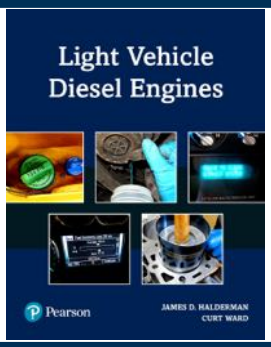
Light Vehicle Diesel Engines

First Edition



Chapter 23
DURAMAX
Diesel Engines

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LEARNING OBJECTIVES (1 of 2)

23.1 Identify the major engine components on the GM Duramax diesel engines.

23.2 Explain the cooling system, air intake system, and the lubrication system service on Duramax engines.

23.3 Discuss the unique features of the upper engine, lower engine, and the engine timing system.

23.4 Discuss engine and component identification.

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LEARNING OBJECTIVES (2 of 2)

- **23.5** Explain the location, function, and diagnosis of the low-pressure fuel system.
- **23.6** Identify the components, location, and function of the high-pressure fuel system.
- **23.7** Discuss messages associated with DEF system

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BACKGROUND (1 of 9)

- **Duramax GM Diesel**
  - Light- to medium-duty trucks
  - Block & heads cast at GM Powertrain foundry
  - Built by GM & Isuzu called DMAX
  - Joint venture in Moraine, Ohio

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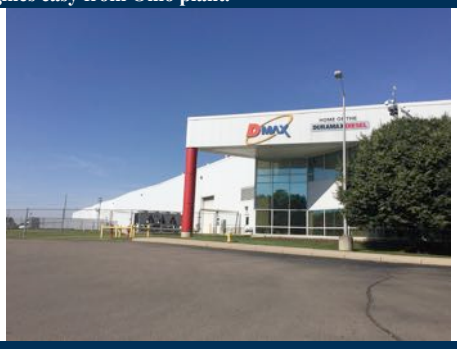
FIGURE 23–1 DMAX plant is located near I-75, and railroad access makes transport of materials and finished engines easy from Ohio plant.



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BACKGROUND (2 of 9)

- **LB7 2001–2003 model year**
  - **RPO code 2001 model year**
    - **Cast-iron block, aluminum crankcase & head**
      - **4 valves per cylinder**
      - **HPCR**
      - **300 hp 3,000 rpm**
      - **520 lb-ft 1,600 rpm**
    - **LB7 Duramax engine suffered from injector cracking issues that could cause symptoms:** **SEE PAGE 268 OF TEXT**

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CHART 23-1 First years of Duramax were labeled as LB7 and used in 2002–2004 model years.

Type	4-cycle Turbocharged and Intercooled
Configuration	90° V-8 Cam-in-block OHV Four valves per cylinder
Displacement	6.6 liter (403 cubic inches)
Bore and stroke	4.06 × 3.90 inches (103 mm × 99 mm)
Compression ratio	17.5:1
Firing order	1-2-7-8-4-5-6-3
Fuel injection system	High-pressure direct injection (Internal return lines)
Starting heat method	Glow plugs (gold color) plus air intake heater
Horsepower	235 HP@ 2,700 RPM (2001–2003) 300 HP @ 3,100 RPM (2004)
Torque	520 lb-ft @ 1,600 RPM (2001–2003) 520 lb-ft @ 1,800 RPM (2004)
Oil capacity with filter	10 quarts (9.5 liters)
VIN Code	1 (8th digit of the VIN)

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BACKGROUND (3 of 9)

- **LLY January 2004**
  - 310 bhp, 545 lb-ft
  - NOx & particulates by 90%
    - **EGR valve**
      - Lower NOx EGR cooler
      - Cool exhaust gases using engine coolant to increase gas density, which increases flow
      - EGR Position sensor, ECM monitor position
        - EGR cooler known to fail over time,
        - Coolant enter intake manifold, caused loss of coolant & steam from tailpipe

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CHART 23-2 second generation of Duramax diesel engines were referred to as LLY

Type	4-cycle Turbocharged and Intercooled
Configuration	90° V-8 Cam-in-block OHV Four valves per cylinder
Displacement	6.6 liter (403 cubic inches)
Bore and stroke	4.06 × 3.90 inches (103 mm × 99 mm)
Compression ratio	17.5:1
Firing order	1-2-7-8-4-5-6-3
Fuel injection system	High-pressure common rail (HPCR) Direct Injection (External return lines)
Starting heat method	Glow plugs (silver color) plus air intake heater
Horsepower	310 HP @ 3,000 RPM
Torque	520 lb-ft @ 1,800 RPM (2004–2005) 605 lb-ft @ 1,800 RPM (2006)
Oil capacity with filter	10 quarts (9.5 liters)
VIN Code	VIN Code 2 (8th digit of the VIN)

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BACKGROUND (4 of 9)

- **LBZ 2006 only**
  - Output 310 bhp & 590 lb-ft of torque
  - Block redesigned
  - Stronger pistons & rods
  - Power was increased
  - Larger radiator & EGR cooler
  - Allison 1000 or ZF 650 6-speed manual transmissions
  - 2007 last year that the Duramax diesel engine available with MT
    - **ISSUES. Because this model was used in only one year, no pattern failures**

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CHART 23-3 third generation of Duramax diesel engines were referred to as LBZ and were considered to be hot rod version because they did not use diesel particulate filter.

