

Component Procedures: Fuel Delivery and Air Induction

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Component Procedures: Fuel Delivery and Air Induction

Parts and Labor (itype_189)

Labor

Operation	Qualifier Path	Skill	Std Hrs	Wty Hrs
Remove & Replace	Fuel Injection > Fuel Rail, R&R > One Bank	B	3.3	1.4
Remove & Replace	Fuel Injection > Fuel Rail, R&R > Both Banks	B	3.8	0.0
Remove & Replace	Fuel Injection > Injector, R&R > Left Bank > ?	B	2.8	0.0
Remove & Replace	Fuel Injection > Injector, R&R > Left Bank > ?	B	0.1	0.0
Remove & Replace	Fuel Injection > Injector, R&R > Left Bank > ?	B	3.3	0.0
Remove & Replace	Fuel Injection > Injector, R&R > Right Bank > ?	B	2.8	0.0
Remove & Replace	Fuel Injection > Injector, R&R > Right Bank > ?	B	0.1	0.0
Remove & Replace	Fuel Injection > Injector, R&R > Right Bank > ?	B	3.3	0.0
Remove & Replace	Fuel Injection > Injector, R&R > Both Sides > ?	B	3.8	0.0
Remove & Replace	Fuel Injection > Pressure Sensor, R&R	B	1.4	1.1
Remove & Replace	Fuel Supply > Cap, R&R	C	0.2	0.0
Remove & Replace	Fuel Supply > Filler Neck, R&R	B	0.6	0.0
Remove & Replace	Fuel Supply > Fuel Pump Controller, R&R	B	0.7	0.6
Remove & Replace	Fuel Supply > Fuel Pump, R&R > High Pressure	B	2.1	1.5
Remove & Replace	Fuel Supply > Fuel Pump, R&R > In Tank	B	4.6	3.3
Remove & Replace	Fuel Supply > Fuel Tank, R&R	B	4.6	3.1
Remove & Replace	Fuel Supply > Line, R&R	B	1.1	0.0
Remove & Replace	Fuel Supply > Pedal Travel Sensor, R&R > APP ?	B	0.5	0.3
Remove & Replace	Intake > Intake Manifold, R&R	B	1.8	1.2
Remove & Replace	Intake > Manifold Gasket, R&R	B	1.4	1.0
Remove & Replace	Intercooler > Hoses, R&R > To Pump	B	3.0	0.0
Remove & Replace	Intercooler > Hoses, R&R > To Radiator	B	2.7	0.0
Remove & Replace	Intercooler > Intercooler, R&R	B	2.6	0.0
Remove & Replace	Intercooler > Pump, R&R > Intercooler Coolant	B	3.4	0.0
Remove & Replace	Supercharger > By-Pass Valve, R&R	B	0.5	0.0
Remove & Replace	Supercharger > Sensor, R&R > Inlet Sensor	B	0.5	0.0
Remove & Replace	Supercharger > Sensor, R&R > Outlet Sensor	B	0.5	0.0
Remove & Replace	Supercharger > Supercharger, R&R	B	7.5	0.0
Remove & Replace	Throttle Body > Gasket, R&R	B	0.6	0.4
Remove & Replace	Throttle Body > Throttle Body, R&R	B	0.6	0.4
Service	Fuel Supply > System, Service	B	5.1	0.0
Clean	Fuel Injection > Injector, Clean > All Inject?	B	0.5	0.0

Specifications Quick Reference (itype_439)

Quick Specifications

- item

Fuel System Description (Article 11088)

Fuel System Overview

The fuel system is an electronic returnless on-demand design. A returnless fuel system reduces the internal temperature of the fuel tank by not returning hot fuel from the engine to the fuel tank. Reducing the internal temperature of the fuel tank results in lower evaporative emissions.

An electric turbine style fuel pump attaches to the primary fuel tank fuel pump module inside the fuel tank.

The fuel pump supplies fuel through the fuel feed pipe to the high pressure fuel pump. The high pressure fuel pump supplies fuel to a variable-pressure fuel rail. Fuel enters the combustion chamber through precision multi-hole fuel injectors. The high pressure fuel pump, fuel rail pressure, fuel injection timing, and injection duration are controlled by the engine control module (ECM).

