

# New Duramax Diesel Engines



Compared with the emissions of gasoline engines, diesels have typically offered benefits, particularly in hydrocarbons and carbon monoxide. But controlling nitrogen oxides (NOx) and particulate mass (PM) have been challenging. New emission regulation changes in the U.S., Canada and Europe require substantial NOx reduction. Meeting these new requirements by engine hardware changes alone has proven to be extremely difficult. However, the advanced aftertreatment technologies of the new Duramax diesel engines have shown great effectiveness in dealing with these emissions. Two new Duramax diesel engines were developed to meet the 2010 Federal emission standards for oxides of nitrogen (NOx) and particulate matter (PM). They reduce NOx to 0.2 grams per brake horsepower per hour (g/bhp-hr). The 2007 standard was 1.2 (g/bhp-hr).

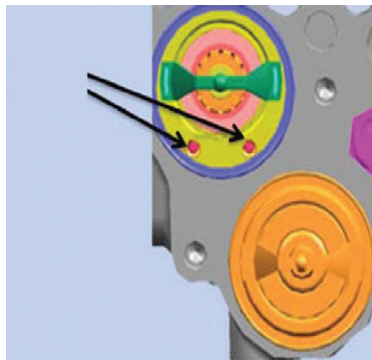


## Engine Applications

The 6.6L Duramax diesel engine (RPO LGH, VIN code L) is used on 2010 interim and 2011 Chevrolet Express and GMC Savana vans and 2011 Chevrolet Silverado and GMC Sierra trucks with RPO ZW9 (chassis cabs or trucks with pickup box delete). The 6.6L Duramax diesel engine (RPO LML, VIN code 8) is used on 2011 Chevrolet Silverado and GMC Sierra pickup models.

## Mechanical Features

These engines use an iron block and aluminum cylinder heads. The bore and stroke are unchanged. The main bearing has been changed to enhance oil film thickness, and oil pump flow is increased. In the cooling system, the thermostat is equipped with bleed holes to improve bleeding air from the system. The thermostat must be positioned with the bleed holes oriented toward the front of the engine. An oval air filter is used on vans and on pickups. Also on pickups, the charge air cooler system has plastic lock rings on the inlet and outlet ducts. Twist the lock rings counterclockwise to release the nozzle turbocharger (VNT) is used. The oil feed has been relocated from the number 4 cam supply port at the left rear of the valve and stepper motor are now positioned in one unit. The position sensor now reflects the true valve position — the valve moves when the stepper motor position sensor reflects the true valve position. A single EGR cooler is used on the Express and Savana van applications, and a dual cooler is used on the LGH engine for Silverado and Sierra truck applications. The LML engine for the pickups also uses a dual cooler with an EGR cooler bypass controlled by the ECM to prevent coking of the EGR cooler during light load and idling.



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## Fuel System Features

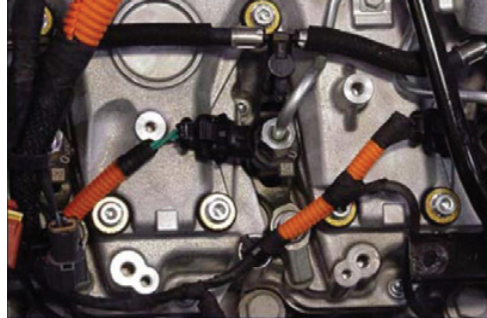
The fuel system supply side is equipped with a fuel filter vacuum switch near the fuel filter. The switch opens if there is a restriction on the supply side, indicated by a vacuum of 13.6–15 Hg. The fuel system high pressure side uses a two-chamber pump that generates 200 megaPascals (mPa) of pressure (29,000 psi). Two high pressure lines feed the right fuel rail. A transfer tube carries fuel to the left fuel rail. A Fuel Rail Pressure sensor (FRP) is located on the rear of the left fuel rail. The high pressure pump is timed so the peak pressure pulses match the injection events. Matching the pressure pulses results in a more constant pressure within the fuel rails. If the pump is removed, it must be

retimed when it is installed. There are timing marks on the pump gear and camshaft gear that must be aligned.

Two Fuel Rail Pressure Regulators (FRPR) are used. FRPR 1 is still located on the injection pump as on previous Duramax engines. FRPR 2 is located on the front of the left fuel rail. This solenoid is normally open. The ECM supplies pulse width modulation to change the duty cycle of FRPR 2 to control the amount of fuel returned to the fuel tank. The new Duramax engines are equipped with Bosch piezoelectric fuel injectors. These injectors operate at high voltage, indicated by the orange color of the injector harness.

Do not make contact with the fuel injector harness, ECM or fuel injectors while the ignition is in the On or Run position. Use certified, insulated Class 0 gloves rated at 1000 volts. Remember to check the expiration date of the gloves.

The ECM supplies high voltage and provides a ground. Voltage is supplied up to 160 volts at 20 amps, and can peak up to 240 volts. This causes the injector to open. The capacitor discharges through an injector for initial opening and holds open with 12 volts. Injectors are grouped into four pairs: 1-4, 6-7, 2-5, and 3-8. If a condition is detected in a group, that group is disabled and a DTC is set. On the fuel system return side, the return lines are now equipped with snap-in connections. The return side is under pressure. A pressure retention valve maintains 0.4 to 1.1 mPa of pressure within the return lines to provide proper fuel injector operation. Improper injector return line pressure may cause a no-start or performance concern. If the engine runs out of fuel, or if the fuel system is serviced, the system must be primed. After priming, a feed line from the low pressure side of the pump backfills the injector return lines. The feed line will also backfill if pressure falls below 0.3 mPa in the injector return lines.



### **Electronic Control Features**

The larger Bosch E86 ECM has three connectors instead of two. It also controls the HCI (Hydrocarbon Injector), FRPR 2, DEF pump, and DEF injector. The ECM has more than 160 new DTCs. The Glow Plug Control Module (GPCM) is located on the alternator bracket on the right side of the engine. The GPCM also provides regulated B+ for the NOx sensors and reductant heaters.

### **Aftertreatment System**

The new Duramax diesel engines use an aftertreatment system to reduce oxides of nitrogen (NOx) by 90%. This system mixes automotive-grade urea — also known as Diesel Exhaust Fluid (DEF) — with NOx to convert the pollutants into nitrogen, water and trace amounts of CO<sub>2</sub>. The urea is quickly hydrolyzed to produce oxidizing ammonia. Two NOx sensors are used by the ECM to adjust DEF dosing in the exhaust system. The Diesel Particulate Filter (DPF) operates the same as on previous engines to remove diesel particulate matter, or soot, from the exhaust. The Hydrocarbon Injector (HCI) is located on the right side of the engine, with a nozzle located in the exhaust downpipe between the turbo and the Diesel Oxidation Catalyst (DOC). Diesel fuel is injected into the exhaust system ahead of the DOC to raise the temperature of the exhaust for DPF regeneration. The regeneration parameters are still based on time, distance, fuel and soot loading, but the algorithms used to determine regeneration now allow more time between generation events.

