GENERAL MOTORS DIGITAL ELECTRONIC FUEL INJECTION

DESCRIPTION

The Digital Electronic Fuel Injection System (DEFI) supplies fuel to the engine through 2 electrically actuated injector valves located in the throttle body which is mounted on top of the intake manifold. The amount of fuel metered through the injectors is controlled by the Electronic Control Module (ECM).

The ECM is a digital electronic computer which receives and computes signals from various sensors mounted on the engine. These signals give the ECM engine demand and engine efficiency information, so it can respond by signaling the injectors to allow the proper amount of fuel into the engine.

OPERATION

SUBSYSTEMS

The DEFI basically consists of 6 subsystems: Fuel supply, air induction, engine sensors, ECM, Idle Speed Control (ISC) and integrated system diagnosis.

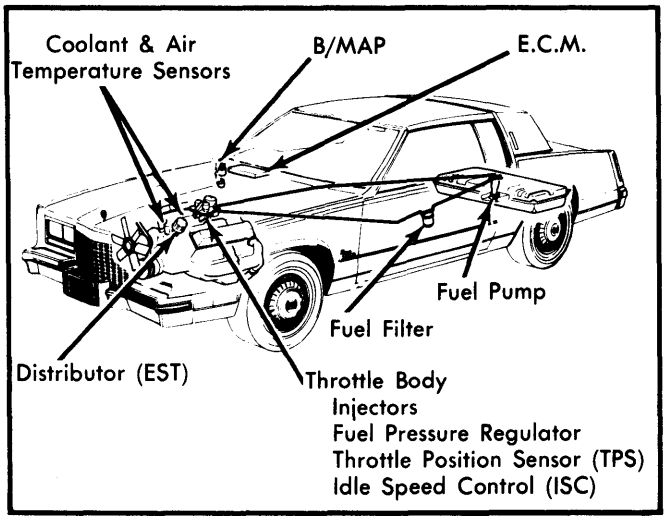


Fig. 1 Digital Electronic Fuel Injection System Components & Relative Location

FUEL SUPPLY

An electric fuel pump, located inside fuel tank as an integral part of fuel gauge sending unit, supplies fuel under pressure to the injectors. The ECM actuates the fuel pump when the ignition is in the "ON" or "START" position. If the engine stalls or is not cranked within 1 second after the ignition is turned to "ON" position, the ECM will diactivate the fuel pump.

Fuel is pumped from the fuel tank through a 10 micron fuel filter, mounted on chassis (near left rear wheel), to the fuel injectors and pressure regulator mounted in the throttle body.

The fuel pressure regulator controls fuel pressure to 10.5 psi across the fuel injectors. Fuel in excess of that used to maintain constant pressure is returned to the fuel tank through a fuel return line.

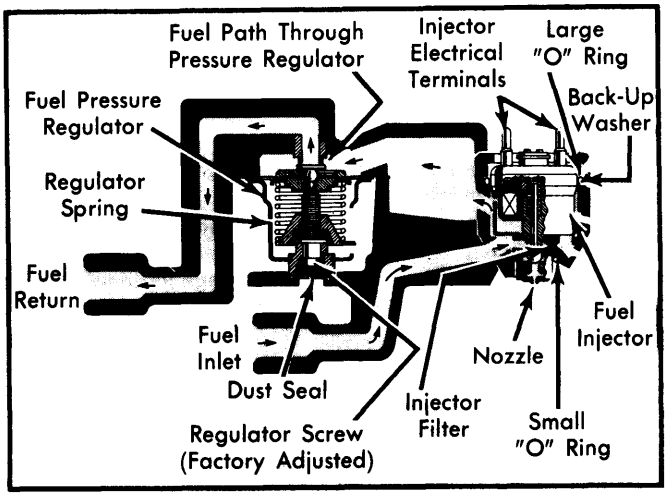


Fig. 2 Metering Body Components

During normal running, 2 fuel injectors are actuated alternately by the ECM and they direct metered atomized fuel into the throttle bores above the throttle valves. Both injectors are actuated simultaneously during cranking.

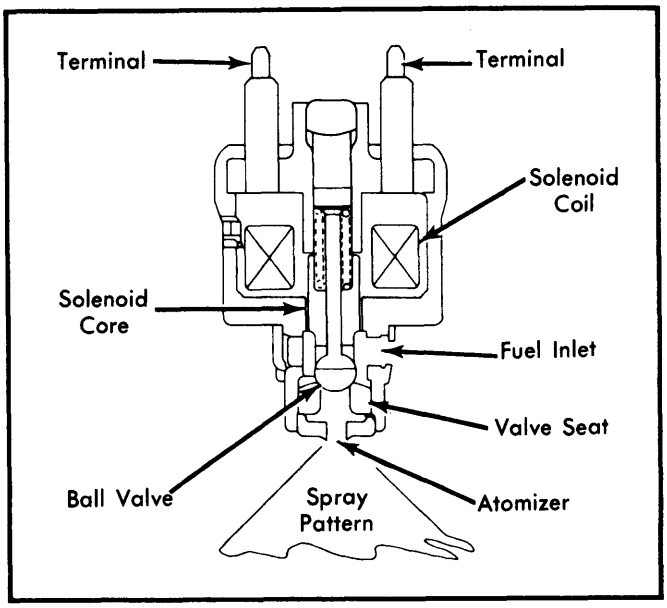


Fig. 3 Cutaway of Injection Valve

AIR INDUCTION

The air induction system consists of the throttle body, intake manifold and includes the Idle Speed Control (ISC) actuator.

Air enters the engine through throttle body at a rate controlled by the throttle valves, which are connected to the accelerator pedal linkage. Idle speed position of throttle valves is controlled by the ISC actuator. A larger throttle valve opening for cold starts and warm-up is accomplished by the ISC actuator moving out further in response to commands from the ECM.

GENERAL MOTORS DIGITAL ELECTRONIC FUEL INJECTION (Cont.)