The primary fuel tank fuel pump module also contains a primary jet pump and a secondary jet pump. Fuel pump flow loss, caused by vapor expulsion in the pump inlet chamber, is diverted to the primary jet pump and the secondary jet pump through a restrictive orifice located on the pump cover. The primary jet pump fills the reservoir of the primary fuel tank fuel pump module. The secondary jet pump creates a venturi action which causes the fuel to be drawn from the secondary side of the fuel tank, through the fuel transfer pipe, to the primary side of the fuel tank.

Electronic Returnless Fuel System

The electronic returnless fuel system is a microprocessor controlled fuel delivery system which transports fuel from the tank to the fuel rail. It functions as an electronic replacement for a traditional, mechanical fuel pressure regulator. A pressure relief regulator valve within the fuel tank provides an added measure of over pressure protection. Desired fuel pressure is commanded by the engine control module (ECM), and transmitted to the fuel pump flow control module via a GMLAN serial data message. A liquid fuel pressure sensor provides the feedback the fuel pump flow control module requires for Closed Loop fuel pressure control.

Fuel Pump Flow Control Module

The fuel pump flow control module is a serviceable GMLAN module. The fuel pump flow control module receives the desired fuel pressure message from the engine control module (ECM) and controls the fuel pump located within the fuel tank to achieve the desired fuel pressure. The fuel pump flow control module sends a 25 kHz PWM signal to the fuel pump, and pump speed is changed by varying the duty cycle of this signal. Maximum current supplied to the fuel pump is 15 A. A liquid fuel pressure sensor provides fuel pressure feedback to the fuel pump flow control module.

Fuel Pressure Sensor

The fuel pressure sensor is a serviceable 5 V, 3-pin device. It is located on the fuel feed line forward of the fuel tank, and receives power and ground from the fuel pump flow control module through a vehicle wiring harness. The sensor provides a fuel pressure signal to the fuel pump flow control module, which is used to provide Closed Loop fuel pressure control.

Fuel Tank

The fuel tank stores the fuel supply. The fuel tank is located in the rear of the vehicle. The fuel tank is held in place by 2 metal straps that attach to the frame. The fuel tank is molded from high-density polyethylene.

The fuel tank is a saddle configuration in order to provide space for a driveshaft through the center area of the fuel tank. Because of the saddle shape of the tank, two fuel tank fuel pump modules are required.

Fuel Fill Pipe

The fuel fill pipe has a built-in restrictor in order to prevent refueling with leaded fuel.

Fuel Filler Cap

The fuel fill pipe has a tethered fuel filler cap. A torque-limiting device prevents the cap from being over-tightened. To install the cap, turn the cap clockwise until you hear audible clicks. This indicates that the cap is correctly torqued and fully seated.

Fuel Tank Fuel Pump Module

An electric turbine style fuel pump attaches to the primary fuel tank fuel pump module inside the fuel tank. The fuel pump supplies fuel through the fuel feed pipe to the high pressure fuel pump. The fuel tank fuel pump module contains a reverse flow check valve. The check valve maintains fuel pressure in the fuel feed pipe in order to prevent long cranking times.

Primary Fuel Tank Fuel Pump Module

The primary fuel tank fuel pump module is located inside of the right side of the fuel tank. The primary fuel tank fuel pump module consists of the following major components:

- The fuel level sensor
- The fuel pump and reservoir assembly
- The fuel filter
- The pressure relief regulator valve
- The fuel strainer
- The primary jet pump
- The secondary jet pump

Secondary Fuel Tank Fuel Pump Module

The secondary fuel tank fuel pump module is located inside of the left side of the fuel tank. The secondary fuel tank fuel pump module consists of the following major components:

- The fuel pick-up

Fuel Level Sensor

The fuel level sensor consists of a float, a wire float arm, and a ceramic resistor card. The position of the float arm indicates the fuel level. The fuel level sensor contains a variable resistor which changes resistance in correspondence with the position of the float arm. The engine control module (ECM) sends the fuel level information via the High Speed CAN -Bus to the body control module (BCM). The BCM then sends the fuel level percentage via the Low Speed CAN-Bus to the instrument cluster in order to control the fuel gauge. The control module monitors the signal circuits of the primary fuel level sensor and the secondary fuel level sensor in order to determine the fuel level.

Fuel Pump

The fuel pump is mounted in the fuel tank fuel pump module reservoir. The fuel pump is an electric pump. Fuel

is pumped to the high pressure fuel pump at a pressure that is based on feedback from the fuel pressure sensor. The fuel pump delivers a constant flow of fuel even during low fuel conditions and aggressive vehicle maneuvers. The fuel pump flex pipe acts to dampen the fuel pulses and noise generated by the fuel pump.

