2009 Vortec 5.3L V-8 (LMG)
VORTEC 5.3L Gen IV V-8 (LMG) TRUCK ENGINE
2009 Model Year Summary

Carryover engine content from 2008 model year

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The next-generation Vortec 5.3L V-8 is standard in the all-new Avalanche SUT and Suburban and Yukon XL full-size sport-utility vehicles. It is optional in the all-new Silverado and Sierra pickups and Tahoe and Yukon full-size sport-utility vehicles.

The Vortec 5.3L has been the most popular Vortec V-8 and it offers technology for every truck buyer's needs: Powertrain's industry leading Active Fuel Management technology, aluminum or cast-iron engine block, available E85 flex-fuel capability. These engines are the fourth-generation descendents of one of the most important and successful engines in automotive history—the original Chevrolet small-block, which debuted in 1955. The Gen IV Vortecs feature technology the creators of the first small block could not have imagined, yet they share one fundamental trait with the original: a market-leading balance of performance, sophistication, economy and durability.

Gen IV Cylinder Block
The Gen IV cylinder block shares two key design elements with GM's original small block V-8: a 90-degree cylinder angle with 4.4 inch bore centers. Beyond that, the latest small block applies design, casting and machining technologies that were unfathomable in the 1950s.

The Gen IV block debuted in 2005 as the foundation for the 400-hp LS2 V-8 in the Chevrolet Corvette, and Pontiac GTO and the Cadillac CTS-*v* in 2006. The new Vortec truck block applies all the improvements in the LS2, tailored for the demands of truck application.
It was developed with the latest math-based tools and data acquired in GM's racing programs, and it an exceptionally light, rigid foundation for an impressively smooth engine. Its deep-skirt design helps maximize strength and minimize vibration. The bulkheads accommodate six-bolt, cross-bolted main-bearing caps that limit crank flex and stiffen the engine's structure. A structural oil pan further stiffens the powertrain.

The new-generation small block is cast with oil ports in its V, or valley, to accommodate advanced technologies in the Vortec 5.3L, including Active Fuel Management (AFM) cylinder deactivation. The Lifter Oil Manifold Assembly (LOMA), a key component of AFM, installs in the valley in place of a conventional engine block cover. As a result, knock sensors located in the valley on the Gen III V-8 have been moved to the outside of the engine block, while the cam sensor has been moved from the rear of the block to the front cover.

The Vortec 5.3L is offered with either a conventional cast-iron (LY6), or an aluminum engine block (LC9), giving customers a choice and allowing technology appropriate to the application. The lighter aluminum block allows vehicle engineers more latitude in tailoring weight distribution, and can mean a slight improvement in fuel economy. The Gen IV aluminum block is cast from A356-T6 alloy, with cast-in iron cylinder liners. It weighs roughly 100 lbs. less than a comparable cast-iron engine block.

Engine Ventilation
The Positive Crankcase Ventilation (PCV) system now incorporates a larger 2.75mm flow orifice and, to aid assembly, has quick-connect fittings for the connections on the engine.

Active Fuel Management
All Gen IV Vortec 5.3L V-8s feature GM's industry leading Active Fuel Management technology (AFM). AFM temporarily de-actives four of the 5.3L's cylinders under light load conditions. It increases fuel economy approximately 6 percent under the federal government's required testing procedure and potentially more in certain real-world driving conditions. Yet truck owners don't sacrifice superior V-8 power and performance to go farther on a tank of gas.

Active Fuel Management stems from a simple premise: most truck owners have more power than they need much of the time. Many choose powerful V-8 engines to be prepared for the occasional heavy load, but during routine commuting that powerful engine operates at a fraction of its capability. Volumetric efficiency is impaired, and that means less than optimal fuel mileage. AFM offers a common-sense solution. It saves fuel by using only half of the Vortec 5.3L's cylinders during some driving conditions, and seamlessly reactivates the other cylinders when a driver demands full power for acceleration or load hauling.

