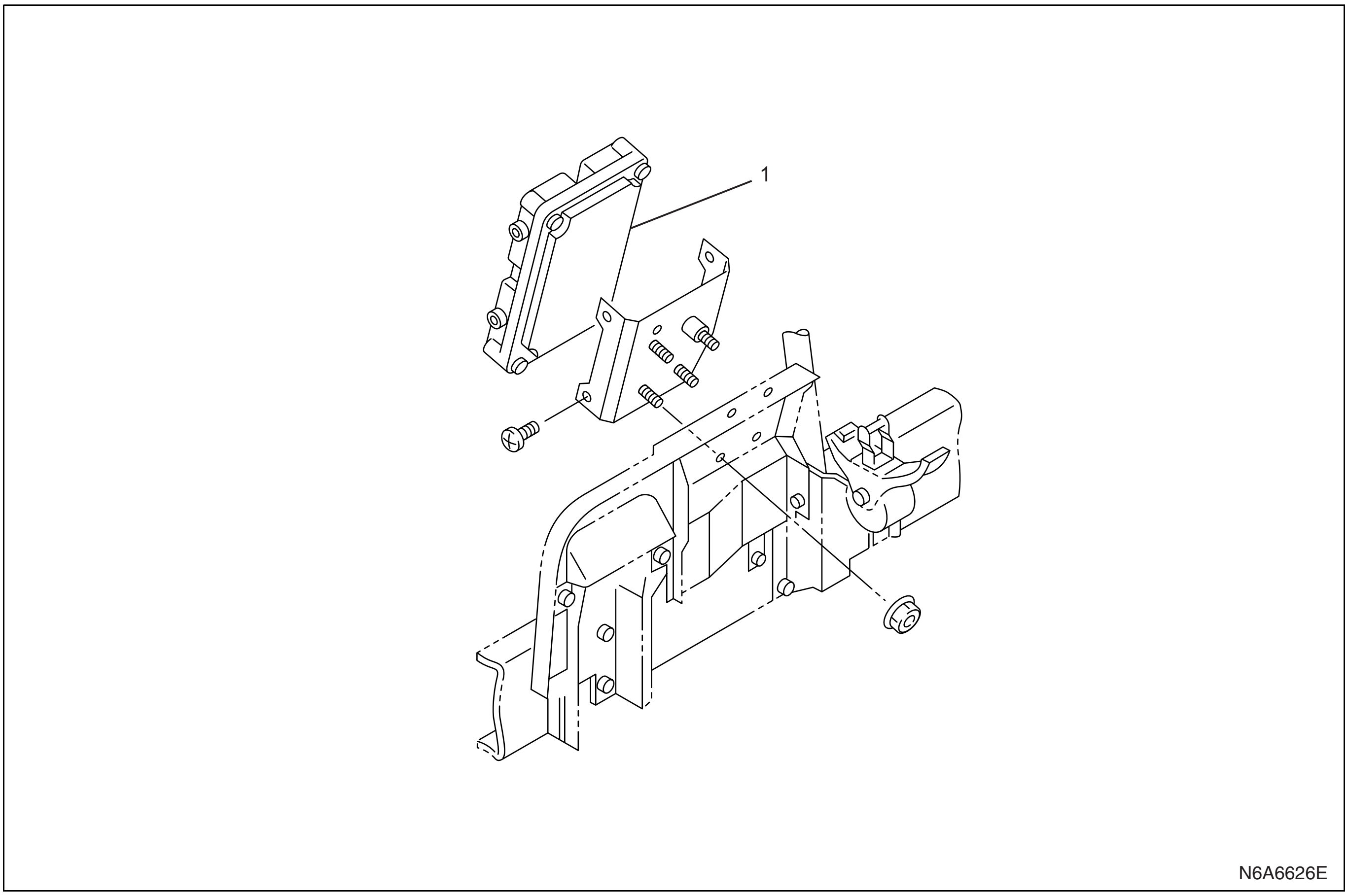
Exhaust Gas Recirculation (EGR) Valve and Intake Throttle Valve



Legend

1. Exhaust Gas Recirculation (EGR) Valve
2. Intake Throttle Valve

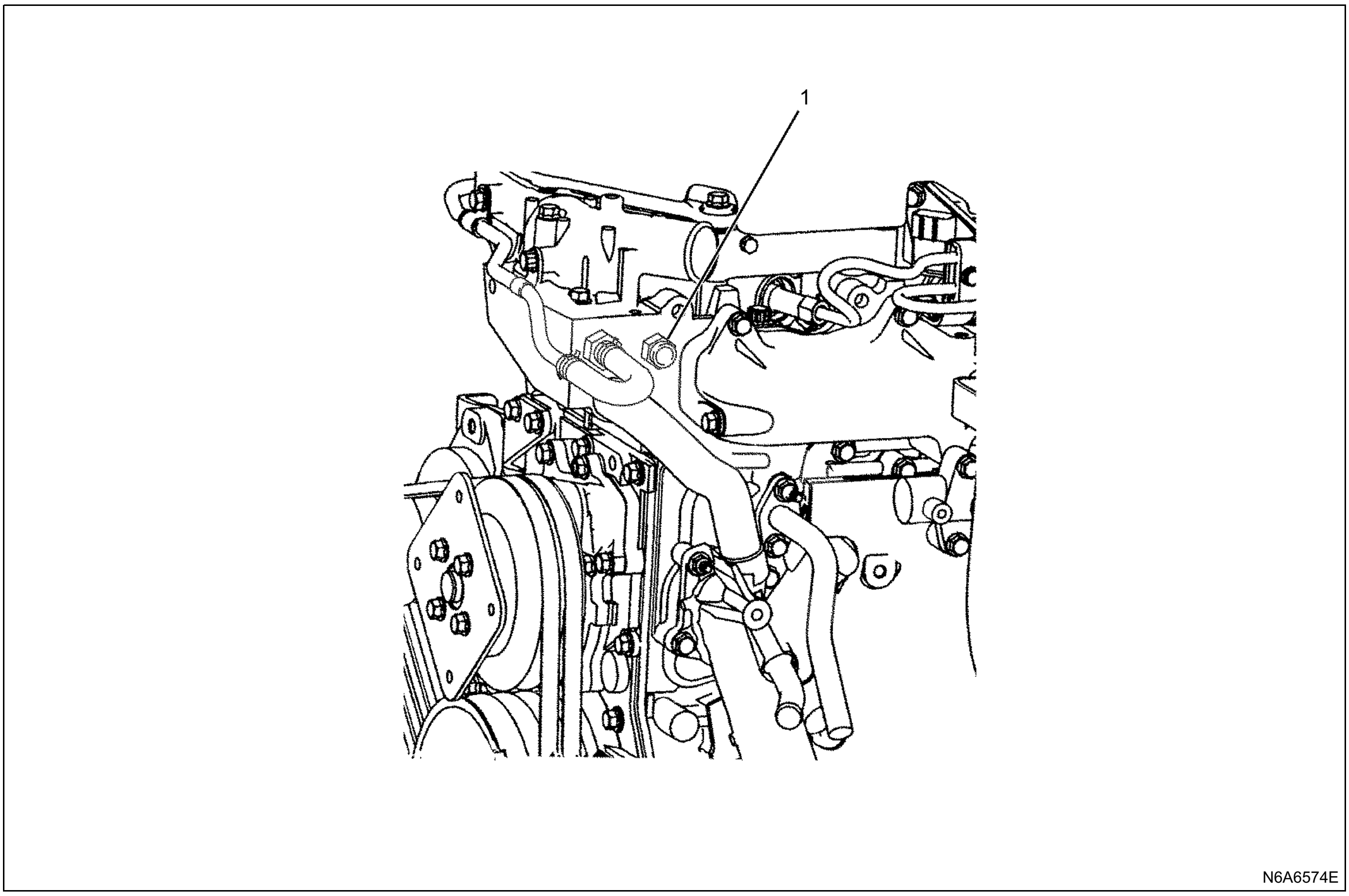
Engine Control Module (ECM)



Legend

1. Engine Control Module (ECM)

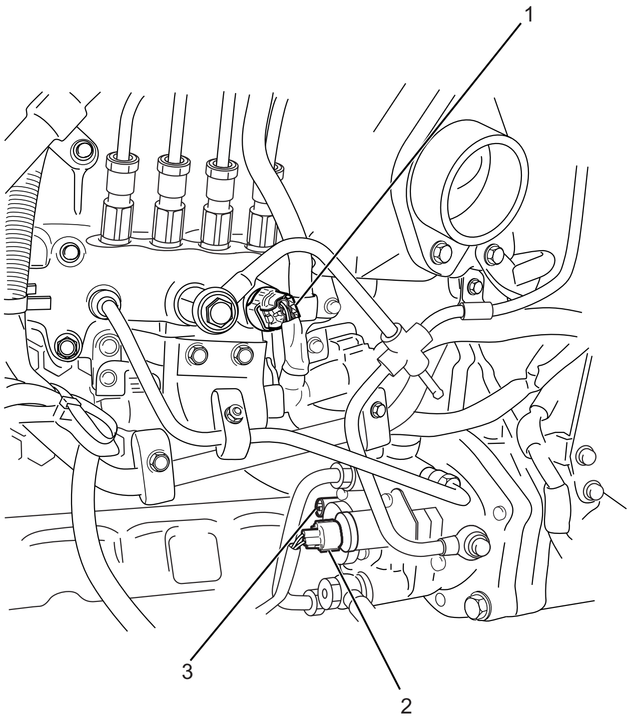
Engine Coolant Temperature (ECT) Sensor



Legend

1. Engine Coolant Temperature (ECT) Sensor

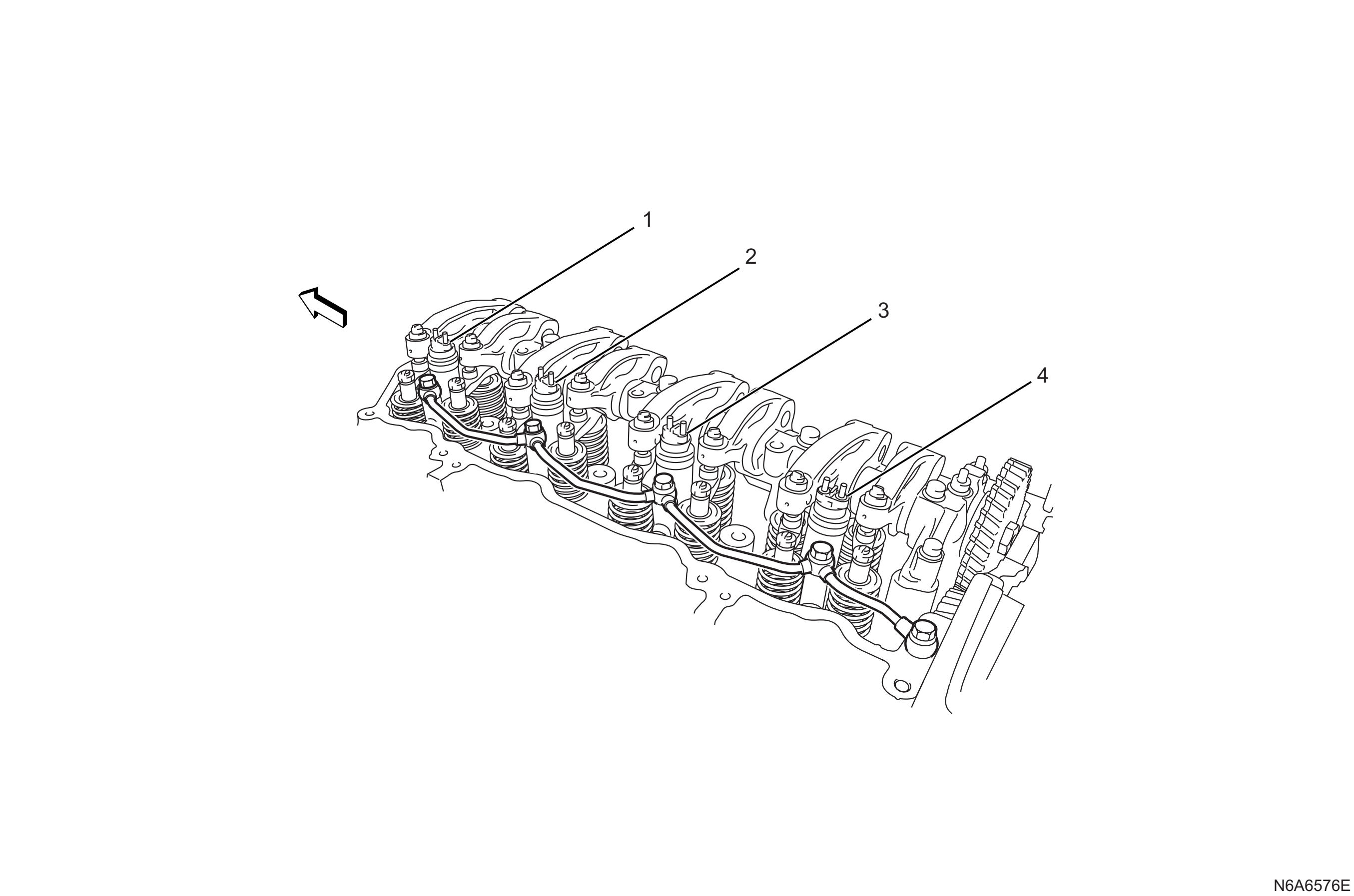
Fuel Rail Pressure (FRP) Sensor, Fuel Temperature (FT) Sensor and Fuel Rail Pressure (FRP) Regulator



Legend

1. Fuel Rail Pressure (FRP) Sensor
2. Fuel Rail Pressure (FRP) Regulator
3. Fuel Temperature (FT) Sensor

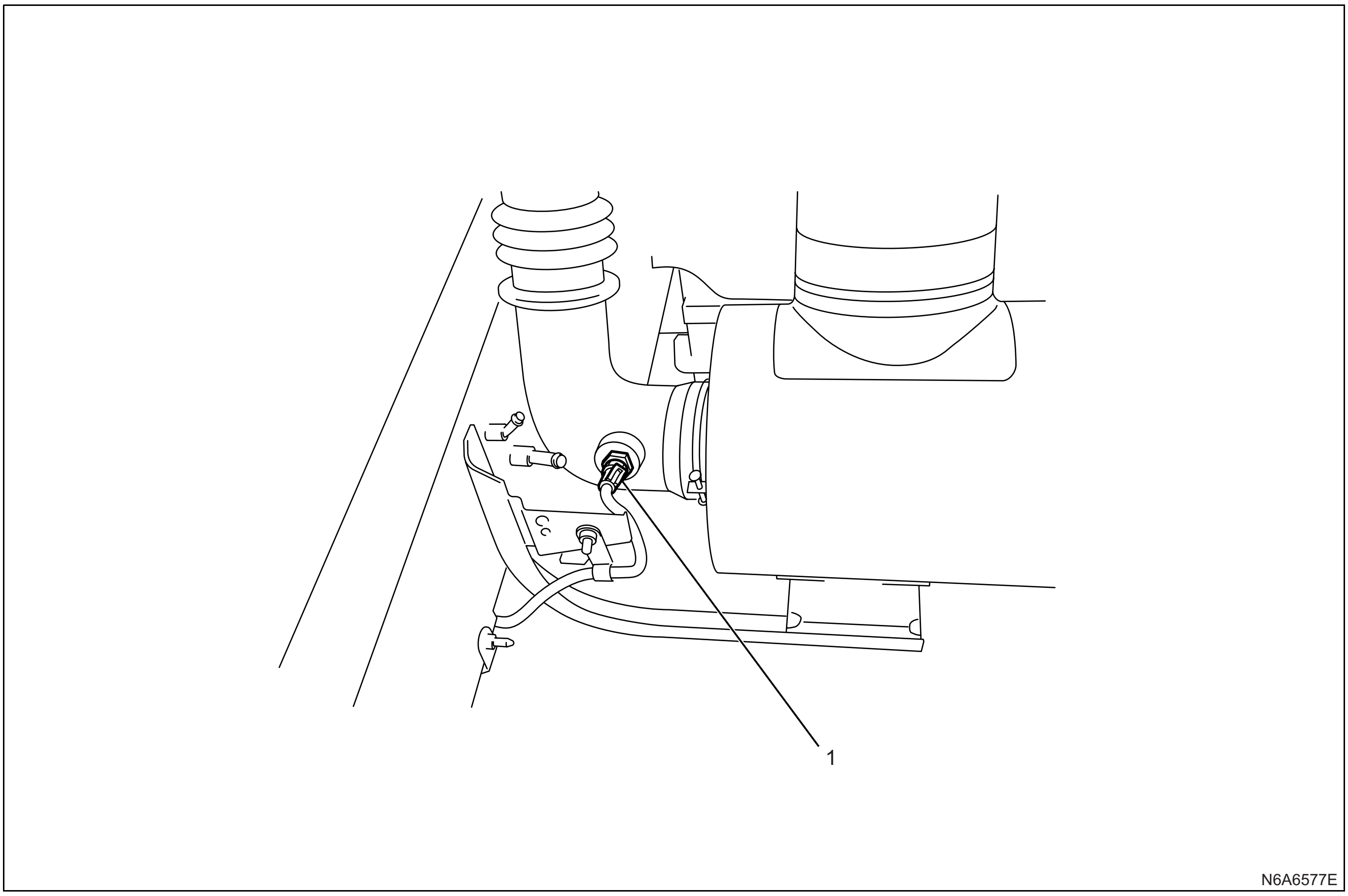
Fuel Injector



Legend

1. Cylinder #1 Injector
2. Cylinder #2 Injector
3. Cylinder #3 Injector
4. Cylinder #4 Injector

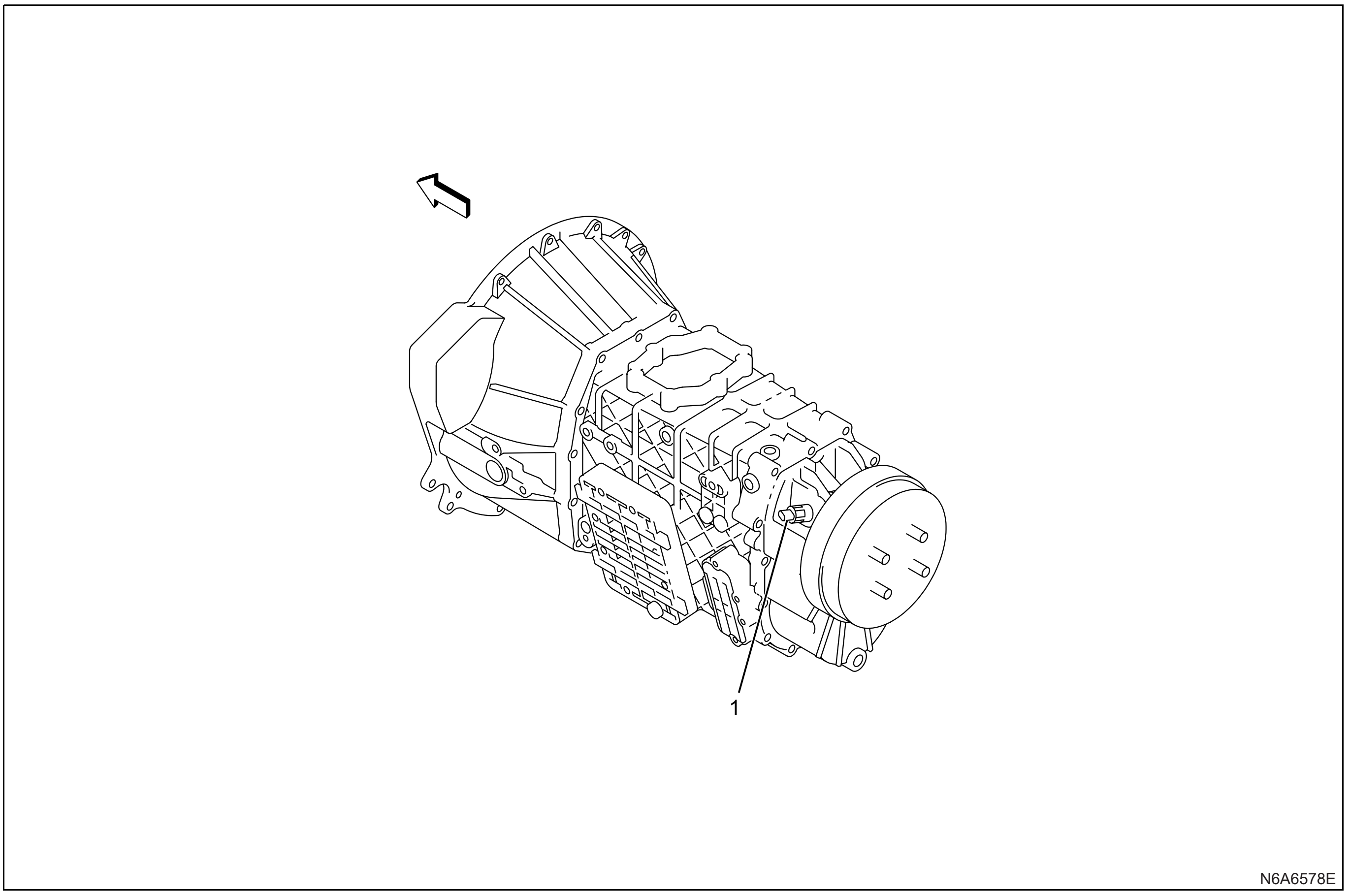
Intake Air Temperature (IAT) Sensor



Legend

1. Intake Air Temperature (IAT) Sensor

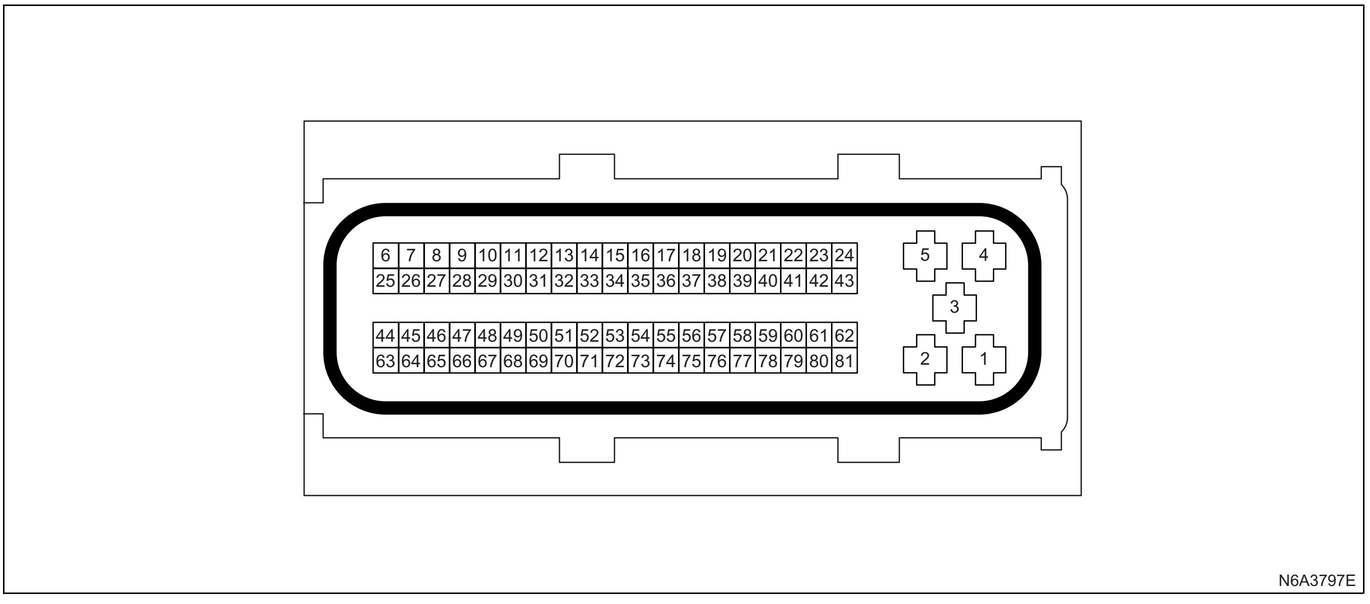
Vehicle Speed Sensor (VSS)



Legend

1. Vehicle Speed Sensor (VSS)

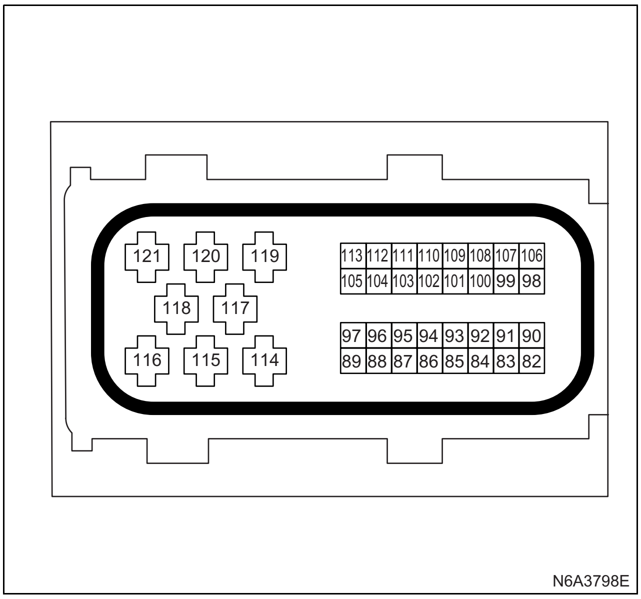
Engine Control Module (ECM) Connector End Views



Connector No.		J-191
Connector Color		Black
Test Adapter No.		J-35616-4A (Pin 1 – 5) J-35616-64A (Pin 6 – 81)
Pin	Wire Color	Pin Function
1	BLK	ECM Power Ground
2	RED	ECM Main Relay Voltage
3	BLK	ECM Power Ground
4	BLK	ECM Power Ground
5	RED	ECM Main Relay Voltage
6	BLU/RED	MIL Control
7	BLU/PNK	Exhaust Brake Lamp Control
8	LT GRN	Engine Speed Signal Output to Tachometer
9	—	Not Used
10	BLK/RED	Glow Plug Relay Control
11	ORN/BLU	Glow Indicator Lamp Control
12	—	Not Used
13	—	Not Used
14	WHT/BLU	Starter Cut Relay Control
15	BLK	Exhaust Brake Solenoid Valve Control
16	—	Not Used
17	—	Not Used
18	BLU/WHT	CAN High Signal
19	YEL/GRN	VSS Signal
20	BLK	APP Sensor 1 Shield Ground
21	BLU/BLK	ECM Main Relay Control
22	—	Not Used
23	—	Not Used
24	YEL/BLK	Ignition ON Switch Input Signal
25	—	Not Used
26	—	Not Used
27	—	Not Used
28	—	Not Used
29	—	Not Used
30	—	Not Used
31	—	Not Used
32	—	Not Used
33	PNK	Refrigerator Switch Input Signal
34	GRN/ORN	A/C Input Signal
35	—	Not Used
36	—	Not Used

Connector No.		J-191
Connector Color		Black
Test Adapter No.		J-35616-4A (Pin 1 – 5) J-35616-64A (Pin 6 – 81)
Pin	Wire Color	Pin Function
37	BLU	CAN Low Signal
38	LT BLU	Keyword 2000 Serial Data
39	BLK	APP Sensor 2 Shield Ground
40	BLU/BLK	ECM Main Relay Control
41	PNK/BLK	APP Sensor 1, Idle Up Sensor & PTO Throttle Sensor Low Reference
42	RED	APP Sensor 1, Idle Up Sensor & PTO Throttle Sensor 5 Volts Reference
43	BLK	ECM Signal Ground
44	BLU/ORN	PTO Mode Switch Input Signal
45	LT GRN/RED	Exhaust Brake Switch Input Signal
46	RED/WHT	Start Switch Input Signal
47	BRN/YEL	Clutch Switch Input Signal (M/T Only)
48	WHT/BLK	Park Brake Switch Input Signal
49	—	Not Used
50	BLK/BLU	Neutral Switch Input Signal
51	LT GRN/BLU	Engine Warm Up Switch Input Signal
52	YEL	Diagnostic Request Switch
53	—	Not Used
54	—	Not Used
55	—	Not Used
56	—	Not Used
57	—	Not Used
58	—	Not Used
59	—	Not Used
60	BLK	APP Sensor 2, BARO Sensor & IAT Sensor Low Reference
61	RED	APP Sensor 2 & BARO Sensor 5 Volts Reference
62	BLK	ECM Signal Ground
63	WHT	APP Sensor 1 Signal
64	WHT	APP Sensor 2 Signal
65	—	Not Used
66	BLU/YEL	Idle Up Sensor Signal
67	—	Not Used
68	—	Not Used

Connector No.		J-191
Connector Color		Black
Test Adapter No.		J-35616-4A (Pin 1 – 5) J-35616-64A (Pin 6 – 81)
Pin	Wire Color	Pin Function
69	—	Not Used
70	BRN	PTO Throttle Sensor Signal
71	BRN/GRN	BARO Sensor Signal
72	RED/GRN	IAT Sensor Signal
73	—	Not Used
74	—	Not Used
75	—	Not Used
76	—	Not Used
77	—	Not Used
78	—	Not Used
79	—	Not Used
80	—	Not Used
81	BLK	ECM Case Ground



Connector No.		E-111
Connector Color		Black
Test Adapter No.		J-35616-4A (Pin 82 – 113) J-35616-64A (Pin 114 – 121)
Pin	Wire Color	Pin Function
82	WHT	FRP Sensor Signal
83	LT GRN/ WHT	FT Sensor Signal
84	GRN/YEL	ECT Sensor Signal
85	—	Not Used

Connector No.		E-111
Connector Color		Black
Test Adapter No.		J-35616-4A (Pin 82 – 113) J-35616-64A (Pin 114 – 121)
Pin	Wire Color	Pin Function
86	WHT/ORN	EGR Valve Position Sensor Signal
87	GRN/BLU	FRP Sensor & EGR Valve Position Sensor 5 Volts Reference
88	—	Not Used
89	GRN/RED	FRP Regulator Low Side
90	WHT	FRP Sensor Signal
91	RED	Boost Pressure Sensor Signal
92	—	Not Used
93	—	Not Used
94	—	Not Used
95	WHT	Boost Pressure Sensor 5 Volts Reference
96	—	Not Used
97	GRN/RED	FRP Regulator Low Side
98	BLU/WHT	CMP Sensor Signal
99	BLU/BLK	CMP Sensor 12 Volts Reference
100	BLK	FRP Sensor & CMP Sensor Shield Ground
101	BRN	FRP Sensor & EGR Valve Position Sensor Low Reference
102	LT GRN/ WHT	Intake Throttle Solenoid Valve Control
103	ORN	EGR Valve Motor Control Low Side
104	—	Not Used
105	WHT/RED	FRP Regulator High Control
106	ORN	CKP Sensor Low Signal
107	YEL	CKP Sensor High Signal
108	BLK	Boost Pressure Sensor & CKP Sensor Shield Ground
109	BLK	Boost Pressure Sensor, ECT Sensor & FT Sensor Low Reference
110	—	Not Used
111	BLK/ORN	EGR Valve Motor Control High Side
112	—	Not Used
113	WHT/RED	FRP Regulator High Control
114	—	Not Used
115	—	Not Used

Connector No.		E-111
Connector Color		Black
Test Adapter No.		J-35616-4A (Pin 82 – 113) J-35616-64A (Pin 114 – 121)
Pin	Wire Color	Pin Function
116	RED	Common 2 (Cylinder #2 & #3) Fuel Injector Drive
117	WHT/YEL	Cylinder #4 Fuel Injector Solenoid Control
118	BLK	Cylinder #2 Fuel Injector Solenoid Control
119	GRN/WHT	Cylinder #1 Fuel Injector Solenoid Control
120	BLK/BLU	Cylinder #3 Fuel Injector Solenoid Control
121	WHT	Common 1 (Cylinder #1 & #4) Fuel Injector Drive

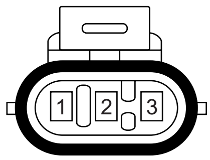
Engine Controls Connector End Views

Accelerator Pedal Position (APP) Sensor

N6A6451E

Connector No.		B-280
Connector Color		Gray
Test Adapter No.		J-35616-33
Pin	Wire Color	Pin Function
1	RED	APP Sensor 2 5 Volts Reference
2	WHT	APP Sensor 2 Signal
3	BLK	APP Sensor 2 Low Reference
4	BLU	APP Sensor 1 5 Volts Reference
5	BLU/WHT	APP Sensor 1 Signal
6	BLU/RED	APP Sensor 1 Low Reference

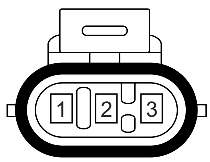
Barometric Pressure (BARO) Sensor



N6A6452E

Connector No.		B-422
Connector Color		Gray
Test Adapter No.		J-35616-33
Pin	Wire Color	Pin Function
1	BLK	BARO Sensor Low Reference
2	BRN/GRN	BARO Sensor Signal
3	RED	BARO Sensor 5 Volts Reference

Boost Pressure Sensor

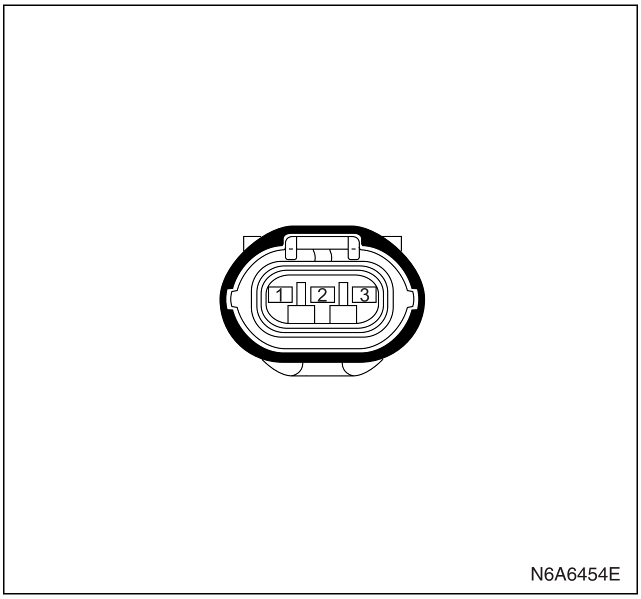


N6A6452E

Connector No.		J-216
Connector Color		Gray
Test Adapter No.		J-35616-33
Pin	Wire Color	Pin Function
1	BLK	Boost Pressure Sensor Low Reference

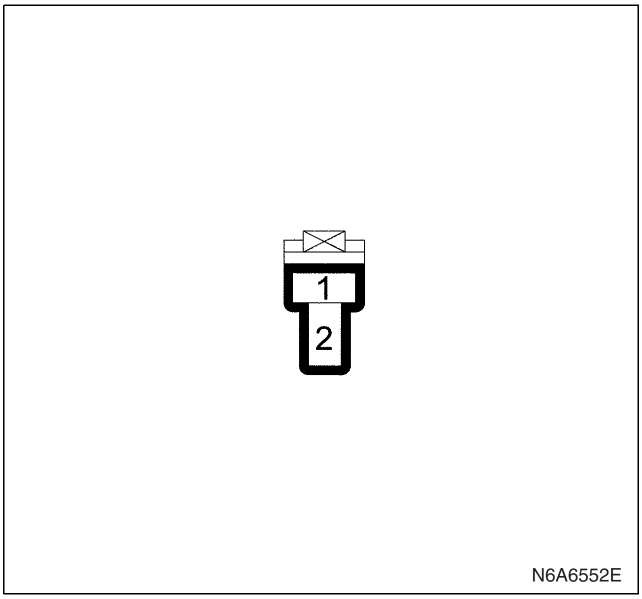
Connector No.		J-216
Connector Color		Gray
Test Adapter No.		J-35616-33
Pin	Wire Color	Pin Function
2	WHT	Boost Pressure Sensor Signal
3	RED	Boost Pressure Sensor 5 Volts Reference

Camshaft Position (CMP) Sensor



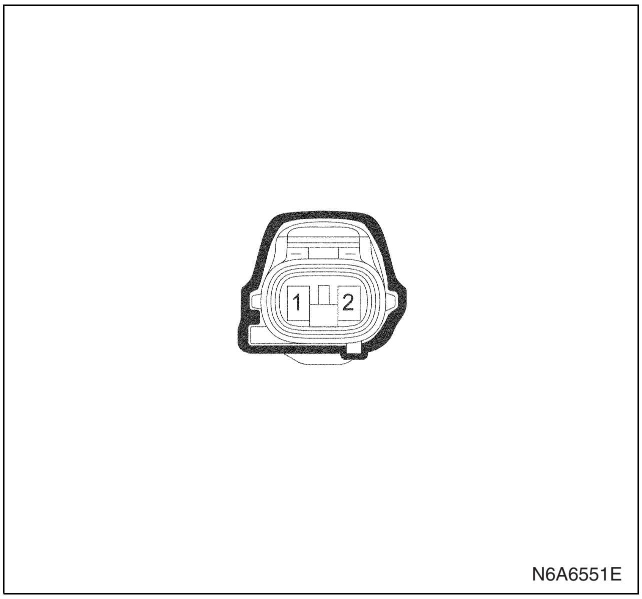
Connector No.		E-112
Connector Color		Black
Test Adapter No.		J-35616-33
Pin	Wire Color	Pin Function
1	BLK	CMP Sensor Shield Ground
2	BLU/WHT	CMP Sensor Signal
3	BLU/BLK	CMP Sensor 12 Volts Reference

Clutch Switch



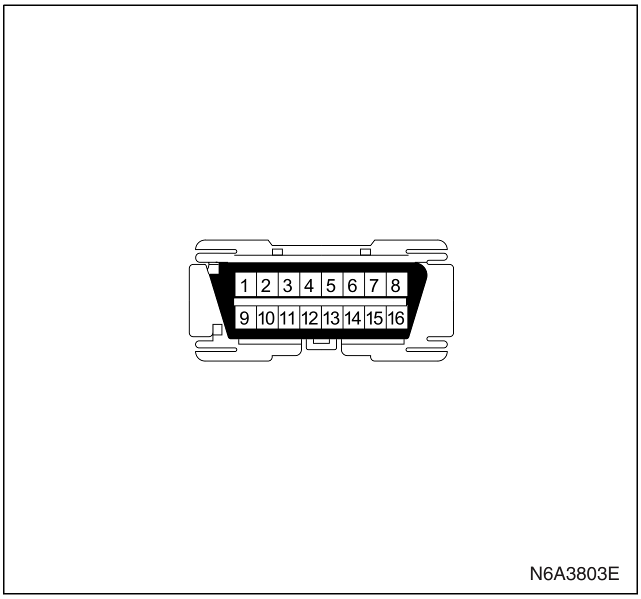
Connector No.		B-89
Connector Color		White
Test Adapter No.		J-35616-42
Pin	Wire Color	Pin Function
1	YEL/BLK	Clutch Pedal Switch Voltage Feed
2	BRN/YEL	Clutch Pedal Switch Signal

Crankshaft Position (CKP) Sensor



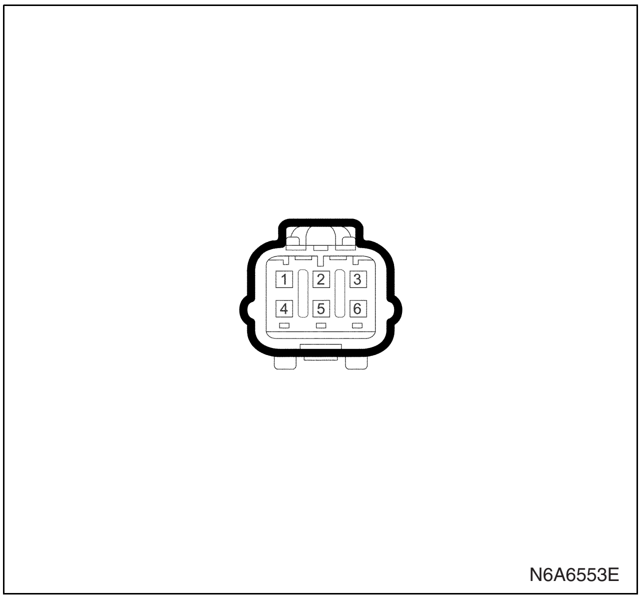
Connector No.		E-98
Connector Color		Gray
Test Adapter No.		J-35616-64A
Pin	Wire Color	Pin Function
1	YEL	CKP Sensor High Signal
2	ORN	CKP Sensor Low Signal

Data Link Connector (DLC)



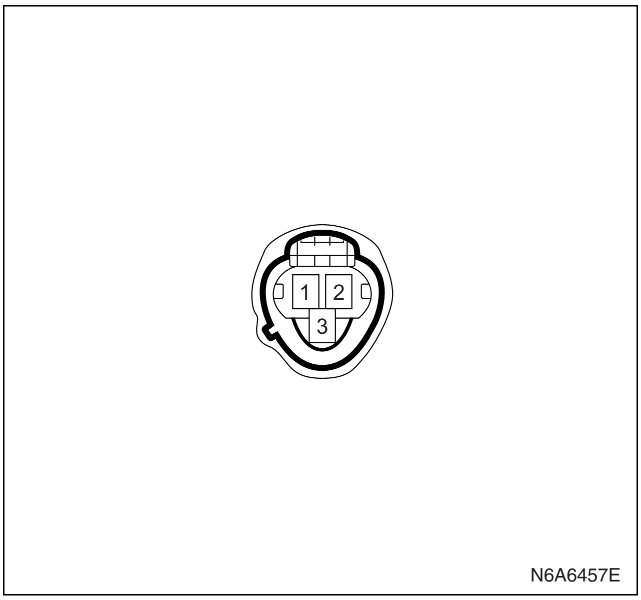
Connector No.		B-79
Connector Color		Black
Test Adapter No.		J-35616-2A
Pin	Wire Color	Pin Function
1	YEL	Diagnostic Request (ECM)
2	WHT/BLK	Class 2 Serial Communication (EHCU)
3	—	Not Used
4	BLK	Ground
5	BLK	Ground
6	—	Not Used
7	LT BLU	Keyword Serial Communication (ECM, TCM or HSA & SRS)
8	—	Not Used
9	—	Not Used
10	—	Not Used
11	BLK/WHT	Diagnostic Request (TCM or HSA)
12	WHT/GRN	Diagnostic Request (EHCU)
13	GRY	Diagnostic Request (SRS)
14	—	Not Used
15	—	Not Used
16	—	Not Used

EGR Valve



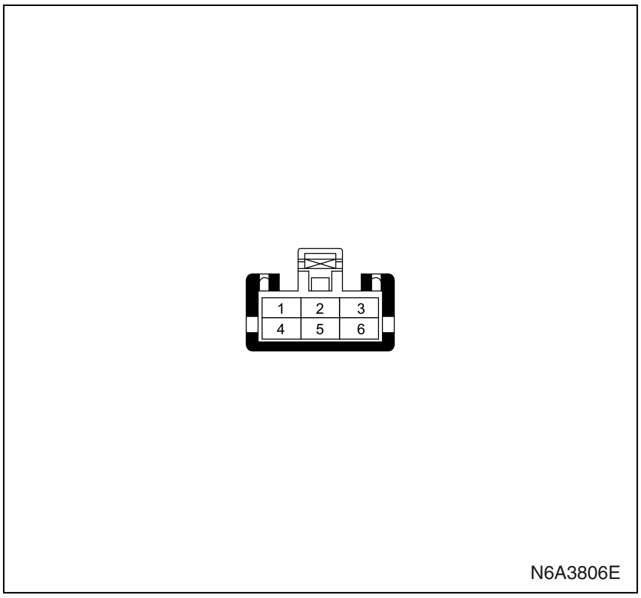
Connector No.		E-94
Connector Color		Gray
Test Adapter No.		J-35616-64A
Pin	Wire Color	Pin Function
1	GRN/BLU	EGR Valve Position Sensor 5 Volts Reference
2	BRN	EGR Valve Position Sensor Low Reference
3	WHT/ORN	EGR Valve Position Sensor Signal
4	BLK/ORN	EGR Valve Motor Control High Side
5	—	Not Used
6	ORN	EGR Valve Motor Control Low Side

Engine Coolant Temperature (ECT) Sensor



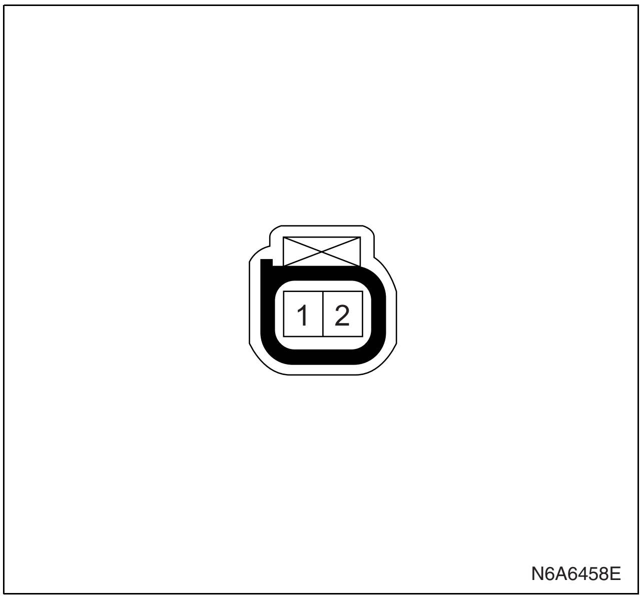
Connector No.		E-90
Connector Color		Gray
Test Adapter No.		J-35616-33
Pin	Wire Color	Pin Function
1	GRN/YEL	ECT Sensor Signal
2	BLK	ECT Sensor Low Reference
3	LT BLUK	ECT Gauge Signal

Engine Warm Up Switch



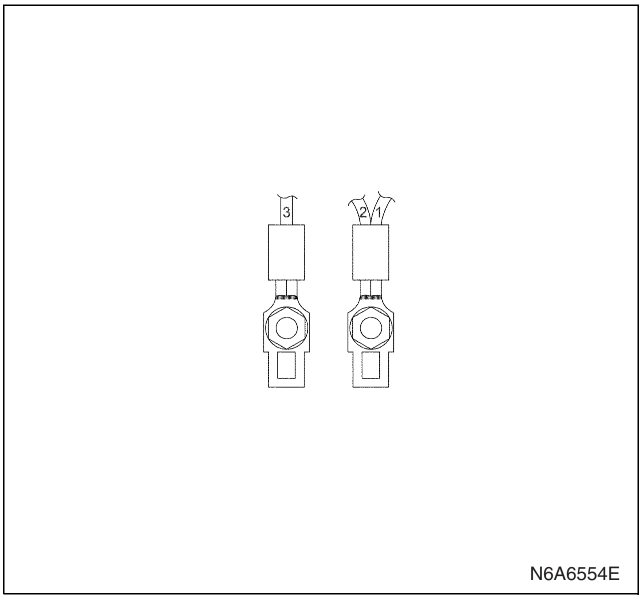
Connector No.		B-31
Connector Color		Gray
Test Adapter No.		J-35616-42
Pin	Wire Color	Pin Function
1	BLK	Indicator Lamp Ground
2	LT GRN/RED	Illumination Lamp Voltage Feed
3	BRN/BLK	Engine Warm Up Switch Voltage Feed
4	LT GRN/BLU	Indicator Lamp Voltage Feed From Engine Warm Up Switch Signal
5	BLK	Illumination Lamp Ground
6	LT GRN/BLU	Engine Warm Up Switch Signal

Exhaust Brake Solenoid Valve



Connector No.		J-31
Connector Color		Black
Test Adapter No.		J-35616-33
Pin	Wire Color	Pin Function
1	LT GRN	Exhaust Brake Solenoid Valve Voltage Feed
2	BLK	Exhaust Brake Solenoid Valve Control

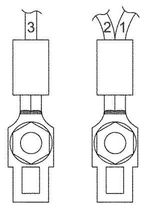
Fuel Injector Cylinder No. 1



Connector No.		E-138
Connector Color		Silver
Pin	Wire Color	Pin Function
1	WHT	Common 1 Fuel Injector Drive
2	WHT	Common 1 Fuel Injector Drive

Connector No.		E-138
Connector Color		Silver
Pin	Wire Color	Pin Function
3	GRN	Cylinder #1 Fuel Injector Solenoid Control

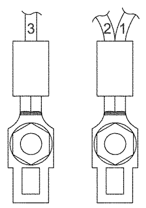
Fuel Injector Cylinder No. 2



N6A6554E

Connector No.		E-139
Connector Color		Silver
Pin	Wire Color	Pin Function
1	RED	Common 2 Fuel Injector Drive
2	RED	Common 2 Fuel Injector Drive
3	BLU	Cylinder #2 Fuel Injector Solenoid Control

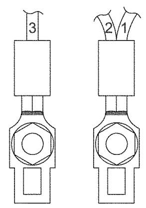
Fuel Injector Cylinder No. 3



N6A6554E

Connector No.		E-140
Connector Color		Silver
Pin	Wire Color	Pin Function
1	RED	Common 2 Fuel Injector Drive
2	RED	Common 2 Fuel Injector Drive
3	YEL	Cylinder #3 Fuel Injector Solenoid Control

Fuel Injector Cylinder No. 4



N6A6554E

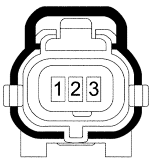
Connector No.		E-141
Connector Color		Silver
Pin	Wire Color	Pin Function
1	WHT	Common 1 Fuel Injector Drive
2	WHT	Common 1 Fuel Injector Drive
3	BLK	Cylinder #4 Fuel Injector Solenoid Control

Fuel Rail Pressure (FRP) Regulator

N6A6455E

Connector No.		E-116
Connector Color		Gray
Test Adapter No.		J-35616-33
Pin	Wire Color	Pin Function
1	WHT/RED	FRP Regulator High Control
2	GRN/RED	FRP Regulator Low Control

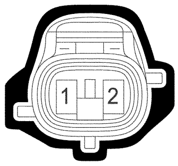
Fuel Rail Pressure (FRP) Sensor



N6A6555E

Connector No.		E-113
Connector Color		Black
Test Adapter No.		J-35616-64A
Pin	Wire Color	Pin Function
1	BRN	FRP Sensor Low Reference
2	WHT	FRP Sensor Signal
3	GRN/BLU	FRP Sensor 5 Volts Reference

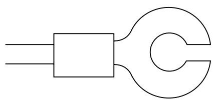
Fuel Temperature (FT) Sensor



N6A6556E

Connector No.		E-93
Connector Color		Green
Test Adapter No.		J-35616-64A
Pin	Wire Color	Pin Function
1	BLK	FT Sensor Low Reference
2	LT GRN/ WHT	FT Sensor Signal

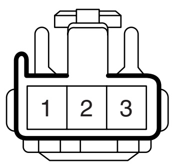
Glow Plug



N6A3809E

Connector No.		E-3
Connector Color		Silver
Pin	Wire Color	Pin Function
1	BLK/YEL	Power Supply

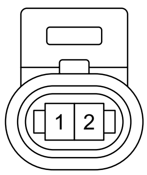
Idle Up Sensor



N6A6467E

Connector No.		B-281
Connector Color		White
Test Adapter No.		J-35616-33
Pin	Wire Color	Pin Function
1	BLU/RED	Idle Up Sensor Low Reference
2	BLU/YEL	Idle Up Sensor Signal
3	BLU	Idle Up Sensor 5 Volts Reference

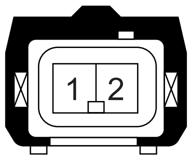
Intake Air Temperature (IAT) Sensor



N6A6468E

Connector No.		J-190
Connector Color		Gray
Test Adapter No.		J-35616-16
Pin	Wire Color	Pin Function
1	RED/GRN	IAT Sensor Signal
2	BLK	IAT Sensor Low Reference

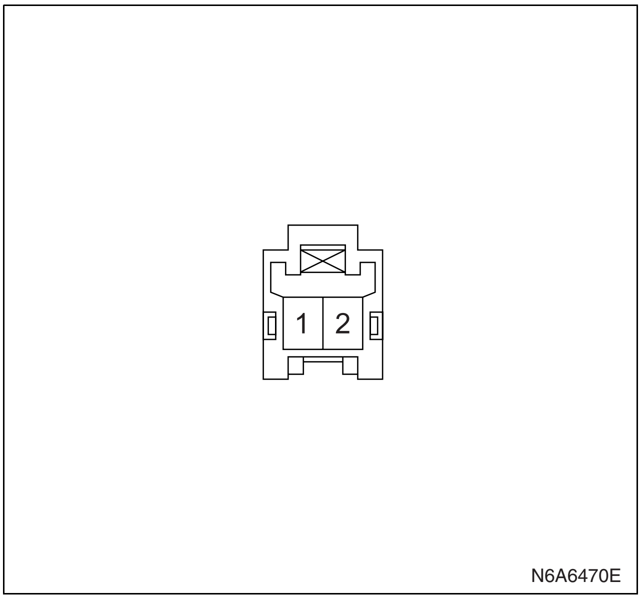
Intake Throttle Solenoid Valve



N6A6469E

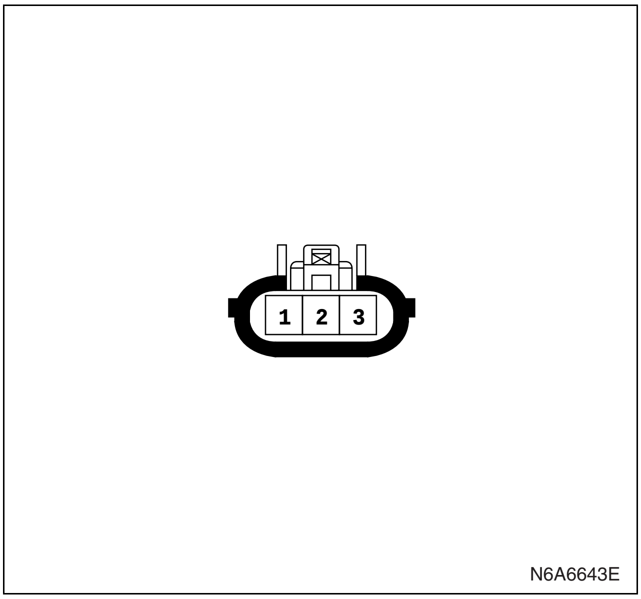
Connector No.		J-40
Connector Color		Black
Test Adapter No.		J-35616-4A
Pin	Wire Color	Pin Function
1	LT GRN	Intake Throttle Solenoid Valve Voltage Feed
2	LT GRN/ WHT	Intake Throttle Solenoid Valve Control

PTO Switch



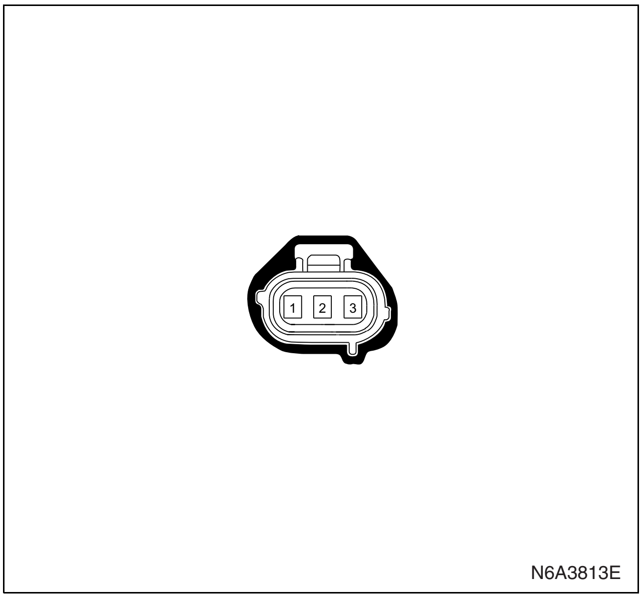
Connector No.		B-84
Connector Color		White
Test Adapter No.		J-35616-33
Pin	Wire Color	Pin Function
1	BLU/ORG	PTO Switch Signal
2	BLK	PTO Switch Ground

PTO Throttle Sensor



Connector No.		J-166
Connector Color		White
Test Adapter No.		J-35616-33
Pin	Wire Color	Pin Function
1	RED	PTO Throttle Sensor 5 Volts Reference
2	BRN	PTO Throttle Sensor Signal
3	PNK/BLK	PTO Throttle Sensor Low Reference

Vehicle Speed Sensor (VSS)



Connector No.		J-32
Connector Color		Gray
Test Adapter No.		J-35616-33
Pin	Wire Color	Pin Function
1	BLK/YEL	VSS Ignition Voltage
2	BLK	VSS Low Reference
3	YEL/GRN	VSS Signal

Diagnostic Information and Procedures

General Service Information

Non-OEM Parts

All of the on-board diagnostic (OBD) has been calibrated to run with original equipment manufacturer (OEM) parts. Accordingly, if commercially sold sensor or switch is installed, it makes a wrong diagnosis and turn on the malfunction indicator lamp (MIL). Aftermarket electronics, such as cellular phones, stereos, and anti-theft devices, may indicate electromagnetic interference (EMI) into the control system if they are improperly installed. This may cause a false sensor reading and turn on the MIL.

Poor Vehicle Maintenance

The sensitivity of OBD will cause the MIL turn on if the vehicle is not maintained properly. Restricted oil filters, fuel filters, and crankcase deposits due to lack of oil changes or improper oil viscosity can trigger actual vehicle faults that were not previously monitored prior to OBD. Poor vehicle maintenance cannot be classified as a “non-vehicle fault”, but with the sensitivity of OBD diagnostics, vehicle maintenance schedules must be more closely followed.

Visual / Physical Engine Compartment Inspection

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

- Inspect all vacuum hoses for punches, cuts, disconnects, and correct routing.
- Inspect hoses that are difficult to see behind other components.
- Inspect all wires in the engine compartment for proper connections, burned or chafed spots, pinched wires, contact with sharp edges or contact with hot exhaust manifolds or pipes.

Basic Knowledge of Tools Required

Lack of basic knowledge of this powertrain when performing diagnostic procedures could result in an incorrect diagnosis or damage to powertrain components. Do not attempt to diagnose a powertrain problem without this basic knowledge. A basic understanding of hand tools is necessary to effectively use this section of the service manual.

Malfunction Indicator Lamp (MIL)

Basically, the MIL is turned on when the ECM detects a DTC that will impact the vehicle emission or performance. When the MIL remains “ON” while the engine is running, or when a malfunction is suspected due to a driveability or emissions problem, a Diagnostic System Check must be performed. The procedures for these checks are given in Diagnostic System Check - Engine Controls.

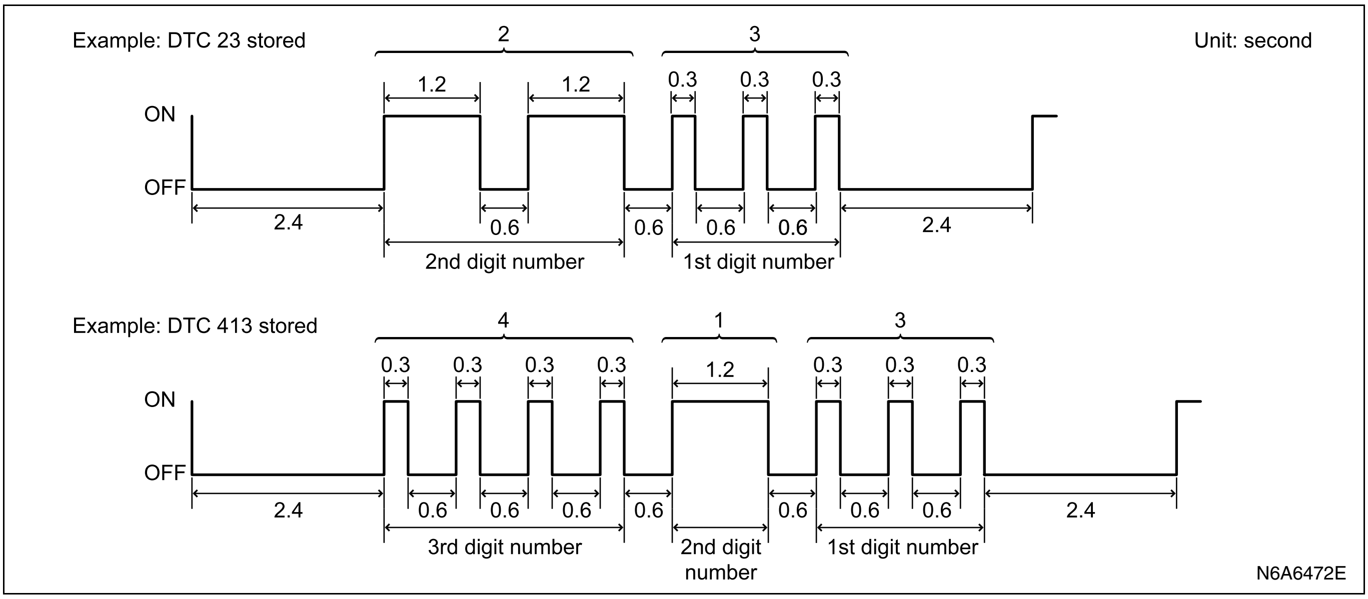
DTC Types

Characteristic of Code

- Stores a DTC on the first trip with a fail
- Dose not request illumination of any lamp

Reading Flash Diagnostic Trouble Codes (DTC)

The provision for communicating with the ECM is the Data Link Connector (DLC). The DTCs stored in the ECM memory can be read either through a hand-held diagnostic scanner such as Tech 2 plugged into the DLC or by counting the number of flashes of the MIL when the diagnostic test terminal of the DLC is grounded. The DLC terminal “1” (diagnostic request) is pulled “Low” (grounded) by jumped to DLC terminal “4”, which is a ground wire. Once terminals “1” and “4” have been connected, the ignition switch must be moved to the “ON” position, with the engine not running. The MIL will indicate a DTC three times is a DTC is present and history. If more than one DTC has been stored in the ECM’s memory, the DTCs will be output numerical order with each DTC being displayed three times. The flash DTC display will continue as long as the DLC is shorted.



Reading Diagnostic Trouble Codes (DTCs) with The Tech 2

The procedure for reading DTC(s) is used a diagnostic Tech 2. To read DTCs, use the Tech 2 "Read DTC Info As Stored By ECU".

Clearing Diagnostic Trouble Codes (DTCs) with The Tech 2 or without Tech 2

Do not clear DTCs unless directed to do so by the service information provided for each diagnostic procedure. To clear DTCs, use with the Tech 2 "Clear DTC Information". If there is no Tech 2, clear with accelerator pedal operation.

Notice:
A history DTC clears after 20 consecutive driving cycles without a fault.

DTC Clear Method with Accelerator Pedal Operation

1. Turn ON the ignition, with the engine OFF.
2. Use a jumper wire and the DLC terminal "1" (diagnostic request) is pulled "Low" (grounded) by jumped to DLC terminal "4".
3. Depress accelerator pedal within 1 – 3 seconds.
4. Release accelerator pedal within 1 – 3 seconds.
5. Depress accelerator pedal within 1 – 3 seconds.
6. Release accelerator pedal within 1 – 3 seconds.
7. Depress accelerator pedal within 1 – 3 seconds.
8. Release accelerator pedal within 1 – 3 seconds.

Notice:
DO NOT touch the accelerator pedal when it is released.

Tech 2 Scan Tool

Isuzu recommend using Tech 2. Refer to the Tech 2 Users Guide for proper start up procedures.

Operating Procedure

1. Press Enter at start screen.
2. Select Diagnostic > appropriate vehicle identification > Engine > 4HK1(Common Rail).
3. The following table shows, which functions are used the available equipment versions.

- F0: Diagnostic Trouble Codes
  - F0: Read DTC Info As Stored By ECU
  - F1: Clear DTC Information
- F1: Data Display
- F2: Snapshot
- F3: Actuator Test
  - F0: Fuel System
    - F0: Rail Pressure Control
    - F1: Injector Balancing
    - F2: Injection Timing
    - F3: Pre Injection Stop
    - F4: Injector Forced Drive
  - F1: Device Controls
    - F0: Glow Plug Relay
    - F1: Exhaust Brake Control
    - F2: EGR Control
- F4: Programming
  - F0: Injector ID Code
    - F0: Injector ID Code
    - F1: ID Code Registration
    - F2: Upload ID Code
    - F3: Download ID Code

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F0: Diagnostic Trouble Codes

The purpose of this mode is to display stored trouble code in the ECM. When “Clear DTC Information” is selected, “Clear DTC Information”, warning screen appears. This screen informs you that by cleaning DTCs “all stored DTC information in the ECM will be erased”.

F1: Data Display

The purpose of this mode is to continuously monitor data parameters. The current actual values of all important sensors and signals, solenoid commands in the system are display through this mode.
Refer to the Tech 2 Data List in this section.

F2: Snapshot

“Snapshot” allow you to focus on making the condition occur, rather than trying to view all of the data in anticipation of the fault. The snapshot will collect parameter information around a trigger point that you select.
Refer to the Tech 2 user instructions for more information.

F3: Actuator Test

The purpose of this mode is to check for correct operation of electronic system actuators. Using actuator test menus can test the state of each actuator and related sensors. Especially when DTC cannot be detected, a faulty circuit can be diagnosed by testing. Even DTC has been detected, the circuit tests using these menus could help discriminate between a mechanical trouble and an electrical trouble.
Refer to the Tech 2 Output Controls in this section.

F4: Programming

The purpose of this mode is to program the fuel injector ID code into the ECM if the fuel injector or ECM is to be replaced.

Tech 2 Data List

The Tech 2 Data List contains all engine related parameters that are available on the Tech 2. Use the Tech 2 Data List only after the following is determined:

- The Diagnostic System Check – Engine Controls is completed.
- No diagnostic trouble codes (DTCs) are present.
- On-board diagnostics are functioning properly.

Tech 2 values from a properly running engine may be used for comparison with the engine you are diagnosing. The Tech 2 Data List represents values that would be seen on a normal running engine.

Important:
A Tech 2 that displays faulty data should not be used. The Tech 2 problem should be reported to the manufacturer. Use of a faulty Tech 2 can result in misdiagnosis and unnecessary parts replacement. Only the parameters listed below are referenced in this service manual for use in diagnosis.

Tech 2 Parameter	Units Displayed	Typical Data Value at Engine Idle	Typical Data Value at 1600 RPM
Operating Conditions: Engine Idling or 1600 RPM / Engine Coolant Temperature is between 75-85°C (167-185°F) / Accelerator Pedal is Constant / Neutral / Accessories OFF / Vehicle Located at Sea Level			
Ignition Voltage	V	22.0 – 30.0	22.0 – 30.0
Battery Voltage	V	22.0 – 30.0	22.0 – 30.0
Desired Idle Speed	RPM	650	650
Engine Speed	RPM	600 – 700	1550 – 1650
APP Sensor 1 (Accelerator Pedal Position)	V	0.3 – 0.7	1.2 – 1.6
APP Sensor 2 (Accelerator Pedal Position)	V	4.1 – 4.5	3.4 – 3.8
Accelerator Pedal Position (APP) Angle	%	0	20 – 26
Differential Fuel Rail Pressure	MPa / psi	-5 – 5 MPa / -725 – 725 psi	-5 – 5 MPa / -725 – 725 psi
Fuel Rail Pressure Sensor	V	1.4 – 1.6	More than 2.0 volts
Rail Pressure Feedback	Shutoff Mode / Wait Mode / Feedback Mode	Feedback Mode	Feedback Mode
Fuel Rail Pressure (FRP) Regulator Command	%	35 – 45	30 – 40
FRP Regulator Feedback	mA	900 – 1300	800 – 1200
Coolant Temperature Sensor	V	0.4 – 0.6	0.4 – 0.6

Tech 2 Parameter	Units Displayed	Typical Data Value at Engine Idle	Typical Data Value at 1600 RPM
Coolant Temperature	°C / °F	75 – 85°C / 167 – 185°F	75 – 85°C / 167 – 185°F
Intake Air Temperature Sensor	V	1.1 – 2.1	1.1 – 2.1
Intake Air Temperature	°C / °F	20 – 40°C / 68 – 104°F	20 – 40°C / 68 – 104°F
Fuel Temperature Sensor	V	2.4 – 2.8	2.4 – 2.8
Fuel Temperature	°C / °F	20 – 50°C / 50 – 122°F	20 – 50°C / 50 – 122°F
Barometric Pressure Sensor	V	Nearly 2.3 volts at sea level	Nearly 2.3 volts at sea level
Barometric Pressure	KPa / psi	Nearly 100 KPa / 14.5 psi at sea level	Nearly 100 KPa / 14.5 psi at sea level
EGR Position Sensor	V	Less than 1.5 volts	Less than 2.0 volts
EGR Position Variance	%	-5 – 5%	-5 – 5%
EGR Solenoid Command	%	Less than 20%	Less than 30%
Boost Pressure Sensor	V	Nearly 1.0 volt at sea level	Less than 1.3 volts at sea level
Boost Pressure	KPa / psi	Nearly 100 KPa / 14.5 psi at sea level	Less than 115 KPa / 16.7 psi at sea level
ASR System Command APP Angle	%	100	100
Vehicle Speed	Km/h / MPH	0	0
Cylinder 1 Compensation	mm^3/st	-5.0 – 5.0 (Varies)	0.0
Cylinder 2 Compensation	mm^3/st	-5.0 – 5.0 (Varies)	0.0
Cylinder 3 Compensation	mm^3/st	-5.0 – 5.0 (Varies)	0.0
Cylinder 4 Compensation	mm^3/st	-5.0 – 5.0 (Varies)	0.0
Engine Mode	Halt Mode / Wait Mode / Crank Mode / Fuel Mode	Fuel Mode	Fuel Mode
Engine Warm Up Switch	On / Off	Off	Off
Ignition Switch	On / Off	On	On
Starter Switch	On / Off	Off	Off
Clutch Pedal Switch	Applied / Release	Released	Released
Park / Neutral Switch	On / Off	On	On
Parking Brake Switch	Applied / Released	Applied	Applied
Exhaust Brake Switch	On / Off	Off	Off
Exhaust Brake Solenoid Valve Command	On / Off	Off	Off
PTO Switch	On / Off	Off	Off
PTO Remote Throttle Angle	%	0	0
PTO Remote Throttle Sensor	V	Less than 0.4 volts	Less than 0.4 volts
Idle Up Sensor	V	0.3 – 0.6	0.3 – 0.6
A/C Clutch Switch (Air Conditioning)	On / Off	Off	Off
ABS Exh. Brake Cut Request	Yes / No	No	No
TCM Exh. Brake Cut Request	Yes / No	No	No
Refrigerator Switch	On / Off	Off	Off
Glow Relay Command	On / Off	Off	Off
Glow Indicator Lamp Command	On / Off	Off	Off

Tech 2 Data Definitions

A list of each message displayed on the Tech 2 will be explained in Engine Controls. This information will assist in emission or driveability problems. The displays can be viewed while the vehicle is being driven. Always perform the Diagnosis System Check – Engine Controls first. The Diagnostic System Check will confirm proper system operation.

Ignition Voltage
This parameter displays the ignition voltage measured at the ignition feed circuit of the ECM. Voltage is applied to the ECM when the ignition switch is ON position.

Battery Voltage
This parameter displays the battery voltage measured at the ECM main relay switched voltage feed circuit of the ECM. Voltage is applied to the ECM when the ECM main relay is energized.

Desired Idle Speed
This parameter displays the idle speed requested by the ECM. The ECM will change desired idle speed based on engine coolant temperature (ECT) and Idle up sensor status.

Engine Speed
This parameter displays the speed of the crankshaft as calculated by the ECM based on inputs from the crankshaft position (CKP) sensor or camshaft position (CMP) sensor. The Tech 2 will display the engine speed in revolution per minute (RPM).

APP Sensor 1 (Accelerator Pedal Position)
This parameter displays the voltage signal sent to the ECM from the 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 depressed to a high voltage when the accelerator pedal is fully depressed.

APP Sensor 2 (Accelerator Pedal Position)
This parameter displays the voltage signal sent to the ECM from the accelerator pedal position (APP) sensor 2 of the APP sensor assembly. APP sensor 2 is a range of values indicating a high voltage when the accelerator pedal is not depressed to a low voltage when the accelerator pedal is fully depressed.

Accelerator Pedal Position (APP) Angle
This parameter displays the angle of the accelerator pedal as calculated by the ECM 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 depressed to a high percentage when the accelerator pedal is fully depressed.

Differential Fuel Rail Pressure
This parameter displays the difference of actual and desired fuel rail pressure (actual value – desired value) as calculated by the ECM using the signal from the fuel rail pressure (FRP) sensor. The negative value is indicating a lower actual fuel rail pressure. The positive value is indicating a higher actual fuel rail pressure.

Fuel Rail Pressure Sensor
This parameter displays the voltage signal sent to the ECM from the fuel rail pressure (FRP) sensor. FRP sensor is a range of values indicating a low voltage when the fuel rail pressure is low to a high voltage when the fuel rail pressure is high.

Rail Pressure Feedback
This parameter displays the state of the fuel rail pressure feedback to the ECM. Wait Mode indicates the ignition switch is turned ON position. Feedback Mode indicates the engine is during crank or run. Shutoff Mode indicates the ignition switch is turned OFF position.

Fuel Rail Pressure (FRP) Regulator Command
This parameter displays the fuel rail pressure (FRP) regulator control duty ratio signal based on inputs to the ECM from various engine sensors. The Tech 2 will display a low percentage when the FRP regulator is controlled to open (fuel supply quantity to the fuel rail is increased). The Tech 2 will display a high percentage when the FRP regulator is controlled to close (fuel supply quantity to the fuel rail is reduced).

FRP Regulator Feedback
This parameter displays the fuel rail pressure (FRP) regulator control feedback current as calculated by the ECM. The Tech 2 will display a low current when the FRP regulator is controlled to open (fuel supply quantity to the fuel rail is increased). The Tech 2 will display a high current when the FRP regulator is controlled to close (fuel supply quantity to the fuel rail is reduced).

Coolant Temperature Sensor
This parameter displays the voltage signal sent to the ECM from the engine coolant temperature (ECT) sensor. Coolant temperature sensor is a range of value indicating a low voltage when the temperature is high and a high voltage when the temperature is low.

Coolant Temperature
This parameter displays the temperature of the engine coolant as calculated by the ECM using the signal from the engine coolant temperature (ECT) sensor. The Tech 2 will display a low temperature when the ECT sensor signal voltage is high, and a high temperature when the ECT sensor signal voltage is low.

Intake Air Temperature Sensor
This parameter displays the voltage signal sent to the ECM from the intake air temperature (IAT) sensor. IAT is a range of value indicating a low voltage when the temperature is high and a high voltage when the temperature is low.

Intake Air Temperature
This parameter displays the temperature of the intake air as calculated by the ECM using the signal from the intake air temperature (IAT) sensor. The Tech 2 will display a low temperature when the IAT sensor signal voltage is high, and a high temperature when the IAT sensor signal voltage is low.

Fuel Temperature Sensor
This parameter displays the voltage signal sent to the ECM from the fuel temperature (FT) sensor. FT sensor is a range of value indicating a low voltage when the temperature is high and a high voltage when the temperature is low.

Fuel Temperature
This parameter displays the temperature of the fuel as calculated by the ECM using the signal from the fuel temperature (FT) sensor. The Tech 2 will display a low temperature when the FT sensor signal voltage is high, and a high temperature when the FT sensor signal voltage is low.

Barometric Pressure Sensor
This parameter displays the voltage signal sent to the ECM from the barometric pressure (BARO) sensor. BARO sensor is a range of values indicating a low voltage in high altitude area to a high voltage in low altitude area.

Barometric Pressure
This parameter displays the barometric pressure (BARO) as calculated by the ECM using the signal from the barometric pressure (BARO) sensor. The Tech 2 will display a low barometric pressure in high altitude area to a high barometric pressure in low altitude area.

EGR Position Sensor
This parameter displays the voltage signal sent to the ECM from the EGR position sensor of the EGR valve. EGR position sensor is a range of values indicating a low voltage when the EGR valve is closed to a high voltage when the EGR valve is opened.

EGR Position Variance
This parameter displays the difference of actual and desired EGR valve position (actual value – desired value) as calculated by the ECM using the signal from the EGR position sensor. The negative value is indicating a lower actual valve position (more closed). The positive value is indicating a higher actual valve position (more opened).

EGR Solenoid Command
This parameter displays the EGR valve control duty ratio signal based on inputs to the ECM from various engine sensors. The Tech 2 will display a low percentage when the EGR valve is controlled to close. The Tech 2 will display a high percentage when the EGR valve is controlled to open.

Boost Pressure Sensor
This parameter displays the voltage signal sent to the ECM from the boost pressure sensor. Boost pressure sensor is a range of values indicating a low voltage when the boost pressure is low (idle or lower engine load) and a high voltage when the boost pressure is high (higher engine load).

Boost Pressure
This parameter displays the boost pressure in the intake duct as calculated by the ECM using the signal from the boost pressure sensor. The Tech 2 will display a low boost pressure when the low engine load to a high boost pressure when the high engine load. Note that the true boost pressure is determined by subtracting barometric pressure from the actual reading.

ASR System Command APP Angle
This parameter displays the controlled angle of the accelerator pedal calculated by the electric hydraulic control module (EHCU) (ABS module) when anti slip regulator (ASR) system operated. The Tech 2 will display 100% when the ECM is not controlled to reduce fuel injection quantity. The Tech 2 will display a low percentage when the ECM is controlled to reduce fuel injection quantity to reduce drive wheels spinning.

Vehicle Speed
This parameter indicates the vehicle speed calculated by the ECM using the signal from the vehicle speed sensor (VSS). The Tech 2 will display a low value at lower vehicle speeds, and a high value at higher vehicle speeds.

Cylinder 1 Compensation
This parameter displays the adjustment of fuel volume for cylinder 1 at low engine speed area as calculated by the ECM. The Tech 2 will display a negative value if the fuel volume is lowered. The Tech 2 will display a positive value if the fuel volume is increased. If there is a cylinder that is excessively high or low value, it may indicate faulty fuel injector, weak or slightly seized cylinder or an incorrectly programmed fuel injector ID code.

Cylinder 2 Compensation
This parameter displays the adjustment of fuel volume for cylinder 2 at low engine speed area as calculated by the ECM. The Tech 2 will display a negative value if the fuel volume is lowered. The Tech 2 will display a positive value if the fuel volume is increased. If there is a cylinder that is excessively high or low value, it may indicate faulty fuel injector, weak or slightly seized cylinder or an incorrectly programmed fuel injector ID code.

Cylinder 3 Compensation
This parameter displays the adjustment of fuel volume for cylinder 3 at low engine speed area as calculated by the ECM. The Tech 2 will display a negative value if the fuel volume is lowered. The Tech 2 will display a positive value if the fuel volume is increased. If there is a cylinder that is excessively high or low value, it may indicate faulty fuel injector, weak or slightly seized cylinder or an incorrectly programmed fuel injector ID code.

Cylinder 4 Compensation
This parameter displays the adjustment of fuel volume for cylinder 4 at low engine speed area as calculated by the ECM. The Tech 2 will display a negative value if the fuel volume is lowered. The Tech 2 will display a positive value if the fuel volume is increased. If there is a cylinder that is excessively high or low value, it may indicate faulty fuel injector, weak or slightly seized cylinder or an incorrectly programmed fuel injector ID code.

Engine Mode
This parameter displays the state of engine. Wait Mode indicates the ignition switch is turned ON position. Crank Mode indicates the engine is during crank. Fuel Mode indicates the engine is run. Halt Mode indicates the ignition switch is tuned OFF position.

Engine Warm Up Switch
This parameter displays the input state of the engine warm up switch to the ECM. The Tech 2 will display On or Off. On indicates the engine warm up switch is closing the engine warm up request circuit to the ECM and allowing to energize the exhaust brake solenoid valve and intake throttle solenoid valve depending on engine condition. Off indicates the engine warm up switch is open.

Ignition Switch
This parameter displays the input state of the ignition switch to the ECM. The Tech 2 will display On or Off. On indicates the ignition switch is turned ON position.

Starter Switch
This parameter displays the input state of the starter switch to the ECM. The Tech 2 will display On or Off. On indicates the ignition switch is turned at START position.

Clutch Pedal Switch
This parameter displays the state of the clutch pedal switch to the ECM. The Tech 2 will display Applied or Released. Released indicates the clutch pedal is not being push down. Applied indicates the clutch switch is being depressed.

Park / Neutral Switch
This parameter displays the input state of the neutral switch to the ECM. The Tech 2 will display On or Off. On indicates the neutral switch is ON position (actual position).

Parking Brake Switch
This parameter displays the input state of the parking brake switch to the ECM. The Tech 2 will display Applied or Released. Applied indicates the parking brake lever is pulled position.

Exhaust Brake Switch
This parameter displays the input state of the exhaust brake switch to the ECM. The Tech 2 will display On or Off. On indicates the exhaust brake switch is closing the exhaust brake request circuit to the ECM and allowing to energize the exhaust brake solenoid valve and intake throttle solenoid valve depending on driving condition. Off indicates the exhaust brake switch is open and exhaust brake will not engage.

Exhaust Brake Solenoid Valve Command
This parameter displays the commanded state of the exhaust brake solenoid valve control circuit. The Tech 2 will display On or Off. On indicates the exhaust brake solenoid valve is being energized by the ECM. Off indicates the exhaust brake solenoid valve is not being commanded On by the ECM.

PTO Switch
This parameter displays the state of the PTO switch to the ECM. The Tech 2 will display On or Off. On indicates the PTO switch is being pressed by controlling the PTO lever or button.

PTO Remote Throttle Angle
This parameter displays the angle of the PTO remote throttle sensor as calculated by the ECM using the signal from the PTO remote throttle sensor. The PTO remote throttle angle is a range of values indicating a low percentage when the throttle sensor is not operated to a high percentage when the throttle sensor is operated.

PTO Remote Throttle Sensor
This parameter displays the voltage signal sent to the ECM from the PTO remote throttle sensor. The PTO remote throttle sensor is a range of values indicating a low voltage when the throttle sensor is not operated to a high voltage when the throttle sensor is operated.