Type	4-cycle Turbocharged and Intercooled
Configuration	90° V-8 Cam-in-block OHV Four valves per cylinder Stronger block and heads Larger connecting rods New piston design
Displacement	6.6 liter (403 cubic inches)
Bore and stroke	4.06 × 3.90 inches (103 mm × 99 mm)
Compression ratio	16.5:1
Firing order	1-2-7-8-4-5-6-3
Fuel injection system	High-pressure common rail (HPCR) Direct injection (External return lines) 7 hole fuel injectors
Starting heat method	Glow plugs plus air intake heater
Horsepower	360 HP @ 3,200 RPM
Torque	650 lb-ft @ 1,800 RPM
Oil capacity with filter	10 quarts (9.5 liters)
VIN Code	VIN Code D (8th digit of the VIN)

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BACKGROUND (5 of 9)

- **LMM Engine, 4th Generation**
  - **2007**
    - 365 bhp @ 3,200 rpm
    - 660 lb-ft of torque at 1,600 rpm
      - Class 4 & 5 medium-duty trucks
      - **FEATURES.** ultra-low sulfur diesel (ULSD) fuel and the use of a diesel particulate filter (DPF).
      - **ISSUES. DPF** caused engine to produce lower fuel economy due to regeneration of diesel particulate filter. Driven as intended,
      - Extra fuel for regeneration not needed compared to when vehicle driven lightly loaded & low speeds.

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CHART 23-4 fourth generation of Duramax diesel engines were referred to as LLM and were first version to use diesel particulate filter.

Type	4-cycle Turbocharged and Intercooled
Configuration	90° V-8 Cam-in-block OHV Four valves per cylinder
Displacement	6.6 liter (403 cubic inches)
Bore and stroke	4.06 × 3.90 inches (103 mm × 99 mm)
Compression ratio	16.5:1
Firing order	1-2-7-8-4-5-6-3
Fuel injection system	High-pressure common rail (HPCR) Direct Injection First Duramax to use DPF
Starting heat method	Glow plugs plus air intake heater
Horsepower	360 HP @ 3,100 RPM
Torque	650 lb-ft @ 1,800 RPM
Oil capacity with filter	10 quarts (9.5 liters)
VIN Code	VIN Code 6 (8th digit of the VIN)

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BACKGROUND (6 of 9)

- **EARLY DURAMAX Versions:**
  - **4 Variations Early Duramax Diesel Engine:**
    - 2001–2004 **LB7**: 2001 no EGR or catalytic converter.
      - Some 2002–2004 had EGR & catalyst
    - 2005–2006 RPO code **LLY**: EGR, catalyst, & variable geometry turbocharger, 310 bhp, 545 lb-ft of torque
    - 2006.5 LLY and **LBZ**
      - 310 bhp & 590 lb-ft of torque for automatic transmission
        - Increased to 360 bhp and 650 lb-ft of torque in 2007
    - 2006–2008: RPO **LMM**: higher horsepower lower emissions
      - Aggressive EGR operation, intake throttle, particulate trap
        - 365 bhp at 3,200 rpm and 660 lb-ft of torque at 1,600 RPM

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BACKGROUND (7 of 9)

- **LML 2011–2016 Version**
  - 60% of components
  - Redesigned from previous version:
    - Upgraded engine block casting
    - Oil pump
    - Higher strength pistons and connecting rods
    - 1ST to use selective catalyst reduction (SCR) & DEF
    - Use of piezo injectors
    - "ninth injector" to supply fuel to DPF during regeneration
    - Able to use bio-diesel up to B20
    - NO known pattern failures

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CHART 23-5 fifth generation of Duramax diesel engines were referred to as LML and first version to use SCR requiring use of DEF.

Type	4-cycle Turbocharged and Intercooled Added an exhaust brake into the turbocharger system
Configuration	90° V-8 Cam-in-block OHV Four valves per cylinder
Displacement	6.6 liter (403 cubic inches)
Bore and stroke	4.06 × 3.90 inches (103 mm × 99 mm)
Compression ratio	16.0:1
Firing order	1-2-7-8-4-5-6-3
Fuel injection system	High-pressure common rail (HPCR) Direct Injection (External return lines) Able to use B20 (20% biodiesel) Uses SCR with urea injection Diesel particulate filter (DPF)
Starting heat method	Glow plugs plus air intake heater
Horsepower	397 HP @ 3,000 RPM
Torque	765 lb-ft @ 1,600 RPM
Oil capacity with filter	10 quarts (9.5 liters)
VIN Code	VIN code 8 (8th digit of the VIN)

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BACKGROUND (8 of 9)

- **LGH RPO**
  - Detuned version of LML
  - Cab, chassis vehicles
  - Commercial vans with following
    - Used in commercial vehicles
    - Not need to meet same EPA STDS as LML
    - Uses a different turbocharger
    - Larger EGR cooler
    - Higher capacity SCR system
    - Still able to use bio-diesel up to B20
    - N o service issues unique to this version.

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CHART 23-6 LGH Duramax diesel engine is a detuned version of the LML and used in commercial vehicles only.