Managed by the new E38 engine control module (ECM), AFM automatically shuts down every second cylinder, according to firing order, during light-load operation. In engineering terms, this allows the working cylinders to achieve better thermal, volumetric and mechanical efficiency and lowering cyclical combustion variation from cylinder to cylinder. As a result, AFM delivers better fuel economy and lower operating costs. Perhaps the most sensible thing about AFM is that it harnesses the engine's existing capabilities, starting with the potential designed into the E38 ECM. The only mechanical components required are special valve lifters for cylinders that are deactivated, and their control system. Active Fuel Management relies on three primary components: De-ac (for deactivation) or collapsible valve lifters, a Lifter Oil Manifold Assembly (LOMA), and the ECM.

One of the most sophisticated engine controllers, the E38 ECM (below) measures load conditions based on inputs from vehicle sensors and interprets that information to mange more than 100 engine operations, from fuel injection to spark control to electronic throttle control. AFM adds an algorithm to the engine control software to manage cylinder deactivation and reactivation. When loads are light, the E38 automatically closes both intake and exhaust valves for half of the cylinders and cuts fuel delivery to those four. The valves re-open to activate all cylinders when the driver demands brisk acceleration or full torque to move a load. The engine's electronic throttle control (ETC) is used to balance torque following cylinder deactivation or reactivation. The transition takes less than 20 milliseconds, and is virtually indiscernible to most drivers.

Valve lifters are operated by the engine's camshaft, and lift a pushrod that operates the valves in the cylinder head. In the Gen IV Vortec 5.3L, the De-ac lifters are installed in cylinders 1, 4, 6 and 7, while the remaining cylinders use conventional lifters. The hydraulically operated De-ac lifters have a spring-loaded locking pin actuated by oil pressure. For deactivation, hydraulic pressure dislodges the locking pin, collapsing the top portion of the lifter into the bottom and removing the ability to lift the pushrod. The bottom of each De-Ac lifter rides up and down on the cam lobe but the top does not move the push rod. The valves do not operate and combustion in that cylinder stops. During reactivation, the oil pressure is removed, and the lifter locks at full length. The pushrods, and therefore the valves, operate normally.

The final AFM component is the LOMA. This cast-aluminum assembly is installed in the Vortec 5.3's V, or valley, in place of a conventional engine block cover. The LOMA holds four solenoids, control wiring and cast-in oil passages. The solenoids are managed by the ECM, and each one controls oil flow to a De-Ac Lifter, activating and de-activating the valves at one cylinder as required for Active Fuel Management.

The Gen IV Vortec 5.3L's fuel injectors are identical for all cylinders; those feeding the de-activated cylinders are simply shut down electrically by the ECM during de-activation. When the cylinders are deactivated, the engine effectively operates as a V4. AFM operation is load based, as measured by the ECM using dozens of inputs, overlain with the driver's demand for power as measured by throttle application. AFM's response time is measured in milliseconds. Operation is always transparent to the driver. The engine returns to V-8 mode the instant the controller determines that acceleration or load requires additional power.

The benefits are substantial. Active Fuel Management reduces overall emissions to the extent that less fuel is used. Further, the savings reflected in EPA numbers may not account for AFM's full impact. Owners who primarily travel long distances at steady speeds will see further fuel-economy improvements.

The exhaust system for the Gen IV Vortec 5.3L required careful tuning to maintain optimal noise and vibration control. In four-cylinder operation, the engine creates second-order exhaust pulses; in eight-cylinder operation, in creates fourth-order exhaust pulses. The system requires special pipe tuning to account for both.

Returnless Fuel Injection with Stainless Steel Fuel Rail

The Vortec 5.3L is equipped with a "returnless'' fuel injection system, also known as a demand system, and the latest-generation Multec injectors with USCAR connectors. The Gen IV V-8s represents one of GM's first applications of USCAR-standard electrical connectors for the fuel injectors. The standard was developed to promote common, reliable connections across the auto industry and streamline regulatory oversight. The connectors are more compact than previous connectors, and designed for improved sealing.