Fuel Filter

The fuel filter is located in the primary fuel tank fuel pump module. The paper filter element traps particles in the fuel that may damage the fuel injection system .

Pressure Relief Regulator Valve

The pressure relief regulator valve replaces the typical fuel pressure regulator used on a mechanical returnless fuel system . The pressure relief regulator valve is closed during normal vehicle operation. The pressure relief regulator valve is used to vent pressure during hot soaks and also functions as a fuel pressure regulator in the event of the fuel pump flow control module defaulting to 100% pulse width modulation (PWM) of the fuel pump. Due to variation in the fuel system pressures, the opening pressure for the pressure relief regulator valve is set higher than the pressure that is used on a mechanical returnless fuel system pressure regulator.

Fuel Strainer

The fuel strainer attaches to the lower end of the primary fuel tank fuel pump module. The fuel strainer is made of woven plastic. The functions of the fuel strainer are to filter contaminants and to wick fuel. The fuel strainer normally requires no maintenance. Fuel stoppage at this point indicates that the fuel tank contains an abnormal amount of sediment or contamination.

Primary and Secondary Jet Pumps

The primary jet pump is located in the primary fuel tank fuel pump module. Fuel pump flow loss, caused by vapor expulsion in the pump inlet chamber, is diverted to the primary jet pump and the secondary jet pump through a restrictive orifice located on the pump cover. The primary jet pump fills the reservoir of the primary fuel tank fuel pump module.

The secondary jet pump creates a venturi action which causes the fuel to be drawn from the secondary side of the fuel tank, through the transfer pipe, to the primary side of the fuel tank.

Nylon Fuel Pipes

- Replace all nylon fuel pipes that are nicked, scratched or damaged during installation, do not attempt to repair the sections of the nylon fuel pipes
 - Do not hammer directly on the fuel harness body clips when installing new fuel pipes. Damage to the nylon pipes may result in a fuel leak.
 - Always cover nylon vapor pipes with a wet towel before using a torch near them. Also, never expose the vehicle to temperatures higher than 115°C (239°F) for more than one hour, or more than 90°C (194°F) for any extended period.
 - Apply a few drops of clean engine oil to the male pipe ends before connecting fuel pipe fittings. This will ensure proper reconnection and prevent a possible fuel leak. (During normal operation, the O-rings located in the female connector will swell and may prevent proper reconnection if not lubricated.)
- Nylon pipes are constructed to withstand maximum fuel system pressure, exposure to fuel additives, and changes in temperature.

Heat resistant rubber hose or corrugated plastic conduit protect the sections of the pipes that are exposed to chafing, high temperature, or vibration.

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

Quick-Connect Fittings

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

High Pressure Fuel Pump

The high fuel pressure necessary for direct injection is supplied by the high pressure fuel pump. The pump is mounted on the rear of the engine and is driven by a three-lobe cam on the Bank 2 exhaust camshaft. This pump also regulates the fuel pressure using an actuator in the form of an internal solenoid-controlled valve. In order to keep the engine running efficiently under all operating conditions, the engine control module (ECM) requests pressure ranging from 2 to 15 MPa (290 to 2176 psi), depending on engine speed and load. Output drivers in the ECM provide the pump control circuit with a 12 V pulse-width modulated (PWM) signal, which regulates fuel pressure by closing and opening the control valve at specific times during pump strokes. This effectively regulates the portion of each pump stroke that is delivered to the fuel rail. When the control solenoid is NOT powered, the pump operates at maximum flow rate. In the event of pump control failure, the

high pressure system is protected by a relief valve in the pump that prevents the pressure from exceeding 17.5 MPa (2538 psi).

Fuel Rail Assembly

The fuel rail assembly attaches to each cylinder head. The fuel rail distributes high pressure fuel to the fuel injectors. The fuel rail assembly consists of the following components:

- The direct fuel injectors
- The fuel rail pressure sensor

Fuel Injectors

The fuel injection system is a high pressure, direct injection, returnless on-demand design. The fuel injectors are mounted in the cylinder head beneath the intake ports and spray fuel directly into the combustion chamber. Direct injection requires high fuel pressure due to the fuel injector's location in the combustion chamber. Fuel pressure must be higher than compression pressure requiring a high pressure fuel pump. The fuel injectors also require more electrical power due to the high fuel pressure. The ECM supplies a separate high voltage supply circuit and a high voltage control circuit for each fuel injector. The injector high voltage supply circuit and the high voltage control circuit are both controlled by the ECM. The ECM energizes each fuel injector by grounding the control circuit. The ECM controls each fuel injector with 65 V. This is controlled by a boost capacitor in the ECM. During the 65 V boost phase, the capacitor is discharged through an injector, allowing for initial injector opening. The injector is then held open with 12 V.