Type	4-cycle Turbocharged and Intercooled Added an exhaust brake into the turbocharger system
Configuration	90° V-8 Cam-in-block OHV Four valves per cylinder
Displacement	6.6 liter (403 cubic inches)
Bore and stroke	4.06 × 3.90 inches (103 mm × 99 mm)
Compression ratio	16.0:1
Firing order	1-2-7-8-4-5-6-3
Fuel injection system	High-pressure common rail (HPCR) Direct Injection (External return lines) Able to use B20 (20% biodiesel) Uses SCR with urea injection Diesel particulate filter (DPF)
Starting heat method	Glow plugs plus air intake heater
Horsepower	290 HP @ 3,100 RPM (commercial van applications) 335 HP @ 3,100 RPM (Silverado/Sierra chassis cab)
Torque	525 lb-ft @ 2,600 RPM (Commercial van applications) 585 lb-ft @ 1,600 RPM Silverado/Sierra Chassis cab)
Oil capacity with filter	10 quarts (9.5 liters)
VIN Code	VIN code L (8th digit of the VIN)

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BACKGROUND (9 of 9)

- **L5P 2017 & Later Version**
  - **Upgraded Version Includes:**
    - New camshaft profile
    - Electronically-controlled variable vane turbocharger
    - Improved cylinder head design
    - New engine block and larger-diameter crankshaft connecting rod journals
    - New air intake system with functional hood scoop
      - **No known pattern failures are known for this version at this time.**

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CHART 23-7 L5P version of Duramax diesel engine features higher horsepower & torque from previous versions, uses unique cold air intake scoop on hood.

Type	4-cycle Turbocharged and Intercooled With exhaust brake (turbocharger system) Cold air intake system Strengthen block with induction hardened cylinder walls
Configuration	90° V-8 Cam-in-block OHV Four valves per cylinder
Displacement	6.6 liter (403 cubic inches)
Bore and stroke	4.06 × 3.90 inches (103 mm × 99 mm)
Compression ratio	16.8:1
Firing order	1-2-7-8-4-5-6-3
Fuel injection system	High-pressure common rail (HPCR) Direct injection (External return lines) Able to use B20 (20% biodiesel) Uses SCR with urea injection Diesel particulate filter (DPF)
Starting heat method	Glow plugs plus air intake heater
Horsepower	445 HP @ 2,800 RPM
Torque	910 lb-ft @ 1,600 RPM
Oil capacity with filter	10 quarts (9.5 liters)
VIN Code	VIN code Y (8th digit of the VIN)

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2.8 INLINE 4-CYLINDER DURAMAX

- **2.8-liter Four-Cylinder Duramax**
  - Option in medium size Chevrolet Colorado
  - GMC Canyon pickup trucks.
    - **SEE CHART 23–8 Page 272 of text**

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CHART 23-8 summary of technical specifications for 4-cylinder 2.8-liter Duramax diesel engine

Type	4-cycle Turbocharged and Intercooled
Configuration	Inline four-cylinder engine Cast iron block/Cast aluminum cylinder head Duly overhead camshaft (DOHC) 16 valve; four valves per cylinder
Displacement	2.8 liter (170 cubic inches)
Bore and stroke	3.70 × 3.94 inches (94 mm × 100mm)
Compression ratio	16.5:1
Fuel injection system	High-pressure common rail (HPCR)
Turbocharger	Water-cooled variable geometry turbo-charger (VGT)
Horsepower	181 HP @ 3,400 RPM
Torque	369 lb-ft @ 2,000 RPM

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What Happened to the 4.5-liter V-8 Duramax?

? FREQUENTLY ASKED QUESTION

4.5-liter 72° V-8 was designed to be used in light duty pickup trucks and vans in 2009. However, economic situation in 2009 caused the project to be placed on hold. It was designed to produce 310 HP and 520 lb-ft of torque, and used SCR and piezoelectric common-rail fuel system.

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ENGINE MECHANICAL (1 of 5)

- **Cast Iron Engine Block**
  - 90 degree "V" deep-skirted design
  - Induction hardened cylinder tops for durability
  - Date code is stamped on block
  - "5227" stands for 227 day of 2005 (8/15/2005)
  - "1200" stands for time block was built
    - Engines built after this date use longer head bolts
    - Engines built before this date use shorter head bolts

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FIGURE 23–2 Cylinder induction hardening is not visible on this engine, but often seen on engines that have a lot of miles on them because upper third of cylinder walls are often different color.

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ENGINE MECHANICAL (2 of 5)

- **Crankshaft & Rods**
  - Forged steel crankshaft hardened BY "**nitriding**"
    - Crankshaft covered in liquid nitrogen
  - Supported on 5 main bearings using 4 bolt main bearing
    - Extra two bolts from side through block
  - Endplay controlled by rear thrust main bearing
  - Rods forged & scored and snapped (broken)
    - Create rough mating surface between cap & rod
    - Rough surface makes it a perfect match

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ENGINE MECHANICAL (3 of 5)

- **Pistons & Rings**
  - **Forged Aluminum Piston With Unique Bowl**
  - Increase swirl for combustion
  - 2 compression rings and 1 oil control ring
  - **Ring groove W/NO ring between top & 2ND compression ring**
    - Groove helps reduce blow-by because expanding gases
    - During combustion can expand into void space
    - **Acts as heat dam** to prevent heat from combustion chamber
    - Traveling to lower part of piston
    - Called "**empty piston ring groove"**

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FIGURE 23–3 connecting rods are scored and then broken. Cap stays secure because mating surfaces are perfectly matched.