Recently introduced on the Gen III Vortec V-8s, returnless fuel injection represents a paradigm shift for GM, developed to improve performance and decrease evaporative emissions. Previously, Vortec 5.3Ls used a return line between the engine and the fuel tank to manage fuel pressure by bleeding off excess fuel at the fuel rail and returning the excess to the tank. The new system eliminates the return lines and moves the fuel pressure regulator from the fuel rail on the engine to the fuel tank. Because it delivers only the amount of fuel needed by the injectors, and returns no fuel to the gas tank, the returnless system essentially eliminates heat transfer from the engine to tank. This reduces the amount of vapor generated in the tank and captured by the vehicle's Onboard Refueling Vapor Recovery (ORVR) system.

With the returnless system, the 5.3L uses a fuel rail manufactured of stainless steel. The stainless steel rail allows installation of baffles that manage fuel pulses in the returnless system and reduce noise.

Advanced Electronic Throttle Control

GM Powertrain has led the industry in applying electronic throttle control (ETC) to its Vortec V-8s, which are now equipped with ETC in all applications. The Gen IV Vortec 5.3L introduces the next generation in truck ETC.

With ETC, there is no mechanical link between the accelerator pedal and the throttle body. A sensor at the pedal measures pedal angle and sends a signal to the engine control module (ECM), which in turn directs an electric motor to open the throttle at the appropriate rate and angle. ETC delivers a number of benefits to the customer. Besides throttle pedal angle, the ECM measures other data, including the transmission's shift patterns and traction at the drive wheels, in determining how far to open the throttle. ETC delivers outstanding throttle response and greater reliability than a mechanical connection, which typically uses a cable that requires adjustment—and sometimes breaks. Cruise control electronics are integrated into the system, further improving reliability and simplifying engine assembly.

The Gen IV Vortec 5.3L takes ETC to the next level by taking advantage of capability built into its advanced E38 ECM (below) and further streamlining the system. Its up-integrated ETC system eliminates a Throttle Actuator Control (TAC) module. The TAC takes commands from the ECM and then operates the electric motor that opens and closes the throttle. The E38 manages the throttle directly, without a TAC. Eliminating the TAC reduces cost and improves reliability. The direct link between the ECM and the throttle motor improves throttle response time (albeit in millisecond increments that are not apparent to the driver) and improves system security by removing a device (the TAC) the must be monitored for malfunction.

The throttle body bore has been further optimized with two slight tapers known as "nostrils". These ever so slight machining changes to the bore provide additional resistance to harmful throttle body deposit formation.

E85 Flexible-Fuel Capability

The Vortec 5.3L (RPO L59) was the first flex-fuel V-8 for full-size sport-utility vehicles. The Gen IV 5.3L's (LC9, LMG, and LMF), feature more sophisticated and robust E85 flex-fuel operation. E85 is a clean-burning alternative fuel made in the United States from homegrown corn and other crops, composed of 85 percent ethanol alcohol and 15 percent gasoline.

The intake and exhaust valve seat material was revised for improved high mileage durability on E85 fuel. Additionally, the intake valve material was also revised for compatibility with the new seats.

Hardware changes for flex-fuel operation are limited to the injectors. Because ethanol has fewer BTUs (less energy) than the same volume of gasoline, more fuel is required to produce the same horsepower at wide-open throttle. Flex fuel engines use unique injectors with a greater cone angle and higher maximum fuel-flow rate. The fuel rail matches the injectors, but it's manufactured of the same stainless steel used for all Vortec V-8s.

The flex-fuel Vortec 5.3L doesn't even require a special fuel sensor. The first flex-fuel engines used a light-reactive sensor to measure fuel composition from 100 percent gasoline to 85 percent ethanol. The Gen IV has a virtual sensor—software programmed in the E38 ECM with no separate physical sensor. Based on readings from the oxygen (O^2) sensors, fuel level sensor and vehicle speed sensors, the ECM adjusts the length of time the fuel injectors open for the type of fuel used. Within a fuel miles after filling up, the E38 controller determines what fuel is powering the Vortec 5.3L and manages the engine accordingly.