ENGINE SENSORS

Each sensor furnishes an electronic signal to ECM, modifying injector pulse to conform to operating conditions of the engine. These sensors are as follows:

Manifold Air Temperature (MAT) – This sensor is mounted in the intake manifold directly in front of the throttle body. The MAT sensor measures air/fuel mixture temperature in the intake manifold. The sensor resistance changes as air temperature changes. ECM receives this change in signal and adjusts injector pulse accordingly. Low temperature produces high resistance.

Coolant Temperature Sensor – The coolant temperature sensor is located in the right front corner of the engine directly below the thermostat. This sensor provides information to ECM for fuel enrichment during cold operation, idle speed control, ignition timing and EGR operation. The coolant temperature sensor operates in the same manner as does the MAT sensor.

Manifold Absolute Pressure (MAP) – The MAP sensor is mounted under the instrument panel near the right side A/C outlet. A hose from the throttle body to the MAP provides a vacuum signal. The sensor monitors changes in intake manifold pressure which result from engine load, speed and barometric pressure variations. As intake manifold pressure increases, additional fuel is required. MAP sends this information to ECM so that the pulse width is increased (time injector is open). As manifold pressure decreases, pulse width is shortened.

Barometric Pressure Sensor (BARO) – The BARO sensor is mounted on the MAP sensor bracket. This unit senses ambient or barometric pressures and signals the ECM on pressure changes due to altitude and weather.

Throttle Position Sensor (TPS) – The throttle position sensor is mounted on side of throttle body and connected directly to throttle shaft. This unit senses throttle movement and position and transmits appropriate electrical signals to ECM. The ECM processes these signals to determine conditions for the ISC system.

Engine Speed Sensor – The engine speed signal comes from speed sensor module in EST distributor. Pulses from distributor are sent to ECM where time between pulses is used to calculate engine speed and spark advance.

ELECTRONIC CONTROL MODULE

The ECM is mounted under the right end of instrument panel and consists of various printed circuit boards mounted in a metal box. All sensor inputs are fed into ECM and are processed to produce proper pulse duration for injectors, correct idle speed and proper spark advance. All sensors send analog inputs, which are converted to digital inputs before processing.

IDLE SPEED CONTROL (ISC)

The ISC is an electrically driven actuator which changes throttle valve angle, in idle position, according to commands from the ECM. This function is bypassed when throttle is opened enough to bring the TPS off its idle circuit. The ISC is located on side of throttle body.

INTEGRATED SYSTEM DIAGNOSIS

An amber "CHECK ENGINE" light mounted in the right hand information center on the instrument panel is used as a warning light for DEFI malfunctions. These malfunctions may be related to sensors or ECM. The light resets automatically when fault clears. An intermittent fault could cause the "CHECK ENGINE" light to flicker or go out. The ECM will store the detected failure with an associated trouble code until fault is repaired or diagnostic system is cleared or 20 ignition switch cycles (intermittent fault only) have occurred without fault reappearing.

DIAGNOSIS

The ECM stores component failure information for the DEFI system. These are stored under a related trouble code which can be recalled for diagnosis and repair. When recalled, these codes will be displayed on the Electronic Climate Control (ECC) panel starting from the lowest numbered code. Oniy codes in which a related malfunction has occurred will be displayed.

Entering ECC Diagnostic Mode – Turn ignition "ON". Depress "OFF" and "WARMER" buttons simultaneously on ECC panel and hold until "••" appears on digital display panel. Release buttons and "88" should appear indicating the beginning of diagnostic readout. Trouble codes will be displayed beginning with lowest numbered code and be repeated 3 times. After the third time, trouble code 70 will appear indicating the beginning of switch test mode.

NOTE – *Entire "88" should appear indicating all segments of number display are working or misdiagnosis could occur.*

Clearing Trouble Codes – Depress "OFF" and "HI" buttons simultaneously on ECC panel until "00" appears on digital display panel. This will erase trouble codes, but will not 'Exit' panel from diagnostic mode.

Exiting Diagnostic Mode – Depress any ECC function keys except "RR DEF". Turn ignition switch "OFF" for 10 seconds. This will 'Exit' panel from diagnostic mode, but will not erase any trouble codes.

Switch Test Procedure – 1) When ECM has diagnosed all systems 3 times "70" will appear on display panel. This indicates start of switch tests. When ready to begin test, depress brake pedal. Code "71" should appear.

NOTE – *Each test action must be performed within 10 seconds from the time the display code appears on panel. Otherwise ECM will store test as having failed.*

2) When code "71" appears on panel, depress brake pedal again. Code "72" should appear. When code "72" appears, depress throttle to wide open position and release. Code "73" should appear.

3) When code "73" appears, shift transmission lever from "Drive" to "Neutral". Code "74" should appear. When code "74" appears, shift transmission lever to "Reverse" then to "Park" position. Code "78" should appear.

GENERAL MOTORS DIGITAL ELECTRONIC FUEL INJECTION (Cont.)

4) When code "78" appears, depress "Average" button on the MPG display panel. Code "79" should appear. When code "79" appears, depress "Reset" button on MPG panel. This completes switch tests.

5) The ECM will now display switch test codes which failed. Each code that failed will display until defective component is repaired or retested properly. The ECC will remain in diagnostic mode and display "00" until ECC mode is selected or ignition is turned "OFF".

NOTE – *Switch test diagnosis chart will be given for trouble code "72" only. All other switch test codes are unrelated to DEFI diagnosis.*

Failure Code Determination – It is necssary to determine if a code is intermittent or if it is a "hard failure" code. Diagnostic charts cannot be used to analyze intermittent failures. To determine which are "hard failure" codes, proceed as follows:

1) Enter diagnostic mode, read and record trouble codes. Clear trouble codes and 'Exit' diagnostic mode. Turn ignition "ON" and wait 5 seconds. Start engine and accelerate to 2000 RPM for 5 seconds.

2) Return to idle and shift transmission to "Drive" position. Shift transmission to "Park" position. If "Check Engine" light comes on, enter diagnostic mode and read trouble codes. Only "hard failure" trouble codes will appear at this time.