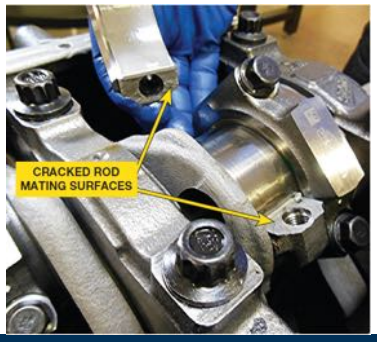

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FIGURE 23–4 piston has 4 grooves for 3 piston rings, but one of 3 grooves is used as heat dam & often referred to as "empty piston ring groove".

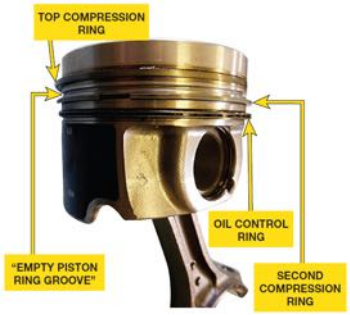

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FIGURE 23–5 (a) openings on underside of piston are designed to allow engine oil to flow to head of piston.

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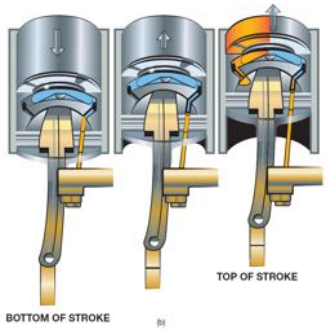
FIGURE 23–5 (b) oil squirters are used to keep head of pistons cooled because most of heat generated in engine is in combustion chamber. This heat needs to be transferred to the engine oil where it can be cooled by engine oil cooler.



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What is a "Remelted Piston"?

FREQUENTLY ASKED QUESTION

The L5P Duramax diesel engine features cast aluminum pistons that have bowl rim of remelted piston used to reduce grain size of the aluminum and to create a more consistent grain structure for greater strength.

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Case of the Tuner Program Gone Bad (1 of 2)

REAL WORLD FIX

2-year-old Duramax engine was not running smoothly and had MIL on. A DTC check indicated stored P0300 (random misfire code) DTC . Technician verified that engine had noticeable misfire, plus noticed some engine noise. When one of the valve covers was removed to check for possible valve train-related issues, several bent pushrods were discovered. DSM discovered following: PCM had been reflashed 5 times, yet the factory program was currently installed. Engine had been operated up to 5,500 RPM, which is much higher than factory programming allowed. Based on these findings, the warranty was canceled. The customer was notified that while a hand-held tuner can be used to recalibrate the PCM to increase engine power, it does so by "taking emissions out of compliance" and can often cause engine damage as in this case. The owner decided to have engine repaired and left programming of PCM the same as when it left factory.

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Case of the Tuner Program Gone Bad (2 of 2)

REAL WORLD FIX

- **Summary:**
- **Complaint**—owner complained of a rough running engine and the check engine light was on.
- **Cause**—engine had been operated at a speed that was higher than it was designed to operate,
- **Correction**—bent pushrods were replaced, at the customer's expense, which corrected the rough running engine concern

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ENGINE MECHANICAL (4 of 5)

- **Valve Train**
  - Camshaft driven by a helical cut gear off crankshaft
  - Roller **solid** lifters
  - With anti-rotation clips
- **Oil Pan**
  - Upper pan cast aluminum
  - Lower pan laminated steel
    - Noise suppressant
    - Oil level sensor

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FIGURE 23–6 (a) Duramax diesel engine uses large diameter roller solid (non-hydraulic) valve lifters.

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FIGURE 23–6 (b) To keep valve lifters from rotating in their bores, an anti-rotation clip is used that allows lifters to move up and down freely.

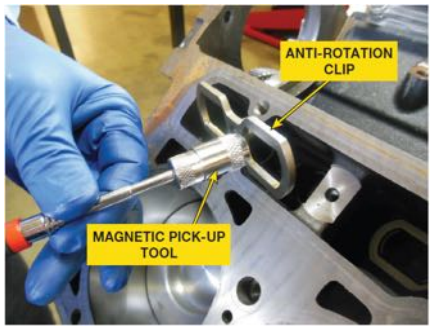

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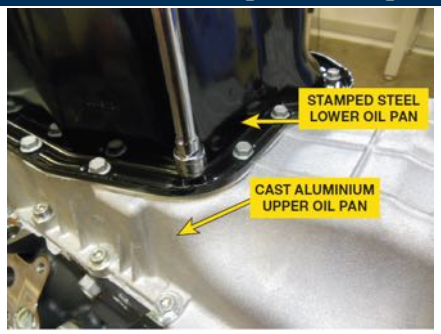
FIGURE 23–7 lower oil pan is stamped steel



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ENGINE MECHANICAL (5 of 5)