Idle Up Sensor
This parameter displays the voltage signal sent to the ECM from the idle up sensor. The idle up sensor is a range of values indicating a low voltage when the idle up sensor rotates in a counterclockwise direction to a high voltage when the idle up sensor rotates in a clockwise direction.

A/C Clutch Switch (Air Conditioning)
This parameter displays the state of the air conditioning (A/C) compressor engage. On indicates the ECM receiving an A/C compressor On signal. Off indicates the ECM is not receiving an A/C compressor On signal.

ABS Exh. Brake Cut Request
This parameter displays the state of the exhaust brake cut request to the ECM from the electric hydraulic control module (EHCU) (ABS module). The Tech 2 will display Yes or No. Yes indicates the EHCU is commanding to release the exhaust brake. No indicates the EHCU is not being commanded to the ECM.

TCM Exh. Brake Cut Request
This parameter displays the state of the exhaust brake cut request to the ECM from the transmission control module (TCM). The Tech 2 will display Yes or No. Yes indicates the TCM is commanding to release the exhaust brake. No indicate the TCM is not being commanded to the ECM.

Refrigerator Switch
This parameter displays the state of the refrigerator compressor engage. On indicates the ECM receiving a refrigerator compressor On signal. Off indicates the ECM is not receiving a refrigerator compressor On signal.

Glow Replay Command
This parameter displays the commanded state of the glow relay control circuit. The Tech 2 will display On or Off. On indicates the glow relay control circuit is being grounded by the ECM, allowing voltage to the glow plugs. Off indicates the glow relay is not being commanded On by the ECM.

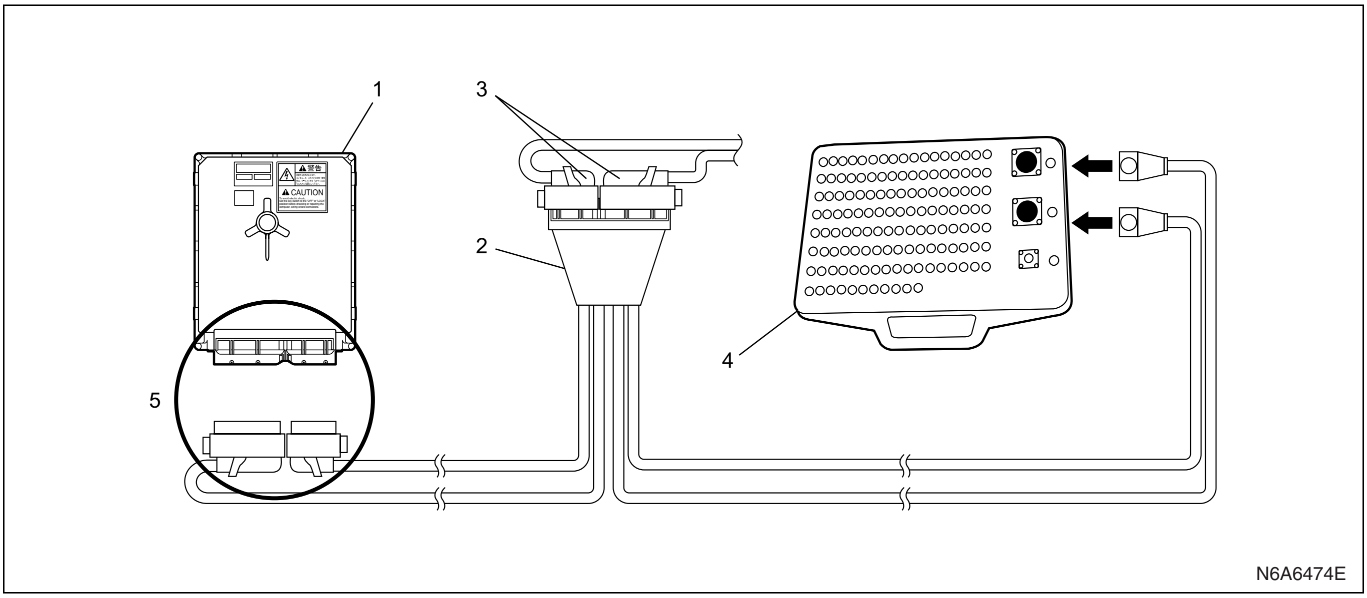
Glow Indicator Lamp Command
This parameter displays the commanded state of the glow indicator lamp control circuit. The glow indicator lamp should be On when the Tech 2 indicates the glow indicator lamp command is On. The glow indicator lamp should be Off when the Tech 2 indicates the glow indicator lamp command is Off.

Tech 2 Output Controls

Tech 2 Output Control	Additional Menu Selection(s)	Descriptions
Rail Pressure Control	Fuel System	The purpose of this test is for checking whether the fuel rail pressure is changing when commanded within 30 – 80 MPa (4,350 – 11,600 psi) when commanded. Faulty fuel supply pump, fuel rail pressure (FRP) regulator solenoid, pressure limiter valve or other fuel lines could be considered if the Differential Fuel Rail Pressure is large.
Injector Balancing	Fuel System	The purpose of this test is for checking whether the fuel injector is operating when commanded OFF. Faulty injector(s) could be considered if engine does not change speed when commanded OFF.
Injection Timing	Fuel System	The purpose of this test is for checking whether the main injection timing is changing when commanded Retard / Advance within -4 – 5°CA.
Pre Injection Stop	Fuel System	The purpose of this test is for checking whether the pilot fuel injection is operated when it is commanded to Off. Faulty injector(s) could be considered if engine noise does not change when commanded Stop.
Injector Forced Drive	Fuel System	The purpose of this test is for checking whether the fuel injector is correctly operating when commanded ON. Faulty injector(s) could be considered if it does not create a clicking noise (solenoid operating noise), contains an interrupted noise or has abnormal noise when commanded ON.
Glow Plug Relay	Device Controls	The purpose of this test is for checking whether the glow relay is operating when commanded ON. Faulty circuit(s) or a faulty glow relay could be considered if not energizing when commanded ON.
Exhaust Brake Control	Device Controls	The purpose of this test is for checking whether the exhaust brake solenoid valve and intake throttle solenoid valve are operating when commanded ON. Faulty circuit(s) or a solenoid valve(s) could be considered if not energizing when commanded ON.
EGR Control	Device Controls	The purpose of this test is for checking whether the EGR valve is correctly moved with command. Restricted valve movement by foreign materials, excessive deposits or a faulty valve could be considered if the EGR Position Variance is large.

Breaker Box

Breaker Box Connection Type A

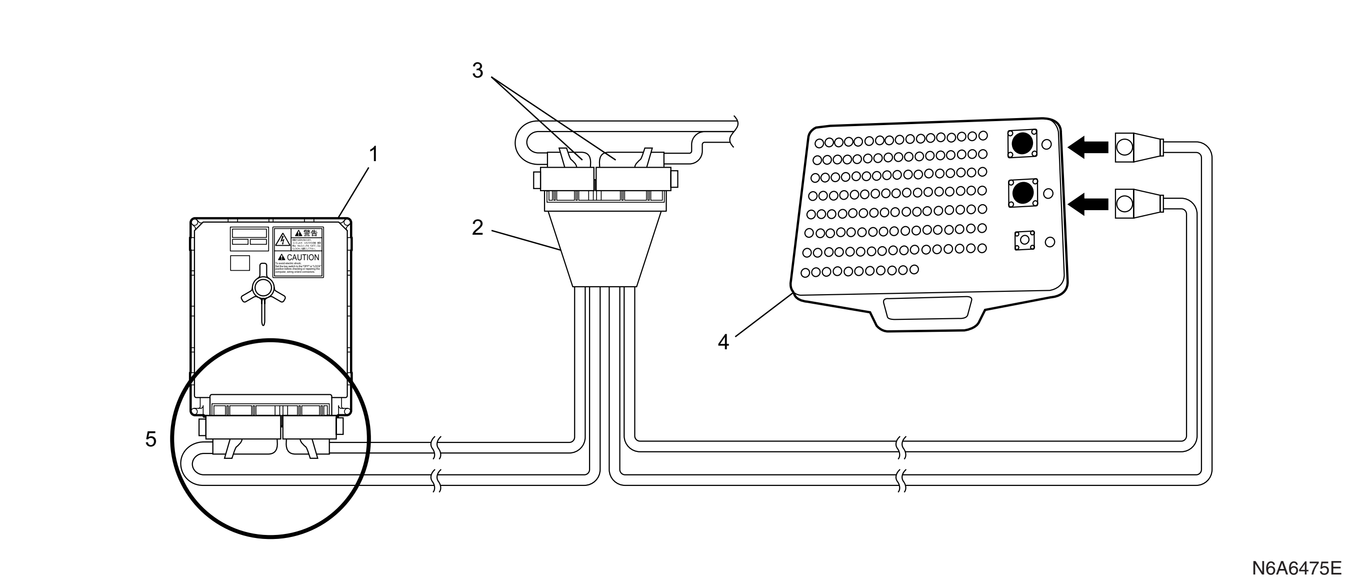


Legend

1. Engine Control Module (ECM)
2. Adapter Harness
3. ECM – Harness Connector
4. Breaker Box
5. ECM disconnected

Although probe to the engine control module (ECM) harness connector is possible by Test Adapter, Breaker Box Connection Type A is suitable usage to prevent misprobe and damage of female terminals when test open circuit or short to ground between the ECM and electrical components, since the terminals where the harness connector of the ECM is thin have gathered.

Breaker Box Connection Type B



Legend

1. Engine Control Module (ECM)
2. Adapter Harness
3. ECM – Harness Connector
4. Breaker Box
5. ECM connected

The ECM and other connectors have water proof terminal that is not allowed to back probe. Breaker Box Connection Type B is suitable usage to test short to voltage circuit or signal check between the ECM and electrical components.

Engine Control System Check Sheet

ENGINE CONTROL SYSTEM CHECK SHEET		Inspectors Name	
Customer's Name		Model & Model Year	
Driver's Name		Chassis No.	
Date Vehicle Brought In		Engine No.	
License No.		Odometer Reading	Km/miles

Problem Symptoms	☐ Engine Does Not Run	☐ Engine does not crank	☐ No initial combustion	☐ No complete combustion
	☐ Hard Start	☐ Engine cranks slowly	☐ Other ( )	
	☐ Incorrect Idle	☐ Abnormal idling speed ☐ Rough idling ☐ Other ( )	☐ High idling speed (RPM)	☐ Low idling speed (RPM)
	☐ Poor Driveability	☐ Hesitation, sag, stumble ☐ Lack of power, sluggishness, sponginess ☐ Other ( )	☐ Surge, chuggles	☐ Cut out, misses
	☐ Engine Stall	☐ Soon after starting ☐ During A/C operation ☐ Other ( )	☐ After accelerator pedal depressed ☐ After accelerator pedal released	☐ Shifting from N to D
	☐ Others	☐ Black smoke ☐ Fuel knock, combustion noise ☐ Other ( )	☐ White smoke	☐ Poor fuel economy

Dates problem occurred					
Problem frequency		☐ Constant ☐ Other ( )	☐ Intermittently (times per day/month)		☐ Once only
Condition When Problem Occurs	Weather	☐ Fine ☐ Various/Other ( )	☐ Cloudy	☐ Rainy	☐ Snow
	Outside Temperature	☐ Hot (approx.) ☐ Any temperature	☐ Warm	☐ Cool	☐ Cold (approx.)
	Place	☐ Highway ☐ Downhill	☐ Suburbs ☐ Rough road	☐ City area ☐ Other ( )	☐ Uphill
	Load Condition	☐ Over (approx. tons) ☐ Other (approx. tons)		☐ No load	
	Engine Temperature	☐ Cold ☐ Other ( )	☐ Warming up	☐ After warming up	☐ Any temperature
	Engine Operation	☐ Starting ☐ Racing ☐ Deceleration ☐ Other ( )	☐ Just after starting (Min.) ☐ Driving ☐ A/C switch On/Off	☐ Constant speed	☐ Idling ☐ Acceleration
	Fuel Amount	☐ Full	☐ Above 1/2	☐ Below 1/2	☐ Near empty
	Fuel Bland				

Condition of MIL	☐ Remains On	☐ Intermittently turns On	☐ Does not turn On
Diagnostic Trouble Code (DTC) or Flash Code	Present Code	☐ Nothing	☐ P or U Code No. ( )
	History Code	☐ Nothing	☐ P or U Code Code No. ( )
Other Additional Condition			

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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 their 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.

Important:
Engine Control System Check Sheet must be used to verify the customer complaint, you need to know the correct (normal) operating behavior of the system and verify that the customer complaint is a valid failure of the system.

Diagnostic System Check – Engine Controls

Description

The Diagnostic System Check – Engine Controls is an organized approach to identifying a condition that is created by a malfunction in the electronic engine control system. 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 order to diagnose the concern. Understanding and correctly using the diagnostic table reduces diagnostic time, and prevents the replacement of good parts.

Test Description

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

1. Lack of communication may be because of a partial or a total malfunction of the Keyword 2000 serial data circuit. The specified procedure determines the particular condition.

4. The presence of DTCs which begin with U, indicate that some other module is not communicating.

10. If there are other modules with DTCs set, refer to the DTC list. The DTC list directs you to the appropriate diagnostic procedure. If the control module stores multiple DTCs, diagnose the DTCs in the following order.

- Component level DTCs, such as sensor DTCs, solenoid DTCs, actuator DTCs, and relay DTCs. Diagnose the multiple DTCs within this category in numerical order. Begin with the lowest numbered DTC, unless the diagnostic table directs you otherwise.

Diagnostic System Check – Engine Controls

Important:

- DO NOT perform this diagnostic if there is not a driveability concern, unless another procedure directs you to this diagnostic.
- Before you proceed with diagnosis, search for applicable service bulletins.
- Unless a diagnostic procedure instructs you, DO NOT clear the DTCs.
- If there is a condition with the starting system, refer to the starting system section in the engine mechanical.
- Ensure the battery has a full charge.
- Ensure the battery cables (+) (–) are clean and tight.
- Ensure the ECM grounds are clean, tight, and in the correct location.
- Ensure the ECM harness connectors are clean and correctly connected.
- Ensure the ECM terminals are clean and correctly mating.
- Ensure the vehicle maintenance has been done enough.
- Ensure the Fuel Injector ID Code Data is correctly programmed.
- If there are fuel system DTC's (P0087, P0088, P0089, P1093, P1094 or P1095), diagnose sensor DTCs, solenoid DTCs, actuator DTCs and relay DTCs FIRST.

Step	Action	Value(s)	Yes	No
1	1. Install the Tech 2. 2. Turn ON the ignition, with the engine OFF. 3. Attempt to establish communication with the listed control modules. • Engine control module (ECM) • Transmission control module (TCM) (Smoother only) • Hill start aid (HSA) control module (If so equipped) • Supplemental restraint system (SRS) control module (If so equipped) Does the Tech 2 communicate with all the listed control modules?	—	Go to Step 2	Go to Tech 2 Does Not Communicate with Keyword Device
2	Attempt to start the engine. Does the engine start and idle?	—	Go to Step 3	Go to Engine Cranks but Does Not Run
3	Select the DTC display function for the following control modules: • ECM • TCM (Smoother only) • HSA control module (If so equipped) • SRS control module (If so equipped) Does the Tech 2 display any DTCs?	—	Go to Step 4	Go to Step 11
4	Does the Tech 2 display DTCs which begin with a U or other control module communication fault DTCs?	—	Go to Applicable DTC	Go to Step 5
5	Does the Tech 2 display ECM DTCs P0601, P0603, P0606, P0611, P0612 or P1630?	—	Go to Applicable DTC	Go to Step 6
6	Does the Tech 2 display ECM DTC P1625?	—	Go to Applicable DTC	Go to Step 7
7	Does the Tech 2 display ECM DTCs P1631, P1632, P1633, P1634 or P1635?	—	Go to Applicable DTC	Go to Step 8
8	Does the Tech 2 display ECM DTCs P0219, P0335, P0336, P0340, P0341 or P1345?	—	Go to Applicable DTC	Go to Step 9
9	Does the Tech 2 display ECM DTCs P0090, P0201, P0202, P0203, P0204, P1261 or P1262?	—	Go to Applicable DTC	Go to Step 10
10	Is there any other code in any controller that has not been diagnosed?	—	Go to Applicable DTC	Go to Step 11
11	Is the customer’s concern with the transmission?	—	Go to Diagnostic System Check – Transmission Controls	Go to Step 12
12	Is the customer’s concern with the HSA system?	—	Go to Diagnostic System Check – HSA Controls	Go to Step 13
13	Is the customer’s concern with the SRS airbag system?	—	Go to Diagnostic System Check – SRS Controls	Go to Step 14

Step	Action	Value(s)	Yes	No
14	1. Review the following symptoms. 2. Refer to the applicable symptom diagnostic table: • Hard Start • Rough, Unstable, or Incorrect Idle and Stalling • High Idle • Cuts Out, Misses • Surge / Chuggles • Lack of Power, Sluggishness, or Sponginess • Hesitation, Sag, Stumble • Fuel Knock / Combustion Noise • Poor Fuel Economy • Excessive Smoke (Black Smoke) • Excessive Smoke (White Smoke) Did you find and correct the condition?	—	System OK	Go to Intermittent Conditions

Tech 2 Does Not Communicate with Keyword Device

Circuit Description

The engine control module (ECM), transmission control module (TCM) and supplemental restraint system (SRS) control module communicates with the Tech 2 over the Keyword 2000 serial data link. The hill start aid (HSA) control module communicates with the Keyword 82 serial data link. However, the ECM, TCM, electric hydraulic control module (EHCU) (ABS module) and the data recording module (DRM) communicate with each other over the controller area network (CAN) link. The CAN link is not used for communication with the Tech 2 and is shared only among each module.

Diagnostic Aids

The following conditions will cause a loss of Keyword serial data communication between the TCM, SRS control module and HSA control module or between the Tech 2 and any control module:

- A Keyword serial data circuit open.
- A Keyword serial data circuit shorted to ground.
- A Keyword serial data circuit shorted to voltage.
- An internal condition within a module or connector on the Keyword serial data circuit, that causes a short to voltage or ground to the Keyword serial data circuit.

Tech 2 Does Not Communicate with Keyword 2000 Device

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn ON the ignition, with the engine OFF. 3. Attempt to communicate with the listed control modules. • Engine control module (ECM) • Transmission control module (TCM) (Smoother only) • Hill start aid (HSA) control module (If so equipped) • Supplemental restraint system (SRS) control module (If so equipped) Does the Tech 2 communicate with all the listed control modules?	—	Go to Step 3	Go to Step 8
3	Does the Tech 2 communicate with the ECM?	—	Go to Step 4	Go to Lost Communication with The ECM
4	Does the Tech 2 communicate with the TCM?	—	Go to Step 5	Go to Diagnostic System Check – Transmission Controls
5	Does the Tech 2 communicate with the HSA control module?	—	Go to Step 6	Go to Diagnostic System Check – HSA Controls
6	Does the Tech 2 communicate with the SRS control module?	—	Go to Step 7	Go to Diagnostic System Check – SRS Controls
7	Test the Keyword serial data circuit for an intermittently short to ground or intermittently short to voltage. Then, test the Keyword serial data circuit for an intermittently open (based on which control module did not communicate) at the connection in the circuit. Did you find and correct the condition?	—	Go to Step 17	System OK

Step	Action	Value(s)	Yes	No
8	1. Turn OFF the ignition. 2. Disconnect the ECM E-111 and J-191 harness connectors. 3. Turn ON the ignition, with the engine OFF. 4. Attempt to communicate with the TCM, HSA control module and SRS control module. Does the Tech 2 communicate with the TCM, HSA control module and SRS control module?	—	Go to Step 13	Go to Step 9
9	1. Turn OFF the ignition. 2. Reconnect the ECM E-111 and J-191 harness connectors. 3. Disconnect the TCM B-425, B-426, B-427 and B-428 harness connectors. 4. Turn ON the ignition, with the engine OFF. 5. Attempt to communicate with the ECM, HSA control module and SRS control module. Does the Tech 2 communicate with the ECM, HSA control module and SRS control module?	—	Go to Step 14	Go to Step 10
10	1. Turn OFF the ignition. 2. Reconnect the TCM B-425, B-426, B-427 and B-428 harness connectors. 3. Disconnect the HSA control module B-285 harness connectors. 4. Turn ON the ignition, with the engine OFF. 5. Attempt to communicate with the ECM, TCM and SRS control module. Does the Tech 2 communicate with the ECM, TCM and SRS control module?	—	Go to Step 15	Go to Step 11
11	1. Turn OFF the ignition. 2. Reconnect the HSA control module B-285 harness connectors. 3. Disconnect the SRS B-243 control module harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Attempt to communicate with the ECM, TCM and HSA control module. Does the Tech 2 communicate with the ECM TCM and HSA control module?	—	Go to Step 16	Go to Step 12
12	Repair the short to ground or short to voltage on the Keyword serial data circuit between the DLC and ECM, TCM, HSA control module and SRS control module. Did you complete the repair?	—	Go to Step 17	—
13	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 17	—

Step	Action	Value(s)	Yes	No
14	Replace the TCM. Refer to Transmission Control Module (TCM) Replacement in the transmission section. Did you complete the replacement?	—	Go to Step 17	—
15	Replace the HSA control module. Refer to Hill Start Aid (HSA) Control Module Replacement in the brake section. Did you complete the replacement?	—	Go to Step 17	—
16	Replace the SRS control module. Refer to Supplemental Restraint System (SRS) control module Replacement in the restraint system section. Did you complete the replacement?	—	Go to Step 17	—
17	Attempt to communicate with the ECM, TCM, HSA control module and SRS control module. Does the Tech 2 communicate with the ECM, TCM, HSA control module and SRS control module?	—	System OK	Go to Step 2

Lost Communication with The Engine Control Module (ECM)

Circuit Description

The engine control module (ECM), transmission control module (TCM) and supplemental restraint system (SRS) control module communicates with the Tech 2 over the Keyword 2000 serial data link. The hill start aid (HSA) control module communicates with the Keyword 82 serial data link. However, the ECM, TCM, electric hydraulic control module (EHCU) (ABS module) and the data recording module (DRM) communicate with each other over the controller area network (CAN) link. The CAN link is not used for communication with the Tech 2 and is shared only among each module.

Lost Communication with The Engine Control Module (ECM)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	Attempt to establish engine control module (ECM) communications with the Tech 2. Does the ECM communicate with the Tech 2?	—	Go to Intermittent Conditions	Go to Step 3
3	Check the ECM E-111 and J-191 connectors for poor connections. Did you find and correct the condition?	—	Go to Step 15	Go to Step 4
4	1. Turn ON the ignition, with the engine OFF. 2. Check the ECM (40A) slow blow fuse, ECM (10A) fuse and Engine (IG) (10A) fuse. Replace and retest if open. If any fuse continues to open, check for a short to ground on each circuit fed by that fuse. 3. Turn OFF the ignition. 4. Disconnect the ECM J-191 harness connector. 5. Turn ON the ignition, with the engine OFF. 6. Connect a test lamp to ground and check for voltage at the ignition voltage supply circuit at the ECM (pin 24 of J-191 connector). Does the test lamp illuminate?	—	Go to Step 5	Go to Step 12
5	1. Turn OFF the ignition. 2. Connect a DMM between the Keyword serial data circuit at the ECM (pin 38 of J-191 connector) and the data link connector (DLC) (pin 7 of B-79 connector). 3. Test the circuits for an open circuit or high resistance. 4. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 6
6	**Important:** An open in a ground circuit at the ECM will not cause a loss of communication. 1. Check ECM ground for corrosion and tightness. 2. Clean or tighten grounds as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 7

Step	Action	Value(s)	Yes	No
7	1. Turn OFF the ignition. 2. Reconnect the ECM harness connector if previously disconnected. 3. Turn ON the ignition, with the engine OFF. 4. Replace the ECM main relay with the glow relay or replace with a known good relay. 5. Attempt to establish Tech 2 communications with the ECM. Does the ECM communicate with the Tech 2?	—	Go to Step 13	Go to Step 8
8	1. Turn OFF the ignition. 2. Remove the ECM main relay. 3. Turn ON the ignition, with the engine OFF. 4. Using a test lamp, check for battery voltage at both of the battery voltage supply circuits to the ECM main relay (pins 3 and 4 of X-18 connector). 5. Repair the open in the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 9
9	1. Reinstall the ECM main relay. 2. Turn the ignition ON and OFF while listening or feeling for the ECM main relay click. Wait 7 seconds between transitions. Does the ECM main relay click when the ignition is turned ON or OFF?	—	Go to Step 11	Go to Step 10
10	Repair the ECM main relay ground circuit between the ECM main relay (pin 5 of X-18 connector) and chassis ground terminal (J-9) for the following conditions: • An open circuit • High resistance or a poor connection at ECM main relay and ground terminal Did you complete the repair?	—	Go to Step 15	—
11	1. Test the ECM main relay voltage feed circuit to the ECM (pins 2 and 5 of J-191 connector) for the following conditions: • An open circuit • High resistance or a poor connection at ECM and ECM main relay 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
12	Repair the open in the ignition voltage circuit to the ECM. Did you complete the repair?	—	Go to Step 15	—
13	Replace the ECM main relay. Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 15	—

Step	Action	Value(s)	Yes	No
15	1. Turn OFF the ignition. 2. Reconnect all previously disconnected fuse, relay and harness connector(s). 3. Turn the ignition ON with the engine OFF. 4. Attempt to establish Tech 2 communications with the ECM. Does the Tech 2 communicate with the ECM?	—	System OK	Go to Step 3

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 and terminals are cleaned and tight.
- The engine cranking speed is normal.
- There is adequate fuel in the fuel tank.
- There is no fuel leak in the fuel line.
- There is no air in the fuel line.
- Filters (Air, Fuel) are clean.
- Fuse and slow blow fuse are normal.

Notice:

- The engine will start even if exhuast brake is fully engage.

Diagnostic Aid

If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Test Description

The numbers below refers to the step number on the diagnostic table.
5. If the fuel rail pressure (FRP) regulator low control circuits between the ECM and the FRP regulator are shorted to ground, FRP Regulator Feedback will be approximately 300 mA or more low as compared with normal.

Engine Cranks but Does Not Run

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Crank the engine for specified amount of time. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the Tech 2 display any DTCs that failed this ignition?	15 seconds	Go to Diagnostic Trouble Code (DTC) List	Go to Step 3
3	1. Turn OFF the ignition. 2. Wait 2 minutes for the fuel pressure to bleed down from the fuel rail. 3. Turn ON the ignition, with the engine OFF. DO NOT start the engine. 4. Observe the Fuel Rail Pressure (FRP) Sensor parameter with a Tech 2. Is the FRP Sensor parameter the specified value?	0.9 – 1.0 Volts	Go to Step 4	Go to Step 6
4	**Notice:** If the vehicle has run out of fuel, air may be trapped in the fuel system. 1. Make sure the fuel tank(s) have adequate fuel and the fuel quality is good (take a sample). 2. Observe the FRP Sensor parameter on the Tech 2 while cranking over the engine for 5 seconds. Does the FRP Sensor reach the specified value during crank?	1.4 Volts	Go to Step 9	Go to Step 5

Step	Action	Value(s)	Yes	No
5	Observe the FRP Regulator Feedback parameter on the Tech 2 while cranking over the engine for 5 seconds. Does the SCV Feedback parameter more than the specified value during crank?	800 mA	Go to Fuel System Check in the Fuel System Section	Go to Step 8
6	1. Turn OFF the ignition. 2. Disconnect the FRP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP sensor (pins 1, 2 and 3 of E-113 connector). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion on each FRP sensor circuit at the harness connector of the ECM (pins 82, 87, 90 and 101 of E-111 connector). 6. Test for high resistance on each FRP sensor circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 7
7	Replace the FRP sensor. Refer to Fuel Rail Pressure (FRP) Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 12	—
8	1. Test the FRP regulator low control circuits between the engine control module (ECM) (pins 89 and 97 of E-111 connector) and the FRP regulator (pin 2 of E-116 connector) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
9	1. Check for normal readings at key up for the following sensor inputs: Use the Tech 2 Data List or a known good vehicle to determine nominal values. • Coolant Temperature • Barometric Pressure (BARO) • Boost Pressure Sensor • EGR Valve Position Sensor 2. Repair the circuit(s) or replace the sensor as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10

Step	Action	Value(s)	Yes	No
10	1. Other possible causes for the no-start condition: • Engine mechanical timing • Flywheel installed incorrectly causing the crankshaft position (CKP) sensor to be incorrectly timed to the engine. Disconnect sensor and attempt to start engine to verify. • Heavily restricted intake or exhaust plugged solid. • Poor engine compression. • Water or gasoline contamination in fuel. 2. Repair as necessary. Did you find and correct the condition?	—	Go to Step 12	—
11	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 12	—
12	1. Reconnect all previously disconnected harness connector(s). 2. Turn OFF the ignition for 30 seconds. 3. Attempt to start the engine. Does the engine start and continue to run?	—	Go to Step 13	Go to Step 2
13	Observe the DTC information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

Engine Starts and Stalls

Description

The engine control module (ECM) constantly monitors the information from various sensors. The ECM controls the systems that affect engine performance. The ECM performs the diagnostic function of the system. The ECM can recognize operational conditions, alert the driver through the malfunction indicator lamp (MIL), and store diagnostic trouble codes (DTCs). DTCs identify the faulty areas to aid the technician in making repairs.
The main relay supplies power to external output devices.

Diagnostic Aid

- Poor connection at the main relay
  Inspect harness connectors for backed-out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal-to-wire connection.
- Damaged harness
  Inspect the wiring harness for damage, shorts to ground, shorts to battery, and open circuits. If the harness appears to be OK, observe the power supply or data list display on the Tech 2 while moving connectors and wiring harnesses related to the main relay. A change in the scan tool display will indicate the location of the fault.
- Air / water or gasoline contamination in the fuel system.

Engine Starts and Stalls

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	Does the engine fail to start?	—	Go to Engine Cranks but Does Not Run	Go to Step 3
3	1. Perform the following checks before proceeding with this chart. • Make sure the idle up control knob to the lowest position. (Full counterclockwise direction) • Check for an adequate supply of fuel in the fuel tank(s) and the quality of the fuel (water or gasoline contamination). If the outside temperature is very cold, the fuel may be gelled. • Check the battery cables for corrosion and for tightness. • Make an under cab visual inspection for obvious fuel leaks and for fuel system line problems. • Make a vehicle inspection for obvious intake or exhaust restrictions (collapsed induction tubing or crushed exhaust). • Check the engine control module (ECM) connectors and ring terminal grounds for tightness. • Check the engine oil level viscosity and quality. 2. Repair as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Turn ON the ignition with the engine OFF. 2. Install the Tech 2 if not installed. 3. Observe the following parameters for skewed sensor readings: • Fuel Rail Pressure (FRP) Sensor with the engine OFF. The FRP Sensor should read 0.9 – 1.0 volt with the key ON and engine OFF. After the engine has stopped running for a minimum 2 minutes. • Boost Pressure and Barometric Pressure (BARO) with the engine OFF. The Boost Pressure and BARO parameters should be within 7.0 kPa (1.0 psi) each other. • Coolant Temperature with the engine OFF and a cold engine. The Coolant Temperature, Intake Air Temperature and Fuel Temperature parameters should be within 5°C (9°F) each other. 4. Refer to the Tech 2 Data List for nominal values. 5. Refer to appropriate DTC or schematic if a problem was found and repair as necessary. Did you find and correct the condition?	—	Go to Step 6	Go to Step 5
5	1. Other possible causes of engine stall: • Incorrect crankshaft to camshaft timing or sensor tooth / gear surface damage / incorrect machining • Poor fuel quality (water or gasoline contamination) • Fuel supply pump problem. Perform the Rail Pressure Control test with the Tech 2. The Differential Fuel Rail Pressure parameter should be within ± 5 MPa (± 725 psi) when commanded pressure range. • Fuel injector(s) problem. Perform the Injector Balancing test with the Tech 2. Repair the wire or replace the appropriate fuel injector that does not change engine speed when commanded OFF. Perform the Injector Forced Drive test with the Tech 2. Repair the wire or replace the appropriate fuel injector that does not create a clicking noise (solenoid operating noise). • ECM main relay circuit malfunction • ECM power / grounding problem 2. Repair as necessary. Did you find and correct the condition?	—	Go to Step 6	Possible fuel related. Refer to Fuel System Check in the Fuel System Section
6	1. Turn OFF the ignition for 30 seconds. 2. Start the engine and accelerate up and down the RPM band. Does the engine continue to run?	—	System OK	Go to Step 2

Diagnostic Trouble Code (DTC) List

DTC	Flash Code	MIL Status	DTC Name	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0087	227	ON	Fuel Rail Pressure (FRP) Too Low	• DTCs P0090, P0192, P0193, P0201 – P0204, P0611, P0612, P1095, P1261, P1262, P1630 and P1635 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts.	Either of following condition is met: • The ECM detects that the FRP sensor signal voltage is 1.0 volt for 10 seconds when the engine speed is between 0 – 600 RPM. • The ECM detects that the FRP sensor signal voltage is less than 1.2 volts for 10 seconds when the engine speed is higher than 900 RPM.	• Fuel leaking at high pressure side. • Loss fuel or less fuel in the fuel tank. • Pressure limiter valve opening pressure drop. • Faulty fuel injector. • Fuel suction side looseness, kinks or blocked. • Faulty or clogged fuel filter. • FRP sensor circuit is intermittently open circuit, poor connection or corrosion. • FRP sensor circuit high resistance. • FRP regulator circuit is intermittently open circuit, poor connection or corrosion. • FRP regulator circuit high resistance. • Faulty FRP sensor. • Faulty FRP regulator. • Faulty fuel supply pump.
P0088	118	ON	Fuel Rail Pressure (FRP) Too High	• DTCs P0192, P0193, P1630 and P1635 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts. • The engine is running.	First Stage DTC • The ECM detects that the FRP sensor signal voltage is more than 3.9 volts for longer than 10 second. Second Stage DTC • The ECM detects that the FRP sensor signal voltage is more than 4.0 volts for longer than 10 second during the ignition cycle after first stage has occurred.	• Loss fuel or less fuel in the fuel tank. • Faulty fuel injector. • Fuel suction side looseness, kinks or blocked. • Faulty or clogged fuel filter. • FRP sensor circuit is intermittently open circuit, poor connection or corrosion. • FRP sensor circuit high resistance. • FRP regulator circuit is intermittently open circuit, poor connection or corrosion. • FRP regulator circuit high resistance. • Faulty FRP sensor. • Faulty FRP regulator. • Faulty fuel supply pump.

DTC	Flash Code	MIL Status	DTC Name	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0089	151	ON	Fuel Rail Regulator Performance	• DTCs P0090, P0192, P0193, P0201 – P0204, P0611, P0612, P1261, P1262, P1630 and P1635 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts. • The engine is running. • The FRP regulator command is more than 40% or commanded fuel supply is less than a predetermined value.	Either of following condition is met: • The ECM detects that the deferential fuel rail pressure is higher than 20 MPa (2,900 psi) for longer than 10 seconds when the engine speed is between 0 – 600 RPM. • The ECM detects that the differential fuel rail pressure is higher than 40 MPa (5,800 psi) for longer than 10 seconds when the engine speed is higher than 900 RPM.	• Faulty or clogged fuel filter. • FRP sensor circuit is intermittently open circuit, poor connection or corrosion. • FRP sensor circuit high resistance. • FRP regulator circuit is intermittently open circuit, poor connection or corrosion. • FRP regulator circuit high resistance. • Faulty FRP sensor. • Faulty FRP regulator. • Faulty fuel supply pump.
P0090	247	ON	Fuel Pressure Regulator Solenoid Control Circuit	• DTC P1630 is not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts. • The FRP regulator command duty cycle is between 10 – 90%.	Either of following condition is met: • The ECM detects that the FRP regulator solenoid feedback current is less than 50 mA. • The ECM detects that the FRP regulator solenoid feedback current is more than 2400 mA. • The ECM detects that the difference of commanded FRP regulator solenoid current and feedback current is more than 1000 mA.	• FRP regulator low control circuit is short to battery, ignition voltage, short to ground, short to the high control circuit, open circuit or high resistance. • FRP regulator high control circuit is short to battery, ignition voltage, short to ground, open circuit or high resistance. • Poor harness connector connection. • Faulty FRP regulator. • Faulty ECM.
P0107	71	ON	Barometric Pressure Sensor Circuit Low Voltage	• DTCs P1630 and P1632 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts.	• The ECM detects that the BARO sensor signal voltage is less than 0.5 volts for 10 seconds.	• Sensor 5V reference circuit is short to ground or short to the low reference circuit. (P1632 may also set.) • Sensor 5V reference circuit is open circuit, high resistance. • Sensor signal circuit is open circuit, high resistance, short to ground or short to the low reference circuit. • Poor harness connector connection. • Faulty sensor. • Faulty ECM.

DTC	Flash Code	MIL Status	DTC Name	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0108	71	ON	Barometric Pressure Sensor Circuit High Voltage	• DTCs P1630 and P1632 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts.	• The ECM detects that the BARO sensor signal voltage is more than 4.9 volts for 10 seconds.	• Sensor 5V reference circuit is short to battery or ignition voltage. (P1632 may also set.) • Sensor signal circuit is short to battery, ignition voltage or short to any 5V reference circuit. • Sensor low reference circuit is open circuit or high resistance. • Poor harness connector connection. • Faulty sensor. • Faulty ECM.
P0112	22	ON	Intake Air Temperature (IAT) Sensor Circuit Low Voltage	• DTCs P1630 and P1632 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts.	• The ECM detects that the IAT sensor signal voltage is less than 0.1 volts for 10 seconds.	• Sensor signal circuit is short to ground or short to the low reference circuit. • Faulty sensor. • Faulty ECM.
P0113	22	ON	Intake Air Temperature (IAT) Sensor Circuit High Voltage	• DTCs P1630 and P1632 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts. • The engine run time is longer than 3 minutes.	• The ECM detects that the IAT sensor signal voltage is more than 4.8 volts for 10 seconds.	• Sensor signal circuit is short to battery, ignition voltage, short to any 5V reference circuit, open circuit, high resistance. • Sensor low reference circuit is open circuit or high resistance. • Poor harness connector connection. • Faulty sensor. • Faulty ECM.
P0117	23	ON	Engine Coolant Temperature (ECT) Sensor Circuit Low Voltage	• DTCs P1630 and P1634 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts.	• The ECM detects that the ECT sensor signal voltage is less than 0.1 volts for 10 seconds.	• Sensor signal circuit is short to ground or short to the low reference circuit. • Faulty sensor. • Faulty ECM.
P0118	23	ON	Engine Coolant Temperature (ECT) Sensor Circuit High Voltage	• DTCs P1630 and P1634 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts. • The engine run time is longer than 3 minutes.	• The ECM detects that the ECT sensor signal voltage is more than 4.8 volts for 10 seconds.	• Sensor signal circuit is short to battery, ignition voltage, short to any 5V reference circuit, open circuit, high resistance. • Sensor low reference circuit is open circuit or high resistance. • Poor harness connector connection. • Faulty sensor. • Faulty ECM.

DTC	Flash Code	MIL Status	DTC Name	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0182	221	ON	Fuel Temperature Sensor Circuit Low Voltage	• DTCs P1630 and P1634 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts.	• The ECM detects that the FT sensor signal voltage is less than 0.1 volts for 10 seconds.	• Sensor signal circuit is short to ground or short to the low reference circuit. • Faulty sensor. • Faulty ECM.
P0183	211	ON	Fuel Temperature Sensor Circuit High Voltage	• DTCs P1630 and P1634 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts. • The engine run time is longer than 3 minutes.	• The ECM detects that the FT sensor signal voltage is more than 4.8 volts for 10 seconds.	• Sensor signal circuit is short to battery, ignition voltage, short to any 5V reference circuit, open circuit, high resistance. • Sensor low reference circuit is open circuit or high resistance. • Poor harness connector connection. • Faulty sensor. • Faulty ECM.
P0192	245	ON	Fuel Rail Pressure (FRP) Sensor Circuit Low Voltage	• DTCs P1630 and P1635 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts.	• The ECM detects that the FRP sensor signal voltage is less than 0.7 volts.	• Sensor 5V reference circuit is short to ground or short to the low reference circuit. (P1635 may also set.) • Sensor 5V reference circuit is open circuit or high resistance. • Sensor signal circuit is short to ground or short to the low reference circuit. • Poor harness connector connection. • Faulty sensor. • Faulty ECM.
P0193	245	ON	Fuel Rail Pressure (FRP) Sensor Circuit High Voltage	• DTCs P1630 and P1635 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts.	• The ECM detects that the FRP sensor signal voltage is more than 4.5 volts.	• Sensor 5V reference circuit is short to battery, ignition voltage. (P1635 may also set.) • Sensor signal circuit is short to battery, ignition voltage, short to any 5V reference circuit, open circuit or high resistance. • Sensor low reference circuit is open circuit or high resistance. • Poor harness connector connection. • Faulty sensor. • Faulty ECM.

DTC	Flash Code	MIL Status	DTC Name	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0201	271	ON	Injector 1 Control Circuit	• DTCs P0204, P0611 and P1261 are not set. • The ignition switch is ON. • The battery voltage is more than 18 volts. • The engine is running.	• The ECM detects that the cylinder #1 fuel injector solenoid coil control circuit is open circuit, shorted to voltage or shorted to common 1 fuel injector drive circuit during engine rotations.	• Cylinder #1 fuel injector solenoid coil control circuit is open circuit, high resistance. • Cylinder #1 fuel injector solenoid coil control circuit is short to battery, ignition voltage or short to common 1 fuel injector drive circuit. • Faulty fuel injector. • Faulty ECM.
P0202	272	ON	Injector 2 Control Circuit	• DTCs P0203, P0612 and P1262 are not set. • The ignition switch is ON. • The battery voltage is more than 18 volts. • The engine is running.	• The ECM detects that the cylinder #2 fuel injector solenoid coil control circuit is open circuit, shorted to voltage or shorted to common 2 fuel injector drive circuit during engine rotations.	• Cylinder #2 fuel injector solenoid coil control circuit is open circuit, high resistance. • Cylinder #2 fuel injector solenoid coil control circuit is short to battery, ignition voltage or short to common 2 fuel injector drive circuit. • Faulty fuel injector. • Faulty ECM.
P0203	273	ON	Injector 3 Control Circuit	• DTCs P0202, P0612 and P1262 are not set. • The ignition switch is ON. • The battery voltage is more than 18 volts. • The engine is running.	• The ECM detects that the cylinder #3 fuel injector solenoid coil control circuit is open circuit, shorted to voltage or shorted to common 2 fuel injector drive circuit during engine rotations.	• Cylinder #3 fuel injector solenoid coil control circuit is open circuit, high resistance. • Cylinder #3 fuel injector solenoid coil control circuit is short to battery, ignition voltage or short to common 2 fuel injector drive circuit. • Faulty fuel injector. • Faulty ECM.
P0204	274	ON	Injector 4 Control Circuit	• DTCs P0201, P0611 and P1261 are not set. • The ignition switch is ON. • The battery voltage is more than 18 volts. • The engine is running.	• The ECM detects that the cylinder #4 fuel injector solenoid coil control circuit is open circuit, shorted to voltage or shorted to common 1 fuel injector drive circuit during engine rotations.	• Cylinder #4 fuel injector solenoid coil control circuit is open circuit, high resistance. • Cylinder #4 fuel injector solenoid coil control circuit is short to battery, ignition voltage or short to common 1 fuel injector drive circuit. • Faulty fuel injector. • Faulty ECM.
P0219	543	OFF	Engine Overspeed	• The ignition switch is ON.	• The ECM detects that the engine speed is higher than 4300 RPM.	• Engine over-running. • Faulty CKP sensor. • Faulty ECM. • Electromagnetic interference and electrical noise.

DTC	Flash Code	MIL Status	DTC Name	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0234	42	ON	Turbocharger Engine Overboost	• DTCs P0237, P0238, P1630 and P1634 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts. • The engine is running. • The fuel injection quantity is lower than a predetermined value.	• The ECM detects that the boost pressure is higher than 228 kPa (33 psi) for 3 seconds.	• Faulty turbocharger wastegate valve. • Faulty boost pressure sensor. • Faulty BARO sensor.
P0236	65	ON	Turbocharger Engine Underboost	• DTCs P0107, P0108, P0237, P0238, P1630 and P1634 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts. • The engine is running. • The fuel injection quantity is higher than a predetermined value.	Either of following condition is met: • The ECM detects that the boost pressure is lower than 78 kPa (11 psi) for 20 seconds when the engine speed is lower than 900 RPM. • The ECM detects that the boost pressure is lower than 82 – 151 kPa (12 – 22 psi) for 20 seconds when the engine speed is between 1200 – 3000 RPM. • The ECM detect that the boost pressure is lower than 100 – 158 kPa (15 – 23 psi) for 20 seconds when the engine speed is between 3300 – 3600 RPM.	• Air leakage. • Intake duct is disconnected. • Intake system is obstructed. • Intake throttle plate sticking in the closed position. • Faulty turbocharger wastegate valve. • Faulty turbocharger. (Shaft stick) • Faulty boost pressure sensor. • Faulty BARO sensor. • Faulty fuel system. (Low fuel pressure)

DTC	Flash Code	MIL Status	DTC Name	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0237	32	ON	Turbocharger Boost Sensor Circuit Low Voltage	• DTCs P1630 and P1634 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts.	• The ECM detects that the boost pressure sensor signal voltage is less than 0.1 volts for 5 seconds.	• Sensor 5V reference circuit is short to ground or short to the low reference circuit. (P1634 may also set.) • Sensor 5V reference circuit is open circuit, high resistance. • Sensor signal circuit is open circuit, high resistance, short to ground or short to the low reference circuit. • Poor harness connector connection. • Faulty sensor. • Faulty ECM.
P0238	32	ON	Turbocharger Boost Sensor Circuit High Voltage	• DTCs P1630 and P1634 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts.	• The ECM detects that the boost pressure sensor signal voltage is more than 4.9 volts for 5 seconds.	• Sensor 5V reference circuit is short to battery or ignition voltage. (P1634 may also set.) • Sensor signal circuit is short to battery, ignition voltage or short to any 5V reference circuit. • Sensor low reference circuit is open circuit or high resistance. • Poor harness connector connection. • Faulty sensor. • Faulty ECM.
P0335	15	ON	Crankshaft Position (CKP) Sensor Circuit	• DTCs P0336, P0340, P0341 and P1345 are not set. • The ignition switch is ON. • The CMP sensor signal pulse is detected.	• The ECM detects that the CKP sensor pulses are not generated during engine rotations.	• Sensor installation is poor condition. • Faulty sensor wheel. • Sensor high circuit is short to battery, ignition voltage, short to any 5V reference circuit, short to ground, open circuit or high resistance. • Sensor low circuit is short to battery, ignition voltage, short to any 5V reference circuit, short to ground, open circuit or high resistance. • Sensor circuits short to each other. • Poor harness connector connection. • Faulty sensor. • Faulty ECM. • Electromagnetic interference and electrical noise.

DTC	Flash Code	MIL Status	DTC Name	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0336	15	ON	Crankshaft Position (CKP) Sensor Performance	• DTCs P0335, P0340, P0341 and P1345 are not set. • The ignition switch is ON. • The CKP sensor signal is detected.	• The ECM detects extra or missing CKP sensor pulses during engine rotations.	• Sensor installation is poor condition. • Faulty sensor wheel. • Sensor circuit is intermittently open circuit or poor connection. • Faulty sensor. • Electromagnetic interference and electrical noise.
P0340	14	ON	Camshaft Position (CMP) Sensor Circuit	• DTCs P0335, P0336, P0341 and P1345 are not set. • The ignition switch is ON. • The crankshaft position (CKP) sensor signal pulse is detected.	• The ECM detects that the CMP sensor pulses are not generated during engine rotations.	• Sensor installation is poor condition. • Faulty sensor wheel. • Sensor 12V reference circuit is short to battery, ignition voltage, short to any 5V reference circuit, short to ground, open circuit or high resistance. • Sensor signal circuit is short to battery, ignition voltage, short to any 5V reference circuit, short to ground, open circuit or high resistance. • Sensor circuits short to each other. • Poor harness connector connection. • Faulty sensor. • Faulty ECM. • Electromagnetic interference and electrical noise.
P0341	14	ON	Camshaft Position (CMP) Sensor Circuit Performance	• DTCs P0335, P0336, P0340 and P1345 are not set. • The ignition switch is ON. • The CMP sensor signal pulse is detected.	• The ECM detects extra or missing CMP sensor pulses during engine rotations.	• Sensor installation is poor condition. • Faulty sensor wheel. • Sensor circuit is intermittently open circuit or poor connection. • Faulty sensor. • Electromagnetic interference and electrical noise.

DTC	Flash Code	MIL Status	DTC Name	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0380	66	ON	Glow Plug Relay Control Circuit	• The ignition switch is ON. • The battery voltage is between 16 – 32 volts.	Either of following condition is met: • The ECM detects a low voltage condition on the glow relay control circuit when the relay is commanded OFF for longer than 5 seconds. • The ECM detects a high voltage condition on the glow relay control circuit when the relay is commanded ON for longer than 5 seconds.	• Relay voltage feed circuit is open circuit or high resistance. • Relay control circuit is short to battery, ignition voltage, short to ground, open circuit or high resistance. • Poor harness connector connection. • Faulty relay. • Faulty ECM.
P0381	67	OFF	Glow Plug Lamp Control Circuit	• The ignition switch is ON. • The ignition voltage is more than 18 volts.	Either of following condition is met: • The ECM detects a low voltage condition on the glow indicator lamp control circuit when the indicator is commanded OFF for longer than 5 seconds. • The ECM detects a high voltage condition on the glow indicator lamp control circuit when the indicator is commanded ON for longer than 5 seconds.	• Lamp voltage feed circuit is open circuit or high resistance. • Lamp control circuit is short to battery, ignition voltage, short to ground, open circuit or high resistance. • Poor harness connector connection. • Faulty instrument panel cluster. • Faulty lamp. • Faulty ECM.
P0485	44	ON	EGR Valve Position Sensor Circuit Low Voltage	• DTCs P1630 and P1635 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts.	• The ECM detects that the EGR valve position sensor signal voltage is less than 0.1 volts for 5 seconds.	• Sensor 5V reference circuit is short to ground or short to the low reference circuit. (P1635 may also set.) • Sensor 5V reference circuit is open circuit, high resistance. • Sensor signal circuit is open circuit, high resistance, short to ground or short to the low reference circuit. • Poor harness connector connection. • Faulty sensor. (EGR valve) • Faulty ECM.

DTC	Flash Code	MIL Status	DTC Name	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0486	44	ON	EGR Valve Position Sensor Circuit High Voltage	• DTCs P1630 and P1635 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts.	• The ECM detects that the EGR valve position sensor signal voltage is more than 4.9 volts for 5 seconds.	• Sensor 5V reference circuit is short to battery or ignition voltage. (P1635 may also set.) • Sensor signal circuit is short to battery, ignition voltage or short to any 5V reference circuit. • Sensor low reference circuit is open circuit or high resistance. • Poor harness connector connection. • Faulty sensor. (EGR valve) • Faulty ECM.
P0488	45	ON	Exhaust Gas Recirculation (EGR) Valve Performance	• DTCs P0485, P0486, P1630 and P1635 are not set. • The ignition switch is ON. • The battery voltage is between 20 – 32 volts. • The ignition voltage is more than 18 volts. • The desired EGR valve position is stable.	• The ECM detects a variance between the actual EGR valve position and desired valve position is more than 20% for longer than 20 seconds when the EGR solenoid command duty is more than 90%.	• Valve stick. • Motor voltage feed circuit is short to battery, ignition voltage, short to ground, short to the sensor low reference circuit, open circuit or high resistance. • Duty signal circuit is short to battery, ignition voltage, short to ground, short to the sensor low reference circuit, open circuit or high resistance. • Poor harness connector connection. • Faulty EGR valve. • Faulty ECM.
P0500	25	ON	Vehicle Speed Sensor (VSS) Circuit	• The ignition switch is ON. • The ignition voltage is more than 18 volts. • The engine speed is more than 2000 RPM. • The commanded fuel is OFF (accelerator pedal is released).	• The ECM detects that the VSS signals are not generated for 5 seconds.	• Faulty sensor installation. • Sensor voltage feed circuit is open circuit or high resistance. • Sensor signal circuit is short to battery, ignition voltage, short to ground, open circuit or high resistance. • Sensor low reference circuit is open circuit or high resistance. • Poor harness connector connection. • Faulty sensor. • Faulty ECM. • Electromagnetic interference and electrical noise.

DTC	Flash Code	MIL Status	DTC Name	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0501	25	ON	Vehicle Speed Sensor (VSS) Performance	• The ignition switch is ON. • The ignition voltage is more than 18 volts.	• The ECM detects that the VSS signal are changed larger than a predetermined vehicle speed.	• Sensor installation is poor condition. • Sensor circuit is intermittently open circuit or poor connection. • Faulty sensor. • Electromagnetic interference and electrical noise.
P0601	53	ON	Control Module Read Only Memory (ROM)	—	• The ECM detects a malfunction in its internal flash read memory (ROM).	• Faulty ECM.
P0603	54	ON	Control Module Read Only Memory (ROM)	—	Either of following condition is met: • The ECM detects a malfunction in its internal electrically erasable & programmable read only memory (EEPROM). • The ECM detects that the calculated checksum does not agree with the ECM internal registered checksum.	• Faulty ECM.
P0606	51/52	ON	Control Module Internal Performance	• The ignition switch is ON. • The battery voltage is more than 16 volts.	Either of following condition is met: • The ECM detects a malfunction in its internal main central processing unit (CPU). (Flash Code 51) • The ECM detects a malfunction in its internal sub CPU. (Flash Code 52)	• ECM voltage feed circuit is high resistance. • ECM ground circuit is open circuit or high resistance. • Faulty ECM.
P0611	34	ON	Fuel Injector Control Module Performance Group 1	• The ignition switch is ON. • The battery voltage is more than 18 volts.	• The ECM detects that the common 1 fuel injector charge up circuit is insufficient charge.	• ECM voltage feed circuit is high resistance. • ECM ground circuit is open circuit or high resistance. • Faulty ECM.
P0612	34	ON	Fuel Injector Control Module Performance Group 2	• The ignition switch is ON. • The battery voltage is more than 18 volts.	• The ECM detects that the common 2 fuel injector charge up circuit is insufficient charge.	• ECM voltage feed circuit is high resistance. • ECM ground circuit is open circuit or high resistance. • Faulty ECM.

DTC	Flash Code	MIL Status	DTC Name	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P0615	19	ON	Starter Relay Control Circuit	• The ignition switch is ON. • The battery voltage is between 16 – 32 volts.	Either of following condition is met: • The ECM detects a low voltage condition on the starter cut relay control circuit when the relay is commanded OFF for longer than 10 seconds. • The ECM detects a high voltage condition on the starter cut relay control circuit when the relay is commanded ON for longer than 10 seconds.	• Relay voltage feed circuit is open circuit or high resistance. • Relay control circuit is short to battery, ignition voltage, short to ground, open circuit or high resistance. • Poor harness connector connection. • Faulty relay. • Faulty ECM.
P0650	77	OFF	Malfunction Indicator Lamp (MIL) Control Circuit	• The ignition switch is ON. • The ignition voltage is more than 18 volts.	Either of following condition is met: • The ECM detects a low voltage condition on the MIL control circuit when the indicator is commanded OFF for longer than 3 seconds. • The ECM detects a high voltage condition on the MIL control circuit when the indicator is commanded ON for longer than 3 seconds.	• Lamp voltage feed circuit is open circuit or high resistance. • Lamp control circuit is short to battery, ignition voltage, short to ground, open circuit or high resistance. • Poor harness connector connection. • Faulty instrument panel cluster. • Faulty lamp. • Faulty ECM.

DTC	Flash Code	MIL Status	DTC Name	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P1093	227	ON	Fuel Rail Pressure (FRP) Too Low	• DTCs P0090, P0192, P0193, P0201 – P0204, P0611, P0612, P1095, P1261, P1262, P1630 and P1635 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts. • The FRP regulator command is less than 33% or commanded fuel supply is more than a predetermined value.	Either of following condition is met: • The ECM detects that the differential fuel rail pressure is -10 MPa (-1,450 psi) for longer than 15 seconds when the engine speed is between 0 – 900 RPM. • The ECM detects that the deferential fuel rail pressure is -15 MPa (-2,170 psi) for longer than 15 seconds when the engine speed is higher than 1200 RPM.	• Loss fuel or less fuel in the fuel tank. • Pressure limiter valve opening pressure drop. • Faulty fuel injector. • Fuel suction side looseness, kinks or blocked. • Faulty or clogged fuel filter. • FRP sensor circuit is intermittently open circuit, poor connection or corrosion. • FRP sensor circuit high resistance. • FRP regulator circuit is intermittently open circuit, poor connection or corrosion. • FRP regulator circuit high resistance. • Faulty FRP sensor. • Faulty FRP regulator. • Faulty fuel supply pump.

DTC	Flash Code	MIL Status	DTC Name	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P1094	226	ON	Fuel Rail Pressure (FRP) Too Low	FRP Regulator Command High DTC • DTCs P0090, P0117, P0118, P0192, P0193, P0201 – P0204, P0500, P0501, P0611, P0612, P1095, P1261, P1262, P1630 and P1635 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts. • The engine is running. • The accelerator pedal position is 0%. • The engine coolant temperature is more than 50°C (122°F). • The vehicle speed is less than 5 km/h (4 MPH). • The engine speed does not vary more than 50 RPM. FRP Drop DTC • DTCs P0090, P0192, P0193, P0201 – P0204, P0611, P0612, P1095, P1261, P1262, P1630 and P1635 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts. • The engine is running. • The accelerator pedal position is 0%. • The engine coolant temperature is more than 50°C (122°F). • The vehicle speed is more than 50 km/h (30 MPH). • The commanded fuel injection quantity is OFF.	FRP Regulator Command High DTC • The ECM detects that the FRP regulator commanded fuel is more than a predetermined range for longer than 15 seconds when the engine speed is between 600 – 1500 RPM. FRP Drop DTC • The ECM detects that the FRP sensor signal voltage is shapely dropped more than 0.2 volts when the engine cuts fuel.	• Fuel leaking at high pressure side. • Loss fuel or less fuel in the fuel tank. • Pressure limiter valve opening pressure drop. • Faulty fuel injector. • Fuel suction side looseness, kinks or blocked. • Faulty or clogged fuel filter. • FRP sensor circuit is intermittently open circuit, poor connection or corrosion. • FRP sensor circuit high resistance. • FRP regulator circuit is intermittently open circuit, poor connection or corrosion. • FRP regulator circuit high resistance. • Faulty FRP sensor. • Faulty FRP regulator. • Faulty fuel supply pump.

DTC	Flash Code	MIL Status	DTC Name	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P1095	225	ON	Fuel Pressure Limiter Activation	• DTCs P0192, P0193, P1630 and P1635 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts.	• The ECM detects that the FRP sensor signal voltage drops quickly from more than 3.7 volts to less than 2.3 volts, and then the differential fuel rail pressure is more than -30 MPa (4,350 psi).	• Loss fuel or less fuel in the fuel tank. • Faulty fuel injector. • Fuel suction side looseness, kinks or blocked. • Faulty or clogged fuel filter. • FRP sensor circuit is intermittently open circuit, poor connection or corrosion. • FRP sensor circuit high resistance. • FRP regulator circuit is intermittently open circuit, poor connection or corrosion. • FRP regulator circuit high resistance. • Faulty FRP sensor. • Faulty FRP regulator. • Faulty fuel supply pump.
P1173	542	OFF	Engine Overheat	• DTCs P0117, P0118, P1630 and P1634 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts. • The engine is running.	• The ECM detects that the engine coolant temperature is more than 110°C (230°F) for 15 seconds.	• Engine overheat. • Faulty engine cooling system. • Faulty engine coolant temperature sensor.
P1220	28	ON	PTO Engine Speed Selector Sensor Circuit High Voltage	• DTCs P1630 and P1631 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts.	• The ECM detects that the PTO throttle sensor signal voltage is more than 4.8 volts.	• Sensor 5V reference circuit is short to battery or ignition voltage. (P1631 may also set.) • Sensor signal circuit is short to battery, ignition voltage or short to any 5V reference circuit. • Sensor low reference circuit is open circuit or high resistance. • Poor harness connector connection. • Faulty sensor. • Faulty ECM.

DTC	Flash Code	MIL Status	DTC Name	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P1225	31	ON	Engine Idle Speed Selector Sensor Circuit	• DTCs P1630 and P1631 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts.	Either of following condition is met: • The ECM detects that the idle up sensor signal voltage is less than 0.1 volts for 5 second. • The ECM detects that the idle up sensor signal voltage is more than 4.9 volts for 5 second.	• Sensor 5V reference circuit is short to battery or ignition voltage, short to ground or short to the low reference circuit. (P1631 may also set.) • Sensor 5V reference circuit is open circuit, high resistance. • Sensor signal circuit is short to battery, ignition voltage or short to any 5V reference circuit, short to ground, short to the low reference circuit, open circuit or high resistance. • Sensor low reference circuit is open circuit or high resistance. • Poor harness connector connection. • Faulty sensor. • Faulty ECM.
P1261	158	ON	Injector Positive Voltage Control Circuit Group 1	• DTC P0611 is not set. • The ignition switch is ON. • The battery voltage is more than 18 volts. • The engine is running.	Either of following condition is met: • The ECM detects that the common 1 fuel injector drive circuit is open circuit, shorted to ground or shorted to voltage during engine rotations. • The ECM detects that the cylinder #1 or #4 fuel injector solenoid coil control circuit is shorted to ground during engine rotations.	• Cylinder #1 or #4 fuel injector solenoid coil control circuit is short to ground. • Common 1 fuel injector drive circuit is short to battery, ignition voltage, short to ground, open circuit or high resistance. • Faulty fuel injector. • Faulty ECM.
P1262	159	ON	Injector Positive Voltage Control Circuit Group 2	• DTC P0612 is not set. • The ignition switch is ON. • The battery voltage is more than 18 volts. • The engine is running.	Either of following condition is met: • The ECM detects that the common 2 fuel injector drive circuit is open circuit, shorted to ground or shorted to voltage during engine rotations. • The ECM detects that the cylinder number 2 or number 3 fuel injector solenoid coil control circuit is shorted to ground during engine rotations.	• Cylinder #2 or #3 fuel injector solenoid coil control circuit is short to ground. • Common 2 fuel injector drive circuit is short to battery, ignition voltage, short to ground, open circuit or high resistance. • Faulty fuel injector. • Faulty ECM.

DTC	Flash Code	MIL Status	DTC Name	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P1271	24	ON	Accelerator Pedal Position (APP) Sensor 1-2 Correlation	• DTCs P1630, P1631 and P1632 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts.	• The ECM detects that the APP sensor 1 and sensor 2 are more than 45% out of range of each other.	• Sensor 5V reference circuit is high resistance. • Sensor signal circuit is high resistance. • Sensor low reference circuit is high resistance. • Faulty sensor. • Faulty ECM. • Electromagnetic interference and electrical noise.
P1277	24	ON	Accelerator Pedal Position (APP) Sensor 1 Circuit Low Voltage	• DTCs P1630 and P1631 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts.	• The ECM detects that the APP sensor 1 signal voltage is less than 0.2 volts.	• Sensor 5V reference circuit is short to ground or short to the low reference circuit. (P1631 may also set.) • Sensor 5V reference circuit is open circuit, high resistance. • Sensor signal circuit is open circuit, high resistance, short to ground or short to the low reference circuit. • Poor harness connector connection. • Faulty sensor. • Faulty ECM.
P1278	24	ON	Accelerator Pedal Position (APP) Sensor 1 Circuit High Voltage	• DTCs P1630 and P1631 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts.	• The ECM detects that the APP sensor 1 signal voltage is more than 4.9 volts.	• Sensor 5V reference circuit is short to battery or ignition voltage. (P1631 may also set.) • Sensor signal circuit is short to battery, ignition voltage or short to any 5V reference circuit. • Sensor low reference circuit is open circuit or high resistance. • Poor harness connector connection. • Faulty sensor. • Faulty ECM.

DTC	Flash Code	MIL Status	DTC Name	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P1282	24	ON	Accelerator Pedal Position (APP) Sensor 2 Circuit Low Voltage	• DTCs P1630 and P1632 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts.	• The ECM detects that the APP sensor 2 signal voltage is less than 0.2 volts.	• Sensor 5V reference circuit is short to ground or short to the low reference circuit. (P1632 may also set.) • Sensor 5V reference circuit is open circuit, high resistance. • Sensor signal circuit is open circuit, high resistance, short to ground or short to the low reference circuit. • Poor harness connector connection. • Faulty sensor. • Faulty ECM.
P1283	24	ON	Accelerator Pedal Position (APP) Sensor 2 Circuit High Voltage	• DTCs P1630 and P1632 are not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts.	• The ECM detects that the APP sensor 2 signal voltage is more than 4.9 volts.	• Sensor 5V reference circuit is short to battery or ignition voltage. (P1632 may also set.) • Sensor signal circuit is short to battery, ignition voltage or short to any 5V reference circuit. • Sensor low reference circuit is open circuit or high resistance. • Poor harness connector connection. • Faulty sensor. • Faulty ECM.
P1345	16	ON	Crankshaft Position (CKP) – Camshaft Position (CMP) Correlation	• DTCs P0335, P0336, P0340 and P0341 are not set. • The ignition switch is ON • The CKP sensor signal is detected. • The CMP sensor signal is detected.	• The ECM detects that the CKP sensor signals and CMP sensor signals are out of synchronization during engine rotations.	• Incorrect engine mechanical timing.

DTC	Flash Code	MIL Status	DTC Name	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P1625	416	ON	Main Relay System Error	ECM main relay open stuck DTC • DTC P1630 is not set. • The ignition switch is ON. • The ignition voltage is more than 18 volts. • The ignition ON time is longer than 3 seconds.	ECM Main Relay Open Stuck DTC • The ECM detects a low voltage condition on the ECM main relay voltage feed circuit when the relay is commanded ON for longer than 5 seconds. ECM Main Relay Close Stuck DTC • The ECM detects that the ECM has been ON when the relay is commanded OFF for longer than 10 seconds.	• Relay switch side voltage feed circuit is open circuit or high resistance. • Relay switched voltage feed circuit is short to battery or high resistance. • Relay coil side voltage supply circuit is short to battery or high resistance. • Relay coil side ground circuit is open circuit or high resistance. • Faulty relay. • Faulty ECM
P1630	36	ON	Control Module A/D Converter Error	—	• The ECM detects a malfunction in its internal analog / digital (A/D) converter.	• Faulty ECM.
P1631	55	ON	5V Reference Circuit 1	• DTC P1630 is not set. • The ignition switch is ON. • The battery voltage is between 16 – 32 volts.	Either of following condition is met: • The ECM detects that the 5 volts reference circuit 1 voltage is less than 4.5 volts. • The ECM detects that the 5 volts reference circuit 1 voltage is more than 5.5 volts.	• APP sensor 1 5V reference circuit is short to battery, ignition voltage or short to ground. • Idle up sensor 5V reference circuit is short to battery, ignition voltage or short to ground. • PTO throttle sensor 5V reference circuit is short to battery, ignition voltage or short to ground. • Faulty APP sensor. • Faulty idle up sensor. • Faulty PTO throttle sensor. • Faulty ECM.

DTC	Flash Code	MIL Status	DTC Name	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P1632	55	ON	5V Reference Circuit 2	• DTC P1630 is not set. • The ignition switch is ON. • The battery voltage is between 16 – 32 volts.	Either of following condition is met: • The ECM detects that the 5 volts reference circuit 2 or 5 voltage is less than 4.5 volts. • The ECM detects that the 5 volts reference circuit 2 or 5 voltage is more than 5.5 volts.	• APP sensor 2 5V reference circuit is short to battery, ignition voltage or short to ground. • FRP sensor 5V reference circuit is short to battery, ignition voltage or short to ground. • EGR valve position sensor 5V reference circuit is short to battery, ignition voltage or short to ground. • BARO sensor 5V reference circuit is short to battery, ignition voltage or short to ground. • Faulty APP sensor. • Faulty FRP sensor. • Faulty EGR valve. • Faulty BARO sensor. • Faulty ECM.
P1633	55	ON	5V Reference Circuit 3	• DTC P1630 is not set. • The ignition switch is ON. • The battery voltage is between 16 – 32 volts.	Either of following condition is met: • The ECM detects that the 5 volts reference circuit 3 or 4 voltage is less than 4.5 volts. • The ECM detects that the 5 volts reference circuit 3 or 4 voltage is more than 5.5 volts.	• Same as DTC P1634.
P1634	55	ON	5V Reference Circuit 4	• DTC P1630 is not set. • The ignition switch is ON. • The battery voltage is between 16 – 32 volts.	Either of following condition is met: • The ECM detects that the 5 volts reference circuit 3 or 4 voltage is less than 4.5 volts. • The ECM detects that the 5 volts reference circuit 3 or 4 voltage is more than 5.5 volts.	• Boost pressure sensor 5V reference circuit is short to battery, ignition voltage or short to ground. • Faulty boost pressure sensor. • Faulty ECM.

DTC	Flash Code	MIL Status	DTC Name	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
P1635	55	ON	5V Reference Circuit 5	• DTC P1630 is not set. • The ignition switch is ON. • The battery voltage is between 16 – 32 volts.	Either of following condition is met: • The ECM detects that the 5 volts reference circuit 2 or 5 voltage is less than 4.5 volts. • The ECM detects that the 5 volts reference circuit 2 or 5 voltage is more than 5.5 volts.	• Same as DTC P1632.
P1681	46	ON	Exhaust Brake Valve Circuit Low Voltage	• The ignition switch is ON. • The battery voltage is between 16 – 32 volts. • The engine is running.	• The ECM detects a low voltage condition on the exhaust brake solenoid valve control circuit for longer than 10 seconds when the solenoid valve is commanded OFF.	• Exhaust brake solenoid valve voltage feed circuit is open circuit or high resistance. • Exhaust brake solenoid valve control circuit is short to ground, open circuit or high resistance. • Poor harness connector connection. • Faulty exhaust brake solenoid valve. • Faulty ECM.
P1682	46	ON	Exhaust Brake Valve Circuit High Voltage	• The ignition switch is ON. • The battery voltage is between 16 – 32 volts. • The engine is running.	• The ECM detects a high voltage condition on the exhaust brake solenoid valve control circuit for longer than 10 seconds when the solenoid valve is commanded ON.	• Exhaust brake solenoid valve control circuit is short to battery or ignition voltage. • Faulty exhaust brake solenoid valve. • Faulty ECM.
U2104	84	ON	CAN Bus Reset Counter Overrun	• The ignition switch is ON.	• The ECM detects that the CAN Bus OFF status.	• CAN Low circuit is short to battery, ignition voltage, short to ground, open circuit or high resistance. • CAN High circuit is short to battery, ignition voltage, short to ground, open circuit or high resistance. • Faulty resistor 1. • Faulty resistor 2. • Faulty ECM. • Faulty DRM. • Faulty TCM. • Faulty EHCU. • Electromagnetic interference and electrical noise.

DTC	Flash Code	MIL Status	DTC Name	Condition for Running the DTC	Condition for Setting the DTC	Possible Cause
U2106	85	ON	Lost CAN Communications With Transmission Control System	• The ignition switch is ON.	• The ECM detects that the CAN Bus messages from the TCM are not being received.	• CAN Low circuit to the TCM is open circuit. • CAN High circuit to the TCM is open circuit. • Faulty resistor 1. • Faulty resistor 2. • Faulty ECM. • Faulty TCM. • Electromagnetic interference and electrical noise.

P0087 (Flash Code 227)

Description

The common rail fuel system is comprised of two fuel pressure sections: a suction side between the fuel tank and the fuel supply pump and a high-pressure side between the fuel supply pump and the fuel injectors. Fuel is drawn from the fuel tank via a feed pump and then pumped into the fuel rail by two plungers, all of which are internal to the fuel supply pump. This high pressure is regulated by the engine control module (ECM) using the fuel rail pressure (FRP) regulator dependant upon values from the FRP sensor attached to the fuel rail. In case of fuel rail overpressure, a pressure limiter valve threaded into the fuel rail will open to release overpressure and return fuel back to the fuel tank.

If the ECM detects that the fuel rail pressure is certain pressure low as compared with engine speed, this DTC will set.

Condition for Running the DTC

- DTCs P0090, P0192, P0193, P0201 – P0204, P0611, P0612, P1095, P1261, P1262, P1630 and P1635 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects that the FRP sensor signal voltage is 1.0 volt for 10 seconds when the engine speed is between 0 – 600 RPM.
- The ECM detects that the FRP sensor signal voltage is less than 1.2 volts for 10 seconds when the engine speed is higher than 900 RPM.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits accelerator control range.
- The ECM inhibits pilot injection.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail at next driving cycle.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- An intermittently sticking FRP regulator may have allowed the fuel pressure to become low enough to set this DTC.
- Normal FRP Sensor readings on the Tech 2 with the engine running in neutral at idle is around 1.4 – 1.6 volts.
- An intermittently sticking fuel injector may have allowed the fuel pressure to drop too much. Use the Tech 2 to perform the Injector Balancing test for each injector. Verify a consistent engine speed change when commanding each fuel injector ON and OFF.
- A skewed FRP sensor value (shifted to a lower pressure) can set this DTC. The FRP Sensor on the Tech 2 should read 0.9 – 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 2 minutes.

Notice:

- This DTC most likely indicates a loss of fuel pressure by a fuel leak from the high pressure side. Inspect the high pressure side fuel leakage between the fuel supply pump and fuel injector FIRST.

Notice:

- The fuel system from the fuel tank(s) to the fuel supply pump is under a slight vacuum with the engine running. As a result, air can enter the fuel system if these connections are not tight or if there is a crack in one of the fuel hoses. Air in the fuel system will cause fuel rail pressure fluctuations especially at high engine speed and load, which may set this DTC.

Notice:

- If the fuel tank is empty or near empty, air might be allowed to go into the fuel system. With air in the fuel system, smooth flow of fuel into the supply pump is interrupted and this DTC may set. Perform bleeding of fuel system after refilling.

Test Description

The numbers below refers to the step number on the diagnostic table.

7. This step checks for a fuel restriction by determining if a high vacuum is being pulled on the fuel system during normal operation.
8. This step checks for an air leak on the suction side of the fuel system by determining if a vacuum can be pulled when a fuel line is plugged.

DTC P0087 (Flash Code 227)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Inspect the high pressure side between the fuel supply pump and the fuel injectors for fuel leakage. The following components may contain an external leak. • Fuel supply pump • Fuel rail • Pressure limiter valve • Flow damper valve • Fuel rail pressure (FRP) sensor • Fuel pipe between the fuel supply pump and fuel rail • Fuel pipe between the fuel rail and fuel injectors • Each fuel pipe sleeve nuts **Notice:** Fuel may leak under the cylinder head cover from the inlet high pressure line. In such case, the engine oil level will rise. Inspect for fuel leakage into the engine oil. **Notice:** Remove and inspect the inlet high pressure joint to the fuel injectors for fuel leaking from the sleeve nut(s). Replace the fuel injector and injection pipe when foreign material was in contact. 2. Repair any fuel system leaks as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 3
3	1. Remove each glow plug from the cylinder head. 2. Inspect the tip of the plugs for wet fuel. **Notice:** Use the engine compression gauge (5-8840-2675-0 / J-26999-12) and gauge adapter (5-8840-2815-0 / EN-46722) to inspect the damage of engine. If poor engine compression (less than 1960 kPa [284 psi]) or variation of each cylinder (more than 294 kPa [43 psi]) is found, inspect the engine mechanical. Refer to the Engine Mechanical section. Repair as necessary. Did you find wet fuel on the glow plug(s)?	—	Go to Step 16	Go to Step 4
4	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P0090, P0192, P0193, P0201 – P0204, P1094, P1095, P1261 or P1262 set?	—	Go to Applicable DTC	Go to Step 5

<table>
<tr><th>Step</th><th>Action</th><th>Value(s)</th><th>Yes</th><th>No</th></tr>
<tr><td>5</td><td>1. Turn OFF the ignition.
2. Wait 2 minutes for the fuel pressure to bleed down from the fuel rail.
3. Turn ON the ignition with the engine OFF. DO NOT start the engine.
4. Observe the FRP Sensor parameter with the Tech 2.

Is the FRP Sensor parameter the specified value?</td><td>0.9 – 1.0 volt</td><td>Go to Step 6</td><td>Go to Step 13</td></tr>
<tr><td>6</td><td>1. Turn OFF the ignition.
2. Check the fuel system line connections between the fuel tank and the fuel supply pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps.

Notice:
The fuel system from the fuel tank(s) to the fuel supply pump is under a slight vacuum with the engine running. As a result, air can enter the fuel system if these connections are not tight. Air in the fuel system will cause fuel rail pressure fluctuations especially at high engine speed and load, which may set this DTC.

3. Pump the priming pump on the fuel filter until it becomes firm. If there is a leak on the suction side of the fuel system between the priming pump and the fuel supply pump, the priming pump will not build up sufficient firmness and fuel leakage may occur.
4. Start the engine and check for high side fuel system leaks at the fuel supply pump and fuel rail.

Notice:
Fuel may leak under the cylinder head cover from the inlet high pressure line. In such case, the engine oil level will rise. Inspect for fuel leakage into the engine oil.

5. Repair any fuel system leaks as necessary.

Did you find and correct the condition?</td><td>—</td><td>Go to Step 20</td><td>Go to Step 7</td></tr>
</table>

Step	Action	Value(s)	Yes	No
7	1. Turn OFF the ignition. 2. Remove the rubber fuel hose from the fuel filter housing (fuel supply pump side). Use a pan to catch the fuel leakage from the removed fuel line. **Important:** The fuel vacuum pump / pressure gauge connector and the adapter hose must be cleaned before connecting to the fuel line. Otherwise, foreign material internal to the tools line may damage the fuel supply pump. 3. Connect the suction side fuel pressure / vacuum gauge adapter (5-8840-2844-0 / EN-47667) with fuel pressure / vacuum gauge assembly (5-8840-2844-0 / J-44638) in series with the filter housing and the disconnected fuel hose. Ensure the service tool and fuel line connections are tight. 4. Bleed the fuel system by priming the priming pump until it becomes firm, then crank over the engine for a maximum of 5 seconds. Repeat as necessary until the engine starts. 5. Let the engine run at idle for at least 1 minute. 6. Monitor the fuel pressure / vacuum gauge while holding the engine speed higher than 2500 RPM for a minimum of 1 minute. Does the fuel pressure / vacuum gauge ever indicate a larger vacuum than the specified amount during the test?	5 inHg	Go to Step 9	Go to Step 8
8	1. Fully clamp off a fuel hose as close to the fuel tank as possible (this will draw vacuum on the fuel system). You can also disconnect a fuel line and plug it. 2. Start the engine and turn the idle up control knob to the highest position. (Full clockwise direction. The idle speed is increased up to 1600 RPM.) 3. Monitor the fuel pressure / vacuum gauge. **Notice:** Release the clamp or open the plug when the gauge is likely to be more than 8 inHg during the test. Can a vacuum of at least the specified amount be pulled on the fuel system?	8 inHg	Go to Step 11	Go to Step 10
9	1. Inspect the fuel lines between the fuel supply pump and fuel tank for being crushed or kinked. 2. Inspect for a plugged fuel tank vent hose. 3. Inspect inside the fuel tank (if possible) for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. 4. Repair as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 14

Step	Action	Value(s)	Yes	No
10	1. Turn OFF the ignition. 2. Check the fuel system line connections between the fuel tank and the fuel supply pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. 3. Repair as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 12
11	1. Turn OFF the ignition. 2. Unclamp or unplug the fuel line from the previous step and reconnect the fuel line (if disconnected). 3. Start the engine and allow it to run for at least 1 minute. 4. Perform the Injector Balancing test with the Tech 2. 5. Command each injector OFF and verify an engine speed change for each injector. Is there an injector that does not change engine speed when commanded OFF?	—	Go to Step 17	Go to Step 19
12	1. Turn OFF the ignition. 2. Disconnect the FRP regulator harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP regulator (pins 1 and 2 of E-116). 4. Disconnect the engine control module (ECM) harness connector. 5. Inspect for an intermittent, for poor connections and corrosion on each FRP regulator circuit at the harness connector of the ECM (pins 89, 97, 105 and 113 of E-111 connector). 6. Test for high resistance on each FRP regulator circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 18
13	1. Turn OFF the ignition. 2. Disconnect the FRP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP sensor (pins 1, 2 and 3 of E-113 connector). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion on each FRP sensor circuit at the harness connector of the ECM (pins 82, 87, 90 and 101 of E-111 connector). 6. Test for high resistance on each FRP circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 15

Step	Action	Value(s)	Yes	No
14	Replace the fuel filter cartridge. Refer to Fuel Filter Cartridge Replacement in the Fuel System Section. Did you complete the replacement?	—	Go to Step 20	—
15	Replace the FRP sensor. Refer to Fuel Rail Pressure (FRP) Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 20	—
16	**Important:** Replacement injector must be programmed. Replace the appropriate injector that was leaking fuel found at Step 3. Refer to Fuel Injector Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 20	—
17	**Important:** Replacement injector must be programmed. Replace the appropriate fuel injector that does not change engine speed when commanded OFF. Refer to Fuel Injector Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 20	—
18	**Important:** The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. **Notice:** Always replace the fuel filter cartridge when a fuel supply pump is replaced. Replace the fuel supply pump and fuel filter cartridge. Refer to Fuel Supply Pump Replacement in this section and Fuel Filter Cartridge Replacement in Fuel System section. Did you complete the replacement?	—	Go to Step 20	—
19	**Notice:** There is a possibility that the pressure limiter valve stuck open or opening pressure has fallen. Replace the pressure limiter valve. Refer to Fuel Rail Replacement in this section. Did you complete the replacement?	—	Go to Step 20	—
20	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 21
21	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0088 (Flash Code 118)

Description

The common rail fuel system is comprised of two fuel pressure sections: a suction side between the fuel tank and the fuel supply pump and a high-pressure side between the fuel supply pump and the fuel injectors. Fuel is drawn from the fuel tank via a feed pump and then pumped into the fuel rail by two plungers, all of which are internal to the fuel supply pump. This high pressure is regulated by the engine control module (ECM) using the fuel rail pressure (FRP) regulator dependant upon values from the FRP sensor attached to the fuel rail. In case of fuel rail overpressure, a pressure limiter valve threaded into the fuel rail will open to release overpressure and return fuel back to the fuel tank.
If the ECM detects that the fuel pressure went excessively high for a certain length of time, this DTC will set (First Stage DTC).
If the ECM detects that during the same ignition cycle the fuel pressure rose even higher than the amount to set DTC P0088 (Second Stage DTC) for a certain length of time, this DTC will also set.