The fuel injector assembly is an inside opening electrical magnetic injector. The injector has six precision machined holes that generate a cone shaped oval spray pattern. The fuel injector has a slim extended tip in order to allow a sufficient cooling jacket in the cylinder head.

Fuel Injection Fuel Rail Fuel Pressure Sensor

The fuel rail pressure sensor detects fuel pressure within the fuel rail. The engine control module (ECM) provides a 5 V reference voltage on the 5 V reference circuit and ground on the low reference circuit. The ECM receives a varying signal voltage on the signal circuit. The ECM monitors the voltage on the fuel rail pressure sensor circuits. When the fuel pressure is high, the signal voltage is high. When the fuel pressure is low, the signal voltage is low.

Fuel Metering Modes of Operation

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

Starting Mode

The ECM supplies voltage to the fuel pump control module when the ECM detects that the ignition is ON. The voltage from the ECM to the fuel pump control module remains active for 2 s, unless the engine is in Crank or Run. While this voltage is being received, the fuel pump control module closes the ground switch of the fuel tank fuel pump module and also supplies a varying voltage to the fuel tank fuel pump module in order to maintain the desired fuel line pressure. The ECM calculates the air/fuel ratio based on inputs from the engine coolant temperature (ECT), manifold absolute pressure (MAP), mass air flow (MAF), and throttle position sensors. The system stays in starting mode until the engine speed reaches a predetermined RPM. During a cold start, the engine control module (ECM) commands dual-pulse mode during Open Loop operation to improve cold start emissions. In dual-pulse mode, the injectors are energized twice during each injection event.

Clear Flood Mode

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

Run Mode

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

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

Specific values for the above conditions exist for each different engine, and are stored in the electrically erasable programmable read-only memory (EEPROM). The system begins Closed Loop operation after reaching these values. In Closed Loop, the ECM calculates the air/fuel ratio, injector ON time, based upon the signal

from various sensors, but mainly from the HO2S. This allows the air/fuel ratio to stay very close to 14.7:1.

Acceleration Mode

When the driver pushes on the accelerator pedal, air flow into the cylinders increases rapidly. To prevent possible hesitation, the ECM increases the pulse width to the injectors to provide extra fuel during acceleration. This is also known as power enrichment. The ECM determines the amount of fuel required based upon throttle position, engine coolant temperature (ECT), manifold absolute pressure (MAP), mass air flow (MAF), and engine speed.

Deceleration Mode

When the driver releases the accelerator pedal, air flow into the engine is reduced. The ECM monitors the corresponding changes in throttle position, mass air flow (MAF), and manifold absolute pressure (MAP). The ECM shuts OFF fuel completely if the deceleration is very rapid, or for long periods, such as long, closed-throttle coast-down. The fuel shuts OFF in order to prevent damage to the catalytic converter s.

Battery Voltage Correction Mode

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

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

Fuel Cutoff Mode

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

- The ignition is OFF. This prevents engine run-on.
- The ignition is ON but there is no ignition reference signal. This prevents flooding or backfiring.
- The engine speed is too high, above red line.
- The vehicle speed is too high, above rated tire speed.
- During an extended, high speed, closed throttle coast down—This reduces emissions and increases engine braking.
- During extended deceleration, in order to prevent damage to the catalytic converters

Fuel Trim

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

Fuel System Cleaning (Article 11438)

The following procedure covers the disassembly and the inspection of the complete fuel supply system. If the fuel system is contaminated, the fuel system can be cleaned. You can usually determine the extent of the fuel system contamination during the disassembly.