TROUBLE CODE ANALYSIS

Begin analysis with lowest numbered trouble code displayed. Charts are given to correspond with each trouble code, for "72" switch test trouble code and for performance related problems. Follow chart(s) for corresponding trouble code displayed during tests. Use performance charts to aid in analysis or when no trouble code is displayed during test sequence. Trouble codes and performance charts are as follows:

TROUBLE CODE CHART REFERENCE

Code	Problem Area
00	Diagnostic program completed.
12	No tach or reference signal to ECM.
14	Short in coolant sensor circuit.
15	Open in coolant sensor circuit.
21	Short in Throttle Position Sensor circuit.
22	Open in Throttle Position Sensor circuit.
28	Short in Idle Speed Control circuit.
29 & 30	Idle Speed Control motor operation.
31	Short in MAP sensor circuit.
32	Open in MAP sensor circuit.
33	MAP/BARO sensor circuit. Signal correlation.
34	Vacuum signal hose-to-MAP sensor.
35	Short in BARO sensor circuit.
36	Open in BARO sensor circuit.
37	Short in MAT sensor circuit.
38	Open in MAT sensor circuit.
55 & 56	Replace ECM. ECM self interrogation. (No Chart)

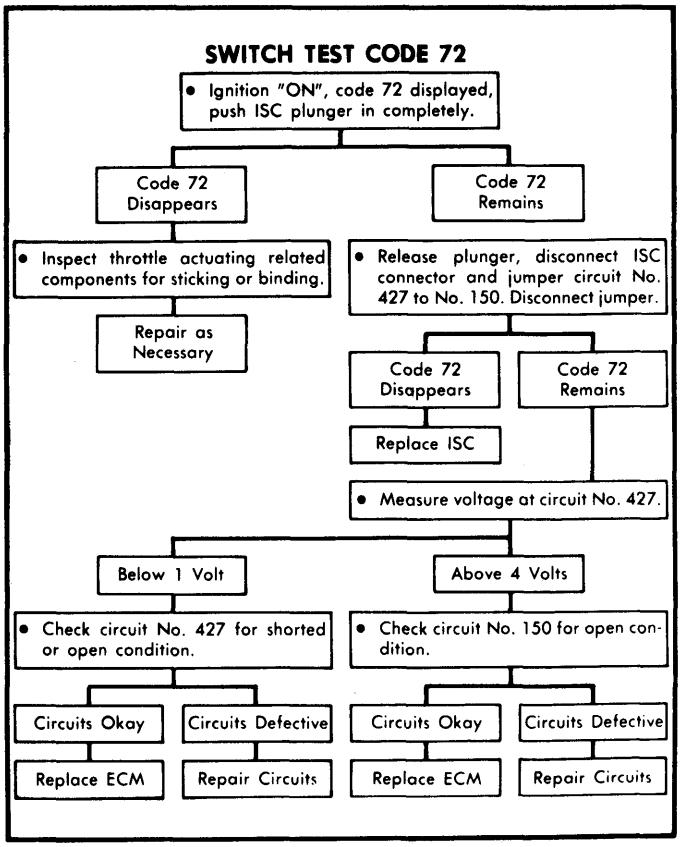
SWITCH TEST CODES

Code	Affected Switch
70	Ready to begin test sequence.
71	Brake light switch. (No Chart)
72	Throttle switch in Idle Speed Control.
73	Automatic Door Lock drive switch. (No Chart)
74	Reverse lamp switch. (No Chart)
78	MPG panel "Average" switch. (No Chart)
79	MPG panel "Reset" switch. (No Chart)

PERFORMANCE CHARTS

Chart	Condition
No. 1	No start or stall after start.
No. 2	Hard starting – Engine cold.
No. 3	"Check Engine" light on – No codes set.
No. 4	"Check Engine" light inoperative.
No. 5	Fuel system diagnosis.
No. 6	Poor performance.
No. 7	Trouble codes cannot display or diagnostic display problems.
No. 8	MPG panel display problems. (No Chart)
No. 9	Improper idle speed.

NOTE – *Follow the sequence given in "Diagnostic Charts" until proper problem identification and correction can be made. Refer to wiring diagram in this article to aid in diagnosis.*



GENERAL MOTORS DIGITAL ELECTRONIC FUEL INJECTION (Cont.)

PERFORMANCE CHART NO. 1

- Read trouble codes and follow appropriate diagnostic procedure.
  - No Codes Set
    - Connect suitable spark tester and crank engine.
      - Spark
        - Ground "Set Timing" pigtail, circuit No. 462, and crank engine.
          - Engine Starts and Runs
            - Check circuit No. 423 for short or open condition.
              - Circuit Okay → Replace ECM
              - Defective Circuit → Repair Circuit
          - No Start
            - Connect fuel pressure gauge and observe cranking pressure.
              - Lower than 9 or Above 12 psi → See Chart No. 5
              - Between 9 and 12 psi
                - Observe injector spray during cranking.
                  - Spray From 1 Injector Only → See Chart No. 6
                  - Spray From Both Injectors → DEFI System Okay
                  - No Spray → Replace ECM
      - No Spark
        - Disconnect 4-way connector at distributor and crank engine.
          - Spark → Replace ECM
          - No Spark → See Gen. Motors Ignition System Diagnostics.
  - Cannot Read Codes → See Performance Chart No. 7

PERFORMANCE CHART NO. 2

- Disconnect ECM connector C-3 and check voltage at harness circuit No. 68 while cranking.
  - +6 Volts → See Chart No. 6
  - Below 1 Volt → Repair Open in Circuit No. 68

PERFORMANCE CHART NO. 3

- Inspect wiring as follows:
  Check "Set Timing" connector for short to ground.
  Check circuit No. 419 and No. 462 for short to ground.
  - All Wiring Okay → Replace ECM
  - Circuit Defect → Repair Circuit

GENERAL MOTORS DIGITAL ELECTRONIC FUEL INJECTION (Cont.)

