GM SIDI Injection System

by Steve Garrett

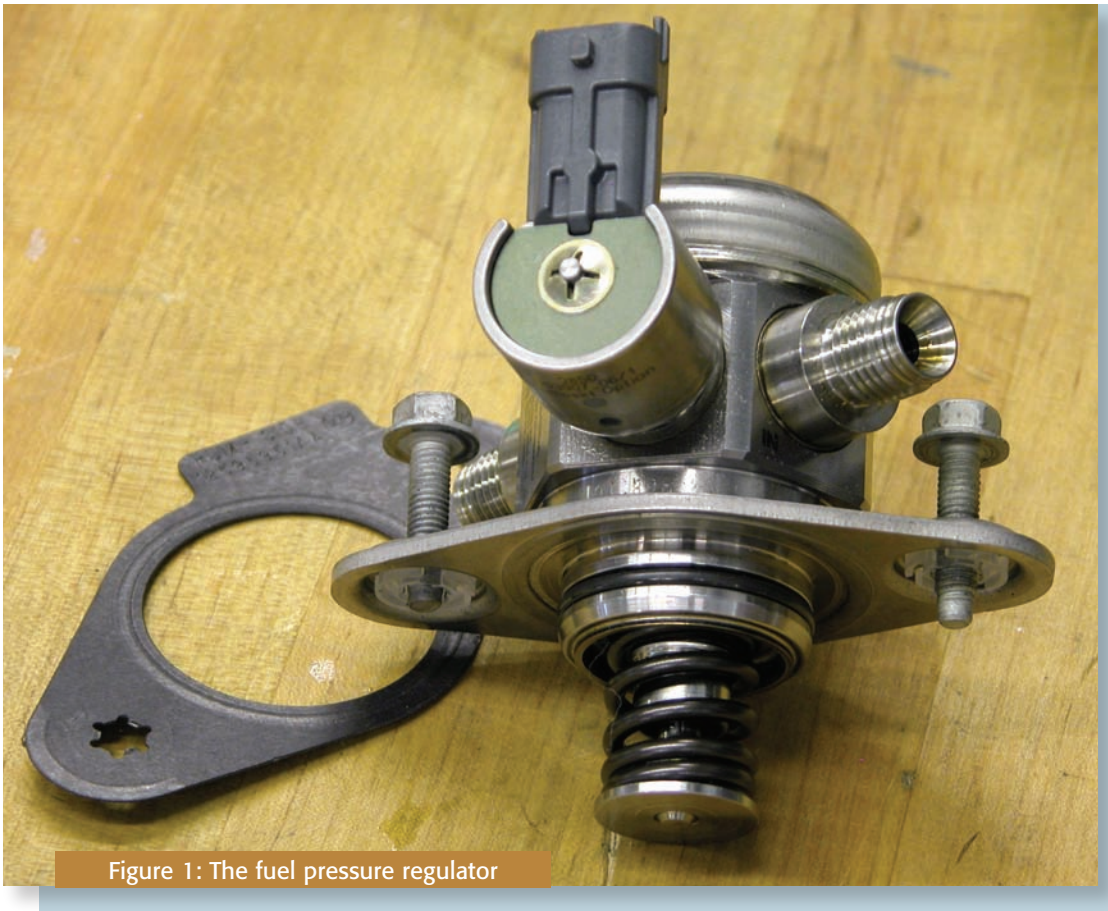

Figure 1: The fuel pressure regulator

A new fuel injection system is being introduced in the GM vehicle lineup for 2007. Known as Spark Ignited Direct Injection (SIDI), the system first appeared in the 2007 Saturn Sky and Pontiac Solstice with the turbocharged 2.0L (LNF) engine.

Direct injection on a gasoline engine offers several advantages, including:

- Up to an 8% increase in fuel economy at cruise speeds and high load driving.
- Lower emissions on cold starts.
- Higher compression and changes in ignition timing can be used to produce more horsepower.

Direct injection systems inject the fuel directly into the combustion chamber. To accomplish this, the fuel system had to be completely redesigned. The new system looks similar to earlier fuel injection systems, but it varies significantly in both construction and operation. The SIDI system consists of these components and systems:

- Low pressure fuel system: Consists of the tank, in-tank pump, fuel pressure pulse dampener, and lines to connect the low pressure system to the high pressure system. The low pressure system operates at about 60 PSI. The low pressure system fuel pressure can be monitored with a pressure gauge just like conventional fuel injection systems.
- High pressure fuel system: Consists of a high pressure fuel pump operated by the engine camshaft; high pressure regulator mounted in the high pressure fuel pump; high pressure fuel line; fuel rail; fuel pressure sensor; and special fuel injectors. The high pressure fuel system operates at pressures as high as 2176 PSI.