- Remove the fuel module assemblies. Refer to Fuel Tank Fuel Pump Module Replacement - Right Side and Fuel Level Sensor Replacement - Left Side .
- Locate the tank in a suitable work area away from any heat, any flame, or any other source of ignition.
- Perform the following procedures:
- Inspect the fuel sender strainer. Replace the primary fuel tank module if the strainer is contaminated.
- Inspect the secondary fuel tank module for debris. Clean the secondary fuel tank module if debris is found.
- Use compressed air in order to apply air pressure to the transfer tube.
- Flush the fuel tank with running hot water for at least five minutes. Pour the water out of the fuel sender assembly opening. Rock the tank in order to ensure that the removal of the water from the tank is complete.
- Refer to Metal Collar Quick Connect Fitting Service in order to disconnect the following quick connect fittings from the fuel rail :
- The feed hose/pipe

- The return hose/pipe
- Use compressed air in order to apply air pressure to the fuel lines in the opposite direction from the normal fuel flow.
- Remove the fuel injectors and fuel rail .
- Clean and inspect the fuel injectors and fuel rail.

Installation Procedure

Assemble the fuel system as follows:

- Install the fuel injectors and fuel rail.
- Install the fuel module assemblies. Refer to Fuel Tank Fuel Pump Module Replacement - Right Side and Fuel Level Sensor Replacement - Left Side .
- Refer to Metal Collar Quick Connect Fitting Service in order to connect the following quick connect fittings to the fuel rail:

Fuel Pipe Fitting Warning (Article 13055)

Document ID: 2063600

Warning:

Always apply a few drops of clean engine oil to the male pipe ends before connecting the fuel pipe

fittings. This will ensure proper reconnection and prevent a possible fuel leak. Always replace O-rings.

Engine Controls - Fastener Specifications (Article 11468)

Application Specification

Metric English

Accelerator Pedal Position (APP) Sensor to Body Retaining Bolt 9 Nm 80 lb in

Air Cleaner Lower Housing to Body Retaining Bolt 10 Nm 89 lb in

Air Cleaner Outlet Duct Hose Clamp 4 Nm 35 lb in

Camshaft Position (CMP) Actuator Solenoid Valve to Engine Front Cover Retaining Bolt 9 Nm 80 lb in

Camshaft Position (CMP) Sensor to Engine Front Cover Retaining Bolt 10 Nm 89 lb in

Crankshaft Position (CKP) Sensor to Engine Block Retaining Bolt 10 Nm 89 lb in

Engine Coolant Temperature (ECT) Sensor 20 Nm 15 lb ft

Evaporative Emission (EVAP) Canister Purge Solenoid Valve bolt 10 Nm 89 lb in

Evaporative Emission (EVAP) Canister to Underbody Retaining Bolt 6 Nm 53 lb in

Fuel Feed Intermediate Pipe Fitting 28 Nm 21 lb ft

Fuel Feed Pipe Bolt 50 Nm 37 lb ft

Fuel Feed Pipe Fitting 28 Nm 21 lb ft

Fuel Pipe Shield 10 Nm 89 lb in

Fuel Pipe Stone Guard to Underbody Retaining Nut 5 Nm 44 lb in

Fuel Pressure Sensor 33 Nm 24 lb ft

Fuel Rail Assembly Bolt

First pass 12 Nm 106 lb in

- First pass

Final pass 23 Nm 17 lb ft

- Final pass

Fuel Rail to Lower Inlet Manifold Retaining Bolt 10 Nm 89 lb in

Fuel Tank Heat Shield 5.5 Nm 49 lb in

Fuel Tank Hose to Filler Tube Clamp 4 Nm 35 lb in

Fuel Tank Strap to Underbody Retaining Bolt 30 Nm 22 lb ft

Filler Tube Support Bracket to Body Retaining Bolt 9 Nm 80 lb in

Heated Oxygen Sensor (HO2S) 42 Nm 31 lb ft

Ignition Coil to Camshaft Cover Retaining Bolt 10 Nm 89 lb in

Intake Manifold Runner Control Solenoid to Upper Intake Manifold Retaining Bolt 10 Nm 89 lb in

Knock Sensor to Engine Block Retaining Bolt 23 Nm 17 lb ft

Manifold Absolute Pressure Sensor 4 Nm 35 lb in

Mass Airflow Sensor with Intake Air Temperature (MAF) Sensor to Air Cleaner Upper Housing Retaining Screw 4 Nm 35 lb in

Rear Frame to Underbody Retaining Bolt

First pass 65 Nm 48 lb ft

Final pass + 120 Degrees

Spark Plug

Fit New Spark Plug 20 Nm 15 lb ft
- Fit New Spark Plug
Refit Existing Spark Plug 18 Nm 13 lb ft
- Refit Existing Spark Plug
Throttle Body to Upper Intake Manifold Retaining Bolt 10 Nm 89 lb in