Condition for Running the DTC

- DTCs P0192, P0193, P1630 and P1635 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.
- The engine is running.

Condition for Setting the DTC

First Stage DTC

- The ECM detects that the FRP sensor signal voltage is more than 3.9 volts for longer than 10 second.

Second Stage DTC

- The ECM detects that the FRP sensor signal voltage is more than 4.0 volts for longer than 10 second during the ignition cycle after first stage has occurred.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits accelerator control range.
- The ECM inhibits pilot injection.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail at next driving cycle.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- An intermittently sticking FRP regulator may have allowed the fuel pressure to become high enough to set this DTC.
- Normal FRP Sensor readings on the Tech 2 with the engine running in neutral at idle is around 1.4 – 1.6 volts.
- A skewed FRP sensor value (shifted to a higher pressure) can set this DTC. The FRP Sensor on the Tech 2 should read 0.9 – 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 2 minutes.

Test Description

The numbers below refer to the step number on the diagnostic table.
6. This step checks for a fuel restriction by determining if a high vacuum is being pulled on the fuel system during normal operation.
7. This step checks for an air leak on the suction side of the fuel system by determining if a vacuum can be pulled when a fuel line is plugged.

DTC P0088 (Flash Code 118)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls

Step	Action	Value(s)	Yes	No
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P0089, P0090, P0192, P0193, P0201 – P0204, P1095, P1261 or P1262 set?	—	Go to Applicable DTC	Go to Step 3
3	1. Turn OFF the ignition for 30 seconds. 2. Place the transmission in Neutral and set the park brake. 3. Start the engine. 4. Observe the Fuel Rail Pressure (FRP) Sensor parameter with the Tech 2. 5. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the Tech 2. Does the FRP Sensor parameter ever exceed the specified value?	3.9 volts	Go to Step 4	An intermittent problem by foreign material in the fuel is suspected. Go to Step 13
4	1. Turn OFF the ignition. 2. Wait 2 minutes for the fuel pressure to bleed down from the fuel rail. 3. Turn ON the ignition with the engine OFF. DO NOT start the engine. 4. Observe the FRP Sensor parameter with the Tech 2. Is the FRP Sensor parameter the specified value?	0.9 – 1.0 volt	Go to Step 5	Go to Step 12
5	1. Turn OFF the ignition. 2. Check the fuel system line connections between the fuel tank and the fuel supply pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. **Notice:** The fuel system from the fuel tank(s) to the fuel supply pump is under a slight vacuum with the engine running. As a result, air can enter the fuel system if these connections are not tight. Air in the fuel system will cause fuel rail pressure fluctuations especially at high engine speed and load, which may set this DTC. 3. Pump the priming pump on the fuel filter until it becomes firm. If there is a leak on the suction side of the fuel system between the priming pump and the fuel supply pump, the priming pump will not build up sufficient firmness and fuel leakage may occur. 4. Start the engine and check for high side fuel system leaks at the fuel supply pump and fuel rail. **Notice:** Fuel may leak under the cylinder head cover from the inlet high pressure line. In such case, the engine oil level will rise. Inspect for fuel leakage into the engine oil. 5. Repair any fuel system leaks as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 6

Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition. 2. Remove the rubber fuel hose from the fuel filter housing (fuel supply pump side). Use a pan to catch the fuel leakage from the removed fuel line. **Important:** The fuel vacuum pump / pressure gauge connector and the adapter hose must be cleaned before connecting to the fuel line. Otherwise, foreign material internal to the tools line may damage the fuel supply pump. 3. Connect the suction side fuel pressure / vacuum gauge adapter (5-8840-2844-0 / EN-47667) with fuel pressure / vacuum gauge assembly (5-8840-2844-0 / J-44638) in series with the filter housing and the disconnected fuel hose. Ensure the service tool and fuel line connections are tight. 4. Bleed the fuel system by priming the priming pump until it becomes firm, then crank over the engine for a maximum of 5 seconds. Repeat as necessary until the engine starts. 5. Let the engine run at idle for at least 1 minute. 6. Monitor the fuel pressure / vacuum gauge while holding the engine speed higher than 2500 RPM for a minimum of 1 minute. Does the fuel pressure / vacuum gauge ever indicate a larger vacuum than the specified amount during the test?	5 inHg	Go to Step 8	Go to Step 7
7	1. Fully clamp off a fuel hose as close to the fuel tank as possible (this will draw vacuum on the fuel system). You can also disconnect a fuel line and plug it. 2. Start the engine and turn the idle up control knob to the highest position. (Full clockwise direction. The idle speed is increased up to 1600 RPM.) 3. Monitor the fuel pressure / vacuum gauge. **Notice:** Release the clamp or open the plug when the gauge is likely to be more than 8 inHg during the test. Can a vacuum of at least the specified amount be pulled on the fuel system?	8 inHg	Go to Step 10	Go to Step 9
8	1. Inspect the fuel lines between the fuel supply pump and fuel tank for being crushed or kinked. 2. Inspect for a plugged fuel tank vent hose. 3. Inspect inside the fuel tank (if possible) for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. 4. Repair as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 13

Step	Action	Value(s)	Yes	No
9	1. Turn OFF the ignition. 2. Check the fuel system line connections between the fuel tank and the fuel supply pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. 3. Repair as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 11
10	1. Turn OFF the ignition. 2. Unclamp or unplug the fuel line from the previous step and reconnect the fuel line (if disconnected). 3. Start the engine and allow it to run for at least 1 minute. 4. Perform the Injector Balancing test with the Tech 2. 5. Command each injector OFF and verify an engine speed change for each injector. Is there an injector that does not change engine speed when commanded OFF?	—	Go to Step 15	Go to Step 11
11	1. Turn OFF the ignition. 2. Disconnect the FRP regulator harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP regulator (pins 1 and 2 of E-116). 4. Disconnect the engine control module (ECM) harness connector. 5. Inspect for an intermittent, for poor connections and corrosion on each FRP regulator circuit at the harness connector of the ECM (pins 89, 97, 105 and 113 of E-111 connector). 6. Test for high resistance on each FRP regulator circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
12	1. Turn OFF the ignition. 2. Disconnect the FRP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP sensor (pins 1, 2 and 3 of E-113 connector). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion on each FRP sensor circuit at the harness connector of the ECM (pins 82, 87, 90 and 101 of E-111 connector). 6. Test for high resistance on each FRP circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 14

Step	Action	Value(s)	Yes	No
13	Replace the fuel filter cartridge. Refer to Fuel Filter Cartridge Replacement in the Fuel System Section. Did you complete the replacement?	—	Go to Step 17	—
14	Replace the FRP sensor. Refer to Fuel Rail Pressure (FRP) Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 17	—
15	**Important:** Replacement injector must be programmed. Replace the appropriate fuel injector that does not change engine speed when commanded OFF. Refer to Fuel Injector Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 17	—
16	**Important:** The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. **Notice:** Always replace the fuel filter cartridge when a fuel supply pump is replaced. Replace the fuel supply pump and fuel filter cartridge. Refer to Fuel Supply Pump Replacement in this section and Fuel Filter Cartridge Replacement in Fuel System section. Did you complete the replacement?	—	Go to Step 17	—
17	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 18
18	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0089 (Flash Code 151)

Description

The common rail fuel system is comprised of two fuel pressure sections: a suction side between the fuel tank and the fuel supply pump and a high-pressure side between the fuel supply pump and the fuel injectors. Fuel is drawn from the fuel tank via a feed pump and then pumped into the fuel rail by two plungers, all of which are internal to the fuel supply pump. This high pressure is regulated by the engine control module (ECM) using the fuel rail pressure (FRP) regulator dependant upon values from the FRP sensor attached to the fuel rail. In case of fuel rail overpressure, a pressure limiter valve threaded into the fuel rail will open to release overpressure and return fuel back to the fuel tank.
If the ECM detects that fuel pressure is a certain pressure higher than the desired fuel pressure for a certain length of time, this DTC will set.

Condition for Running the DTC

- DTCs P0090, P0192, P0193, P0201 – P0204, P0611, P0612, P1261, P1262, P1630 and P1635 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.
- The engine is running.
- The FRP regulator command is more than 40% or commanded fuel supply is less than a predetermined value.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects that the deferential fuel rail pressure is higher than 20 MPa (2,900 psi) for longer than 10 seconds when the engine speed is between 0 – 600 RPM.
- The ECM detects that the differential fuel rail pressure is higher than 40 MPa (5,800 psi) for longer than 10 seconds when the engine speed is higher than 900 RPM.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits accelerator control range.
- The ECM inhibits pilot injection.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail at next driving cycle.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- An intermittently sticking FRP regulator may have allowed the fuel pressure to become high enough to set this DTC.
- Normal FRP Sensor readings on the Tech 2 with the engine running in neutral at idle is around 1.4 – 1.6 volts.
- A skewed FRP sensor value (shifted to a higher pressure) can set this DTC. The FRP Sensor on the Tech 2 should read 0.9 – 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 2 minutes.

DTC P0089 (Flash Code 151)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P0090, P0192, P0193, P0201 – P0204, P1261 or P1262 set?	—	Go to Applicable DTC	Go to Step 3

Step	Action	Value(s)	Yes	No
3	1. Turn OFF the ignition. 2. Wait 2 minutes for the fuel pressure to bleed down from the fuel rail. 3. Turn ON the ignition with the engine OFF. DO NOT start the engine. 4. Observe the Fuel Rail Pressure (FRP) Sensor parameter with the Tech 2. Is the FRP Sensor parameter the specified value?	0.9 – 1.0 volt	Go to Step 4	Go to Step 5
4	1. Turn OFF the ignition. 2. Disconnect the FRP regulator harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP regulator (pins 1 and 2 of E-116). 4. Disconnect the engine control module (ECM) harness connector. 5. Inspect for an intermittent, for poor connections and corrosion on each FRP regulator circuit at the harness connector of the ECM (pins 89, 97, 105 and 113 of E-111 connector). 6. Test for high resistance on each FRP regulator circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 6
5	1. Turn OFF the ignition. 2. Disconnect the FRP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP sensor (pins 1, 2 and 3 of E-113 connector). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion on each FRP sensor circuit at the harness connector of the ECM (pins 82, 87, 90 and 101 of E-111 connector). 6. Test for high resistance on each FRP circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 8
6	1. Turn OFF the ignition for 30 seconds. 2. Place the transmission in Neutral and set the Park brake. 3. Start the engine. 4. Let the engine idle with the engine coolant temperature between 60 – 85°C (140 – 185°F) and accessories OFF while observing the Differential Fuel Rail Pressure parameter with the Tech 2. Is the Differential Fuel Rail Pressures parameter with the specified value?	± 5 MPa (± 725 psi)	Go to Step 7	Go to Step 9

Step	Action	Value(s)	Yes	No
7	**Notice:** An intermittent problem by foreign material in the fuel is suspected. Replace the fuel filter cartridge. Refer to Fuel Filter Cartridge Replacement in the Fuel System Section. Did you complete the replacement?	—	Go to Step 10	—
8	Replace the FRP sensor. Refer to Fuel Rail Pressure (FRP) Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 10	—
9	**Important:** The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. **Notice:** Always replace the fuel filter cartridge when a fuel supply pump is replaced. Replace the fuel supply pump and fuel filter cartridge. Refer to Fuel Supply Pump Replacement in this section and Fuel Filter Cartridge Replacement in Fuel System section. Did you complete the replacement?	—	Go to Step 10	—
10	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 11
11	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0090 (Flash Code 247)

Circuit Description

The fuel rail pressure (FRP) regulator is installed to the fuel supply pump and controls the suction fuel quantity into the fuel rail. The FRP regulator is fully opened in the normal state and larger drive current results in smaller opening. The engine control module (ECM) calculates desired fuel rail pressure and fuel flow rate and it compares the calculated desired fuel rail pressure to the actual value to determine the FRP regulator position. When the actual fuel rail pressure is higher than the desired value, the FRP regulator is closed to decease the flow rate. If the ECM detects an excessively low or high FRP regulator solenoid feedback current, this DTC will set.

Condition for Running the DTC

- DTC P1630 is not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.
- The FRP regulator command duty cycle is between 10 – 90%.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects that the FRP regulator solenoid feedback current is less than 50 mA.
- The ECM detects that the FRP regulator solenoid feedback current is more than 2400 mA.
- The ECM detects that the difference of commanded FRP regulator solenoid current and feedback current is more than 1000 mA.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits accelerator control range.
- The ECM inhibits pilot injection.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Test Description

The numbers below refers to the step number on the diagnostic table.
7. If the FRP regulator high control circuits between the ECM and the FRP regulator are shorted to voltage, engine stalls and will not start.
8. If the FRP regulator low control circuits between the ECM and the FRP regulator are shorted to ground, this DTC may not set. This condition will cause engine stall or no engine start.

DTC P0090 (Flash Code 247)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn ON the ignition, with the engine OFF. 2. Observe the Fuel Rail Pressure (FRP) Regulator Feedback parameter with the Tech 2. Is the FRP Regulator Feedback parameter more than the specified value?	300 mA	Go to Step 4	Go to Step 5
4	Is the FRP Regulator Feedback parameter more than the specified value at Step 3?	900 mA	Go to Step 7	Go to Step 8

Step	Action	Value(s)	Yes	No
5	1. Turn ON the ignition, with the engine OFF. 2. Disconnect the FRP regulator harness connector. 3. Connect a test lamp between the FRP regulator high control circuit (pin 1 of E-116 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. DO NOT start the engine. Does the test lamp illuminate?	—	Go to Step 6	Go to Step 9
6	1. Turn OFF the ignition. 2. Connect a test lamp between the FRP regulator low control circuit (pin 2 of E-116 connector) and battery voltage. 3. Turn ON the ignition, with the engine OFF. DO NOT start the engine. Does the test lamp illuminate?	—	Go to Step 11	Go to Step 10
7	1. Test the FRP regulator high control circuits between the engine control module (ECM) (pins 105 and 113 of E-111 connector) and the FRP regulator (pin 1 of E-116 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
8	1. Test the FRP regulator low control circuits between the ECM (pins 89 and 97 of E-111 connector) and the FRP regulator (pin 2 of E-116 connector) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
9	1. Test the FRP regulator high control circuits between the ECM (pins 105 and 113 of E-111 connector) and the FRP regulator (pin 1 of E-116 connector) for the following conditions: • An open circuit • A short to ground • A short to the low control circuits • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12
10	**Important:** The ECM may be damaged if the FRP regulator low control circuit is shorted to a voltage source. 1. Test the FRP regulator low control circuits between the ECM (pins 89 and 97 of E-111 connector) and the FRP regulator (pin 2 of E-116 connector) for the following conditions: • An open circuit • A short to battery or ignition voltage • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12

Step	Action	Value(s)	Yes	No
11	1. Turn OFF the ignition. 2. Disconnect the FRP regulator harness connector. 3. Inspect for an intermittent and for poor connections at the FRP regulator harness connector. 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 13
12	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections on the FRP regulator circuits at the harness connector of the ECM (pins 89, 97, 105 and 113 of E-111 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
13	**Important:** The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. Replace the fuel supply pump. Refer to Fuel Supply Pump Replacement in this section. (FRP regulator is part of the fuel supply pump assembly) Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 15	—
15	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 16
16	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0107 (Flash Code 71)

Circuit Description

The barometric pressure (BARO) sensor is located under the instrument panel cluster (IPC) near the pedal bracket. The BARO sensor is a transducer that varies voltage according to the barometric pressure changes and the generated voltage is input to the engine control module (ECM) for the BARO signal. The BARO sensor has the following circuits.

- 5 volts reference circuit.
- Low reference circuit.
- BARO sensor signal circuit.

The ECM supplies 5 volts to the BARO sensor on the 5 volts reference circuit. The ECM also provides a ground on the low reference circuit. The BARO sensor provides a signal to the ECM on the BARO signal circuit, which is relative to the pressure changes barometric pressure. The ECM should detect a low signal voltage at a low barometric pressure, such as high altitude place. The ECM should detect high signal voltage at a high barometric pressure. The ECM uses this voltage signal to calibrate the fuel injection quantity and injection timing for altitude compensation. If the ECM detects an excessively low BARO sensor signal voltage, this DTC will set.

Condition for Running the DTC

- DTCs P1630 and P1632 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.

Condition for Setting the DTC

- The ECM detects that the BARO sensor signal voltage is less than 0.5 volts for 10 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses a BARO substitution of 75 kPa (11 psi) for engine control.
- The ECM inhibits EGR valve control.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P0107 (Flash Code 71)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P1632 also set?	—	Go to DTC P1632	Go to Step 3
3	1. Turn ON the ignition, with the engine OFF. 2. Observe the Barometric Pressure (BARO) Sensor parameter with the Tech 2. Is the BARO Sensor parameter less than the specified value?	0.5 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the BARO sensor harness connector. 3. Connect a DMM between the 5 volts reference circuit of the BARO sensor harness (pin 3 of B-422 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 5	Go to Step 6

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire between the 5 volts reference circuit and the signal circuit of the BARO sensor harness (pins 3 and 2 of B-422 connector). 3. Turn ON the ignition, with the engine OFF. 4. Observe the BARO Sensor parameter with the Tech 2. Is the BARO Sensor parameter more than specified value?	4.5 volts	Go to Step 8	Go to Step 7
6	1. Test the 5 volts reference circuit between the engine control module (ECM) (pin 61 of J-191 connector) and the BARO sensor (pin 3 of B-422 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
7	1. Test the signal circuit between the ECM (pin 71 of J-191 connector) and the BARO sensor (pin 2 of B-422 connector) for the following conditions: • An open circuit • A short to ground • A short to the low reference circuit • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
8	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the BARO sensor (pins 2 and 3 of B-422 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections on the BARO sensor circuits at the harness connector of the ECM (pins 61 and 71 of J-191 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
10	Replace the BARO sensor. Refer to Barometric Pressure (BARO) Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 12	—
11	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 12	—

Step	Action	Value(s)	Yes	No
12	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 13
13	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0108 (Flash Code 71)

Circuit Description

The barometric pressure (BARO) sensor is located under the instrument panel cluster (IPC) near the pedal bracket. The BARO sensor is a transducer that varies voltage according to the barometric pressure changes and the generated voltage is input to the engine control module (ECM) for the BARO signal. The BARO sensor has the following circuits.

- 5 volts reference circuit.
- Low reference circuit.
- BARO sensor signal circuit.

The ECM supplies 5 volts to the BARO sensor on the 5 volts reference circuit. The ECM also provides a ground on the low reference circuit. The BARO sensor provides a signal to the ECM on the BARO signal circuit, which is relative to the pressure changes barometric pressure. The ECM should detect a low signal voltage at a low barometric pressure, such as high altitude place. The ECM should detect high signal voltage at a high barometric pressure. The ECM uses this voltage signal to calibrate the fuel injection quantity and injection timing for altitude compensation. If the ECM detects an excessively high BARO sensor signal voltage, this DTC will set.

Condition for Running the DTC

- DTCs P1630 and P1632 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.

Condition for Setting the DTC

- The ECM detects that the BARO sensor signal voltage is more than 4.9 volts for 10 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses a BARO substitution of 75 kPa (11 psi) for engine control.
- The ECM inhibits EGR valve control.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P0108 (Flash Code 71)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Barometric Pressure (BARO) Sensor parameter with the Tech 2. Is the BARO Sensor parameter more than the specified value?	4.9 volts	Go to Step 3	Go to Diagnostic Aids
3	1. Turn ON the ignition, with the engine OFF. 2. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P1632 also set?	—	Go to Step 4	Go to Step 5
4	1. Turn OFF the ignition. 2. Disconnect the BARO sensor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the BARO Sensor parameter with the Tech 2. Is the BARO Sensor parameter less than the specified value?	0.5 volts	Go to DTC P1632	Go to Step 7

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Disconnect the BARO sensor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the BARO Sensor parameter with the Tech 2. Is the BARO Sensor parameter less than the specified value?	0.5 volts	Go to Step 6	Go to Step 7
6	1. Turn OFF the ignition. 2. Connect a test lamp between the low reference circuit of the BARO sensor harness (pin 1 of B-422 connector) and battery voltage. 3. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 8
7	**Important:** The BARO sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the engine control module (ECM) (pin 71 of J-191 connector) and the BARO sensor (pin 2 of B-422 connector) for the following conditions: • A short to battery or ignition voltage • A short to any 5 volts reference 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
8	1. Test the low reference circuit between the ECM (pin 60 of J-191 connector) and the BARO sensor (pin 1 of B-422 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10
9	1. Turn OFF the ignition. 2. Inspect for an intermittent and for a poor connection at the harness connector of the BARO sensor (pin 1 of B-422 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 11
10	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the BARO sensor circuit at the harness connector of the ECM (pin 60 of J-191 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
11	Replace the BARO sensor. Refer to Barometric Pressure (BARO) Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 13	—

Step	Action	Value(s)	Yes	No
12	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 14
14	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0112 (Flash Code 22)

Circuit Description

The intake air temperature (IAT) sensor is fitted between the air cleaner and turbocharger. The 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 engine control module (ECM) 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 ECM detects a high voltage on the IAT signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the IAT signal circuit. If the ECM detects an excessively low IAT signal voltage, this DTC will set.

Condition for Running the DTC

- DTCs P1630 and P1632 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.

Condition for Setting the DTC

- The ECM detects that the IAT sensor signal voltage is less than 0.1 volts for 10 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses an IAT substitution of -10°C (14°F) for engine control.
- The ECM inhibits EGR valve control.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Use the Temperature vs. Resistance table to test the IAT sensor at various temperature levels to evaluate the possibility of a skewed sensor. A skewed sensor could result in poor driveability concerns.

DTC P0112 (Flash Code 22)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Intake Air Temperature (IAT) Sensor parameter with the Tech 2. Is the IAT Sensor parameter less than the specified value?	0.1 volts	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the IAT sensor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the IAT Sensor parameter with the Tech 2. Is the IAT Sensor parameter more than the specified value?	4.8 volts	Go to Step 5	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Test the signal circuit between the engine control module (ECM) (pin 72 of J-191 connector) and the IAT sensor (pin 1 of J-190 connector) for the following conditions: • A short to ground • A short to the low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 6
5	Replace the IAT sensor. Refer to Intake Air Temperature (IAT) Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 8	—
6	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect connections on the IAT sensor circuits at the harness connector of the ECM (pins 60 and 72 of J-191 connector) for corrosion. 4. Repair or clean the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
7	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 8	—
8	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 9
9	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0113 (Flash Code 22)

Circuit Description

The intake air temperature (IAT) sensor is fitted between the air cleaner and turbocharger. The 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 engine control module (ECM) 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 ECM detects a high voltage on the IAT signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the IAT signal circuit. If the ECM detects an excessively high IAT signal voltage, this DTC will set.

Condition for Running the DTC

- DTCs P1630 and P1632 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.
- The engine run time is longer than 3 minutes.

Condition for Setting the DTC

- The ECM detects that the IAT sensor signal voltage is more than 4.8 volts for 10 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses an IAT substitution of -10°C (14°F) for engine control.
- The ECM inhibits EGR valve control.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Use the Temperature vs. Resistance table to test the IAT sensor at various temperature levels to evaluate the possibility of a skewed sensor. A skewed sensor could result in poor driveability concerns.

DTC P0113 (Flash Code 22)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Intake Air Temperature (IAT) Sensor parameter with the Tech 2. Is the IAT Sensor parameter more than the specified value?	4.8 volts	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the IAT sensor harness connector. 3. Connect a DMM between the signal circuit of the IAT sensor harness (pin 1 of J-190 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	5.5 volts	Go to Step 4	Go to Step 5

Step	Action	Value(s)	Yes	No
4	**Important:** The IAT sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the engine control module (ECM) (pin 72 of J-191 connector) and the IAT sensor (pin 1 of J-190 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
5	1. Turn OFF the ignition. 2. Connect a test lamp between the signal circuit of the IAT sensor harness (pin 1 of J-190 connector) and a known good ground. 3. Connect a DMM between the probe of the test lamp and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 9	Go to Step 6
6	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire between the signal circuit and low reference circuit of the IAT sensor harness (pins 1 and 2 of J-190 connector). 3. Turn ON the ignition, with the engine OFF. 4. Observe the IAT Sensor parameter with the Tech 2. Is the IAT Sensor parameter less than the specified value?	0.1 volts	Go to Step 10	Go to Step 7
7	1. Test the signal circuit between the ECM (pin 72 of J-191 connector) and the IAT sensor (pin 1 of J-190 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 8
8	1. Test the low reference circuit between the ECM (pin 60 of J-191 connector) and the IAT sensor (pin 2 of J-190 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
9	1. Test the signal circuit between the ECM (pin 72 of J-191 connector) and the IAT sensor (pin 1 of J-190 connector) for a short to any 5 volts reference circuit. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
10	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the IAT sensor (pins 1 and 2 of J-190 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 12

Step	Action	Value(s)	Yes	No
11	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections on the IAT sensor circuits at the harness connector of the ECM (pins 60 and 72 of J-191 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
12	Replace the IAT sensor. Refer to Intake Air Temperature (IAT) Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 14	—
13	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 14	—
14	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 15
15	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0117 (Flash Code 23)

Circuit Description

The engine coolant temperature (ECT) sensor is installed to the thermostat housing. The ECT sensor is a variable resistor. The ECT sensor has a signal circuit and a low reference circuit. The ECT sensor measures the temperature of the engine coolant. The engine control module (ECM) supplies 5 volts to the ECT signal circuit and a ground for the ECT low reference circuit. When the ECT sensor is cold, the sensor resistance is high. When the engine coolant temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the ECT signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the ECT signal circuit. If the ECM detects an excessively low ECT signal voltage, this DTC will set.

Condition for Running the DTC

- DTCs P1630 and P1634 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.

Condition for Setting the DTC

- The ECM detects that the ECT sensor signal voltage is less than 0.1 volts for 10 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses an ECT substitution of -20°C (-4°F) for engine starting control.
- The ECM uses an ECT substitution of 110°C (230°F) for engine control.
- The ECM inhibits EGR valve control.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- 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.

DTC P0117 (Flash Code 23)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Coolant Temperature Sensor parameter with the Tech 2. Is the Coolant Temperature Sensor parameter less than the specified value?	0.1 volts	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the engine coolant temperature (ECT) sensor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Coolant Temperature Sensor parameter with the Tech 2. Is the Coolant Temperature Sensor parameter more than the specified value?	4.8 volts	Go to Step 5	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Test the signal circuit between the engine control module (ECM) (pin 84 of E-111 connector) and the ECT sensor (pin 1 of E-90 connector) for the following conditions: • A short to ground • A short to the low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 6
5	Replace the ECT sensor. Refer to Engine Coolant Temperature (ECT) Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 8	—
6	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect connections on the ECT sensor circuits at the harness connector of the ECM (pins 84 and 109 of E-111 connector) for corrosion. 4. Repair or clean the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
7	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 8	—
8	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 9
9	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0118 (Flash Code 23)

Circuit Description

The engine coolant temperature (ECT) sensor is installed to the thermostat housing. The ECT sensor is a variable resistor. The ECT sensor has a signal circuit and a low reference circuit. The ECT sensor measures the temperature of the engine coolant. The engine control module (ECM) supplies 5 volts to the ECT signal circuit and a ground for the ECT low reference circuit. When the ECT sensor is cold, the sensor resistance is high. When the engine coolant temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the ECT signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the ECT signal circuit. If the ECM detects an excessively high ECT signal voltage, this DTC will set.

Condition for Running the DTC

- DTCs P1630 and P1634 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.
- The engine run time is longer than 3 minutes.

Condition for Setting the DTC

- The ECM detects that the ECT sensor signal voltage is more than 4.8 volts for 10 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses an ECT substitution of -20°C (-4°F) for engine starting control.
- The ECM uses an ECT substitution of 110°C (230°F) for engine control.
- The ECM inhibits EGR valve control.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- 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.

DTC P0118 (Flash Code 23)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Coolant Temperature Sensor parameter with the Tech 2. Is the Coolant Temperature Sensor parameter more than the specified value?	4.8 volts	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the engine coolant temperature (ECT) sensor harness connector. 3. Connect a DMM between the signal circuit of the ECT sensor harness (pin 1 of E-90 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	5.5 volts	Go to Step 4	Go to Step 5

Step	Action	Value(s)	Yes	No
4	**Important:** The ECT sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the engine control module (ECM) (pin 84 of E-111 connector) and the ECT sensor (pin 1 of E-90 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
5	1. Turn OFF the ignition. 2. Connect a test lamp between the signal circuit of the ECT sensor harness (pin 1 of E-90 connector) and a known good ground. 3. Connect a DMM between the probe of the test lamp and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 9	Go to Step 6
6	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire between the signal circuit and low reference circuit of the ECT sensor harness (pins 1 and 2 of E-90 connector). 3. Turn ON the ignition, with the engine OFF. 4. Observe the Coolant Temperature Sensor parameter with the Tech 2. Is the Coolant Temperature Sensor parameter less than the specified value?	0.1 volts	Go to Step 10	Go to Step 7
7	1. Test the signal circuit between the ECM (pin 84 of E-111 connector) and the ECT sensor (pin 1 of E-90 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 8
8	1. Test the low reference circuit between the ECM (pin 109 of E-111 connector) and the ECT sensor (pin 2 of E-90 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
9	1. Test the signal circuit between the ECM (pin 84 of E-111 connector) and the ECT sensor (pin 1 of E-90 connector) for a short to any 5 volts reference circuit. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
10	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the ECT sensor (pins 1 and 2 of E-90 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 12

Step	Action	Value(s)	Yes	No
11	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections on the ECT sensor circuits at the harness connector of the ECM (pins 84 and 109 of E-111 connector). 4. Repair the connection(s) as necessary. 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 in this section. Did you complete the replacement?	—	Go to Step 14	—
13	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 14	—
14	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 15
15	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0182 (Flash Code 211)

Circuit Description

The fuel temperature (FT) sensor is installed to the fuel supply pump. The FT sensor is a variable resistor. The FT sensor has a signal circuit and a low reference circuit. The FT sensor measures the fuel temperature of the fuel. The engine control module (ECM) supplies 5 volts to the FT signal circuit and a ground for the FT low reference circuit. When the FT sensor is cold, the sensor resistance is high. When the fuel temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the FT signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the FT signal circuit. If the ECM detects an excessively low FT signal voltage, this DTC will set.

Condition for Running the DTC

- DTCs P1630 and P1634 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.

Condition for Setting the DTC

- The ECM detects that the FT sensor signal voltage is less than 0.1 volts for 10 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses a FT substitution of -20°C (-4°F) for engine starting control.
- The ECM uses a FT substitution of 70°C (158°F) for engine control.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- Before starting a cold engine, FT sensor and engine coolant temperature (ECT) sensor temperature should be relatively close to each other.
- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- 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.

DTC P0182 (Flash Code 211)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Fuel Temperature (FT) Sensor parameter with the Tech 2. Is the FT Sensor parameter less than the specified value?	0.1 volts	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the FT sensor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the FT Sensor parameter with the Tech 2. Is the FT Sensor parameter more than the specified value?	4.8 volts	Go to Step 5	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Test the signal circuit between the engine control module (ECM) (pin 83 of E-111 connector) and the FT sensor (pin 2 of E-93 connector) for the following conditions: • A short to ground • A short to the low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 6
5	Replace the FT sensor. Refer to Fuel Temperature (FT) Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 8	—
6	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect connections on the FT sensor circuits at the harness connector of the ECM (pins 83 and 109 of E-111 connector) for corrosion. 4. Repair or clean the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
7	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 8	—
8	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 9
9	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0183 (Flash Code 211)

Circuit Description

The fuel temperature (FT) sensor is installed to the fuel supply pump. The FT sensor is a variable resistor. The FT sensor has a signal circuit and a low reference circuit. The FT sensor measures the fuel temperature of the fuel. The engine control module (ECM) supplies 5 volts to the FT signal circuit and a ground for the FT low reference circuit. When the FT sensor is cold, the sensor resistance is high. When the fuel temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the FT signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the FT signal circuit. If the ECM detects an excessively high FT signal voltage, this DTC will set.

Condition for Running the DTC

- DTCs P1630 and P1634 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.
- The engine run time is longer than 3 minutes.

Condition for Setting the DTC

- The ECM detects that the FT sensor signal voltage is more than 4.8 volts for 10 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses a FT substitution of -20°C (-4°F) for engine starting control.
- The ECM uses a FT substitution of 70°C (158°F) for engine control.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- Before starting a cold engine, FT sensor and engine coolant temperature (ECT) sensor temperature should be relatively close to each other.
- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- 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.

DTC P0183 (Flash Code 211)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Fuel Temperature (FT) Sensor parameter with the Tech 2. Is the FT Sensor parameter more than the specified value?	4.8 volts	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the FT sensor harness connector. 3. Connect a DMM between the signal circuit of the FT sensor harness (pin 2 of E-93 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	5.5 volts	Go to Step 4	Go to Step 5

Step	Action	Value(s)	Yes	No
4	**Important:** The FT sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the engine control module (ECM) (pin 83 of E-111 connector) and the FT sensor (pin 2 of E-93 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
5	1. Turn OFF the ignition. 2. Connect a test lamp between the signal circuit of the FT sensor harness (pin 2 of E-93 connector) and a known good ground. 3. Connect a DMM between the probe of the test lamp and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 9	Go to Step 6
6	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire between the signal circuit and low reference circuit of the FT sensor harness (pins 1 and 2 of E-93 connector). 3. Turn ON the ignition, with the engine OFF. 4. Observe the FT Sensor parameter with the Tech 2. Is the FT Sensor parameter less than the specified value?	0.1 volts	Go to Step 10	Go to Step 7
7	1. Test the signal circuit between the ECM (pin 83 of E-111 connector) and the FT sensor (pin 2 of E-93 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 8
8	1. Test the low reference circuit between the ECM (pin 109 of E-111 connector) and the FT sensor (pin 1 of E-93 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
9	1. Test the signal circuit between the ECM (pin 83 of E-111 connector) and the FT sensor (pin 2 of E-93 connector) for a short to any 5 volts reference circuit. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
10	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the FT sensor (pins 1 and 2 of E-93 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 12

Step	Action	Value(s)	Yes	No
11	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections on the FT sensor circuits at the harness connector of the ECM (pins 83 and 109 of E-111 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
12	Replace the FT sensor. Refer to Fuel Temperature (FT) Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 14	—
13	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 14	—
14	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 15
15	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0192 (Flash Code 245)

Circuit Description

The fuel rail pressure (FRP) sensor is installed to the fuel rail and it detects the fuel pressure in the fuel rail, converts the pressure into a voltage signal, and sends the signal to the engine control module (ECM). The FRP sensor has the following circuits.

- 5 volts reference circuit.
- Low reference circuit.
- FRP sensor signal circuit.

The ECM supplies 5 volts to the FRP sensor on the 5 volts reference circuit. The ECM also provides a ground on the low reference circuit. Higher fuel rail pressure provides higher FRP sensor voltage while lower pressure provides lower FRP sensor voltage. The ECM calculates actual fuel rail pressure (fuel pressure) from the voltage signal and uses the result in fuel injection control and other control tasks. The ECM monitors the FRP sensor signal for voltage outside the normal range. If the ECM detects an excessively low FRP sensor signal voltage, this DTC will set.

Condition for Running the DTC

- DTCs P1630 and P1635 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.

Condition for Setting the DTC

- The ECM detects that the FRP sensor signal voltage is less than 0.7 volts.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits accelerator control range.
- The ECM inhibits pilot injection.
- The ECM inhibits EGR valve control.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- Electrical or magnetic interference may affect intermittent condition.
- The Differential Fuel Rail Pressure parameter on the Tech 2 will be fixed at 0 MPa (0 psi) when this DTC is set.

DTC P0192 (Flash Code 245)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P1635 also set?	—	Go to DTC P1635	Go to Step 3
3	1. Start the engine. 2. Observe the Fuel Rail Pressure (FRP) Sensor parameter with the Tech 2. Is the FRP Sensor parameter less than the specified value?	0.7 volts	Go to Step 4	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the FRP sensor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Fuel Rail Pressure (FRP) Sensor parameter with the Tech 2. Is the FRP Sensor parameter more than the specified value?	4.5 volts	Go to Step 5	Go to Step 6
5	1. Turn OFF the ignition. 2. Connect a DMM between the 5 volts reference circuit of the FRP sensor harness (pin 3 of E-113 connector) and a known good ground. 3. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 8	Go to Step 7
6	1. Test the signal circuits between the engine control module (ECM) (pins 82 and 90 of E-111 connector) and the FRP sensor (pin 2 of E-113 connector) for the following conditions: • A short to ground • A short to the low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
7	1. Test the 5 volts reference circuit between the ECM (pin 87 of E-111 connector) and the FRP sensor (pin 3 of E-113 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
8	1. Turn OFF the ignition. 2. Inspect for an intermittent and for a poor connection at the harness connector of the FRP sensor (pin 3 of E-113 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the FRP sensor circuit at the harness connector of the ECM (pin 87 of E-111 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
10	Replace the FRP sensor. Refer to Fuel Rail Pressure (FRP) Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 12	—

Step	Action	Value(s)	Yes	No
11	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 12	—
12	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 13
13	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0193 (Flash Code 245)

Circuit Description

The fuel rail pressure (FRP) sensor is installed to the fuel rail and it detects the fuel pressure in the fuel rail, converts the pressure into a voltage signal, and sends the signal to the engine control module (ECM). The FRP sensor has the following circuits.

- 5 volts reference circuit.
- Low reference circuit.
- FRP sensor signal circuit.

The ECM supplies 5 volts to the FRP sensor on the 5 volts reference circuit. The ECM also provides a ground on the low reference circuit. Higher fuel rail pressure provides higher FRP sensor voltage while lower pressure provides lower FRP sensor voltage. The ECM calculates actual fuel rail pressure (fuel pressure) from the voltage signal and uses the result in fuel injection control and other control tasks. The ECM monitors the FRP sensor signal for voltage outside the normal range. If the ECM detects an excessively high FRP sensor signal voltage, this DTC will set.

Condition for Running the DTC

- DTCs P1630 and P1635 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.

Condition for Setting the DTC

- The ECM detects that the FRP sensor signal voltage is more than 4.5 volts.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits accelerator control range.
- The ECM inhibits pilot injection.
- The ECM inhibits EGR valve control.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- Electrical or magnetic interference may affect intermittent condition.
- The Differential Fuel Rail Pressure parameter on the Tech 2 will be fixed at 0 MPa (0 psi) when this DTC is set.

DTC P0193 (Flash Code 245)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check-Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P1635 also set?	—	Go to DTC P1635	Go to Step 3
3	1. Start the engine. 2. Observe the Fuel Rail Pressure (FRP) Sensor parameter with the Tech 2. Is the FRP Sensor parameter more than the specified value?	4.5 volts	Go to Step 4	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the FRP sensor harness connector. 3. Connect a DMM between the signal circuit of the FRP sensor harness (pin 2 of E-113 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than specified value?	5.5 volts	Go to Step 10	Go to Step 5
5	1. Turn OFF the ignition. 2. Connect a test lamp between the signal circuit of the FRP sensor harness (pin 2 of E-113 connector) and a known good ground. 3. Connect a DMM between the probe of the test lamp and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 9	Go to Step 6
6	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire between the signal circuit and the low reference circuit of the FRP sensor harness (pins 1 and 2 of E-113 connector). 3. Turn ON the ignition, with the engine OFF. 4. Observe the FRP Sensor parameter with the Tech 2. Is the FRP Sensor parameter less than the specified value?	0.7 volts	Go to Step 11	Go to Step 7
7	1. Test the low reference circuit between the engine control module (ECM) (pin 101 of E-111 connector) and the FRP sensor (pin 1 of E-113 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 8
8	1. Test the signal circuit between the ECM (pins 82 and 90 of E-111 connector) and the FRP sensor (pin 2 of E-113 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12
9	1. Test the signal circuits between the ECM (pins 82 and 90 of E-111 connector) and the FRP sensor (pin 2 of E-113 connector) for a short to any 5 volts reference circuit. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14

Step	Action	Value(s)	Yes	No
10	**Important:** The FRP sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuits between ECM (pins 82 and 90 of E-111 connector) and the FRP sensor (pin 2 of E-113 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
11	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the FRP sensor (pins 1 and 2 of E-113 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 13
12	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections on the FRP sensor circuits at the harness connector of the ECM (pins 82, 90 and 101 of E-111 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
13	Replace the FRP sensor. Refer to Fuel Rail Pressure (FRP) Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 15	—
15	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 16
16	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0201 (Flash Code 271)

Circuit Description

The engine control module (ECM) calculates the optimum fuel injection ON time using data sent from various engine sensors. The ECM supplies a high voltage along with grounding the fuel injector control circuit when it needs to energize the fuel injector (turn it ON). The ECM also supplies battery voltage to the fuel injector solenoid control circuit to allow for fault detection. If the cylinder number 1 fuel injector solenoid control circuit is open circuit, shorted to voltage or shorted to the common 1 fuel injector drive circuit, this DTC will set.

Condition for Running the DTC

- DTCs P0204, P0611 and P1261 are not set.
- The ignition switch is ON.
- The battery voltage is more than 18 volts.
- The engine is running.

Condition for Setting the DTC

- The ECM detects that the cylinder number 1 fuel injector solenoid coil control circuit is open circuit, shorted to voltage or shorted to common 1 fuel injector drive circuit during engine rotations.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail at next driving cycle.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P0201 (Flash Code 271)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the in-line harness connector (H-125) from the cylinder head cover case. 3. Connect a DMM between the common 1 fuel injector drive circuit (pin 1 of H-125 female side connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage less than the specified value?	1.0 volt	Go to Step 4	Go to Step 9
4	Connect a DMM between the cylinder number 1 fuel injector control circuit (pin 5 of H-125 female side connector) and a known good ground. Is the DMM voltage less than the specified value?	16.0 volts	Go to Step 5	Go to Step 10
5	Is the DMM voltage more than the specified value at Step 4?	12.0 volts	Go to Step 6	Go to Step 11

Step	Action	Value(s)	Yes	No
6	1. Inspect for an intermittent and for a poor connection at the in-line harness connector (pin 5 of H-125 connector). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 7
7	1. Remove the cylinder head cover. Refer to Fuel Injector Replacement in this section. 2. Inspect the fuel injector harness for loose injector terminal nuts, objects touching injector terminals. 3. Inspect for an intermittent and for a poor connection at the in-line harness connector (pin 5 of H-126 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 8
8	1. Test the cylinder number 1 fuel injector solenoid control circuit between the fuel injector terminal (pins 1, 2 and 3 of E-138 connector) and the in-line harness connector (pins 1, 4 and 5 of H-126 connector) for the following conditions: • An open circuit • A short to the common 1 fuel injector drive circuit • High resistance 2. Repair or replace the injector harness as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 13
9	1. Test the cylinder number 1 fuel injector solenoid control circuit and common 1 fuel injector drive circuit for a short to each other between the engine control module (ECM) (pins 119 and 121 of E-111 connector) and the in-line harness connector (pins 1 or 4 and 5 of H-125 connector). 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
10	1. Test the cylinder number 1 fuel injector solenoid control circuit between the ECM (pin 119 of E-111 connector) and the in-line harness connector (pin 5 of H-125 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
11	1. Test the cylinder number 1 fuel injector solenoid control circuit between the ECM (pin 119 of E-111 connector) and the in-line harness connector (pin 5 of H-125 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12

Step	Action	Value(s)	Yes	No
12	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the cylinder number 1 fuel injector control circuit at the harness connector of the ECM (pin 119 of E-111 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
13	**Important:** Replacement injector must be programmed. Replace the cylinder number 1 fuel injector. Refer to Fuel Injector Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 15	—
15	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 16
16	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0202 (Flash Code 272)

Circuit Description

The engine control module (ECM) calculates the optimum fuel injection ON time using data sent from various engine sensors. The ECM supplies a high voltage along with grounding the fuel injector control circuit when it needs to energize the fuel injector (turn it ON). The ECM also supplies battery voltage to the fuel injector solenoid control circuit to allow for fault detection. If the cylinder number 2 fuel injector solenoid control circuit is open circuit, shorted to voltage or shorted to the common 2 fuel injector drive circuit, this DTC will set.

Condition for Running the DTC

- DTCs P0203, P0612 and P1262 are not set.
- The ignition switch is ON.
- The battery voltage is more than 18 volts.
- The engine is running.

Condition for Setting the DTC

- The ECM detects that the cylinder number 2 fuel injector solenoid coil control circuit is open circuit, shorted to voltage or shorted to common 2 fuel injector drive circuit during engine rotations.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail at next driving cycle.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P0202 (Flash Code 272)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the in-line harness connector (H-125) from the cylinder head cover case. 3. Connect a DMM between the common 2 fuel injector drive circuit (pin 2 of H-125 female side connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage less than the specified value?	1.0 volt	Go to Step 4	Go to Step 9
4	Connect a DMM between the cylinder number 2 fuel injector control circuit (pin 6 of H-125 female side connector) and a known good ground. Is the DMM voltage less than the specified value?	16.0 volts	Go to Step 5	Go to Step 10
5	Is the DMM voltage more than the specified value at Step 4?	12.0 volts	Go to Step 6	Go to Step 11

Step	Action	Value(s)	Yes	No
6	1. Inspect for an intermittent and for a poor connection at the in-line harness connector (pin 6 of H-125 connector). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 7
7	1. Remove the cylinder head cover. Refer to Fuel Injector Replacement in this section. 2. Inspect the fuel injector harness for loose injector terminal nuts, objects touching injector terminals. 3. Inspect for an intermittent and for a poor connection at the in-line harness connector (pin 6 of H-126 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 8
8	1. Test the cylinder number 2 fuel injector solenoid control circuit between the fuel injector terminal (pins 1, 2 and 3 of E-139 connector) and the in-line harness connector (pins 2, 3 and 6 of H-126 connector) for the following conditions: • An open circuit • A short to the common 2 fuel injector drive circuit • High resistance 2. Repair or replace the injector harness as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 13
9	1. Test the cylinder number 2 fuel injector solenoid control circuit and common 2 fuel injector drive circuit for a short to each other between the engine control module (ECM) (pins 116 and 118 of E-111 connector) and the in-line harness connector (pins 2 or 3 and 6 of H-125 connector). 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
10	1. Test the cylinder number 2 fuel injector solenoid control circuit between the ECM (pin 118 of E-111 connector) and the in-line harness connector (pin 6 of H-125 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
11	1. Test the cylinder number 2 fuel injector solenoid control circuit between the ECM (pin 118 of E-111 connector) and the in-line harness connector (pin 6 of H-125 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12

Step	Action	Value(s)	Yes	No
12	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the cylinder number 2 fuel injector control circuit at the harness connector of the ECM (pin 118 of E-111 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
13	**Important:** Replacement injector must be programmed. Replace the cylinder number 2 fuel injector. Refer to Fuel Injector Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 15	—
15	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 16
16	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0203 (Flash Code 273)

Circuit Description

The engine control module (ECM) calculates the optimum fuel injection ON time using data sent from various engine sensors. The ECM supplies a high voltage along with grounding the fuel injector control circuit when it needs to energize the fuel injector (turn it ON). The ECM also supplies battery voltage to the fuel injector solenoid control circuit to allow for fault detection. If the cylinder number 3 fuel injector solenoid control circuit is open circuit, shorted to voltage or shorted to the common 2 fuel injector drive circuit, this DTC will set.

Condition for Running the DTC

- DTCs P0202, P0612 and P1262 are not set.
- The ignition switch is ON.
- The battery voltage is more than 18 volts.
- The engine is running.

Condition for Setting the DTC

- The ECM detects that the cylinder number 3 fuel injector solenoid coil control circuit is open circuit, shorted to voltage or shorted to common 2 fuel injector drive circuit during engine rotations.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail at next driving cycle.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P0203 (Flash Code 273)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the in-line harness connector (H-125) from the cylinder head cover case. 3. Connect a DMM between the common 2 fuel injector drive circuit (pin 3 of H-125 female side connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage less than the specified value?	1.0 volt	Go to Step 4	Go to Step 9
4	Connect a DMM between the cylinder number 3 fuel injector control circuit (pin 7 of H-125 female side connector) and a known good ground. Is the DMM voltage less than the specified value?	16.0 volts	Go to Step 5	Go to Step 10
5	Is the DMM voltage more than the specified value at Step 4?	12.0 volts	Go to Step 6	Go to Step 11

Step	Action	Value(s)	Yes	No
6	1. Inspect for an intermittent and for a poor connection at the in-line harness connector (pin 7 of H-125 connector). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 7
7	1. Remove the cylinder head cover. Refer to Fuel Injector Replacement in this section. 2. Inspect the fuel injector harness for loose injector terminal nuts, objects touching injector terminals. 3. Inspect for an intermittent and for a poor connection at the in-line harness connector (pin 7 of H-126 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 8
8	1. Test the cylinder number 3 fuel injector solenoid control circuit between the fuel injector terminal (pins 1, 2 and 3 of E-140 connector) and the in-line harness connector (pins 2, 3 and 7 of H-126 connector) for the following conditions: • An open circuit • A short to the common 2 fuel injector drive circuit • High resistance 2. Repair or replace the injector harness as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 13
9	1. Test the cylinder number 3 fuel injector solenoid control circuit and common 2 fuel injector drive circuit for a short to each other between the engine control module (ECM) (pins 116 and 120 of E-111 connector) and the in-line harness connector (pins 2 or 3 and 7 of H-125 connector). 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
10	1. Test the cylinder number 3 fuel injector solenoid control circuit between the ECM (pin 120 of E-111 connector) and the in-line harness connector (pin 7 of H-125 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
11	1. Test the cylinder number 3 fuel injector solenoid control circuit between the ECM (pin 120 of E-111 connector) and the in-line harness connector (pin 7 of H-125 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12

Step	Action	Value(s)	Yes	No
12	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the cylinder number 3 fuel injector control circuit at the harness connector of the ECM (pin 120 of E-111 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
13	**Important:** Replacement injector must be programmed. Replace the cylinder number 3 fuel injector. Refer to Fuel Injector Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 15	—
15	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 16
16	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0204 (Flash Code 274)

Circuit Description

The engine control module (ECM) calculates the optimum fuel injection ON time using data sent from various engine sensors. The ECM supplies a high voltage along with grounding the fuel injector control circuit when it needs to energize the fuel injector (turn it ON). The ECM also supplies battery voltage to the fuel injector solenoid control circuit to allow for fault detection. If the cylinder number 4 fuel injector solenoid control circuit is open circuit, shorted to voltage or shorted to the common 1 fuel injector drive circuit, this DTC will set.

Condition for Running the DTC

- DTCs P0201, P0611 and P1261 are not set.
- The ignition switch is ON.
- The battery voltage is more than 18 volts.
- The engine is running.

Condition for Setting the DTC

- The ECM detects that the cylinder number 4 fuel injector solenoid coil control circuit is open circuit, shorted to voltage or shorted to common 1 fuel injector drive circuit during engine rotations.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail at next driving cycle.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P0204 (Flash Code 274)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the in-line harness connector (H-125) from the cylinder head cover case. 3. Connect a DMM between the common 1 fuel injector drive circuit (pin 4 of H-125 female side connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage less than the specified value?	1.0 volt	Go to Step 4	Go to Step 9
4	Connect a DMM between the cylinder number 4 fuel injector control circuit (pin 8 of H-125 female side connector) and a known good ground. Is the DMM voltage less than the specified value?	16.0 volts	Go to Step 5	Go to Step 10
5	Is the DMM voltage more than the specified value at Step 4?	12.0 volts	Go to Step 6	Go to Step 11

Step	Action	Value(s)	Yes	No
6	1. Inspect for an intermittent and for a poor connection at the in-line harness connector (pin 8 of H-125 connector). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 7
7	1. Remove the cylinder head cover. Refer to Fuel Injector Replacement in this section. 2. Inspect the fuel injector harness for loose injector terminal nuts, objects touching injector terminals. 3. Inspect for an intermittent and for a poor connection at the in-line harness connector (pin 8 of H-126 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 8
8	1. Test the cylinder number 4 fuel injector solenoid control circuit between the fuel injector terminal (pins 1, 2 and 3 of E-141 connector) and the in-line harness connector (pins 1, 4 and 8 of H-126 connector) for the following conditions: • An open circuit • A short to the common 1 fuel injector drive circuit • High resistance 2. Repair or replace the injector harness as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 13
9	1. Test the cylinder number 4 fuel injector solenoid control circuit and common 1 fuel injector drive circuit for a short to each other between the engine control module (ECM) (pins 117 and 121 of E-111 connector) and the in-line harness connector (pins 1 or 4 and 8 of H-125 connector). 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
10	1. Test the cylinder number 4 fuel injector solenoid control circuit between the ECM (pin 117 of E-111 connector) and the in-line harness connector (pin 8 of H-125 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
11	1. Test the cylinder number 4 fuel injector solenoid control circuit between the ECM (pin 117 of E-111 connector) and the in-line harness connector (pin 8 of H-125 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12

Step	Action	Value(s)	Yes	No
12	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the cylinder number 4 fuel injector control circuit at the harness connector of the ECM (pin 117 of E-111 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
13	**Important:** Replacement injector must be programmed. Replace the cylinder number 4 fuel injector. Refer to Fuel Injector Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 15	—
15	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 16
16	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0219 (Flash Code 543)

Circuit Description

The crankshaft position (CKP) sensor is located on top of the flywheel housing. The engine control module (ECM) calculates the engine speed and exact position of the crankshaft based on the signal from the CKP sensor. If the ECM detects an engine overrun condition, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

- The ECM detects that the engine speed is higher than 4300 RPM.

Action Taken When the DTC Sets

- The ECM does not illuminate the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the DTC

- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- This DTC is caused by an engine overspeed condition, which was most likely caused by driver error (i.e. downshifting a manual transmission on a steep grade). Since this DTC does not illuminate any lamps, clear the DTC and ensure there are no signs of engine damage. Excessive engine overspeed may damage internal engine components.
- Make sure the CKP sensor is tight and the sensor wheel teeth are not damaged.

DTC P0219 (Flash Code 543)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	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 DTC P0335, P0336, P0340 or P0341 is also set, diagnose that DTC first. 1. Install the Tech 2. 2. Start the engine. 3. Observe the Engine Speed parameter with the Tech 2. 4. Accelerate the engine as necessary. Does the Engine Speed parameter ever exceed the specified value?	3700 RPM	Go to Step 4	Go to Step 3
3	Ask the driver if overrun is caused by gear slip-out, shift error, down-slope driving, etc. If engine overrun has experienced, the engine must be inspected and repaired as necessary. Did you complete the action?	—	Go to Step 17	—
4	1. Remove the crankshaft position (CKP) sensor. Refer to CKP Sensor replacement in this section. 2. Visually inspect the CKP sensor for the following conditions: • For physical damage • For being loose • For improper installation Did you find and correct the condition?	—	Go to Step 17	Go to Step 5

Step	Action	Value(s)	Yes	No
5	Visually inspect for damage, metal particles on magnet and for flywheel teeth damage. Did you find and correct the condition?	—	Go to Step 17	Go to Step 6
6	1. Turn OFF the ignition. 2. Disconnect the crankshaft position (CKP) sensor harness connector. 3. Connect a DMM across the CKP sensor terminals. 4. Measure the resistance across the CKP sensor. Does the CKP sensor resistance measure within the specified range?	105 – 145 Ω	Go to Step 7	Go to Step 15
7	1. Connect a DMM across the CKP sensor terminals (measure sensor output voltage). 2. Place the DMM on the AC volt scale. 3. Start the engine. 4. Monitor the DMM while accelerating the engine between idle and W.O.T. (accelerator pedal full travel). Does the DMM indicate an AC voltage increase in accordance with an engine speed increase?	—	Go to Step 8	Go to Step 15
8	1. Turn ON the ignition, with the engine OFF. 2. Connect a DMM between the CKP sensor harness (pin 1 of E-98 connector) and a known good ground. 3. Connect a DMM between the CKP sensor harness (pin 2 of E-98 connector) and a known good ground. Is each DMM voltage within the specified value?	0.4 – 1.4 volts	Go to Step 10	Go to Step 9
9	Is the DMM voltage more than the specified value at Step 8?	—	Go to Step 12	Go to Step 11
10	1. Test the CKP sensor circuits between the engine control module (ECM) (pins 106 and 107 of E-111 connector) and CKP sensor (pins 1 and 2 of E-98 connector) for a short to each other. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 13
11	1. Test the CKP sensor circuits between the ECM (pins 106 and 107 of E-111 connector) and CKP sensor (pins 1 and 2 of E-98 connector) for the following conditions: • An open circuit • A short to ground • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 14

Step	Action	Value(s)	Yes	No
12	1. Test the CKP sensor circuits between the ECM (pins 106 and 107 of E-111 connector) and CKP sensor (pins 1 and 2 of E-98 connector) for the following conditions: • A short to battery or ignition voltage • A short to any 5 volts reference 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
13	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the CKP sensor (pins 1 and 2 of E-98 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
14	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections on the CKP sensor circuits at the harness connector of the ECM (pins 106 and 107 of E-111 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
15	Replace the CKP sensor. Refer to Crankshaft Position (CKP) Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 17	—
16	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 17	—
17	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Accelerate the Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the Engine Speed parameter with Tech 2. Does the Engine Speed parameter ever exceed the specified value?	3700 RPM	Go to Step 4	Go to Step 18
18	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0234 (Flash Code 42)

Circuit Description

The boost pressure sensor is located in the air induction tubing. The sensor is a transducer that varies voltage according to changes in the air pressure inside the air tubing. The engine control module (ECM) monitors the boost pressure sensor signal for abnormal values. If the ECM detects that the boost pressure sensor signal is excessively high, this DTC will set.

Condition for Running the DTC

- DTCs P0237, P0238, P1630 and P1634 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.
- The engine is running.
- The fuel injection quantity is lower than a predetermined value.

Condition for Setting the DTC

- The ECM detects that the boost pressure is higher than 228 kPa (33 psi) for 3 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- An open circuit or high resistance in the boost pressure low reference circuit may set this DTC.
- Check the turbocharger wastegate valve for a sticking or close stuck condition.
- Use the Tech 2 to verify the integrity of the boost pressure sensor signal. Compare the sensor values under all load conditions for an excessively high value. Use the Tech 2 data list values for nominal sensor readings.
- The fuel with which gasoline was mixed may set this DTC.

Test Description

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

2. A skewed boost pressure sensor value (shifted to a higher pressure) can set this DTC. The Boost Pressure on the Tech 2 should read near Barometric Pressure (BARO) with the key ON and engine OFF.

3. A skewed BARO sensor value (shifted to a lower pressure) may indicate a wrong boost pressure sensor reading. The BARO on the Tech 2 should read near surrounding barometric pressure.

DTC P0234 (Flash Code 42)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn ON the ignition, with the engine OFF. 3. Observe the Boost Pressure and Barometric Pressure (BARO) with the Tech 2. Does the Tech 2 indicate that the difference between the Boost Pressure and BARO is more than the specified value?	7.0 kPa (1.0 psi)	Go to Step 3	Go to Step 4
3	1. Observe the BARO parameter with the Tech 2. 2. Compare the BARO value to the range specified in the altitude vs. barometric pressure table. Refer to Altitude vs Barometric Pressure. Is the BARO parameter within the range specified?	—	Go to Step 5	Go to Step 8

Step	Action	Value(s)	Yes	No
4	1. Inspect the following for possible causes of high boost pressure. • Wastegate for a stuck closed condition. Refer to the Turbocharger in Engine Mechanical section for diagnosis. • Oil in the air induction tubing causing an incorrect boost pressure sensor signal. When there is adhesion of oil inside of the tubing, intercooler or turbocharger it needs to be wiped off. 2. Repair the condition as necessary. Did you find and correction the condition?	—	Go to Step 11	Go to Diagnostic Aids
5	1. Turn OFF the ignition. 2. Disconnect the boost pressure sensor harness connector. 3. Inspect for an intermittent and for a poor connection at the boost pressure sensor harness connector (pin 1 of J-216 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 6
6	1. Turn ON the ignition, with the engine OFF. 2. Connect a test lamp between the boost pressure sensor low reference circuit (pin 1 of J-216 connector) and battery voltage. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 7
7	Repair the high resistance in low reference circuit between the engine control module (ECM) (pin 109 of E-111 connector) and boost pressure sensor (pin 1 of J-216 connector). Did you complete the repair?	—	Go to Step 11	—
8	1. Turn OFF the ignition. 2. Disconnect the BARO sensor harness connector. 3. Inspect for an intermittent and for poor connections at the BARO sensor harness connector (pins 2 and 3 of B-422 connector). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion on each BARO sensor circuit at the harness connector of the ECM (pins 61 and 71 of J-191 connector). 6. Test for high resistance on each BARO sensor circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 10
9	Replace the boost pressure sensor. Refer to Boost Pressure Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 11	—
10	Replace the BARO sensor. Refer to Barometric Pressure (BARO) Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 11	—

Step	Action	Value(s)	Yes	No
11	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 12
12	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0236 (Flash Code 65)

Circuit Description

The boost pressure sensor is located in the air induction tubing. The sensor is a transducer that varies voltage according to changes in the air pressure inside the air tubing. The engine control module (ECM) monitors the boost pressure sensor signal for abnormal values. If the ECM detects that the boost pressure sensor signal is excessively low, this DTC will set.

Condition for Running the DTC

- DTCs P0107, P0108, P0237, P0238, P1630 and P1634 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.
- The engine is running.
- The fuel injection quantity is higher than a predetermined value.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects that the boost pressure is lower than 78 kPa (11 psi) for 20 seconds when the engine speed is lower than 900 RPM.
- The ECM detects that the boost pressure is lower than 82 – 151 kPa (12 – 22 psi) for 20 seconds when the engine speed is between 1200 – 3000 RPM.
- The ECM detect that the boost pressure is lower than 100 – 158 kPa (15 – 23 psi) for 20 seconds when the engine speed is between 3300 – 3600 RPM.

Notice:

- If the barometric pressure (BARO) is lower than 100 kPa (15 psi), a compensated value (100 kPa – BARO) is added to the above thresholds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- Induction air leakage can cause a low boost pressure condition. A whistling noise may be heard if a component is allowing air to enter the induction system. Close the throttle plate, remove the boost pressure sensor and introduce shop air into the line. Feel around the air tubing for leaks.
- Check for cracked air tubing that may only open during certain engine movement conditions.
- Check the turbocharger wastegate valve for a sticking or stuck open condition.
- Use the Tech 2 to verify the integrity of the boost pressure sensor signal. Compare the sensor values under all load conditions for an excessively low value. Use the Tech 2 data list values for nominal sensor readings.
- Fuel system problem (low fuel pressure condition) may set this DTC.

Test Description

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

3. A skewed boost pressure sensor value (shifted to a low pressure) can set this DTC. The Boost Pressure on the Tech 2 should read near barometric pressure (BARO) with the key ON and engine OFF.

4. A BARO sensor value (shifted to a higher pressure) may indicate a wrong boost pressure sensor reading. The BARO on the Tech 2 should read near surrounding barometric pressure.

DTC P0236 (Flash Code 65)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls

Step	Action	Value(s)	Yes	No
2	1. Inspect the following for possible causes of low boost pressure. • Air leakage around the boost pressure sensor or debris in the sensor hole. • Air leaking around any of the air induction tubing between the turbocharger and intake manifold. Check for damaged components and for loose clamps. • Turbine shaft binding causing lower turbocharger shaft spinning speeds. Refer to the Turbocharger in Engine Mechanical section for diagnosis. • Turbocharger wastegate valve for a stuck open condition. Refer to the Turbocharger in Engine Mechanical section for diagnosis. • Restricted air cleaner element, restricted or collapsed air tubing between the air cleaner and the intake throttle. • Intake throttle plate sticking in the closed position. Move intake throttle plate rod by hand to verify smooth operation. • Oil in the air induction tubing causing an incorrect boost pressure sensor signal. When there is adhesion of oil inside of the tubing, intercooler or turbocharger it needs to be wiped off. 2. Repair the condition as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 3
3	1. Install the Tech 2. 2. Turn ON the ignition, with the engine OFF. 3. Observe the Boost Pressure and Barometric Pressure (BARO) with the Tech 2. Does the Tech 2 indicate that the difference between the Boost Pressure and BARO is more than the specified value?	7.0 kPa (1.0 psi)	Go to Step 4	Go to Diagnostic Aids
4	1. Observe the BARO parameter with the Tech 2. 2. Compare the BARO value to the range specified in the altitude vs. barometric pressure table. Refer to Altitude vs Barometric Pressure. Is the BARO parameter within the range specified?	—	Go to Step 5	Go to Step 6

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Disconnect the boost pressure sensor harness connector. 3. Inspect for an intermittent and for poor connections at the boost pressure sensor harness connector (pins 2 and 3 of J-216 connector). 4. Disconnect the engine control module (ECM) harness connector. 5. Inspect for an intermittent, for poor connections and corrosion on each boost pressure sensor circuit at the harness connector of the ECM (pins 91 and 95 of E-111 connector). 6. Test for high resistance on each boost pressure sensor circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 9
6	1. Turn OFF the ignition. 2. Disconnect the BARO sensor harness connector. 3. Inspect for an intermittent and for a poor connection at the BARO sensor harness connector (pin 1 of B-422 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 11	Go to Step 7
7	1. Turn ON the ignition, with the engine OFF. 2. Connect a test lamp between the BARO sensor low reference circuit (pin 1 of B-422 connector) and battery voltage. Does the test lamp illuminate?	—	Go to Step 10	Go to Step 8
8	Repair the high resistance in low reference circuit between the ECM (pin 60 of J-191 connector) and BARO sensor (pin 1 of B-422 connector). Did you complete the repair?	—	Go to Step 11	—
9	Replace the boost pressure sensor. Refer to Boost Pressure Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 11	—
10	Replace the BARO sensor. Refer to Barometric Pressure (BARO) Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 11	—
11	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 12

Step	Action	Value(s)	Yes	No
12	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0237 (Flash Code 32)

Circuit Description

The boost pressure sensor is located in the air induction tubing. The boost pressure sensor is a transducer that varies voltage according to changes in the air pressure inside the air tubing. The boost pressure sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- Boost pressure sensor signal circuit

The engine control module (ECM) supplies 5 volts to the boost pressure sensor on the 5 volts reference circuit. The ECM also provides a ground on the low reference circuit. The boost pressure sensor provides a signal to the ECM on the boost pressure signal circuit which is relative to the pressure changes in the manifold. The ECM should detect a low signal voltage at a low boost pressure, such as low engine load. The ECM should detect high signal voltage at a high boost pressure, such as high engine load. The ECM monitors the boost pressure sensor signal for voltage outside the normal range of the boost pressure sensor. If the ECM detects an excessively low boost pressure sensor signal voltage, this DTC will set.

Condition for Running the DTC

- DTCs P1630 and P1634 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.

Condition for Setting the DTC

- The ECM detects that the boost pressure sensor signal voltage is less than 0.1 volts for 5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses a boost pressure substitution of 100 kPa (14.5 psi) for engine control.
- The ECM inhibits EGR valve control.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P0237 (Flash Code 32)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P1634 also set?	—	Go to DTC P1634	Go to Step 3
3	1. Start the engine. 2. Observe the Boost Pressure Sensor parameter with the Tech 2. Is the Boost Pressure Sensor parameter less than the specified value?	0.1 volts	Go to Step 4	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the boost pressure sensor harness connector. 3. Connect a DMM between the 5 volts reference circuit of the boost pressure sensor harness (pin 3 of J-216 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 5	Go to Step 6
5	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire between the 5 volts reference circuit and the signal circuit of the boost pressure sensor harness (pins 3 and 2 of J-216 connector). 3. Turn ON the ignition, with the engine OFF. 4. Observe the Boost Pressure Sensor parameter with the Tech 2. Is the Boost Pressure Sensor parameter more than specified value?	4.5 volts	Go to Step 8	Go to Step 7
6	1. Test the 5 volts reference circuit between the engine control module (ECM) (pin 95 of E-111 connector) and the boost pressure sensor (pin 3 of J-216 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
7	1. Test the signal circuit between the ECM (pin 91 of E-111 connector) and the boost pressure sensor (pin 2 of J-216 connector) for the following conditions: • An open circuit • A short to ground • A short to the low reference circuit • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
8	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the boost pressure sensor (pins 2 and 3 of J-216 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections on the boost pressure sensor circuits at the harness connector of the ECM (pins 91 and 95 of E-111 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11

Step	Action	Value(s)	Yes	No
10	Replace the boost pressure sensor. Refer to Boost Pressure Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 12	—
11	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 12	—
12	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 13
13	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0238 (Flash Code 32)

Circuit Description

The boost pressure sensor is located in the air induction tubing. The boost pressure sensor is a transducer that varies voltage according to changes in the air pressure inside the air tubing. The boost pressure sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- Boost pressure sensor signal circuit

The engine control module (ECM) supplies 5 volts to the boost pressure sensor on the 5 volts reference circuit. The ECM also provides a ground on the low reference circuit. The boost pressure sensor provides a signal to the ECM on the boost pressure signal circuit which is relative to the pressure changes in the manifold. The ECM should detect a low signal voltage at a low boost pressure, such as low engine load. The ECM should detect high signal voltage at a high boost pressure, such as high engine load. The ECM monitors the boost pressure sensor signal for voltage outside the normal range of the boost pressure sensor. If the ECM detects an excessively high boost pressure sensor signal voltage, this DTC will set.

Condition for Running the DTC

- DTCs P1630 and P1634 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.

Condition for Setting the DTC

- The ECM detects that the boost pressure sensor signal voltage is more than 4.9 volts for 5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM uses a boost pressure substitution of 100 kPa (14.5 psi) for engine control.
- The ECM inhibits EGR valve control.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P0238 (Flash Code 32)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Observe the Boost Pressure Sensor parameter with the Tech 2. Is the Boost Pressure Sensor parameter more than the specified value?	4.9 volts	Go to Step 3	Go to Diagnostic Aids
3	1. Start the engine. 2. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P1634 also set?	—	Go to Step 4	Go to Step 5
4	1. Turn OFF the ignition. 2. Disconnect the boost pressure sensor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Boost Pressure Sensor parameter with the Tech 2. Is the Boost Pressure Sensor parameter less than the specified value?	0.1 volts	Go to DTC P1634	Go to Step 7

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Disconnect the boost pressure sensor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Boost Pressure Sensor parameter with the Tech 2. Is the Boost Pressure Sensor parameter less than the specified value?	0.1 volts	Go to Step 6	Go to Step 7
6	1. Turn OFF the ignition. 2. Connect a test lamp between the low reference circuit of the boost pressure sensor harness (pin 1 of J-216 connector) and battery voltage. 3. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 8
7	**Important:** The boost pressure sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the engine control module (ECM) (pin 91 of E-111 connector) and the boost pressure sensor (pin 2 of J-216 connector) for the following conditions: • A short to battery or ignition voltage • A short to any 5 volts reference 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
8	1. Test the low reference circuit between the ECM (pin 109 of E-111 connector) and the boost pressure sensor (pin 1 of J-216 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10
9	1. Turn OFF the ignition. 2. Inspect for an intermittent and for a poor connection at the harness connector of the boost pressure sensor (pin 1 of J-216 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 11
10	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the boost pressure sensor circuit at the harness connector of the ECM (pin 109 of E-111 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
11	Replace the boost pressure sensor. Refer to Boost Pressure Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 13	—

Step	Action	Value(s)	Yes	No
12	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 14
14	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0335 (Flash Code 15)

Circuit Description

The crankshaft position (CKP) sensor is located on top of the flywheel housing. There are 56 notches spaced 6° apart and a 30° section that is open span. This open span portion allows for the detection of cylinder #1 top dead center (TDC). The CKP sensor is a magnetic coil type sensor, which generates an AC signal voltage based on the crankshaft rotational speed. The engine control module (ECM) monitors both the CKP sensor and camshaft position (CMP) sensor signals to ensure they correlate with each other. If the ECM receives a certain amount of CMP sensor signal pulses without a CKP sensor signal, this DTC will set.

Condition for Running the DTC

- DTCs P0336, P0340, P0341 and P1345 are not set.
- The ignition switch is ON.
- The CMP sensor signal pulse is detected.

Condition for Setting the DTC

- The ECM detects that the CKP sensor pulses are not generated during engine rotations.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail at next driving cycle.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Ensure the sensor is tight and the flywheel teeth are not damaged.

DTC P0335 (Flash Code 15)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine (Note a slight start delay may be noticed). 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the crankshaft position (CKP) sensor harness connector. 3. Connect a DMM across the CKP sensor terminals. 4. Measure the resistance across the CKP sensor. Does the CKP sensor resistance measure within the specified range?	105 – 145 Ω	Go to Step 4	Go to Step 13
4	1. Connect a DMM across the CKP sensor terminals (measure sensor output voltage). 2. Place the DMM on the AC volt scale. 3. Start the engine. 4. Monitor the DMM while accelerating the engine between idle and W.O.T. (accelerator pedal full travel). Does the DMM indicate an AC voltage increase in accordance with an engine speed increase?	—	Go to Step 5	Go to Step 10

Step	Action	Value(s)	Yes	No
5	1. Turn ON the ignition, with the engine OFF. 2. Connect a DMM between the CKP sensor harness (pin 1 of E-98 connector) and a known good ground. 3. Connect a DMM between the CKP sensor harness (pin 2 of E-98 connector) and a known good ground. Is each DMM voltage within the specified value?	0.4 – 1.4 volts	Go to Step 7	Go to Step 6
6	Is the DMM voltage more than the specified value at Step 5?	—	Go to Step 9	Go to Step 8
7	1. Test the CKP sensor circuits between the engine control module (ECM) (pins 106 and 107 of E-111 connector) and CKP sensor (pins 1 and 2 of E-98 connector) for a short to each other. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 11
8	1. Test the CKP sensor circuits between the ECM (pins 106 and 107 of E-111 connector) and CKP sensor (pins 1 and 2 of E-98 connector) for the following conditions: • An open circuit • A short to ground • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 12
9	1. Test the CKP sensor circuits between the ECM (pins 106 and 107 of E-111 connector) and CKP sensor (pins 1 and 2 of E-98 connector) for the following conditions: • A short to battery or ignition voltage • A short to any 5 volts reference 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
10	1. Inspect the CKP sensor for tightness. Retest if the sensor was loose. 2. Remove the CKP sensor and check for damage, metal particles on magnet and for flywheel teeth damage. Did you find and correct the condition?	—	Go to Step 15	Go to Step 13
11	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the CKP sensor (pins 1 and 2 of E-98 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14

Step	Action	Value(s)	Yes	No
12	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections on the CKP sensor circuits at the harness connector of the ECM (pins 106 and 107 of E-111 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
13	Replace the CKP sensor. Refer to Crankshaft Position (CKP) Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 15	—
15	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 16
16	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0336 (Flash Code 15)

Circuit Description

The crankshaft position (CKP) sensor is located on top of the flywheel housing. There are 56 notches spaced 6° apart and a 30° section that is open span. This open span portion allows for the detection of cylinder #1 top dead center (TDC). The CKP sensor is a magnetic coil type sensor, which generates an AC signal voltage based on the crankshaft rotational speed. The engine control module (ECM) monitors both the CKP sensor and camshaft position (CMP) sensor signals to ensure they correlate with each other. If the ECM receives extra or missing CKP sensor signal pulses, this DTC will set.

Condition for Running the DTC

- DTCs P0335, P0340, P0341 and P1345 are not set.
- The ignition switch is ON.
- The CKP sensor signal is detected.

Condition for Setting the DTC

- The ECM detects extra or missing CKP sensor pulses during engine rotations.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail at next driving cycle.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- An intermittent CKP sensor signal may set this DTC.
- Ensure the sensor is tight and the flywheel teeth are not damaged.

DTC P0336 (Flash Code 15)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P0335 also set?	—	Go to DTC P0335	Go to Step 3
3	1. Inspect all of the circuits going to the crankshaft position (CKP) sensor for the following: • Routed too closely to fuel injection wiring or components • Routed too closely to after-market add-on electrical equipment • Routed too closely 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

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the CKP sensor harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the CKP sensor (pins 1 and 2 of E-98 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 5
5	1. Turn OFF the ignition. 2. Disconnect the engine control module (ECM) harness connector. 3. Inspect for an intermittent and for a poor connection on these CKP sensor circuits at the harness connector of the ECM (pins 106, 107 and 108 of E-111 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 6
6	1. Remove the CKP sensor. Refer to Crankshaft Position (CKP) Sensor Replacement in this section. 2. Visually inspect the CKP sensor for the following conditions: • Physical damage • Loose or improper installation 3. The following conditions may cause this DTC to set: • Excessive air gap between the CKP sensor and the sensor rotor • Electromagnetic interference in the CKP sensor circuits • Foreign material passing between the CKP sensor and the sensor rotor Did you find and correct the condition?	—	Go to Step 9	Go to Step 7
7	Inspect the CKP sensor rotor for the following conditions: • Physical damage • Improper installation Refer to Flywheel Replacement in Engine Mechanical section. Did you find and correct the condition?	—	Go to Step 9	Go to Step 8
8	Replace the CKP sensor. Refer to Crankshaft Position (CKP) Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 9	—
9	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 10
10	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0340 (Flash Code 14)

Circuit Description

The camshaft position (CMP) sensor is installed on the cylinder head at the rear of the camshaft gear. The CMP sensor has the following circuits.

- 12 volts reference circuit
- CMP sensor signal circuit
- CMP sensor shield circuit

The engine control module (ECM) supplies 12 volts to the CMP sensor on the 12 volts reference circuit. The CMP sensor provides a signal to the ECM on the CMP signal circuit. The CMP sensor detects a total of five through holes (four holes arranged equally every 90° and one reference hole on the camshaft gear flange surface) and sends signals to the engine control module (ECM). Receiving these signals, the ECM determines cylinder #1 compression top dead center (TDC). If the ECM detects that CMP sensor signals are not generated, this DTC will set.

Condition for Running the DTC

- DTCs P0335, P0336, P0341 and P1345 are not set.
- The ignition switch is ON.
- The crankshaft position (CKP) sensor signal pulse is detected.

Condition for Setting the DTC

- The ECM detects that the CMP sensor pulses are not generated during engine rotations.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail at next driving cycle.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Ensure the sensor is tight and the camshaft gear flange surface is not damaged.

Notice:

- If this DTC is set, the engine cranks but does not start.

Test Description

The numbers below refers to the step number on the diagnostic table.

6. If the CMP sensor signal circuit between the ECM and the sensor is shorted to ground or shield circuit, the voltage reading on the DMM indicates same level as battery.

DTC P0340 (Flash Code 14)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. If engine does not start, crank over the engine for 10 seconds. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the camshaft position (CMP) sensor harness connector. 3. Connect a DMM between the 12 volts reference circuit (pin 3 of E-112 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the DMM voltage indicate within the specified value?	11 – 13 volts	Go to Step 5	Go to Step 4

Step	Action	Value(s)	Yes	No
4	Is the DMM voltage more than the specified value at Step 3?	—	Go to Step 9	Go to Step 8
5	1. Turn OFF the ignition. 2. Connect a DMM between the signal circuit (pin 2 of E-112 connector) and battery voltage. 3. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	22 volts	Go to Step 6	Go to Step 10
6	1. Turn OFF the ignition. 2. Connect a test lamp between the signal circuit (pin 2 of E-112 connector) and battery voltage. 3. Connect a DMM between the probe of the test lamp and battery voltage. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	22 volts	Go to Step 11	Go to Step 7
7	1. Turn OFF the ignition. 2. Connect a test lamp between the shield circuit (pin 1 of E-112 connector) and battery voltage. 3. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 13	Go to Step 12
8	1. Test the CMP sensor 12 reference circuit between the engine control module (ECM) (pin 99 of E-111 connector) and the CMP sensor (pin 3 of E-112 connector) for the following conditions: • An open circuit • A short to ground • A short to any 5 volts reference • A short to the signal circuit • A short to the shield circuit • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 14
9	1. Test the CMP sensor 12 volts reference circuit between the ECM (pin 99 of E-111 connector) and the CMP sensor (pin 3 of E-112 connector) for short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18

Step	Action	Value(s)	Yes	No
10	**Important:** The CMP sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the CMP sensor signal circuit between the ECM (pin 98 of E-111 connector) and the CMP sensor (pin 2 of E-112 connector) for the following conditions: • An open circuit • A short to battery or ignition voltage • A short to any 5 volts reference • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 14
11	1. Test the CMP sensor signal circuit between the ECM (pin 98 of E-111 connector) and the CMP sensor (pin 2 of E-112 connector) for a short to ground or short to the shield circuit. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
12	**Important:** The ECM may be damaged if the sensor shield circuit is shorted to a voltage source. 1. Test the CMP sensor shield circuit between the ECM (pin 100 of E-111 connector) and the CMP sensor (pin 1 of E-112 connector) for the following conditions: • An open circuit • A short to battery or ignition voltage • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 14
13	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the CMP sensor (pins 1, 2 and 3 of E-112 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 15
14	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on these CMP sensor circuits at the harness connector of the ECM (pins 98, 99 and 100 of E-111 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18

Step	Action	Value(s)	Yes	No
15	1. Remove the CMP sensor. Refer to Camshaft Position (CMP) Sensor Replacement in this section. 2. Visually inspect the CMP sensor for the following conditions: • For physical damage • For being loose • For improper installation Did you find and correct the condition?	—	Go to Step 19	Go to Step 16
16	Visually inspect the camshaft gear surface for damage. Did you find and correct the condition?	—	Go to Step 19	Go to Step 17
17	Replace the CMP sensor. Refer to Camshaft Position (CMP) Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 19	—
18	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 19	—
19	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. If engine does not start, crank over the engine for 10 seconds. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 20
20	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0341 (Flash Code 14)

Circuit Description

The camshaft position (CMP) sensor is installed on the cylinder head at the rear of the camshaft gear. The CMP sensor has the following circuits.