PERFORMANCE CHART NO. 4

- Check if coolant temperature light is on with ignition "ON".

"OFF"

- Check 20 amp gauge fuse (in fuse block).

Blown → Replace Fuse

Okay

- Measure voltage at fuse with ignition "ON".

12 Volts → Repair Open in Circuit No. 39

Zero Volts → Repair Open in Fuse Feed Circuit

"ON"

- Disconnect ECM connector C-1 and jumper circuit No. 419 from harness to ground. Ignition "ON".

"Check Engine" Light On → Replace ECM

"Check Engine" Light Off

- Check for burned out bulb or open condition in circuit No. 419 and correct as necessary.

TROUBLE CODE 12

- Disconnect 4-way connector at distributor.
- With ignition "ON", engine stopped, measure voltage at circuit No. 430 from distributor.

0.5 Volts or Less → Crank Engine

No Voltage → See Gen. Motors Ignition System Diagnostics.

Voltage

- Check for Open or Short in Circuit No. 430.

Circuit Okay → Replace ECM

Circuit Defective → Repair Circuit

5 Volts → Replace ECM

PERFORMANCE CHART NO. 5

- Install fuel pressure gauge and observe fuel pressure while cranking.

Above 12 psi

- Disconnect fuel return line at throttle body and install fuel pressure gauge to return fitting.

Above 12 psi → Replace Fuel Pressure Regulator

Between 9 and 12 psi → Remove Restriction in Fuel Return Line

Between 9 and 12 psi → Pressure Okay

Below 9 psi

- Ignition "OFF", connect voltmeter to fuel pump fuse(in mini fuse block). Observe meter as ignition is turned "ON".

Goes to 12 Volts Then to Zero Volts

- Ignition "OFF", disconnect 6-way connector at tail panel and connect voltmeter to circuit No. 120. Observe voltage as ignition is turned "ON".

Goes to 12 Volts Then to Zero Volts

- Plug return line at throttle body and observe fuel pressure with ignition "ON".

Above 9 psi → Replace Fuel Pressure Regulator

Below 9 psi

- Inspect fuel filter and lines for restriction.

Restriction → Remove Restriction

No Restriction → Replace Fuel Pump

Does Not Go to 12 Volts → Repair Open in Circuit No. 120

Does Not Go to 12 Volts

- Ignition "OFF", connect voltmeter to circuit No. 465 at fuel pump relay and observe voltage as ignition is turned "ON".

Goes to 12 Volts Then to Zero Volts

- Check voltage at circuit 2X of fuel pump relay.

12 Volts

- Check circuit No. 151 and 2Z for open condition.

Open → Repair Defective Circuit

No Open → Replace Fuel Pump Relay

Zero Volts → Repair Open in Circuit 2X

Does Not Go to 12 Volts

- Check circuit No. 465 for open condition.

Open → Repair Circuit

No Open → Replace ECM

GENERAL MOTORS DIGITAL ELECTRONIC FUEL INJECTION (Cont.)

TROUBLE CODE 14

- Disconnect coolant sensor Connector.
- Clear trouble codes and exit diagnostic mode.
- Reenter diagnostic mode and read codes.

Code 15

- Check for Short in Coolant sensor jumper harness.

  - **Harness Okay** → Replace Sensor
  - **Harness Defective** → Repair Short in Harness

No Code 15

- Disconnect ECM connector C-3.
- Connect ohmmeter from pin No. 410 to ground.

  - **Zero Ohms** → Repair Short in Circuit No. 410
  - **Infinite Ohms**

- Connect ohmmeter between circuit No. 410 and No. 470.

  - **Zero Ohms** → Repair Short Between Circuit No. 410 and No. 470
  - **Infinite Ohms** → Replace ECM

TROUBLE CODE 15

- Clear codes. Turn ignition "OFF".
- Disconnect coolant sensor and jumper harness connector circuit No. 410 to No. 470.
- Ignition "ON", reenter and read codes.

Code 14

- Replace Coolant Sensor

No Code 14

- Ignition "OFF", disconnect ECM connector C-3 and check for continuity of circuit No. 410 and of circuit No. 470.

  - **Continuity** → Replace ECM
  - **No Continuity** → Repair Open Circuit

PERFORMANCE CHART NO. 6

- Remove air cleaner assembly, check fuel pressure and observe fuel spray at idle.

Okay

- Ground "Set Timing" lead (circuit No. 462) and set timing to 10°. Disconnect "Set Timing" lead from ground and check timing.

  Remains at 10°

  - Engine running, disconnect distributor connector and measure voltage at circuit No. 424 of harness.

    - **Above 4 Volts** → See Gen. Motors Ignition System Diagnostics.
    - **Below 1 Volt**

  - Check circuit No. 424 for short to ground.

    - **No Short** → Replace ECM
    - **Short** → Repair Circuit

  Advances

  - Check EGR operation.

    - **Okay**
    - **Not Okay** → Repair EGR System

  - Check for wide open throttle.

    - **No Wide Open Throttle** → Repair Throttle to Open Properly
    - **Wide Open Throttle Okay** → DEFI System Okay

Not Okay

- **One Injector Bad**

  - Reverse injector connectors and observe spray.

    - **Problem Moves to Other Injector**

      - Inspect 3 amp injector fuse (in mini fuse block).

        - **Fuse Okay**

          - Check circuits No. 467, 468, 481 and 482 for open condition.

            - **Open** → Repair Circuit
            - **No Open** → Replace ECM

        - **Fuse Blown** → Replace Fuse

    - **Problem Remains on Bad Injector** → Replace Injector

- **Both Injectors Bad** → See Chart No. 5

- If fuse continues to blow, check circuit No. 481 and No. 482 for short to ground.

  - **Short** → Repair Circuit
  - **No Short** → Replace ECM

GENERAL MOTORS DIGITAL ELECTRONIC FUEL INJECTION (Cont.)