- **Oil Pump/Cooler**
  - Oil pump driven off crankshaft
  - Regulator located on high pressure side of pump
  - Reaches pressure piston moves uncovers bleed ports
  - Oil pressure:
    - 1,000 RPM – 6 PSI (42 kPa) minimum
    - 2,000 RPM – 18 PSI (125 kPa) minimum
    - 4,000 RPM – 24 PSI (166 kPa) minimum

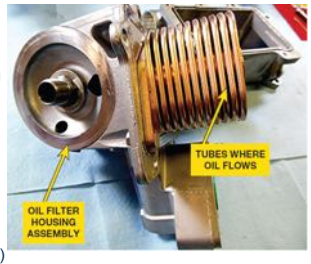

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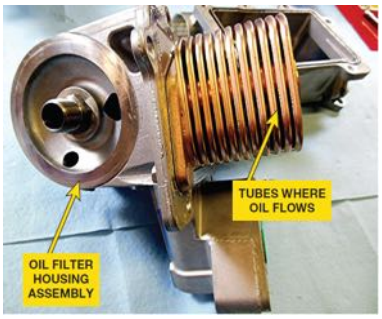
FIGURE 23–8 Oil cooler showing construction



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COOLING SYSTEM (1 of 3)

- **Gear Driven Water Pump**
  - Mounted on left side of engine
  - Driven by camshaft
    - **Uses Two Thermostats**
    - **Primary & Secondary**
  - **Primary Thermostat** controls both **bypass** coolant flow
  - Engine cold & flow though radiator when hot
  - Primary starts to open at 180°F (82°C)
  - Bypass is still open so flow split between
  - Recirculated through engine & to radiator
  - At 185°F (85°C), primary thermostat **blocks**
  - Fully open at 203°F (95°C).

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FIGURE 23–9 water pump gear driven by camshaft gear

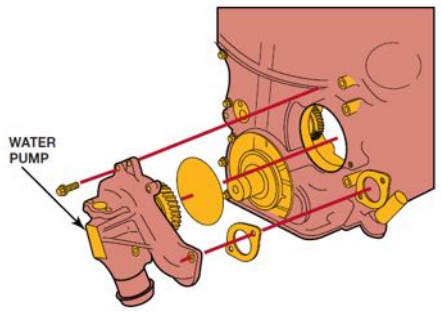

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FIGURE 23–10 (a) water pump assembly as it looks after removal from engine.

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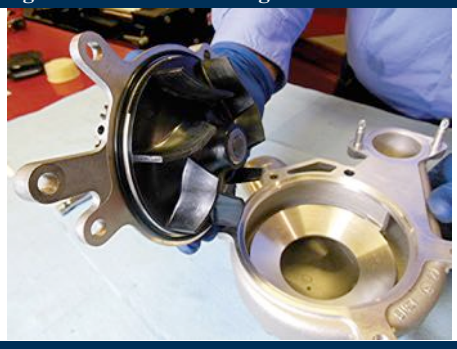
FIGURE 23–10 (b) impeller & bearing assembly as it is being removed from housing



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COOLING SYSTEM (2 of 3)

- **Secondary Thermostat**
  - Used to restrict flow of coolant through radiator
  - When closed
  - Starts to open at 185°F (85°C)
  - Fully open at 212°F (100°C).
  - 2 bleed holes must be correctly positioned
  - For proper operation of cooling system

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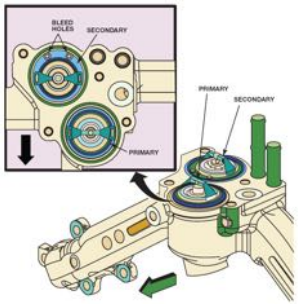
FIGURE 23–11 Duramax diesel engines use two thermostats, a primary and a secondary to precisely control engine temperature.



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CYLINDER HEADS

- **Aluminum Cylinder Heads**
  - 4 valves to cause swirl effect
  - 2 intake & 2 exhaust valves
  - Operated by bridge (crosshead)
  - Connects 1 rocker arm
  - Open both valves same time
  - **Head Gaskets**: Multilayered steel (MLS) gaskets

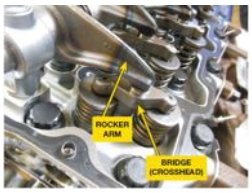

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FIGURE 23–12 Rocker arms depress valve bridges which then open 2 valves at same time.

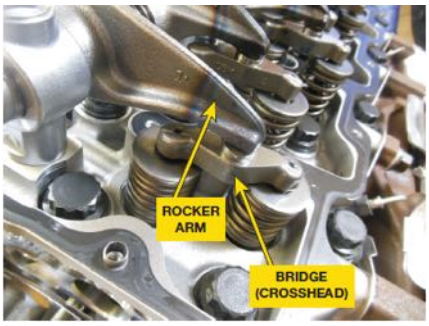

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FIGURE 23–13 markings on head gasket include left (L) and right (R) heads, as well as thickness for LMM, LML and LGH Duramax diesel engines with location of a hole within an oval. Check service information for exact marking and specifications for engine being serviced.

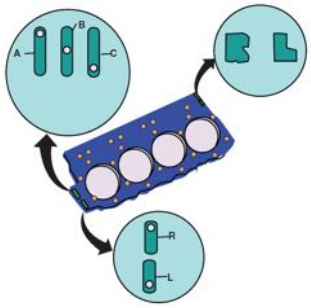

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CHART 23-9 gasket thickness and piston intrusion (distance piston rises above block at TDC). This measurement seldom needed unless engine has been machined. In most cases, all that is needed is to replace head gasket with replacement of same thickness.