- 12 volts reference circuit
- CMP sensor signal circuit
- CMP sensor shield circuit

The engine control module (ECM) supplies 12 volts to the CMP sensor on the 12 volts reference circuit. The CMP sensor provides a signal to the ECM on the CMP signal circuit. The CMP sensor detects a total of five through holes (four holes arranged equally every 90° and one reference hole on the camshaft gear flange surface) and sends signals to the engine control module (ECM). Receiving these signals, the ECM determines cylinder #1 compression top dead center (TDC). If the ECM receives extra or missing CMP sensor signal pulses, this DTC will set.

Condition for Running the DTC

- DTCs P0335, P0336, P0340 and P1345 are not set.
- The ignition switch is ON.
- The CMP sensor signal pulse is detected.

Condition for Setting the DTC

- The ECM detects extra or missing CMP sensor pulses during engine rotations.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail at next driving cycle.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- An intermittent CMP sensor signal may set this DTC.
- Ensure the sensor is tight and the camshaft gear flange surface is not damaged.

Notice:

- If this DTC is set, the engine cranks but does not start.

DTC P0341 (Flash Code 14)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. If engine does not start, crank over the engine for 10 seconds. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P0340 also set?	—	Go to DTC P0340	Go to Step 3
3	1. Inspect all of the circuits going to the camshaft position (CMP) sensor for the following: • Routed too closely to fuel injection wiring or components • Routed too closely to after-market add-on electrical equipment • Routed too closely 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

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the CMP sensor harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the CMP sensor (pins 1, 2 and 3 of E-112 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 5
5	1. Turn OFF the ignition. 2. Disconnect the engine control module (ECM) harness connector. 3. Inspect for an intermittent and for a poor connection on these CMP sensor circuit at the harness connector of the ECM (pins 98, 99 and 100 of E-111 connector). 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 in this section. 2. Visually inspect the CMP sensor for the following conditions: • Physical damage • Loose or improper installation 3. The following conditions may cause this DTC to set: • Excessive air gap between the CMP sensor and the camshaft gear surface (sensor rotor) • Electromagnetic interference in the CMP sensor circuits • Foreign material passing between the CMP sensor and the camshaft gear surface (sensor rotor) Did you find and correct the condition?	—	Go to Step 9	Go to Step 7
7	Inspect the camshaft gear surface (CMP sensor rotor) for physical damage. 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 in this section. Did you complete the replacement?	—	Go to Step 9	—
9	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. If engine does not start, crank over the engine for 10 seconds. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 10
10	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0380 (Flash Code 66)

Circuit Description

The engine control module (ECM) controls the glow relay which supplies power to the glow plugs based on engine coolant temperature. In the after glow phase, the glow indicator light is not illuminated but glow plugs remain active for a certain period. If the ECM detects an open circuit or short circuit on the glow relay control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The battery voltage is between 16 – 32 volts.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects a low voltage condition on the glow relay control circuit when the relay is commanded OFF for longer than 5 seconds.
- The ECM detects a high voltage condition on the glow relay control circuit when the relay is commanded ON for longer than 5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail at next driving cycle.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Test Description

The numbers below refers to the step number on the diagnostic table.
2. Listen for an audible click when the glow relay operates. Command both the ON and OFF states.
6. Tests if ground is constantly being applied to the glow relay.

DTC P0380 (Flash Code 66)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn ON the ignition, with the engine OFF. 3. Perform the Glow Relay Test with the Tech 2. 4. Command the Glow Relay ON with the Tech 2. Does the glow relay click when commanded ON with the Tech 2?	—	Go to Step 3	Go to Step 4
3	1. Turn OFF the ignition for 30 seconds. 2. Turn ON the ignition, with the engine OFF. 3. Disconnect the engine coolant temperature (ECT) sensor harness connector in order to gain glow ON time long enough. 4. Turn ON the ignition for 30 seconds while observing the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 11	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Replace the glow relay with the starter relay or replace with a known good relay. 3. Turn ON the ignition, with the engine OFF. 4. Perform the Glow Relay Test with the Tech 2. 5. Command the Glow Relay ON with the Tech 2. Does the glow relay click when commanded ON with the Tech 2?	—	Go to Step 8	Go to Step 5
5	1. Turn OFF the ignition. 2. Remove the glow relay. 3. Turn ON the ignition, with the engine OFF. 4. Probe the voltage feed circuit of the glow relay coil side (pin 4 of X-20 connector) with a test lamp that is connected to a known good ground. Does the test lamp illuminate?	—	Go to Step 6	Go to Step 7
6	1. Test the control circuit of glow relay between the engine control module (ECM) (pin 10 of J-191 connector) and the glow relay (pin 5 of X-20 connector) for the following conditions: • An open circuit • A short to ground • A short to battery or ignition voltage 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
7	Repair the open circuit or high resistance on the voltage feed circuit between the ENG (10A) fuse and the glow relay coil side (pin 4 of X-20 connector). Check the ENG (IG) (10 A) fuse first. Did you complete the repair?	—	Go to Step 12	—
8	1. Turn OFF the ignition. 2. Remove the glow relay. 3. Inspect for an intermittent and for a poor connection on each glow plug relay terminal. 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the glow relay circuit at the harness connector of the ECM (pin 10 of J-191 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
10	Replace the glow relay. Did you complete the replacement?	—	Go to Step 12	—

Step	Action	Value(s)	Yes	No
11	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 12	—
12	1. Reconnect all previously disconnected fuse, relay or harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Disconnect the ECT sensor harness connector in order to gain glow ON time long enough. 5. Turn ON the ignition for 30 seconds while observing the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 13
13	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0381 (Flash Code 67)

Circuit Description

The glow indicator lamp is located on the instrument panel cluster (IPC). The glow control system is operated when the engine coolant temperature is low, which allows easier engine starting. If the ignition switch is turned ON when the engine coolant temperature is low, the engine control module (ECM) illuminates the glow indicator lamp and turns ON the glow plugs. After a fixed time passes, the ECM turns OFF the glow indicator lamp and the glow plugs. The ECM monitors the glow indicator lamp control circuit for conditions that are incorrect for the commanded state of the glow indicator lamp. For example, a failure condition exists if the ECM detects low voltage when the glow indicator lamp is commanded OFF, or high voltage when the glow indicator lamp is commanded ON. If the ECM detects an improper voltage on the glow indicator control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The ignition voltage is more than 18 volts.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects a low voltage condition on the glow indicator lamp control circuit when the indicator is commanded OFF for longer than 5 seconds.
- The ECM detects a high voltage condition on the glow indicator lamp control circuit when the indicator is commanded ON for longer than 5 seconds.

Action Taken When the DTC Sets

- The ECM does not illuminate the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the DTC

- A current DTC clears when the diagnostic runs and does not fail at next driving cycle.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P0381 (Flash Code 67)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
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 cluster (IPC) is completely inoperative, refer to Diagnostic System Check. 2. Turn OFF the ignition for 30 seconds. 3. Disconnect the engine coolant temperature (ECT) sensor harness connector in order to gain glow ON time long enough. 4. Turn ON the ignition for 20 seconds while observing the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Inspect the Meter (10A) fuse in the glove box. Is the Meter (10A) fuse open?	—	Go to Step 4	Go to Step 5
4	Replace the Meter (10A) fuse. If the fuse continues to open, repair the short to ground on one of the circuits that is fed by the Meter (10A) fuse or replace the shorted attached component fed by the Meter (10A) fuse. Did you complete the repair?	—	Go to Step 19	—

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Disconnect the engine control module (ECM) J-191 harness connector. 3. Turn ON the ignition, with the engine OFF. Is the glow indicator lamp OFF?	—	Go to Step 6	Go to Step 13
6	1. Remove the Meter (10A) fuse that supplies voltage to the glow indicator lamp. 2. Turn ON the ignition, with the engine OFF. 3. Measure the voltage from the glow indicator lamp control circuit in the ECM harness connector (pin 11 of J-191 connector) to a good ground. Is the voltage less than the specified value?	1 volt	Go to Step 7	Go to Step 14
7	1. Turn OFF the ignition. 2. Install the Meter (10A) fuse that supplies ignition voltage to the glow indicator lamp. 3. Turn ON the ignition, with the engine OFF. 4. Connect a 3-amp fused jumper wire between the glow indicator lamp control circuit of the ECM harness connector (pin 11 of J-191 connector) and a known good ground. Is the glow indicator lamp illuminated?	—	Go to Step 12	Go to Step 8
8	1. Turn OFF the ignition. 2. Remove the IPC. 3. Remove the glow indicator lamp bulb from the IPC. Is the glow indicator bulb burned out?	—	Go to Step 16	Go to Step 9
9	1. Connect a test lamp between the glow indicator lamp ignition voltage circuit of the IPC harness connector (pin 18 of B-51 connector) and a known good ground. 2. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 10	Go to Step 15
10	1. Test the glow indicator lamp control circuit between the ECM (pin 11 of J-191 connector) and the IPC (pin 15 of B-52 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 11
11	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the IPC (pins 18 of B-51 and 15 of B-52 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 17

Step	Action	Value(s)	Yes	No
12	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the glow indicator lamp control circuit at the harness connector of the ECM (pin 11 of J-191 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
13	Repair the short to ground on the control circuit of the glow indicator lamp between the ECM (pin 11 of J-191 connector) and the IPC (pin 15 of B-52 connector). Did you complete the repair?	—	Go to Step 19	—
14	Repair the short to battery or ignition voltage on the control circuit of the glow indicator lamp between the ECM (pin 11 of J-191 connector) and the IPC (pin 15 of B-52 connector). Did you complete the repair?	—	Go to Step 19	—
15	Repair the open or high resistance on the ignition voltage circuit of the glow indicator lamp between the Meter (10A) fuse and the IPC (pin 18 of B-51 connector). Did you complete the repair?	—	Go to Step 19	—
16	Replace the glow indicator lamp bulb. Did you compete the replacement?	—	Go to Step 19	—
17	Repair or replace the IPC. Did you complete the repair or replacement?	—	Go to Step 19	—
18	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 19	—
19	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Disconnect the ECT sensor harness connector in order to gain glow ON time long enough. 5. Turn ON the ignition for 20 seconds while observing the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 20
20	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0485 (Flash Code 44)

Circuit Description

The exhaust gas recirculation (EGR) valve position sensor is installed on the EGR valve body together with the EGR valve control motor. The EGR valve position sensor changes output voltage according to EGR valve position. The EGR position sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- EGR valve position sensor signal circuit

The engine control module (ECM) supplies 5 volts to the EGR valve position sensor on the 5 volts reference circuit. The ECM also provides a ground on the low reference circuit. The EGR valve position sensor provides a signal to the ECM on the EGR valve position signal circuit, which is relative to the position changes of the EGR valve. The ECM monitors the EGR position sensor signals for voltage outside the normal range of the EGR position. If the ECM detects an excessively low EGR valve position signal voltage, this DTC will set.

Condition for Running the DTC

- DTCs P1630 and P1635 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.

Condition for Setting the DTC

- The ECM detects that the EGR valve position sensor signal voltage is less than 0.1 volts for 5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM inhibits EGR valve control.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P0485 (Flash Code 44)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P1635 also set?	—	Go to DTC P1635	Go to Step 3
3	1. Start the engine. 2. Observe the EGR Position Sensor parameter with the Tech 2. Is the EGR Position Sensor parameter less than the specified value?	0.1 volts	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the EGR valve harness connector. 3. Connect a DMM between the 5 volts reference circuit of the EGR position sensor harness (pin 1 of E-94 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 5	Go to Step 6

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire between the 5 volts reference circuit and the signal circuit of the EGR valve position sensor harness (pins 1 and 3 of E-94 connector). 3. Turn ON the ignition, with the engine OFF. 4. Observe the EGR Position Sensor parameter with the Tech 2. Is the EGR Position Sensor parameter more than specified value?	4.5 volts	Go to Step 8	Go to Step 7
6	1. Test the 5 volts reference circuit between the engine control module (ECM) (pin 87 of E-111 connector) and the EGR valve position sensor (pin 1 of E-94 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
7	1. Test the signal circuit between the ECM (pin 86 of E-111 connector) and the EGR valve position sensor (pin 3 of E-94 connector) for the following conditions: • An open circuit • A short to ground • A short to the low reference circuit • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
8	1. Turn OFF the ignition. 2. Disconnect the EGR valve harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the EGR valve (pins 1 and 3 of E-94 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections on the EGR valve position sensor circuits at the harness connector of the ECM (pins 86 and 87 of E-111 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11
10	Replace the EGR valve. Refer to EGR Valve Replacement in this section. (EGR valve position sensor is internal to EGR valve) Did you complete the replacement?	—	Go to Step 12	—
11	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 12	—

Step	Action	Value(s)	Yes	No
12	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 13
13	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0486 (Flash Code 44)

Circuit Description

The exhaust gas recirculation (EGR) valve position sensor is installed on the EGR valve body together with the EGR valve control motor. The EGR valve position sensor changes output voltage according to EGR valve position. The EGR position sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- EGR valve position sensor signal circuit

The engine control module (ECM) supplies 5 volts to the EGR valve position sensor on the 5 volts reference circuit. The ECM also provides a ground on the low reference circuit. The EGR valve position sensor provides a signal to the ECM on the EGR valve position signal circuit, which is relative to the position changes of the EGR valve. The ECM monitors the EGR position sensor signals for voltage outside the normal range of the EGR position. If the ECM detects an excessively high EGR valve position signal voltage, this DTC will set.

Condition for Running the DTC

- DTCs P1630 and P1635 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.

Condition for Setting the DTC

- The ECM detects that the EGR valve position sensor signal voltage is more than 4.9 volts for 5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM inhibits EGR valve control.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P0486 (Flash Code 44)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Observe the EGR Position Sensor parameter with the Tech 2. Is the EGR Position Sensor parameter more than the specified valve?	4.9 volts	Go to Step 3	Go to Diagnostic Aids
3	1. Start the engine. 2. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P1635 also set?	—	Go to Step 4	Go to Step 5
4	1. Turn OFF the ignition. 2. Disconnect the EGR valve harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the EGR Position Sensor parameter with the Tech 2. Is the DMM voltage less than the specified value?	0.1 volts	Go to DTC P1635	Go to Step 7

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Disconnect the EGR valve harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the EGR Position Sensor parameter with the Tech 2. Is the DMM voltage less than the specified value?	0.1 volts	Go to Step 6	Go to Step 7
6	1. Turn OFF the ignition. 2. Connect a test lamp between the low reference circuit of the EGR position sensor harness (pin 2 of E-94 connector) and battery voltage. 3. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 8
7	**Important:** The EGR position sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the engine control module (ECM) (pin 86 of E-111 connector) and the EGR position sensor (pin 3 of E-94 connector) for the following conditions: • A short to battery or ignition voltage • A short to any 5 volts reference 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
8	1. Test the low reference circuit between the ECM (pin 101 of E-111 connector) and the EGR position sensor (pin 2 of E-94 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10
9	1. Turn OFF the ignition. 2. Disconnect the EGR position sensor connector. 3. Inspect for an intermittent and for a poor connection at the harness connector of the EGR position sensor (pin 2 of E-94 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 11
10	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the EGR position sensor circuit at the harness connector of the ECM (pin 101 of E-111 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
11	Replace the EGR valve. Refer to EGR Valve Replacement in this section. (EGR valve position sensor is internal to EGR valve) Did you complete the replacement?	—	Go to Step 13	—

Step	Action	Value(s)	Yes	No
12	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 14
14	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0488 (Flash Code 45)

Circuit Description

The engine control module (ECM) controls the EGR valve opening based on the barometric pressure, engine speed, engine coolant temperature and fuel injection quantity. The ECM controls the EGR valve by controlling the EGR motor. The EGR valve position is detected by the EGR valve position sensor, and relayed to ECM. If the ECM detects a variance between the actual EGR position and desired EGR position for a calibrated amount of time while the EGR valve is commanded open, this DTC will set.

Condition for Running the DTC

- DTCs P0485, P0486, P1630 and P1635 are not set.
- The ignition switch is ON.
- The battery voltage is between 20 – 32 volts.
- The ignition voltage is more than 18 volts.
- The desired EGR valve position is stable.

Condition for Setting the DTC

- The ECM detects a variance between the actual EGR valve position and desired valve position is more than 20% for longer than 20 seconds when the EGR solenoid command duty is more than 90%.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM inhibits EGR valve control.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail at next driving cycle.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- A sticking or intermittently sticking EGR valve may set this DTC.

DTC P0488 (Flash Code 45)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P0485 or P0486 set?	—	Go to Applicable DTC	Go to Step 3
3	1. Clear the DTCs with the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Perform the EGR Control test with the Tech 2 several times. 5. Command the Desired EGR Position “Increase” and “Decrease” with the Tech 2 while observing the EGR Position Variance. Does the EGR Position Variance parameter follow within the specified value?	± 5%	Go to Diagnostic Aids	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition for 30 seconds. 2. Disconnect the EGR valve harness connector. 3. Connect a test lamp between the EGR valve motor voltage feed circuit (pin 4 of E-94 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp blink then go out?	—	Go to Step 6	Go to Step 5
5	Does the test lamp continuously illuminate at Step 4?	—	Go to Step 10	Go to Step 9
6	1. Turn OFF the ignition for 30 seconds. 2. Connect a test lamp between the EGR valve duty signal circuit (pin 6 of E-94 connector) and a known good ground. 3. Turn ON the ignition, with the engine OFF. Does the test lamp blink then go out (note that the test lamp will not blink normally)?	—	Go to Step 14	Go to Step 7
7	Does the test lamp continuously illuminate at Step 6?	—	Go to Step 11	Go to Step 8
8	1. Turn OFF the ignition. 2. Connect a test lamp between the EGR valve duty signal circuit (pin 6 of E-94 connector) and battery voltage. 3. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 12	Go to Step 13
9	1. Test the EGR valve motor voltage feed circuit between the engine control module (ECM) (pin 111 of E-111 connector) and the EGR valve (pin 4 of E-94 connector) for the following conditions: • An open circuit • A short to ground • A short to the EGR valve position sensor low reference circuit • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 16
10	1. Test the EGR valve motor voltage feed circuit between the ECM (pin 111 of E-111 connector) and the EGR valve (pin 4 of E-94 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 19
11	1. Test the EGR valve motor duty signal circuit between the ECM (pin 103 of E-111 connector) and the EGR valve (pin 6 of E-94 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 19

Step	Action	Value(s)	Yes	No
12	1. Test the EGR valve motor duty signal circuit between the ECM (pin 103 of E-111 connector) and the EGR valve (pin 6 of E-94 connector) for the following conditions: • A short to ground • A short to the EGR valve position sensor low reference circuit 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 19
13	1. Test the EGR valve motor duty signal circuit between the ECM (pin 103 of E-111 connector) and the EGR valve (pin 6 of E-94 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 15
14	1. Test the EGR valve motor voltage feed circuit and motor duty signal circuit between the ECM (pins 103 and 111 of E-111 connector) and the EGR valve (pins 4 and 6 of E-94 connector) for a short circuit each other. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 19
15	1. Turn OFF the ignition. 2. Disconnect the EGR valve harness connector. 3. Inspect for an intermittent and for poor connections at the EGR valve harness connector (pins 4 and 6 of E-94 connector). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent and for a poor connection on the EGR valve motor duty signal circuit at the harness connector of the ECM (pin 103 of E-111 connector). 6. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 17
16	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the EGR valve motor voltage feed circuit at the harness connector of the ECM (pin 111 of E-111 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 19
17	Replace the EGR valve. Refer to EGR Valve Replacement in this section. Did you complete the replacement?	—	Go to Step 18	—

Step	Action	Value(s)	Yes	No
18	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Perform the EGR Control test with the Tech 2 several times. 6. Command the Desired EGR Position “Increase” and “Decrease” with the Tech 2 while observing the EGR Position Variance. Does the EGR Position Variance parameter follow within the specified value?	± 5%	Go to Step 20	Go to Step 19
19	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 20	—
20	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 21
21	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0500 (Flash Code 25)

Circuit Description

The vehicle speed sensor (VSS) is used by the engine control module (ECM) and speedometer, which generates a speed signal from the transmission output shaft. The VSS has the following circuits.

- Ignition voltage feed circuit
- VSS signal circuit
- VSS low reference circuit

The VSS uses a hall effect element. It interacts with the magnetic field created by the rotating magnet and outputs square wave pulse signal. The ECM calculates the vehicle speed by the VSS. If the ECM detects VSS signals are not generated, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The ignition voltage is more than 18 volts.
- The engine speed is more than 2000 RPM.
- The commanded fuel is OFF (accelerator pedal is released).

Condition for Setting the DTC

- The ECM detects that the VSS signals are not generated for 5 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail at next driving cycle.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Electrical or magnetic interference may affect intermittent condition.

DTC P0500 (Flash Code 25)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Drive the vehicle. 3. Observe the Vehicle Speed parameter with the Tech 2. Does the Vehicle Speed parameter indicate correct vehicle speed?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Inspect the Meter (10A) fuse in the glove box fuse block. Is the Meter (10A) fuse open?	—	Go to Step 4	Go to Step 5
4	Replace the Meter (10A) fuse. If the fuse continues to open, repair the short to ground on one of the circuits that fed by the Meter (10A) fuse or replace the shorted attached component fed by the Meter (10A) fuse. Did you complete the repair?	—	Go to Step 16	—

Step	Action	Value(s)	Yes	No
5	1. Remove the vehicle speed sensor (VSS). Refer to Vehicle Speed Sensor (VSS) replacement in this section. 2. Visually inspect the VSS for the following conditions: • Physical damage • Being loose • Improper installation • For transmission output shaft teeth damage 3. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 6
6	1. Turn OFF the ignition. 2. Disconnect the VSS harness connector. 3. Connect a test lamp between the ignition voltage feed circuit of the VSS harness (pin 1 of J-32 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 9
7	1. Keep the ignition switch ON. 2. Connect a test lamp between the low reference circuit of the VSS harness (pin 2 of J-32 connector) and battery voltage. Does the test lamp illuminate?	—	Go to Step 8	Go to Step 10
8	1. Turn ON the ignition, with the engine OFF. 2. Intermittently jump the signal circuit of the VSS (pin 3 of J-32 connector) with a test lamp that is connected to 12 volts (apply from a battery) while monitoring the Vehicle Speed parameter with the Tech 2. Does the Tech 2 indicate any vehicle speed when the circuit is intermittently pulled to 12 volts?	—	Go to Step 12	Go to Step 11
9	Repair the open circuit or high resistance on the VSS ignition voltage feed circuit between the VSS (pin 1 of J-32 connector) and the Meter (10A) fuse. Did you complete the repair?	—	Go to Step 16	—
10	Repair the open or high resistance in the VSS low reference circuit between the VSS (pin 2 of J-32 connector) and ground terminal (B-1). Did you complete the repair?	—	Go to Step 16	—

Step	Action	Value(s)	Yes	No
11	1. Test the VSS signal circuit between the engine control module (ECM) (pin 19 of J-191 connector) and the VSS (pin 3 of J-32 connector), then between the instrument panel cluster (IPC) (pin 17 of B-52 connector) and the VSS (pin 3 of J-32 connector) for the following conditions: • An open circuit • A short to ground • A short to battery or ignition voltage • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 13
12	1. Turn OFF the ignition. 2. Disconnect the VSS harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the VSS (pins 1, 2 and 3 of J-32 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 14
13	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the VSS signal circuit at the harness connector of the ECM (pin 19 of J-191 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 15
14	Replace the VSS. Refer to Vehicle Speed Sensor (VSS) Replacement in this section. Did you complete the replacement?	—	Go to Step 16	—
15	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 16	—
16	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Drive the vehicle. 5. Observe the Vehicle Speed parameter with the Tech 2. Does the Vehicle Speed parameter indicate correct vehicle speed?	—	Go to Step 17	Go to Step 3
17	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0501 (Flash Code 25)

Circuit Description

The vehicle speed sensor (VSS) is used by the engine control module (ECM) and speedometer, which generates a speed signal from the transmission output shaft. The VSS has the following circuits.

- Ignition voltage feed circuit
- VSS signal circuit
- VSS low reference circuit

The VSS uses a hall effect element. It interacts with the magnetic field created by the rotating magnet and outputs square wave pulse signal. The ECM calculates the vehicle speed by the VSS. If the ECM detects VSS signals are changed sharply, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The ignition voltage is more than 18 volts.

Condition for Setting the DTC

- The ECM detects that the VSS signal are changed larger than a predetermined vehicle speed.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail at next driving cycle.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Electrical or magnetic interference may affect intermittent condition.

DTC P0501 (Flash Code 25)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Inspect all of the circuits going to the vehicle speed sensor (VSS) for the following: • Routed too closely to fuel injection wiring or components • Routed too closely to after-market add-on electrical equipment • Routed too closely 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 7	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the VSS harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the VSS (pins 1, 2 and 3 of J-32 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the engine control module (ECM) harness connector. 3. Inspect for an intermittent and for a poor connection on VSS circuit at the harness connector of the ECM (pin 19 of J-191 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 5
5	1. Remove the VSS. Refer to Vehicle Speed Sensor (VSS) Replacement in this section. 2. Visually inspect the VSS for the following conditions: • Physical damage • Being loose • Improper installation 3. The following conditions may cause this DTC to set: • Electromagnetic interference in the VSS circuits 4. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
6	Replace the VSS. Refer to Vehicle Speed Sensor (VSS) Replacement in this section. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Drive the vehicle. 5. Observe the Vehicle Speed parameter with the Tech 2. Does the Vehicle Speed parameter indicate correct vehicle speed?	—	Go to Step 8	Go to Step 2
8	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0601 (Flash Code 53)

Circuit Description

This diagnostic applies to internal microprocessor integrity conditions within the engine control module (ECM).

Condition for Setting the MIL / DTC

- The ECM detects a malfunction in its internal flash read only memory (ROM).

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM stops engine running.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the diagnostic runs and does not fail at next ignition cycle.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If this DTC is present, the engine cranks but does not start.

DTC P0601 (Flash Code 53)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. If engine does not start, crank over the engine for 10 seconds. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0603 (Flash Code 54)

Circuit Description

This diagnostic applies to internal microprocessor integrity conditions within the engine control module (ECM).

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects a malfunction in its internal electrically erasable & programmable read only memory (EEPROM).
- The ECM detects that the calculated checksum does not agree with the ECM internal registered checksum.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

DTC P0603 (Flash Code 54)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0606 (Flash Code 51, 52)

Circuit Description

This diagnostic applies to internal microprocessor integrity conditions within the engine control module (ECM).

Condition for Running the DTC

- The ignition switch is ON.
- The battery voltage is more than 16 volts.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects a malfunction in its internal main central processing unit (CPU). (Flash Code 51)
- The ECM detects a malfunction in its internal sub CPU. (Flash Code 52)

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits accelerator control range.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

DTC P0606 (Flash Code 51, 52)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 8
3	1. Test each ground circuit between the engine control module (ECM) (pins 1, 3, 4, 43, 62 and 81 of J-191 connector) and the chassis ground terminal (J-9) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 4
4	1. Turn OFF the ignition. 2. Inspect for an intermittent, for poor tightening and corrosion at the chassis ground terminal (J-9). 3. Repair the tightening or clean the corrosion as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 5
5	1. Test each ECM main relay voltage feed circuit between the ECM (pins 2 and 5 of J-191 connector) and the ECM main relay (pin 2 of X-18 connector) for high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 6

Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM 1, 2, 3, 4, 5, 43, 62 and 81 of J-191 connector. 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
7	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 8	—
8	1. Reconnect all previously disconnected relay or harness connector(s). 2. Clear the DTCs with he Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 9
9	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0611 (Flash Code 34)

Circuit Description

The charge up circuit in the engine control module (ECM) steps up the voltage for fuel injectors and is divided into two banks, common 1 and 2. The common 1 covers fuel injectors in cylinders 1 and 4, and the common 2 covers fuel injectors in cylinders 2 and 3. If the common 1 fuel injector charge up voltage circuit in the ECM is excessively low, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The battery voltage is more than 18 volts.

Condition for Setting the DTC

- The ECM detects that the common 1 fuel injector charge up circuit is insufficient charge.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits accelerator control range.
- The ECM inhibits pilot injection.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P0611 (Flash Code 34)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 8
3	1. Test each ground circuit between the engine control module (ECM) (pins 1, 3, 4, 43, 62 and 81 of J-191 connector) and the chassis ground terminal (J-9) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 4
4	1. Turn OFF the ignition. 2. Inspect for an intermittent, for poor tightening and corrosion at the chassis ground terminal (J-9). 3. Repair the tightening or clean the corrosion as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 5
5	1. Test each ECM main relay voltage feed circuit between the ECM (pins 2 and 5 of J-191 connector) and the ECM main relay (pin 2 of X-18 connector) for high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 6

Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM 1, 2, 3, 4, 5, 43, 62 and 81 of J-191 connector. 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
7	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 8	—
8	1. Reconnect all previously disconnected relay or harness connector(s). 2. Clear the DTCs with he Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 9
9	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0612 (Flash Code 34)

Circuit Description

The charge up circuit in the engine control module (ECM) steps up the voltage for fuel injectors and is divided into two banks, common 1 and 2. The common 1 covers fuel injectors in cylinders 1 and 4, and the common 2 covers fuel injectors in cylinders 2 and 3. If the common 2 fuel injector charge up voltage circuit in the ECM is excessively low, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The battery voltage is more than 18 volts.

Condition for Setting the DTC

- The ECM detects that the common 2 fuel injector charge up circuit is insufficient charge.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits accelerator control range.
- The ECM inhibits pilot injection.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P0612 (Flash Code 34)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 8
3	1. Test each ground circuit between the engine control module (ECM) (pins 1, 3, 4, 43, 62 and 81 of J-191 connector) and the chassis ground terminal (J-9) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 4
4	1. Turn OFF the ignition. 2. Inspect for an intermittent, for poor tightening and corrosion at the chassis ground terminal (J-9). 3. Repair the tightening or clean the corrosion as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 5
5	1. Test each ECM main relay voltage feed circuit between the ECM (pins 2 and 5 of J-191 connector) and the ECM main relay (pin 2 of X-18 connector) for high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 6

Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the ECM 1, 2, 3, 4, 5, 43, 62 and 81 of J-191 connector. 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 8	Go to Step 7
7	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 8	—
8	1. Reconnect all previously disconnected relay or harness connector(s). 2. Clear the DTCs with he Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 9
9	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0615 (Flash Code 19)

Circuit Description

The engine control module (ECM) controls the starter cut relay which de-energizes the starter relay based on engine speed inputs. The starter cut relay uses normally close type relay. During engine stopping, the relay is closed to allow grounding the starter relay. Once engine run, the ECM energizes the starter cut relay to open the starter relay circuit and starter motor is cut even the ignition is positioned at START. If the ECM detects an improper voltage on the starter cut relay control circuit, this DTC will set. This diagnostic only applies manual transmission model.

Condition for Running the DTC

- The ignition switch is ON.
- The battery voltage is between 16 – 32 volts.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects a low voltage condition on the starter cut relay control circuit when the relay is commanded OFF for longer than 10 seconds.
- The ECM detects a high voltage condition on the starter cut relay control circuit when the relay is commanded ON for longer than 10 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail at next driving cycle.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P0615 (Flash Code 19)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. DO NOT start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 4	Go to Step 3
3	1. Start the engine. 2. Monitor the DTC Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 8	Go to Diagnostic Aids
4	Start the engine. Does the engine start?	—	Go to Step 6	Go to Step 5
5	1. Turn OFF the ignition. 2. Replace the starter cut relay with the marker lamp relay or replace with a known good relay. 3. Start the engine. Does the engine start?	—	Go to Step 14	Go to Step 9

Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition. 2. Remove the starter cut relay. 3. Connect a test lamp between the starter cut relay voltage feed circuit (pin 3 of X-26 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 10
7	1. Reinstall the starter cut relay. 2. Start the engine. 3. Disconnect the starter cut relay. 4. Connect a test lamp between the starter cut relay control circuit (pin 5 of X-26 connector) and battery voltage. Does the test lamp illuminate?	—	Go to Step 12	Go to Step 11
8	1. Test the starter cut relay control circuit between the engine control module (ECM) (pin 14 of J-191 connector) and the starter cut relay (pin 5 of X-26 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 15
9	1. Test the starter cut relay control circuit between the ECM (pin 14 of J-191 connector) and the starter cut relay (pin 5 of X-26 connector) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 15
10	Repair the open circuit or high resistance on the voltage feed circuit between the ECM (10A) fuse and the starter cut relay (pin 3 of X-26 connector). Check the ECM (10A) fuse first. Did you complete the repair?	—	Go to Step 16	—
11	1. Test the starter cut relay control circuit between the ECM (pin 14 of J-191 connector) and the starter cut relay (pin 5 of X-26 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 13
12	1. Turn OFF the ignition. 2. Remove the starter cut relay. 3. Inspect for an intermittent and for a poor connection on each starter cut relay terminal. 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 14

Step	Action	Value(s)	Yes	No
13	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the starter cut relay circuit at the harness connector of the ECM (pin 14 of J-191 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 15
14	Replace the starter cut relay. Did you complete the replacement?	—	Go to Step 16	—
15	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 16	—
16	1. Reconnect all previously disconnected fuse, relay or harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition for 5 seconds. 5. Start the engine. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 17
17	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P0650 (Flash Code 77)

Circuit Description

The malfunction indicator lamp (MIL) is located on the instrument panel cluster (IPC). The MIL informs the driver that an emission system or a performance related fault has occurred and that the engine control system requires service. The engine control module (ECM) 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 ECM detects low voltage when the MIL is commanded OFF, or high voltage when the MIL is commanded ON. If the ECM detects an improper voltage on the MIL control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The ignition voltage is more than 18 volts.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects a low voltage condition on the MIL control circuit when the indicator is commanded OFF for longer than 3 seconds.
- The ECM detects a high voltage condition on the MIL control circuit when the indicator is commanded ON for longer than 3 seconds.

Action Taken When the DTC Sets

- The ECM does not illuminate the MIL when the diagnostic runs and fails.

Condition for Clearing the DTC

- A current DTC clears when the diagnostic runs and does not fail at next driving cycle.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P0650 (Flash Code 77)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
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 cluster (IPC) is completely inoperative, refer to Diagnostic System Check. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition for 30 seconds while observing the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Inspect the Meter (10A) fuse in the glove box. Is the Meter (10A) fuse open?	—	Go to Step 4	Go to Step 5
4	Replace the Meter (10A) fuse. If the fuse continues to open, repair the short to ground on one of the circuits that is fed by the Meter (10A) fuse or replace the shorted attached component fed by the Meter (10A) fuse. Did you complete the repair?	—	Go to Step 19	—
5	1. Turn OFF the ignition. 2. Disconnect the engine control module (ECM) J-191 harness connector. 3. Turn ON the ignition, with the engine OFF. Is the malfunction indicator lamp (MIL) OFF?	—	Go to Step 6	Go to Step 13

Step	Action	Value(s)	Yes	No
6	1. Remove the Meter (10A) fuse that supplies voltage to the MIL. 2. Turn ON the ignition, with the engine OFF. 3. Measure the voltage from the MIL control circuit in the ECM harness connector (pin 6 of J-191 connector) to a good ground. Is the voltage less than the specified value?	1 volt	Go to Step 7	Go to Step 14
7	1. Turn OFF the ignition. 2. Install the Meter (10A) fuse that supplies ignition 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 ECM harness connector (pin 6 of J-191 connector) and a known good ground. Is the MIL illuminated?	—	Go to Step 12	Go to Step 8
8	1. Turn OFF the ignition. 2. Remove the IPC. 3. Remove the MIL bulb from the IPC. Is the MIL bulb burned out?	—	Go to Step 16	Go to Step 9
9	1. Connect a test lamp between the MIL ignition voltage circuit of the IPC harness connector (pin 18 of B-51 connector) and a known good ground. 2. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 10	Go to Step 15
10	1. Test the MIL control circuit between the ECM (pin 6 of J-191 connector) and the IPC (pin 5 or 13 of B-51 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 11
11	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the IPC (pins 5 or 13 and 18 of B-51 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 17
12	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the MIL control circuit at the harness connector of the ECM (pin 6 of J-191 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
13	Repair the short to ground on the control circuit of the MIL between the ECM (pin 6 of J-191 connector) and the IPC (pin 5 or 13 of B-51 connector). Did you complete the repair?	—	Go to Step 19	—

Step	Action	Value(s)	Yes	No
14	Repair the short to battery or ignition voltage on the control circuit of the MIL between the ECM (pin 6 of J-191 connector) and the IPC (pin 5 or 13 of B-51 connector). Did you complete the repair?	—	Go to Step 19	—
15	Repair the open or high resistance on the ignition voltage circuit of the MIL between the Meter (10A) fuse and the IPC (pin 18 of B-51 connector). Did you complete the repair?	—	Go to Step 19	—
16	Replace the MIL bulb. Did you compete the replacement?	—	Go to Step 19	—
17	Repair or replace the IPC. Did you complete the repair or replacement?	—	Go to Step 19	—
18	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 19	—
19	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition for 30 seconds while observing the DTC Information with the Tech 2. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 20
20	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1093 (Flash Code 227)

Description

The common rail fuel system is comprised of two fuel pressure sections: a suction side between the fuel tank and the fuel supply pump and a high-pressure side between the fuel supply pump and the fuel injectors. Fuel is drawn from the fuel tank via a feed pump and then pumped into the fuel rail by two plungers, all of which are internal to the fuel supply pump. This high pressure is regulated by the engine control module (ECM) using the fuel rail pressure (FRP) regulator dependant upon values from the FRP sensor attached to the fuel rail. In case of fuel rail overpressure, a pressure limiter valve threaded into the fuel rail will open to release overpressure and return fuel back to the fuel tank.
If the ECM detects that the fuel pressure is a certain pressure lower than the desired fuel rail pressure for a certain length of time, this DTC will set.

Condition for Running the DTC

- DTCs P0090, P0192, P0193, P0201 – P0204, P0611, P0612, P1095, P1261, P1262, P1630 and P1635 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.
- The FRP regulator command is less than 33% or commanded fuel supply is more than a predetermined value.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects that the differential fuel rail pressure is -10 MPa (-1,450 psi) for longer than 15 seconds when the engine speed is between 0 – 900 RPM.
- The ECM detects that the differential fuel rail pressure is -15 MPa (-2,170 psi) for longer than 15 seconds when the engine speed is higher than 1200 RPM.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits accelerator control range.
- The ECM inhibits pilot injection.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail at next driving cycle.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- An intermittently sticking FRP regulator may have allowed the fuel pressure to become low enough to set this DTC.
- Normal FRP Sensor readings on the Tech 2 with the engine running in neutral at idle is around 1.4 – 1.6 volts.
- An intermittently sticking fuel injector may have allowed the fuel pressure to drop too much. Use the Tech 2 to perform the Injector Balancing test for each injector. Verify a consistent engine speed change when commanding each fuel injector ON and OFF.
- A skewed FRP sensor value (shifted to a lower pressure) can set this DTC. The FRP Sensor on the Tech 2 should read 0.9 – 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 2 minutes.

Notice:

- This DTC most likely indicates a loss of fuel pressure by a fuel leak from the high pressure side. Inspect the high pressure side fuel leakage between the fuel supply pump and fuel injector FIRST.

Notice:

- The fuel system from the fuel tank(s) to the fuel supply pump is under a slight vacuum with the engine running. As a result, air can enter the fuel system if these connections are not tight or if there is a crack in one of the fuel hoses. Air in the fuel system will cause fuel rail pressure fluctuations especially at high engine speed and load, which may set this DTC.

Notice:

- If the fuel tank is empty or near empty, air might be allowed to go into the fuel system. With air in the fuel system, smooth flow of fuel into the supply pump is interrupted and this DTC may set. Perform bleeding of fuel system after refilling.

Test Description

The numbers below refers to the step number on the diagnostic table.
5. This step checks for a fuel restriction by determining if a high vacuum is being pulled on the fuel system during normal operation.
6. This step checks for an air leak on the suction side of the fuel system by determining if a vacuum can be pulled when a fuel line is plugged.

DTC P1093 (Flash Code 227)

Schematic Reference: Engine Controls Schematics

Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P0090, P0192, P0193, P0201 – P0204, P1094, P1095, P1261 or P1262 set?	—	Go to Applicable DTC	Go to Step 3
3	1. Turn OFF the ignition. 2. Wait 2 minutes for the fuel pressure to bleed down from the fuel rail. 3. Turn ON the ignition with the engine OFF. DO NOT start the engine. 4. Observe the Fuel Rail Pressure (FRP) Sensor parameter with the Tech 2. Is the FRP Sensor parameter the specified value?	0.9 – 1.0 volt	Go to Step 4	Go to Step 11
4	1. Turn OFF the ignition. 2. Check the fuel system line connections between the fuel tank and the fuel supply pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. **Notice:** The fuel system from the fuel tank(s) to the fuel supply pump is under a slight vacuum with the engine running. As a result, air can enter the fuel system if these connections are not tight. Air in the fuel system will cause fuel rail pressure fluctuations especially at high engine speed and load, which may set this DTC. 3. Pump the priming pump on the fuel filter until it becomes firm. If there is a leak on the suction side of the fuel system between the priming pump and the fuel supply pump, the priming pump will not build up sufficient firmness and fuel leakage may occur. 4. Start the engine and check for high side fuel system leaks at the fuel supply pump and fuel rail. **Notice:** Fuel may leak under the cylinder head cover from the inlet high pressure line. In such case, the engine oil level will rise. Inspect for fuel leakage into the engine oil. 5. Repair any fuel system leaks as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 5

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Remove the rubber fuel hose from the fuel filter housing (fuel supply pump side). Use a pan to catch the fuel leakage from the removed fuel line. **Important:** The fuel vacuum pump / pressure gauge connector and the adapter hose must be cleaned before connecting to the fuel line. Otherwise, foreign material internal to the tools line may damage the fuel supply pump. 3. Connect the suction side fuel pressure / vacuum gauge adapter (5-8840-2844-0 / EN-47667) with fuel pressure / vacuum gauge assembly (5-8840-2844-0 / J-44638) in series with the filter housing and the disconnected fuel hose. Ensure the service tool and fuel line connections are tight. 4. Bleed the fuel system by priming the priming pump until it becomes firm, then crank over the engine for a maximum of 5 seconds. Repeat as necessary until the engine starts. 5. Let the engine run at idle for at least 1 minute. 6. Monitor the fuel pressure / vacuum gauge while holding the engine speed higher than 2500 RPM for a minimum of 1 minute. Does the fuel pressure / vacuum gauge indicate a larger vacuum than the specified amount during the test?	5 inHg	Go to Step 7	Go to Step 6
6	1. Fully clamp off a fuel hose as close to the fuel tank as possible (this will draw vacuum on the fuel system). You can also disconnect a fuel line and plug it. 2. Start the engine and turn the idle up control knob to the highest position. (Full clockwise direction. The idle speed is increased up to 1600 RPM.) 3. Monitor the fuel pressure / vacuum gauge. **Notice:** Release the clamp or open the plug when the gauge is likely to be more than 8 inHg during the test. Can a vacuum of at least the specified amount be pulled on the fuel system?	8 inHg	Go to Step 9	Go to Step 8
7	1. Inspect the fuel lines between the fuel supply pump and fuel tank for being crushed or kinked. 2. Inspect for a plugged fuel tank vent hose. 3. Inspect inside the fuel tank (if possible) for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. 4. Repair as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 12

Step	Action	Value(s)	Yes	No
8	1. Turn OFF the ignition. 2. Check the fuel system line connections between the fuel tank and the fuel supply pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. 3. Repair as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 10
9	1. Turn OFF the ignition. 2. Unclamp or unplug the fuel line from the previous step and reconnect the fuel line (if disconnected). 3. Start the engine and allow it to run for at least 1 minute. 4. Perform the Injector Balancing test with the Tech 2. 5. Command each injector OFF and verify an engine speed change for each injector. Is there an injector that does not change engine speed when commanded OFF?	—	Go to Step 14	Go to Step 16
10	1. Turn OFF the ignition. 2. Disconnect the FRP regulator harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP regulator (pins 1 and 2 of E-116). 4. Disconnect the engine control module (ECM) harness connector. 5. Inspect for an intermittent, for poor connections and corrosion on each FRP regulator circuit at the harness connector of the ECM (pins 89, 97, 105 and 113 of E-111 connector). 6. Test for high resistance on each FRP regulator circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 15
11	1. Turn OFF the ignition. 2. Disconnect the FRP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP sensor (pins 1, 2 and 3 of E-113 connector). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion on each FRP sensor circuit at the harness connector of the ECM (pins 82, 87, 90 and 101 of E-111 connector). 6. Test for high resistance on each FRP circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 13

Step	Action	Value(s)	Yes	No
12	Replace the fuel filter cartridge. Refer to Fuel Filter Cartridge Replacement in the Fuel System Section. Did you complete the replacement?	—	Go to Step 17	—
13	Replace the FRP sensor. Refer to Fuel Rail Pressure (FRP) Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 17	—
14	**Important:** Replacement injector must be programmed. Replace the appropriate fuel injector that does not change engine speed when commanded OFF. Refer to Fuel Injector Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 17	—
15	**Important:** The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. **Notice:** Always replace the fuel filter cartridge when a fuel supply pump is replaced. Replace the fuel supply pump and fuel filter cartridge. Refer to Fuel Supply Pump Replacement in this section and Fuel Filter Cartridge Replacement in Fuel System section. Did you complete the replacement?	—	Go to Step 17	—
16	**Notice:** There is a possibility that the pressure limiter valve stuck open or opening pressure has fallen. Replace the pressure limiter valve. Refer to Fuel Rail Replacement in this section. Did you complete the replacement?	—	Go to Step 17	—
17	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 18
18	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1094 (Flash Code 226)

Description

The common rail fuel system is comprised of two fuel pressure sections: a suction side between the fuel tank and the fuel supply pump and a high-pressure side between the fuel supply pump and the fuel injectors. Fuel is drawn from the fuel tank via a feed pump and then pumped into the fuel rail by two plungers, all of which are internal to the fuel supply pump. This high pressure is regulated by the engine control module (ECM) using the fuel rail pressure (FRP) regulator dependant upon values from the FRP sensor attached to the fuel rail. In case of fuel rail overpressure, a pressure limiter valve threaded into the fuel rail will open to release overpressure and return fuel back to the fuel tank.

If the ECM detects that the differential fuel rail pressure is small at low engine speed but the FRP regulator commanded fuel is certain amount high for a certain length of time, this DTC will set. (FRP Regulator Command High DTC)

If the ECM detects that the fuel rail pressure sensor signal voltage is certain amount low for a certain length of time when fuel cut, DTC will also set. (FRP Drop DTC)

Condition for Running the DTC

FRP Regulator Command High DTC

- DTCs P0090, P0117, P0118, P0192, P0193, P0201 – P0204, P0500, P0501, P0611, P0612, P1095, P1261, P1262, P1630 and P1635 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.
- The engine is running.
- The accelerator pedal position is 0%.
- The engine coolant temperature is more than 50°C (122°F).
- The vehicle speed is less than 5 km/h (4 MPH).
- The engine speed does not vary more than 50 RPM.

FRP Drop DTC

- DTCs P0090, P0192, P0193, P0201 – P0204, P0611, P0612, P1095, P1261, P1262, P1630 and P1635 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.
- The engine is running.
- The accelerator pedal position is 0%.
- The engine coolant temperature is more than 50°C (122°F).
- The vehicle speed is more than 50 km/h (30 MPH).
- The commanded fuel injection quantity is OFF.

Condition for Setting the DTC

FRP Regulator Command High DTC

- The ECM detects that the FRP regulator commanded fuel is more than a predetermined range for longer than 15 seconds when the engine speed is between 600 – 1500 RPM.

FRP Drop DTC

- The ECM detects that the FRP sensor signal voltage is shapely dropped more than 0.2 volts when the engine cuts fuel.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits accelerator control range.
- The ECM inhibits pilot injection.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail at next driving cycle.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- An intermittently sticking FRP regulator may have allowed the fuel pressure to become low enough to set this DTC.
- Normal FRP Sensor readings on the Tech 2 with the engine running in neutral at idle is around 1.4 – 1.6 volts.
- An intermittently sticking fuel injector may have allowed the fuel pressure to drop too much. Use the Tech 2 to perform the Injector Balancing test for each injector. Verify a consistent engine speed change when commanding each fuel injector ON and OFF.
- A skewed FRP sensor value (shifted to a lower pressure) can set this DTC. The FRP Sensor on the Tech 2 should read 0.9 – 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 2 minutes.

Notice:

- This DTC most likely indicates a loss of fuel pressure by a fuel leak from the high pressure side. Inspect the high pressure side fuel leakage between the fuel supply pump and fuel injector FIRST.

Notice:

- The fuel system from the fuel tank(s) to the fuel supply pump is under a slight vacuum with the engine running. As a result, air can enter the fuel system if these connections are not tight or if there is a crack in one of the fuel hoses. Air in the fuel system will cause fuel rail pressure fluctuations especially at high engine speed and load, which may set this DTC.

Notice:

- If the fuel tank is empty or near empty, air might be allowed to go into the fuel system. With air in the fuel system, smooth flow of fuel into the supply pump is interrupted and this DTC may set. Perform bleeding of fuel system after refilling.

Test Description

The numbers below refers to the step number on the diagnostic table.
7. This step checks for a fuel restriction by determining if a high vacuum is being pulled on the fuel system during normal operation.
8. This step checks for an air leak on the suction side of the fuel system by determining if a vacuum can be pulled when a fuel line is plugged.

DTC P1094 (Flash Code 226)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

<table>
<tr><th>Step</th><th>Action</th><th>Value(s)</th><th>Yes</th><th>No</th></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. Inspect the high pressure side between the fuel supply pump and the fuel injectors for fuel leakage. The following components may contain an external leak.
• Fuel supply pump
• Fuel rail
• Pressure limiter valve
• Flow damper valve
• Fuel rail pressure (FRP) sensor
• Fuel pipe between the fuel supply pump and fuel rail
• Fuel pipe between the fuel rail and fuel injectors
• Each fuel pipe sleeve nuts
Notice:
Fuel may leak under the cylinder head cover from the inlet high pressure line. In such case, the engine oil level will rise. Inspect for fuel leakage into the engine oil.
Notice:
Remove and inspect the inlet high pressure joint to the fuel injectors for fuel leaking from the sleeve nut(s). Replace the fuel injector and injection pipe when foreign material was in contact.
2. Repair any fuel system leaks as necessary.
Did you find and correct the condition?</td><td>—</td><td>Go to Step 20</td><td>Go to Step 3</td></tr>
</table>

Step	Action	Value(s)	Yes	No
3	1. Remove each glow plug from the cylinder head. 2. Inspect the tip of the plugs for wet fuel. **Notice:** Use the engine compression gauge (5-8840-2675-0 / J-26999-12) and gauge adapter (5-8840-2815-0 / EN-46722) to inspect the damage of engine. If poor engine compression (less than 1960 kPa [284 psi]) or variation of each cylinder (more than 294 kPa [43 psi]) is found, inspect the engine mechanical. Refer to the Engine Mechanical section. Repair as necessary. Did you find wet fuel on the glow plug(s)?	—	Go to Step 16	Go to Step 4
4	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P0090, P0192, P0193, P0201 – P0204, P1094, P1095, P1261 or P1262 set?	—	Go to Applicable DTC	Go to Step 5
5	1. Turn OFF the ignition. 2. Wait 2 minutes for the fuel pressure to bleed down from the fuel rail. 3. Turn ON the ignition with the engine OFF. DO NOT start the engine. 4. Observe the FRP Sensor parameter with the Tech 2. Is the FRP Sensor parameter the specified value?	0.9 – 1.0 volt	Go to Step 6	Go to Step 13

Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition. 2. Check the fuel system line connections between the fuel tank and the fuel supply pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. **Notice:** The fuel system from the fuel tank(s) to the fuel supply pump is under a slight vacuum with the engine running. As a result, air can enter the fuel system if these connections are not tight. Air in the fuel system will cause fuel rail pressure fluctuations especially at high engine speed and load, which may set this DTC. 3. Pump the priming pump on the fuel filter until it becomes firm. If there is a leak on the suction side of the fuel system between the priming pump and the fuel supply pump, the priming pump will not build up sufficient firmness and fuel leakage may occur. 4. Start the engine and check for high side fuel system leaks at the fuel supply pump and fuel rail. **Notice:** Fuel may leak under the cylinder head cover from the inlet high pressure line. In such case, the engine oil level will rise. Inspect for fuel leakage into the engine oil. 5. Repair any fuel system leaks as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 7
7	1. Turn OFF the ignition. 2. Remove the rubber fuel hose from the fuel filter housing (fuel supply pump side). Use a pan to catch the fuel leakage from the removed fuel line. **Important:** The fuel vacuum pump / pressure gauge connector and the adapter hose must be cleaned before connecting to the fuel line. Otherwise, foreign material internal to the tools line may damage the fuel supply pump. 3. Connect the suction side fuel pressure / vacuum gauge adapter (5-8840-2844-0 / EN-47667) with fuel pressure / vacuum gauge assembly (5-8840-2844-0 / J-44638) in series with the filter housing and the disconnected fuel hose. Ensure the service tool and fuel line connections are tight. 4. Bleed the fuel system by priming the priming pump until it becomes firm, then crank over the engine for a maximum of 5 seconds. Repeat as necessary until the engine starts. 5. Let the engine run at idle for at least 1 minute. 6. Monitor the fuel pressure / vacuum gauge while holding the engine speed higher than 2500 RPM for a minimum of 1 minute. Does the fuel pressure / vacuum gauge ever indicate a larger vacuum than the specified amount during the test?	5 inHg	Go to Step 9	Go to Step 8

Step	Action	Value(s)	Yes	No
8	1. Fully clamp off a fuel hose as close to the fuel tank as possible (this will draw vacuum on the fuel system). You can also disconnect a fuel line and plug it. 2. Start the engine and turn the idle up control knob to the highest position. (Full clockwise direction. The idle speed is increased up to 1600 RPM.) 3. Monitor the fuel pressure / vacuum gauge. **Notice:** Release the clamp or open the plug when the gauge is likely to be more than 8 inHg during the test. Can a vacuum of at least the specified amount be pulled on the fuel system?	8 inHg	Go to Step 11	Go to Step 10
9	1. Inspect the fuel lines between the fuel supply pump and fuel tank for being crushed or kinked. 2. Inspect for a plugged fuel tank vent hose. 3. Inspect inside the fuel tank (if possible) for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. 4. Repair as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 14
10	1. Turn OFF the ignition. 2. Check the fuel system line connections between the fuel tank and the fuel supply pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. 3. Repair as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 12
11	1. Turn OFF the ignition. 2. Unclamp or unplug the fuel line from the previous step and reconnect the fuel line (if disconnected). 3. Start the engine and allow it to run for at least 1 minute. 4. Perform the Injector Balancing test with the Tech 2. 5. Command each injector OFF and verify an engine speed change for each injector. Is there an injector that does not change engine speed when commanded OFF?	—	Go to Step 17	Go to Step 19

Step	Action	Value(s)	Yes	No
12	1. Turn OFF the ignition. 2. Disconnect the FRP regulator harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP regulator (pins 1 and 2 of E-116). 4. Disconnect the engine control module (ECM) harness connector. 5. Inspect for an intermittent, for poor connections and corrosion on each FRP regulator circuit at the harness connector of the ECM (pins 89, 97, 105 and 113 of E-111 connector). 6. Test for high resistance on each FRP regulator circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 18
13	1. Turn OFF the ignition. 2. Disconnect the FRP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP sensor (pins 1, 2 and 3 of E-113 connector). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion on each FRP sensor circuit at the harness connector of the ECM (pins 82, 87, 90 and 101 of E-111 connector). 6. Test for high resistance on each FRP circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 20	Go to Step 15
14	Replace the fuel filter cartridge. Refer to Fuel Filter Cartridge Replacement in the Fuel System Section. Did you complete the replacement?	—	Go to Step 20	—
15	Replace the FRP sensor. Refer to Fuel Rail Pressure (FRP) Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 20	—
16	**Important:** Replacement injector must be programmed. Replace the appropriate injector that was leaking fuel found at Step 3. Refer to Fuel Injector Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 20	—

Step	Action	Value(s)	Yes	No
17	**Important:** Replacement injector must be programmed. Replace the appropriate fuel injector that does not change engine speed when commanded OFF. Refer to Fuel Injector Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 20	—
18	**Important:** The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. **Notice:** Always replace the fuel filter cartridge when a fuel supply pump is replaced. Replace the fuel supply pump and fuel filter cartridge. Refer to Fuel Supply Pump Replacement in this section and Fuel Filter Cartridge Replacement in Fuel System section. Did you complete the replacement?	—	Go to Step 20	—
19	**Notice:** There is a possibility that the pressure limiter valve stuck open or opening pressure has fallen. Replace the pressure limiter valve. Refer to Fuel Rail Replacement in this section. Did you complete the replacement?	—	Go to Step 20	—
20	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 21
21	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1095 (Flash Code 225)

Description

The common rail fuel system is comprised of two fuel pressure sections: a suction side between the fuel tank and the fuel supply pump and a high-pressure side between the fuel supply pump and the fuel injectors. Fuel is drawn from the fuel tank via a feed pump and then pumped into the fuel rail by two plungers, all of which are internal to the fuel supply pump. This high pressure is regulated by the engine control module (ECM) using the fuel rail pressure (FRP) regulator dependant upon values from the FRP sensor attached to the fuel rail. In case of fuel rail overpressure, a pressure limiter valve threaded into the fuel rail will open to release overpressure and return fuel back to the fuel tank.

If the ECM detects that the fuel rail pressure went excessively high, then sharply decreased, this DTC will set indicating high fuel pressure, which activated the pressure limiter valve.

Condition for Running the DTC

- DTCs P0192, P0193, P1630 and P1635 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.

Condition for Setting the DTC

- The ECM detects that the FRP sensor signal voltage drops quickly from more than 3.7 volts to less than 2.3 volts, and then the differential fuel rail pressure is more than -30 MPa (4,350 psi).

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail at next driving cycle.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- An intermittently sticking FRP regulator may have allowed the fuel pressure to become high enough to open the pressure limiter valve.
- Normal FRP Sensor readings on the Tech 2 with the engine running in neutral at idle is around 1.4 – 1.6 volts.
- A skewed FRP sensor value (shifted to a higher pressure) can set this DTC. The FRP Sensor on the Tech 2 should read 0.9 – 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 2 minutes.

Notice:

- The fuel system from the fuel tank(s) to the fuel supply pump is under a slight vacuum with the engine running. As a result, air can enter the fuel system if these connections are not tight or if there is a crack in one of the fuel hoses. Air in the fuel system will cause fuel rail pressure fluctuations especially at high engine speed and load, which may set this DTC.

Notice:

- If the fuel tank is empty or near empty, air might be allowed to go into the fuel system. With air in the fuel system, smooth flow of fuel into the supply pump is interrupted and this DTC may set. Perform bleeding of fuel system after refilling.

Test Description

The numbers below refers to the step number on the diagnostic table.

6. This step checks for a fuel restriction by determining if a high vacuum is being pulled on the fuel system during normal operation.

7. This step checks for an air leak on the suction side of the fuel system by determining if a vacuum can be pulled when a fuel line is plugged.

DTC P1095 (Flash Code 225)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls

Step	Action	Value(s)	Yes	No
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P0089, P0090, P0192, P0193, P0201 – P0204, P1261 or P1262 set?	—	Go to Applicable DTC	Go to Step 3
3	1. Turn OFF the ignition for 30 seconds. 2. Place the transmission in Neutral and set the park brake. 3. Start the engine. 4. Accelerate the engine between idle and W.O.T. (accelerator pedal full travel) many times while observing the DTC Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 4	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Wait 2 minutes for the fuel pressure to bleed down from the fuel rail. 3. Turn ON the ignition with the engine OFF. DO NOT start the engine. 4. Observe the Fuel Rail Pressure (FRP) Sensor parameter with the Tech 2. Is the FRP Sensor parameter the specified value?	0.9 – 1.0 volt	Go to Step 5	Go to Step 12
5	1. Turn OFF the ignition. 2. Check the fuel system line connections between the fuel tank and the fuel supply pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. **Notice:** The fuel system from the fuel tank(s) to the fuel supply pump is under a slight vacuum with the engine running. As a result, air can enter the fuel system if these connections are not tight. Air in the fuel system will cause fuel rail pressure fluctuations especially at high engine speed and load, which may set this DTC. 3. Pump the priming pump on the fuel filter until it becomes firm. If there is a leak on the suction side of the fuel system between the priming pump and the fuel supply pump, the priming pump will not build up sufficient firmness and fuel leakage may occur. 4. Start the engine and check for high side fuel system leaks at the fuel supply pump and fuel rail. **Notice:** Fuel may leak under the cylinder head cover from the inlet high pressure line. In such case, the engine oil level will rise. Inspect for fuel leakage into the engine oil. 5. Repair any fuel system leaks as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 6

Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition. 2. Remove the rubber fuel hose from the fuel filter housing (fuel supply pump side). Use a pan to catch the fuel leakage from the removed fuel line. **Important:** The fuel vacuum pump / pressure gauge connector and the adapter hose must be cleaned before connecting to the fuel line. Otherwise, foreign material internal to the tools line may damage the fuel supply pump. 3. Connect the suction side fuel pressure / vacuum gauge adapter (5-8840-2844-0 / EN-47667) with fuel pressure / vacuum gauge assembly (5-8840-2844-0 / J-44638) in series with the filter housing and the disconnected fuel hose. Ensure the service tool and fuel line connections are tight. 4. Bleed the fuel system by priming the priming pump until it becomes firm, then crank over the engine for a maximum of 5 seconds. Repeat as necessary until the engine starts. 5. Let the engine run at idle for at least 1 minute. 6. Monitor the fuel pressure / vacuum gauge while holding the engine speed higher than 2500 RPM for a minimum of 1 minute. Does the fuel pressure / vacuum gauge ever indicate a larger vacuum than the specified amount during the test?	5 inHg	Go to Step 8	Go to Step 7
7	1. Fully clamp off a fuel hose as close to the fuel tank as possible (this will draw vacuum on the fuel system). You can also disconnect a fuel line and plug it. 2. Start the engine and turn the idle up control knob to the highest position. (Full clockwise direction. The idle speed is increased up to 1600 RPM.) 3. Monitor the fuel pressure / vacuum gauge. **Notice:** Release the clamp or open the plug when the gauge is likely to be more than 8 inHg during the test. Can a vacuum of at least the specified amount be pulled on the fuel system?	8 inHg	Go to Step 10	Go to Step 9
8	1. Inspect the fuel lines between the fuel supply pump and fuel tank for being crushed or kinked. 2. Inspect for a plugged fuel tank vent hose. 3. Inspect inside the fuel tank (if possible) for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. 4. Repair as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 13

Step	Action	Value(s)	Yes	No
9	1. Turn OFF the ignition. 2. Check the fuel system line connections between the fuel tank and the fuel supply pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. 3. Repair as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 11
10	1. Turn OFF the ignition. 2. Unclamp or unplug the fuel line from the previous step and reconnect the fuel line (if disconnected). 3. Start the engine and allow it to run for at least 1 minute. 4. Perform the Injector Balancing test with the Tech 2. 5. Command each injector OFF and verify an engine speed change for each injector. Is there an injector that does not change engine speed when commanded OFF?	—	Go to Step 15	Go to Step 11
11	1. Turn OFF the ignition. 2. Disconnect the FRP regulator harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP regulator (pins 1 and 2 of E-116). 4. Disconnect the engine control module (ECM) harness connector. 5. Inspect for an intermittent, for poor connections and corrosion on each FRP regulator circuit at the harness connector of the ECM (pins 89, 97, 105 and 113 of E-111 connector). 6. Test for high resistance on each FRP regulator circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 16
12	1. Turn OFF the ignition. 2. Disconnect the FRP sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the FRP sensor (pins 1, 2 and 3 of E-113 connector). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion on each FRP sensor circuit at the harness connector of the ECM (pins 82, 87, 90 and 101 of E-111 connector). 6. Test for high resistance on each FRP circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 17	Go to Step 14

Step	Action	Value(s)	Yes	No
13	Replace the fuel filter cartridge. Refer to Fuel Filter Cartridge Replacement in the Fuel System Section. Did you complete the replacement?	—	Go to Step 17	—
14	Replace the FRP sensor. Refer to Fuel Rail Pressure (FRP) Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 17	—
15	**Important:** Replacement injector must be programmed. Replace the appropriate fuel injector that does not change engine speed when commanded OFF. Refer to Fuel Injector Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 17	—
16	**Important:** The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. **Notice:** Always replace the fuel filter cartridge when a fuel supply pump is replaced. Replace the fuel supply pump and fuel filter cartridge. Refer to Fuel Supply Pump Replacement in this section and Fuel Filter Cartridge Replacement in Fuel System section. Did you complete the replacement?	—	Go to Step 17	—
17	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 18
18	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1173 (Flash Code 542)

Circuit Description

The engine coolant temperature (ECT) sensor is installed to the thermostat housing. The ECT sensor is a variable resistor. The ECT sensor has a signal circuit and a low reference circuit. The ECT sensor measures the temperature of the engine coolant. The engine control module (ECM) supplies 5 volts to the ECT signal circuit and a ground for the ECT low reference circuit. When the ECT sensor is cold, the sensor resistance is high. When the engine coolant temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the ECT signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the ECT signal circuit. If the ECM detects an excessive high coolant temperature, this DTC will set.

Condition for Running the DTC

- DTCs P0117, P0118, P1630 and P1634 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.
- The engine is running.

Condition for Setting the DTC

- The ECM detects that the engine coolant temperature is more than 110°C (230°F) for 15 seconds.

Action Taken When the DTC Sets

- The ECM does not illuminate the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the DTC

- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- After starting the engine, the ECT should rise steadily to about 80°C – 85°C (176°F – 185°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.

Notice:

- This DTC is caused by an engine overheat condition (i.e. low engine coolant level). Since this DTC does not illuminate any lamps, clear the DTC and ensure there are no signs of engine damage. Excessive engine overheat may damage internal engine components.

DTC P1173 (Flash Code 542)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P0117 also set?	—	Go to DTC P0117	Go to Step 3
3	1. Start the engine and wait until engine is fully warms upped. 2. Observe the Coolant Temperature parameter with the Tech 2. Is the Coolant Temperature parameter more than the specified value?	110°C (230°F)	Go to Step 5	Go to Step 4

Step	Action	Value(s)	Yes	No
4	Ask the driver if overheat is caused by low engine coolant level, etc. If engine overheat has experienced, the engine must be inspected and repaired as necessary. Did you complete the action?	—	Go to Step 7	—
5	1. Test the engine coolant temperature (ECT) sensor at various temperature levels to evaluate the possibility if a skewed sensor. 2. Replace the ECT sensor as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
6	1. Test the engine cooling system for the following condition. Refer to diagnosis of the engine cooling system section for testing. • Engine coolant level • Engine coolant leakage • Cooling fan belt slippage • Cooling fan clutch working • Thermostat working • Water pump working • Radiator clogging 2. Repair or replace as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Diagnostic Aids
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine and wait until engine is fully warms upped. 5. Observe the Coolant Temperature parameter with the Tech 2. Is the Coolant Temperature parameter more than the specified value?	110°C (230°F)	Go to Step 2	Go to Step 8
8	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1220 (Flash Code 28)

Circuit Description

The power take off (PTO) throttle sensor (body builder installed) detects the PTO control throttle angle. The engine control module (ECM) receives the PTO control throttle angle from the throttle sensor and controls the fuel injection quantity (engine speed) during PTO. The PTO throttle sensor has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- PTO throttle sensor signal circuit

The ECM supplies 5 volts to the PTO throttle sensor on the 5 volts reference circuit. The ECM also provides a ground on the low reference circuit. The ECM monitors the PTO throttle sensor signal for voltages outside the normal range of the PTO throttle sensor. If the ECM detects an excessively high PTO throttle sensor signal voltage, this DTC will set.

Condition for Running the DTC

- DTCs P1630 and P1631 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.

Condition for Setting the DTC

- The ECM detects that the PTO throttle sensor signal voltage is more than 4.8 volts.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM disables PTO throttle sensor control.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- PTO throttle sensor may have an intermittent open somewhere in the operating range.

DTC P1220 (Flash Code 28)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Observe the PTO Remote Throttle Sensor parameter with the Tech 2 while turning the PTO throttle sensor. Does the PTO Remote Throttle Sensor parameter ever exceed specified value?	4.8 volts	Go to Step 3	Go to Diagnostic Aids
3	1. Start the engine. 2. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P1631 also set?	—	Go to Step 4	Go to Step 5
4	1. Turn OFF the ignition. 2. Disconnect the PTO throttle sensor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the PTO Remote Throttle Sensor parameter with the Tech 2. Is the PTO Remote Throttle Sensor parameter less than the specified value?	0.2 volts	Go to DTC P1631	Go to Step 7

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Disconnect the PTO throttle sensor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the PTO Remote Throttle Sensor parameter with the Tech 2. Is the PTO Remote Throttle Sensor parameter less than the specified value?	0.2 volts	Go to Step 6	Go to Step 7
6	1. Turn OFF the ignition. 2. Connect a test lamp between the low reference circuit of the PTO throttle sensor harness (pin 3 of J-166 connector) and battery voltage. 3. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 8
7	**Important:** The PTO throttle sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the engine control module (ECM) (pin 70 of J-191 connector) and the PTO throttle sensor (pin 2 of J-166 connector) for the following conditions: • A short to battery or ignition voltage • A short to any 5 volts reference 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
8	1. Test the low reference circuit between the ECM (pin 41 of J-191 connector) and the PTO throttle sensor (pin 3 of J-166 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10
9	1. Turn OFF the ignition. 2. Inspect for an intermittent and for a poor connection at the harness connector of the PTO throttle sensor (pin 3 of J-166 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 11
10	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the PTO throttle sensor circuit at the harness connector of the ECM (pin 41 of J-191 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
11	Replace the PTO throttle sensor. Did you complete the replacement?	—	Go to Step 13	—

Step	Action	Value(s)	Yes	No
12	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Observe the PTO Remote Throttle Sensor parameter with the Tech 2 while turning the PTO throttle sensor. Is the PTO Remote Throttle Sensor parameter more than the specified value?	4.8 volts	Go to Step 3	Go to Step 14
14	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1225 (Flash Code 31)

Circuit Description

The idle up sensor controls the idle speed during warm-up and it is installed in the driver's side instrument panel. This sensor is active only when the gear position is in the neutral position. When the selector lever is moved to another position, the signal is ignored. The engine control module (ECM) receives the idle up signal from the idle up sensor and controls the fuel injection quantity. The idle up sensor has following circuits.

- 5 volts reference circuit
- Low reference circuit
- Idle up sensor signal circuit

The ECM monitors the idle up sensor signals for voltages outside the normal range of the idle up sensor. If the ECM detects an excessively low or high idle up sensor voltage, this DTC will set.

Condition for Running the DTC

- DTCs P1630 and P1631 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects that the idle up sensor signal voltage is less than 0.1 volts for 5 second.
- The ECM detects that the idle up sensor signal voltage is more than 4.9 volts for 5 second.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM disables idle up sensor control.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Idle up sensor may have an intermittent open somewhere in the operating range.

DTC P1225 (Flash Code 31)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Fully turn the idle up sensor to lowest position (full counterclockwise direction) and highest position (full clock wise direction) while observing the Idle Up Sensor parameter with the Tech 2. Is the Idle Up Sensor parameter within the specified valve?	0.2 – 4.8 volts	Go to Diagnostic Aids	Go to Step 3
3	1. Start the engine. 2. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P1631 also set?	—	Go to Step 4	Go to Step 5
4	Is the Idle Up Sensor parameter less than the specified value at Step 2?	0.1 volts	Go to DTC P1631	Go to Step 8

Step	Action	Value(s)	Yes	No
5	1. Turn ON the ignition, with the engine OFF. 2. Turn the idle up sensor to lowest position (full counterclockwise direction). 3. Observe the Idle Up Sensor parameter with the Tech 2. Is the Idle Up Sensor parameter less than the specified value?	0.1 volts	Go to Step 6	Go to Step 9
6	1. Turn OFF the ignition. 2. Disconnect the idle up sensor harness connector. 3. Connect a DMM between the 5 volts reference circuit of the idle up sensor harness (pin 3 of B-281 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 7	Go to Step 11
7	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire between the 5 volts reference circuit and the signal circuit of the idle up sensor harness (pin 2 and 3 of B-281 connector). 3. Turn ON the ignition, with the engine OFF. 4. Observe the Idle Up Sensor parameter with the Tech 2. Is the Idle Up Sensor parameter more than the specified value?	4.5 volts	Go to Step 15	Go to Step 12
8	1. Turn OFF the ignition. 2. Disconnect the idle up sensor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Idle Up Sensor parameter with the Tech 2. Is the Idle Up Sensor parameter less than the specified value?	0.1 volts	Go to DTC P0631	Go to Step 13
9	1. Turn OFF the ignition. 2. Disconnect the idle up sensor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Idle Up Sensor parameter with the Tech 2. Is the Idle Up Sensor parameter less than the specified value?	0.1 volts	Go to Step 10	Go to Step 13
10	1. Turn OFF the ignition. 2. Connect a test lamp between the low reference circuit of the idle up sensor harness (pin 1 of B-281 connector) and battery voltage. 3. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 15	Go to Step 14

Step	Action	Value(s)	Yes	No
11	1. Test the 5 volts reference circuit between the engine control module (ECM) (pin 42 of J-191 connector) and the idle up sensor harness (pin 3 of B-281 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 16
12	1. Test the signal circuit between the ECM (pin 66 of J-191 connector) and the idle up sensor (pin 2 of B-281 connector) for the following conditions: • An open circuit • A short to ground • A short to the low reference circuit • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 16
13	**Important:** The idle up sensor may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the ECM (pin 66 of J-191 connector) and the idle up sensor (pin 2 of B-281 connector) for the following conditions: • A short to battery or ignition voltage • A short to any 5 volts reference 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18
14	1. Test the low reference circuit between the ECM (pin 41 of J-191 connector) and the idle up sensor (pin 1 of B-281 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 16
15	1. Turn OFF the ignition. 2. Disconnect the idle up sensor harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the idle up sensor (pins 1, 2 and 3 of B-281 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 17
16	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections on the idle up sensor circuits at the harness connector of the ECM (pins 41, 42 and 66 of J-191 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 19	Go to Step 18

Step	Action	Value(s)	Yes	No
17	Replace the idle up sensor. Refer to Idle Up Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 19	—
18	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 19	—
19	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Fully turn the idle up sensor to lowest position (full counterclockwise direction) and highest position (full clock wise direction) while observing the Idle Up Sensor parameter with the Tech 2. Is the Idle Up Sensor parameter within the specified valve?	0.2 – 4.8 volts	Go to Step 20	Go to Step 3
20	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1261 (Flash Code 158)

Circuit Description

The common 1 fuel injector drive circuit is a high-voltage supply which drives injectors for cylinder number 1 and 4 in conjunction with the engine control module (ECM) grounding the fuel injector control circuit. The ECM also supplies battery voltage to the fuel injector solenoid control circuit to allow for fault detection. If the common 1 fuel injector drive circuit is open circuit, short to ground or short to voltage, this DTC will set. Or, if the cylinder number 1 or number 4 fuel injector solenoid control circuit is shorted to ground, this DTC will also set.

Condition for Running the DTC

- DTC P0611 is not set.
- The ignition switch is ON.
- The battery voltage is more than 18 volts.
- The engine is running.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects that the common 1 fuel injector drive circuit is open circuit, shorted to ground or shorted to voltage during engine rotations.
- The ECM detects that the cylinder number 1 or number 4 fuel injector solenoid coil control circuit is shorted to ground during engine rotations.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits accelerator control range.
- The ECM inhibits pilot injection.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL and exhaust brake indicator lamp when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail at next driving cycle.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P1261 (Flash Code 158)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	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 DTC P0201 or P0204 is also set, diagnose that DTC first. 1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the in-line harness connector (H-125) from the cylinder head cover case. 3. Connect a DMM between the cylinder number 1 fuel injector control circuit (pin 5 of H-125 female side connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	12.0 volt	Go to Step 4	Go to Step 6

Step	Action	Value(s)	Yes	No
4	1. Connect a test lamp between the common 1 fuel injector drive circuit (pin 1 or 4 of H-125 female side connector) and a known good ground. 2. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 5
5	1. Connect a test lamp between the common 1 fuel injector drive circuit (pins 1 or 4 of H-125 female side connector) and battery voltage. 2. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 8	Go to Step 9
6	1. Test the cylinder number 1 or number 4 fuel injector solenoid control circuit between the engine control module (ECM) and the in-line harness connector (H-125 connector) for a short to ground. • Cylinder #1: Between pin 119 of E-111 connector and 5 of H-125 connector • Cylinder #4: Between pin 117 of E-111 connector and 8 of H-125 connector 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
7	1. Test the common 1 fuel injector drive circuit between the ECM (pin 121 of E-111 connector) and the in-line harness connector (pins 1 and 4 of H-125 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
8	1. Test the common 1 fuel injector drive circuit between the ECM (pin 121 of E-111 connector) and the in-line harness connector (pins 1 and 4 of H-125 connector) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
9	1. Inspect for an intermittent and for a poor connection at the in-line harness connector (pins 1 and 4 of H-125 connector). 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the common 1 fuel injector drive circuit at the harness connector of the ECM (pin 121 of E-111 connector). 4. Inspect for an open circuit or high resistance on the common 1 fuel injector drive circuit between the ECM (pin 121 of E-111 connector) and the in-line harness connector (pins 1 and 4 of H-125 connector). 5. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 10

Step	Action	Value(s)	Yes	No
10	1. Remove the cylinder head cover. Refer to Fuel Injector Replacement in this section. 2. Inspect the fuel injector harness for loose injector terminal nuts, objects touching injector terminals. 3. Inspect for an intermittent and for a poor connection at the in-line harness connector (pins 1 and 4 of H-126 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 11
11	1. Disconnect the fuel injector harness from the cylinder number 1 and number 4 fuel injectors (E-138 and E-141 connector). 2. Measure the insulation resistance between cylinder number 1 fuel injector terminals and a known good ground. 3. Measure the insulation resistance between cylinder number 4 fuel injector terminals and a known good ground. Is the insulation resistance more than the specified value on each measurement?	1 MΩ	Go to Step 12	Go to Step 13
12	Repair or replace the injector harness. Refer to Fuel Injector Replacement in this section. Did you complete the repair or replace?	—	Go to Step 15	—
13	**Important:** Replacement injector must be programmed. Replace the appropriate fuel injector that was less insulation resistance found at Step 11. Refer to Fuel Injector Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 15	—
15	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 16
16	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1262 (Flash Code 159)

Circuit Description

The common 2 fuel injector drive circuit is a high-voltage supply which drives injectors for cylinder number 2 and 3 in conjunction with the engine control module (ECM) grounding the fuel injector control circuit. The ECM also supplies battery voltage to the fuel injector solenoid control circuit to allow for fault detection. If the common 2 fuel injector drive circuit is open circuit, short to ground or short to voltage, this DTC will set. Or, if the cylinder number 2 or number 3 fuel injector solenoid control circuit is shorted to ground, this DTC will also set.