High Pressure Fuel Pump

The high pressure fuel pump is mounted on the engine at the rear of the cylinder head. It's operated by a triangle-shaped lobe on the camshaft. A roller mounts to the bottom of the pump

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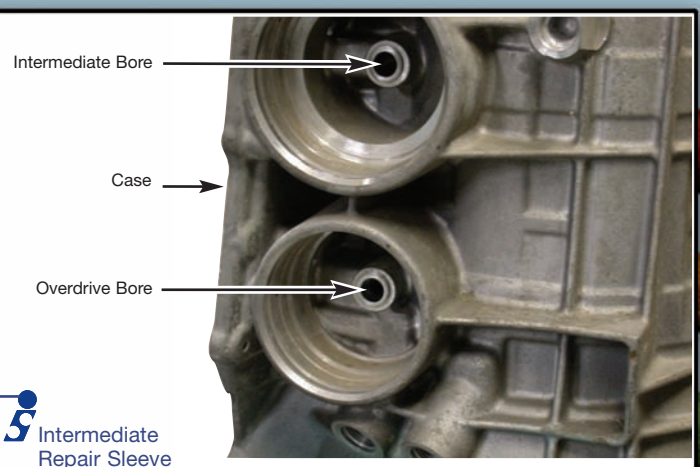

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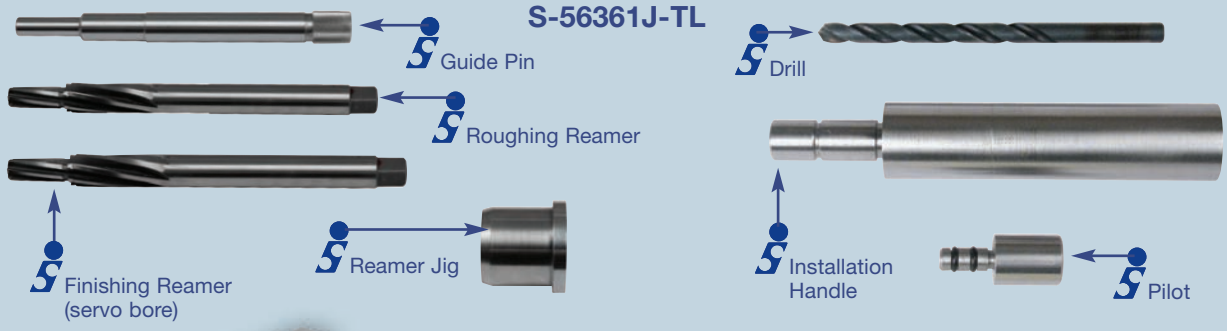

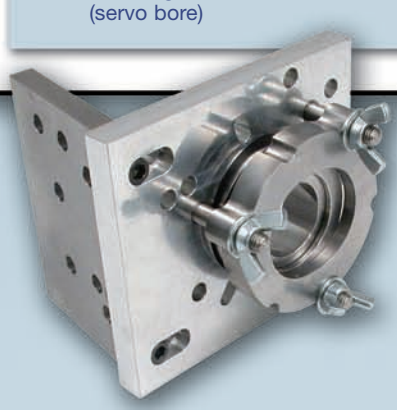

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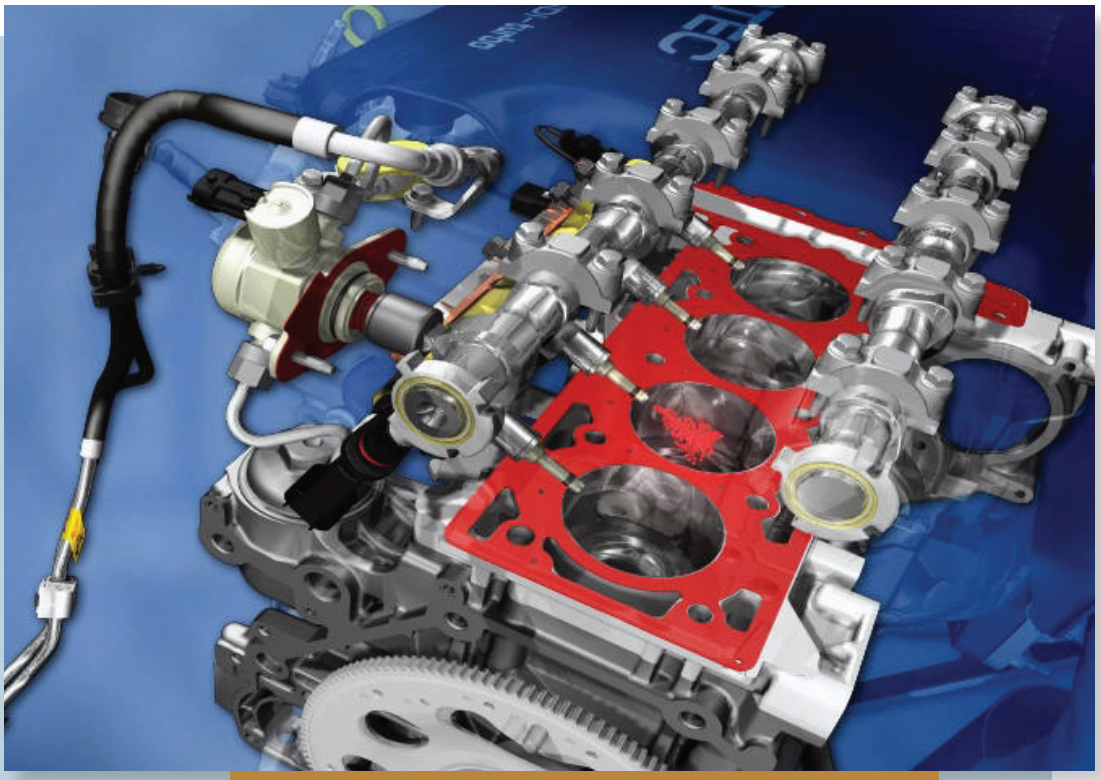