GASKET MARKING	GASKET THICKNESS (Inch/mm)	PISTON PROJECTION (Inch/mm)
A	0.0354–0.0394 (0.90–1.00)	0.0088–0.0108 (0.223–0.274)
B	0.0374–0.0413 (0.95–1.05)	0.0108–0.0128 (0.274–0.325)
C	0.0394–0.0433 (1.00–1.10)	0.0128–0.0148 (0.325–0.375)

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SERVICE INFORMATION

- **Engine Oil:**
  - API CJ-4, SAE 15W-40 under most conditions
  - SAE 5W-40 < 0°F (–18°C)
  - **Coolant**
    - DEX-COOL mixed 50/50 with demineralized water
  - **Air Filter**
    - Restriction indicator, on air cleaner housing
    - Indicator plunger green, air filter is useable
    - Indicator plunger red, filter should be replaced

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Quick and Easy Test for Diesel Fuel in the Oil

TECH TIP

Using a clean paper towel is a quick and easy way to check for diesel fuel in engine oil. Remove dipstick and place end of it above a clean white paper towel. The engine oil dripped from end of dipstick will cause a dark spot in center. If there is diesel fuel in oil, this will spread out causing lighter area around oil spot.

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LOW-PRESSURE SIDE FUEL SYSTEM

- **Fuel Tank**
  - **Fuel tank module in tank**
    - 2 components:
      - 1. Pickup screen
      - 2. Fuel level sensor: resistance of 40 ohms empty, 250 ohms full
  - **Fuel Conditioning Module**
    - Fuel filter
    - Water-in-fuel (WIF) sensor
    - Located at bottom next to drain
    - Manual primer pump
  - **Fuel Filter Replacement** Page 279

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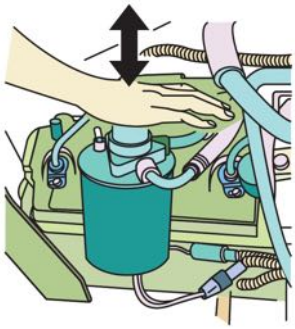
FIGURE 23–15 Depressing primer pump bleeds air from system.



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FUEL AERATION

- **Aeration**
  - Low-pressure fuel system under vacuum
  - Air can enter system, small holes, loose fittings
  - Yet fuel will not leak
  - **Symptoms of Air:** Page 279 of text
  - **Diagnosis of Fuel Aeration:** Page 279 of text

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FIGURE 23–16 low-pressure fuel system on a Duramax is under a vacuum created by suction pump inside high-pressure fuel pump assembly.

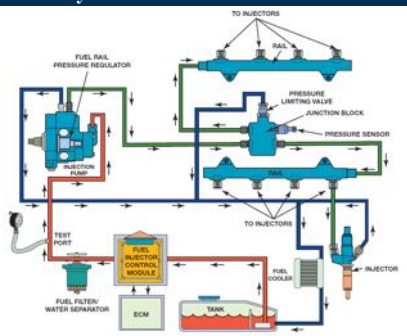

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CHART 23-10: vacuum values when testing low side of Duramax diesel engine fuel system. If this vacuum test fails, it is usually due to a restricted fuel filter.

ENGINE SPEED/LOAD	VACUUM (in. Hg.)
Cranking	5
Idle speed	1–3
Hard acceleration	6–10
3,000 RPM – No Load	3–5
2,750–3,000 RPM – Full load	10–12

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HIGH-PRESSURE FUEL SYSTEM (1 of 4)

- **High-Pressure Fuel Pump (HPFP)**
  - Gear pump used to draw fuel from fuel tank
  - 3-cylinder design mounted to right head
  - Timed to engine
  - Delivers 2,900–29,000 PSI
  - **Fuel Rail Pressure Regulator (FRPR)**
    - **Control Fuel Rail Pressure: Figure 23-16**

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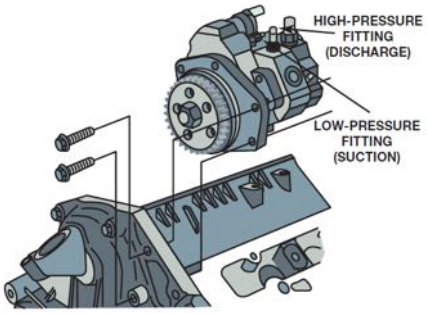
FIGURE 23–17 high-pressure fuel pump (HPFP) driven by camshaft gear at front of engine.



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WARNING

- **High-pressure fuel lines deliver fuel under extreme pressures. Use extreme caution when looking for leaks as fuel under pressure may penetrate skin causing injury or death.**

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HIGH-PRESSURE FUEL SYSTEM (2 of 4)

- **HPFP Flow**
  - Fuel drawn in by gear-type suction
  - PCM pulses fuel pressure regulator (FPR)
  - Meter amount of fuel entering pump pistons
  - Pump pistons moved by lobes on gear driven shaft
  - Each piston has its own outlet
  - Both go to fuel rail on right bank
  - Line from right fuel rail feeds left side fuel rail
  - **Injector Operation: Page 279 of text**
    - **Piezo injectors controlled by PCM**

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FIGURE 23–18 Green area represents fuel being drawn into pump. Orange area low-pressure fuel from suction pump, feeding fuel to high-pressure pistons and for lubrication. Red sections represent high-pressure fuel that is delivered to fuel lines. blue area is fuel return and lube circuit.