Condition for Running the DTC

- DTC P0612 is not set.
- The ignition switch is ON.
- The battery voltage is more than 18 volts.
- The engine is running.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects that the common 2 fuel injector drive circuit is open circuit, shorted to ground or shorted to voltage during engine rotations.
- The ECM detects that the cylinder number 2 or number 3 fuel injector solenoid coil control circuit is shorted to ground during engine rotations.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits accelerator control range.
- The ECM inhibits pilot injection.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL and exhaust brake indicator lamp when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail at next driving cycle.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P1262 (Flash Code 159)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	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 DTC P0202 or P0203 is also set, diagnose that DTC first. 1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the in-line harness connector (H-125) from the cylinder head cover case. 3. Connect a DMM between the cylinder number 2 fuel injector control circuit (pin 6 of H-125 female side connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	12.0 volt	Go to Step 4	Go to Step 6

Step	Action	Value(s)	Yes	No
4	1. Connect a test lamp between the common 2 fuel injector drive circuit (pin 2 or 3 of H-125 female side connector) and a known good ground. 2. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 7	Go to Step 5
5	1. Connect a test lamp between the common 2 fuel injector drive circuit (pins 2 or 3 of H-125 female side connector) and battery voltage. 2. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 8	Go to Step 9
6	1. Test the cylinder number 2 or number 3 fuel injector solenoid control circuit between the engine control module (ECM) and the in-line harness connector (H-125 connector) for a short to ground. • Cylinder #2: Between pin 118 of E-111 connector and 6 of H-125 connector • Cylinder #3: Between pin 120 of E-111 connector and 7 of H-125 connector 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
7	1. Test the common 2 fuel injector drive circuit between the ECM (pin 116 of E-111 connector) and the in-line harness connector (pins 2 and 3 of H-125 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
8	1. Test the common 2 fuel injector drive circuit between the ECM (pin 116 of E-111 connector) and the in-line harness connector (pins 2 and 3 of H-125 connector) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
9	1. Inspect for an intermittent and for a poor connection at the in-line harness connector (pins 2 and 3 of H-125 connector). 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the common 2 fuel injector drive circuit at the harness connector of the ECM (pin 116 of E-111 connector). 4. Inspect for an open circuit or high resistance on the common 2 fuel injector drive circuit between the ECM (pin 116 of E-111 connector) and the in-line harness connector (pins 2 and 3 of H-125 connector). 5. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 10

Step	Action	Value(s)	Yes	No
10	1. Remove the cylinder head cover. Refer to Fuel Injector Replacement in this section. 2. Inspect the fuel injector harness for loose injector terminal nuts, objects touching injector terminals. 3. Inspect for an intermittent and for a poor connection at the in-line harness connector (pins 2 and 3 of H-126 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 11
11	1. Disconnect the fuel injector harness from the cylinder number 2 and number 3 fuel injectors (E-139 and E-140 connector). 2. Measure the insulation resistance between cylinder number 2 fuel injector terminals and a known good ground. 3. Measure the insulation resistance between cylinder number 3 fuel injector terminals and a known good ground. Is the insulation resistance more than the specified value on each measurement?	1 MΩ	Go to Step 12	Go to Step 13
12	Repair or replace the injector harness. Refer to Fuel Injector Replacement in this section. Did you complete the repair or replace?	—	Go to Step 15	—
13	**Important:** Replacement injector must be programmed. Replace the appropriate fuel injector that was less insulation resistance found at Step 11. Refer to Fuel Injector Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 15	—
15	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 16
16	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1271 (Flash Code 24)

Circuit Description

The accelerator pedal position (APP) sensor is mounted on the accelerator pedal control assembly. The sensor is made up of two individual sensors within one housing. The APP sensor 1 and APP sensor 2 are potentiometer type sensors, each with the following circuits.

- 5 volts reference circuit
- Low reference circuit
- Signal circuit

The engine control module (ECM) supplies 5 volts to the APP sensor on the 5 volts reference circuits. The ECM also provides a ground on the low reference circuits. The APP sensor provides a signal to the ECM on the APP sensor signal circuits, which is relative to the position changes of the accelerator pedal angle. The APP sensor 1 signal voltage is low at rest and increases as the pedal is depressed. The APP sensor 2 signal voltage is high at rest and decreases as the pedal is depressed. If the ECM detects that the APP sensor 1 signal and the APP sensor 2 signal are out of the correlation, this DTC will set.

Condition for Running the DTC

- DTCs P1630, P1631 and P1632 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.

Condition for Setting the DTC

- The ECM detects that the APP sensor 1 and sensor 2 are more than 45% out of range of each other.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM blinks the exhaust brake indicator lamp when the diagnostic runs and fails.
- The ECM inhibits exhaust brake control.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL and exhaust brake indicator lamp when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail at next driving cycle.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P1271 (Flash Code 24)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P1277, P1278, P1282, P1283, P1631 or P1632 set?	—	Go to Applicable DTC	Go to Step 3
3	1. Turn OFF the ignition for 30 seconds. 2. Start the engine. 3. Monitor the DTC Information with the Tech 2. 4. Fully depress and release the accelerator pedal. Does the DTC fail this ignition?	—	Go to Step 4	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the accelerator pedal position (APP) sensor harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the APP sensor (pins 1, 2, 3, 4, 5 and 6 of B-280 connector). 4. Disconnect the engine control module (ECM) harness connector. 5. Inspect for an intermittent, for poor connections and corrosion on each APP sensor circuit at the harness connector of the ECM (pins 41, 42, 60, 61, 63 and 64 of J-191 connector). 6. Test for high resistance on each APP sensor circuit. 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 5
5	1. Test the APP sensor 1 and sensor 2 signal circuit between the ECM (pin 63 and 64 of J-191 connector) and the APP sensor (pin 2 and 5 of B-280 connector) for a short circuit each other. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 6
6	Replace the APP sensor. Refer to Accelerator Pedal Position (APP) Sensor Replacement in this section. (APP sensor 1 and sensor 2 is internal to APP sensor assembly) Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Fully depress and release the accelerator pedal. Does the DTC fail this ignition?	—	Go to Step 8	Go to Step 10
8	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 9	—
9	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Fully depress and release the accelerator pedal. Does the DTC fail this ignition?	—	Go to Step 2	Go to Step 10

Step	Action	Value(s)	Yes	No
10	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1277 (Flash Code 24)

Circuit Description

The accelerator pedal position (APP) sensor is mounted on the accelerator pedal control assembly. The sensor is made up of two individual sensors within one housing. The engine control module (ECM) uses the APP sensors to determine the amount of acceleration or deceleration desired by the person driving the vehicle via the fuel injector control. The APP sensor 1 has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- APP sensor 1 signal circuit

The ECM supplies 5 volts to the APP sensor 1 on the 5 volts reference circuit. The ECM also provides a ground on the low reference circuit. The APP sensor 1 provides a signal to the ECM on the APP sensor 1 signal circuit, which is relative to the position changes of the accelerator pedal angle. The ECM monitors the APP sensor 1 signal for voltages outside the normal range of the APP sensor 1. If the ECM detects an excessively low APP sensor 1 signal voltage, this DTC will set.

Condition for Running the DTC

- DTCs P1630 and P1631 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.

Condition for Setting the DTC

- The ECM detects that the APP sensor 1 signal voltage is less than 0.2 volts.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM blinks the exhaust brake indicator lamp when the diagnostic runs and fails.
- The ECM inhibits exhaust brake control.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL and exhaust brake indicator lamp when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail at next driving cycle.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- APP sensor 1 may have an intermittent open somewhere in the pedal range.

DTC P1277 (Flash Code 24)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P1631 also set?	—	Go to DTC P1631	Go to Step 3
3	1. Turn ON the ignition, with the engine OFF. 2. Observe the Accelerator Pedal Position (APP) Sensor 1 parameter with the Tech 2. Is the APP Sensor 1 parameter less than the specified value?	0.2 volts	Go to Step 4	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the APP sensor harness connector. 3. Connect a DMM between the 5 volts reference circuit of the APP sensor 1 harness (pin 4 of B-280 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 5	Go to Step 6
5	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire between the 5 volts reference circuit and the signal circuit of the APP sensor 1 harness (pins 4 and 5 of B-280 connector). 3. Turn ON the ignition, with the engine OFF. 4. Observe the APP Sensor 1 parameter with the Tech 2. Is the APP Sensor 1 parameter more than specified value?	4.5 volts	Go to Step 8	Go to Step 7
6	1. Test the 5 volts reference circuit between the engine control module (ECM) (pin 42 of J-191 connector) and the APP sensor 1 (pin 4 of B-280 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
7	1. Test the signal circuit between the ECM (pin 63 of J-191 connector) and the APP sensor 1 (pin 5 of B-280 connector) for the following conditions: • An open circuit • A short to ground • A short to the low reference circuit • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
8	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the APP sensor (pins 4 and 5 of B-280 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections on the APP sensor 1 circuits at the harness connector of the ECM (pins 42 and 63 of J-191 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11

Step	Action	Value(s)	Yes	No
10	Replace the APP sensor. Refer to Accelerator Pedal Position (APP) Sensor Replacement in this section. (APP sensor 1 is internal to APP sensor assembly) Did you complete the replacement?	—	Go to Step 12	—
11	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 12	—
12	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Fully depress and release the accelerator pedal while observing the APP Sensor 1 parameter with the Tech 2. Is the APP Sensor 1 parameter less than the specified value?	0.2 volts	Go to Step 3	Go to Step 13
13	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1278 (Flash Code 24)

Circuit Description

The accelerator pedal position (APP) sensor is mounted on the accelerator pedal control assembly. The sensor is made up of two individual sensors within one housing. The engine control module (ECM) uses the APP sensors to determine the amount of acceleration or deceleration desired by the person driving the vehicle via the fuel injector control. The APP sensor 1 has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- APP sensor 1 signal circuit

The ECM supplies 5 volts to the APP sensor 1 on the 5 volts reference circuit. The ECM also provides a ground on the low reference circuit. The APP sensor 1 provides a signal to the ECM on the APP sensor 1 signal circuit, which is relative to the position changes of the accelerator pedal angle. The ECM monitors the APP sensor 1 signal for voltages outside the normal range of the APP sensor 1. If the ECM detects an excessively high APP sensor 1 signal voltage, this DTC will set.

Condition for Running the DTC

- DTCs P1630 and P1631 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.

Condition for Setting the DTC

- The ECM detects that the APP sensor 1 signal voltage is more than 4.9 volts.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM blinks the exhaust brake indicator lamp when the diagnostic runs and fails.
- The ECM inhibits exhaust brake control.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL and exhaust brake indicator lamp when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail at next driving cycle.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- APP sensor 1 may have an intermittent open somewhere in the pedal range.

DTC P1278 (Flash Code 24)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Fully depress and release the accelerator pedal while observing the Accelerator Pedal Position (APP) Sensor 1 parameter with the Tech 2. Does the APP Sensor 1 parameter ever exceed the specified value?	4.8 volts	Go to Step 3	Go to Diagnostic Aids
3	1. Start the engine. 2. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is the DTC P1631 also set?	—	Go to Step 4	Go to Step 5

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the APP sensor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the APP Sensor 1 parameter with the Tech 2. Is the APP Sensor 1 parameter less than the specified value?	0.2 volts	Go to DTC P1631	Go to Step 7
5	1. Turn OFF the ignition. 2. Disconnect the APP sensor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the APP Sensor 1 parameter with the Tech 2. Is the APP Sensor 1 parameter less than the specified value?	0.2 volts	Go to Step 6	Go to Step 7
6	1. Turn OFF the ignition. 2. Connect a test lamp between the low reference circuit of the APP sensor 1 harness (pin 6 of B-280 connector) and battery voltage. 3. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 8
7	**Important:** The APP sensor 1 may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the engine control module (ECM) (pin 63 of J-191 connector) and the APP sensor 1 (pin 5 of B-280 connector) for the following conditions: • A short to battery or ignition voltage • A short to any 5 volts reference 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
8	1. Test the low reference circuit between the ECM (pin 41 of J-191 connector) and the APP sensor 1 (pin 6 of B-280 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10
9	1. Turn OFF the ignition. 2. Inspect for an intermittent and for a poor connection at the harness connector of the APP sensor (pin 6 of B-280 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 11

Step	Action	Value(s)	Yes	No
10	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the APP sensor 1 circuit at the harness connector of the ECM (pin 41 of J-191 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
11	Replace the APP sensor. Refer to Accelerator Pedal Position (APP) Sensor Replacement in this section. (APP sensor 1 is internal to APP sensor assembly) Did you complete the replacement?	—	Go to Step 13	—
12	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Fully depress and release the accelerator pedal while observing the APP Sensor 1 parameter with the Tech 2. Does the APP Sensor 1 parameter ever exceed the specified value?	4.8 volts	Go to Step 3	Go to Step 14
14	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1282 (Flash Code 24)

Circuit Description

The accelerator pedal position (APP) sensor is mounted on the accelerator pedal control assembly. The sensor is made up of two individual sensors within one housing. The engine control module (ECM) uses the APP sensors to determine the amount of acceleration or deceleration desired by the person driving the vehicle via the fuel injector control. The APP sensor 2 has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- APP sensor 2 signal circuit

The ECM supplies 5 volts to the APP sensor 2 on the 5 volts reference circuit. The ECM also provides a ground on the low reference circuit. The APP sensor 2 provides a signal to the ECM on the APP sensor 2 signal circuit, which is relative to the position changes of the accelerator pedal angle. The ECM monitors the APP sensor 2 signal for voltages outside the normal range of the APP sensor 2. If the ECM detects an excessively low APP sensor 2 signal voltage, this DTC will set.

Condition for Running the DTC

- DTCs P1630 and P1632 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.

Condition for Setting the DTC

- The ECM detects that the APP sensor 2 signal voltage is less than 0.2 volts.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM blinks the exhaust brake indicator lamp when the diagnostic runs and fails.
- The ECM inhibits exhaust brake control.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL and exhaust brake indicator lamp when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail at next driving cycle.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- APP sensor 2 may have an intermittent open somewhere in the pedal range.

DTC P1282 (Flash Code 24)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P1632 also set?	—	Go to DTC P1632	Go to Step 3
3	1. Turn ON the ignition, with the engine OFF. 2. Observe the Accelerator Pedal Position (APP) Sensor 2 parameter with the Tech 2. Is the APP Sensor 2 parameter less than the specified value?	0.2 volts	Go to Step 4	Go to Diagnostic Aids

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the APP sensor harness connector. 3. Connect a DMM between the 5 volts reference circuit of the APP sensor 2 harness (pin 1 of B-280 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Is the DMM voltage more than the specified value?	4.5 volts	Go to Step 5	Go to Step 6
5	1. Turn OFF the ignition. 2. Connect a 3-amp fused jumper wire between the 5 volts reference circuit and the signal circuit of the APP sensor 2 harness (pins 1 and 2 of B-280 connector). 3. Turn ON the ignition, with the engine OFF. 4. Observe the APP Sensor 2 parameter with the Tech 2. Is the APP Sensor 2 parameter more than specified value?	4.5 volts	Go to Step 8	Go to Step 7
6	1. Test the 5 volts reference circuit between the engine control module (ECM) (pin 61 of J-191 connector) and the APP sensor 2 (pin 1 of B-280 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
7	1. Test the signal circuit between the ECM (pin 64 of J-191 connector) and the APP sensor 2 (pin 2 of B-280 connector) for the following conditions: • An open circuit • A short to ground • A short to the low reference circuit • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 9
8	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the APP sensor (pins 1 and 2 of B-280 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 10
9	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for poor connections on the APP sensor 1 circuits at the harness connector of the ECM (pins 61 and 64 of J-191 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 12	Go to Step 11

Step	Action	Value(s)	Yes	No
10	Replace the APP sensor. Refer to Accelerator Pedal Position (APP) Sensor Replacement in this section. (APP sensor 2 is internal to APP sensor assembly) Did you complete the replacement?	—	Go to Step 12	—
11	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 12	—
12	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Fully depress and release the accelerator pedal while observing the APP Sensor 2 parameter with the Tech 2. Is the APP Sensor 2 parameter less than the specified value?	0.2 volts	Go to Step 3	Go to Step 13
13	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1283 (Flash Code 24)

Circuit Description

The accelerator pedal position (APP) sensor is mounted on the accelerator pedal control assembly. The sensor is made up of two individual sensors within one housing. The engine control module (ECM) uses the APP sensors to determine the amount of acceleration or deceleration desired by the person driving the vehicle via the fuel injector control. The APP sensor 2 has the following circuits.

- 5 volts reference circuit
- Low reference circuit
- APP sensor 2 signal circuit

The ECM supplies 5 volts to the APP sensor 2 on the 5 volts reference circuit. The ECM also provides a ground on the low reference circuit. The APP sensor 2 provides a signal to the ECM on the APP sensor 2 signal circuit, which is relative to the position changes of the accelerator pedal angle. The ECM monitors the APP sensor 2 signal for voltages outside the normal range of the APP sensor 2. If the ECM detects an excessively high APP sensor 2 signal voltage, this DTC will set.

Condition for Running the DTC

- DTCs P1630 and P1632 are not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.

Condition for Setting the DTC

- The ECM detects that the APP sensor 2 signal voltage is more than 4.9 volts.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM blinks the exhaust brake indicator lamp when the diagnostic runs and fails.
- The ECM inhibits exhaust brake control.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL and exhaust brake indicator lamp when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail at next driving cycle.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- APP sensor 2 may have an intermittent open somewhere in the pedal range.

DTC P1283 (Flash Code 24)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Fully depress and release the accelerator pedal while observing the Accelerator Pedal Position (APP) Sensor 2 parameter with the Tech 2. Does the APP Sensor 2 parameter ever exceed the specified value?	4.8 volts	Go to Step 3	Go to Diagnostic Aids
3	1. Start the engine. 2. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is the DTC P1632 also set?	—	Go to Step 4	Go to Step 5

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition. 2. Disconnect the APP sensor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the APP Sensor 2 parameter with the Tech 2. Is the APP Sensor 2 parameter less than the specified value?	0.2 volts	Go to DTC P1632	Go to Step 7
5	1. Turn OFF the ignition. 2. Disconnect the APP sensor harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the APP Sensor 2 parameter with the Tech 2. Is the APP Sensor 2 parameter less than the specified value?	0.2 volts	Go to Step 6	Go to Step 7
6	1. Turn OFF the ignition. 2. Connect a test lamp between the low reference circuit of the APP sensor 2 harness (pin 3 of B-280 connector) and battery voltage. 3. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 8
7	**Important:** The APP sensor 2 may be damaged if the sensor signal circuit is shorted to a voltage source. 1. Test the signal circuit between the engine control module (ECM) (pin 64 of J-191 connector) and the APP sensor 2 (pin 2 of B-280 connector) for the following conditions: • A short to battery or ignition voltage • A short to any 5 volts reference 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
8	1. Test the low reference circuit between the ECM (pin 60 of J-191 connector) and the APP sensor 2 (pin 3 of B-280 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10
9	1. Turn OFF the ignition. 2. Inspect for an intermittent and for a poor connection at the harness connector of the APP sensor (pin 3 of B-280 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 11

Step	Action	Value(s)	Yes	No
10	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the APP sensor 2 circuit at the harness connector of the ECM (pin 60 of J-191 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
11	Replace the APP sensor. Refer to Accelerator Pedal Position (APP) Sensor Replacement in this section. (APP sensor 2 is internal to APP sensor assembly) Did you complete the replacement?	—	Go to Step 13	—
12	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Fully depress and release the accelerator pedal while observing the APP Sensor 2 parameter with the Tech 2. Does the APP Sensor 2 parameter ever exceed the specified value?	4.8 volts	Go to Step 3	Go to Step 14
14	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1345 (Flash Code 16)

Circuit Description

The crankshaft position (CKP) sensor is located on top of the flywheel housing. There are 56 notches spaced 6° apart and a 30° section that is open span. This open span portion allows for the detection of cylinder #1 top dead center (TDC).
The camshaft position (CMP) sensor is installed on the cylinder head at the rear of the camshaft gear. The CMP sensor detects a total of five through holes (four holes arranged equally every 90° and one reference hole on the camshaft gear flange surface).
Detecting the open span portion from the CKP sensor and one reference hole from the CMP sensor, the engine control module (ECM) determines cylinder #1 compression top dead center (TDC) to ensure they correlate with each other. If the ECM detects both signals are out of synchronization, this DTC will set.

Condition for Running the DTC

- DTCs P0335, P0336, P0340 and P0341 are not set.
- The ignition switch is ON.
- The CKP sensor signal is detected.
- The CMP sensor signal is detected.

Condition for Setting the DTC

- The ECM detects that the CKP sensor signals and CMP sensor signals are out of synchronization during engine rotations.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail at next driving cycle.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- This DTC is caused by an incorrect mechanical timing condition, which was most likely cased by wrong installation of timing gear, flywheel or camshaft.

DTC P1345 (Flash Code 16)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. If engine does not start, crank over the engine for 10 seconds. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is the DTC P0335, P0336, P0340 or P0341 also set?	—	Go to Applicable DTC	Go to Step 3
3	Inspect the engine mechanical timing. Refer to the Engine Mechanical section. Repair as necessary. **Notice:** If the flywheel dowel pin is missing or pushed in and the flywheel is incorrectly installed, this DTC may set. Did you complete the repair?	—	Go to Step 4	—
4	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. If engine does not start, crank over the engine for 10 seconds. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 5

Step	Action	Value(s)	Yes	No
5	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1625 (Flash Code 416)

Circuit Description

The engine control module (ECM) main relay is energized to feed the battery voltage to the ECM through the relay switch side when the ECM receives an ignition voltage switch ON signal. When the ignition switch is OFF, the ECM main relay is de-energized after a certain length of time passed.
If the ECM detects the ECM main relay is turned OFF before ECM commanded OFF, this DTC will set. (ECM main relay open stuck DTC)
If the ECM detects the ECM has been ON when the relay is commanded OFF, this DTC will also set. (ECM main relay close stuck DTC)

Condition for Running the DTC

ECM main relay open stuck DTC

- DTC P1630 is not set.
- The ignition switch is ON.
- The ignition voltage is more than 18 volts.
- The ignition ON time is longer than 3 seconds.

Condition for Setting the DTC

ECM main relay open stuck DTC

- The ECM detects a low voltage condition on the ECM main relay voltage feed circuit when the relay is commanded ON for longer than 5 seconds.

ECM main relay close stuck DTC

- The ECM detects that the ECM has been ON when the relay is commanded OFF for longer than 10 seconds.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.
- Faulty or sticking ECM main relay will set this DTC.

DTC P1625 (Flash Code 416)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	Does the engine start?	—	Go to Step 4	Go to Step 8
4	1. Turn OFF the ignition. 2. Disconnect the ECM main relay. Does the engine start?	—	Go to Step 5	Go to Step 6
5	Repair the short to battery on the voltage feed circuits to the engine control module (ECM) between the ECM (pins 2 and 5 of J-191 connector) and the ECM main relay (pin 2 of X-18 connector). Did you complete the repair?	—	Go to Step 13	—

Step	Action	Value(s)	Yes	No
6	1. Turn OFF the ignition for 30 seconds. 2. Replace the ECM main relay with the glow relay or replace with a known good relay. 3. Turn ON the ignition, with the engine OFF. 4. Turn ON the ignition. 5. Monitor the DTC Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 7	Go to Step 11
7	1. Test the voltage supply circuits to the ECM main relay between the ECM (pins 21 and 40 of J-191 connector) and the ECM main relay (pin 4 of X-18 connector) for a short to battery. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
8	1. Turn OFF the ignition for 30 seconds. 2. Replace the ECM main relay with the glow relay or replace with a known good relay. 3. Start the engine. Does the engine start?	—	Go to Step 11	Go to Step 9
9	1. Turn OFF the ignition. 2. Inspect for an intermittent, for poor tightening and corrosion at the chassis ground terminal (J-9). 3. Repair the tightening or clean the corrosion as necessary. 4. Inspect the ECM (40A) slow blow fuse for open. 5. Replace the ECM (40A) slow blow fuse if open. If it continues to open, repair the short to ground on one of the circuits that is fed by the ECM (40A) slow blow fuse. Did you find and correct the condition?	—	Go to Step 13	Go to Step 10

Step	Action	Value(s)	Yes	No
10	1. Turn OFF the ignition. 2. Disconnect the ECM main relay. 3. Inspect for an intermittent and for poor connections and corrosion on each ECM main relay terminal (pins 2, 3, 4 and 5 of X-18 connector). 4. Disconnect the ECM harness connector. 5. Inspect for an intermittent, for poor connections and corrosion on the ECM main relay voltage supply and feed circuits at the harness connector of the ECM (pins 2, 5, 21 and 40 of J-191 connector). 6. Test for high resistance on each ECM main relay circuit. • Between pins 2 and 5 of J-191 and pin 2 of X-18 connector • Between pins 21 and 40 of J-191 connector and pin 4 of X-18 connector • Between ECM (40A) slow blow fuse and pin 3 of X-18 connector • Between pin 5 of X-18 connector and chassis ground (J-9) 7. Repair the connection(s) or circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
11	Replace the ECM main relay. Did you complete the replacement?	—	Go to Step 13	—
12	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected relay or harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Turn ON the ignition. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 14
14	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1630 (Flash Code 36)

Circuit Description

This diagnostic applies to internal microprocessor integrity conditions within the engine control module (ECM).

Condition for Setting the DTC

- The ECM detects a malfunction in its internal analog / digital (A/D) converter.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits accelerator control range.
- The ECM inhibits pilot injection.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

DTC P1630 (Flash Code 36)

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Step 4
3	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 4	—
4	1. Clear the DTCs with the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 5
5	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1631 (Flash Code 55)

Circuit Description

The engine control module (ECM) provides 5 volts reference voltage through the reference circuit 1 to the following sensors:

- Accelerator pedal position (APP) sensor 1
- PTO throttle sensor
- Idle up sensor

The 5 volts reference circuits are bussed together outside the ECM. Therefore, a short circuit condition on one sensor 5 volts reference circuit may affect the entire 5 volt reference circuit 1. The ECM monitors the voltage on the 5 volts reference circuit 1. If the ECM detects the voltage is excessively low or high, this DTC will set.

Condition for Running the DTC

- DTC P1630 is not set.
- The ignition switch is ON.
- The battery voltage is between 16 – 32 volts.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects that the 5 volts reference circuit 1 voltage is less than 4.5 volts.
- The ECM detects that the 5 volts reference circuit 1 voltage is more than 5.5 volts.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM blinks the exhaust brake indicator lamp when the diagnostic runs and fails.
- The ECM inhibits exhaust brake control.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- The ECM turns OFF the exhaust brake indicator lamp when the diagnostic runs and does not fail.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P1631 (Flash Code 55)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the idle up sensor harness connector. 3. Connect a DMM between the 5 volts reference circuit of the idle up sensor harness (pin 3 of B-281 connector) and a known good ground. 4. Turn ON the ignition, with engine OFF. Is the DMM voltage less than the specified value?	5.5 volts	Go to Step 4	Go to Step 7
4	Is the DMM voltage more than the specified value at Step 3?	4.5 volts	Go to Step 9	Go to Step 5

Step	Action	Value(s)	Yes	No
5	1. Keep the DMM with connected to the idle up sensor harness connector. 2. Turn OFF the ignition. 3. Disconnect the accelerator pedal position (APP) sensor harness connector. 4. Turn ON the ignition, with the engine OFF. Does the DMM voltage change to more than the specified value when the APP harness connector is disconnected?	4.5 volts	Go to Step 10	Go to Step 6
6	**Notice:** If no PTO throttle sensor is installed, skip to Step 8. 1. Keep the DMM with connected to the idle up sensor harness connector. 2. Turn OFF the ignition. 3. Disconnect the PTO throttle sensor harness connector. 4. Turn ON the ignition, with the engine OFF. Does the DMM voltage change to more than the specified value when the PTO throttle sensor harness connector is disconnected?	4.5 volts	Go to Step 11	Go to Step 8
7	1. Test the 5 volts reference circuit 1 between the engine control module (ECM) (pin 42 of J-191 connector) and the following components for a short to battery or ignition voltage: • APP sensor 1 (pin 4 of B-280 connector) • PTO throttle sensor (pin 1 of J-166 connector) • Idle up sensor (pin 3 of B-281 connector) 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
8	1. Test the 5 volts reference circuit 1 between the ECM (pin 42 of J-191 connector) and the following components for a short to ground or short to the low reference circuit: • APP sensor 1 (pin 4 of B-280 connector) • PTO throttle sensor (pin 1 of J-166 connector) • Idle up sensor (pin 3 of B-281 connector) 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 13	Go to Step 12
9	Replace the idle up sensor. Refer to Idle Up Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 13	—
10	Replace the APP sensor. Refer to Accelerator Pedal Position (APP) Sensor Replacement in this section. (APP sensor 1 is internal to APP sensor assembly) Did you complete the replacement?	—	Go to Step 13	—
11	Replace the PTO throttle sensor. Did you complete the replacement?	—	Go to Step 13	—

Step	Action	Value(s)	Yes	No
12	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 13	—
13	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 14
14	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1632 (Flash Code 55)

Circuit Description

The engine control module (ECM) provides 5 volts reference voltage through the reference circuit 2 to the following sensors:

- Accelerator pedal position (APP) sensor 2
- Barometric pressure (BARO) sensor

The ECM also provides 5 volts reference voltage through the reference circuit 5 to the following sensors:

- Fuel rail pressure (FRP) sensor
- EGR valve position sensor

The 5 volts reference circuits 2 and 5 are independent of each other outside of the ECM, but are bussed together inside the ECM. Therefore, a short circuit condition on one sensor 5 volts reference circuit may affect the entire 5 volt reference circuit 2 and 5. The ECM monitors the voltage on the 5 volts reference circuit 2 and 5. If the ECM detects the voltage is excessively low or high, this DTC and DTC P1635 will also set.

Condition for Running the DTC

- DTC P1630 is not set.
- The ignition switch is ON.
- The battery voltage is between 16 – 32 volts.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects that the 5 volts reference circuit 2 or 5 voltage is less than 4.5 volts.
- The ECM detects that the 5 volts reference circuit 2 or 5 voltage is more than 5.5 volts.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM blinks the exhaust brake indicator lamp when the diagnostic runs and fails.
- The ECM limits accelerator control range.
- The ECM inhibits pilot injection.
- The ECM inhibits EGR valve control.
- The ECM inhibits exhaust brake control.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL and exhaust brake indicator lamp when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P1632 (Flash Code 55)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the EGR valve harness connector. 3. Connect a DMM between the 5 volts reference circuit of the EGR valve position sensor harness (pin 1 of E-94 connector) and a known good ground. 4. Turn ON the ignition, with engine OFF. Is the DMM voltage less than the specified value?	5.5 volts	Go to Step 4	Go to Step 8
4	Is the DMM voltage more than the specified value at Step 3?	4.5 volts	Go to Step 10	Go to Step 5

Step	Action	Value(s)	Yes	No
5	1. Keep the DMM with connected to the EGR valve position sensor harness connector. 2. Turn OFF the ignition. 3. Disconnect the fuel rail pressure (FRP) sensor harness connector. 4. Turn ON the ignition, with the engine OFF. Does the DMM voltage change to more than the specified value when the FRP sensor harness connector is disconnected?	4.5 volts	Go to Step 11	Go to Step 6
6	1. Keep the DMM with connected to the EGR valve position sensor harness connector. 2. Turn OFF the ignition. 3. Disconnect the barometric pressure (BARO) sensor harness connector. 4. Turn ON the ignition, with the engine OFF. Does the DMM voltage change to more than the specified value when the BARO sensor harness connector is disconnected?	4.5 volts	Go to Step 13	Go to Step 7
7	1. Keep the DMM with connected to the EGR valve position sensor harness connector. 2. Turn OFF the ignition. 3. Disconnect the accelerator pedal position (APP) sensor harness connector. 4. Turn ON the ignition, with the engine OFF. Does the DMM voltage change to more than the specified value when the APP sensor harness connector is disconnected?	4.5 volts	Go to Step 12	Go to Step 9
8	1. Test the 5 volts reference circuit 2 between the engine control module (ECM) (pin 61 of J-191 connector) and the following components for a short to battery or ignition voltage: • APP sensor 2 (pin 1 of B-280 connector) • BARO sensor (pin 3 of B-422 connector) 2. Test the 5 volts reference circuit 5 between the ECM (pin 87 of E-111 connector) and the following components for a short to battery or ignition voltage: • FRP sensor (pin 3 of E-113 connector) • EGR position sensor (pin 1 of E-94 connector) 3. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14

Step	Action	Value(s)	Yes	No
9	1. Test the 5 volts reference circuit 2 between the ECM (pin 61 of J-191 connector) and the following components for a short to ground or short to the low reference circuit: • APP sensor 2 (pin 1 of B-280 connector) • BARO sensor (pin 3 of B-422 connector) 2. Test the 5 volts reference circuit 5 between the ECM (pin 87 of E-111 connector) and the following components for a short to ground or short to the low reference circuit: • FRP sensor (pin 3 of E-113 connector) • EGR position sensor (pin 1 of E-94 connector) 3. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 15	Go to Step 14
10	Replace the EGR valve. Refer to EGR Valve Replacement in this section. (EGR valve position sensor is internal to EGR valve) Did you complete the replacement?	—	Go to Step 15	—
11	Replace the FRP sensor. Refer to Fuel Rail Pressure (FRP) Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 15	—
12	Replace the APP sensor. Refer to Accelerator Pedal Position (APP) Sensor Replacement in this section. (APP sensor 2 is internal to APP sensor assembly) Did you complete the replacement?	—	Go to Step 15	—
13	Replace the BARO sensor. Refer to Barometric Pressure (BARO) Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 15	—
14	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 15	—
15	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 16
16	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1633 (Flash Code 55)

Circuit Description

The engine control module (ECM) has ability to provide 5 volts reference voltage through the reference circuit 3. But it is not used. The ECM provides 5 volts reference voltage through the reference circuit 4 to the boost pressure sensor. The 5 volts reference circuits 3 and 4 are independent of each other outside of the ECM, but are bussed together inside the ECM. Therefore, a short circuit condition on one sensor 5 volts reference circuit may affect the entire 5 volt reference circuit 3 and 4. The ECM monitors the voltage on the 5 volts reference circuit 3 and 4. If the ECM detects the voltage is excessively low or high, this DTC and DTC P1634 will also set.

Condition for Running the DTC

- DTC P1630 is not set.
- The ignition switch is ON.
- The battery voltage is between 16 – 32 volts.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects that the 5 volts reference circuit 3 or 4 voltage is less than 4.5 volts.
- The ECM detects that the 5 volts reference circuit 3 or 4 voltage is more than 5.5 volts.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits accelerator control range.
- The ECM inhibits pilot injection.
- The ECM inhibits EGR valve control.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P1633 (Flash Code 55)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to DTC P1634	Go to Diagnostic Aids

P1634 (Flash Code 55)

Circuit Description

The engine control module (ECM) provides 5 volts reference voltage through the reference circuit 4 to the boost pressure sensor. The ECM also has ability to provide 5 volts reference voltage through the reference circuit 3. But it is not used. The 5 volts reference circuits 3 and 4 are independent of each other outside of the ECM, but are bussed together inside the ECM. Therefore, a short circuit condition on one sensor 5 volts reference circuit may affect the entire 5 volt reference circuit 3 and 4. The ECM monitors the voltage on the 5 volts reference circuit 3 and 4. If the ECM detects the voltage is excessively low or high, this DTC and DTC P1633 will also set.

Condition for Running the DTC

- DTC P1630 is not set.
- The ignition switch is ON.
- The battery voltage is between 16 – 32 volts.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects that the 5 volts reference circuit 3 or 4 voltage is less than 4.5 volts.
- The ECM detects that the 5 volts reference circuit 3 or 4 voltage is more than 5.5 volts.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM limits accelerator control range.
- The ECM inhibits pilot injection.
- The ECM inhibits EGR valve control.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P1634 (Flash Code 55)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Disconnect the boost pressure sensor harness connector. 3. Connect a DMM between the 5 volts reference circuit of the boost pressure sensor harness (pin 3 of J-216 connector) and a known good ground. 4. Turn ON the ignition, with engine OFF. Is the DMM voltage less than the specified value?	5.5 volts	Go to Step 4	Go to Step 5
4	Is the DMM voltage more than the specified value at Step 3?	4.5 volts	Go to Step 7	Go to Step 6

Step	Action	Value(s)	Yes	No
5	1. Test the 5 volts reference circuit 3 between the engine control module (ECM) (pin 95 of E-111 connector) and the boost pressure sensor (pin 3 of J-216 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 8
6	1. Test the 5 volts reference circuit 3 between the ECM (pin 95 of E-111 connector) and the boost pressure sensor (pin 3 of J-216 connector) for a short to ground or short to the low reference circuit. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 9	Go to Step 8
7	Replace the boost pressure sensor. Refer to Boost Pressure Sensor Replacement in this section. Did you complete the replacement?	—	Go to Step 9	Go to Step 8
8	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 9	Go to Step 8
9	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 10
10	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1635 (Flash Code 55)

Circuit Description

The engine control module (ECM) provides 5 volts reference voltage through the reference circuit 5 to the following sensors:

- Fuel rail pressure (FRP) sensor
- EGR valve position sensor

The ECM also provides 5 volts reference voltage through the reference circuit 2 to the following sensors:

- Accelerator pedal position (APP) sensor 2
- Barometric pressure (BARO) sensor

The 5 volts reference circuits 2 and 5 are independent of each other outside of the ECM, but are bussed together inside the ECM. Therefore, a short circuit condition on one sensor 5 volts reference circuit may affect the entire 5 volt reference circuit 2 and 5. The ECM monitors the voltage on the 5 volts reference circuit 2 and 5. If the ECM detects the voltage is excessively low or high, this DTC and DTC P1632 will also set.

Condition for Running the DTC

- DTC P1630 is not set.
- The ignition switch is ON.
- The battery voltage is between 16 – 32 volts.

Condition for Setting the DTC

Either of following condition is met:

- The ECM detects that the 5 volts reference circuit 2 or 5 voltage is less than 4.5 volts.
- The ECM detects that the 5 volts reference circuit 2 or 5 voltage is more than 5.5 volts.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM blinks the exhaust brake indicator lamp when the diagnostic runs and fails.
- The ECM limits accelerator control range.
- The ECM inhibits pilot injection.
- The ECM inhibits EGR valve control.
- The ECM inhibits exhaust brake control.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL and exhaust brake indicator lamp when the key is cycled after a current DTC clears.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P1635 (Flash Code 55)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to DTC P1632	Go to Diagnostic Aids

P1681 (Flash Code 46)

Circuit Description

The engine control module (ECM) controls the exhaust brake which energizes the intake throttle solenoid valve and exhaust brake solenoid valve based on vehicle running condition. The ECM commands each solenoid valve to close each throttle valve by applying vacuum. If the ECM detects that an open circuit or short to ground on the exhaust brake solenoid valve control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The battery voltage is between 16 – 32 volts.
- The engine is running.

Condition for Setting the DTC

- The ECM detects a low voltage condition on the exhaust brake solenoid valve control circuit for longer than 10 seconds when the solenoid valve is commanded OFF.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM blinks the exhaust brake indicator lamp when the diagnostic runs and fails.
- The ECM inhibits exhaust brake control.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- The ECM turns OFF the exhaust brake indicator lamp when the diagnostic runs and does not fail.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

DTC P1681 (Flash Code 46)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Perform the Exhaust Brake Control test with the Tech 2. 5. Command the Exhaust Brake ON with the Tech 2. Does the exhaust brake solenoid valve click when commanded ON with the Tech 2 (note that intake throttle solenoid valve also click when commanded ON)?	—	Go to Step 3	Go to Step 4
3	1. Turn OFF the ignition for 30 seconds. 2. Start the engine. 3. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does the DTC fail this ignition?	—	Go to Step 13	Go to Diagnostic Aids
4	1. Turn OFF the ignition. 2. Disconnect the exhaust brake solenoid valve harness connector. 3. Connect a test lamp between the voltage feed circuit of the exhaust brake solenoid valve harness (pin 1 of J-31 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 5	Go to Step 7

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Connect a test lamp between the control circuit of the exhaust brake solenoid valve harness (pin 2 of J-31 connector) and battery voltage. 3. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 9	Go to Step 6
6	1. Keep the test lamp with connected. 2. Perform the Exhaust Brake Control test with the Tech 2. 3. Command the Exhaust Brake ON with the Tech 2. Does the test lamp illuminate?	—	Go to Step 10	Go to Step 8
7	Repair the open circuit or high resistance on the voltage feed circuit between the ECM (10A) fuse and the exhaust brake solenoid valve (pin 1 of J-31 connector). Check the ECM (10A) fuse first. Did you complete the repair?	—	Go to Step 14	—
8	1. Test the control circuit between the engine control module (ECM) (pin 15 of J-191 connector) and the exhaust brake solenoid valve (pin 2 of J-31 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 11
9	1. Test the control circuit between the ECM (pin 15 of J-191 connector) and the exhaust brake solenoid valve (pin 2 of J-31 connector) for a short to ground. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
10	1. Turn OFF the ignition. 2. Disconnect the exhaust brake solenoid valve harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the exhaust brake solenoid valve (pins 1 and 2 of J-31 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 12
11	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the exhaust brake solenoid valve control circuit at the harness connector of the ECM (pin 15 of J-191 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 14	Go to Step 13
12	Replace the exhaust brake solenoid valve. Refer to Exhaust Brake Solenoid Valve Replacement in Exhaust System section. Did you complete the replacement?	—	Go to Step 14	—

Step	Action	Value(s)	Yes	No
13	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 14	—
14	1. Reconnect all previously disconnected fuse or harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. 5. Operate the vehicle within the Conditions for Running the DTC. Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 15
15	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

P1682 (Flash Code 46)

Circuit Description

The engine control module (ECM) controls the exhaust brake which energizes the intake throttle solenoid valve and exhaust brake solenoid valve based on vehicle running condition. The ECM commands each solenoid valve to close each throttle valve by applying vacuum. If the ECM detects that a short to battery or ignition voltage on the exhaust brake solenoid valve control circuit, this DTC will set.

Condition for Running the DTC

- The ignition switch is ON.
- The battery voltage is between 16 – 32 volts.
- The engine is running.

Condition for Setting the DTC

- The ECM detects a high voltage condition on the exhaust brake solenoid valve control circuit for longer than 10 seconds when the solenoid valve is commanded ON.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM blinks the exhaust brake indicator lamp when the diagnostic runs and fails.
- The ECM inhibits exhaust brake control.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- The ECM turns OFF the exhaust brake indicator lamp when the diagnostic runs and does not fail.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Test Description

The number below refers to the step number on the diagnostic table.
3. If the exhaust brake solenoid valve control circuit between the ECM and the solenoid valve is normal, voltage level low DTC P1681 will set.

DTC P1682 (Flash Code 46)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Perform the Exhaust Brake Control test with the Tech 2. 5. Command the Exhaust Brake ON with the Tech 2. Does the exhaust brake solenoid valve click when commanded ON with the Tech 2 (note that intake throttle solenoid valve also click when commanded ON)?	—	Go to Diagnostic Aids	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the exhaust brake solenoid valve harness connector. 3. Start the engine. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Does DTC P1681 set, but not DTC P1682?	—	Go to Step 5	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Test the control circuit between the engine control module (ECM) (pin 15 of J-191 connector) and the exhaust brake solenoid valve (pin 2 of J-31 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 7	Go to Step 6
5	Replace the exhaust brake solenoid valve. Refer to Exhaust Brake Solenoid Valve Replacement in Exhaust System section. Did you complete the replacement?	—	Go to Step 7	—
6	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 7	—
7	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Lift the driving wheels or drive the vehicle. 5. Let the vehicle run so that the exhaust brake may operate enough time (longer than 3 seconds). Did the DTC fail this ignition?	—	Go to Step 2	Go to Step 8
8	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

U2104, U2106 (Flash Code 84, 85)

Circuit Description

The engine control module (ECM), the transmission control module (TCM), the electric hydraulic control module (EHCU) (ABS module) and the data recording module (DRM) communicate control and diagnostic information via a controller area network (CAN) communication bus. The ECM monitors CAN operational status by expecting a constant flow of messages from the TCM, EHCU and DRM. If the ECM fails to receive an expected message from the TCM, EHCU and DRM, DTC U2104 or U2106 will set depending on what communication is lost.

Condition for Running the DTC

- The ignition switch is ON.

Condition for Setting the DTC

U2104

- The ECM detects that the CAN Bus OFF status.

U2106

- The ECM detects that the CAN Bus messages from the TCM are not being received.

Action Taken When the DTC Sets

- The ECM illuminates the malfunction indicator lamp (MIL) when the diagnostic runs and fails.
- The ECM blinks the exhaust brake indicator lamp when the diagnostic runs and fails.
- The ECM inhibits exhaust brake control.

Condition for Clearing the MIL / DTC

- The ECM turns OFF the MIL when the key is cycled after a current DTC clears.
- The ECM turns OFF the exhaust brake indicator lamp when the diagnostic runs and does not fail.
- A current DTC clears when the diagnostic runs and does not fail.
- A history DTC clears after 20 consecutive driving cycles without a fault. Or clear with the Tech 2 or accelerator pedal operation.

Diagnostic Aid

- If an intermittent condition is suspected, refer to Intermittent Conditions in this section.

Notice:

- Diagnostic charts are different depending on the specification of the vehicle.

DTC U2104, U2106 (Flash Code 84, 85)

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Chart for without Smoother and ABS

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Monitor the engine control module (ECM) Diagnostic Trouble Code (DTC) Information with the Tech 2. 4. Start the engine. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Turn OFF the ignition. 2. Measure the resistance across the controller area network (CAN) Low and High circuits by back probing the resistor 1 (pins 1 and 2 of B-387 connector) (resistor 1 is located near the driver's side dash panel. It is blue connector). Is the resistance within the specified value (parallel resistance of the 120 Ω resister 1 and the 120 Ω resistor 2 should be 60 Ω)?	50 – 70 Ω	Go to Step 9	Go to Step 4
4	Is the resistance less than the specified value at Step 3?	—	Go to Step 5	Go to Step 7

Step	Action	Value(s)	Yes	No
5	1. Keep the DMM with connected. 2. Disconnect the engine control module (ECM) harness connectors. Is the resistance within the specified value?	50 – 70 Ω	Go to Step 23	Go to Step 6
6	1. Keep the DMM with connected. 2. Disconnect the data recording module (DRM) harness connector (DRM is located behind the glove box). Is the resistance within the specified value?	50 – 70 Ω	Go to Step 22	Go to Step 16
7	1. Disconnect the resistor 1 harness connector. 2. Measure the resistance of the resistor 1. Is the resistance within the specified value?	110 – 130 Ω	Go to Step 8	Go to Step 20
8	1. Disconnect the resister 2 harness connector (resistor 2 is located behind the radio and above the heater unit. It is blue connector). 2. Measure the resistance of the resistor 2. Is the resistance within the specified value?	110 – 130 Ω	Go to Step 17	Go to Step 21
9	1. Disconnect the resistor 1 and resistor 2 harness connector. 2. Turn ON the ignition, with the engine OFF. 3. Connect a DMM between the CAN Low circuit (pin 1 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. 4. Connect a DMM between the CAN High circuit (pin 2 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. Are both voltage readings within the specified value?	1.3 – 3.7 volts	Go to Step 10	Go to Step 12
10	1. Turn OFF the ignition. 2. Disconnect the ECM harness connectors. 3. Turn ON the ignition, with the engine OFF. 4. Connect a DMM between the CAN Low circuit (pin 1 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. 5. Connect a DMM between the CAN High circuit (pin 2 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. Are both voltage readings within the specified value?	1.3 – 3.7 volts	Go to Step 11	Go to Step 14

Step	Action	Value(s)	Yes	No
11	1. Turn OFF the ignition. 2. Reconnect the ECM harness connectors. 3. Disconnect the DRM harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Connect a DMM between the CAN Low circuit (pin 1 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. 6. Connect a DMM between the CAN High circuit (pin 2 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. Are both voltage readings within the specified value?	1.3 – 3.7 volts	Go to Diagnostic Aids	Go to Step 15
12	1. Turn OFF the ignition. 2. Disconnect the ECM harness connectors. 3. Disconnect the DRM harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Test the CAN Low and CAN High circuits among the resistor 1, resistor 2, ECM and DRM for a short to ground and short to voltage. Did you find and correct the condition?	—	Go to Step 24	Go to Step 13
13	1. Turn OFF the ignition. 2. Reconnect the ECM harness connectors. 3. Turn ON the ignition, with the engine OFF. 4. Connect a DMM between the CAN Low circuit (pin 1 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. 5. Connect a DMM between the CAN High circuit (pin 2 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. Are both voltage readings within the specified value?	1.3 – 3.7 volts	Go to Step 22	Go to Step 23
14	1. Test for an open or high resistance in the CAN Low or High circuit (which ever voltage reading did not read between 1.3 – 3.7 volts in Step 10) between the DRM and joint connection. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 24	Go to Step 18
15	1. Test for an open or high resistance in the CAN Low or High circuit (which ever voltage reading did not read between 1.3 – 3.7 volts in Step 11) between the ECM and joint connection. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 24	Go to Step 19

Step	Action	Value(s)	Yes	No
16	Repair the short circuit each other across the CAN Low and High circuits among the resistor 1, resistor 2, ECM and DRM. Did you complete the repair?	—	Go to Step 24	—
17	1. Repair the open circuit or high resistance on the CAN Low and High circuits between the resistor 1 (pins 1 and 2 of B-387 connector) and the resistor 2 (pins 1 and 2 of B-431 connector). 2. Inspect for an intermittent, for poor connections and corrosion on the CAN Low and High circuits at the harness connector of the each resistor. Did you complete the repair?	—	Go to Step 24	—
18	1. Inspect for an intermittent, for poor connections and corrosion on the CAN Low and High circuits at the harness connector of the DRM (pins 2 and 8 of B-429 connector). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 24	Go to Step 22
19	1. Inspect for an intermittent, for poor connections and corrosion on the CAN Low and High circuits at the harness connector of the ECM (pins 18 and 37 of J-191 connector). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 24	Go to Step 23
20	Replace the resistor 1. Did you complete the replacement?	—	Go to Step 24	—
21	Replace the resistor 2. Did you complete the replacement?	—	Go to Step 24	—
22	Replace the DRM. Refer to Data Recording Module (DRM) Replacement. Did you complete the replacement?	—	Go to Step 24	—
23	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 24	—
24	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 25
25	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

Chart for with Soother but without ABS

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Monitor the engine control module (ECM) Diagnostic Trouble Code (DTC) Information with the Tech 2. 4. Start the engine. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	Attempt to communicate with the transmission control module (TCM) via the Transmission Data table. Does the Tech 2 communicate with the TCM?	—	Go to Step 4	Go to Diagnostic System Check – Transmission Controls
4	1. Turn OFF the ignition. 2. Measure the resistance across the controller area network (CAN) Low and High circuits by back probing the resistor 1 (pins 1 and 2 of B-387 connector) (resistor 1 is located near the driver's side dash panel. It is blue connector). Is the resistance within the specified value (parallel resistance of the 120 Ω resister 1 and the 120 Ω resistor 2 should be 60 Ω)?	50 – 70 Ω	Go to Step 11	Go to Step 5
5	Is the resistance less than the specified value at Step 4?	—	Go to Step 6	Go to Step 9
6	1. Keep the DMM with connected. 2. Disconnect the TCM harness connectors. Is the resistance within the specified value?	50 – 70 Ω	Go to Step 29	Go to Step 7
7	1. Keep the DMM with connected. 2. Disconnect the engine control module (ECM) harness connectors. Is the resistance within the specified value?	50 – 70 Ω	Go to Step 30	Go to Step 8
8	1. Keep the DMM with connected. 2. Disconnect the data recording module (DRM) harness connector (DRM is located behind the glove box). Is the resistance within the specified value?	50 – 70 Ω	Go to Step 28	Go to Step 21
9	1. Disconnect the resistor 1 harness connector. 2. Measure the resistance of the resistor 1. Is the resistance within the specified value?	110 – 130 Ω	Go to Step 10	Go to Step 26
10	1. Disconnect the resister 2 harness connector (resistor 2 is located behind the radio and above the heater unit. It is blue connector). 2. Measure the resistance of the resistor 2. Is the resistance within the specified value?	110 – 130 Ω	Go to Step 22	Go to Step 27

Step	Action	Value(s)	Yes	No
11	1. Disconnect the resistor 1 and resistor 2 harness connector. 2. Turn ON the ignition, with the engine OFF. 3. Connect a DMM between the CAN Low circuit (pin 1 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. 4. Connect a DMM between the CAN High circuit (pin 2 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. Are both voltage readings within the specified value?	1.3 – 3.7 volts	Go to Step 12	Go to Step 15
12	1. Turn OFF the ignition. 2. Disconnect the ECM harness connectors. 3. Disconnect the TCM harness connectors. 4. Turn ON the ignition, with the engine OFF. 5. Connect a DMM between the CAN Low circuit (pin 1 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. 6. Connect a DMM between the CAN High circuit (pin 2 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. Are both voltage readings within the specified value?	1.3 – 3.7 volts	Go to Step 13	Go to Step 18
13	1. Turn OFF the ignition. 2. Reconnect the TCM harness connectors. 3. Disconnect the DRM harness connectors. 4. Turn ON the ignition, with the engine OFF. 5. Connect a DMM between the CAN Low circuit (pin 1 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. 6. Connect a DMM between the CAN High circuit (pin 2 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. Are both voltage readings within the specified value?	1.3 – 3.7 volts	Go to Step 14	Go to Step 19
14	1. Turn OFF the ignition. 2. Reconnect the ECM harness connectors. 3. Disconnect the TCM harness connectors. 4. Turn ON the ignition, with the engine OFF. 5. Connect a DMM between the CAN Low circuit (pin 1 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. 6. Connect a DMM between the CAN High circuit (pin 2 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. Are both voltage readings within the specified value?	1.3 – 3.7 volts	Go to Diagnostic Aids	Go to Step 20

Step	Action	Value(s)	Yes	No
15	1. Turn OFF the ignition. 2. Disconnect the ECM harness connectors. 3. Disconnect the TCM harness connectors. 4. Disconnect the DRM harness connector. 5. Turn ON the ignition, with the engine OFF. 6. Test the CAN Low and CAN High circuits among the resistor 1, resistor 2, ECM, TCM and DRM for a short to ground and short to voltage. Did you find and correct the condition?	—	Go to Step 31	Go to Step 16
16	1. Turn OFF the ignition. 2. Reconnect the ECM harness connectors. 3. Turn ON the ignition, with the engine OFF. 4. Connect a DMM between the CAN Low circuit (pin 1 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. 5. Connect a DMM between the CAN High circuit (pin 2 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. Are both voltage readings within the specified value?	1.3 – 3.7 volts	Go to Step 17	Go to Step 30
17	1. Turn OFF the ignition. 2. Reconnect the TCM harness connectors. 3. Turn ON the ignition, with the engine OFF. 4. Connect a DMM between the CAN Low circuit (pin 1 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. 5. Connect a DMM between the CAN High circuit (pin 2 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. Are both voltage readings within the specified value?	1.3 – 3.7 volts	Go to Step 28	Go to Step 29
18	1. Test for an open or high resistance in the CAN Low or High circuit (which ever voltage reading did not read between 1.3 – 3.7 volts in Step 12) between the DRM and joint connection. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 31	Go to Step 23
19	1. Test for an open or high resistance in the CAN Low or High circuit (which ever voltage reading did not read between 1.3 – 3.7 volts in Step 13) between the TCM and joint connection. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 31	Go to Step 24

Step	Action	Value(s)	Yes	No
20	1. Test for an open or high resistance in the CAN Low or High circuit (which ever voltage reading did not read between 1.3 – 3.7 volts in Step 14) between the ECM and joint connection. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 31	Go to Step 25
21	Repair the short circuit each other across the CAN Low and High circuits among the resistor 1, resistor 2, ECM, TCM and DRM. Did you complete the repair?	—	Go to Step 31	—
22	1. Repair the open circuit or high resistance on the CAN Low and High circuits between the resistor 1 (pins 1 and 2 of B-387 connector) and the resistor 2 (pins 1 and 2 of B-431 connector). 2. Inspect for an intermittent, for poor connections and corrosion on the CAN Low and High circuits at the harness connector of the each resistor. Did you complete the repair?	—	Go to Step 31	—
23	1. Inspect for an intermittent, for poor connections and corrosion on the CAN Low and High circuits at the harness connector of the DRM (pins 2 and 8 of B-429 connector). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 31	Go to Step 28
24	1. Inspect for an intermittent, for poor connections and corrosion on the CAN Low and High circuits at the harness connector of the TCM (pins 2 and 3 of B-427 connector). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 31	Go to Step 29
25	1. Inspect for an intermittent, for poor connections and corrosion on the CAN Low and High circuits at the harness connector of the ECM (pins 18 and 37 of J-191 connector). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 31	Go to Step 30
26	Replace the resistor 1. Did you complete the replacement?	—	Go to Step 31	—
27	Replace the resistor 2. Did you complete the replacement?	—	Go to Step 31	—
28	Replace the DRM. Refer to Data Recording Module (DRM) Replacement. Did you complete the replacement?	—	Go to Step 31	—
29	Replace the TCM. Refer to Transmission Control Module (TCM) Replacement in the transmission section. Did you complete the replacement?	—	Go to Step 31	—

Step	Action	Value(s)	Yes	No
30	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 31	—
31	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 32
32	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

Chart for with ABS but without Smoother

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Monitor the engine control module (ECM) Diagnostic Trouble Code (DTC) Information with the Tech 2. 4. Start the engine. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	Attempt to communicate with the electrical hydraulic control unit (EHCU) (ABS module) via the ABS Data table. Does the Tech 2 communicate with the EHCU?	—	Go to Step 4	Go to Diagnostic System Check – Anti-lock Brake System Controls
4	1. Turn OFF the ignition. 2. Measure the resistance across the controller area network (CAN) Low and High circuits by back probing the resistor 1 (pins 1 and 2 of B-387 connector) (resistor 1 is located near the driver's side dash panel. It is blue connector). Is the resistance within the specified value (parallel resistance of the 120 Ω resister 1 and the 120 Ω resistor 2 should be 60 Ω)?	50 – 70 Ω	Go to Step 12	Go to Step 5
5	Is the resistance less than the specified value at Step 4?	—	Go to Step 6	Go to Step 10
6	1. Keep the DMM with connected. 2. Disconnect the EHCU harness connector. Is the resistance within the specified value?	110 – 130 Ω	Go to Step 7	Go to Step 20
7	Measure the resistance across the CAN Low and High circuits by back probing the resistor 2 (pins 1 and 2 of B-431 connector) (resistor 2 is located behind the radio and above the heater unit. It is blue connector). Is the resistance within the specified value?	110 – 130 Ω	Go to Step 29	Go to Step 8

Step	Action	Value(s)	Yes	No
8	1. Keep the DMM with connected. 2. Disconnect the engine control module (ECM) harness connectors. Is the resistance within the specified value?	110 – 130 Ω	Go to Step 30	Go to Step 9
9	1. Keep the DMM with connected. 2. Disconnect the data recording module (DRM) harness connector (DRM is located behind the glove box). Is the resistance within the specified value?	110 – 130 Ω	Go to Step 28	Go to Step 21
10	1. Disconnect the resistor 1 harness connector. 2. Measure the resistance of the resistor 1. Is the resistance within the specified value?	110 – 130 Ω	Go to Step 11	Go to Step 26
11	1. Disconnect the resister 2 harness connector (resistor 2 is located behind the radio and above the heater unit. It is blue connector). 2. Measure the resistance of the resistor 2. Is the resistance within the specified value?	110 – 130 Ω	Go to Step 22	Go to Step 27
12	1. Disconnect the resistor 1 and resistor 2 harness connector. 2. Turn ON the ignition, with the engine OFF. 3. Connect a DMM between the CAN Low circuit (pin 1 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. 4. Connect a DMM between the CAN High circuit (pin 2 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. Are both voltage readings within the specified value?	1.3 – 3.7 volts	Go to Step 13	Go to Step 15
13	1. Turn OFF the ignition. 2. Disconnect the ECM harness connectors. 3. Disconnect the EHCU harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Connect a DMM between the CAN Low circuit (pin 1 of B-431 connector) and a known good ground at the resistor 2 harness connector. Record the voltage reading. 6. Connect a DMM between the CAN High circuit (pin 2 of B-431 connector) and a known good ground at the resistor 2 harness connector. Record the voltage reading. Are both voltage readings within the specified value?	1.3 – 3.7 volts	Go to Step 14	Go to Step 18

Step	Action	Value(s)	Yes	No
14	1. Turn OFF the ignition. 2. Reconnect the ECM harness connectors. 3. Disconnect the DRM harness connectors. 4. Turn ON the ignition, with the engine OFF. 5. Connect a DMM between the CAN Low circuit (pin 1 of B-431 connector) and a known good ground at the resistor 2 harness connector. Record the voltage reading. 6. Connect a DMM between the CAN High circuit (pin 2 of B-431 connector) and a known good ground at the resistor 2 harness connector. Record the voltage reading. Are both voltage readings within the specified value?	1.3 – 3.7 volts	Go to Diagnostic Aids	Go to Step 19
15	1. Turn OFF the ignition. 2. Disconnect the ECM harness connectors. 3. Disconnect the EHCU harness connector. 4. Disconnect the DRM harness connector. 5. Turn ON the ignition, with the engine OFF. 6. Test the CAN Low and CAN High circuits among the resistor 1, resistor 2, ECM, EHCU and DRM for a short to ground and short to voltage. Did you find and correct the condition?	—	Go to Step 31	Go to Step 16
16	1. Turn OFF the ignition. 2. Keep the ECM and DRM harness connectors with disconnect. 3. Reconnect the EHCU harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Connect a DMM between the CAN Low circuit (pin 1 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. 6. Connect a DMM between the CAN High circuit (pin 2 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. Are both voltage readings within the specified value?	1.3 – 3.7 volts	Go to Step 17	Go to Step 29
17	1. Turn OFF the ignition. 2. Reconnect the ECM harness connectors. 3. Turn ON the ignition, with the engine OFF. 4. Connect a DMM between the CAN Low circuit (pin 1 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. 5. Connect a DMM between the CAN High circuit (pin 2 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. Are both voltage readings within the specified value?	1.3 – 3.7 volts	Go to Step 28	Go to Step 30

Step	Action	Value(s)	Yes	No
18	1. Test for an open or high resistance in the CAN Low or High circuit (which ever voltage reading did not read between 1.3 – 3.7 volts in Step 13) between the DRM and joint connection. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 31	Go to Step 23
19	1. Test for an open or high resistance in the CAN Low or High circuit (which ever voltage reading did not read between 1.3 – 3.7 volts in Step 14) between the ECM and joint connection. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 31	Go to Step 25
20	Repair the short circuit each other across the CAN Low and High circuits between the resistor 1 and EHCU. Did you complete the repair?	—	Go to Step 31	—
21	Repair the short circuit each other across the CAN Low and High circuits among the resistor 2, ECM, DRM and EHCU. Did you complete the repair?	—	Go to Step 31	—
22	1. Test the CAN Low and High circuits between the resistor 1 (pins 1 and 2 of B-387 connector) and the EHCU (pins 14 and 15 of J-177 connector) for an open circuit or high resistance. 2. Test the CAN Low and High circuits between the resistor 2 (pins 1 and 2 of B-431 connector) and the EHCU (pins 26 and 27 of J-177 connector) for an open circuit or high resistance. 3. Inspect for an intermittent, for poor connections and corrosion on the CAN Low and High circuits at the harness connector of the each resistor. 4. Repair the circuit(s) or connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 31	Go to Step 24
23	1. Inspect for an intermittent, for poor connections and corrosion on the CAN Low and High circuits at the harness connector of the DRM (pins 2 and 8 of B-429 connector). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 31	Go to Step 28
24	1. Inspect for an intermittent, for poor connections and corrosion on the CAN Low and High circuits at the harness connector of the EHCU (pins 14, 15, 26 and 27 of J-177 connector). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 31	Go to Step 29

Step	Action	Value(s)	Yes	No
25	1. Inspect for an intermittent, for poor connections and corrosion on the CAN Low and High circuits at the harness connector of the ECM (pins 18 and 37 of J-191 connector). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 31	Go to Step 30
26	Replace the resistor 1. Did you complete the replacement?	—	Go to Step 31	—
27	Replace the resistor 2. Did you complete the replacement?	—	Go to Step 31	—
28	Replace the DRM. Refer to Data Recording Module (DRM) Replacement. Did you complete the replacement?	—	Go to Step 31	—
29	Replace the EHCU. Refer to Electric Hydraulic Control Unit (EHCU Replacement in the Anti-lock Brake section). Did you complete the replacement?	—	Go to Step 31	—
30	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 31	—
31	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 32
32	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

Chart for with Smoother and ABS

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Monitor the engine control module (ECM) Diagnostic Trouble Code (DTC) Information with the Tech 2. 4. Start the engine. Does the DTC fail this ignition?	—	Go to Step 3	Go to Diagnostic Aids
3	Attempt to communicate with the transmission control module (TCM) via the Transmission Data table. Does the Tech 2 communicate with the TCM?	—	Go to Step 4	Go to Diagnostic System Check – Transmission Controls

Step	Action	Value(s)	Yes	No
4	Attempt to communicate with the electrical hydraulic control unit (EHCU) (ABS module) via the ABS Data table. Does the Tech 2 communicate with the EHCU?	—	Go to Step 5	Go to Diagnostic System Check – Anti-lock Brake System Controls
5	1. Turn OFF the ignition. 2. Measure the resistance across the controller area network (CAN) Low and High circuits by back probing the resistor 1 (pins 1 and 2 of B-387 connector) (resistor 1 is located near the driver's side dash panel. It is blue connector). Is the resistance within the specified value (parallel resistance of the 120 Ω resister 1 and the 120 Ω resistor 2 should be 60 Ω)?	50 – 70 Ω	Go to Step 14	Go to Step 6
6	Is the resistance less than the specified value at Step 5?	—	Go to Step 7	Go to Step 12
7	1. Keep the DMM with connected. 2. Disconnect the EHCU harness connector. Is the resistance within the specified value?	110 – 130 Ω	Go to Step 9	Go to Step 8
8	1. Keep the DMM with connected. 2. Disconnect the TCM harness connectors. Is the resistance within the specified value?	110 – 130 Ω	Go to Step 35	Go to Step 25
9	Measure the resistance across the CAN Low and High circuits by back probing the resistor 2 (pins 1 and 2 of B-431 connector) (resistor 2 is located behind the radio and above the heater unit. It is blue connector). Is the resistance within the specified value?	110 – 130 Ω	Go to Step 36	Go to Step 10
10	1. Keep the DMM with connected. 2. Disconnect the engine control module (ECM) harness connectors. Is the resistance within the specified value?	110 – 130 Ω	Go to Step 37	Go to Step 11
11	1. Keep the DMM with connected. 2. Disconnect the data recording module (DRM) harness connector (DRM is located behind the glove box). Is the resistance within the specified value?	110 – 130 Ω	Go to Step 34	Go to Step 26
12	1. Disconnect the resistor 1 harness connector. 2. Measure the resistance of the resistor 1. Is the resistance within the specified value?	110 – 130 Ω	Go to Step 13	Go to Step 32
13	1. Disconnect the resister 2 harness connector (resistor 2 is located behind the radio and above the heater unit. It is blue connector). 2. Measure the resistance of the resistor 2. Is the resistance within the specified value?	110 – 130 Ω	Go to Step 27	Go to Step 33

Step	Action	Value(s)	Yes	No
14	1. Disconnect the resistor 1 and resistor 2 harness connector. 2. Turn ON the ignition, with the engine OFF. 3. Connect a DMM between the CAN Low circuit (pin 1 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. 4. Connect a DMM between the CAN High circuit (pin 2 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. Are both voltage readings within the specified value?	1.3 – 3.7 volts	Go to Step 15	Go to Step 18
15	1. Turn OFF the ignition. 2. Disconnect the ECM harness connectors. 3. Disconnect the EHCU harness connectors. 4. Disconnect the DRM harness connector. 5. Turn ON the ignition, with the engine OFF. 6. Connect a DMM between the CAN Low circuit (pin 1 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. 7. Connect a DMM between the CAN High circuit (pin 2 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. Are both voltage readings within the specified value?	1.3 – 3.7 volts	Go to Step 16	Go to Step 23
16	1. Turn OFF the ignition. 2. Reconnect the DRM harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Connect a DMM between the CAN Low circuit (pin 1 of B-431 connector) and a known good ground at the resistor 2 harness connector. Record the voltage reading. 5. Connect a DMM between the CAN High circuit (pin 2 of B-431 connector) and a known good ground at the resistor 2 harness connector. Record the voltage reading. Are both voltage readings within the specified value?	1.3 – 3.7 volts	Go to Step 17	Go to Step 22
17	1. Turn OFF the ignition. 2. Reconnect the ECM harness connectors. 3. Disconnect the DRM harness connectors. 4. Turn ON the ignition, with the engine OFF. 5. Connect a DMM between the CAN Low circuit (pin 1 of B-431 connector) and a known good ground at the resistor 2 harness connector. Record the voltage reading. 6. Connect a DMM between the CAN High circuit (pin 2 of B-431 connector) and a known good ground at the resistor 2 harness connector. Record the voltage reading. Are both voltage readings within the specified value?	1.3 – 3.7 volts	Go to Diagnostic Aids	Go to Step 24

Step	Action	Value(s)	Yes	No
18	1. Turn OFF the ignition. 2. Disconnect the ECM harness connectors. 3. Disconnect the TCM harness connectors. 4. Disconnect the EHCU harness connector. 5. Disconnect the DRM harness connector. 6. Turn ON the ignition, with the engine OFF. 7. Test the CAN Low and CAN High circuits among the resistor 1, resistor 2, ECM, EHCU and DRM for a short to ground and short to voltage. Did you find and correct the condition?	—	Go to Step 38	Go to Step 19
19	1. Turn OFF the ignition. 2. Keep the ECM, TCM and DRM harness connectors with disconnect. 3. Reconnect the EHCU harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Connect a DMM between the CAN Low circuit (pin 1 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. 6. Connect a DMM between the CAN High circuit (pin 2 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. Are both voltage readings within the specified value?	1.3 – 3.7 volts	Go to Step 20	Go to Step 36
20	1. Turn OFF the ignition. 2. Reconnect the TCM harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Connect a DMM between the CAN Low circuit (pin 1 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. 5. Connect a DMM between the CAN High circuit (pin 2 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. Are both voltage readings within the specified value?	1.3 – 3.7 volts	Go to Step 21	Go to Step 35
21	1. Turn OFF the ignition. 2. Reconnect the ECM harness connectors. 3. Turn ON the ignition, with the engine OFF. 4. Connect a DMM between the CAN Low circuit (pin 1 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. 5. Connect a DMM between the CAN High circuit (pin 2 of B-387 connector) and a known good ground at the resistor 1 harness connector. Record the voltage reading. Are both voltage readings within the specified value?	1.3 – 3.7 volts	Go to Step 34	Go to Step 37

Step	Action	Value(s)	Yes	No
22	1. Test for an open or high resistance in the CAN Low or High circuit (which ever voltage reading did not read between 1.3 – 3.7 volts in Step 16) between the DRM and joint connection. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 38	Go to Step 28
23	1. Test for an open or high resistance in the CAN Low or High circuit (which ever voltage reading did not read between 1.3 – 3.7 volts in Step 15) between the TCM and joint connection. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 38	Go to Step 29
24	1. Test for an open or high resistance in the CAN Low or High circuit (which ever voltage reading did not read between 1.3 – 3.7 volts in Step 17) between the ECM and joint connection. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 38	Go to Step 31
25	Repair the short circuit each other across the CAN Low and High circuits among the resistor 1, TCM and EHCU. Did you complete the repair?	—	Go to Step 38	—
26	Repair the short circuit each other across the CAN Low and High circuits among the resistor 2, ECM, DRM and EHCU. Did you complete the repair?	—	Go to Step 38	—
27	1. Test the CAN Low and High circuits between the resistor 1 (pins 1 and 2 of B-387 connector) and the EHCU (pins 14 and 15 of J-177 connector) for an open circuit or high resistance. 2. Test the CAN Low and High circuits between the resistor 2 (pins 1 and 2 of B-431 connector) and the EHCU (pins 26 and 27 of J-177 connector) for an open circuit or high resistance. 3. Inspect for an intermittent, for poor connections and corrosion on the CAN Low and High circuits at the harness connector of the each resistor. 4. Repair the circuit(s) or connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 38	Go to Step 30
28	1. Inspect for an intermittent, for poor connections and corrosion on the CAN Low and High circuits at the harness connector of the DRM (pins 2 and 8 of B-429 connector). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 38	Go to Step 34

Step	Action	Value(s)	Yes	No
29	1. Inspect for an intermittent, for poor connections and corrosion on the CAN Low and High circuits at the harness connector of the TCM (pins 2 and 3 of B-427 connector). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 38	Go to Step 35
30	1. Inspect for an intermittent, for poor connections and corrosion on the CAN Low and High circuits at the harness connector of the EHCU (pins 14, 15, 26 and 27 of J-177 connector). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 38	Go to Step 36
31	1. Inspect for an intermittent, for poor connections and corrosion on the CAN Low and High circuits at the harness connector of the ECM (pins 18 and 37 of J-191 connector). 2. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 38	Go to Step 37
32	Replace the resistor 1. Did you complete the replacement?	—	Go to Step 38	—
33	Replace the resistor 2. Did you complete the replacement?	—	Go to Step 38	—
34	Replace the DRM. Refer to Data Recording Module (DRM) Replacement. Did you complete the replacement?	—	Go to Step 38	—
35	Replace the TCM. Refer to Transmission Control Module (TCM) Replacement in the transmission section. Did you complete the replacement?	—	Go to Step 38	—
36	Replace the EHCU. Refer to Electric Hydraulic Control Unit (EHCU Replacement in the Anti-lock Brake section). Did you complete the replacement?	—	Go to Step 38	—
37	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 38	—
38	1. Reconnect all previously disconnected harness connector(s). 2. Clear the DTCs with the Tech 2. 3. Turn OFF the ignition for 30 seconds. 4. Start the engine. Did the DTC fail this ignition?	—	Go to Step 3	Go to Step 39
39	Observe the DTC Information with the Tech 2. Are there any DTCs that you have not diagnosed?	—	Go to Diagnostic Trouble Code (DTC) List	System OK

EGR Control System Check

Description

The engine control module (ECM) controls the EGR valve opening based on the barometric pressure, engine speed, engine coolant temperature and fuel injection quantity. The ECM controls the EGR valve by controlling the EGR motor. The EGR valve position is detected by the EGR valve position sensor, and relayed to ECM.

Condition for Running the EGR Control

- The engine coolant temperature is between 65°C (149°F) and 95°C (198°F).
- The barometric pressure (BARO) is more than 90 kPa (13 psi).

EGR Control System Check

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Are any DTCs set in which the “Action Taken When the DTC Sets” under that particular code states, “The ECM inhibits EGR valve control”?	—	Refer to Applicable DTC	Go to Step 3
3	1. Turn OFF the ignition. 2. Inspect for the following conditions: • An EGR valve gasket that is missing or damaged. • EGR gas leakage any of the EGR passages between the exhaust manifold and intake manifold. • Restricted or collapsed EGR passage between the exhaust manifold and the EGR valve. • Any type of restriction in the exhaust system. • Restrict air cleaner element, restrict or collapsed air tubing between the air cleaner and the intake manifold. • Skewed engine coolant temperature (ECT) sensor. Refer to Temperature vs Resistance table to test the ECT sensor at various temperature levels to evaluate the possibility of a skewed sensor. • Skewed barometric pressure (BARO) sensor. Determine the outside barometric pressure from your location specified in the altitude vs barometric pressure table. Refer to Altitude vs Barometric Pressure. • Any water intrusion in the induction system. • Air leaking around any of the air induction tubing between the air cleaner and the intake manifold. 3. Repair the condition as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Turn OFF the ignition for 30 seconds. 2. Start the engine and warm up (allow engine coolant temperature to reach at least 70°C [158°F]). 3. Observe the EGR Position Variance parameter with the Tech 2. Does the EGR Position Variance parameter within the specified value?	± 5%	Go to Step 5	Go to Step 6
5	1. Perform the EGR Control test with the Tech 2 several times. 2. Command the Desired EGR Position “Increase” and “Decrease” with the Tech 2 while observing the EGR Position Variance. Does the EGR Position Variance parameter follow within the specified value?	± 5%	System OK	Go to Step 6
6	1. Turn OFF the ignition. 2. Remove the EGR valve assembly from the engine. Refer to EGR Valve Replacement in this section. 3. Inspect the following for possible causes of EGR valve sticking. • Restricted EGR valve by foreign materials • Excessive deposits at valve Did you find and correct the condition?	—	Go to Step 10	Go to Step 7
7	1. Turn OFF the ignition. 2. Disconnect the EGR valve harness connector. 3. Inspect for an intermittent, for poor connections and corrosion at the harness connector of the EGR valve (pins 1, 2, 3, 4 and 6 of E-94 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 8
8	1. Turn OFF the ignition. 2. Disconnect the engine control module (ECM) harness connector. 3. Inspect for an intermittent, for poor connections and corrosion on the EGR valve circuits at the harness connector of the ECM (pins 86, 87, 101, 103 and 111 of E-111 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 10	Go to Step 9
9	Replace the EGR valve. Refer to EGR Valve Replacement in this section. Did you complete the replacement?	—	Go to Step 10	—
10	Reconnect all previously disconnected components or harness connector(s). Is the action complete?	—	Go to Step 2	—

Glow Control System Check

Description

The glow control system consists of the engine control module (ECM), the glow relay, the glow indicator lamp and glow plugs. The glow control system is operated when the engine coolant temperature is low, which allows easier engine starting. The ECM commands the glow relay ON for a certain length of time at ignition switch is ON with engine OFF. In after glow phase, the glow plugs remain energized for a certain period with engine run.

Glow Control Operation

- The glow control system operates when the engine coolant temperature is less than 10°C (50°F).
- The glow indicator lamp is illuminated between 0.5 seconds and 15 seconds according to the engine coolant temperature. It illuminates 0.5 seconds at 10°C (50°F) or more.
- The glow relay is energized between 1 second and 30 seconds according to the engine coolant temperature. It energizes 1 second at 10°C (50°F) or more.

Glow Control System Check

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P0117, P0118, P0380 or P0381 set?	—	Refer to Applicable DTC	Go to Step 3
3	1. Turn OFF the ignition. 2. Make sure the metal bus bar that connects switched battery voltage supply terminal (E-3) and all glow plugs is secured tightly. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the metal bus bar (glow plug power supply E-3 terminal) and a known good ground. 5. Perform the Glow Relay Test with the Tech 2. 6. Command the Glow Relay ON with the Tech 2 while observing the test lamp. Does the test lamp turn ON only when commanded ON with the Tech 2?	—	Go to Step 4	Go to Step 5
4	1. Turn OFF the ignition. 2. Remove the metal bus bar from the glow plugs. 3. Measure resistance of each glow plug between the glow plug terminals and a known good ground. Make sure to record all measurements and take them quickly as to not allow engine temperature changes between measurements. Are the resistances within the specified value each other?	1 Ω	System OK	Go to Step 15

Step	Action	Value(s)	Yes	No
5	1. Turn OFF the ignition. 2. Replace the glow relay with the starter relay or replace with a known good relay. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the metal bus bar (glow plug power supply E-3 connector) and a known good ground. 5. Perform the Glow Relay Test with the Tech 2. 6. Command the Glow Relay ON with the Tech 2 while observing the test lamp. Does the test lamp turn ON only when commanded ON with the Tech 2?	—	Go to Step 9	Go to Step 6
6	Inspect the Glow (60A) slow blow fuse in the chassis side fuse & relay box. Is the Glow (60A) slow blow fuse open?	—	Go to Step 10	Go to Step 7
7	1. Turn OFF the ignition. 2. Remove the glow relay in the chassis side fuse & relay box. 3. Connect a test lamp between the voltage feed circuit of the glow relay terminal (pin 3 of X-20 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 8	Go to Step 11
8	1. Turn ON the ignition, with the engine OFF. 2. Connect a test lamp between the power supply circuit to the glow plugs (pin 2 of X-20 connector) and a known good ground. Does the test lamp illuminate?	—	Go to Step 13	Go to Step 12
9	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the glow relay terminals (pins 2 and 3 of X-20 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 16	Go to Step 14
10	1. Replace the Glow (60A) slow blow fuse. If the slow blow fuse continues to open, repair the short to ground on a circuit fed by the slow blow fuse or check for a shorted attached component. 2. Repair the short to ground or replace the component as necessary. Did you complete the repair?	—	Go to Step 16	—
11	Repair the open circuit in the battery voltage supply circuit between the Glow (60A) slow blow fuse and the glow relay (pin 3 of X-20 connector). Did you complete the repair?	—	Go to Step 16	—
12	Repair the open circuit in the switched battery voltage supply circuit between the glow relay (pin 2 of X-20 connector) and the glow plugs (E-3 terminal). Did you complete the repair?	—	Go to Step 16	—

Step	Action	Value(s)	Yes	No
13	**Important:** The glow plugs may be burnt out if the battery voltage supply circuit is shorted to a voltage source. Repair the short to battery or ignition voltage on the switched battery voltage supply circuit between the glow relay (pin 2 of X-20 connector) and the glow plugs (E-3 terminal). Did you complete the repair?	—	Go to Step 16	—
14	Replace the glow relay. Did you complete the replacement?	—	Go to Step 16	—
15	Replace the appropriate glow plug. Did you complete the replacement?	—	Go to Step 16	—
16	1. Reconnect all previously disconnected components, relay, fuse or harness connector(s). 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Connect a test lamp between the metal bus bar (glow plug power supply E-3 connector) and a known good ground. 5. Perform the Glow Relay Test with the Tech 2. 6. Command the Glow Relay ON with the Tech 2 while observing the test lamp. Does the test lamp turn ON only when commanded ON with the Tech 2?	—	Go to Step 4	Go to Step 5

Engine Warm Up Control System Check

Description

The engine warm up system consists of the engine control module (ECM), the intake throttle valve, the intake throttle solenoid valve, the exhaust brake valve, the exhaust brake solenoid valve and the engine warm up switch. The engine warm up system is operated when the engine coolant temperature is low, which promotes engine warm up. The ECM commands the both intake throttle solenoid valve and the exhaust brake solenoid valve to close each valve by applying vacuum pressure based on engine coolant temperature and warm up request switch input signal.

Condition for Running the Engine Warm Up Control

- The engine warm up switch is ON.
- The accelerator pedal is not depressed.
- The engine coolant temperature is less than 65°C (149°F).
- The vehicle is stationary.

Test Description

The number below refers to the step number on the diagnostic table.
7. Use the Tech 2 to observe the Accelerator Pedal Position (APP) Angle. The APP Angle parameter should change linearly from 0% to 100% according to the accelerator pedal operation.
8. Use the Tech 2 to observe the Vehicle Speed. The Vehicle Speed parameter should indicate correct vehicle speed.