E85 fuel provides an environmentally friendly companion or alternative to gasoline. It is biodegradable and doesn't contaminate the water supply. Ethanol can be produced from various feed stocks, including corn and wheat stalks, forestry and agricultural waste, and even municipal waste.

E38 Engine Control Module
An advanced controller manages the multitude of operations that occur within the Vortec 5,3L every split second. All Gen IV 5.3L's use one of the three controllers in the GM's new family of engine control modules (ECM), which will direct nearly all the engines in Powertrain's line-up. In most applications they 5.3L is managed by the new E38 ECM. The E38 is the mid-line controller in the family, yet in combination with advanced sensor technology, it includes the ability to control and synchronize advanced technologies such as Active Fuel Management (AFM) cylinder de-activation.

The E38 features 32-bit processing, compared to the conventional 16-bit processing in previous Vortec engines. It operates at 59 MHz, with 32 megabytes of flash memory, 128 kilobytes of RAM and a high-speed CAN bus, and it synchronizes more than 100 functions, from spark timing to cruise control operation to traction control calculations. The E38 works roughly 50 times faster than the first computers used on automobile engines in the late 1970s, which managed five or six functions.

The family strategy behind GM's new ECMs allows engineers to apply standard manufacturing and service procedures to all powertrains, and quickly upgrade certain engine technologies while leaving others alone. It creates both assembly and procurement efficiencies, as well as volume sourcing. In short, it creates a solid, flexible, efficient engine-control foundation, allowing engineers to focus on innovations and get them to market more quickly. The family of controllers means the ECM and corresponding connectors can be packaged and mounted identically in virtually every GM vehicle. Powertrain creates all the software for the three ECMs, which share a common language and hardware interface that's tailored to each vehicle.

The E38 also applies a new, rate-based monitoring protocol sometimes known as run-at-rate diagnostics. Rate-based diagnostics improve the robustness of the Onboard Diagnostics System (OBD II) and ensure optimal performance of emissions control systems. The new software increases the frequency at which the ECM checks various Vortec 5.3L systems, and particularly emissions-control systems such as the catalytic converter and oxygen sensors. Rate-based diagnostics more reliably monitor real-word operation of these systems, and allow regulatory agencies to more easily measure and certify emissions compliance.

58X Ignition System

The Vortec 5.3L has an advanced 58X crankshaft position encoder to ensure that ignition timing is accurate throughout its operating range. The 58X crankshaft ring and sensor provide more immediate, accurate information on the crankshaft's position during rotation. This allows the E38 ECM to adjust ignition timing with greater precision, which optimizes performance and economy. Engine starting is also more consistent in all operating conditions.

In conjunction with 58X crankshaft timing, the Gen IV Vortec V-8s apply the latest digital cam-timing technology. The cam sensor is now located in the front engine cover, and it reads a 4X sensor target on the cam sprocket. The target ring has four equally spaced segments that communicate the camshaft's position more quickly and accurately than previous systems with a single segment.

The dual 58X/4X measurement ensures extremely accurate timing for the life of the engine. Moreover, it provides an effective back-up system in the event one sensor fails.

Enhanced Noise, Vibration and Harshness Control

The Gen IV Vortec V-8s were developed for quieter operation, with virtually every system or component reviewed in an effort to reduce noise, vibration and harshness. Quiet features built into the engines are complemented by improved engine cradles and mounting systems. These help reduce vibrations transmitted through the chassis and into the passenger compartment.

The NVH enhancements include floating pin pistons, which reduce noise and increase durability. These pistons have wrist pins that "float" inside new lead-free rod bushings and the piston pin bores. Compared to a conventional fixed pin assembly, in which the connecting rod is fixed to the piston's wrist pin and the pin rotates in the pin bore, the floating pins reduce stress on the pin. They allow tighter pin to pin-bore tolerances and reduce noise generated as the piston moves through the cylinder. To further reduce wear, the pistons are coated with a polymer material, which limits bore scuffing, or abrasion of the cylinder wall over time from the piston's up-down motion. The polymer coating also dampens noise generated by the piston's movement. The result for the customer is less engine wear, improved durability and quieter operation.