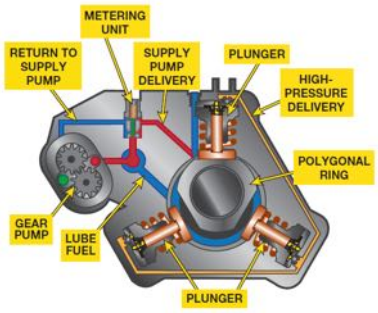

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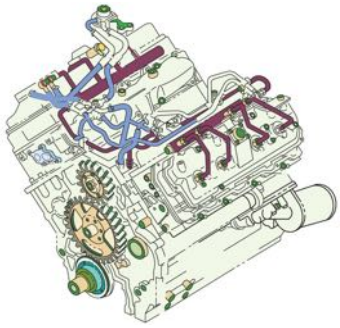
FIGURE 23–19 fuel high-pressure lines are highlighted to show how they are routed.



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HIGH-PRESSURE FUEL SYSTEM (3 of 4)

- **Duramax Injectors**
  - Controlled by ECM/PCM after 2006
  - High-side (positive) driver & low-side (negative) driver
  - Allows ECM/PCM monitor injector operation
  - Run internal diagnosis
- **FICM (Fuel Injection Control Module)**
  - Early PCM used boost capacitor
  - increase vehicle system voltage
  - 12 volts-250 volts 20 amperes power injectors
  - Drivers located in **FICM (PRIOR TO 2006 ENGINES)**
  - **After 2006 in ECM**

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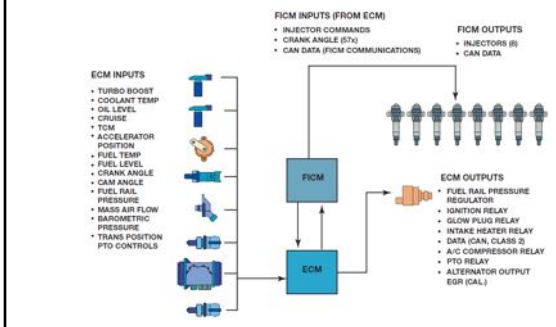
FIGURE 23–20 typical Duramax fuel control system showing the role of the ECM/PCM & FICM (EARLY ENGINES LB7 LBZ & LLY, Dropped in 2006 with Bosch ECM)



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HIGH-PRESSURE FUEL SYSTEM (4 of 4)

- **Fuel Injector**
  - **Injector Quantity Adjustment (IQA) Code**
  - Marked on each injector
  - Indicates flow rate of injector to WCM/PCM
  - Programed into PCM
  - **Early Injectors Solenoid Controlled**
  - **Late Model Piezo Controlled**

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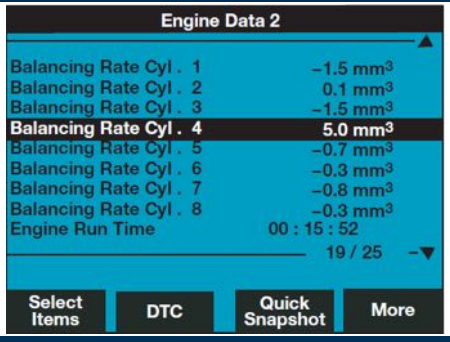
FIGURE 23–21 modifiers for each cylinder are displayed on scan tool and are shown in cubic millimeters (mm3).



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GLOW PLUGS & EGR

- **Each Cylinder Has Glow Plug**
  - Less than one ohm of electrical resistance
  - Draw 20 to 25 amperes each.
  - glow plug control module (GPCM)
  - Controls operation of glow plugs
- **Exhaust Gas Recirculation** (EGR)
  - Reduce NOx) emissions
  - Uses two-wire stepper motor
  - 3-wire integrated position sensor
  - PCM also cycles EGR 5 times at key-on
  - Remove any built up soot

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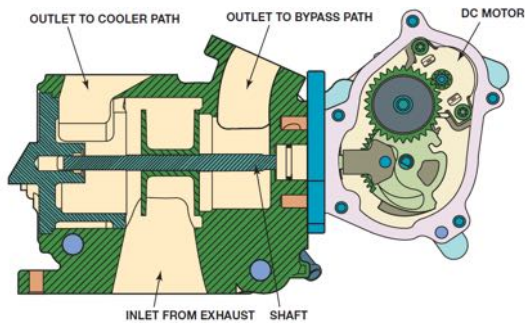
FIGURE 23–23 EGR valve is complex unit and includes passages that allow exhaust gases to bypass cooler when at idle speed and is located over rear of right head.