Engine Warm Up Control System Check

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	Does the exhaust brake operate correctly?	—	Go to Step 3	Go to Exhaust Brake Control System Check
3	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Is DTC P0117, P0118, P1271, P1277, P1278, P1282, P1283, P1631, P1632, P1635, P1681 or P1682 set?	—	Refer to Applicable DTC	Go to Step 4
4	1. Park the vehicle. 2. Make sure the idle up control knob to the lowest position. (Full counterclockwise direction) 3. Cool down the engine as necessary (allow engine coolant temperature to cool down at least 60°C [140°F]). 4. Start the engine. 5. Turn ON the engine warm up switch. Are the intake throttle valve and the exhaust brake valve closed when switched ON?	—	Go to Step 5	Go to Step 9
5	Does the engine warm up switch indicator lamp illuminate?	—	Go to Step 6	Go to Step 15
6	Turn OFF the engine warm up switch. Does the engine warm up system cancel?	—	Go to Step 7	Go to Step 19

Step	Action	Value(s)	Yes	No
7	1. Turn ON the engine warm up switch. 2. Press the accelerator pedal. Does the engine warm up system cancel?	—	Go to Step 8	Observe the Accelerator Pedal Position (APP) Angle parameter and refer to APP sensor DTC
8	1. Lift the driving wheels or drive the vehicle. 2. Turn ON the engine warm up switch. Does the engine warm up system cancel?	—	System OK	Observe the Vehicle Speed parameter and refer to DTC P0500
9	1. Start the engine. 2. Turn ON the engine warm up switch. 3. Observe the Engine Warm Up Switch parameter with the Tech 2. Does the Engine Warm Up Switch parameter indicate ON?	—	Go to Step 10	Go to Step 11
10	Observe the Exhaust Brake Solenoid Command parameter with the Tech 2. Does the Exhaust Brake Solenoid Command parameter indicate ON when engine warm up switch is ON?	—	Problem is relating to either solenoid valves, throttle valves and vacuum pressure lines. Refer to applicable diagnostic chart in the Exhaust System Section or refer to Exhaust Brake Control System Check	The ECM is not allowing engine warm up control. Refer to Condition for Running the Engine Warm Up Control
11	1. Turn OFF the ignition. 2. Remove the bezel surrounding the instrument panel cluster (IPC) enough to disconnect the engine warm up switch. 3. Disconnect the engine warm up switch. 4. Connect a test lamp between the voltage feed circuit of the engine warm up switch harness (pin 3 of B-31 connector) and a known good ground. 5. Start the engine. Does the test lamp illuminate?	—	Go to Step 12	Go to Step 13
12	1. Start the engine. 2. Observe the Engine Warm Up Switch parameter with the Tech 2 while momentarily jumping 3-amp fused jumper wire across the engine warm up switch harness connector between pins 3 and 6 of B-31 connector. Does the Tech 2 indicate ON when the circuit is jumpered and OFF when the circuit is not jumpered?	—	Go to Step 21	Go to Step 14
13	Repair the open circuit or high resistance on the voltage feed circuit between the Fuel Heater (10A) fuse and the engine warm up switch (pin 3 of B-31 connector). Did you complete the repair?	—	Go to Step 25	—

Step	Action	Value(s)	Yes	No
14	1. Test the engine warm up switch signal circuit between the engine control module (ECM) (pin 51 of J-191 connector) and the engine warm up switch (pin 6 of B-31 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 25	Go to Step 22
15	1. Turn OFF the ignition. 2. Remove the bezel surrounding the IPC enough to disconnect the engine warm up switch. 3. Connect the engine warm up switch if disconnected. 4. Probe a test lamp between the engine warm up switch indicator lamp harness (pin 4 of B-31 connector) and a known good ground. 5. Start the engine. 6. Turn ON the engine warm up switch. Does the test lamp illuminate?	—	Go to Step 16	Go to Step 17
16	1. Probe a test lamp across the engine warm up switch indicator lamp harness (pins 1 and 4 of B-31 connector). 2. Start the engine. 3. Turn ON the engine warm up switch. Does the test lamp illuminate?	—	Go to Step 21	Go to Step 18
17	Repair the open circuit between the engine warm up switch signal circuit and the indicator lamp circuit (pins 4 and 6 of B-31 connector). Did you compete the repair?	—	Go to Step 25	—
18	Repair the open circuit or high resistance on the engine warm up switch indicator lamp ground circuit between the engine warm up switch (pin 1 of B-31 connector) and ground terminal (B-1). Did you complete the repair?	—	Go to Step 25	—
19	1. Turn OFF the ignition. 2. Remove the bezel surrounding the IPC enough to disconnect the engine warm up switch. 3. Disconnect the engine warm up switch if disconnected. 4. Start the engine. Does the engine warm up system cancel?	—	Go to Step 23	Go to Step 20
20	1. Test the engine warm up switch signal circuit between the ECM (pin 51 of J-191 connector) and the engine warm up switch (pin 6 of B-31 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 25	Go to Step 24

Step	Action	Value(s)	Yes	No
21	1. Turn OFF the ignition. 2. Disconnect the engine warm up switch harness connector. 3. Inspect for an intermittent and for poor connections at the harness connector of the engine warm up switch (pins 1, 3, 4 and 6 of B-31 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 25	Go to Step 23
22	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the engine warm up switch signal circuit at the harness connector of the ECM (pin 51 of J-191 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 25	Go to Step 24
23	Replace the engine warm up switch. Did you complete the replacement?	—	Go to Step 25	—
24	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 25	—
25	Reconnect all previously disconnected fuse or harness connector(s). Is the action complete?	—	Go to Step 2	—

Exhaust Brake Control System Check

Description

The exhaust brake control system consists of the engine control module (ECM), the intake throttle valve, the intake throttle solenoid valve, the exhaust brake valve, the exhaust brake solenoid valve and the exhaust brake switch. The ECM commands the both intake throttle solenoid valve and the exhaust brake solenoid valve to close each valve by applying vacuum pressure based on vehicle running conditions and exhaust brake switch input signal.

Condition for Running the Exhaust Brake Control

- The exhaust brake switch is ON.
- The accelerator pedal is not depressed.
- The clutch pedal is not depressed.
- The neutral switch is OFF (other than neutral).
- The vehicle speed is higher than predetermined range.

Test Description

The number below refers to the step number on the diagnostic table.

7. Use the Tech 2 to observe the Accelerator Pedal Position (APP) Angle. The APP Angle parameter should change linearly from 0% to 100% according to the accelerator pedal operation.

10. If the Exhaust Brake Solenoid Command parameter indicates OFF, use the Tech 2 to observe the Vehicle Speed, APP Angle, Clutch Switch and Neutral Switch parameters which allows the exhaust brake control. Refer to Engine Controls Schematic for each input.

Exhaust Brake Control System Check

Schematic Reference: Engine Controls Schematics
Connector End View Reference: Engine Controls Connector End Views or Engine Control Module (ECM) Connector End Views

Chart 1 of 2

Step	Action	Value(s)	Yes	No
1	Did you perform the Diagnostic System Check – Engine Controls?	—	Go to Step 2	Go to Diagnostic System Check – Engine Controls
2	1. Install the Tech 2. 2. Turn OFF the ignition for 30 seconds. 3. Turn ON the ignition, with the engine OFF. 4. Monitor the Diagnostic Trouble Code (DTC) Information with the Tech 2. Are any DTCs set in which the “Action Taken When the DTC Sets” under that particular code states, “The ECM inhibits exhaust brake control”?	—	Refer to Applicable DTC	Go to Step 3
3	1. Start the engine. 2. Turn ON the exhaust brake switch. Does the exhaust brake indicator lamp in the instrument panel cluster (IPC) illuminate?	—	Go to Step 4	Go to Chart 2 of 2 Step 1
4	Turn OFF the exhaust brake switch. Does the exhaust brake indicator lamp in the IPC go out?	—	Go to Step 5	Go to Chart 2 of 2 Step 2
5	1. Turn ON the ignition, with the engine OFF. 2. Perform the Exhaust Brake Control test with the Tech 2. 3. Command the Exhaust Brake ON with the Tech 2. Does the exhaust brake solenoid valve and intake throttle solenoid valve click when commanded ON with the Tech 2 (note that intake throttle solenoid valve and exhaust brake solenoid valve energized at the same time)?	—	Go to Step 6	If both solenoid valves or only exhaust brake solenoid valve is not operated, refer to DTC P1681 or P1682. If only intake throttle solenoid valve is not operated, Go to Step 11

Step	Action	Value(s)	Yes	No
6	1. Lift the driving wheels or drive the vehicle. 2. Turn ON the exhaust brake. 3. Let the vehicle run so that the exhaust brake may operate enough. Does the exhaust brake operate (note that if the vehicle speed is reduced but engine valve noise is heard, intake throttle valve may not be operated)?	—	Go to Step 7	Go to Step 10
7	1. Turn ON the exhaust brake switch. 2. Let the vehicle run so that the exhaust brake may operate enough. 3. Press the accelerator pedal during the exhaust brake is operating. Does the exhaust brake cancel?	—	Go to Step 8	Observe the Accelerator Pedal Position (APP) Angle parameter and refer to APP sensor DTC
8	**Notice:** If the vehicle fitted with Smoother, skip to Step 9. 1. Turn ON the exhaust brake switch. 2. Let the vehicle run so that the exhaust brake may operate enough. 3. Press the clutch pedal during the exhaust brake is operating. Does the exhaust brake cancel?	—	System OK	Go to Step 18
9	1. Turn ON the exhaust brake switch. 2. Let the vehicle run so that the exhaust brake may operate enough. 3. Operate the selector lever during the exhaust brake is operating. Does the exhaust brake cancel?	—	System OK	Refer to Diagnostic System Check – Transmission Controls
10	1. Turn ON the exhaust brake switch. 2. Trigger the Snapshot function in order to capture and store engine parameters while the vehicle is running. 3. Let the vehicle run so that the exhaust brake may operate enough. 4. Review the Exhaust Brake Solenoid Command parameter with the Tech 2 in order to see the specific running conditions. Does the Exhaust Brake Solenoid Command parameter indicate ON when the exhaust brake may operate enough?	—	Problem is relating to either solenoid valves, throttle valves and vacuum pressure lines. Refer to applicable diagnostic chart in the Exhaust System Section	The ECM is not allowing exhaust brake control. Refer to Condition for Running the Exhaust Brake Control
11	1. Turn OFF the ignition. 2. Disconnect the intake throttle solenoid valve harness connector. 3. Connect a test lamp between the voltage feed circuit of the intake throttle solenoid valve harness (pin 1 of J-40 connector) and a known good ground. 4. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 12	Go to Step 14

Step	Action	Value(s)	Yes	No
12	1. Connect a test lamp across the intake throttle solenoid valve harness (pin 1 and 2 of J-40 connector). 2. Turn ON the ignition, with the engine OFF. 3. Perform the Exhaust Brake Control test with the Tech 2. 4. Command the Exhaust Brake ON with the Tech 2. Does the test lamp illuminate when commanded ON with the Tech 2, then goes out?	—	Go to Step 15	Go to Step 13
13	1. Test the control circuit of the intake throttle solenoid valve between the engine control module (ECM) (pin 102 of E-111 connector) and the intake throttle solenoid valve (pin 2 of J-40 connector) for the following conditions: • An open circuit • A short to ground • A short to battery or ignition voltage • High resistance 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 30	Go to Step 16
14	Repair the open circuit or high resistance on the voltage feed circuit between the ECM (10A) fuse and the intake throttle solenoid valve (pin 1 of J-40 connector). Did you complete the repair?	—	Go to Step 30	—
15	1. Turn OFF the ignition. 2. Disconnect the intake throttle valve. 3. Inspect for an intermittent and for poor connections at the harness connector of the intake throttle solenoid valve (pins 1 and 2 of J-40 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 30	Go to Step 17
16	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the intake throttle solenoid valve control circuit at the harness connector of the ECM (pin 102 of E-111 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 30	Go to Step 29
17	Replace the intake throttle solenoid valve. Did you complete the replacement?	—	Go to Step 30	—
18	1. Turn ON the ignition, with the engine OFF. 2. Observe the Clutch Pedal Switch parameter with the Tech 2 while fully depressing and releasing the clutch pedal. Does the Tech 2 indicate Applied when the clutch pedal is applied and Released when the clutch pedal is released?	—	Problem is intermittent. Refer to Condition for Running the Exhaust Brake Control	Go to Step 19

Step	Action	Value(s)	Yes	No
19	1. Check to ensure the clutch pedal switch is adjusted correctly. The plunger should be all the way in when the pedal is released, yet should not impede with the clutch pedal full upward travel. 2. Adjust the clutch pedal switch as necessary. Did you find and correct the condition?	—	Go to Step 30	Go to Step 20
20	1. Turn OFF the ignition. 2. Disconnect the clutch pedal switch harness connector. 3. Turn ON the ignition, with the engine OFF. 4. Observe the Clutch Pedal Switch parameter with the Tech 2 while momentarily jumping across the clutch pedal switch harness connector between pins 1 and 2 of B-89 connector. Does the Tech 2 indicate Applied when the circuit is jumpered and Released when the circuit is not jumpered?	—	Go to Step 26	Go to Step 21
21	1. Connect a test lamp between the ignition voltage feed circuit of the clutch pedal switch harness (pin 1 of B-89 connector) and a known good ground. 2. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 22	Go to Step 23
22	1. Connect a test lamp between the signal circuit of the clutch pedal switch harness (pin 2 of B-89 connector) and a known good ground. 2. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 24	Go to Step 25
23	Repair the open circuit or high resistance on the ignition voltage feed circuit between the ENG (IG) (10A) fuse and the clutch pedal switch (pin 1 of B-89 connector). Check the ENG (IG) (10A) fuse is first. Did you complete the repair?	—	Go to Step 30	—
24	1. Test the clutch pedal switch signal circuit between the ECM (pin 47 of J-191 connector) and the clutch pedal switch (pin 2 of B-89 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 30	Go to Step 29
25	1. Test the clutch pedal switch signal circuit between the ECM (pin 47 of J-191 connector) and the clutch pedal switch (pin 2 of B-89 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 30	Go to Step 27

Step	Action	Value(s)	Yes	No
26	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the clutch pedal switch (pins 1 and 2 of B-89 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 30	Go to Step 28
27	1. Turn OFF the ignition. 2. Disconnect for an intermittent and for a poor connection on the clutch pedal switch signal circuit at the harness connector of the ECM (pin 47 of J-191 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 30	Go to Step 29
28	Replace the clutch pedal switch. Refer to Clutch Pedal Switch Replacement. Did you complete the replacement?	—	Go to Step 30	—
29	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 30	—
30	Reconnect all previously disconnected fuse or harness connector(s). Is the action complete?	—	Go to Step 2	—

Chart 2 of 2

Step	Action	Value(s)	Yes	No
1	1. Start the engine, if stopped. 2. Turn ON the exhaust brake switch. 3. Observe the Exhaust Brake Switch parameter with the Tech 2. Does the Exhaust Brake Switch parameter indicate ON?	—	Go to Step 14	Go to Step 5
2	1. Start the engine, if stopped. 2. Turn OFF the exhaust brake switch. 3. Observe the Exhaust Brake Switch parameter with the Tech 2. Does the Exhaust Brake Switch parameter indicate OFF?	—	Go to Step 16	Go to Step 3
3	1. Turn OFF the ignition. 2. Disconnect the exhaust brake switch B-69 harness connector (located on the steering column support bracket). 3. Start the engine. 4. Observe the Exhaust Brake Switch parameter with the Tech 2. Does the Exhaust Brake Switch parameter indicate OFF?	—	Go to Step 13	Go to Step 4

Step	Action	Value(s)	Yes	No
4	1. Test the exhaust brake switch signal circuit between the engine control module (ECM) (pin 45 of J-191 connector) and the exhaust brake switch (pin 2 of B-69 connector) for a short to battery or ignition voltage. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 30	Go to Step 29
5	1. Turn OFF the ignition. 2. Inspect the Fuel Heater (10A) fuse in the glove box fuse block. Is the Fuel Heater (10A) fuse open?	—	Go to Step 6	Go to Step 7
6	Replace the Fuel Heater (10A) fuse. If the fuse continues to open, repair the short to ground on one of the circuits that fed by the Fuel Heater (10A) fuse or replace the shorted attached component fed by the Fuel Heater (10A) fuse. Did you complete the repair?	—	Go to Step 30	—
7	1. Turn OFF the ignition. 2. Disconnect the exhaust brake switch B-69 harness connector (located on the steering column support bracket). 3. Connect a test lamp between the voltage feed circuit of the exhaust brake switch harness (pin 5 of B-69 male side connector) and a known good ground. 4. Start the engine. Does the test lamp illuminate?	—	Go to Step 8	Go to Step 9
8	1. Observe the Exhaust Brake Switch parameter with the Tech 2 while momentarily jumping 3-amp fused jumper wire across the exhaust brake switch harness connector between pins 2 and 5 of the B-69 connector. Does the Tech 2 indicate ON when the circuit is jumpered and OFF when the circuit is not jumpered?	—	Go to Step 11	Go to Step 10
9	Repair the open circuit or high resistance on the voltage feed circuit between the Fuel Heater (10A) fuse and the exhaust brake switch (pin 5 of B-69 connector). Did you complete the repair?	—	Go to Step 30	—
10	1. Test the exhaust brake switch signal circuit between the ECM (pin 45 of J-191 connector) and the exhaust brake switch (pin 2 of B-69 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 30	Go to Step 12

Step	Action	Value(s)	Yes	No
11	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the exhaust brake switch (pins 2 and 5 of B-69 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 30	Go to Step 13
12	1. Turn OFF the ignition. 2. Disconnect for an intermittent and for a poor connection on the exhaust brake switch signal circuit at the harness connector of the ECM (pin 45 of J-191 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 30	Go to Step 29
13	Repair or Replace the exhaust brake switch. Did you complete the replacement?	—	Go to Step 30	—
14	1. Turn OFF the ignition. 2. Inspect the Meter (10A) fuse in the glove box. Is the Meter (10A) fuse open?	—	Go to Step 15	Go to Step 17
15	Replace the Meter (10A) fuse. If the fuse continues to open, repair the short to ground on one of the circuits that is fed by the Meter (10A) fuse or replace the shorted attached component fed by the Meter (10A) fuse. Did you complete the repair?	—	Go to Step 30	—
16	1. Turn OFF the ignition. 2. Disconnect the ECM J-191 harness connector. 3. Turn ON the ignition, with the engine OFF. Is the exhaust brake indicator lamp OFF?	—	Go to Step 29	Go to Step 24
17	1. Turn OFF the ignition. 2. Remove the Meter (10A) fuse that supplies voltage to the exhaust brake indicator lamp. 3. Disconnect the ECM J-191 harness connector. 4. Turn ON the ignition, with the engine OFF. 5. Measure the voltage from the exhaust brake indicator lamp control circuit in the ECM harness connector (pin 7 of J-191 connector) to a good ground. Is the voltage less than the specified value?	1 volt	Go to Step 18	Go to Step 25
18	1. Turn OFF the ignition. 2. Install the Meter (10A) fuse that supplies ignition voltage to the exhaust brake indicator lamp. 3. Turn ON the ignition, with the engine OFF. 4. Connect a 3-amp fused jumper wire between the exhaust brake indicator lamp control circuit of the ECM harness connector (pin 7 of J-191 connector) and a known good ground. Is the exhaust brake indicator lamp illuminated?	—	Go to Step 23	Go to Step 19

Step	Action	Value(s)	Yes	No
19	1. Turn OFF the ignition. 2. Remove the instrument panel cluster (IPC). 3. Remove the exhaust brake indicator lamp bulb from the IPC. Is the exhaust brake indicator lamp bulb burned out?	—	Go to Step 27	Go to Step 20
20	1. Connect a test lamp between the exhaust brake indicator lamp ignition voltage circuit of the IPC harness connector (pin 18 of B-51 connector) and a known good ground. 2. Turn ON the ignition, with the engine OFF. Does the test lamp illuminate?	—	Go to Step 21	Go to Step 26
21	1. Test the exhaust brake indicator lamp control circuit between the ECM (pin 7 of J-191 connector) and the IPC (pin 6 of B-51 connector) for an open circuit or high resistance. 2. Repair the circuit(s) as necessary. Did you find and correct the condition?	—	Go to Step 30	Go to Step 22
22	1. Turn OFF the ignition. 2. Inspect for an intermittent and for poor connections at the harness connector of the IPC (pins 6 and 18 of B-51 connector). 3. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 30	Go to Step 28
23	1. Turn OFF the ignition. 2. Disconnect the ECM harness connector. 3. Inspect for an intermittent and for a poor connection on the exhaust brake indicator lamp control circuit at the harness connector of the ECM (pin 7 of J-191 connector). 4. Repair the connection(s) as necessary. Did you find and correct the condition?	—	Go to Step 30	Go to Step 29
24	Repair the short to ground on the control circuit of the exhaust brake indicator lamp between the ECM (pin 7 of J-191 connector) and the IPC (pin 6 of B-51 connector). Did you complete the repair?	—	Go to Step 30	—
25	Repair the short to battery or ignition voltage on the control circuit of the exhaust brake indicator lamp between the ECM (pin 7 of J-191 connector) and the IPC (pin 6 of B-51 connector). Did you complete the repair?	—	Go to Step 30	—
26	Repair the open or high resistance on the voltage feed circuit of the exhaust brake indicator lamp between the Meter (10A) fuse and the IPC (pin 6 of B-51 connector). Did you complete the repair?	—	Go to Step 30	—
27	Replace the exhaust brake indicator lamp bulb. Did you compete the replacement?	—	Go to Step 30	—

Step	Action	Value(s)	Yes	No
28	Repair or replace the IPC. Did you complete the repair or replacement?	—	Go to Step 30	—
29	**Important:** Replacement ECM must be programmed. Replace the ECM. Refer to Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming in this section. Did you complete the replacement?	—	Go to Step 30	—
30	Reconnect all previously disconnected fuse or harness connector(s). Is the action complete?	—	Go to Chart 1 of 2 Step 2	—

Symptoms – Engine Controls

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 engine control module (ECM) and malfunction indicator lamp (MIL) are operating correctly.
- There are no diagnostic trouble codes (DTCs) stored, or a DTC exists but without the MIL.
- The Tech 2 data is within the normal operating range. Refer to Tech 2 Data List in this section.
- Verify the customer concern and locate the correct symptom in the table of contents. Inspect the items indicated under that symptom.

Visual and Physical Inspection

Several of the symptom procedures ask for 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 ECM grounds are clean, tight, and in their proper location.
- The vacuum hoses are not split or kinked, and properly connected. Inspect throughly for any type of leak or restriction.
- The air intake ducts are not collapsed or damaged.
- 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 add-on electrical equipment devices, lights, and cellular phones. Verify that no aftermarket equipment is connected to the keyword 2000 serial data circuit. If you cannot locate an intermittent condition, a cellular phone communication signal may cause the condition.

Important:
The problem may or may not turn ON the 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. Remove the terminal from the connector body in order to inspect for poor terminal wire connection.

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 the Tech 2 in order to help detect intermittent conditions. Useful features of the Tech 2 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.
- Use the Plot Function on the Tech 2 in order to plot selected data parameters. Review this stored information to aid in locating an intermittent problem. Refer to the Tech 2 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 MIL with no stored DTC:

- The ECM grounds are loose or dirty. Refer to Engine Controls Schematics.
- The MIL circuit intermittently shorted to ground.
- Electrical system interference caused by a malfunctioning relay, ECM driven solenoid, or switch. The electrical component can cause a sharp electrical surge. Normally, the problem will occur when the malfunctioning component is operating.
- There are any open diodes.

Important:
The following symptom tables contain groups of possible causes for each symptom. The order of these procedures is not important. If the Tech 2 readings do not indicate the problems, then proceed in a logical order, easiest to check or most likely to cause first. In order to determine if a specific vehicle is using a particular system or component, refer to Engine Controls Schematics for an application.

Use the following tables when diagnosing a symptom complaint:

- Intermittent Conditions
- Hard Start
- Rough, Unstable, or Incorrect Idle and Stalling

- High Idle
- Cuts Out, Misses
- Surge / Chuggles
- Lack of Power, Sluggishness, or Sponginess
- Hesitation, Sag, Stumble
- Fuel Knock / Combustion Noise
- Poor Fuel Economy
- Excessive Smoke (Black Smoke)
- Excessive Smoke (White Smoke)

Intermittent Conditions

Checks	Action
DEFINITION: The problem is not currently present but is indicated in DTC History. OR There is a customer complaint, but the symptom cannot currently be duplicated, if the problem is not DTC related.	
Preliminary Checks	• 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 Tech 2 data. • Move related connectors and wiring with the component commanded ON, and OFF, with the Tech 2. 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 intermittent. 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. • 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.

Checks	Action
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. • If the intermittent is related to heat, review the data for a relationship with 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.
Electromagnetic Interference (EMI) and Electrical Noise	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 injection 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 the engine control module (ECM) 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 failure while in use, but do not fail when the accessories are not in use. • Test for any 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.
Duplicating Failure Conditions	• If none of the previous tests are successful, attempt to duplicate and/or capture the failure conditions. • 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.
Tech 2 Snapshot	The Tech 2 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 Tech 2 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 Tech 2 user instructions for more information on the Snapshot function.

Hard Start

Checks	Action
DEFINITION: The engine cranks OK, but does not start for a long time. The engine does eventually run, or may start but immediately dies.	

Checks	Action
Preliminary Checks	• Diagnostic System Check – Engine Controls. • Ensure the driver is using the correct starting procedure. • Inspect the engine control module (ECM) grounds for being clean, tight, and in their proper locations. • Inspect that the harness connectors are correctly connected. • Inspect the fuel type and quality. • Inspect the programmed fuel injector ID code for each cylinder. • Inspect the Tech 2 Data List in this section.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Tech 2 Data List in this section. • Use the Tech 2 to compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance on the low reference circuit and signal circuit or for a skewed sensor. • Use the Tech 2 to observe the Fuel Rail Pressure (FRP) Sensor parameter with the engine OFF. The FRP Sensor on the Tech 2 should read 0.9 – 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 2 minutes. If not, check for high resistance in the 5 volts reference circuit, low reference circuit, signal circuits or for a skewed sensor. • Inspect the crankshaft position (CKP) sensor is tight and the flywheel teeth are not damaged. • Inspect the camshaft position (CMP) sensor is tight and the camshaft gear flange surface is not damaged.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System Check Chart and appropriate procedure in the Fuel System section. • Inspect for air in the fuel system. • Inspect for water contamination in the fuel. • Inspect for external fuel leaks or high engine oil level. • Measure the fuel return rate from the fuel injectors. • Inspect the fuel lines between the fuel tank and fuel supply pump for being crushed or kinked. • Inspect for a plugged fuel tank vent hose. • Inspect inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. • Inspect the fuel lines between the fuel tank and fuel supply pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. • Inspect the fuel supply pump operation. **Notice:** The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. • Perform the Injector Balancing test with the Tech 2. Repair the wire or replace the appropriate fuel injector that does not change engine speed when commanded OFF. • Perform the Injector Forced Drive test with the Tech 2. Repair the wire or replace the appropriate fuel injector that does not create a clicking noise (solenoid operating noise), contents an interrupted noise or has abnormal nose when commanded ON. • Inspect the fuel rail pressure (FRP) regulator feedback current on the Tech 2.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Inspect the air cleaner and air intake ducts for a restriction, holes, or leaks. • Inspect for a restriction in the turbocharger inlet duct. • Inspect the intake throttle valve for a stuck closed position. • Inspect for a restriction or leak in the intake manifold.

Checks	Action
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section. • Inspect the exhaust brake valve for a stuck closed position. • Inspect for a restriction in the exhaust pipes.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Inspect for poor cylinder compression. Proper compression is more than 1960 kPa (284 psi) and variation of each cylinder is less than 294 kPa (43 psi). • Improper mechanical timing (timing gear) • Improper valve gap • Broken or weak valve springs • Worn camshaft lobes
Electrical System Checks	Inspect the engine electrical for the following conditions. Refer to the Engine Electrical section. • Inspect the glow plug control (preheating) system operation. Refer to Glow Control System Check in this section. • Inspect the fuel heater operation. • Inspect for slow cranking speed. • Inspect for weakened batteries.

Rough, Unstable, or Incorrect Idle And Stalling

Checks	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 Checks	• Diagnostic System Check – Engine Controls. • Remove the air cleaner and check for dirt, or for air ducts being plugged or restricted. Replace as necessary. • Inspect the Engine Control Module (ECM) grounds for being clean, tight, and in their proper locations. • Inspect that the harness connectors are correctly connected. • Inspect the fuel type and quality. • Inspect the programmed fuel injector ID code for each cylinder. • Inspect the Tech 2 Data List in this section.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Tech 2 Data List in this section. • Use the Tech 2 to compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance on the low reference circuit and signal circuit or for a skewed sensor. • Use the Tech 2 to observe the Fuel Rail Pressure (FRP) Sensor parameter with the engine OFF. The FRP Sensor on the Tech 2 should read 0.9 – 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 2 minutes. If not, check for high resistance in the 5 volts reference circuit, low reference circuit, signal circuits or for a skewed sensor. • Use the Tech 2 to observe the Differential Fuel Rail Pressure parameter at idle in Neutral. Differential Fuel Rail Pressure parameter should always be within ± 5 MPa (± 725 psi). • Inspect the crankshaft position (CKP) sensor is tight and the flywheel teeth are not damaged. • Inspect the camshaft position (CMP) sensor is tight and the camshaft gear flange surface is not damaged.

Checks	Action
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System Check Chart and appropriate procedure in the Fuel System section. • Inspect for air in the fuel system. • Inspect for water contamination in the fuel. • Inspect for external fuel leaks or high engine oil level. • Measure the fuel return rate from the fuel injectors. • Inspect the fuel lines between the fuel tank and fuel supply pump for being crushed or kinked. • Inspect for a plugged fuel tank vent hose. • Inspect inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition. • Inspect the fuel lines between the fuel tank and fuel supply pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps. • Inspect the fuel supply pump operation. **Notice:** The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. • Perform the Injector Balancing test with the Tech 2. Repair the wire or replace the appropriate fuel injector that does not change engine speed when commanded OFF. • Perform the Injector Forced Drive test with the Tech 2. Repair the wire or replace the appropriate fuel injector that does not create a clicking noise (solenoid operating noise), contents an interrupted noise or has abnormal nose when commanded ON. • Use the Tech 2 to observe the Cylinder Compensation for each cylinder at idle. If there is a cylinder that is excessively high or low value, it may indicate faulty fuel injector, weak or slightly seized cylinder or an incorrectly programmed fuel injector ID code. • Inspect the fuel rail pressure (FRP) regulator feedback current on the Tech 2.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Inspect the air cleaner and air intake ducts for a restriction, holes, or leaks. • Inspect for a restriction in the turbocharger inlet duct. • Inspect the intake throttle valve for a stuck closed position. • Inspect for a restriction or leak in the intake manifold.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section. • Inspect the exhaust brake valve for a stuck closed position. • Inspect for a restriction in the exhaust pipes.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Inspect for poor cylinder compression. Proper compression is more than 1960 kPa (284 psi) and variation of each cylinder is less than 294 kPa (43 psi). • Improper mechanical timing (timing gear) • Improper valve gap • Broken or weak valve springs • Worn camshaft lobes • Inspect for incorrect basic engine parts such as camshaft, cylinder head, pistons, etc.

Checks	Action
Additional Checks	• Electromagnetic interference (EMI) on the reference circuit can cause an engine miss condition. The Tech 2 can usually detect EMI by monitoring the engine speed. A sudden increase in speed with little change in actual engine speed change indicates that EMI is present. If a problem exists, check routing of high voltage components, such as fuel injector solenoid valve wiring, near the sensor circuits. • Inspect for faulty engine mounts. • Inspect faulty crank pulley. • Inspect faulty generator & A/C compressor. • Inspect the generator output voltage. • Inspect the EGR system operating correctly. Refer to EGR Control System Check in this section. • Inspect the A/C operation.

High Idle

Checks	Action
DEFINITION: Engine idle speed is higher than normal in regardless of engine coolant temperature.	
Preliminary Checks	• Diagnostic System Check – Engine Controls. • Inspect that the harness connectors are correctly connected. • Inspect the idle up control knob turned fully counterclockwise. • Use the Tech 2 to compare the engine speed and tachometer on the instrument panel cluster (IPC). • Inspect the fuel type and quality. • Inspect the engine oil level. • Inspect the Tech 2 Data List in this section.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Tech 2 Data List in this section. • Use the Tech 2 to compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance on the low reference circuit and signal circuit or for a skewed sensor. • Use the Tech 2 to observe the Fuel Rail Pressure (FRP) Sensor parameter with the engine OFF. The FRP Sensor on the Tech 2 should read 0.9 – 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 2 minutes. If not, check for high resistance in the 5 volts reference circuit, low reference circuit, signal circuits or for a skewed sensor. • Use the Tech 2 to observe the Differential Fuel Rail Pressure parameter at idle in Neutral. Differential Fuel Rail Pressure parameter should always be within ± 5 MPa (± 725 psi). • Use the Tech 2 to observe the Idle Up Sensor parameter. Idle Up Sensor parameter should be less than 0.7 volts at full turned counterclockwise. If not, check for high resistance in low reference circuit or skewed sensor. • Use the Tech 2 to observe the Accelerator Pedal Position (APP) Angle. APP Angle parameter should change linearly from 0% to 100% according to the accelerator pedal operation.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to the Fuel System section. • Inspect the fuel injectors. Remove the injectors and visually inspect. (Injector tip(s) may be damaged) • Measure the fuel return from the fuel injectors. See Fuel System Check Chart in the Fuel System section.

Cut Out, Misses

<table>
<tr><th>Checks</th><th>Action</th></tr>
<tr><td colspan="2">DEFINITION: A constant jerking that follows the engine speed, usually more pronounced as the engine load increase. The exhaust has a steady spitting sound at idle, low speed, or hard acceleration for the fuel starvation that can cause the engine to cut-out.</td></tr>
<tr><td>Preliminary Check</td><td>• Diagnostic System Check – Engine Controls.
• Inspect that the harness connectors are correctly connected.
• Inspect the engine control module (ECM) grounds for being clean, tight, and in their proper locations.
• Inspect the Tech 2 Data List in this section.</td></tr>
<tr><td>Sensor Checks</td><td>Inspect the engine control sensors for the following conditions. Refer to the Tech 2 Data List in this section.
• Use the Tech 2 to observe the Accelerator Pedal Position (APP) Angle. APP Angle parameter should change linearly from 0% to 100% according to the accelerator pedal operation.
• Use the Tech 2 to observe the Fuel Rail Pressure (FRP) Sensor parameter with the engine OFF. The FRP Sensor on the Tech 2 should read 0.9 – 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 2 minutes. If not, check for high resistance in the 5 volts reference circuit, low reference circuit, signal circuits or for a skewed sensor.
• Use the Tech 2 to observe the Differential Fuel Rail Pressure parameter at idle and W.O.T. (accelerator pedal full travel) in Neutral. Differential Fuel Rail Pressure parameter should always be within ± 5 MPa (± 725 psi).
• Inspect the crankshaft position (CKP) sensor is tight and the flywheel teeth are not damaged.
• Inspect the camshaft position (CMP) sensor is tight and the camshaft gear flange surface is not damaged.</td></tr>
<tr><td>Fuel System Checks</td><td>Inspect the fuel system for the following conditions. Refer to Fuel System Check Chart and appropriate procedure in the Fuel System section.
• Inspect for air in the fuel system.
• Inspect for water contamination in the fuel.
• Inspect the fuel lines between the fuel tank and fuel supply pump for being crushed or kinked.
• Inspect for a plugged fuel tank vent hose.
• Inspect inside the fuel tank for any foreign material that may be getting drawn into the fuel line pickup causing a blocked condition.
• Inspect the fuel lines between the fuel tank and fuel supply pump for tightness and all fuel hoses for cuts, cracks and for the use of proper clamps.
• Perform the Injector Balancing test with the Tech 2. Repair the wire or replace the appropriate fuel injector that does not change engine speed when commanded OFF.
• Perform the Injector Forced Drive test with the Tech 2. Repair the wire or replace the appropriate fuel injector that does not create a clicking noise (solenoid operating noise), contents an interrupted noise or has abnormal nose when commanded ON.
• Use the Tech 2 to observe the Cylinder Compensation for each cylinder at idle. If there is a cylinder that is excessively high or low value, it may indicate faulty fuel injector, weak or slightly seized cylinder or an incorrectly programmed fuel injector ID code.</td></tr>
<tr><td>Air Intake System Checks</td><td>Inspect the air intake system for the following conditions.
• Inspect the air cleaner and air intake ducts for a restriction, holes, or leaks.
• Inspect for a restriction in the turbocharger inlet duct.
• Inspect the intake throttle valve for a stuck closed position.
• Inspect for a restriction or leak in the intake manifold.</td></tr>
</table>

Checks	Action
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section. • Inspect the exhaust brake valve for a stuck closed position. • Inspect for a restriction in the exhaust pipes.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Inspect for poor cylinder compression. Proper compression is more than 1960 kPa (284 psi) and variation of each cylinder is less than 294 kPa (43 psi). • Improper valve timing • Improper valve gap • Broken or weak valve springs • Worn camshaft lobes
Additional Checks	• Inspect the generator output voltage. • Electromagnetic interference (EMI) on the reference circuit can cause an engine miss condition. The Tech 2 can usually detect EMI by monitoring the engine speed. A sudden increase in speed with little change in actual engine speed change indicates that EMI is present. If a problem exists, check routing of high voltage components, such as fuel injector solenoid wiring, near the sensor circuits.

Surges / Chuggles

Checks	Action
DEFINITION: The engine has a power variation under a steady throttle or cruise. The vehicle seems to speed up and slow down with no change in the accelerator pedal.	
Preliminary Checks	• Diagnostic System Check – Engine Controls. • Ensure the driver understands the A/C compressor operation. • Use the Tech 2 in order to make sure the Vehicle Speed parameter reading matches the vehicle speedometer. • Inspect the engine control module (ECM) grounds for being clean, tight, and in their proper locations. • Inspect that the harness connectors are correctly connected. • Inspect the fuel type and quality. • Inspect the programmed fuel injector ID code for each cylinder. • Inspect the Tech 2 Data List in this section.

Checks	Action
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Tech 2 Data List in this section. • Use the Tech 2 to observe the Fuel Rail Pressure (FRP) Sensor parameter with the engine OFF. The FRP Sensor on the Tech 2 should read 0.9 – 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 2 minutes. If not, check for high resistance in the 5 volts reference circuit, low reference circuit, signal circuits or for a skewed sensor. • Use the Tech 2 to observe the Differential Fuel Rail Pressure parameter at idle and W.O.T. (accelerator pedal full travel) in Neutral. Differential Fuel Rail Pressure parameter should always be within ± 5 MPa (± 725 psi). • Use the Tech 2 to observe the Accelerator Pedal Position (APP) Angle. APP Angle parameter should change linearly from 0% to 100% according to the accelerator pedal operation. Also inspect the APP Angle when the accelerator pedal is steady. If the indicating angle fluctuates, check for an intermittent open, high resistance in the circuits or for a skewed sensor. • Inspect the crankshaft position (CKP) sensor is tight and the flywheel circumference is not damaged. • Inspect the crankshaft position (CKP) sensor is tight and the flywheel teeth are not damaged. • Inspect the camshaft position (CMP) sensor is tight and the camshaft gear flange surface is not damaged.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System Check Chart and appropriate procedure in the Fuel System section. • Install a fuel pressure / vacuum gauge (5-8840-2844-0 / J-44638) between the fuel filter and fuel tank to check the fuel pressure. If the fuel pressure at any engine speed is a larger vacuum than 5 inHg, a restriction exists in the fuel supply lines between the fuel tank and the fuel supply pump. • Inspect the fuel supply pump operation. **Notice:** The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. • Perform the Injector Balancing test with the Tech 2. Repair the wire or replace the appropriate fuel injector that does not change engine speed when commanded OFF. • Perform the Injector Forced Drive test with the Tech 2. Repair the wire or replace the appropriate fuel injector that does not create a clicking noise (solenoid operating noise), contents an interrupted noise or has abnormal nose when commanded ON.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Inspect the air cleaner and air intake ducts for a restriction, holes, or leaks. • Inspect for a restriction in the turbocharger inlet duct. • Inspect the intake throttle valve for a stuck closed position. • Inspect for a restriction or leak in the intake manifold.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section. • Inspect the exhaust brake valve for a stuck closed position. • Inspect for a restriction in the exhaust pipes.
Additional Checks	• Inspect the generator output voltage. • Inspect the EGR system operating correctly. Refer to EGR Control System Check in this section. • Inspect the A/C operation.

Lack of Power, Sluggishness, Sponginess

Checks	Action
DEFINITION: The engine delivers less than expected power. There is little or no increase in speed when partially applying the accelerator pedal.	
Preliminary Checks	• Diagnostic System Check – Engine Controls. • Compare the vehicle with a similar unit. Ensure the vehicle has an actual problem. • Remove the air cleaner and check for dirt, or for air ducts being plugged or restricted. Replace as necessary. • Have the tire sizes changed • Are excessively heavy loads being carried? • Inspect for clutch slip. • Inspect brake drag. • Inspect for a proper transmission shift pattern and down shift operation. • Inspect the fuel quality (cetane index). • Inspect the engine oil level and quality. • Use the Tech 2 in order to make sure the Vehicle Speed parameter reading matches the vehicle speedometer. • Inspect the engine control module (ECM) grounds for being clean, tight, and in their proper locations. • Inspect the programmed fuel injector ID code for each cylinder. • Inspect the Tech 2 Data List in this section.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Tech 2 Data List in this section. • Use the Tech 2 to compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance on the low reference circuit and signal circuit or for a skewed sensor. • Use the Tech 2 to observe the Fuel Rail Pressure (FRP) Sensor parameter with the engine OFF. The FRP Sensor on the Tech 2 should read 0.9 – 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 2 minutes. If not, check for high resistance in the 5 volts reference circuit, low reference circuit, signal circuits or for a skewed sensor. • Use the Tech 2 to observe the Differential Fuel Rail Pressure parameter at idle and W.O.T. (accelerator pedal full travel) in Neutral. Differential Fuel Rail Pressure parameter should always be within ± 5 MPa (± 725 psi). • Use the Tech 2 to observe the Boost Pressure and Barometric Pressure (BARO) with ignition ON and engine OFF. Boost Pressure and BARO parameters should be within the 1.0 psi (7.0 kPa) each other. • Use the Tech 2 to observe the Accelerator Pedal Position (APP) Angle. APP Angle parameter should change linearly from 0% to 100% according to the accelerator pedal operation.

Checks	Action
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System Check Chart and appropriate procedure in the Fuel System section. • Install a fuel pressure / vacuum gauge (5-8840-2844-0 / J-44638) between the fuel filter and fuel tank to check the fuel pressure. If the fuel pressure at any engine speed is a larger vacuum than 5 inHg, a restriction exists in the fuel supply lines between the fuel tank and the fuel supply pump. • Inspect the fuel supply pump operation. **Notice:** The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. • Perform the Injector Balancing test with the Tech 2. Repair the wire or replace the appropriate fuel injector that does not change engine speed when commanded OFF. • Perform the Injector Forced Drive test with the Tech 2. Repair the wire or replace the appropriate fuel injector that does not create a clicking noise (solenoid operating noise), contents an interrupted noise or has abnormal nose when commanded ON.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Inspect the air cleaner and air intake ducts for a restriction, holes, or leaks. • Inspect for a restriction in the turbocharger inlet duct. • Inspect the intake throttle valve for a stuck closed position. • Inspect for a restriction or leak in the intake manifold. • Inspect for a worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Refer to turbocharger inspection in the Engine Mechanical section. • Inspect for turbocharger wastegate valve operation. Refer to wastegate valve inspection in the Engine Mechanical section.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section. • Inspect the exhaust brake valve for a stuck closed position. • Inspect for a restriction in the exhaust pipes.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Inspect for poor cylinder compression. Proper compression is more than 1960 kPa (284 psi) and variation of each cylinder is less than 294 kPa (43 psi). • Improper valve timing • Improper valve gap • Broken or weak valve springs • Worn camshaft lobes
Additional Checks	• Inspect the generator output voltage. • Inspect the EGR system operating correctly. Refer to EGR Control System Check in this section. • Inspect the engine overheat condition. Refer to the Engine Cooling section. • Inspect the A/C operation.

Hesitation, Sag, Stumble

Checks	Action
DEFINITION: The vehicle has a momentary lack of response when pushing down on the accelerator. The condition can occur at any vehicle speed. The condition is usually most severe when trying to make the vehicle move from a stop. If severe enough, the condition may cause the engine to stall.	

Checks	Action
Preliminary Checks	• Diagnostic System Check – Engine Controls. • Compare the vehicle with a similar unit. Ensure the vehicle has an actual problem. • Remove the air cleaner and check for dirt, or for air ducts being plugged or restricted. Replace as necessary. • Inspect for a proper transmission shift pattern and down shift operation. • Inspect the fuel quality (cetane index). • Inspect the engine oil level and quality. • Inspect the engine control module (ECM) grounds for being clean, tight, and in their proper locations. • Inspect the programmed fuel injector ID code for each cylinder. • Inspect the Tech 2 Data List in this section.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Tech 2 Data List in this section. • Use the Tech 2 to compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance on the low reference circuit and signal circuit or for a skewed sensor. • Use the Tech 2 to observe the Fuel Rail Pressure (FRP) Sensor parameter with the engine OFF. The FRP Sensor on the Tech 2 should read 0.9 – 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 2 minutes. If not, check for high resistance in the 5 volts reference circuit, low reference circuit, signal circuits or for a skewed sensor. • Use the Tech 2 to observe the Differential Fuel Rail Pressure parameter at idle and W.O.T. (accelerator pedal full travel) in Neutral. Differential Fuel Rail Pressure parameter should always be within ± 5 MPa (± 725 psi). • Use the Tech 2 to observe the Boost Pressure and Barometric Pressure (BARO) with ignition ON and engine OFF. Boost Pressure and BARO parameters should be within the 1.0 psi (7.0 kPa) each other. • Use the Tech 2 to observe the Accelerator Pedal Position (APP) Angle. APP Angle parameter should change linearly from 0% to 100% according to the accelerator pedal operation. • Inspect the crankshaft position (CKP) sensor is tight and the flywheel teeth are not damaged. • Inspect the camshaft position (CMP) sensor is tight and the camshaft gear flange surface is not damaged.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System Check Chart and appropriate procedure in the Fuel System section. • Install a fuel pressure / vacuum gauge (5-8840-2844-0 / J-44638) between the fuel filter and fuel tank to check the fuel pressure. If the fuel pressure at any engine speed is a larger vacuum than 5 inHg, a restriction exists in the fuel supply lines between the fuel tank and the fuel supply pump. • Inspect the fuel supply pump operation. **Notice:** The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. • Perform the Injector Balancing test with the Tech 2. Repair the wire or replace the appropriate fuel injector that does not change engine speed when commanded OFF. • Perform the Injector Forced Drive test with the Tech 2. Repair the wire or replace the appropriate fuel injector that does not create a clicking noise (solenoid operating noise), contents an interrupted noise or has abnormal nose when commanded ON.

Checks	Action
Air Intake System Checks	Inspect the air intake system for the following conditions. • Inspect the air cleaner and air intake ducts for a restriction, holes, or leaks. • Inspect for a restriction in the turbocharger inlet duct. • Inspect the intake throttle valve for a stuck closed position. • Inspect for a restriction or leak in the intake manifold. • Inspect for a worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Refer to turbocharger inspection in the Engine Mechanical section. • Inspect for turbocharger wastegate valve operation. Refer to wastegate valve inspection in the Engine Mechanical section.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section. • Inspect for a restriction in the exhaust pipes.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Inspect for poor cylinder compression. Proper compression is more than 1960 kPa (284 psi) and variation of each cylinder is less than 294 kPa (43 psi). • Improper valve timing • Improper valve gap • Broken or weak valve springs • Worn camshaft lobes
Additional Checks	• Inspect the generator output voltage. • Inspect the EGR system operating correctly. Refer to EGR Control System Check in this section. • Inspect the engine overheat condition. Refer to the Engine Cooling section. • Inspect the A/C operation.

Fuel Knock / Combustion Noise

Checks	Action
DEFINITION: A mild to severe ping, usually worse under acceleration. The engine makes sharp metallic knocks that change with the throttle opening.	
Preliminary Checks	• Diagnostic System Check – Engine Controls. • Ensure the vehicle has an actual problem. • Inspect for smoke associated with the combustion noise. • Inspect the fuel quality (cetane index). • Inspect the programmed fuel injector ID code for each cylinder. • Inspect the Tech 2 Data List in this section.

Checks	Action
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Tech 2 Data List in this section. • Use the Tech 2 to compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance on the low reference circuit and signal circuit or for a skewed sensor. • Use the Tech 2 to observe the Fuel Rail Pressure (FRP) Sensor parameter with the engine OFF. The FRP Sensor on the Tech 2 should read 0.9 – 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 2 minutes. If not, check for high resistance in the 5 volts reference circuit, low reference circuit, signal circuits or for a skewed sensor. • Use the Tech 2 to observe the Differential Fuel Rail Pressure parameter at idle and W.O.T. (accelerator pedal full travel) in Neutral. Differential Fuel Rail Pressure parameter should always be within ± 5 MPa (± 725 psi). • Inspect the crankshaft position (CKP) sensor is tight and the flywheel teeth are not damaged. • Inspect the camshaft position (CMP) sensor is tight and the camshaft gear flange surface is not damaged.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to Fuel System Check Chart and appropriate procedure in the Fuel System section. • Install a fuel pressure / vacuum gauge (5-8840-2844-0 / J-44638) between the fuel filter and fuel tank to check the fuel pressure. If the fuel pressure at any engine speed is a larger vacuum than 5 inHg, a restriction exists in the fuel supply lines between the fuel tank and the fuel supply pump. • Inspect the fuel supply pump operation. **Notice:** The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. • Inspect the fuel injectors. Remove the injectors and visually inspect. • Perform the Injector Balancing test with the Tech 2. Repair the wire or replace the appropriate fuel injector that does not change engine speed when commanded OFF. • Perform the Injector Forced Drive test with the Tech 2. Repair the wire or replace the appropriate fuel injector that does not create a clicking noise (solenoid operating noise), contents an interrupted noise or has abnormal nose when commanded ON. • Perform the Pre Injection Stop test with the Tech 2. Replace the injectors if engine noise does not change when commanded Stop. • Use the Tech 2 to observe the Cylinder Compensation for each cylinder at idle. If there is a cylinder that is excessively high or low value, it may indicate faulty fuel injector, weak or slightly seized cylinder or an incorrectly programmed fuel injector ID code.
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Inspect for poor cylinder compression. Proper compression is more than 1960 kPa (284 psi) and variation of each cylinder is less than 294 kPa (43 psi). • Inspect for incorrect basic engine parts such as camshaft, cylinder head, pistons, etc. • Inspect for any excessive oil entering combustion chamber.
Additional Checks	• Inspect the EGR system operating correctly. Refer to EGR Control System Check in this section. • Inspect other possible causes that can make similar noise such as loose component parts, bracket, mount and weak clutch damper spring.

Poor Fuel Economy

<table>
<tr><th>Checks</th><th>Action</th></tr>
<tr><td colspan="2">DEFINITION: Fuel economy, as measured by actual road tests and several tanks of fuel, is noticeably lower than expected. Also, the economy is noticeably lower than it was on this vehicle at one time, as previously shown by actual road tests.</td></tr>
<tr><td>Preliminary Checks</td><td>• Remove the air cleaner and check for dirt, or for air ducts being plugged or restricted. Replace as necessary.
• Inspect the driving habits of the owner.
• Is the A/C ON full time, defroster mode ON?
• Are the tires at the correct pressure?
• Are the tire sizes changed
• Are excessively heavy loads being carried?
• Is the acceleration too much, too often?
• Inspect for clutch slip.
• Inspect brake drag.
• Inspect dive belt tension.
• Inspect for a proper transmission shift pattern and down shift operation.
• Inspect the fuel quality (cetane index).
• Inspect the engine oil level and quality.
• Suggest to the owner to fill the fuel tank and recheck the fuel economy.
• Suggest to the driver to read the Important Facts on Fuel Economy in the Owner Manual.
• Inspect the odometer is correctly operated.
• Inspect the programmed fuel injector ID code for each cylinder.</td></tr>
<tr><td>Sensor Checks</td><td>Inspect the engine control sensors for the following conditions. Refer to the Tech 2 Data List in this section.
• Use the Tech 2 to compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance on the low reference circuit and signal circuit or for a skewed sensor.</td></tr>
<tr><td>Fuel System Checks</td><td>Inspect the fuel system for the following conditions. Refer to the Fuel System section.
• Inspect the fuel type and quality.
• Check fuel leak.</td></tr>
<tr><td>Cooling System Checks</td><td>Inspect the cooling system for the following conditions. Refer to the Cooling System Section.
• Inspect the engine coolant level.
• Inspect the engine thermostat for always being open or for the wrong heat range.
• Inspect the engine cooling fan for always being ON.</td></tr>
<tr><td>Air Intake System Checks</td><td>Inspect the air intake system for the following conditions.
• Inspect the air cleaner and air intake ducts for a restriction, holes, or leaks.
• Inspect for a restriction in the turbocharger inlet duct.
• Inspect the intake throttle valve for a stuck closed position.
• Inspect for a restriction or leak in the intake manifold.</td></tr>
<tr><td>Exhaust System Checks</td><td>Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section.
• Inspect the exhaust brake valve for a stuck closed position.
• Inspect for a restriction in the exhaust pipes.</td></tr>
<tr><td>Engine Mechanical Checks</td><td>Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section.
• Inspect for poor cylinder compression. Proper compression is more than 1960 kPa (284 psi) and variation of each cylinder is less than 294 kPa (43 psi).</td></tr>
</table>

Excessive Smoke (Black Smoke)

Checks	Action
DEFINITION: Black smoke under load, idle or start up hot or cold.	
Preliminary Check	• Ensure the vehicle has an actual problem. • Inspect the engine control module (ECM) grounds for being clean, tight, and in their proper locations. • Remove the air cleaner and check for dirt, or for air ducts being plugged or restricted. Replace as necessary. • Inspect the fuel quality (cetane index). • Inspect the engine oil level and quality. • Inspect the programmed fuel injector ID code for each cylinder.
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Tech 2 Data List in this section. • Use the Tech 2 to compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance on the low reference circuit and signal circuit or for a skewed sensor. • Use the Tech 2 to observe the Fuel Rail Pressure (FRP) Sensor parameter with the engine OFF. The FRP Sensor on the Tech 2 should read 0.9 – 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 2 minutes. If not, check for high resistance in the 5 volts reference circuit, low reference circuit, signal circuits or for a skewed sensor. • Use the Tech 2 to observe the Differential Fuel Rail Pressure parameter at idle and W.O.T. (accelerator pedal full travel) in Neutral. Differential Fuel Rail Pressure parameter should always be within ± 5 MPa (± 725 psi). • Use the Tech 2 to observe the Boost Pressure and Barometric Pressure (BARO) with ignition ON and engine OFF. Boost Pressure and BARO parameters should be within the 1.0 psi (7.0 kPa) each other. • Use the Tech 2 to observe the Accelerator Pedal Position (APP) Angle. APP Angle parameter should change linearly from 0% to 100% according to the accelerator pedal operation.
Fuel System Checks	Inspect the fuel system for the following conditions. Refer to the Fuel System section. • Inspect the fuel supply pump operation. **Notice:** The fuel supply pump must be timed to the engine and adjustment value must be learned to the ECM. • Perform the Injector Balancing test with the Tech 2. Repair the wire or replace the appropriate fuel injector that does not change engine speed when commanded OFF. • Perform the Injector Forced Drive test with the Tech 2. Repair the wire or replace the appropriate fuel injector that does not create a clicking noise (solenoid operating noise), contents an interrupted noise or has abnormal nose when commanded ON. • Use the Tech 2 to observe the Cylinder Compensation for each cylinder at idle. If there is a cylinder that is excessively high or low value, it may indicate faulty fuel injector, weak or slightly seized cylinder or an incorrectly programmed fuel injector ID code. • Inspect the fuel injectors. Remove the injectors and visually inspect.

Checks	Action
Air Intake System Checks	Inspect the air intake system for the following conditions. • Inspect the air intake system for the following conditions. • Inspect the air cleaner and air intake ducts for a restriction, holes, or leaks. • Inspect for a restriction in the turbocharger inlet duct. • Inspect the intake throttle valve for a stuck closed position. • Inspect for a restriction or leak in the intake manifold. • Inspect for a worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Refer to turbocharger inspection in the Engine Mechanical section.
Exhaust System Checks	Inspect the exhaust system for a possible restriction. Refer to the Exhaust System section. • Inspect the exhaust brake valve for a stuck closed position. • Inspect for a restriction in the exhaust pipes.
Engine Mechanical Check	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Inspect for poor cylinder compression. Proper compression is more than 1960 kPa (284 psi) and variation of each cylinder is less than 294 kPa (43 psi). • Inspect for incorrect basic engine parts such as camshaft, cylinder head, pistons, etc. • Inspect for any excessive oil entering combustion chamber. • Improper valve timing • Improper valve gap • Broken or weak valve springs • Worn camshaft lobes
Additional Checks	• Inspect the EGR system operating correctly. Refer to EGR Control System Check in this section. • Inspect the excessive blow-by gasses. • Inspect the Tech 2 Data List in this section.

Excessive Smoke (White Smoke)

Checks	Action
DEFINITION: White smoke under load, idle or start up hot or cold.	
Preliminary Check	• Ensure the vehicle has an actual problem. • Inspect the engine control module (ECM) grounds for being clean, tight, and in their proper locations. • Inspect the fuel quality (cetane index). • Inspect the programmed fuel injector ID code for each cylinder.

Checks	Action
Sensor Checks	Inspect the engine control sensors for the following conditions. Refer to the Tech 2 Data List in this section. • Use the Tech 2 to compare the Coolant Temperature with the Intake Air Temperature (IAT) and Fuel Temperature (FT) on a cold engine condition. If the difference among temperature reading is more than 5°C (9°F) on a cold engine, check for high resistance on the low reference circuit and signal circuit or for a skewed sensor. • Use the Tech 2 to observe the Fuel Rail Pressure (FRP) Sensor parameter with the engine OFF. The FRP Sensor on the Tech 2 should read 0.9 – 1.0 volt with the key ON and engine OFF after the engine has stopped running for a minimum of 2 minutes. If not, check for high resistance in the 5 volts reference circuit, low reference circuit, signal circuits or for a skewed sensor. • Use the Tech 2 to observe the Differential Fuel Rail Pressure parameter at idle and W.O.T. (accelerator pedal full travel) in Neutral. Differential Fuel Rail Pressure parameter should always be within ± 5 MPa (± 725 psi). • Use the Tech 2 to observe the Boost Pressure and Barometric Pressure (BARO) with ignition ON and engine OFF. Boost Pressure and BARO parameters should be within the 1.0 psi (7.0 kPa) each other. • Use the Tech 2 to observe the Accelerator Pedal Position (APP) Angle. APP Angle parameter should change linearly from 0% to 100% according to the accelerator pedal operation. • Inspect the crankshaft position (CKP) sensor is tight and the flywheel teeth are not damaged. • Inspect the camshaft position (CMP) sensor is tight and the camshaft gear flange surface is not damaged.
Fuel System Checks	• Check for a stuck open fuel injector. Remove each glow plug from the cylinder head and inspect the tip of the glow plugs for wet fuel. Use the cylinder compression gauge. Proper compression is more than 1960 kPa (284 psi) and variation of each cylinder is less than 294 kPa (43 psi). If poor compression is observed, inspect the engine mechanical. • Perform the Injector Balancing test with the Tech 2. Repair the wire or replace the appropriate fuel injector that does not change engine speed when commanded OFF. • Perform the Injector Forced Drive test with the Tech 2. Repair the wire or replace the appropriate fuel injector that does not create a clicking noise (solenoid operating noise), contents an interrupted noise or has abnormal nose when commanded ON. • Use the Tech 2 to observe the Cylinder Compensation for each cylinder at idle. If there is a cylinder that is excessively high or low value, it may indicate faulty fuel injector, weak or slightly seized cylinder or an incorrectly programmed fuel injector ID code. • Inspect the fuel injectors. Remove the injectors and visually inspect.
Air Intake System Checks	Inspect the air intake system for the following conditions. • Inspect the air intake system for the following conditions. • Inspect the air cleaner and air intake ducts for a restriction, holes, or leaks. • Inspect for a restriction in the turbocharger inlet duct. • Inspect the intake throttle valve for a stuck closed position. • Inspect for a restriction or leak in the intake manifold. • Inspect for a worn or damaged turbocharger turbine wheel, shaft or compressor wheel. Refer to turbocharger inspection in the Engine Mechanical section.

Checks	Action
Engine Mechanical Checks	Inspect the engine mechanical for the following conditions. Refer to the Engine Mechanical section. • Inspect for poor cylinder compression. Proper compression is more than 1960 kPa (284 psi) and variation of each cylinder is less than 294 kPa (43 psi). • Inspect for incorrect basic engine parts such as camshaft, cylinder head, pistons, etc. • Improper valve timing • Improper valve gap • Broken or weak valve springs • Worn camshaft lobes • Inspect for any excessive fuel entering combustion chamber. • Inspect for coolant entering the combustion chamber.
Electrical System Checks	Inspect the engine electrical for the following conditions. • Inspect the glow plug control (preheating) system operation. Refer to Glow Control System Check in this section.

Repair Instructions

Engine Control Module (ECM) Replacement / Fuel Injector ID Code Data Programming

If the ECM is replaced the Fuel Injector ID Code Data (24, 0-9 or A-F characters for each fuel injector) MUST be reprogrammed into the new ECM.

Uploading the Fuel Injector ID Code Data from the ECM

Important:
Only perform this procedure if the ECM is being replaced. The current fuel injector ID code data can be determined with the Tech 2. If the ECM does not communicate with the Tech 2, go to the next procedure.

1. Install the Tech 2.
2. Turn ON the ignition, with the engine OFF.
3. Select Diagnostics > appropriate vehicle identification > 4HK1 (Common Rail) > Programming > Injector ID Code > Upload ID Code.
4. After complete the upload, turn OFF the Tech 2.
5. Turn OFF the ignition.

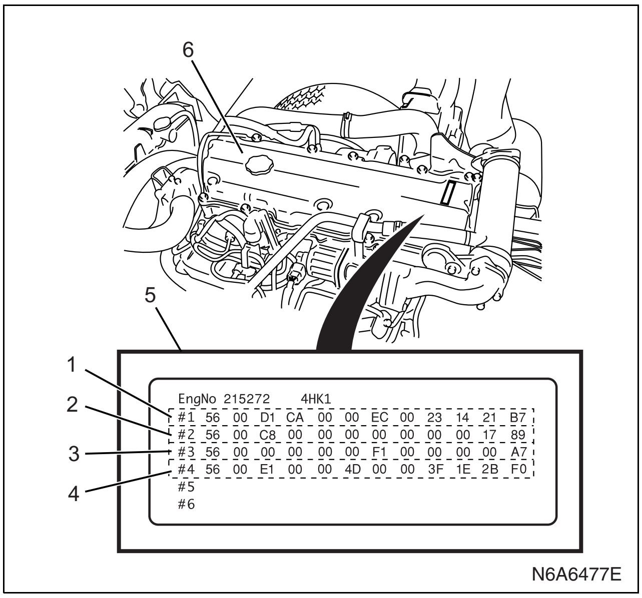
Retrieving the Fuel Injector ID Code Data with a Non-communicating ECM

Important:
Only perform following procedure if the ECM is being replaced and the Tech 2 does not communicate. The current fuel injector ID code data can not be determined with the Tech 2, the fuel injector numbers must be recorded from the factory affixed label on the cylinder head cover or each fuel injector ID plate.

Recording from the label on cylinder head cover;

Important:
Only perform this procedure if the fuel injectors are not being replaced in the past.

1. Record all numbers of each cylinder on the label.

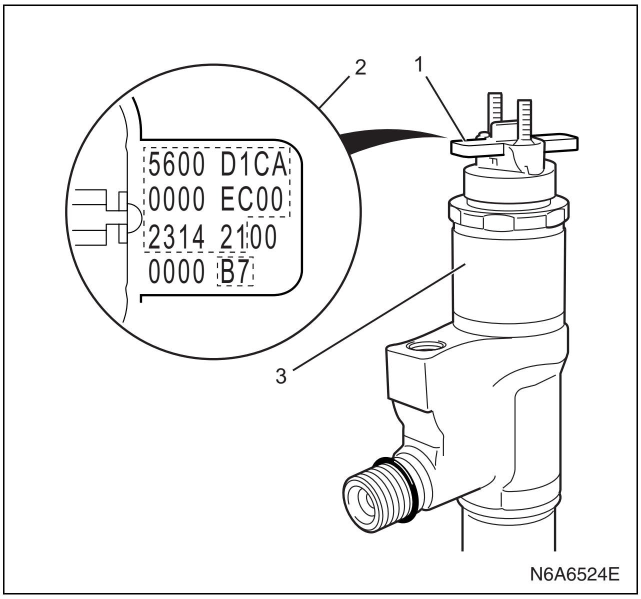


Legend

1. Cylinder Number 1 Fuel Injector ID Code
2. Cylinder Number 2 Fuel Injector ID Code
3. Cylinder Number 3 Fuel Injector ID Code
4. Cylinder Number 4 Fuel Injector ID Code
5. Injector ID Code Label
6. Cylinder Head Cover

Recording from the each fuel injector ID plate

1. Remove the cylinder head cover. Refer to Fuel Injector replacement in this section.
2. Record 24 figures of each fuel injector ID plate. The correct order for the fuel injector ID code for the following illustration is as follows:
   56 00 D1 CA 00 00 EC 00 23 14 21 B7



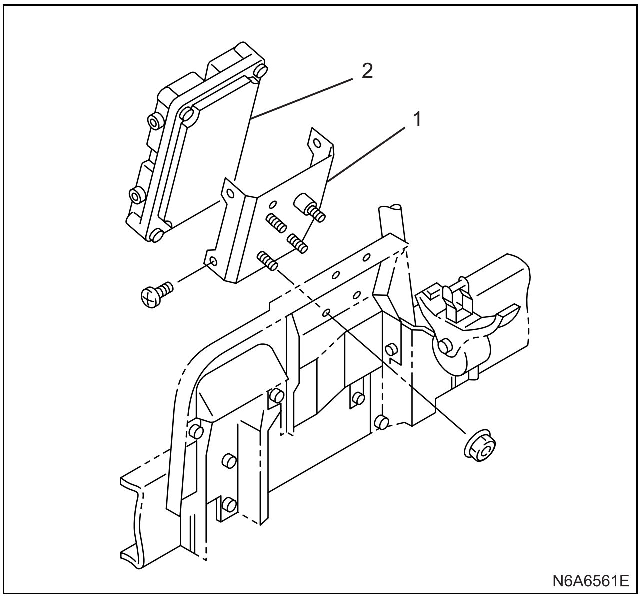
Legend

1. Fuel Injector ID Plate
2. Fuel Injector ID Code
3. Fuel Injector

Removal Procedure

Important:
Take care not to give a strong impact to the ECM.

1. Turn OFF the ignition.
2. Disconnect the negative battery cable.
3. Disconnect the ECM connectors.
4. Remove the ECM bracket fixing nuts.
5. Remove the ECM bracket with the ECM.
6. Remove the ECM fixing bolts.
7. Remove the ECM.



Legend

1. ECM Bracket
2. ECM

Installation Procedure

Important:
Do not use a fallen ECM or the ECM that received a strong impact.

1. Install the ECM on the ECM bracket.

   Tighten:
   Bolts to 8.6 — 13.5 N·m (0.88 — 1.38 kg·m / 6.4 — 10.0 lb·ft)
2. Install the ECM bracket with the ECM.
3. Tighten the ECM bracket fixing nuts.
4. Connect the ECM connectors.
5. Connect the negative battery cable.

Fuel Injector ID Code Data Programming Procedure

Important:
Only perform this procedure if the fuel injector ID code data can be uploaded with the Tech 2. If the ECM can not be uploaded with the Tech 2, go to the next procedure.

1. Install the Tech 2.
2. Turn ON the ignition, with the engine OFF.
3. Select Diagnostics > appropriate vehicle identification > 4HK1 (Common Rail) > Programming > Injector ID Code > Download ID Code.
4. After complete the download, turn OFF the ignition for 30 second.
5. Turn ON the ignition.
6. Select Diagnostics > appropriate vehicle identification > 4HK1 (Common Rail) > Programming > Injector ID Code > Injector ID Code. At this point, all downloaded fuel injector ID code data can be verified. Compare the ID code values downloaded into the ECM and each fuel injector.
7. Start the engine and let idle.

Important:
In order to make the fuel supply pump characteristic learn into the replaced ECM, let the engine idle until warm-up. If the fuel system DTC's stored in the meantime, once clear DTC and warm-up the engine again.

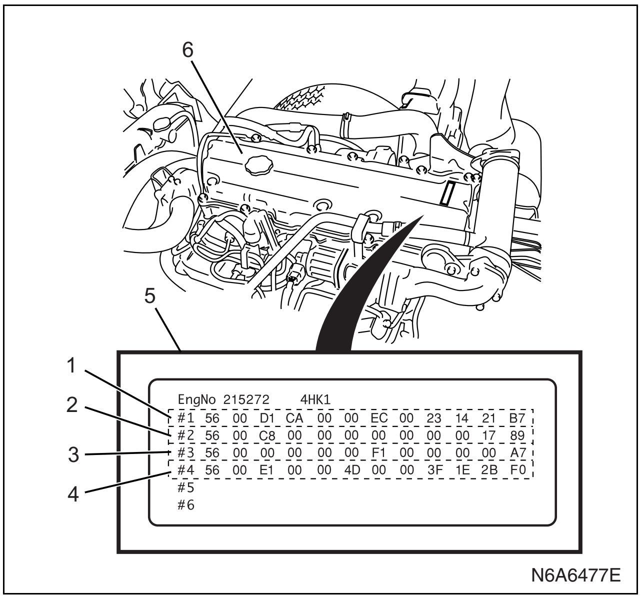
8. Inspect for a proper engine running condition and for no DTC's. Refer to the Diagnostic System Check-Engine Controls if needed.

Important:
If the current injector ID code data can not be uploaded with the Tech 2, the recorded all numbers must be entered into the Tech 2.

1. Install the Tech 2.
2. Turn ON the ignition, with the engine OFF.

3. Select Diagnostics > appropriate vehicle identification > 4HK1 (Common Rail) > Programming > Injector ID Code > ID Code Registration.
4. Select the cylinder 1 to 4 and press Change. If the ID code data are recorded from the label on cylinder head cover, go to a..
   If the ID code data are recorded from the each fuel injector ID plate, go to b..
   a. Input 22 figures. The correct order for the cylinder number 1 fuel injector ID code for the following illustration is as follows:
      56 00 D1 CA 00 00 EC 00 23 14 21

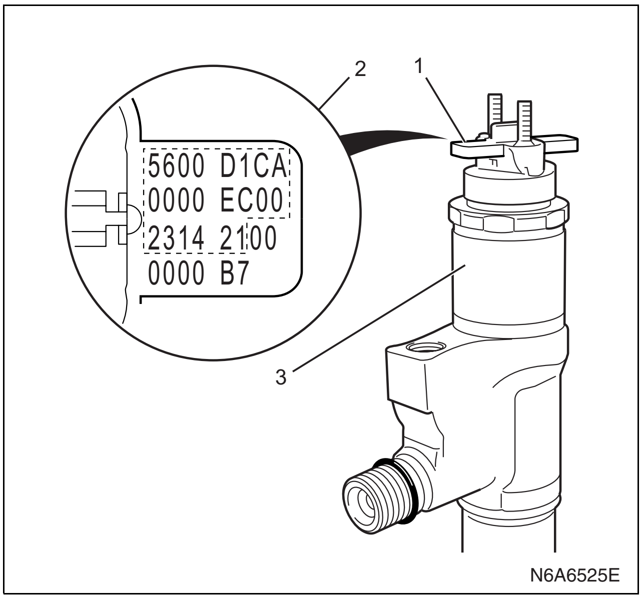
Important:
The number of places required for input is 22 figures except last 2 figures.



Legend
1. Cylinder Number 1 Fuel Injector ID Code
2. Cylinder Number 2 Fuel Injector ID Code
3. Cylinder Number 3 Fuel Injector ID Code
4. Cylinder Number 4 Fuel Injector ID Code
5. Injector ID Code Label
6. Cylinder Head Cover

   b. Input 22 figures. Then, input in order from the left edge of upper sequence to the right edge of lower sequence. The correct order for the fuel injector ID code for the following illustration is as follows:
      56 00 D1 CA 00 00 EC 00 23 14 21

Important:
The number of places required for input is 22 figures except last 2 figures.



Legend
1. Fuel Injector ID Plate
2. Fuel Injector ID Code
3. Fuel Injector

5. After complete the registration, turn OFF the ignition for 30 second.
6. Turn ON the ignition.
7. Select Diagnostics > appropriate vehicle identification > 4HK1 (Common Rail) > Programming > Injector ID Code > Injector ID Code. At this point, all registered fuel injector ID code data can be verified. Compare the ID code values registered into the ECM and each fuel injector including the last 2 figures. If the registered ID code is incorrect, go back to Step 4 ID Code Registration.
8. Start the engine and let idle.

Important:
In order to make the fuel supply pump characteristic learn into the replaced ECM, let the engine idle until warm-up. If the fuel system DTC's stored in the meantime, once clear DTC and warm-up the engine again.

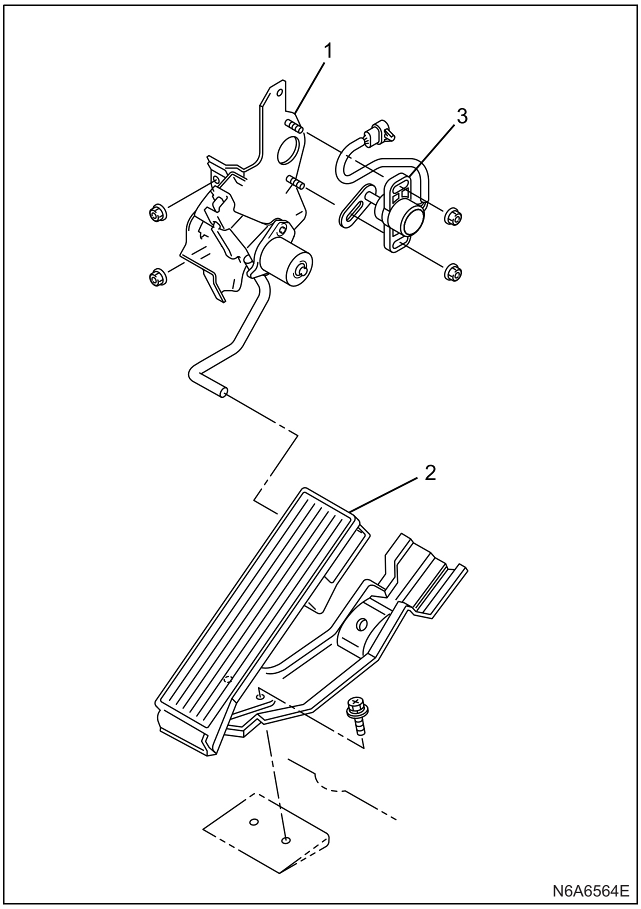
9. Inspect for a proper engine running condition and for no DTC's. Refer to the Diagnostic System Check-Engine Controls if needed.

Accelerator Pedal Position (APP) Sensor Replacement

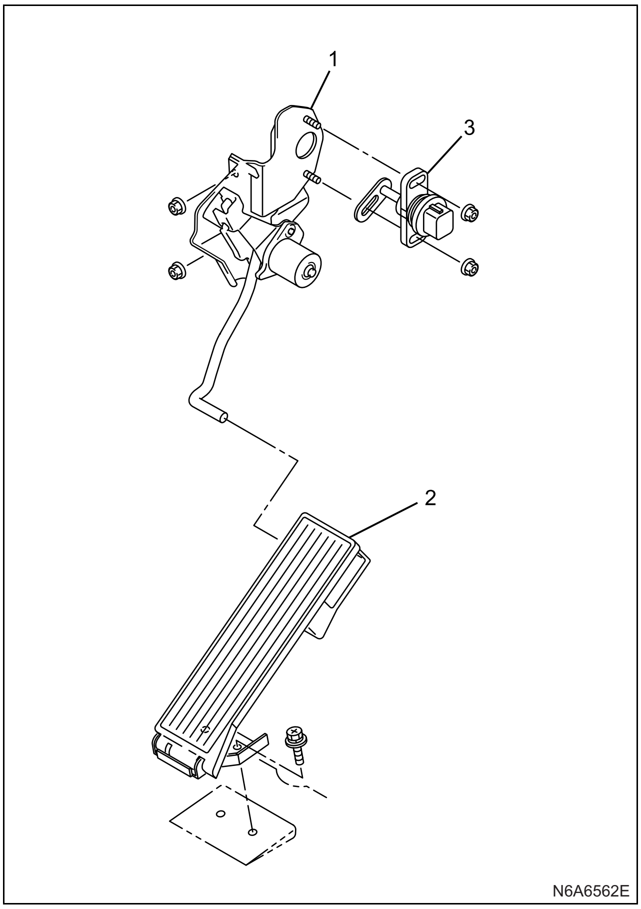
Removal Procedure

1. Turn off the ignition.
2. Disconnect the negative battery cable.
3. Remove the control link bracket assembly (1) fixing nuts.

- LHD Model



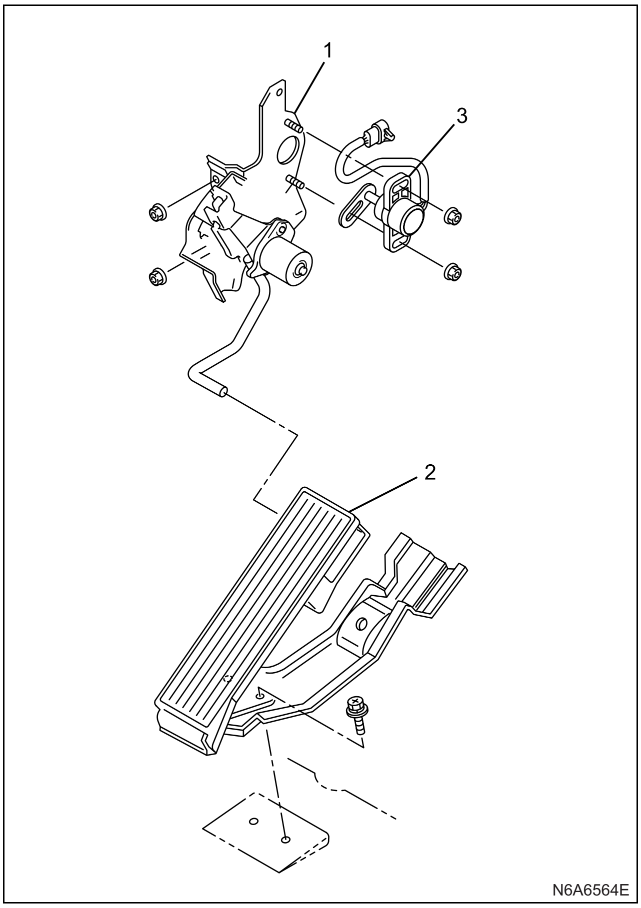
- RHD Model



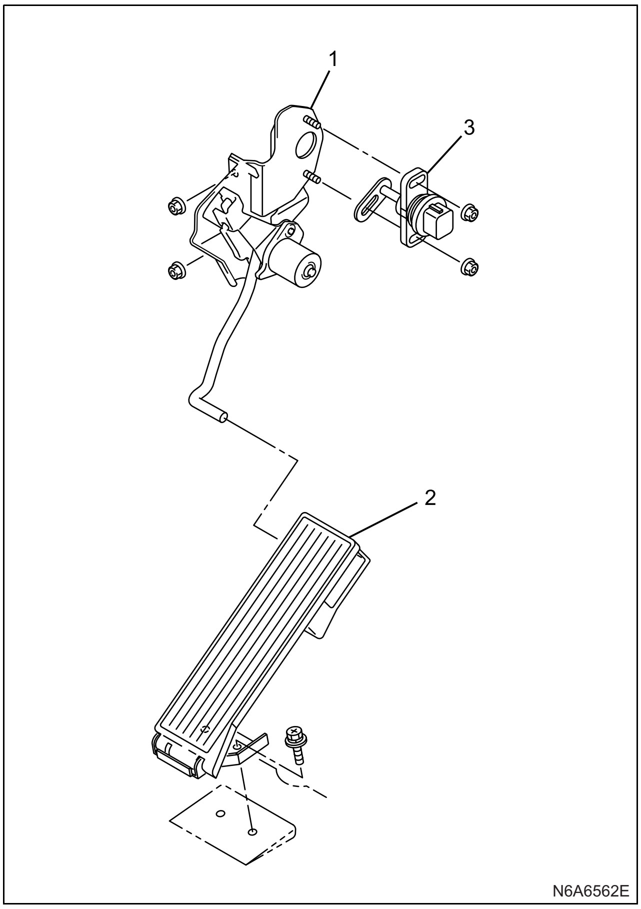
4. Remove the pedal assembly (2) fixing bolts.
5. Disconnect the accelerator pedal position (APP) sensor (3) connector.
6. Remove the APP sensor (3) fixing nuts.

Installation Procedure

- LHD Model



- RHD Model

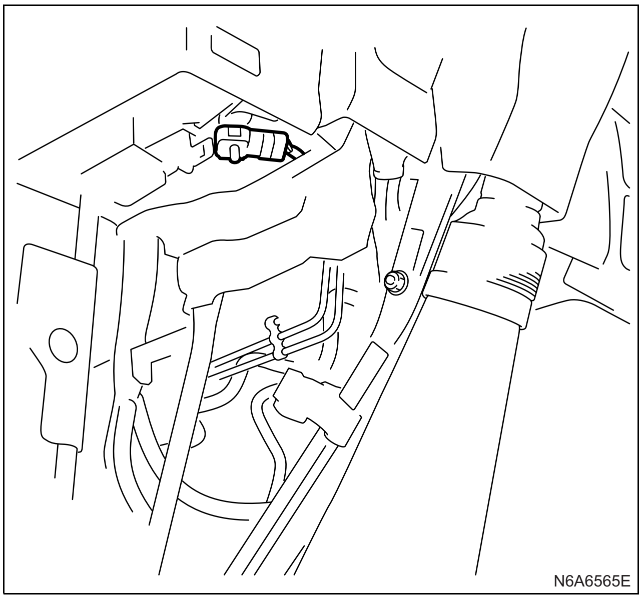


1. Install the APP sensor (3) on the control link bracket assembly (1).
2. Connect the APP sensor (3) connector.
3. Install the pedal assembly (2).
4. Install the control link bracket assembly (1).
5. Connect the nagative battery cable.