TROUBLE CODE 21

- Perform switch tests.
  - Test No. 72 Passes
    - Ignition "ON", disconnect TPS and read voltage at pin No. 417 of TPS harness connector.
      - Above 4 Volts
        - Disconnect C-3 connector at ECM and test for continuity between circuit No. 417 and No. 474.
          - Continuity → Repair Short Between Circuit No. 417 and No. 474
          - No Continuity → Replace ECM
      - Below 1 Volt
        - Ignition "OFF".
        - Check continuity of TPS circuit No. 476 to ground. (Shorted.)
          - Continuity → Replace TPS
          - No Continuity
            - Ignition "OFF", disconnect ECM connector C-3 and check continuity of circuit No. 476 in harness.
              - Continuity → Replace ECM
              - No Continuity → Repair Open in Circuit No. 476
  - Code 72 Set → Refer to Switch Test Code 72 Diagnostic Chart

TROUBLE CODE 22

- Clear codes and exit diagnostic mode.
- Disconnect TPS connector and jumper harness circuits No. 476 to No. 417.
- Reenter and read codes.
  - Code 21 → Replace ECM
  - No Code 21
    - Check continuity of circuit No. 417 and circuit No. 476.
      - Continuity → Replace ECM
      - No Continuity → Repair Open in Circuit
  - No Display "• •" Only
    - Check for short between circuit No. 417 and No. 476 and from circuit No. 417 to ground.
      - No Short → Replace ECM
      - Short → Repair Circuit

NOTE – *This chart assumes that MPG panel is working.*

PERFORMANCE CHART NO. 7

- Ignition "ON", enter diagnostics.
  - "• •" Appears
    - Continue
      - "88" Then Appears → Replace ECM
      - "88" Does Not Appear
        - Check voltage at circuit No. 474 of TPS connector.
          - 5 Volts
            - Measure voltage in circuit No. 451 at ECM connector C-3.
              - Above 1 Volt
                - Check circuit No. 451 (from ECM connector C-3 to ECC control head) for open condition.
                  - Open → Repair Circuit
                  - No Open → Replace ECC Control Head
              - Below 1 Volt
                - Check circuit No. 461 (from ECM connector C-1 to ECC control head) for open condition.
                  - Open → Repair Circuit
                  - No Open → Replace ECM
          - Zero Volts
            - Check circuits No. 471, 474 and 475 for short to ground.
              - No Short → Replace ECM
              - Short → Repair Circuit
  - "• •" Does Not Appear → Replace ECC Control Head

GENERAL MOTORS DIGITAL ELECTRONIC FUEL INJECTION (Cont.)

TROUBLE CODE 28

- Disconnect ISC connector and jumper circuit No. 150 to No. 427 at harness.
- Clear codes. Start engine.
- When "Check Engine" light comes on, reenter and read codes.

No Code 28 → Replace ISC Motor

Code 28 → Check circuit No. 425 for short to ground.

- Short → Repair Circuit
- No Short → Check circuit No. 426 for short to ground.
  - Short → Repair Circuit
  - No Short → Check for short between circuit No. 425 and circuit No. 426.
    - Short → Repair Circuit
    - No Short → Replace ECM

TROUBLE CODE 29 & 30

- Perform switch tests.

Test No. 72 Passes

- Disconnect ISC connector.
- Ground ISC circuit No. 426.
- Connect ISC circuit No. 425 to 12 volts.

Actuator Does Not Extend → Replace ISC

Actuator Extends → Reverse Leads

Actuator Retracts

- Reverse leads and extend actuator.
- Check circuits No. 425 and No. 426 for a shorted or open condition.

Circuits Okay → Replace ECM

Circuits Defective → Repair Circuits

Actuator Does Not Retract → Replace ISC

Code 72 Set → Refer to Switch Test Code 72 Diagnostic Chart

PERFORMANCE CHART NO. 9

- Read diagnostic codes and perform switch tests. Diagnose and repair as required.
- Check idle speed.

Rough Idle
Check Following:

- EGR Operation.
- A/C Compressor Signal.
- Vacuum Leaks.
- Ignition Timing.
- Fuel Pressure.

Idle Speed Low
Check Following:

- TPS Adjustment.
- ISC Actuator Operation.
- Injector Operation.

Idle Speed High
Check Following:

- TPS Adjustment.
- Vacuum Leak.

System Malfunction → Correct as Necessary → System Repair Does Not Cure Idle Problem

Systems Okay

- Temporarily install new ECM and check idle speed.

Speed Incorrect → Install Original ECM. Problem Not DEFI Related

Speed Correct → Replace ECM

GENERAL MOTORS DIGITAL ELECTRONIC FUEL INJECTION (Cont.)

TROUBLE CODE 31

- Ignition "ON", disconnect MAP sensor connector.
- Check voltage at circuit No. 432.

Above 1 Volt

- Check circuit No. 432 for short with any +5 volt circuit.

  - **No Short** → Replace ECM
  - **Short** → Repair Circuit

Below 1 Volt

- Ignition "OFF", check continuity of circuit No. 469 to ground.

  - **Continuity** → Replace MAP Sensor
  - **No Continuity**

- Check for open in circuit No. 469.

  - **Circuit Open** → Repair Circuit
  - **Circuit Okay** → Replace ECM

TROUBLE CODE 32

- Disconnect MAP sensor circuit and jumper harness connector circuit No. 432 to No. 475.
- Clear codes and exit diagnostic mode.
- Reenter and read code.

  - **Code 31** → Replace MAP Sensor
  - **No Code 31**

- Check for open condition in circuits No. 432 and No. 475.

  - **Open** → Repair Circuit
  - **No Open** → Replace ECM

  - **No Display "• •" Only**

- Check circuit No. 432 in harness for short to ground.

  - **Short** → Repair Circuit
  - **No Short** → Replace ECM

TROUBLE CODE 33

- Ignition "ON", measure voltage at MAP sensor connector. Connect voltmeter as follows:
  Negative lead to circuit No. 469.
  Positive lead to circuit No. 432.
- Repeat for BARO sensor. Connect voltmeter as follows:
  Negative lead to circuit No. 473.
  Positive lead to circuit No. 433.