Figure 2: High Pressure Fuel Line

and rides on the cam lobe. The pump provides high-pressure fuel to the fuel injectors. A pressure relief valve is built into the pump assembly.

High Pressure Regulator

The fuel pressure regulator (figure 1) for the high pressure system is mounted on the high pressure fuel pump. The regulator is an electronically-controlled solenoid. The solenoid controls the inlet pressure and volume to the high pressure fuel pump. The ECM controls both the power and ground for the regulator solenoid. If the regulator is de-energized, a spring will hold the regulator valve in the default position, forcing the high pressure pump into low pressure mode. The high pressure system is designed to maintain an outlet pressure of 2176 PSI.

High Pressure Fuel Line

A high pressure fuel line (figure 2) is used to connect the high pressure pump to the fuel rail. The line is stainless steel and requires replacement any time it's been removed. When installing a new line, always lubricate the fitting with engine oil before tightening.

Fuel Rail and Pressure Sensor

The fuel rail is made of stainless steel and houses the injectors and fuel pressure sensor. The fuel pressure sensor (figure 3) is mounted on the end of the rail. The sensor is a typical strain-gauge design. It's a 3-wire sensor, with a 5-volt reference, sensor signal, and ground.

At low pressure, the signal voltage

to the ECM will be low. If the fuel pressure is high, the signal voltage will be high. The ECM uses the sensor to monitor the high pressure system, and it enables you to monitor the high pressure system using a scan tool. There are no provisions to measure the high pressure system pressure directly, using a pressure gauge.