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Case of the Limited Engine Speed (1 of 2)

REAL WORLD FIX

Customer was concerned that 6.6 Duramax engine ran great, but would not rev over 2,200 RPM. service technician checked and did not find any stored DTC s or technical service bulletins (TSBs) that were related to this fault. A quick check with other technicians revealed that if the power take-off (PTO) button was in the "on" position, this would cause the engine to not rev higher than 2,200 RPM. The PTO button was found to be in "on" position and PTO speed set to 2,200 RPM. After turning PTO button to "off," engine operated normally. ● **SEE FIGURE 23–22.**

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Case of the Limited Engine Speed (2 of 2)

REAL WORLD FIX

- **Summary:**
- **Concern**—Customer stated that diesel engine would not rev faster than 2,200 RPM.
- **Cause**—power take-off (PTO) button was in "on" position, which limited maximum engine speed to 2,200 RPM
- **Correction**—PTO button, located below climate controls in center of vehicle instrument panel, was turned to "off" and this solved customer concern.

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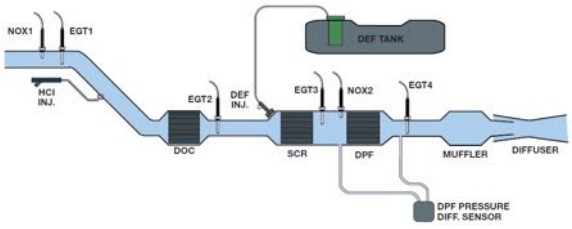
FIGURE 23–24 Snap-on scan tool screen shot of PTO status



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DURAMAX DIESEL AFTERTREATMENT SYSTEM (1 of 3)

- Aftertreatment System
  - Conform To Diesel Emissions:
    - Non-methane hydrocarbons (NMHC)
    - Carbon monoxide (CO)
    - Oxides of nitrogen (NOx)
    - Particulate matter (PM)

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DURAMAX DIESEL AFTERTREATMENT SYSTEM (2 of 3)

- **Components & Sensors:** Pages 282-283
  - NOX1, NOX2
  - EGT 1, EGT 2, and EGT 3
  - Diesel Particulate Filter (DPF)
  - Diesel Oxidation Catalyst (DOC)
  - HCI Injector
  - SCR & Diesel Exhaust Fluid (DEF) injector
  - Diesel Exhaust Fluid (DEF) Tank & Injector
  - DEF Warning System

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DURAMAX DIESEL AFTERTREATMENT SYSTEM (3 of 3)

- Page 284 of text
  - Exhaust Fluid Low Speed Limited Soon..
  - Exhaust Fluid Empty Refill Now Is Displayed
  - Exhaust Fluid Quality Poor See Owners
  - Manual Now
  - Xxx Mile (Km) Until 65 Mph (105 Km/H) Max Speed
  - Xxx Miles (Km) Until 55 Mph (88 Km/H) Max
  - XXX MILES (KM)) UNTIL 4 MPH (7km/H MAX Speed

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QUESTION? 1 (1 of 2)

- What is the purpose and function of the fourth piston ring groove?

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ANSWER 1 (1 of 2)

- **Ring groove W/NO ring between top & 2ND compression ring**
  - Groove helps reduce blow-by because expanding gases
  - During combustion can expand into void space
  - **Acts as heat dam** to prevent heat from combustion chamber
  - Traveling to lower part of piston
  - Called "**empty piston ring groove**"

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QUESTION? 1 (2 of 2)

- How does the fuel get to the high-pressure fuel pump from the fuel tank?

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ANSWER 1 (2 of 2)

- High-Pressure Fuel Pump (HPFP) uses a Gear pump used to draw fuel from fuel tank

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Summary (1 of 4)

- Duramax engines are built by a GM and Isuzu partnership company called DMAX, a joint venture in Moraine near Dayton in southwest Ohio.
- All Duramax diesel engines used a cast iron block and aluminum cylinder heads.
- The regular production option (RP O) code for Duramax engines changes with each version and includes LB7, LLY, LBZ, LLM, LML, LGH, and L5P.
- The cylinder block is cast from grey iron and uses a deep skirt design. The cylinder area is induction hardened and then polished to increase wear resistance

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Summary (2 of 4)

- The crankshaft is supported on five main bearings using four bolt main bearing caps and an extra two bolts from the side through the block for added support.
- The Duramax family of diesel engines uses two thermostats, a primary and a secondary.
- There are three different thicknesses of head gaskets used and they are marked so that the correct replacement gasket can be used.
- The specified engine oil to be used in Duramax diesel engines includes API CJ-4 with a viscosity of SAE 15W-40 under most conditions.

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Summary (3 of 4)

- From the fuel tank, fuel is drawn through the lines to the fuel conditioning module which contains the:
  - Fuel filter
  - Water-in-fuel (WIF) sensor and is located at the bottom of the filter next to the drain
  - Manual primer pump
- The high-pressure fuel pump (HPFP) used on a Duramax diesel engine includes a gear pump used to draw fuel from the fuel tank. The high-pressure pump is a 3-cylinder design and is mounted to the right front cylinder head, timed to the engine.

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Summary (4 of 4)

- The aftertreatment system on the 2007+ Duramax diesel engine allows it to conform to diesel emission regulations pertaining to:
  - Non-methane hydrocarbons (NMHC)
  - Carbon monoxide (CO)
  - Oxides of nitrogen (NOx)
  - Particulate matter (PM)
- When the diesel exhaust fluid (DEF) level is getting low, range remaining will be displayed in either miles or kilometers.

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