Readings Within 0.3 of Each Other

- Jumper circuit No. 433 (BARO) to circuit No. 432 (MAP).
- Clear codes and exit diagnostics. Reenter and read codes.

  - **Code 33** → Replace ECM
  - **No Code 33** → Replace MAP Sensor

- Clear codes. Reenter and read codes.

  - **Code 33** → Replace ECM
  - **No Code 33** → System Repaired

Either Reading Below 2 Volts → Replace Sensor With Low Voltage

Readings Differ by More Than 0.3 Volts

- Replace Either MAP or BARO Sensor. Recheck Voltage.

  - **New Sensor Voltage Reads Closer to Original BARO Sensor** → Replace MAP Sensor
  - **New Sensor Voltage Reads Closer to Original MAP Sensor** → Replace BARO Sensor

GENERAL MOTORS DIGITAL ELECTRONIC FUEL INJECTION (Cont.)

TROUBLE CODE 34

- Inspect MAP hose for vacuum leaks.
  - No Leak Found
    - Clear codes and test drive vehicle. Reenter and read codes.
      - Code 34 → Replace MAP Sensor
      - No Code 34 → System Okay
  - Leak Found → Replace Hose

TROUBLE CODE 35

- Ignition "ON", disconnect BARO sensor connector.
- Measure voltage at circuit No. 433 of harness.
  - Above 1 Volt
    - Check circuit No. 473 for short with any +5 volt circuit.
      - Short → Repair Circuit
      - No Short → Replace ECM
  - Below 1 Volt
    - Connect voltmeter positive lead to circuit No. 471 of harness and negative lead to circuit No. 473 of harness. Read voltage.
      - Above 4 Volts → Replace BARO Sensor
      - Below 4 Volts
        - Check circuit No. 473 for open condition.
          - Circuit Okay → Replace ECM
          - Open → Repair Circuit

TROUBLE CODE 36

- Disconnect BARO connector and jumper circuit No. 433 to circuit No. 471.
- Clear codes and exit diagnostic mode. Reenter and read codes.
  - No Code 35
    - Check circuit No. 433 and circuit No. 471 for open condition.
      - Open → Repair Circuit
      - No Open → Replace ECM
  - Code 35 → Replace BARO Sensor
  - Diagnostics Cannot Be Read
    - Check circuit No. 433 for shorted condition.
      - No Short → Replace ECM
      - Short → Repair Circuit

TROUBLE CODE 37

- Clear codes and exit diagnostics. Disconnect MAT sensor connector. Reenter and read codes.
  - Code 38 → Replace MAT Sensor
  - No Code 38
    - Check circuit No. 472 for shorted condition.
      - Short → Repair Circuit
      - No Short → Replace ECM

TROUBLE CODE 38

- Clear codes and exit diagnostic mode.
- Disconnect MAT sensor connector and jumper circuit No. 470 to No. 472 at harness.
- Reenter and read codes.
  - Code 37 → Replace MAT Sensor
  - No Code 37
    - Check circuit No. 470 and No. 472 for open condition.
      - No Open → Replace ECM
      - Open → Repair Circuit

GENERAL MOTORS DIGITAL ELECTRONIC FUEL INJECTION (Cont.)