All New Technical Service Bulletins (itype_432)

Tsbs

- Maintenance Cleaning of Fuel Injectors and Information Regarding Gasoline Detergent Additive (04-06-04-051L, 2026/05/08)
- Diagnostic Tip: Fuel Injected Gasoline Engines Possible No Start Extended Crank No Power or Fuel Pressure Related DTC's (PIP5596A, 2024/03/04)
- Stalling - Hesitation - Lack Of Performance P018B And/Or P2635 Setting In High Ambient Temperatures (PIP5507B, 2017/07/18)
- Fuel and Oil Additives - Facts and Myths - Maximizing Gasoline Fuel Economy (05-00-89-072H, 2026/05/05)
- Information on Rough Idle, Crank No Start, Extended Crank or Misfire Due to Excessive Carbon on Top of Valves or Sticking Valves, Malfunction Indicator Light (MIL) Illuminated - DTC P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307, P0308 Set (16-NA-383, 2026/05/05)
- Diagnostic Tip for Hard Start, Rough Idle, Heavy Smoke from the Tail Pipe, Strong Diesel Smell and/or Hesitation Stall or No Start, Malfunction Indicator Lamp (MIL) Illuminated - Multiple DTCs Set (26-NA-026, 2026/01/22)
- SES Light With A P2097 Or P2099 (PIP4964F, 2025/04/29)
- TOP TIER™ Detergent Gasoline and TOP TIER™ Diesel Fuel Information and Licensed Brands (05-06-04-022W, 2025/07/14)

All Technical Service Bulletins (itype_100)

Tsbs

- Diagnostic Tip: Fuel Injected Gasoline Engines Possible No Start Extended Crank No Power or Fuel Pressure Related DTC's (PIP5596A, 2024/03/04)
- SES Light with Fuel Trim and or Oxygen Sensor Codes (PIP4925B, 2018/12/03)
- Fuel System - MIL ON, Misfire, Injector DTC's Set (PIP4924D, 2014/01/21)
- EPA Summer Grade Gasoline Waiver Allows Use of Winter Grade Surplus Potential Drivability Concerns P0300 P0171 P0174 P228C Fuel Smell Odor Longer Extended Cranking Time Hesitation Engine Stalls (PIP5725A, 2021/03/19)
- Stalling - Hesitation - Lack Of Performance P018B And/Or P2635 Setting In High Ambient Temperatures (PIP5507B, 2017/07/18)
- Fuel System - Cold Start Misfire After Engine/Fuel Sys Repair (PI1296, 2014/08/19)
- Fuel and Oil Additives - Facts and Myths - Maximizing Gasoline Fuel Economy (05-00-89-072H, 2026/05/05)
- Information on Rough Idle, Crank No Start, Extended Crank or Misfire Due to Excessive Carbon on Top of Valves or Sticking Valves, Malfunction Indicator Light (MIL) Illuminated - DTC P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307, P0308 Set (16-NA-383, 2026/05/05)
- SES Light With A P2097 Or P2099 (PIP4964F, 2025/04/29)
- Fuel System - E85 Fuel Usage Information/Recommendations (05-06-04-035E, 2015/05/27)
- Maintenance Cleaning of Fuel Injectors and Information Regarding Gasoline Detergent Additive (04-06-04-051L, 2026/05/08)
- Information on Malfunction Indicator Lamp (MIL) Illuminated with Multiple Fuel Trim and/or Oxygen Sensor Codes Set (20-NA-065, 2022/08/15)
- Fuel System - GM Fuel System Treatment PLUS(R) Info. (05-00-89-078C, 2012/04/19)
- Diagnostic Tips For I/M Flags Resetting After Ignition Cycled (PIP5627, 2019/02/15)
- Engine - THIS BULLETIN HAS BEEN CANCELED (04-06-04-054E, 2012/08/06)
- Diagnostic Tip for Hard Start, Rough Idle, Heavy Smoke from the Tail Pipe, Strong Diesel Smell and/or Hesitation Stall or No Start, Malfunction Indicator Lamp (MIL) Illuminated - Multiple DTCs Set (26-NA-026, 2026/01/22)
- TOP TIER™ Detergent Gasoline and TOP TIER™ Diesel Fuel Information and Licensed Brands (05-06-04-022W, 2025/07/14)
- Fuel System - Information on Top Tier Detergent Gasoline (04-06-04-047M, 2014/10/06)
- Engine Controls - Single Cylinder Misfire Diagnostics (PIP5062C, 2014/05/02)