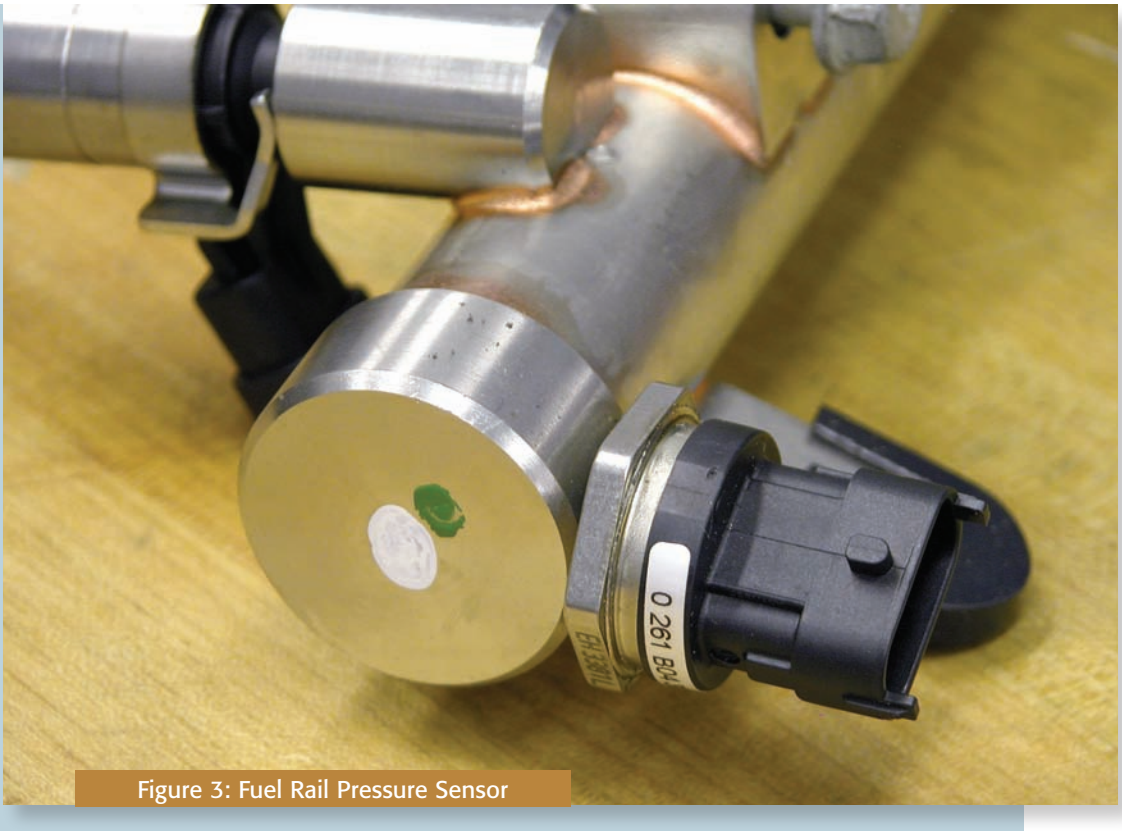

Figure 3: Fuel Rail Pressure Sensor

Fuel Injectors

The fuel injectors (figure 4) are mounted in the cylinder head below the intake valves. The tip of the injector is exposed to the combustion chamber. The inside-opened electromagnetic injector is constructed of stainless steel.

The ECM controls the voltage feed and ground for the injectors, much like other fuel injection systems, but the operating voltage is much higher. The ECM operates the injectors at 65 volts DC.

The ECM uses a step-up DC/DC transformer and capacitor to create a 65-volt, peak-and-hold control signal. During the peak phase, the ECM will discharge the capacitor to quickly initialize injector movement. During hold, the ECM driver will modulate the 12-volt injector circuit to maintain the injector position. The injector has six precision holes in its tip to provide an oval spray pattern.

SIDI Service

The SIDI system service is similar to other fuel-injected applications, with a few exceptions:

- The high and low pressure systems will require system pressure to be relieved before you can service fuel system components safely. The low pressure system can be

depressurized using methods similar to other fuel injection systems. The high pressure system can be depressurized using a scan tool to cycle the injectors with the ignition off, or by leaving the vehicle sit until system pressure drops to zero. You can check high system pressure with your scan tool.

Note: If you use a scan tool to depressurize the system, GM recommends changing the engine oil after completing the service.

- The high pressure fuel pump retaining bolts, gasket and O-ring must be replaced any time they've been removed.
- The seals on the injector and their holddown clamps must be replaced any time an injector has been removed. The new seals require installation tool (EN 48266-1) and a sizing tool (EN 48266-2).

Diagnostic Codes

Several new DTCs have been added to provide information about the SIDI system:

P0087 — Fuel Rail/System Pressure Too Low: The actual fuel pressure (high system) is more than 1500 kPa below the desired fuel system pressure.

P0088 — Fuel Rail Pressure (FRP) Too High: The actual fuel pressure (high system) is more than 2000 kPa above the desired fuel system pressure.

P0089 — Fuel Pressure Regulator Performance: The fuel pressure correction required is more than +3,000 kPa or less than –3,000 kPa.

P0090 — Fuel Pressure Regulator Control Circuit: The fuel pressure regulator solenoid voltage was between 1 and 4.5 volts with the fuel pressure regulator solenoid commanded on, for longer than 4 seconds.

P0091 — Fuel Pressure Regulator 1 Control Circuit Low: The fuel pressure regulator solenoid voltage was less than 1 volt with the fuel pressure regulator solenoid commanded off, for longer than 4 seconds.

P0092 — Fuel Pressure Regulator 1 Control Circuit High: The fuel pressure regulator solenoid voltage is more than 4.5 volts with the fuel pressure regulator solenoid commanded on, for longer than 4 seconds

P0261 — Injector 1 Control Circuit Low Voltage

P0262 — Injector 1 Control Circuit High Voltage

P0264 — Injector 2 Control Circuit Low Voltage

P0265 — Injector 2 Control Circuit High Voltage

P0267 — Injector 3 Control Circuit Low Voltage

P0268 — Injector 3 Control Circuit High Voltage

P0270 — Injector 4 Control Circuit Low Voltage

P0271 — Injector 4 Control Circuit High Voltage

P2146 — Fuel Injector Group Cylinder 1 Supply Voltage Circuit/Open

P2149 — Fuel Injector Group Cylinder 2 Supply Voltage Circuit/Open

P2152 — Fuel Injector Group Cylinder 3 Supply Voltage Circuit/Open

P2155 — Fuel Injector Group Cylinder 4 Supply Voltage Circuit/Open

As you can see, the SIDI system really isn't that complicated. Even though some new components and service procedures were added, service for this system won't be that difficult for those that choose to repair these vehicles. Times are changing, and so far we've just seen the tip of the iceberg compared to what's coming. So keep your chin up and get as much training as you can: Things are going to get fun!

Figure 4: Injector