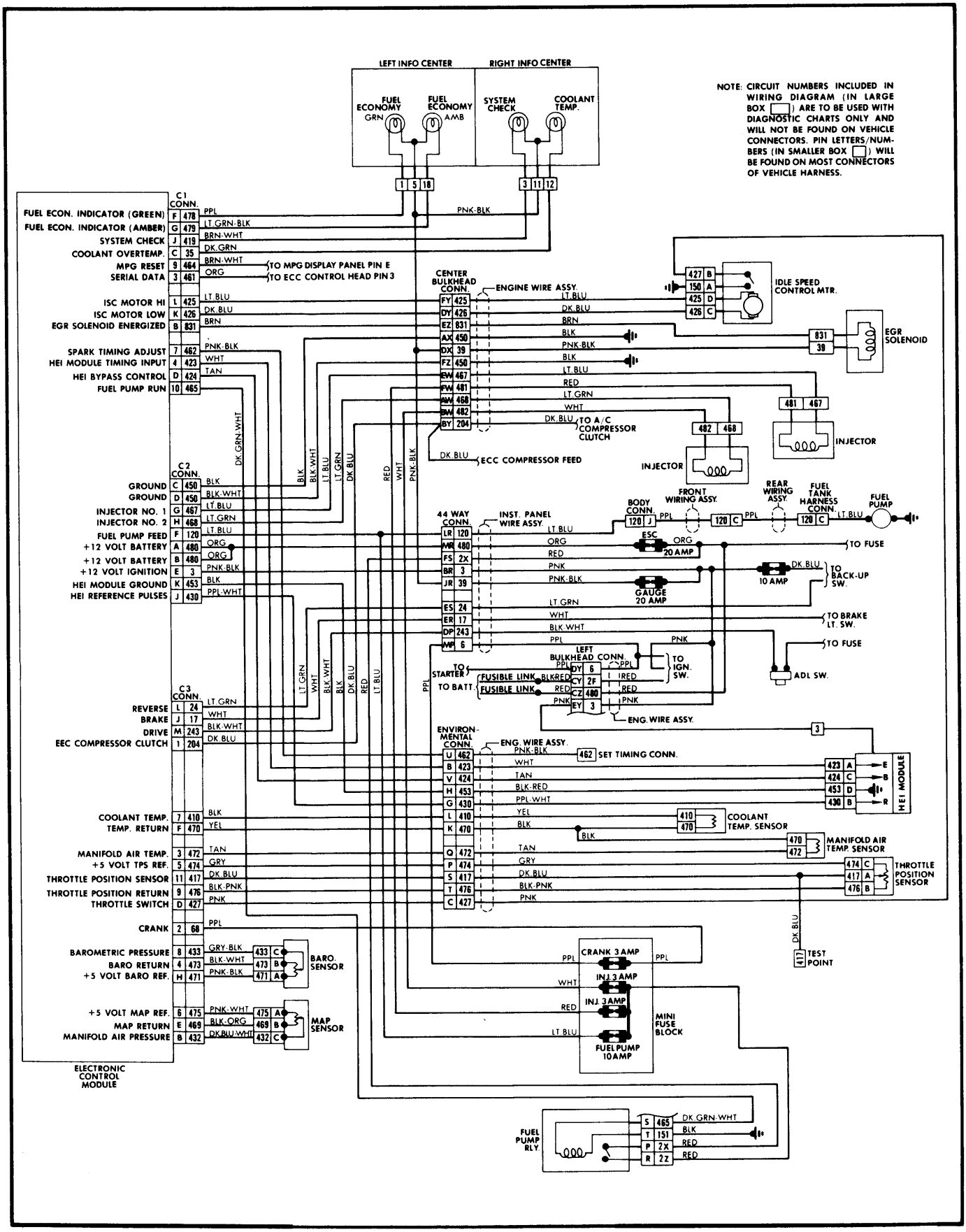


Fig. 4 General Motors Digital Electronic Fuel Injection Wiring Diagram

GENERAL MOTORS DIGITAL ELECTRONIC FUEL INJECTION (Cont.)

REMOVAL & INSTALLATION

ELECTRONIC CONTROL MODULE (ECM)

Removal – Disconnect battery negative cable. Remove lower instrument panel cover. Remove 3 nuts securing ECM and 1 nut securing ground strap. Disconnect harness connectors and remove ECM.

Installation – Position ECM under right end of instrument panel and attach harness connectors. Place ECM onto its bracket and install ground strap and retaining nuts. Install lower instrument panel and connect negative battery cable.

THROTTLE BODY ASSEMBLY

Removal – Disconnect connectors to ISC, TPS and both injectors. Disconnect throttle cable, throttle return spring, fuel lines and vacuum hoses, noting position for reassembly. Remove 3 throttle body mounting screws, throttle body and gasket.

NOTE – *Removal of throttle body is not necessary unless throttle shafts or throttle body replacement is required.*

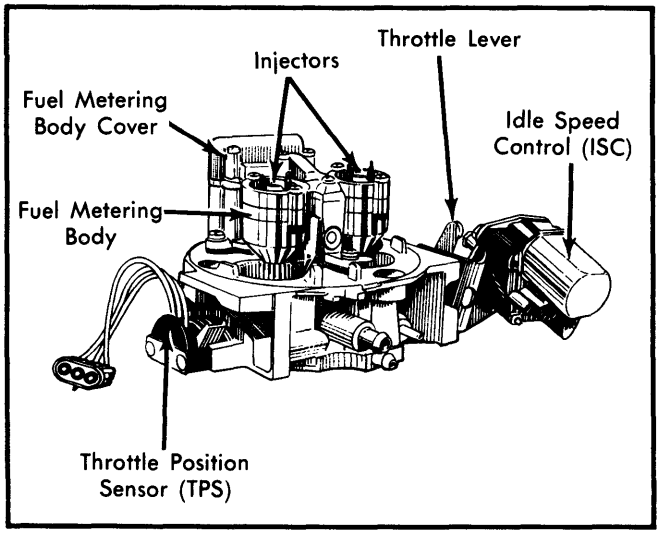


Fig. 5 Throttle Body – TPS Side

Installation – Position throttle body and new throttle body gasket on intake manifold and install mounting screws. Connect fuel lines and vacuum hoses. Reconnect wiring harness connectors to TPS, ISC and fuel injectors.

THROTTLE POSITION SENSOR (TPS)

Removal – Disconnect harness connector from throttle position sensor. File tamper-proof spot weld from mounting screw heads and remove screws from TPS bracket and remove TPS.

Installation – Install TPS to right side of throttle body. Install 2 mounting screws and tighten so throttle body will move but is not loose. Adjust throttle position sensor following procedures given under *ADJUSTMENTS*.

IDLE SPEED CONTROL ACTUATOR (ISC)

Removal & Installation – Disconnect harness connector from ISC. Remove 2 mounting screws and ISC. Position ISC on left side of throttle body and install mounting screws. Adjust ISC following procedures given under *ADJUSTMENTS*.

INJECTORS & PRESSURE REGULATOR

Removal – Disconnect harness connectors from injectors. Remove 8 screws securing pressure regulator and fuel metering cover to throttle body and remove cover and regulator. With a lifting-twisting motion, carefully remove injectors. Discard upper and lower "O" rings being careful not to lose upper "O" ring back-up washer.

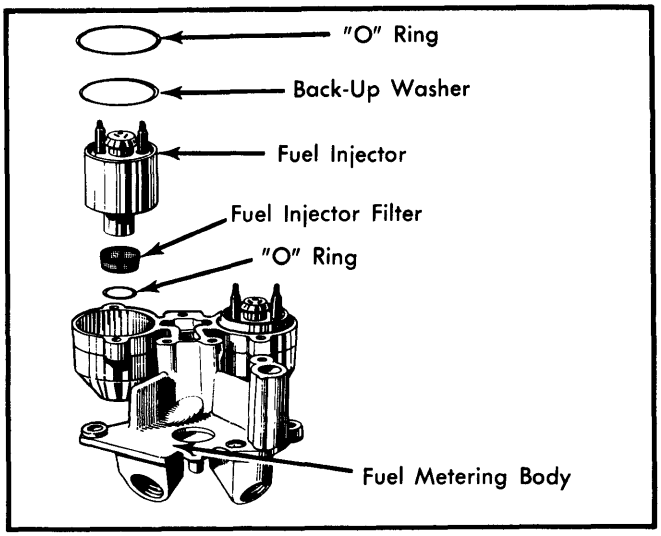


Fig. 6 Exploded View of Injector Components

Installation – Lubricate and install new "O" rings. Position injectors in fuel metering body with connectors aligned in a cross car orientation. Install fuel metering cover assembly and retaining screws. Tighten screws evenly and install harness connectors.