Repair Tips (itype_110)

Tsbs

- Fuel System - E85 Fuel Usage Information/Recommendations (05-06-04-035E, 2015/05/27)
- Fuel System - GM Fuel System Treatment PLUS(R) Info. (05-00-89-078C, 2012/04/19)
- Fuel System - MIL ON, Misfire, Injector DTC's Set (PIP4924D, 2014/01/21)
- Fuel System - Cold Start Misfire After Engine/Fuel Sys Repair (PI1296, 2014/08/19)
- Fuel System - Information on Top Tier Detergent Gasoline (04-06-04-047M, 2014/10/06)
- Engine Controls - Single Cylinder Misfire Diagnostics (PIP5062C, 2014/05/02)

Fuel System Diagnosis (Article 11386)

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Circuit/System Description

The engine control module (ECM) supplies voltage to the fuel pump control module when the ECM detects that the ignition is ON. The voltage from the ECM to the fuel pump control module remains active for 2 s, unless the engine is in Crank or Run. While this voltage is being received, the fuel pump control module closes the ground switch of the fuel pump and also supplies a varying voltage to the fuel tank pump module in order to maintain the desired fuel rail pressure .

The fuel system is an electronic returnless on-demand design. A returnless fuel system reduces the internal temperature of the fuel tank by not returning hot fuel from the engine to the fuel tank. Reducing the internal temperature of the fuel tank results in lower evaporative emission s.

An electric turbine style fuel pump attaches to the primary fuel tank fuel pump module inside the fuel tank.

The fuel pump supplies fuel through the fuel feed pipe to the high pressure fuel pump . The high pressure fuel pump supplies fuel to a variable-pressure fuel rail . Fuel enters the combustion chamber through precision multi-hole fuel injectors . The high pressure fuel pump, fuel rail pressure, fuel injection timing, and injection duration are controlled by the engine control module (ECM).

The primary fuel tank fuel pump module also contains a primary jet pump and a secondary jet pump. Fuel pump flow loss, caused by vapor expulsion in the pump inlet chamber, is diverted to the primary jet pump and the secondary jet pump through a restrictive orifice located on the pump cover. The primary jet pump fills the reservoir of the primary fuel tank fuel pump module. The secondary jet pump creates a venturi action which causes the fuel to be drawn from the secondary side of the fuel tank, through the fuel transfer pipe, to the primary side of the fuel tank.

Diagnostic Aids

- A faulty component may cause the following noises: — Buzz / Knock / Rattle / Tick @ 600 to 800 RPM
- An erratic low side fuel pressure leak-down reading may be caused by air/vapor in the fuel feed line, which can be caused by the following:
 - Ambient conditions
 - Engine operating conditions — Cold Start-Up / Warm / Hot
 - Fuel Alcohol Content
 - Fuel blend — Summer / Winter
 - Fuel octane rating

Reference Information

Description and Operation

Fuel System Description

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Special Tools

- CH 48027 - Digital Pressure Gauge
- J 37287 - Fuel Line Shut-off Adapter

Circuit/System Verification

- Repair all fuel system related DTCs before performing this diagnostic.
- Inspect the fuel system for damage or external leaks before proceeding.