Barometric Pressure (BARO) Sensor Replacement

Removal Procedure

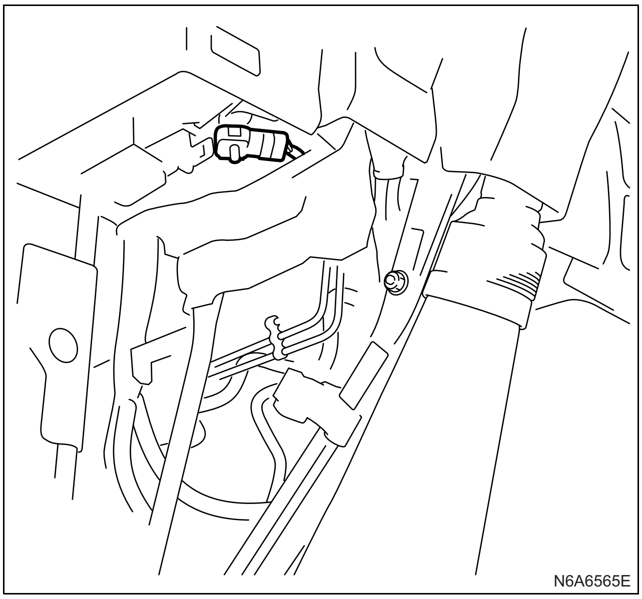
1. Turn off the ignition.
2. Disconnect the negative battery cable.
3. Disconnect the barometric pressure (BARO) sensor connector that is located under the instrument panel cluster (IPC).



4. Remove the BARO sensor.

Installation Procedure

1. Install the BARO sensor on the installation bracket.

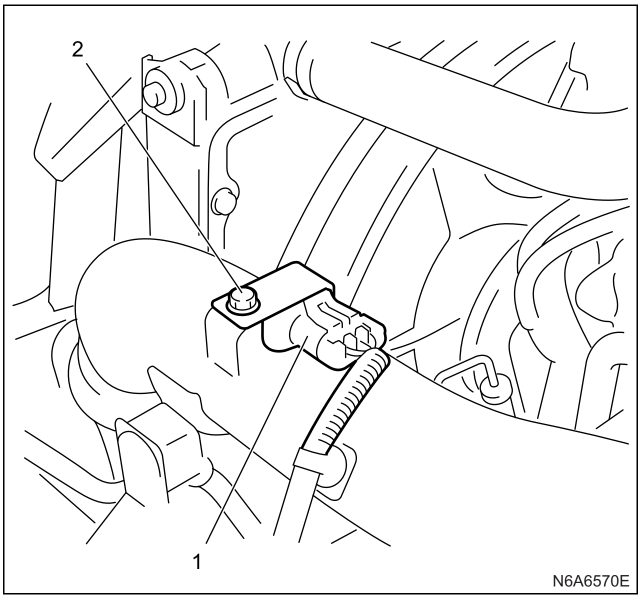


2. Connect the BARO sensor connector.
3. Connect the nagative battery cable.

Boost Pressure Sensor Replacement

Removal Procedure

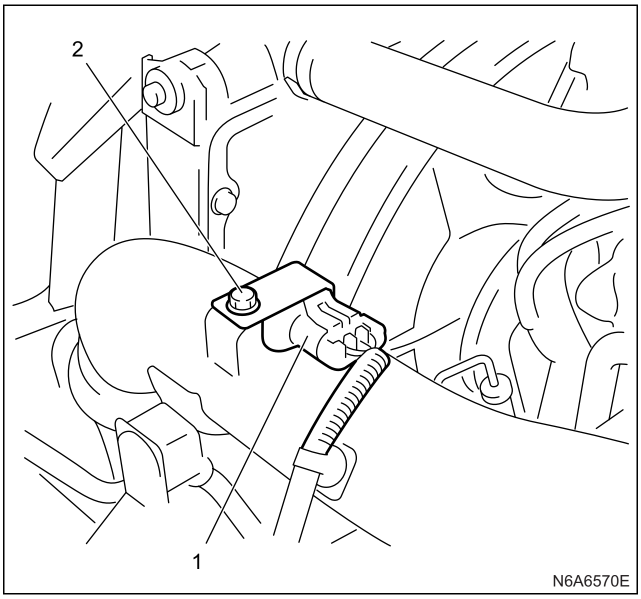
1. Turn off the ignition.
2. Loosen the boost pressure sensor bolt (2).
3. Disconnect the boost pressure sensor connector.
4. Remove the boost pressure sensor (1).



Installation Procedure

1. Install the boost pressure sensor (1).
2. Tighten the boost pressure sensor bolt (2).

   Tighten:
   Bolt to 8 N·m (0.8 kg·m / 69 lb·in)

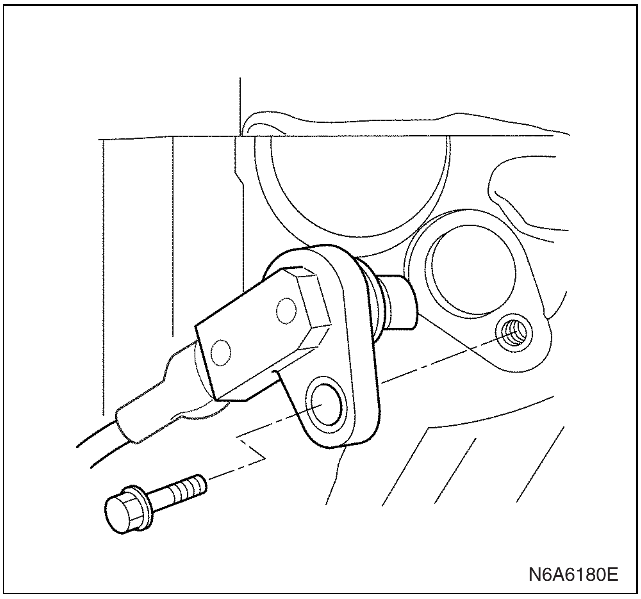


3. Connect the boost pressure sensor connector.

Camshaft Position (CMP) Sensor Replacement

Removal Procedure

1. Turn off the ignition.
2. Loosen the camshaft position (CMP) sensor retaining bolt.

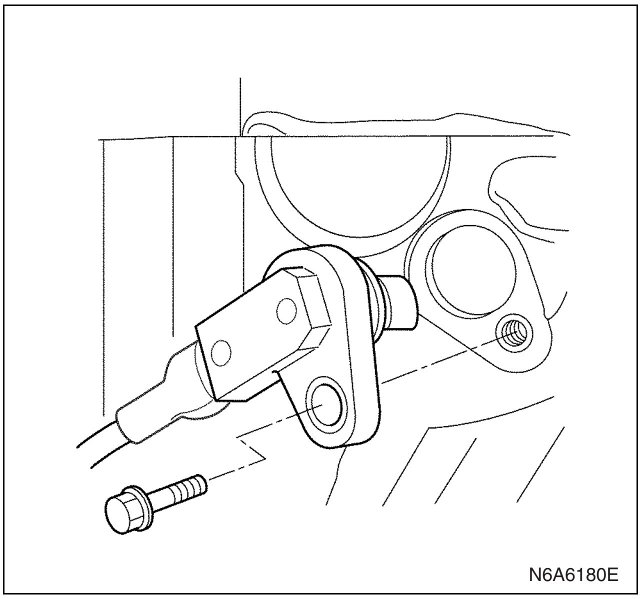


3. Remove the CMP sensor.

Installation Procedure

1. Install the CMP sensor.
   - Apply engine oil over the O-ring nice and thin and install it.
2. Tighten the CMP sensor retaining bolt.

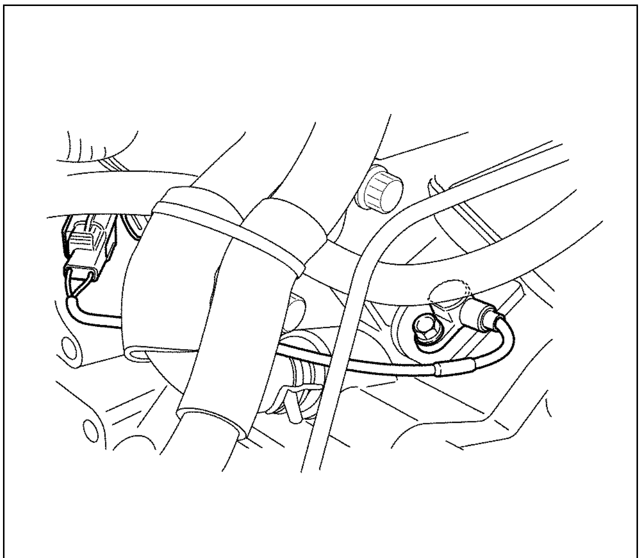
   Tighten:
   Bolt to 8 N·m (0.8 kg·m / 69 lb·in)



Crankshaft Position (CKP) Sensor Replacement

Removal Procedure

1. Disconnect the negative battery cable.
2. Loosen the crankshaft position (CKP) sensor retaining bolt.



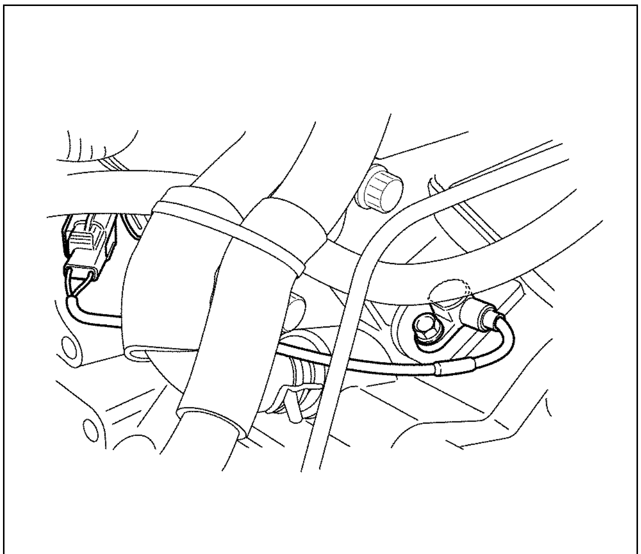
N6A6056E

3. Remove the CKP sensor.

Installation Procedure

1. Install the CKP sensor.
2. Tighten the CKP sensor retaining bolt.

   Tighten:
   Bolt to 8 N·m (0.8 kg·m / 69 lb·in)

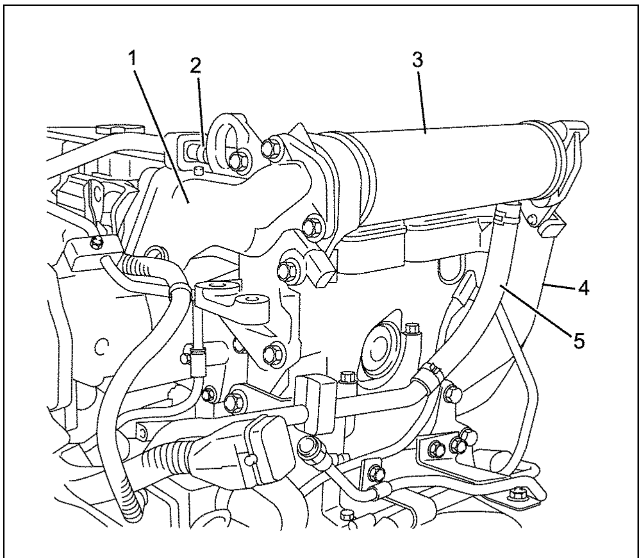


N6A6056E

EGR Valve Replacement

Removal Procedure

1. Drain engine coolant. Refer to Engine Cooling System section.
2. Remove the EGR valve connector.
3. Remove the EGR pipe.



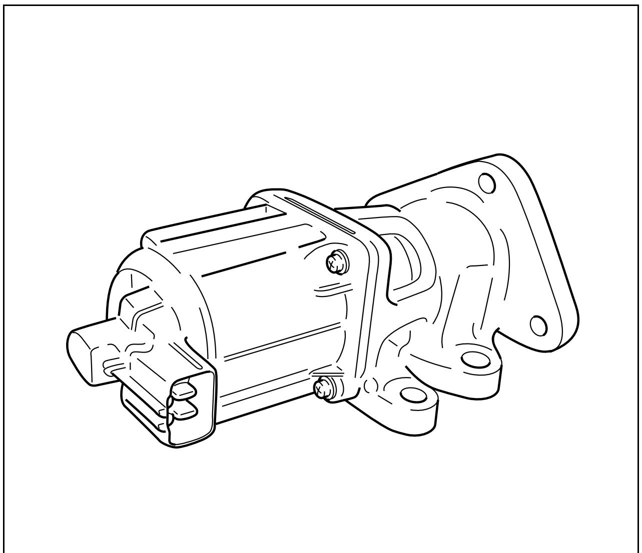
N6A6025E

Legend

1. EGR Adapter
2. Water Return Pipe
3. EGR Cooler
4. EGR Pipe
5. Water Feed Pipe

4. Remove the cooling water pipes.
5. Remove the EGR adapter.
6. Remove the EGR cooler.
7. Remove the EGR valve.

Caution:
After removing the EGR valve and EGR adapter, seal the opening so that foreign matter does not enter.



N6A6491E

Inspection Procedure

- **Gas leak check**
  - Check for gas leak in various parts of the EGR gas line.

If the results of the check show abnormalities, repair or replace the defective parts.

- **EGR valve check**

Installation Procedure

1. Mount the EGR valve.
   - Insert the gasket and temporarily fit the EGR valve.

Notice:
Temporarily tighten the bolts.

2. Install the EGR cooler.
   - Temporarily fit the EGR cooler to the bracket.

Notice:
Temporarily tighten the bolts.

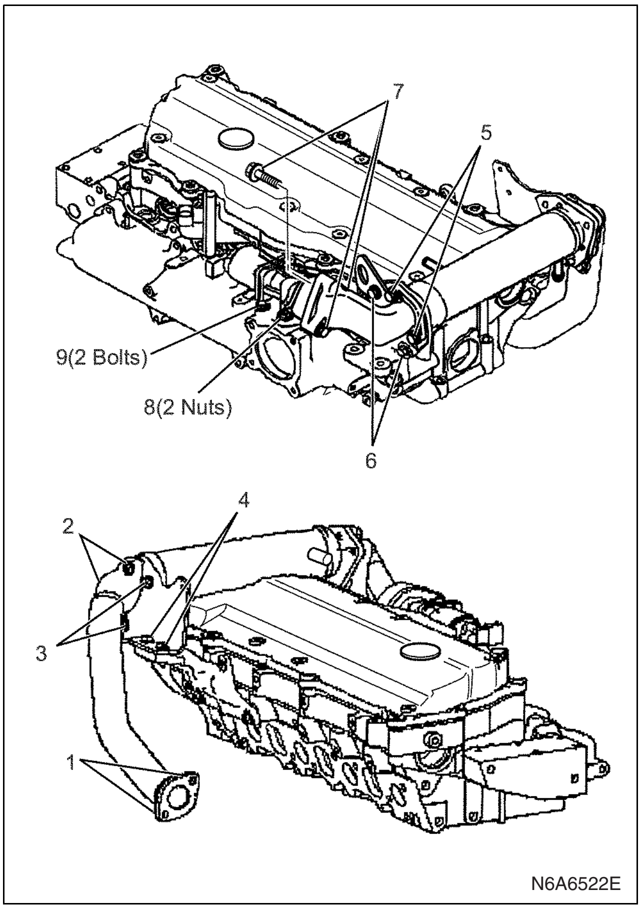
3. Install the EGR adapter.
   - Temporarily fit the EGR adapter between the EGR cooler and exhaust manifold.

Notice:
Temporarily tighten the bolts.

4. Install the EGR pipe.
   - Insert the gasket between the two ends of the EGR pipe and temporarily fit it.

Notice:
Temporarily tighten the bolts.

During temporary assembly, tighten the nuts and bolts to the specified torque in the order shown in the illustration.



Legend

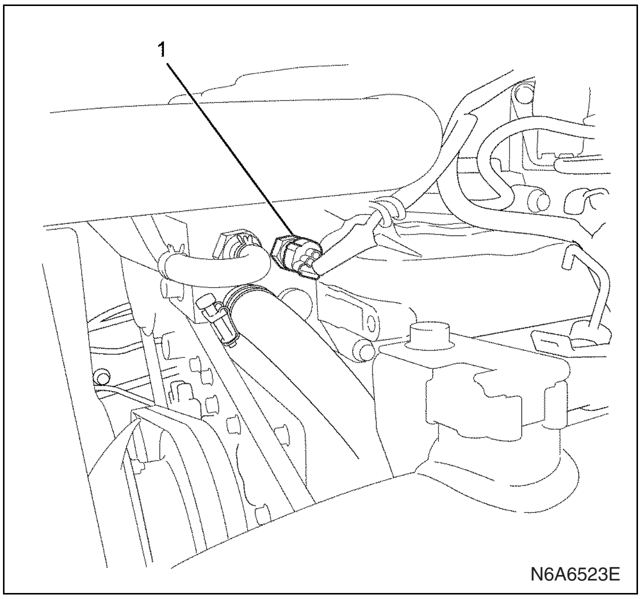
1 ~ 9 Show The Order of Tighten Bolts and Nuts.

Tighten:
1 : 31 N·m (3.2 kg·m / 23 lb·ft)
2, 4 : 28 N·m (2.9 kg·m / 21 lb·ft)
3, 5, 6, 7, 8, 9 : 24 N·m (2.4 kg·m / 17 lb·ft)

Engine Coolant Temperature (ECT) Sensor Replacement

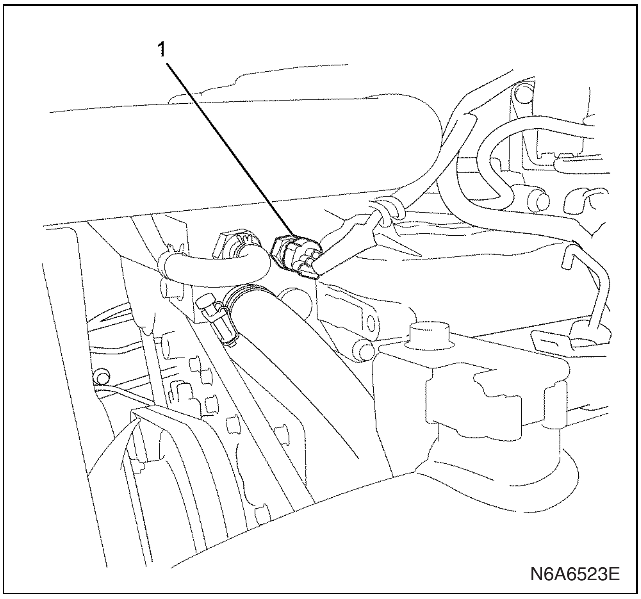
Removal Procedure

1. Turn off the ignition.
2. Disconnect the engine coolant temperature (ECT) sensor connector.
3. Remove the ECT sensor (1).



Installation Procedure

1. Install the ECT sensor (1).



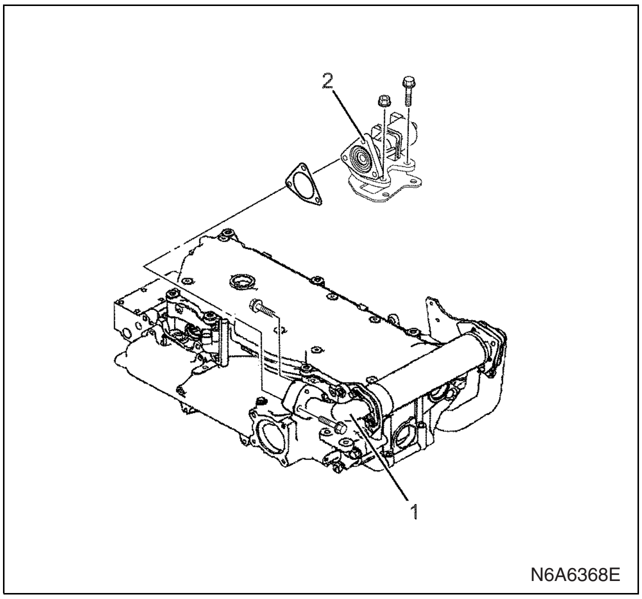
2. Connect the ECT sensor connector.
3. Replenish any lost engine coolant.

Fuel Injector Replacement / Fuel Injector ID Code Data Programming

Important:
The Fuel Injector ID Code Data Programming MUST be done when the fuel injector is being replaced. The Fuel Injector ID Code information MUST be recorded before assembling the cylinder head cover.

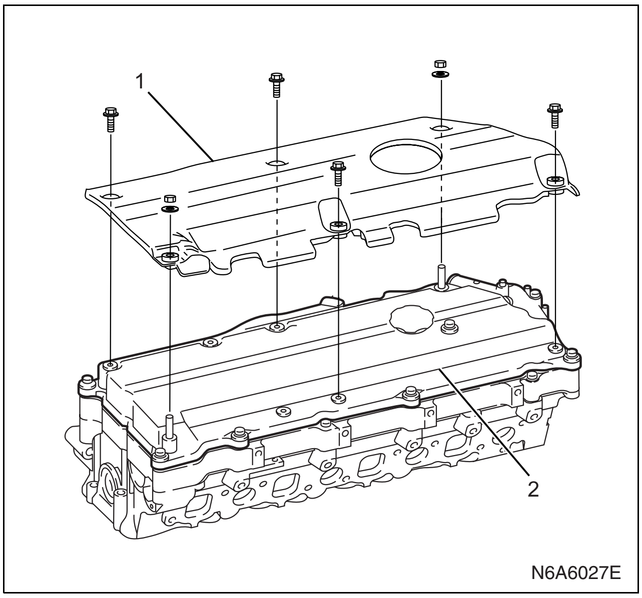
Removal Procedure

1. Remove the engine harness, the throttle position sensor, the EGR valve, the pressure sensor, and all of the fuel injector connectors.
2. Remove the EGR valve and the EGR adapter.
3. Tape the EGR case holes shut to prevent the entry of foreign material.



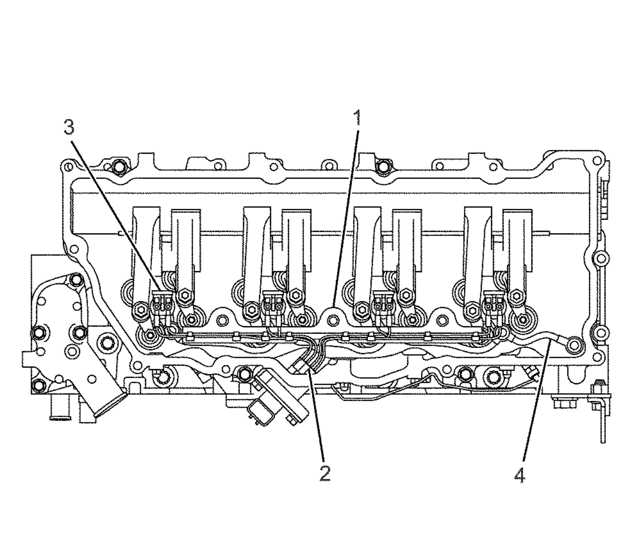
Legend
1. EGR Adapter
2. EGR Valve

4. Remove the sound insulation cover.
5. Remove the head cover.



Legend
1. Sound Insulation Cover (For Europe)
2. Head Cover

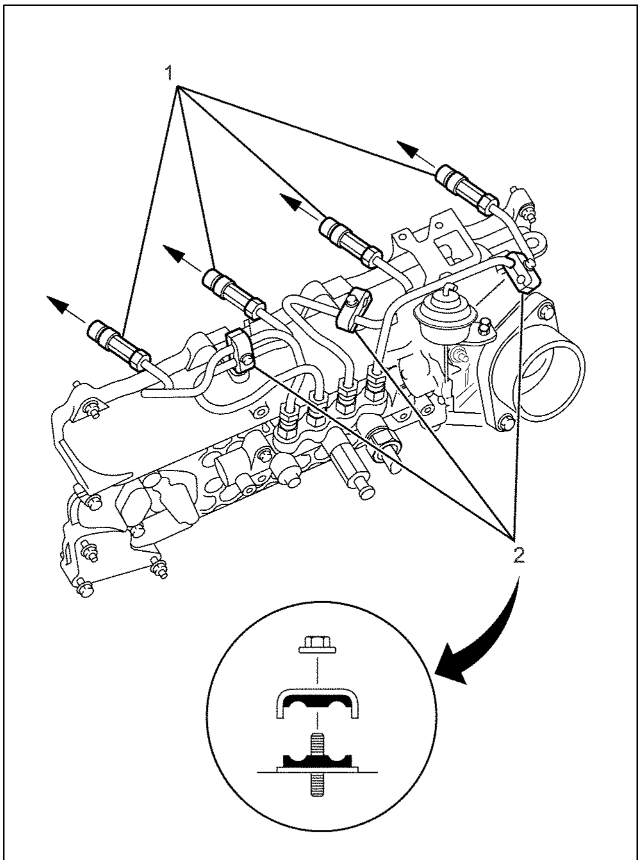
6. Loosen the fuel injector terminal nuts.
7. Loosen the fuel injector harness bracket bolts. Remove the inside connector and the harness bracket.
8. Remove the fuel injector leak-off pipe.
9. Remove the lower cover.



N6A6124E

Legend
1. Harness Bracket
2. Harness Connector
3. Fuel Injector Terminal
4. Fuel Leak-Off Pipe

10. Remove the fuel injection pipe clips and the injection pipes.



N6A6128E

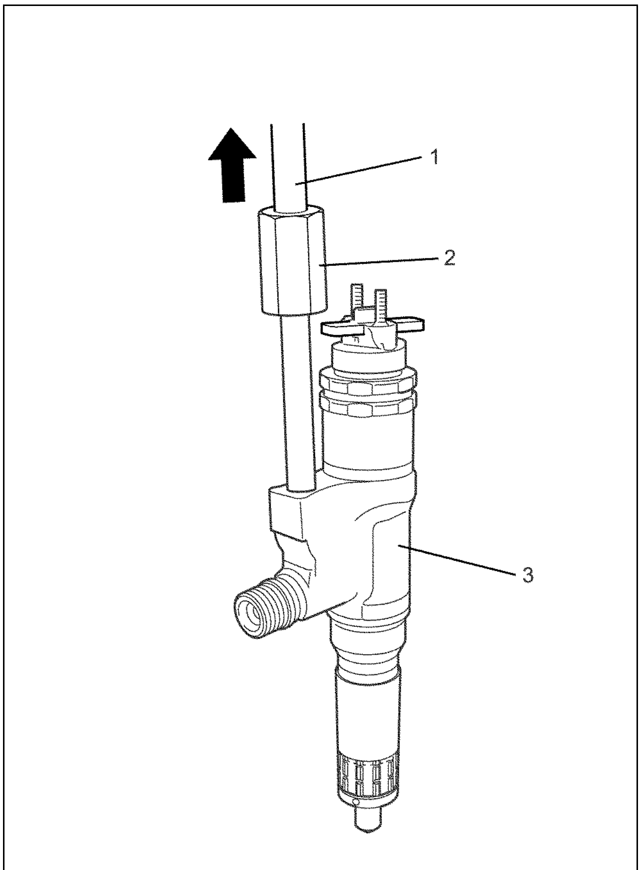
Legend
1. Fuel Injection Pipe
2. Pipe Clip

11. Loosen the fuel injector clamp fixing bolts and remove the fuel injectors.

If the fuel injectors are difficult to remove, use the fuel injector remover. Install the fuel injector remover to the leak-off pipe attachment part on the fuel injector. Use a sliding hammer to force the fuel injector clamp off the fuel injector.

Caution:
Do not remove the fuel injector sleeve.

Special tools
Fuel injector remover: 5-8840-2826-0 (EN-46720)
Sliding hammer: 5-8840-0019-0 (J-23907)



N6A6129E

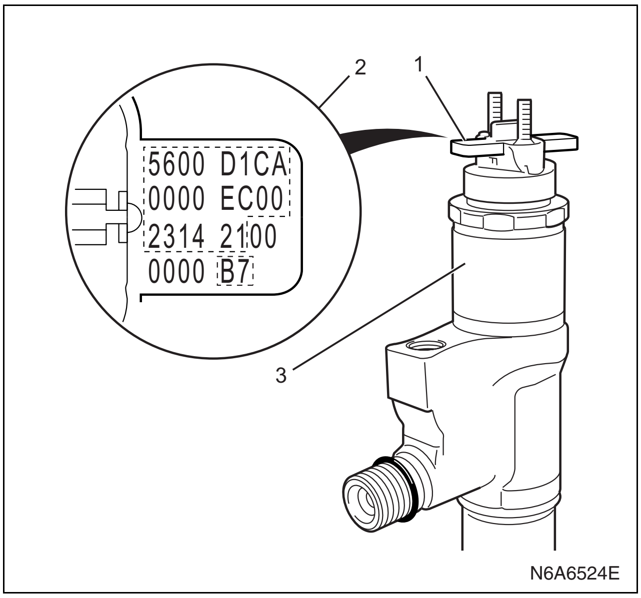
Legend
1. Sliding Hammer
2. Remover
3. Fuel Injector Assembly

12. Mark each fuel injector with the number of the cylinder from which it was removed. Store the fuel injectors in a safe place. Position the fuel injector so that the nozzle is protected.

Caution:
- Do not tamper with the electromagnetic portion of the fuel injector. Reduced electromagnetic function will result in injector failure.

Recording from the each fuel injector ID plate

Record 24 figures of each fuel injector ID plate. The correct order for the fuel injector ID code for the following illustration is as follows:
56 00 D1 CA 00 00 EC 00 23 14 21 B7



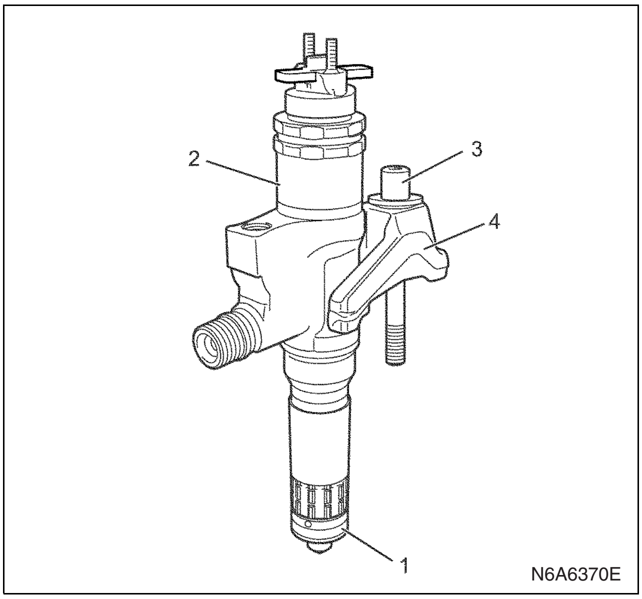
Legend

1. Fuel Injector ID Plate
2. Fuel Injector ID Code
3. Fuel Injector

Installation Procedure

Important:
Install each of the fuel injectors on its original position. (the cylinder from which it was removed)

1. Install a new gasket and O-ring to each of the fuel injector clamps. Refer to the illustration.

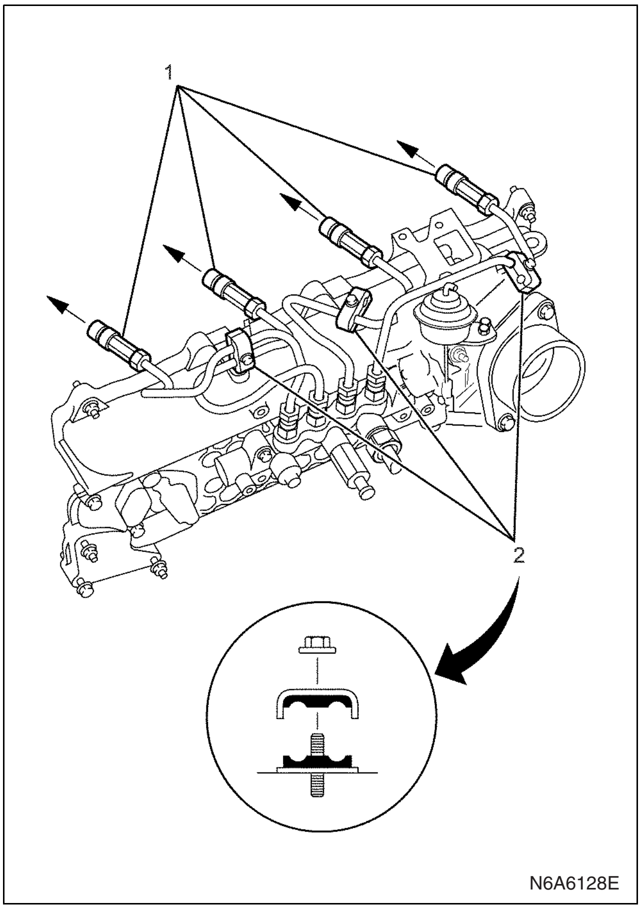


Legend

1. Gasket
2. Fuel Injector
3. Bolt
4. Fuel Injector Clamp

2. Apply molybdenum to the threads and seating surfaces of the clamp bolts.
3. Install the fuel injector clamps to the cylinder head.
4. Temporarily tighten the clamp bolts.
5. Apply a thin coat of engine oil to the outer surface of the fuel injector side sleeve nuts.
6. Install the fuel injection pipes to the position shown in the illustration.
7. Use a spanner to carefully the sleeve nuts until the fuel injection pipes contact the fuel injector and common rail.
8. Tighten the fuel injection pipe clips to the specified torque.

   Tighten:
   Clips to 6 N·m (0.6 kg·m / 52 lb·in)



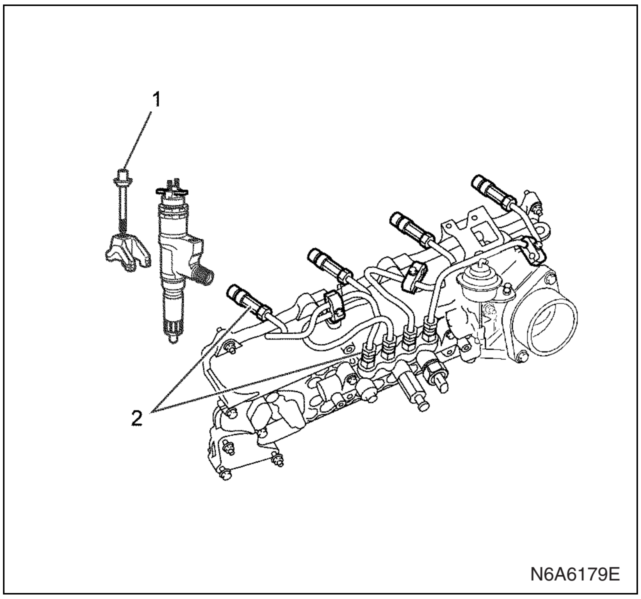
Legend
1. Fuel Injection Pipe
2. Pipe Clip

9. Final tighten the injection clamp bolts to the specified torque.

   Tighten:
   Bolts to 30 N·m (3.1 kg·m / 22 lb·ft)

10. Tighten the injection pipes to the specified torque.

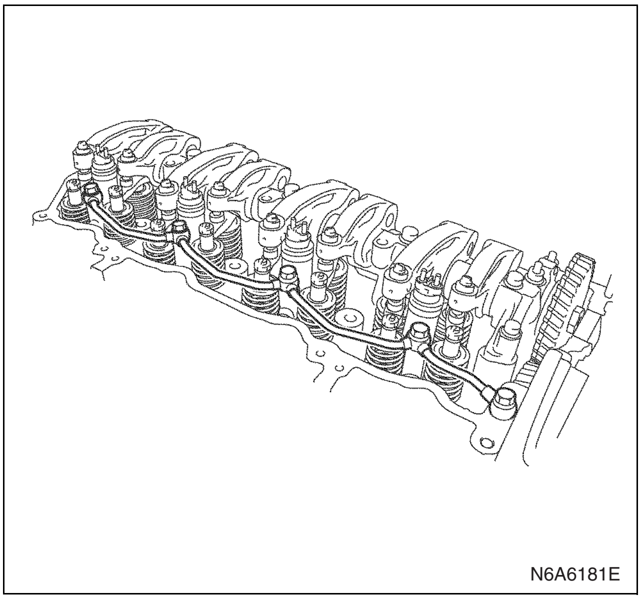
    Tighten:
    Injection pipes to 44 N·m (4.5 kg·m / 33 lb·ft)



Legend
1. Clamp Bolt
2. Sleeve Nut

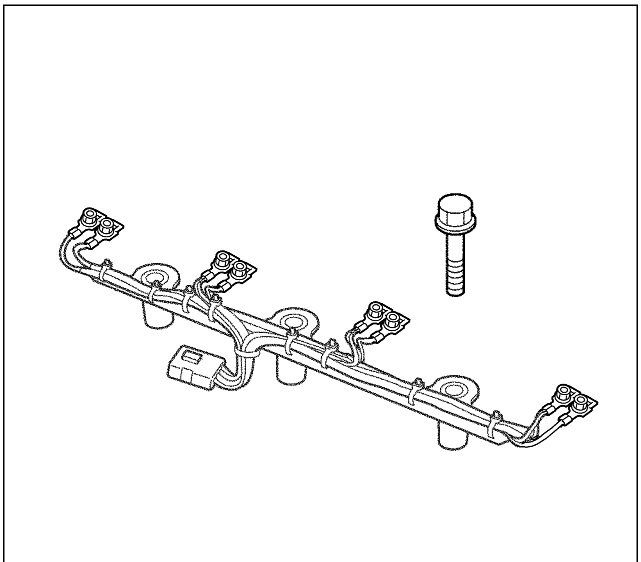
11. Install the nozzle leak off pipes together with the new gaskets. Tighten the pipes to the specified torque.

    Tighten:
    Pipes to 12 N·m (1.2 kg·m / 104 lb·in)



12. Install the fuel injector harness connectors. Work from the inside out.
13. Install the harness bracket and tighten the bolts to the specified torque.

    Tighten:
    Bolts to 48 N·m (4.9 kg·m / 35 lb·ft)

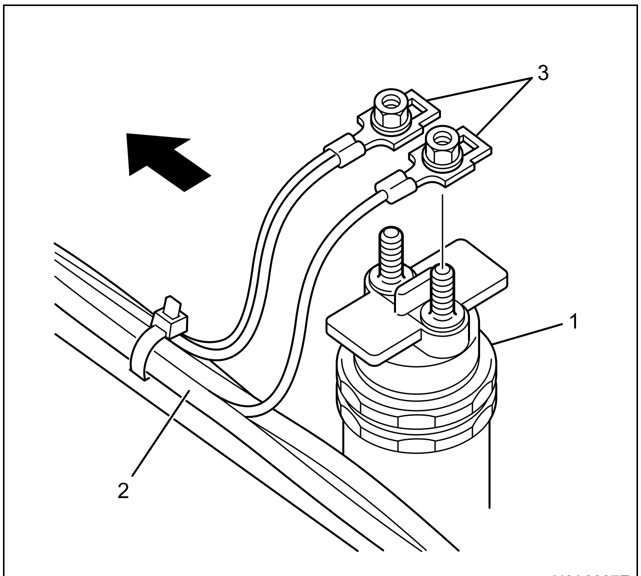

N6A6182E

14. Install the fuel injector terminal nuts to the injector.

    Tighten:
    Nut to 2 N·m (0.2 kg·m / 17 lb·in)

Caution:

- Do not overtighten the nuts. Damage to the terminal studs will result.
- The terminal nut with two wires is engine front side.



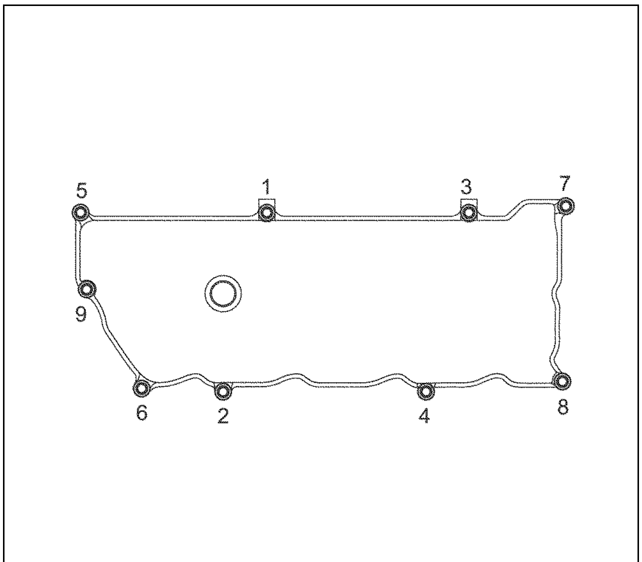
N6A6627E

Legend

1. Fuel Injector
2. Harness
3. Terminal Nut

15. Install the gasket to the cylinder head cover.
16. Install the cylinder head cover and tighten up according to the order.

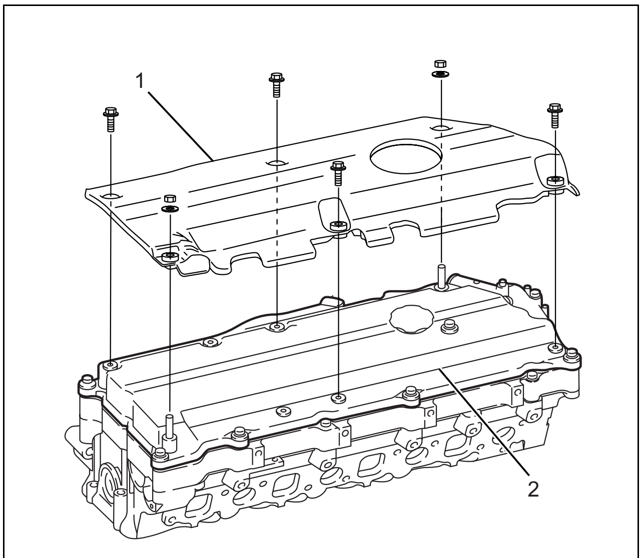
    Tighten:
    Bolts to 18 N·m (1.8 kg·m / 13 lb·ft)



N6A6029E

17. Install the sound insulation cover (For Europe)

    Tighten:
    Bolts to 8 N·m (0.8 kg·m / 6 lb·ft)



N6A6027E

Legend

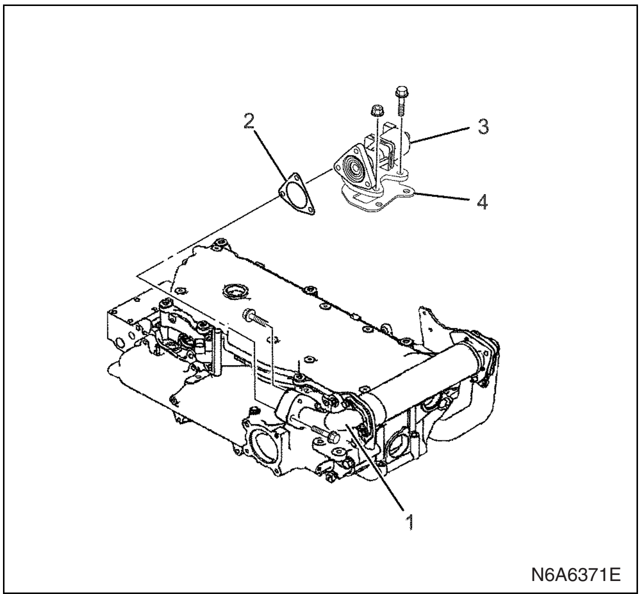
1. Sound Insulation Cover (For Europe)
2. Head Cover

18. Install the gasket to the EGR valve and tighten the bolts to the specified torque.

    Tighten:
    Bolts to 24 N·m (2.4 kg·m / 17 lb·ft)

19. Install the gasket to the EGR adapter and tighten the bolts to the specified torque.

    Tighten:
    Bolts to 24 N·m (2.4 kg·m / 17 lb·ft)



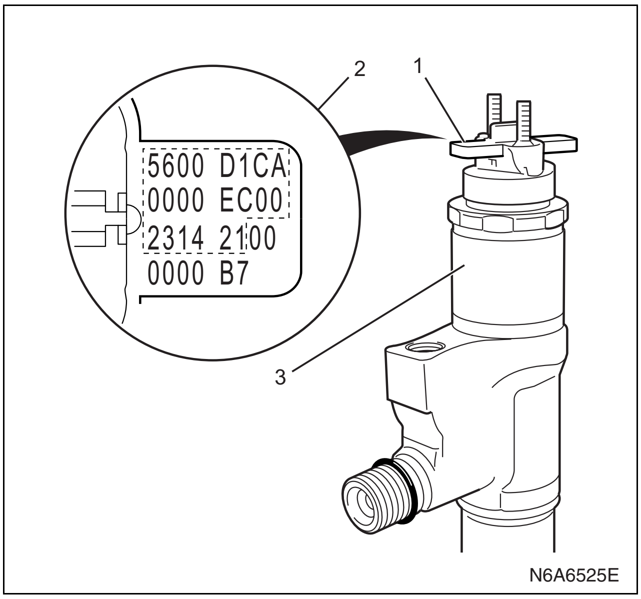
Legend
1. EGR Adapter
2. EGR Valve Gasket
3. EGR Valve
4. EGR Valve Gasket

20. Attach the engine harness connectors. Each composite connector should make a loud click when it is securely attached.

Fuel Injector ID Code Data Programming Procedure

1. Install the Tech 2.
2. Turn ON the ignition, with the engine OFF.
3. Select Diagnostics > appropriate vehicle identification > 4HK1 (Common Rail) > Programming > Injector ID Code > ID Code Registration.
4. Select replaced cylinder and press Change. Input 22 figures. Then, input in order from the left edge of upper sequence to the right sequence. The correct order for the fuel injector ID code for the following illustration is as follows:
   56 00 D1 CA 00 00 EC 00 23 14 21

Important:
The number of places required for input is 22 figures except last 2 figures.



Legend
1. Fuel Injector ID Plate
2. Fuel Injector ID Code
3. Fuel Injector

5. After complete the registration, turn OFF the ignition for 30 second.
6. Turn ON the ignition.
7. Select Diagnostics > appropriate vehicle identification > 4HK1 (Common Rail) > Programming > Injector ID Code > Injector ID Code. At this point, all registered fuel injector ID code data can be verified. Compare the ID code values registered into the ECM and each fuel injector including the last 2 figures. If the registered ID code is incorrect, go back to Step 4 ID Code Registration.
8. Start the engine and let idle.
9. Inspect for a proper engine running condition and for no DTC’s. Refer to the Diagnostic System Check-Engine Controls if needed.

Notice:
After replacement of the fuel injector, perform the following procedure.
All fuel injectors are replaced:
Remove the fuel injector ID code label on the cylinder head cover.
Any fuel injector(s) is replaced:
Blackout the replaced cylinder fuel injector ID code on the cylinder head cover with a marking pen or equivalent.

Fuel Rail Pressure (FRP) Sensor Replacement

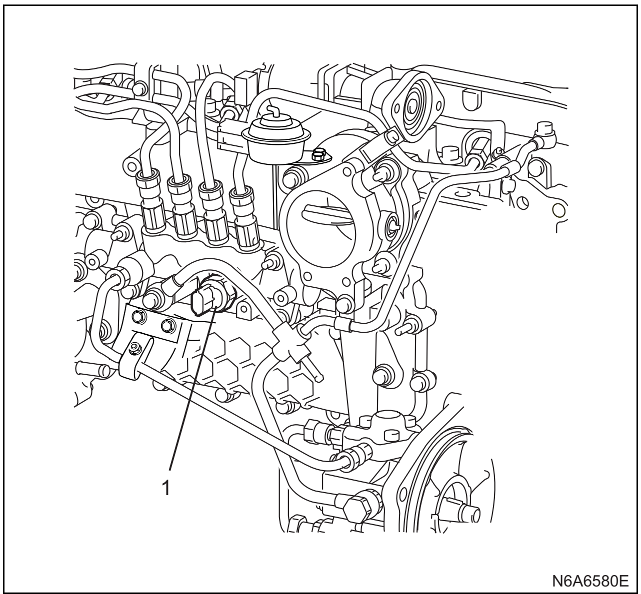
Removal Procedure

WARNING:
TO PREVENT LEAKED FUEL FROM CATCHING FIRE, DO NOT WORK WHILE THE ENGINE IS HOT.

Preparation:
- Pour detergent into a steam cleaner, and throughly wash around the sensor and the fuel rail.
- Remove water completely using air blow.

Notice:
Make sure that foreign matter will be prevented from getting in.

1. Remove the air intake pipe.
2. Disconnect the fuel rail pressure (FRP) sensor connector.
3. Remove the FRP sensor.



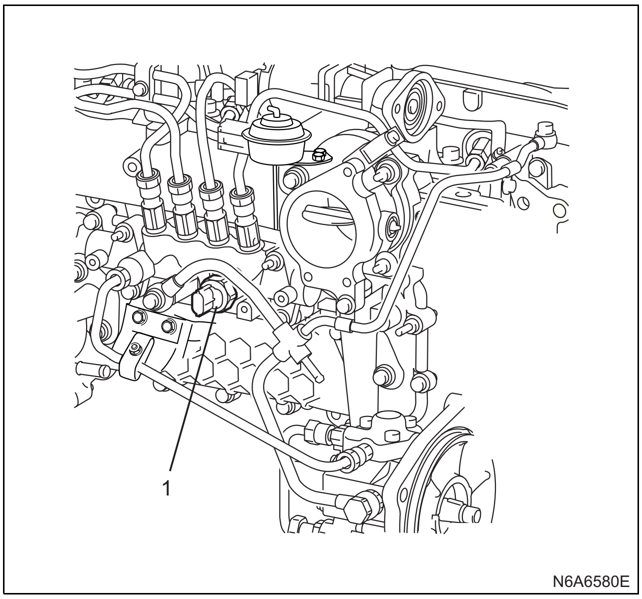
Legend
1. Fuel Rail Pressure (FRP) Sensor

Installation Procedure

Important:
- FRP sensor cannot be reused after assembly. (The seal is deformed after tightening. This may result in defective seal if reused.)
- Keep the protective cap attached until assembly.
- Take care not to allow water or foreign matter to get inside the connector.
- Do not let foreign matter attach to the threaded portion. Also, make sure the installation part is free of foreign matter before installation.

1. Apply grease to the threads of the FRP sensor.
2. Install the FRP sensor.

   Tighten:
   FRP sensor to 98 N·m (10 kg·m / 72 lb·ft)



Legend
1. Fuel Rail Pressure (FRP) Sensor

3. Connect the FRP sensor connector.
4. Install the air intake pipe.

Notice:
- Carefully check for fuel leak after starting the engine.
- After the sensor is replaced, clear the trouble code and make sure the sensor operates normally using a scan tool.

Fuel Pressure Limiter Replacement

Removal Procedure

WARNING:
TO PREVENT LEAKED FUEL FROM CATCHING FIRE, DO NOT WORK WHILE THE ENGINE IS HOT.

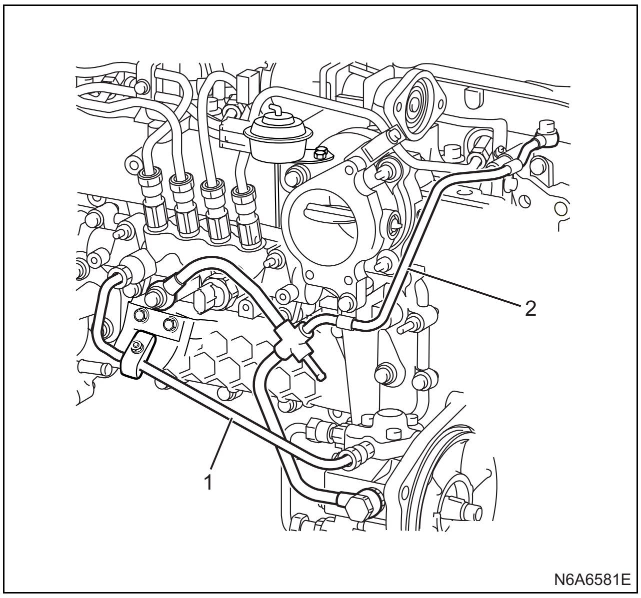
Preparation:
- Pour detergent into a steam cleaner, and throughly wash around the sensor and the fuel rail.
- Remove water completely using air blow.

Notice:
Make sure that foreign matter will be prevented from getting in.

1. Remove the air intake pipe.
2. Remove the fuel leak off hose from the leak off pipe.
   - Cover the removed fuel hose, keep it facing upward and secure it using wire, etc.
3. Remove the fuel pipe.

Important:
Loosen the fuel pipe gradually not to scatter high pressure fuel.

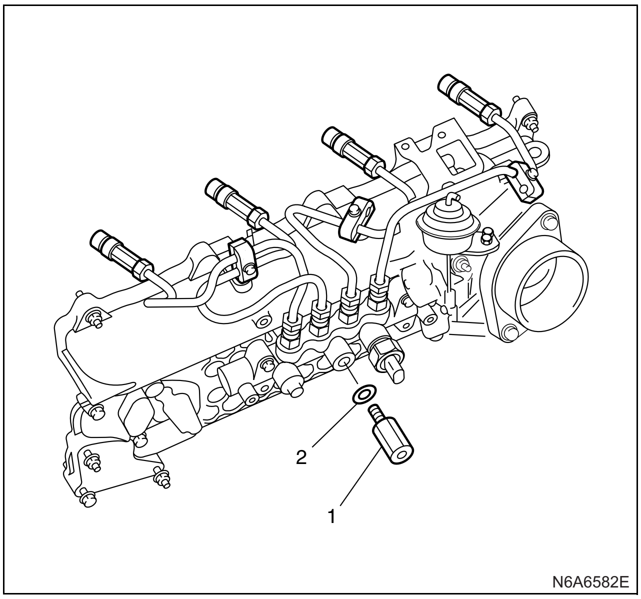
4. Remove the clips and the fuel leak off pipe.



Legend
1. Fuel Pipe
2. Fuel Leak Off Pipe

5. Remove the fuel pressure limiter.

Important:
Do not damage the seat surface when removing the gasket.



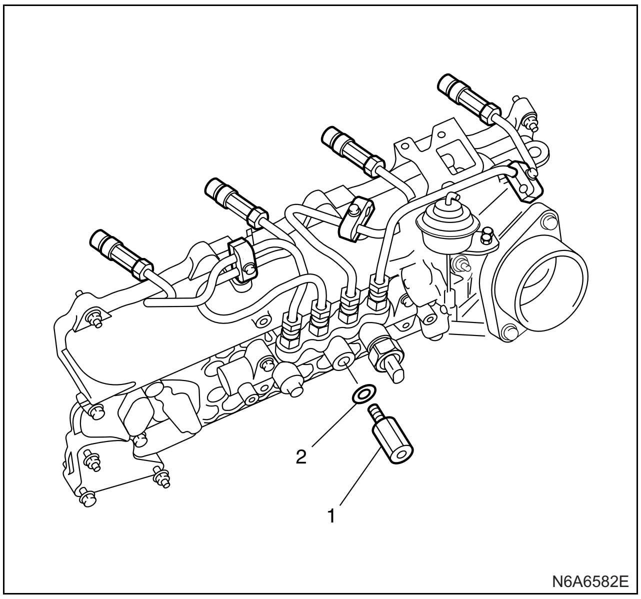
Legend
1. Fuel Pressure Limiter
2. Gasket

Installation Procedure

Important:
- Do not reuse the removed fuel pressure limiter and gaskets.
- Do not let foreign matter attach to the threaded portion. Also, make sure the installation part is free of foreign matter before installation.

1. Install the fuel pressure limiter.

   Tighten:
   Fuel pressure limiter to 172 N·m (17.5 kg·m / 127 lb·ft)



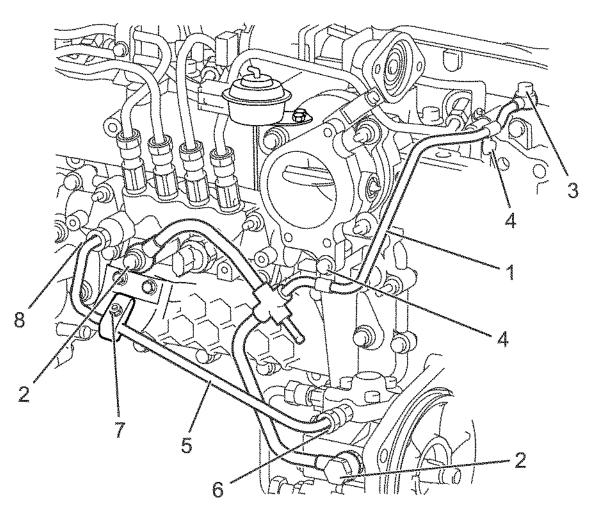
Legend
1. Fuel Pressure Limiter
2. Gasket

2. Tighten the fuel leak off pipe (1) using the mounting eyebolt and the clips using the specified torque.

   Tighten:
   (2): 18 N·m (1.8 kg·m / 13 lb·ft)
   (3): 12 N·m (1.2 kg·m / 9 lb·ft)
   (4): 8 N·m (0.8 kg·m / 69 lb·in)

3. Tighten the fuel pipe (5) using the mounting sleeve nut and the clip using the specified torque.

   Tighten:
   (6): 44 N·m (4.5 kg·m / 33 lb·ft)
   (7): 6 N·m (0.6 kg·m / 52 lb·in)
   (8): 44 N·m (4.5 kg·m / 33 lb·ft)



N6A6386E

4. Install the fuel leak off hose to the fuel leak off pipe.
5. Install the air intake pipe.

Notice:
- Carefully check for fuel leak after starting the engine.
- After the fuel pressure limiter is replaced, clear the trouble code and make sure the fuel pressure limiter operates normally using a scan tool.

Fuel Rail Replacement

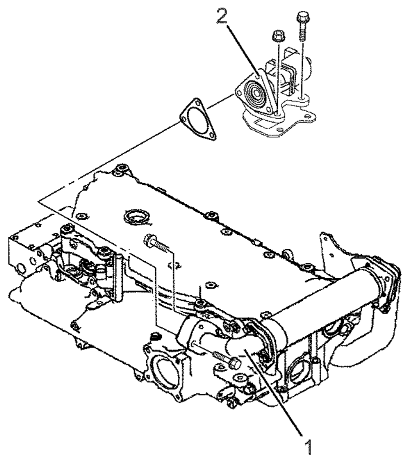
Removal Procedure

WARNING:
TO PREVENT LEAKED FUEL FROM CATCHING FIRE, DO NOT WORK WHILE THE ENGINE IS HOT.

Preparation:
- Pour detergent into a steam cleaner, and throughly wash around the sensor and the fuel rail.
- Remove water completely using air blow.

Notice:
Make sure that foreign matter will be prevented from getting in.

1. Remove the air intake pipe.
   - Disconnect the connector for the intake air temperature sensor.
2. Remove the fuel leak off hose from the leak off pipe.
   - Cover the removed fuel hose, keep it facing upward and secure it using wire, etc.
3. Disconnect the fuel rail pressure sensor harness connector.
4. Remove the EGR valve and the EGR adapter.
5. Tape the EGR case holes shut to prevent the entry of foreign material.

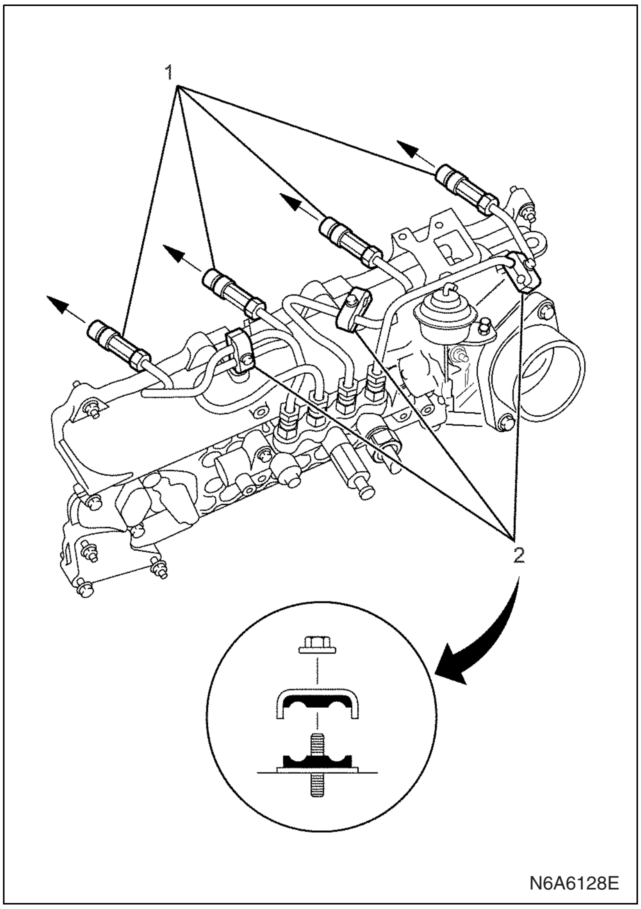


N6A6368E

Legend
1. EGR Adapter
2. EGR Valve

6. Remove the injection pipe clip and remove the injection pipes.

Important:
Loosen the injection pipes gradually not to scatter high pressure fuel.

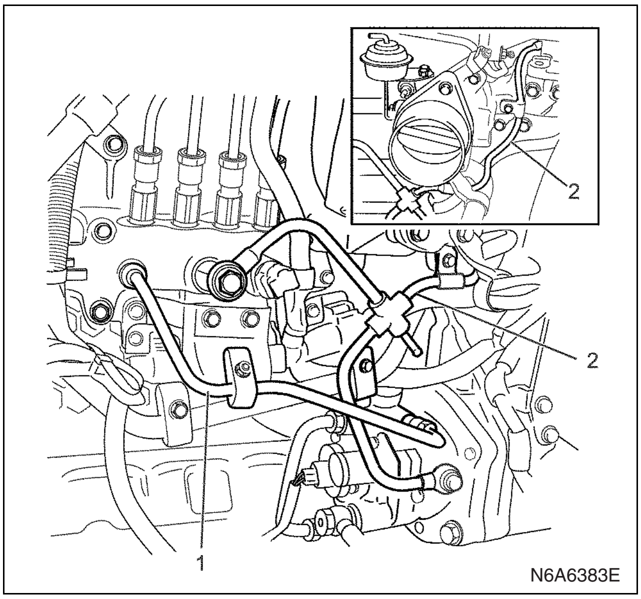


Legend
1. Fuel Injection Pipe
2. Fuel Injection Pipe Clip

7. Remove the fuel pipe.

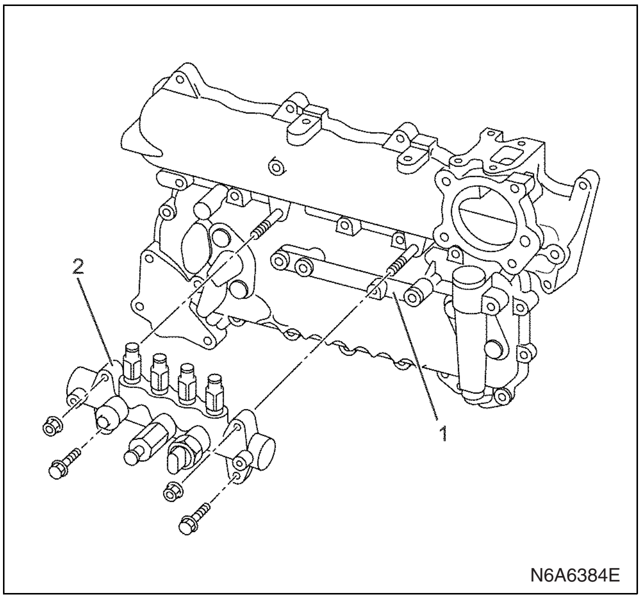
Important:
Loosen the fuel pipe gradually not to scatter high pressure fuel.

8. Remove the clips and the fuel leak off pipe.



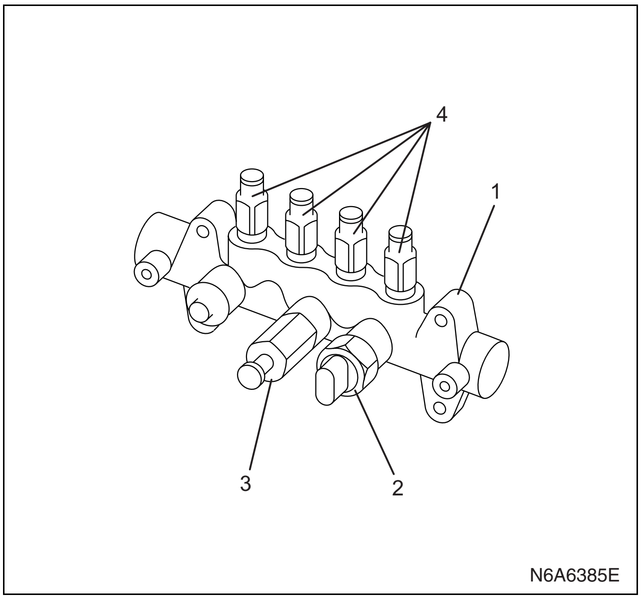
Legend
1. Fuel Pipe
2. Fuel Leak-Off Pipe

9. Remove the fuel rail and the fuel rail bracket.
   - Do not remove the flow damper. The dampers should always remain in the fuel rail.
   - Take care not to damage the connector unit of the pressure sensor.



Legend
1. Fuel Rail Bracket
2. Fuel Rail

Disassembly
1. Remove the fuel pressure limiter.
2. Remove the fuel rail pressure sensor.



Legend
1. Fuel Rail
2. Fuel Rail Pressure Sensor
3. Fuel Pressure Limiter
4. Flow Damper

Reassembly

1. Install the fuel pressure limiter.

   Tighten:
   Fuel pressure limiter to 172 N·m (17.5 kg·m / 127 lb·ft)

2. Install the fuel rail pressure sensor.

   Tighten:
   Fuel rail pressure sensor to 98 N·m (10 kg·m / 72 lb·ft)

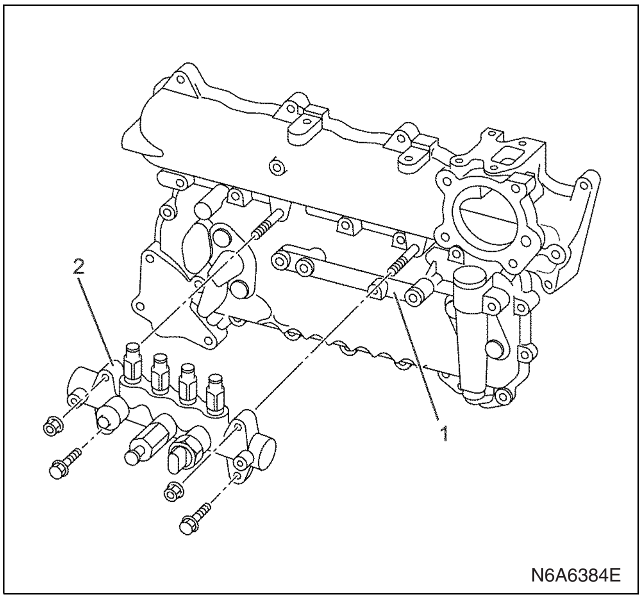
Installation Procedure

1. Tighten the fuel rail bracket using the specified mounting torque.

   Tighten:
   Nuts to 19 N·m (1.9 kg·m / 14 lb·ft)

2. Tighten the fuel rail using the specified mounting torque.

   Tighten:
   Bolts to 19 N·m (1.9 kg·m / 14 lb·ft)



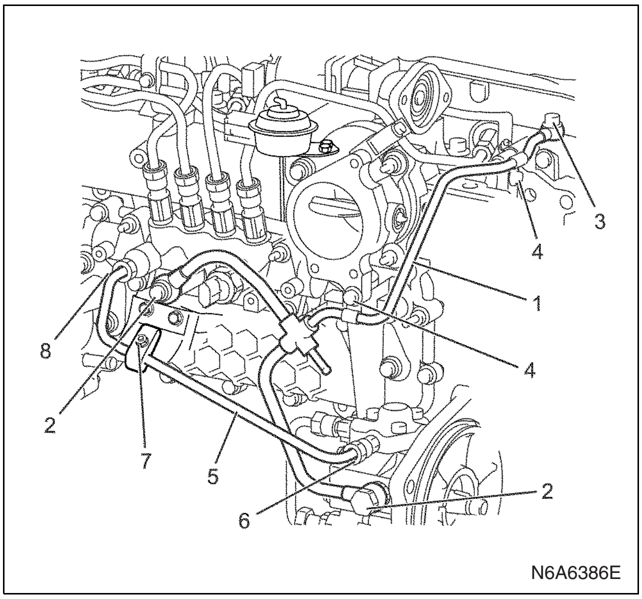
Legend
1. Fuel Rail Bracket
2. Fuel Rail

3. Tighten the fuel leak off pipe (1) using the mounting eyebolt and the clips using the specified torque.

   Tighten:
   (2): 18 N·m (1.8 kg·m / 13 lb·ft)
   (3): 12 N·m (1.2 kg·m / 9 lb·ft)
   (4): 8 N·m (0.8 kg·m / 69 lb·in)

4. Tighten the fuel pipe (5) using the mounting sleeve nut and the clip using the specified torque.

   Tighten:
   (6): 44 N·m (4.5 kg·m / 33 lb·ft)
   (7): 6 N·m (0.6 kg·m / 52 lb·in)
   (8): 44 N·m (4.5 kg·m / 33 lb·ft)



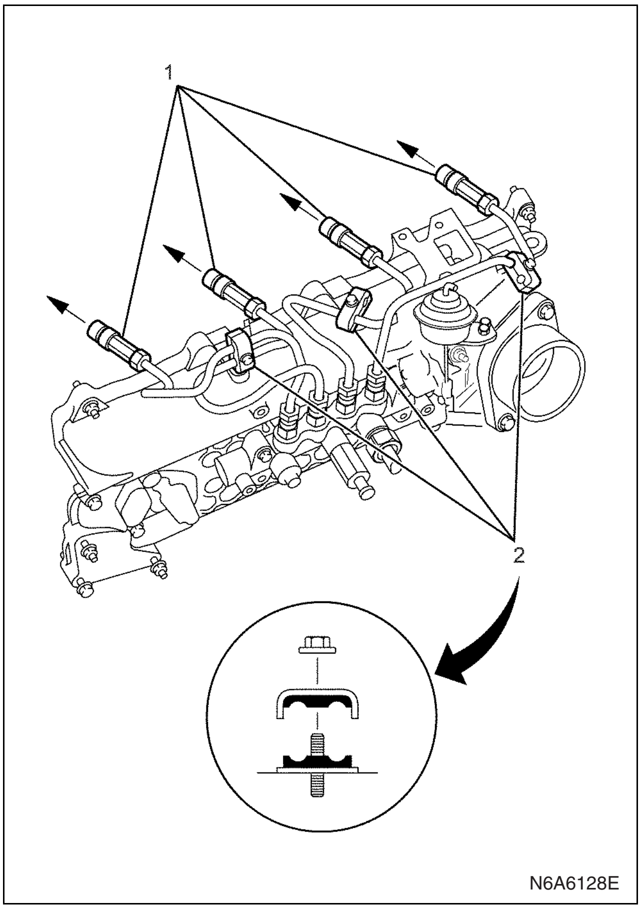
5. Install the fuel leak off hose to the fuel leak off pipe.

6. Tighten the injection pipe and the clip using the specified mounting torque.

   Tighten:
   Injection pipe sleeve nut to 44 N·m (4.5 kg·m / 33 lb·ft)

   Injection pipe clip to 6 N·m (0.6 kg·m / 52 lb·in)

   - Apply a thin coat of engine oil on the periphery of the sleeve nut on the injector side and assemble.



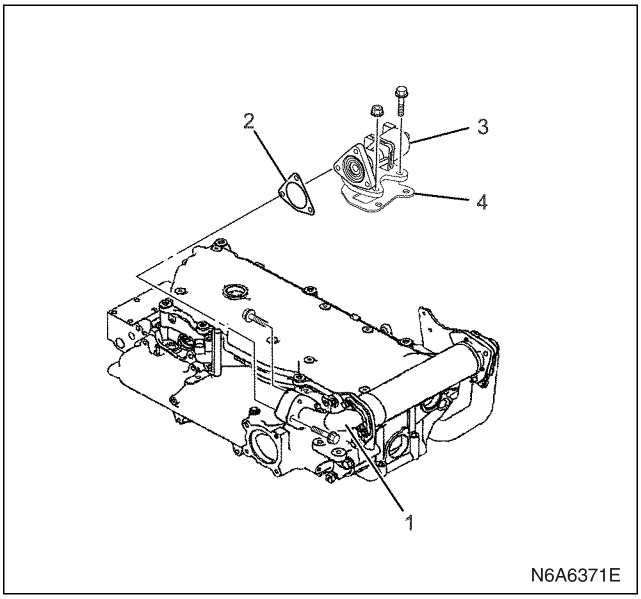
Legend
1. Fuel Injection Pipe
2. Fuel Injection Pipe Clip

7. Connect the fuel rail pressure (FRP) sensor connector.
8. Install the gasket to the EGR valve and tighten the bolts to the specified torque.

   Tighten:
   Bolts to 24 N·m (2.4 kg·m / 17 lb·ft)

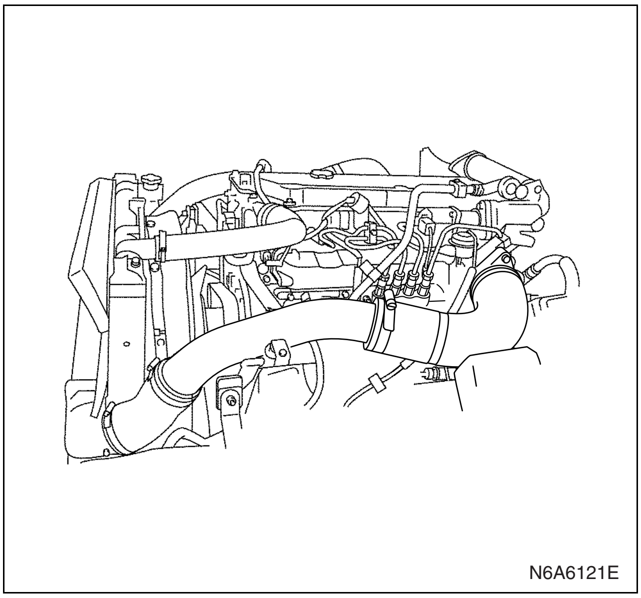
9. Install the gasket to the EGR adapter and tighten the bolts to the specified torque.

   Tighten:
   Bolts to 24 N·m (2.4 kg·m / 17 lb·ft)



Legend
1. EGR Adapter
2. EGR Valve Gasket
3. EGR Valve
4. EGR Valve Gasket

10. Install the air intake duct.
    - Connect the connector for the intake air temperature sensor.

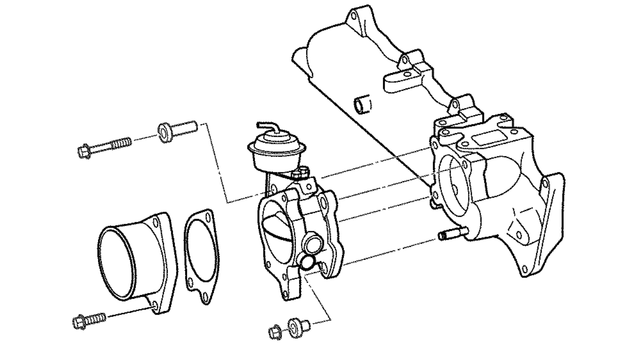


Fuel Supply Pump Replacement

Removal Procedure

Important:
The fuel supply pump must be timed to the engine.

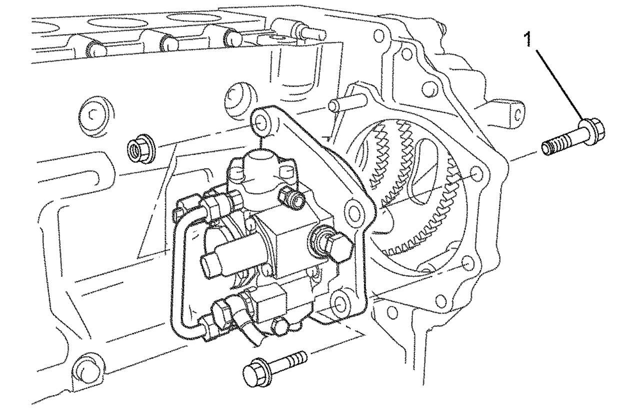
1. Remove the intake pipe and the intake throttle valve.
2. Remove the fuel pipe and fuel leak-off pipe.



N6A6374E

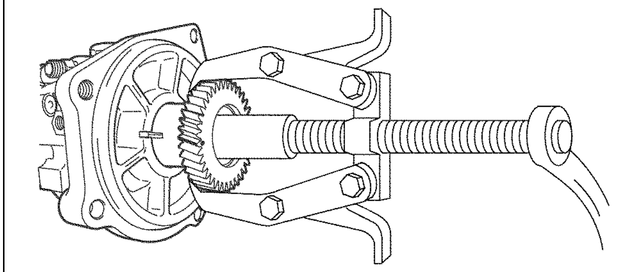
3. Remove the fuel feed hose.
4. Disconnect the fuel temperature sensor and the fuel rail pressure regulator harness connector from the fuel supply pump.
5. Remove the fuel supply pump attachment bolts and nuts, then remove the fuel supply pump.

Notice:
One of the attachment bolt (1) secures the fuel supply pump to the flywheel housing as denoted in the picture below.



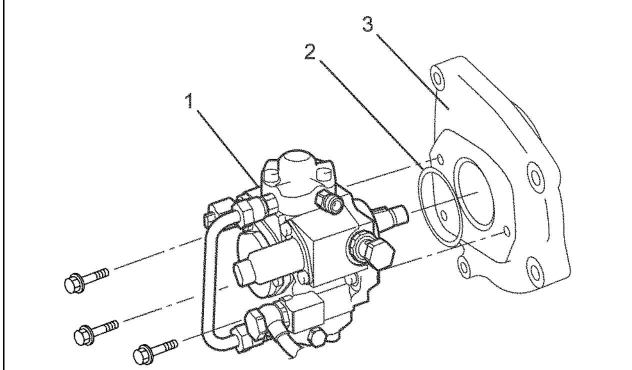
N6A6375E

6. Use a gear puller to remove the fuel supply pump gear and the O-ring.



N6A6376E

7. Loosen the 3 bolts holding the fuel supply pump bracket. Remove the bracket and the O-ring.



N6A6377E

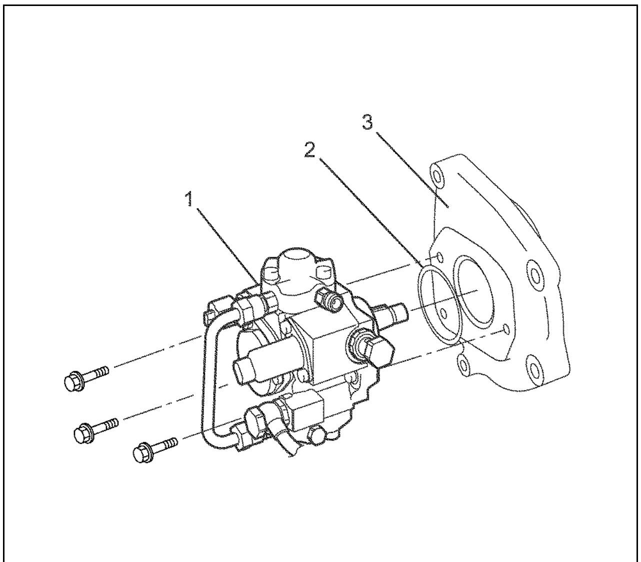
Legend
1. Fuel Supply Pump
2. O-Ring
3. Fuel Supply Pump Bracket

Installation Procedure

1. Install the O-ring to the fuel supply pump.
2. Install the pump to the bracket and tighten the 3 bolts to the specified torque.

   Tighten:
   Bolts to 19 N·m (1.9 kg·m / 14 lb·ft)

Caution:
Take care not to twist the O-ring.



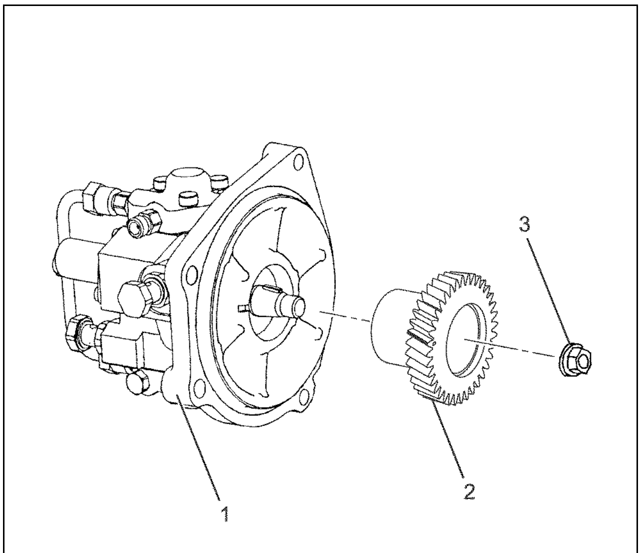
N6A6377E

Legend

1. Fuel Supply Pump
2. O-Ring
3. Fuel Supply Pump Bracket

3. Align the fuel supply pump shaft key and gear. Install the gear and tighten the nut to the specified torque.
   There is a round alignment mark on the gear (white paint).