NOTE – *DO NOT remove 4 fuel pressure regulator screws from fuel metering cover. Fuel pressure regulator and fuel metering cover are serviced as an assembly only. Do not soak fuel metering cover in carburetor cleaner as fuel pressure regulator diaphragms and gaskets will be damaged.*

FUEL METERING BODY

Removal & Installation – Remove fuel inlet and outlet lines, fitting nuts and gaskets from fuel metering body. Remove 3 retaining screws and lift off metering body. To install, use new gaskets and reverse disassembly procedure.

FUEL FILTER ASSEMBLY

Removal – Remove fuel inlet hose and discard clamp. Remove fuel outlet line from fitting of filter. Remove screws securing filter to bracket and remove filter. Remove inlet and outlet fittings from filter (if needed for new assembly). If necessary to remove fuel filter bracket, loosen lower mounting screw and remove upper mounting screw. Remove bracket and clean mounting surfaces.

GENERAL MOTORS DIGITAL ELECTRONIC FUEL INJECTION (Cont.)

Installation – Reinstall bracket in reverse order of removal. Position fuel filter to bracket and install mounting screws and fuel lines.

NOTE – *Dry fuel system may require substantial cranking before engine will start.*

FUEL PUMP

Removal – With fuel tank removed, remove nuts holding fuel gauge sending unit and fuel pump feed wires to tank. Using suitable tool remove cam lock ring from fuel tank. Remove gauge sending unit and fuel pump. Pull off filter from fuel pick-up line. Remove fuel pump from bracket and discard rubber mounts.

Installation – Install new rubber mounts to pump and install pump onto sending unit assembly. Install in-tank filter in same position prior to removal. Install in-tank pump and sending unit assembly into tank. Position unit so index tab is in proper location to seat correctly. Install cam lock ring and locknuts.

MANIFOLD ABSOLUTE PRESSURE SENSOR (MAP) & BAROMETRIC PRESSURE SENSOR (BARO)

Removal – Remove right side lower instrument panel and glove box liner. Disconnect harness connectors from both sensors and vacuum hose from MAP sensor. Remove screw holding ground strap to mounting bracket and remove mounting bracket screws. Remove sensors and bracket as an assembly.

Installation – Reverse removal procedure and note MAP sensor has female connector on sensor and BARO sensor has male connector on sensor. Reinstall glove box liner and lower instrument panel.

COOLANT TEMPERATURE SENSOR

Removal – Drain radiator until coolant level is below that of sensor. Remove alternator (if necessary to gain access to sensor). Disconnect harness connector from sensor and remove sensor from block.

Installation – Apply non-hardening sealer to threads of sensor and install sensor. Reconnect harness connector and install alternator. Refill radiator.

MANIFOLD AIR TEMPERATURE SENSOR (MAT)

Removal & Installation – Remove sensor from manifold (directly in front of throttle body). When installing, coat threads with a non-hardening sealer.

ADJUSTMENTS

THROTTLE POSITION SENSOR & MINIMUM AIR RATE

1) Run engine to normal operating temperature. Remove air cleaner assembly. Accelerate engine to 1500 RPM and push ISC plunger to its fully retracted positon. Holding plunger, disconnect harness connector to ISC. Plunger should stay retracted.

2) Release throttle and set engine to 400 RPM (±25 RPM). Connect voltmeter positive lead to TPS test lead (circuit No. 417) and negative lead to negative battery cable. Adjust TPS position so voltmeter reads 0.50 to 0.55 volts and tighten screws. Disconnect voltmeter, reconnect ISC and install air cleaner assembly.

IDLE SPEED CONTROL (ISC)

1) Run engine to normal operating temperature. Remove air cleaner assembly. Accelerate engine to 1500 RPM and disconnect TPS harness connector. Engine "OFF", ISC plunger should be fully extended.

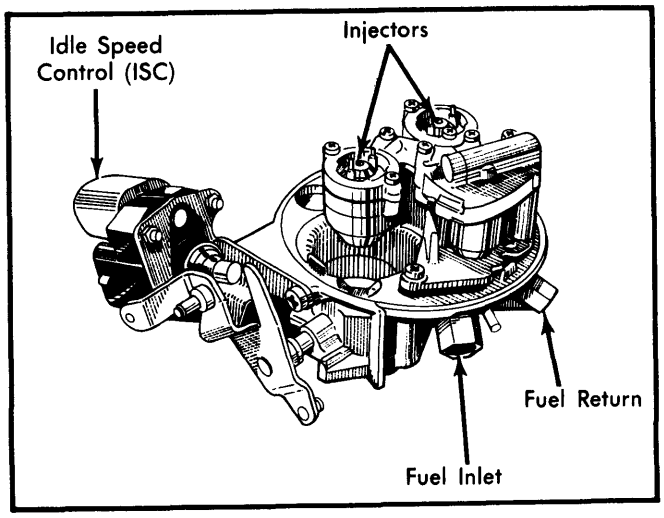


Fig. 7 Throttle Body – Throttle Side

2) Disconnect ISC harness connector and start engine. Set engine speed to 2000 RPM by turning hex on end of ISC plunger.

3) Repeat steps 1) and 2) if adjustment was necessary to recheck proper operation of ISC. TPS may need adjustment if idle speed is too low. Reconnect harness connectors and install air cleaner assembly.

NOTE – *Enter diagnostics, clear trouble codes and exit diagnostics after each adjustment procedures to clear ISC malfunction code. This code may be set from disconnecting ISC during adjustment procedures.*

TIGHTENING SPECIFICATIONS

Application	Ft. Lbs.
Throttle Body Mounting Screws	15
Temperature Sensors	15
Fuel Filter	15
Fuel Pump	INCH Lbs. 55