- Verify that adequate fuel is in the fuel tank before proceeding.
 - The Fuel Pump Enable may need to be commanded ON a few times in order to obtain the highest possible fuel pressure.
 - Before proceeding with this test review the User Manual CH 48027–5 for Safety Information and Instructions.
 - Ignition OFF, all accessories OFF, install a CH 48027 - Gauge . Refer to Fuel Pressure Gauge Installation and Removal .
 - Ignition ON, engine OFF, command the Fuel Pump Enable ON with a scan tool. Verify the fuel pressure is between 345–650 kPa (50–94 psi) with the fuel pump running.
 - Engine idling at normal operating temperature, the Fuel Pump Flow Control Module Fuel Pressure Sensor parameter should read between 300–400 kPa (43–58 psi).
- Circuit/System Testing
- DO NOT start the engine.
 - Ignition ON, engine OFF, command the Fuel Pump Enable ON with a scan tool and observe the fuel pressure gauge while the fuel pump is operating. Verify the fuel pressure is between 345–650 kPa (50–94 psi).
 - If the fuel pressure is greater than the specified range, replace the primary fuel tank fuel pump module.
 - If the fuel pressure is less than the specified range, test, inspect, and repair the items listed below. If all items test normal, replace the primary fuel tank fuel pump module.
 - Restricted fuel feed pipe
 - Inspect the harness connectors and the ground circuits of the fuel pump for poor connections.
 - Verify that the fuel pressure, after the fuel pump is turned off, decreases to less than 600 kPa (87 psi).
 - If the fuel pressure stays above 600 kPa (87 psi), replace the primary fuel tank fuel pump module.
 - Verify that the fuel pressure does not decrease more than 34 kPa (5 psi) in 1 minute.
 - If the fuel pressure decreases more than the specified value, perform the following procedure:
 - Ignition OFF, relieve the fuel pressure. Refer to Fuel Pressure Relief .
 - Install the J 37287 - Adapter between the chassis fuel feed hose and the engine compartment fuel feed pipe.
 - Open the valve on the J 37287 - Adapter .
 - Ignition ON, command the Fuel Pump Enable ON with a scan tool and bleed the air from the CH 48027 - Gauge .
 - Command the Fuel Pump Enable ON and then OFF with a scan tool.
 - Close the valve on the J 37287 - Adapter .
 - Monitor the fuel pressure for 1 min.
 - If the fuel pressure decreases more than 34 kPa (5 psi) within the specified time, locate and replace the leaking fuel injector (s).
 - If the fuel pressure does not decrease more than 34 kPa (5 psi) within the specified time, replace the primary fuel tank fuel pump module.
 - Relieve the fuel pressure to 69 kPa (10 psi). Verify that the fuel pressure does not decrease more than 14 kPa (2 psi) in 5 min.
 - If the fuel pressure decreases more than the specified value, replace the primary fuel tank fuel pump module.
 - Operate the vehicle within the conditions of the customer's concern while monitoring the fuel pressure with the CH 48027 - Gauge . The fuel pressure should not drop off during acceleration, cruise or hard cornering.
 - If the fuel pressure drops off, test, inspect, and repair the items listed below. If all items test normal, replace the primary fuel tank fuel pump module.
 - Inspect the harness connectors and the ground circuits of the fuel pump for poor connections
 - If the fuel system tests normal, refer to Symptoms - Engine Controls , Fuel Injector Solenoid Coil Test , and Fuel Injector Balance Test .

Repair Instructions

Perform the Diagnostic Repair Verification after completing the diagnostic procedure.

- Fuel Feed Pipe Replacement
- Fuel Line Replacement - Chassis
- Fuel Injector Replacement
- Fuel Tank Fuel Pump Module Replacement - Right Side

Driveability (itype_131)

Tsbs

- Stalling - Hesitation - Lack Of Performance P018B And/Or P2635 Setting In High Ambient Temperatures (PIP5507B, 2017/07/18)

Out of specification (itype_158)

Tsbs

- Diagnostic Tips For I/M Flags Resetting After Ignition Cycled (PIP5627, 2019/02/15)

Fluids, Chemicals and Additives (itype_112)

Tsbs

- Maintenance Cleaning of Fuel Injectors and Information Regarding Gasoline Detergent Additive (04-06-04-051L, 2026/05/08)

- Fuel and Oil Additives - Facts and Myths - Maximizing Gasoline Fuel Economy (05-00-89-072H, 2026/05/05)

- Information on Rough Idle, Crank No Start, Extended Crank or Misfire Due to Excessive Carbon on Top of Valves or Sticking Valves, Malfunction Indicator Light (MIL) Illuminated - DTC P0300, P0301, P0302, P0303, P0304, P0305, P0306, P0307, P0308 Set (16-NA-383, 2026/05/05)

New / Updated Parts (itype_117)

Tsbs

- Engine - THIS BULLETIN HAS BEEN CANCELED (04-06-04-054E, 2012/08/06)

OEM Policies and Procedures (itype_120)

Tsbs

- EPA Summer Grade Gasoline Waiver Allows Use of Winter Grade Surplus Potential Drivability Concerns P0300 P0171 P0174 P228C Fuel Smell Odor Longer Extended Cranking Time Hesitation Engine Stalls (PIP5725A, 2021/03/19)

- TOP TIER™ Detergent Gasoline and TOP TIER™ Diesel Fuel Information and Licensed Brands (05-06-04-022W, 2025/07/14)