   Tighten:
   Nut to 64 N·m (6.5 kg·m / 47 lb·ft)

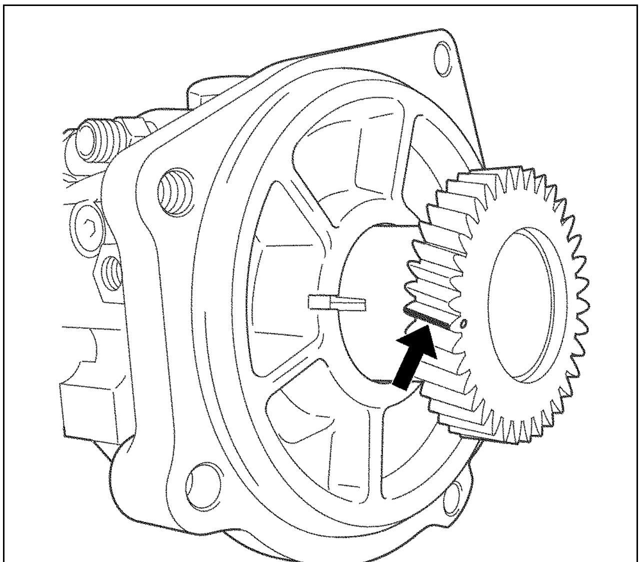


N6A6378E

Legend

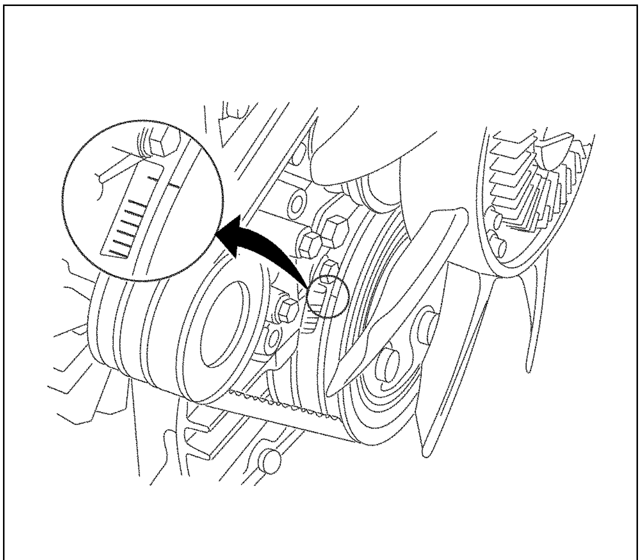
1. Fuel Supply Pump
2. Fuel Supply Gear
3. Nut

4. Apply white paint to the top of the fuel supply pump gear tooth directly above the stamped 'O' mark. Refer to the illustration.



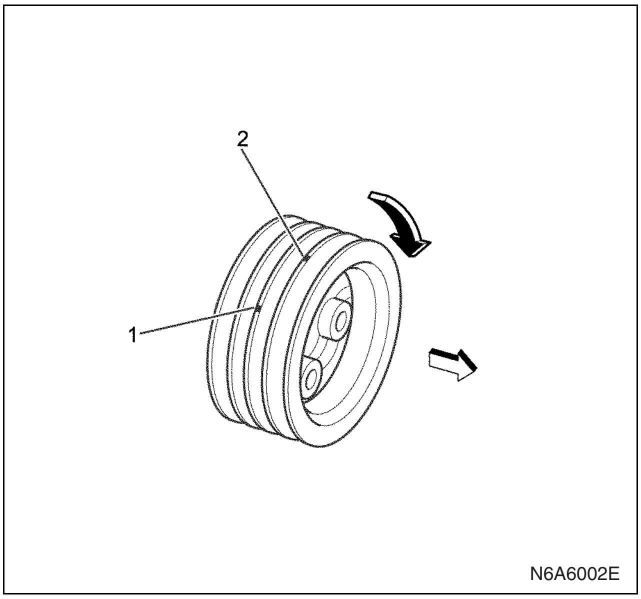
N6A6379E

5. Turn the crankshaft in the normal direction of engine rotation until the No.1 or No.4 cylinder is at TDC on the compression stroke.
   Refer to illustration.



N6A6003E

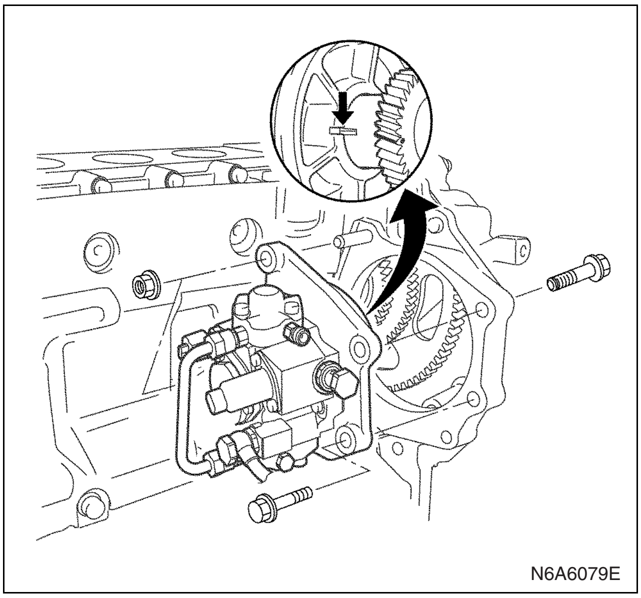
Notice:
There are 2 timing marks on the crankshaft pulley.
Mark (1) is near the front cover and is used to bring the 4HK1-TC engine to TDC.
Mark (2) is not applicable to this engine.
Be sure to use mark (1) when bringing the engine to TDC.



6. Remove the oil drain adapter.
7. Install the O-ring to the fuel supply pump.
8. Align the slits as shown in the illustration.
9. Insert the stud bolts into the guides and temporarily tighten them.

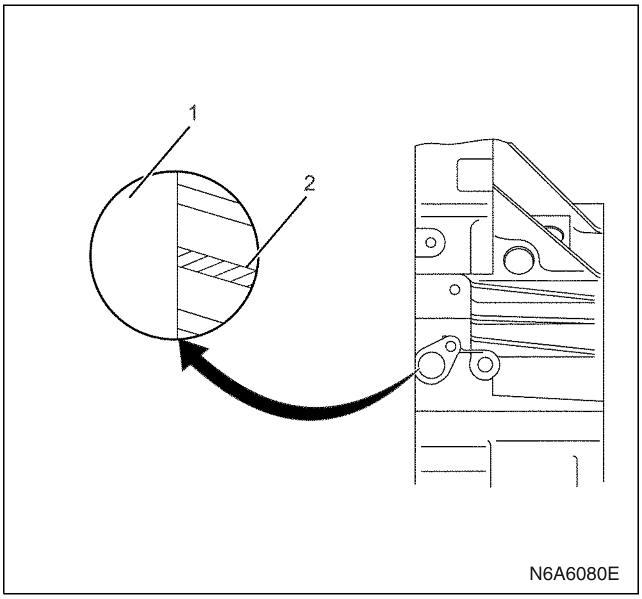
Caution:

- If the stud bolts (cylinder block side) have been loosened or replaced, apply Locktite No. 262 to the recessed portion of the bolts.



- Check that the round alignment mark (white paint) is positioned as shown in the illustration when viewed from the plug hole. If necessary, reposition the gear.
- Tighten the stud bolts and the nuts to the specified torque.

Tighten:
Nuts to 50 N·m (5.1 kg·m / 37 lb·ft)
Bolts to 76 N·m (7.7 kg·m / 56 lb·ft)

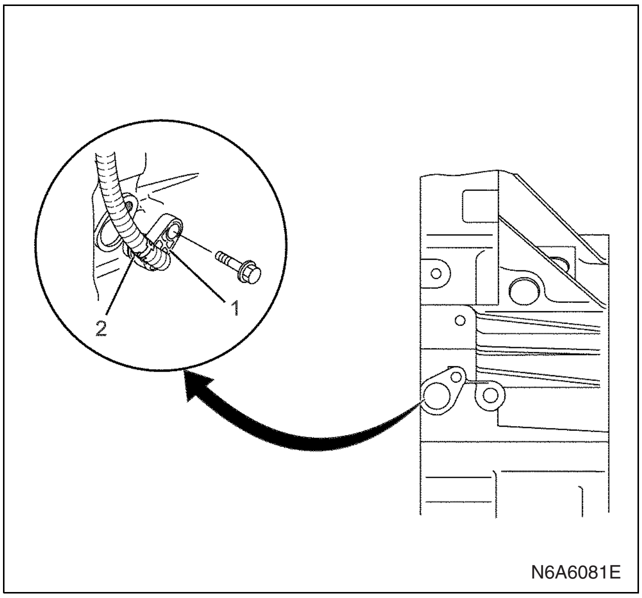


Legend

1. Plug Hole
2. Alignment Mark

10. Apply a light coat of engine oil to the O-ring.
11. Install the oil drain adapter to the plug hole. Tighten the bolt to the specified torque.

Tighten:
Bolt to 8 N·m (0.8 kg·m / 69 lb·in)



Legend

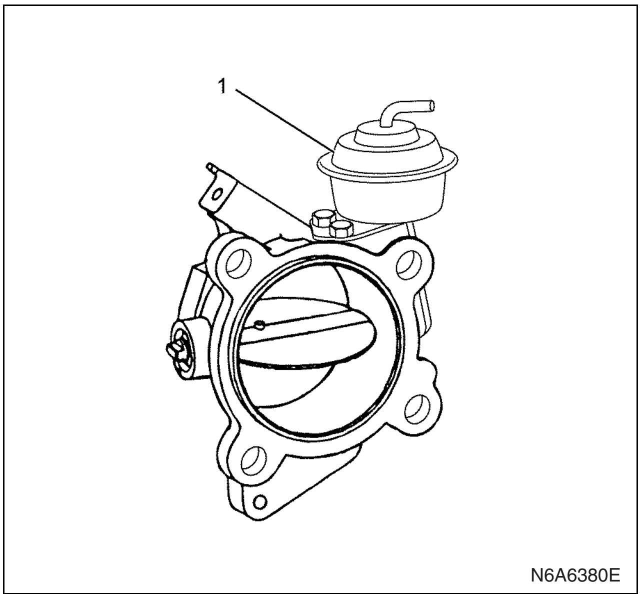
1. Oil Drain Adapter
2. O-Ring

12. Connect the fuel temperature sensor and the suction control valve connectors to the fuel supply pump.
13. Install the fuel feed hose.
14. Install the throttle assembly.

- Coat the fluid gasket and mount within 7 minutes.

  Tighten:
  Throttle assembly to 24 N·m (2.4 kg·m / 17 lb·ft)

- Install the intake throttle valve chamber hose.



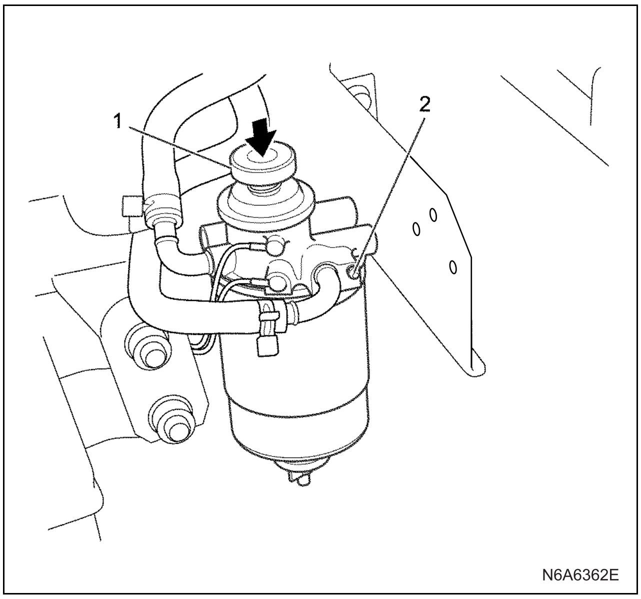
Legend
1. Intake throttle Valve Chamber

15. Install the fuel pipe and fuel leak-off pipe.

Important:
In order to make the fuel supply pump characteristic learn into the ECM, let the engine idle until warm-up. If the fuel system DTC's stored in the meantime, once clear DTC and warm-up the engine again.

16. Inspect for a proper engine running condition and for no DTC's. Refer to the Diagnostic System Check-Engine Controls if needed.

Fuel System Air Bleeding



Legend
1. Priming Pump
2. Air Bleed Plug

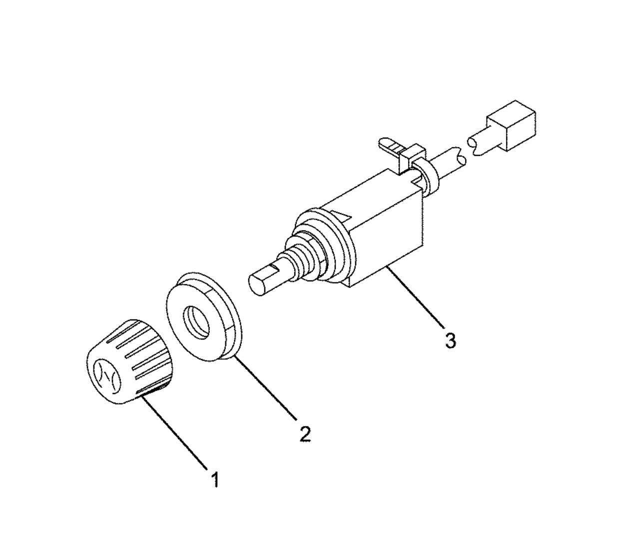
1. Before starting the engine
   a. Fit a tray below the fuel filter (below the air bleed plug).
   b. Loosen the plug adequately and operate the priming pump more than 20 times until the fuel overflows from plug hole.
   c. Tighten the plug, and operate the priming pump more than 10 times until it is filled with fuel. After waiting for approximately a minute, loosen the plug and bleed off the air in the fuel filter. (This work must be repeated a minimum of three times until no more air comes out from the plug.)
   d. Tighten the plug firmly and wipe the fuel in the surrounding area. Operate the priming pump (10 to 15 times) till it is filled with fuel and then send fuel to the engine.
2. After starting the engine
   a. Start the engine by rotating the starter without depressing the accelerator pedal.
   b. After starting, maintain the idling rotation for 5 seconds.
   c. Slowly rotate the idling control knob clockwise and maintain it for 3 minutes.
   d. Fully depress the accelerator pedal and increase the rotations to maximum. (Repeat this operation several times)
   e. Rotate the idling knob counterclockwise and return to idling mode.

Caution:
If the air bleeding work is insufficient then it could lead to faults in the engine. Therefore, the procedures after starting the engine should always be implemented.

Idle Up Sensor Replacement

Removal Procedure

1. Turn off the ignition.
2. Remove the idle up sensor knob (1).
3. Disconnect the idle up sensor connector.
4. Remove the idle up sensor holder (2).



N6A6584E

5. Remove the idle up sensor (3).

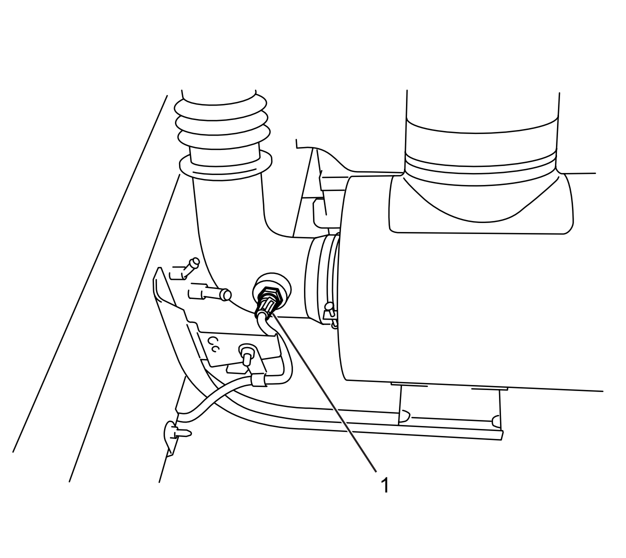
Installation Procedure

1. Install the idle up sensor (3).
2. Install the idle up sensor holder (2).
3. Install the idle up sensor knob (1).
4. Connect the idle up sensor connector.

Intake Air Temperature (IAT) Sensor Replacement

Removal Procedure

1. Turn off the ignition.
2. Disconnect the intake air temperature (IAT) sensor connector (1).
3. Remove the IAT sensor.



N6A6559E

Installation Procedure

1. Coat threads of the IAT sensor with sealer (9985490) in full circumference.
2. Tighten the IAT sensor.

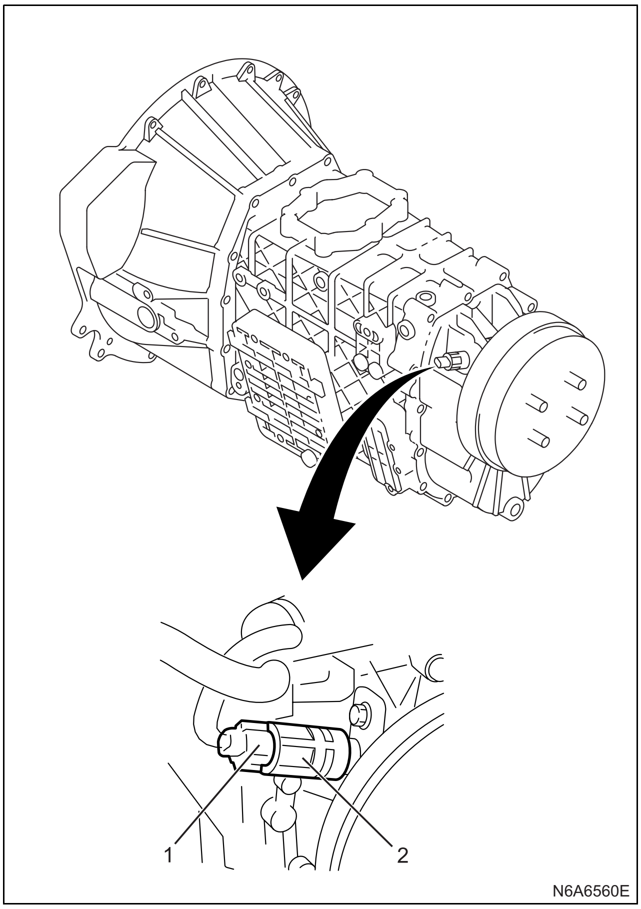
   Tighten:
   IAT sensor to 10.8 — 16.3 N·m (1.1 — 1.7 kg·m / 8.0 — 12.0 lb·ft)

3. Connect the IAT sensor connector.

Vehicle Speed Sensor (VSS) Replacement

Removal procedure

1. Turn off the ignition.
2. Disconnect the vehicle speed sensor connector (1).
3. Remove the vehicle speed sensor (2).



Installation procedure

1. Tighten the vehicle speed sensor (2).

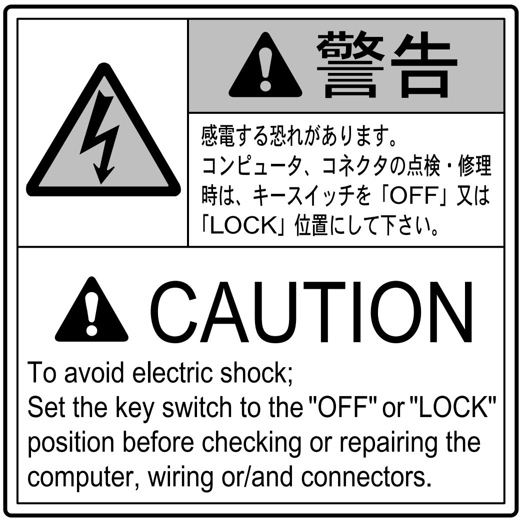
   Tighten:
   Vehicle speed sensor to 27 N·m (2.8 kg·m / 20 lb·ft)

2. Connect the vehicle speed sensor connector (1).

Description and Operation

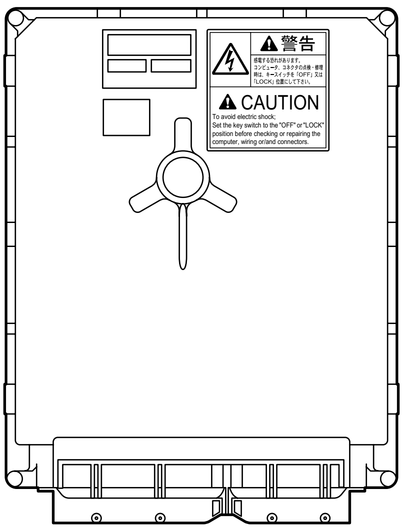
Engine Control Module (ECM) Description

Engine Control Module (ECM) Service Precautions



N6A6480E

Important:
Symbol warns you of an electric shock hazard. To avoid shock and possible serious injury, DO NOT touch the terminals. When disconnecting the harness connectors, always turn OFF the ignition switch or disconnect the battery cable.



N6A6481E

The engine control module (ECM) is designed to withstand normal current draws associated with vehicle operation. Avoid overloading any circuit. When testing for opens and shorts, do not ground or apply voltage to any of the ECM circuits unless instructed to do so. In some cases, these circuits should only be tested using a digital multimeter (DMM). The ECM should remain connected to the ECM harness.

The engine control module (ECM) is located inside of engine side cover on the left via mounting bracket and is beside the engine. The ECM mainly controls the following:

- The fuel system control
- The exhaust gas recirculation (EGR) system control
- The preheating (glow) system control
- On-board diagnostics for engine control

The ECM constantly observes the information from various sensors. The ECM controls the systems that affect vehicle performance. The ECM performs the diagnostic function of the system. The ECM can recognize operational problems, alert the driver through the malfunction indicator lamp (MIL), and store diagnostic trouble codes (DTCs). DTCs identify the system faults to aid the technician in making repairs.

ECM Voltage Description

The ECM supplies a buffered voltage to various switches and sensors. The ECM can do this because resistance in the ECM is so high in value that a test lamp may not illuminate when connected to the circuit. An ordinary shop voltmeter may not give an accurate reading because the voltmeter input impedance is too low. Use a 10-megaohm input impedance DMM, to ensure accurate voltage readings. The input and/or output devices in the ECM include analog-to-digital converters, signal buffers, counters, and special drivers. The ECM controls most components with electronic switches which complete a ground circuit when turned ON.

Aftermarket Electrical and Vacuum Equipment

Aftermarket or add-on electrical and vacuum equipment is defined as any equipment which connects to the vehicle’s electrical or vacuum systems that is installed on a vehicle after the vehicle leaves the factory. No allowances have been made in the vehicle design for this type of equipment. No add-on vacuum equipment should be added to this vehicle. Add-on electrical equipment must only be connected to the vehicle’s electrical system at the battery power and ground. Add-on electrical equipment, even when installed to these guidelines, may still cause the powertrain system to malfunction. This may also include equipment not connected to the vehicle electrical system such as portable telephones and audios. Therefore, the first step in diagnosing any powertrain fault is to eliminate all aftermarket electrical equipment from the vehicle. After this is done, if the fault still exists, the fault may be diagnosed in the normal manner.

Electrostatic Discharge Damage

Electronic components used in the ECM are often designed to carry very low voltage. Electronic components are susceptible to damage caused by electrostatic discharge. By comparison, as much as 4,000 volts may be needed for a person to feel even the zap of a static discharge. There are several ways for a person to become statically charged. The most common methods of charging are by friction and induction.

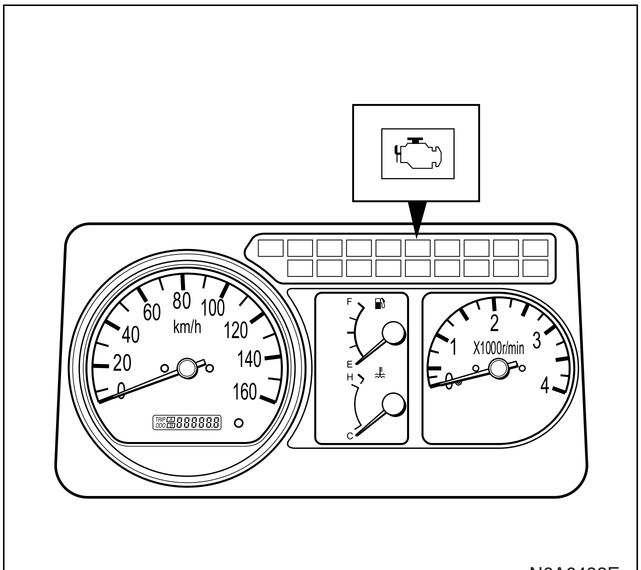
- An example of charging by friction is a person sliding across a vehicle seat.

Important:
To prevent possible electrostatic discharge damage, follow these guidelines:

- Do not touch the ECM connector pins or soldered components on the ECM circuit board.
- Do not open the replacement part package until the part is ready to be installed.
- Before removing the part from the package, ground the package to a known good ground on the vehicle.
- If the part has been handled while sliding across the seat, while sitting down from a standing position, or while walking a distance, touch a known good ground before installing the part.
- Charge by induction occurs when a person with well insulated shoes stands near a highly charged object and momentarily touches ground. Charges of the same polarity are drained off leaving the person highly charged with opposite polarity.

Malfunction Indicator Lamp (MIL) Operation

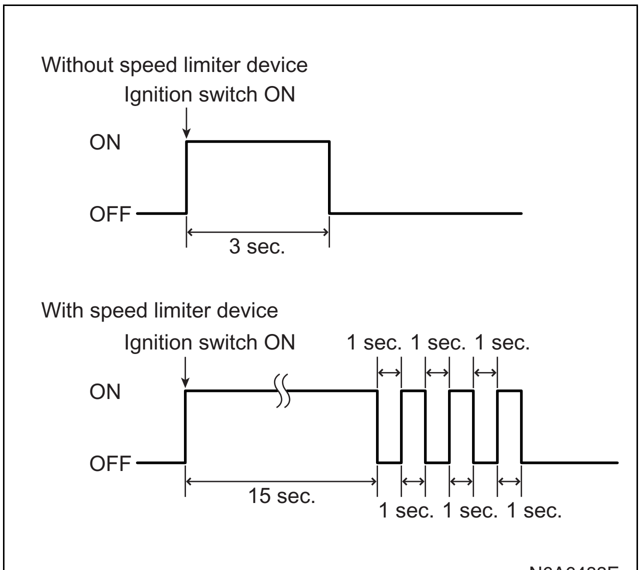
The malfunction indicator lamp (MIL) is located in the instrument panel cluster. The MIL will display the following symbols when commanded ON:



N6A6482E

The MIL indicates that an emission or performance 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 for approximately 3 seconds when the ignition switch is turned ON, with the engine OFF. This is a bulb test to ensure the MIL is able to illuminate. (Without speed limiter device)
- The MIL illuminates for approximately 15 seconds and blinks 3 times when the ignition switch is turned ON, with the engine OFF. This is a bulb test to ensure the MIL is able to illuminate and a speed limiter device installation check. (With speed limiter device)
- The MIL remains illuminated if the engine control module (ECM) detects a fault. A diagnostic trouble code (DTC) is stored any time the ECM illuminates the MIL due to an emission or performance related fault.

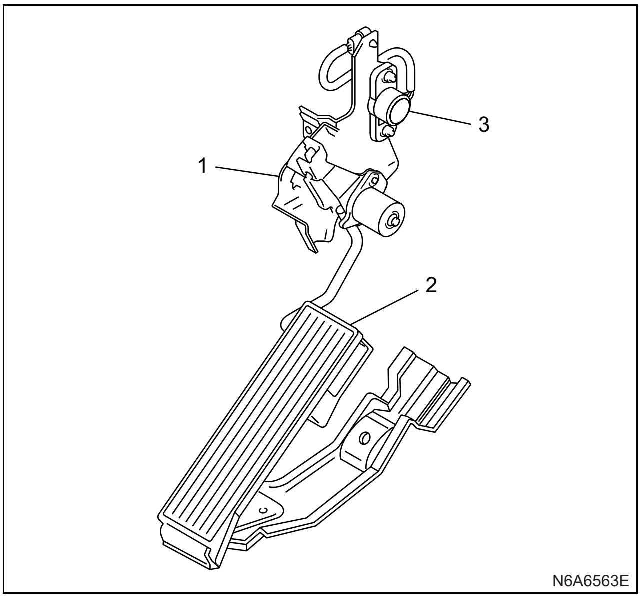


N6A6483E

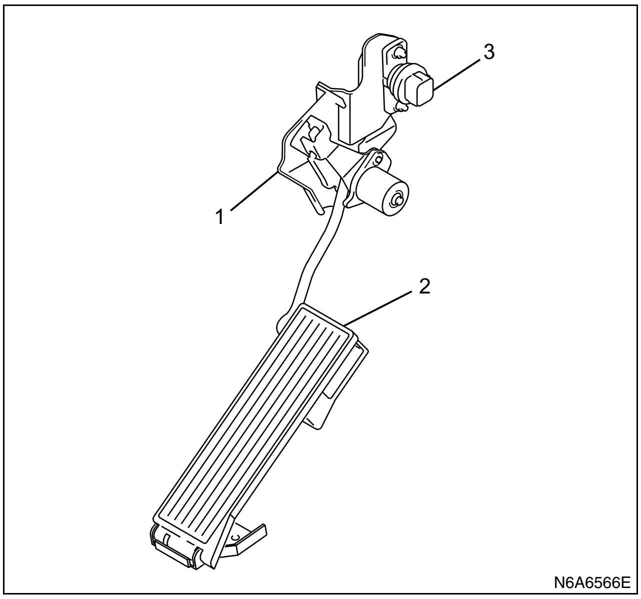
Engine Control Component Description

Accelerator Pedal Position (APP) Sensor

- LHD Model



- RHD Model

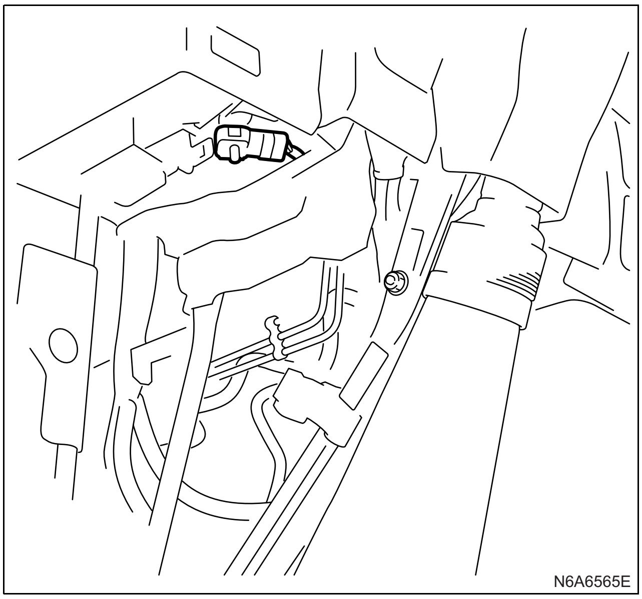


Legend

1. Control Link Bracket Assembly
2. Pedal Assembly
3. Accelerator Pedal Position (APP) Sensor

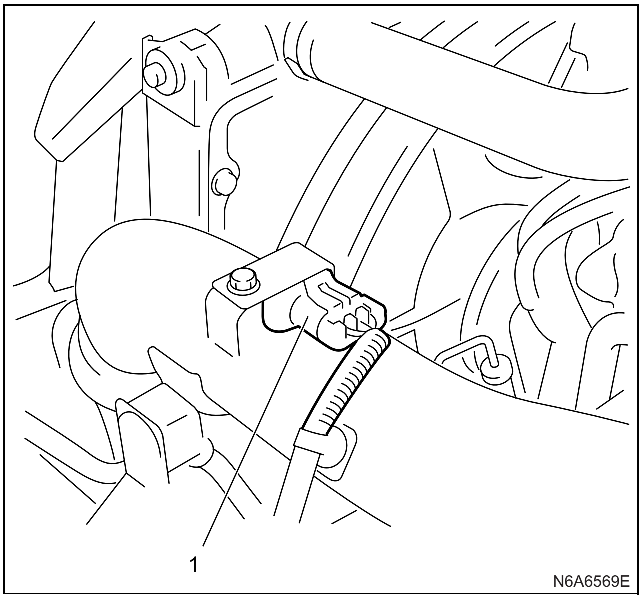
The accelerator pedal position (APP) sensor is mounted on the control link bracket assembly. The sensor is made up of two individual sensors within one housing. The engine control module (ECM) uses the APP sensor to determine the amount of acceleration or deceleration desired by the person driving the vehicle via the fuel injector control.

Barometric Pressure (BARO) Sensor



The barometric pressure (BARO) sensor is located under the instrument panel cluster (IPC) near the pedal bracket. The BARO sensor is a transducer that varies voltage according to the barometric pressure changes and the generated voltage is input to the engine control module (ECM) for the BARO signal. The ECM should detect a low signal voltage at a low barometric pressure, such as high altitude place. The ECM should detect high signal voltage at a high barometric pressure. The ECM uses this voltage signal to calibrate the fuel injection quantity and injection timing for altitude compensation.

Boost Pressure Sensor

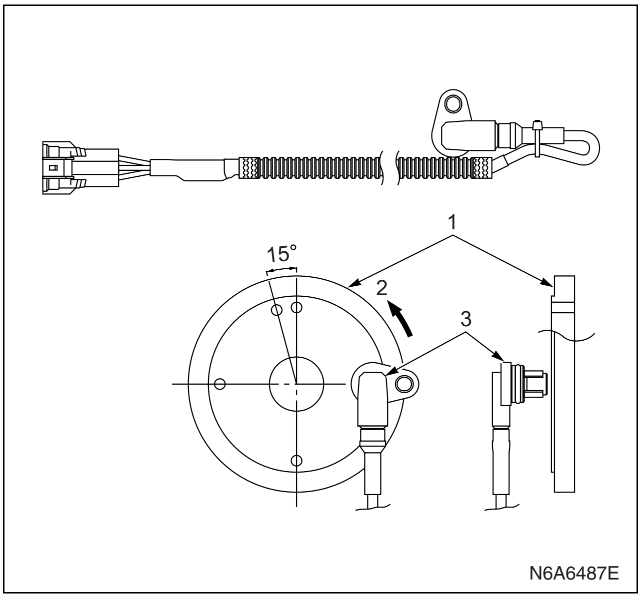


Legend

1. Boost Pressure Sensor

The boost pressure sensor is located in the air induction tubing. The boost pressure sensor is a transducer that varies voltage according to changes in the air pressure inside the air tubing. The boost pressure sensor provides a signal to the engine control module (ECM) on the boost pressure signal circuit which is relative to the pressure changes in the induction tubing. The ECM should detect a low signal voltage at a low boost pressure, such as low engine load. The ECM should detect high signal voltage at a high boost pressure, such as high engine load.

Camshaft Position (CMP) Sensor

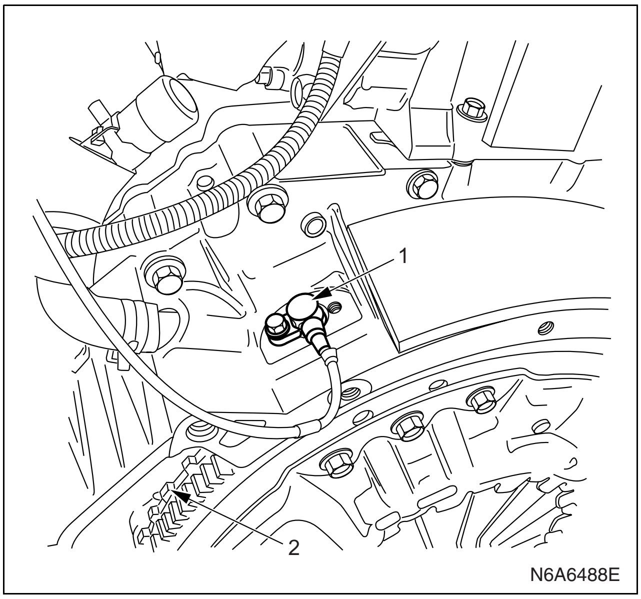


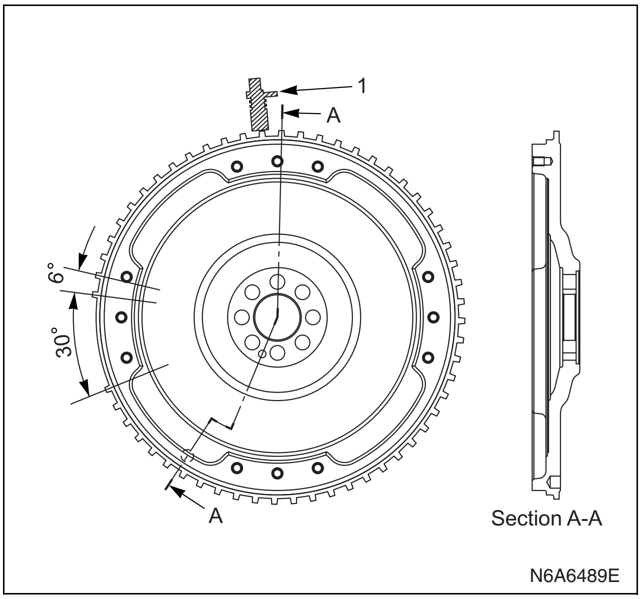
Legend

1. Camshaft Gear
2. Gear Rotating Direction
3. Camshaft Position (CMP) Sensor

The camshaft position (CMP) sensor is installed on the cylinder head at the rear of the camshaft gear. The CMP sensor detects a total of five through holes (four holes arranged equally every 90° and one reference hole on the camshaft gear flange surface) and sends signals to the engine control module (ECM). Receiving these signals, the ECM determines cylinder #1 compression top dead center (TDC).

Crankshaft Position (CKP) Sensor



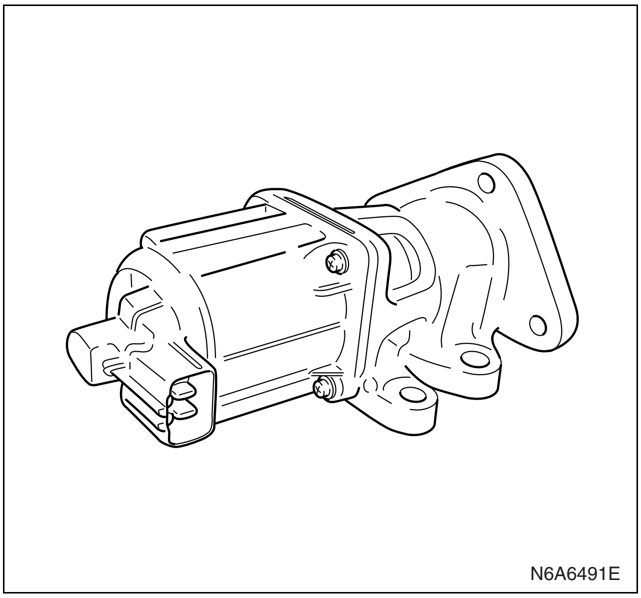


Legend

1. Crankshaft Position (CKP) Sensor
2. Flywheel hollow

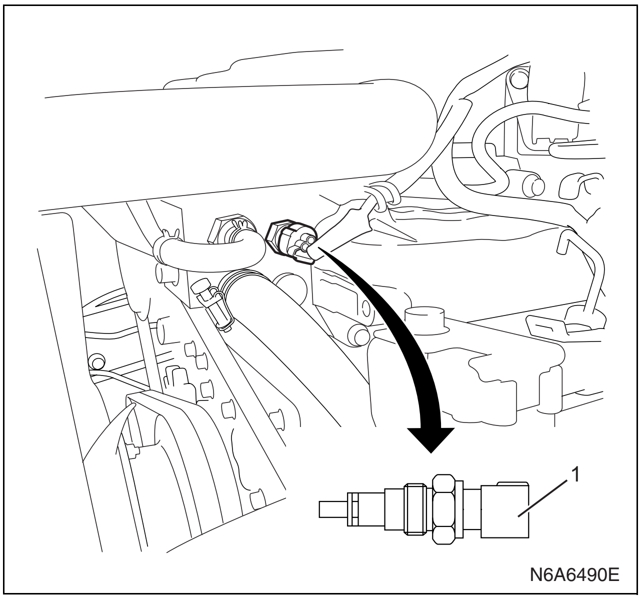
The crankshaft position (CKP) sensor is located on top of the flywheel housing. There are 56 notches spaced 6° apart and a 30° section that is open span. This open span portion allows for the detection of cylinder #1 top dead center (TDC). The CKP sensor is a magnetic coil type sensor, which generates an AC signal voltage based on the crankshaft rotational speed. The engine control module (ECM) monitors both the CKP sensor and camshaft position (CMP) sensor signals to ensure they correlate with each other.

Exhaust Gas Recirculation (EGR) Valve and Position Sensor



The control current from the engine control module (ECM) operates the EGR motor to control the lift amount of EGR valve. Also, a valve position sensor is provided at the rear of the motor to feed actual valve lift amount back to the ECM for more precision control of the EGR amount. The EGR valve position sensor is applied with reference voltage (5 volts) at all times from the ECM to detect the EGR valve lift amount in the form of voltage change and sends its signal to the ECM.

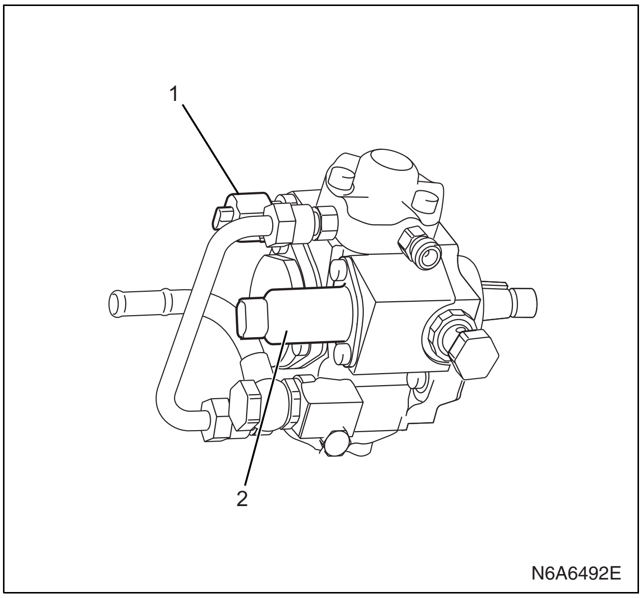
Engine Coolant Temperature (ECT) Sensor



Legend
1. Engine Coolant Temperature (ECT) Sensor

The engine coolant temperature (ECT) sensor is installed to the thermostat housing. The ECT sensor is a variable resistor. The ECT sensor measures the temperature of the engine coolant. The engine control module (ECM) supplies 5 volts to the ECT signal circuit and a ground for the ECT low reference circuit. When the ECT sensor is cold, the sensor resistance is high. When the engine coolant temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the ECT signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the ECT signal circuit.

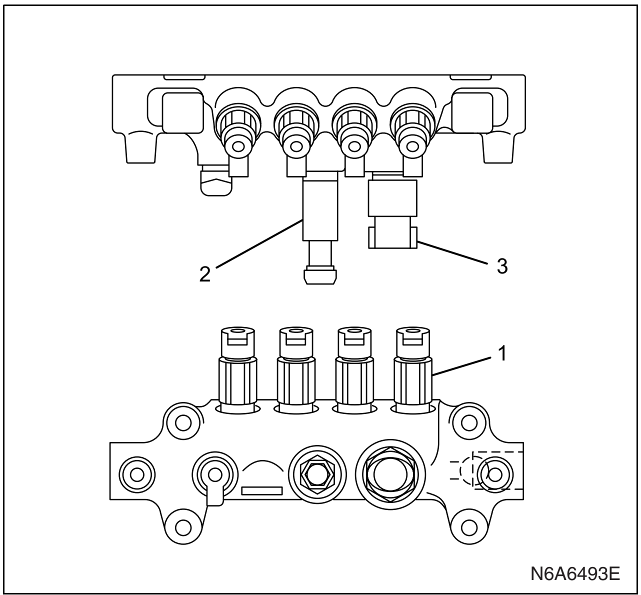
Fuel Rail Pressure (FRP) Regulator



Legend
1. Fuel Temperature (FT) Sensor
2. Fuel Rail Pressure (FRP) Regulator

The fuel rail pressure (FRP) regulator is installed to the fuel supply pump and controls the suction fuel quantity into the fuel rail. The FRP regulator is fully opened in the normal state and larger drive current results in smaller opening. The engine control module (ECM) calculates desired fuel rail pressure and fuel flow rate and it compares the calculated desired fuel rail pressure to the actual value to determine the FRP regulator position. When the actual fuel rail pressure is higher than the desired value, the FRP regulator is closed to decease the flow rate.

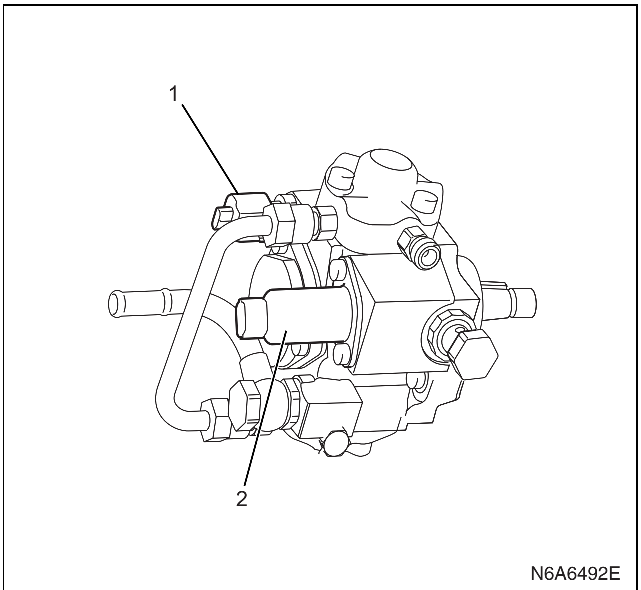
Fuel Rail Pressure (FRP) Sensor



Legend
1. Flow Damper
2. Pressure Limiter
3. Fuel Rail Pressure (FRP) Sensor

The fuel rail pressure (FRP) sensor is installed to the fuel rail and it detects the fuel pressure in the fuel rail, converts the pressure into a voltage signal, and sends the signal to the engine control module (ECM). Higher fuel rail pressure provides higher FRP sensor voltage while lower pressure provides lower FRP sensor voltage. The ECM calculates actual fuel rail pressure (fuel pressure) from the voltage signal and uses the result in fuel injection control and other control tasks.

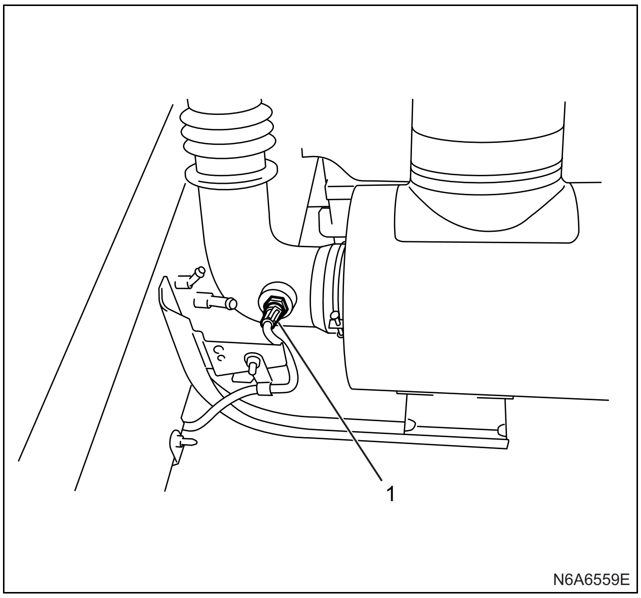
Fuel Temperature (FT) Sensor



Legend
1. Fuel Temperature (FT) Sensor
2. Fuel Rail Pressure (FRP) Regulator

The fuel temperature (FT) sensor is installed to the fuel supply pump. The FT sensor is a variable resistor. The FT sensor measures the fuel temperature of the fuel. The engine control module (ECM) supplies 5 volts to the FT signal circuit and a ground for the FT low reference circuit. When the FT sensor is cold, the sensor resistance is high. When the fuel temperature increases, the sensor resistance decreases. With high sensor resistance, the ECM detects a high voltage on the FT signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the FT signal circuit.

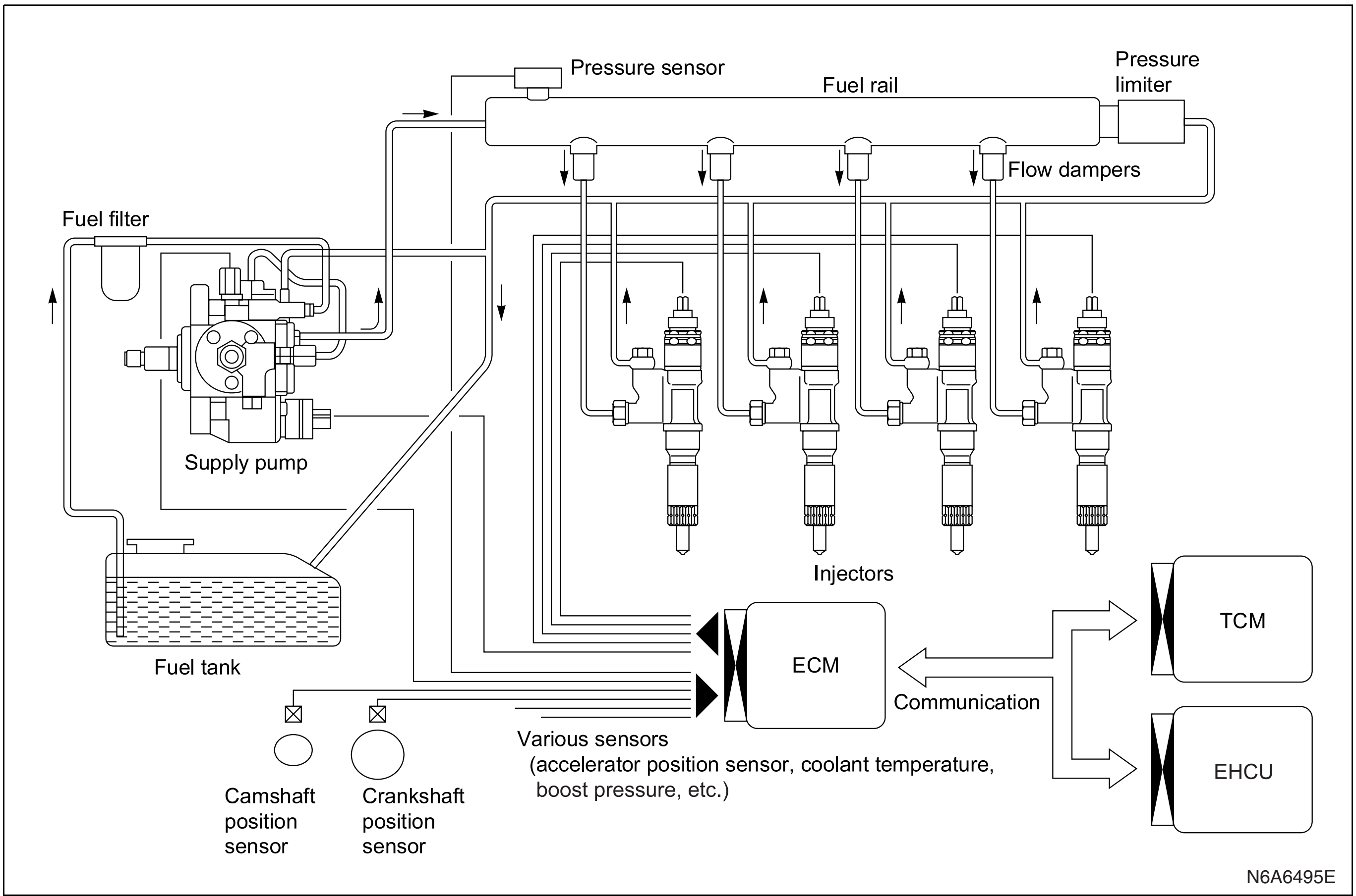
Intake Air Temperature (IAT) Sensor



Legend
1. Intake Air Temperature (IAT) Sensor

The intake air temperature (IAT) sensor is fitted between the air cleaner and turbocharger. The IAT sensor is a variable resistor. The IAT sensor measures the temperature of the air entering the engine. The engine control module (ECM) 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 ECM detects a high voltage on the IAT signal circuit. With lower sensor resistance, the ECM detects a lower voltage on the IAT signal circuit.

Fuel System Description



The common rail system uses a type of accumulator chamber called the fuel rail to store pressurized fuel, and injectors that contain electronically controlled solenoid valves to spray the pressurized fuel in the combustion chambers. The injection system (injection pressure, injection rate, and injection timing) is controlled by the engine control module (ECM), and therefore the common rail system can be controlled independently, free from the influence of engine speed and load. This ensures a stable injection pressure at all time, particularly in the low engine speed range, so that black smoke specific to diesel engines generated during vehicle starting or acceleration can be reduced dramatically. As a result, exhaust gas emissions are clear and reduced, and higher output is achieved.

1. High Pressure Control

- Enables high pressure injection from low engine speed range.
- Optimizes control to minimize particulate matter and NOx emissions.

2. Injection Timing Control

- Enables finely tuned optimized control in accordance with running conditions.

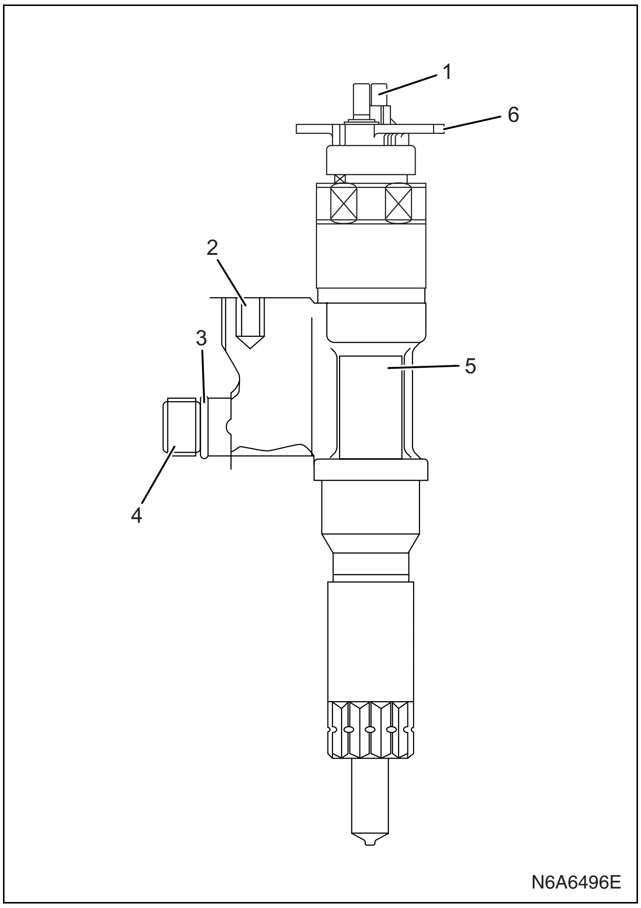
3. Injection Rate Control

- Pilot injection control that performs a small amount of injection before main injection.

The fuel rail system consists primarily of a fuel supply pump, fuel rail, injectors, and ECM.

Fuel System Component Description

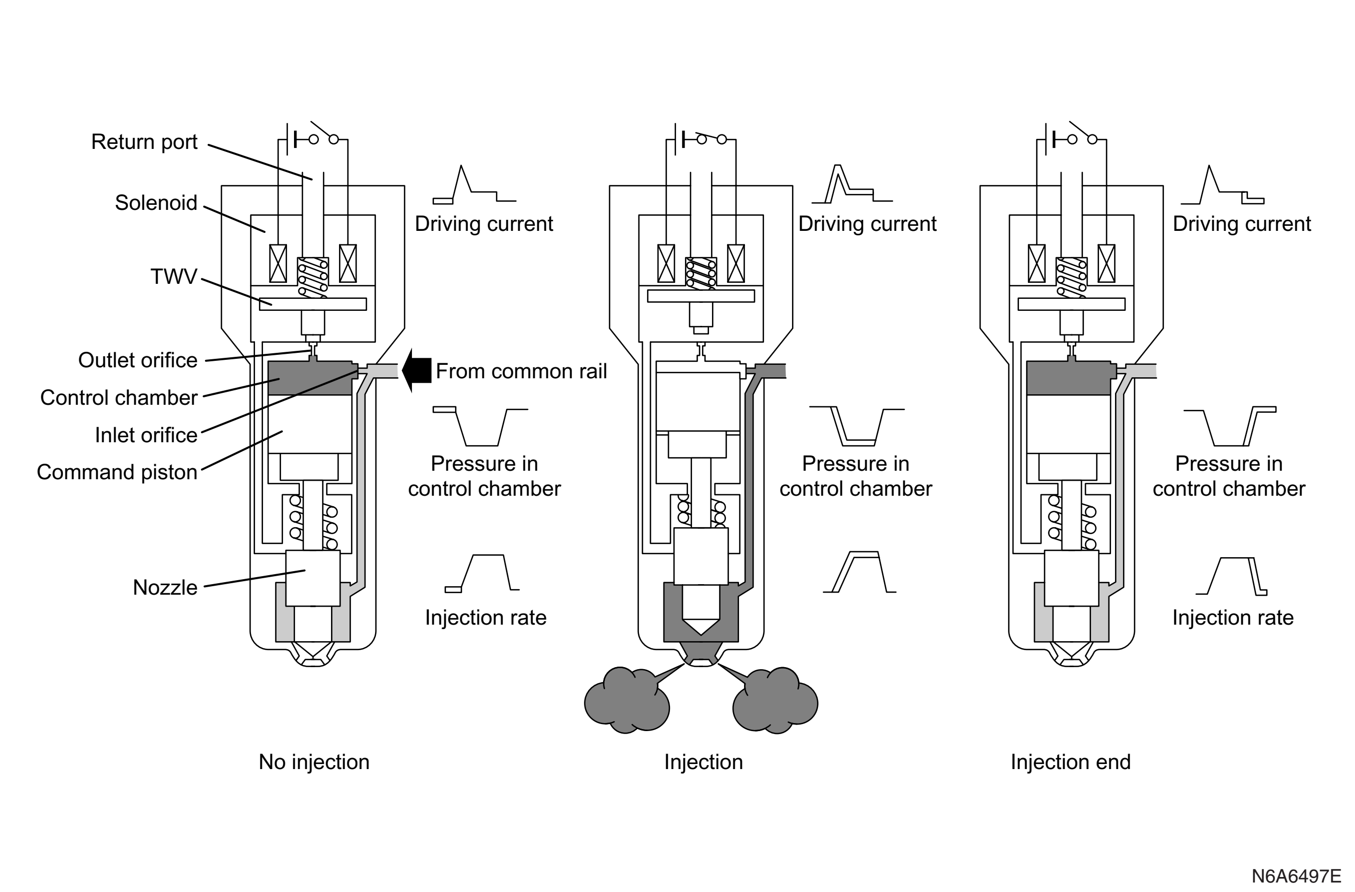
Injector



Legend

1. Terminal Stud
2. Fuel Leak Off Port
3. O-ring
4. Fuel Inlet Port
5. Injector Parts Number Marking
6. Fuel Injector ID Plate

Electronic control type injectors controlled by the engine control module (ECM) are used. Compared with conventional injection nozzles, a command piston, solenoid valve, etc. are added.
ID codes displaying various injector characteristic are laser marked in the plate, and ID codes showing these in numeric form (30 alphanumeric figures are displayed and only 24 are used) are laser marked in the plate. This system uses fuel injector flow rate information (ID codes) to optimize injection quantity control. When an injector is newly installed in a vehicle, it is necessary to input the ID codes in the ECM.
QR (Quick Response) codes or fuel injector flow rate (ID codes) have been adopted to enhance the injection quantity precision of the injectors. The adoption of codes enables injection quantity dispersion control throughout all pressure ranges, contributing to improvement in combustion efficiency, reduction in exhaust gas emissions and consistent horsepower throughout the vehicle built.



1) Non-injection state

The two way valve (TWV) closes the outlet orifice by means of a spring force, when no current is supplied from the engine control module (ECM) to the solenoid. At this time, the fuel pressure applied to the nozzle leading end is equal to the fuel pressure applied to the control chamber through the inlet orifice. As for the force competition in this state, the pressure on the command piston upper surface + nozzle spring force defeat the pressure on the nozzle leading end, and consequently the nozzle is pushed downward to close the injection holes.

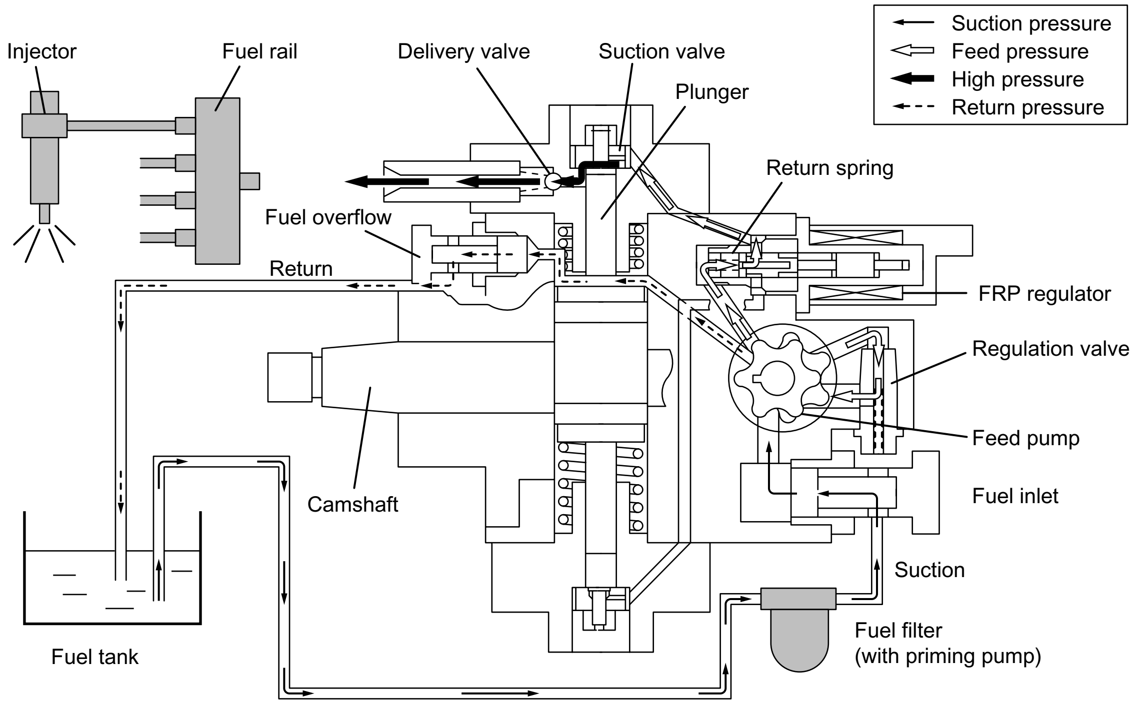
2) Injection start

The TWV is pulled up to open the outlet orifice, and thus the fuel leaks toward the return port, when the current is supplied from the ECM to the solenoid. As a result, the nozzle is pushed up together with the command piston by the fuel pressure applied to the nozzle leading end, and then the nozzle injection holes open to inject the fuel.

3) Injection end

The TWV lowers to close the outlet orifice, when the ECM shuts off a current supply to the solenoid. As a result, the fuel cannot leak from the control chamber, and thus the fuel pressure in the control chamber rises abruptly and then the nozzle is pushed down by the command piston to close the nozzle injection holes, resulting in the end of fuel injection.

Fuel Supply Pump

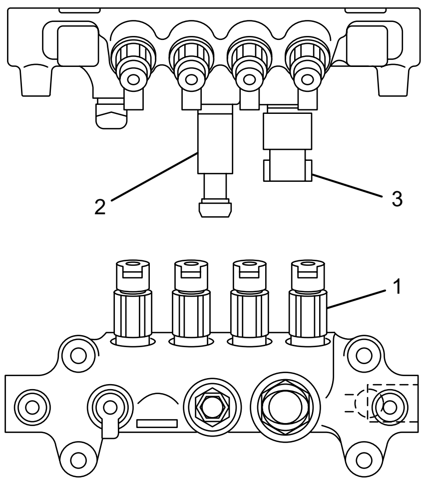


N6A6498E

The fuel supply pump is the heart of the common rail type electronic fuel injection system. The fuel supply pump is installed at the same location as the conventional injection type pump, which spins at a 1 to 1 ratio of fuel supply pump to crankshaft speed. A fuel rail pressure (FRP) regulator and fuel temperature sensor are part of the fuel supply pump assembly.

Fuel is drawn from the fuel tank via the fuel supply pump by the use of an internal feed pump (trochoid type). This feed pump pumps fuel into a 2-plunger chamber also internal to the fuel supply pump. Fuel into this chamber is regulated by the FRP regulator solely controlled by current supplied from the engine control module (ECM). No current to the solenoid results in maximum fuel flow whereas full current to the solenoid produces no fuel flow. As the engine spins, these two plungers produce high pressure in the fuel rail. Since the ECM controls the flow of fuel into this 2-plunger chamber, it therefore controls the quantity and pressure of the fuel supply to the fuel rail. This optimizes performance, improves economy and reduces NOx emissions.

Fuel Rail (Common Rail)



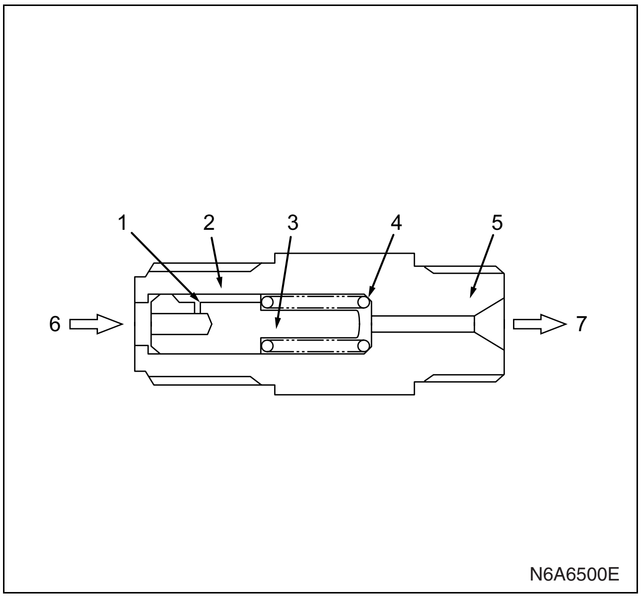
N6A6493E

Legend

1. Flow Damper
2. Pressure Limiter
3. Fuel Rail Pressure (FRP) Sensor

Along with the employment of a common rail type electronic control fuel injection system, the fuel rail is provided to store high pressure fuel between supply pump and injectors. A pressure sensor and a pressure limiter are installed on the fuel rail. The pressure sensor detects the fuel pressure inside the fuel rail and sends its signal to the engine control module (ECM). Based on this signal, the ECM controls the fuel pressure inside the fuel rail via the fuel rail pressure (FRP) regulator of the supply pump. The pressure limiter opens the valve mechanically to relieve the pressure when the fuel pressure inside the fuel rail is excessive.

Flow Damper



Legend

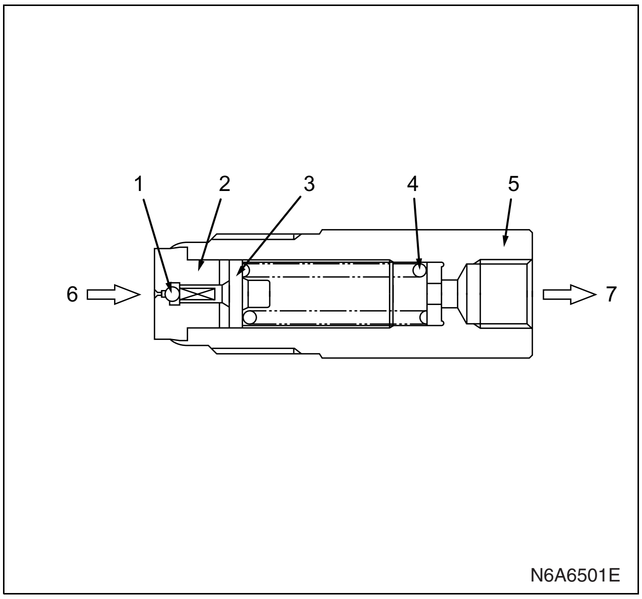
1. Orifice
2. Slit
3. Piston
4. Return Spring
5. Housing
6. Fuel Rail
7. Injector

The flow dampers are installed at the outlet of fuel rail to damp a pulsation of fuel pressure inside the fuel rail or to cut off the fuel supply when the fuel leaks downstream of flow damper. The fuel is supplied to the injectors through an orifice of the piston. The pressure pulsation occurring in the fuel rail is dampered by a resistive force of the return spring and a passing resistance of the orifice, wherein the piston acts as a damper. Also, the leading end of piston closes the fuel supply port to cut off the fuel supply, if the fuel leak occurs in the injection pipe or injectors. Since fuel pressure on the downstream side of flow damper supplied through an orifice + resistive force of return spring do not balance, the fuel pressure applied on the piston surface prior to the orifice will allow the fuel to be cut off. The piston will return when the fuel pressure inside the fuel rail is less than 1.0 MPa (145 psi).

Fuel Rail Pressure Sensor

Refer to Engine Control Component Description.

Pressure Limiter

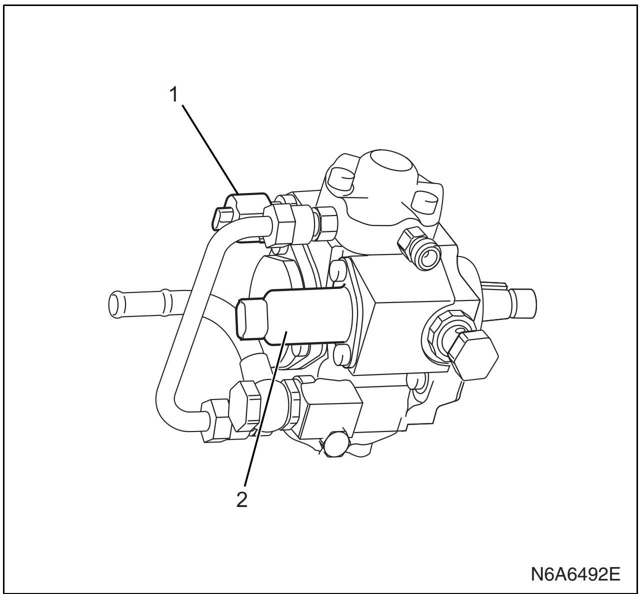


Legend

1. Valve
2. Valve Body
3. Valve Guide
4. Spring
5. Housing
6. Fuel Rail
7. Fuel Return Pipe

The pressure limiter relieves pressure by opening the valve if abnormally high pressure is generated. The valve opens when pressure in rail reaches approximately 200 MPa (29,000 psi), and closes when pressure falls to approximately 50 MPa (7,250 psi). Fuel leakage through the pressure limiter re-turns to the fuel tank.

Fuel Rail Pressure (FRP) Regulator



Legend

1. Fuel Temperature (FT) Sensor
2. Fuel Rail Pressure (FRP) Regulator

The engine control module (ECM) controls the duty ratio of the linear type fuel rail pressure (FRP) regulator (the length of time that the current is applied to the FRP regulator), in order to control the quantity of fuel that is supplied to the high-pressure plungers. Since only the quantity of fuel that is required for achieving the target rail pressure is drawn in, the drive load of the supply pump is decreased.
When current flows to the FRP regulator, variable electromotive force is created in accordance with the duty ratio, moving the armature to the left side. The armature moves the cylinder to the left side, changing the opening of the fuel passage and thus regulating the fuel quantity. With the FRP regulator OFF, the return spring contracts, completely opening the fuel passage and supplying fuel to the plungers (Full quantity intake and full quantity discharge). When the FRP regulator is ON, the force of the return spring moves the cylinder to the right, closing the fuel passage (normally opened).
By turning the FRP regulator ON/OFF, fuel is supplied in an amount corresponding to the actuation duty ratio, and fuel is discharged by the plungers.

Fuel Injection Quantity Control Description

Fuel Injection Quantity Control

This control determines the fuel injection quantity by adding coolant temperature, fuel temperature, intake air temperature, barometric pressure, vehicle speed and some switch inputs information corrections to the basic injection quantity is calculated by the engine control module (ECM) based on the engine operating conditions (engine speed, accelerator pedal pressing amount and boost pressure sensor). More fuel rate indicates if the engine load is increased as the accelerator pedal is stepped on at constant engine speed.
Combined with high pressure injection of atomized fuel, this control improves exhaust gas and ensures proper fuel consumption. Compared with conventional mechanical governors, an electronic control system provides higher degree of freedom of fuel injection quantity control, thereby presenting high accelerator response (acceleration feeling and pressing feeling).

Starting Injection Quantity Control

At the engine starting (after the key switch is turned to the START position to start the engine, up to return of key switch to the ON position), optimum fuel injection quantity is controlled based on the information on the engine speed and coolant temperature. At low temperature, the fuel injection quantity increases. When the engine started completely, this boosted quantity mode at the starting is cancelled and normal running mode is restored.

Idle Speed Control

A control is made so as to achieve stable idling speed at all time regardless of engine secular changes or engine condition variations. The ECM sets target idling speed and controls the fuel injection quantity according to the engine conditions (actual engine speed, coolant temperature and engine load) to follow actual engine speed to the target idling speed so as to ensure stable idling speed.

Idle Vibration Control

A control is made so as to reduce the engine vibration caused by torque variations between cylinders due to variations in fuel injection quantity of each cylinder or injector performance. The ECM corrects the injection quantity between cylinders based on the revolution signals from the crankshaft position (CKP) sensor. Normal range of correction quantity between cylinders is within $\pm$ 5 mm^3.

Fuel Injection Timing Control Description

The injection timing suitable for the vehicle conditions is controlled based on the inputs from respective sensors. The injection timing is determined by comparing actually measured values of pulse signals from the CKP sensor with the target injection timing stored in the map of the ECM.

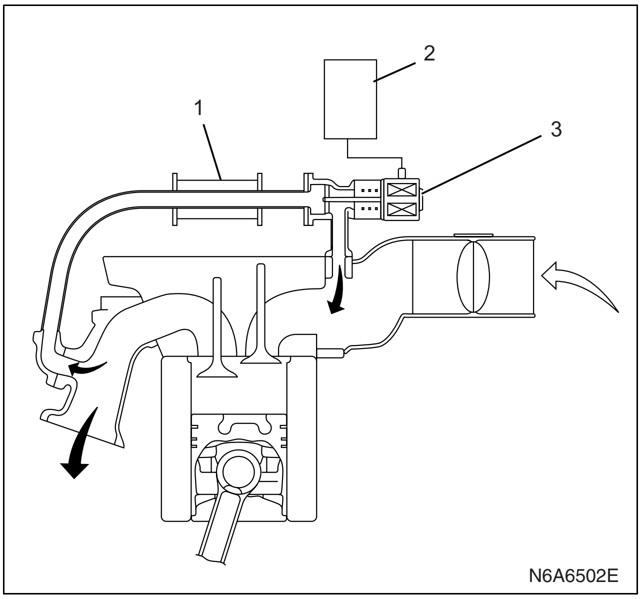
Coolant Temperature Compensation

At the engine starting when the engine coolant temperature is low, the coolant temperature is detected to advance the injection timing for reduction of white smoke emission.

High Altitude Compensation

During running at a highland where air density is low, the atmospheric pressure is detected to advance the injection timing for reduction of white smoke emission.

Exhaust Gas Recirculation (EGR) System Description

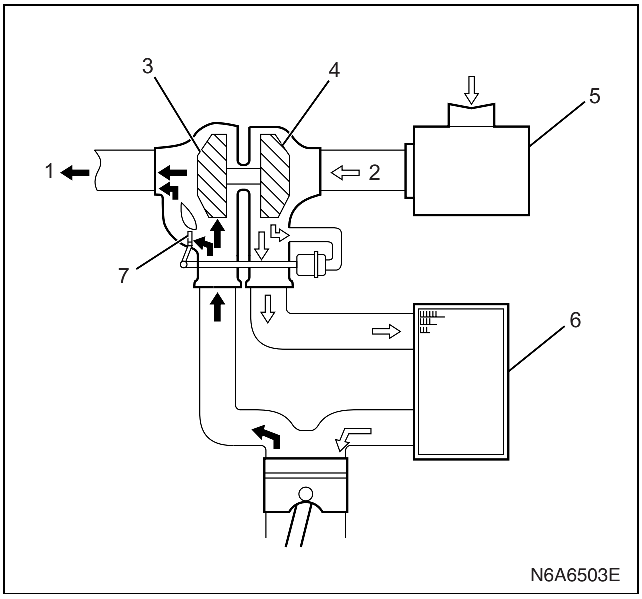


Legend
1. EGR Cooler
2. ECM
3. EGR Valve

The EGR system recirculates a part of exhaust gas back into the intake manifold, which results in reducing nitrogen oxide (NOx) emissions. The EGR control system uses an electronic control system to ensure both driveability and low emission. The control current from the engine control module (ECM) operates the motor to control the lift amount of EGR valve. Also, an EGR position sensor is provided at the rear of the motor to feed actual valve lift amount back to the ECM for more precision control of the EGR amount.

The EGR control starts when the conditions for engine speed, engine coolant temperature and barometric pressure are satisfied. Then, the valve opening is calculated according to the engine speed, and target fuel injection quantity. Based on this valve opening, the drive duty of the motor is determined and the motor is driven accordingly.
A potentiometer type EGR valve position sensor is employed and installed on the EGR valve body. The EGR valve position sensor is supplied with reference voltage (5V) and ground at all times from the ECM. The ECM reads the EGR position sensor voltage input and determines the EGR lift position.

Turbocharger Description



Legend
1. Exhaust Gas
2. Clean Air
3. Turbine Wheel
4. Compressor Wheel
5. Air Cleaner
6. Charge Air Cooler (Intercooler)
7. Wastegate Valve

The turbocharger is used to increase the amount of air that enters the engine cylinders. This allows a proportional increase of fuel to be injected into the cylinders, resulting in increased power output, more complete combustion of fuel, and increased cooling of the cylinder heads, pistons, valves, and exhaust gas. This cooling effect helps extend engine life.
Heat energy and pressures in the engine exhaust gas are utilized to drive the turbine. Exhaust gas is directed to the turbine housing. The turbine housing acts as a nozzle to direct the shaft wheel assembly. Since the compressor wheel is attached directly to the shaft, the compressor wheel rotates at the same speed as the turbine wheel. Clean air from the air cleaner is drawn into the compressor housing and wheel. The air is compressed and delivered through a crossover pipe to

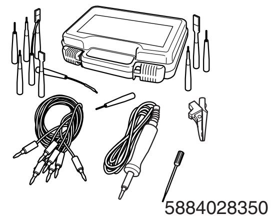
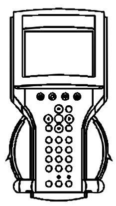
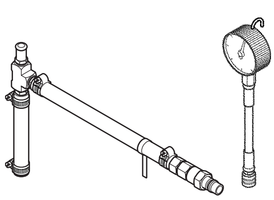
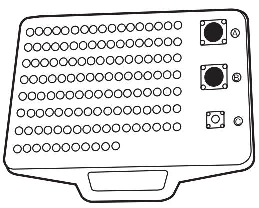
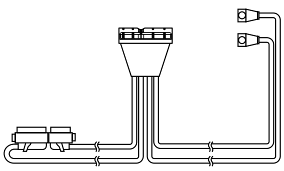
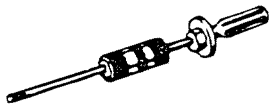
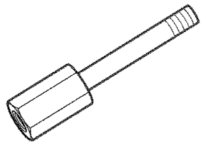
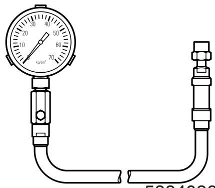
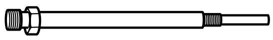
the engine air intake manifold, then into the cylinders. The amount of air pressure rise and air volume delivered to the engine from the compressor outlet is regulated by a waste gate valve in the exhaust housing. The position of the waste gate valve is controlled by the amount of pressure built up on the intake side of the turbocharger. The diaphragm on the inside of the waste gate is pressure sensitive, and controls the position of the valve inside the turbocharger. The position of the valve will increase or decrease the amount of boost to the turbocharger.

The charge air cooler also helps the performance of the diesel. Intake air is drawn through the air cleaner and into the turbocharger compressor housing. Pressurized air from the turbocharger then flows forward through the charge air cooler located in the front of the radiator. From the charge air cooler, the air flows back into the intake manifold.

The charge air cooler is a heat exchanger that uses air flow to dissipate heat from the intake air. As the turbocharger increases air pressure, the air temperature increases. Lowering the intake air temperature increases the engine efficiency and power by packing more air molecules into the same space.

Special Tools and Equipment

Special Tools and Equipment

Illustration	Tool Number / Description
 5884028350	5-8840-2835-0 (J-35616-C) Connector Test Adapter Kit (With Test Lamp)
 5884002850	5-8840-0285-0 (J-39200) Digital Multimeter
	Tech 2 Kit
 5884028440	5-8840-2844-0 Fuel Pressure / Vacuum Gauge Set (J-44638 / Fuel Pressure / Vacuum Gauge Assembly) (EN-47667 / Suction Side Fuel Pressure / Vacuum Gauge Adapter)
	Breaker Box
	Adapter Harness
 5884000190	5-8840-0019-0 (J-23907) Sliding Hammer
 EN46720	5-8840-2826-0 (EN-46720) Fuel Injector Remover
 5884026750	5-8840-2675-0 (J-26999-12) Compression Gauge
 5884028150	5-8840-2815-0 (EN-46722) Gauge Adapter