The Gen IV Vortecs also feature a new heavy-duty timing chain developed expressly for quiet operation. The chain, which connects the cam and crankshaft, is validated for 200,000 miles of operation and fitted with a new leaf-spring dampener. Even the most durable chains stretch with time. In many engines they must be adjusted or replaced at scheduled intervals. The Vortec 5.3L's chain dampener maintains optimal chain tension for the life of the engine and eliminates any flapping motion that might develop as the chain stretches with mileage. It ensures that the timing chain operates as smoothly and quietly as new, even as the engine accumulates high mileage.

Exhaust manifolds were developed to improve durability and sealing and reduce operational noise. Cast nodular iron was the material of choice for its basic durability and excellent heat management properties. The manifolds feature saw cuts along their cylinder head mounting flange. Originally developed for the big-block Vortec 8.1L, these cuts split the flange into three separate sections, allowing each section to move under extreme hot-cold temperature fluctuations without interacting with, or creating stress on, another section. The cuts virtually eliminate friction on –and movement of—the exhaust manifold gaskets. This helps ensure proper sealing for the life of the engine and reduces the chance of gasket failure.

The exhaust manifolds are fitted with new triple-layer heat shields fabricated from stainless steel and insulating material. The shields limit heat transfer from the engine to the engine bay, allowing the Vortec 5.3L to reach optimal operating temperature more quickly, yet reducing heat in the engine compartment once that temperature is achieved. They also dampen the sound of exhaust gas rushing through the manifolds and further reduce the amount of engine operational noise that finds its way into the vehicle interior.

Low Modulus A/C compressor drive belt

The 5.3L V-8 LC9 utilizes a low modulus A/C compressor drive belt in the accessory drive system. This belt provides the same 150,000 mile durability as the old belt, but allows elimination of the tensioner required with the former material, which saves product cost and reduces mass.

Advanced Ignition Coils

The Vortec 5.3L's individual coil-near-plug ignition features advanced coils developed for the LS2 and LS7 Corvette V-8s. The new coils are smaller and lighter than those used on previous Vortec V-8s. While they are still mounted on the rocker covers, they attach with a new mounting bracket that simplifies engine assembly. An individual coil for each spark plug delivers maximum voltage and consistent spark density, with no variation between cylinders.

Iridium Tip Spark Plugs

Improvements to the Vortec 5.3L's ignition system include advanced spark-plug technology. Its spark plugs have an iridium electrode tip and an iridium core in the conductor. The iridium plug has a recommended life of 100,000 miles, but it offers a number of advantages over the platinum-tip plugs previously used in Vortec V-8s.

The iridium spark plug has higher internal resistance, maintaining optimal spark density over its useful life. Its "self-cleaning" properties are improved, decreasing potential for plug fouling and further reducing the likelihood of maintenance over the 100,000-mile plug life. The electrode design improves combustion efficiency for maximum fuel economy and minimum emissions. Finally, iridium is more plentiful than platinum, reducing the plug's material cost and preserving scarce noble metals.

Overview
At face value, the Gen IV Vortec 5.3L shares little with the original Chevrolet small-block V-8, save its classic 4.4-inch cylinder-bore centers. While the first small block remains one of most important (and beloved) engines in automotive history, its designers could hardly have imagined the technologies applied in the latest Vortec 5.3L. Yet in spirit, the two engines are closer than 50 years of engine development suggest. The Chevy small block changed the automotive landscape. With its innovative AFM technology, the Gen IV is set to do exactly the same thing.

The Vortec 5.3L builds on the solid foundation of its immediate predecessor: The Gen III Vortec V-8s. Gen III introduced a host of advanced technologies to the overhead-valve V-8, including aluminum cylinder heads, a thermoplastic intake manifold and electronic throttle control. Its cylinder heads have replicated ports that are identical in every detail, allowing consistent cylinder-to-cylinder airflow. The valvetrain was developed on the belief that lighter is more efficient. A steel camshaft provides excellent durability. Steel roller rockers add stiffness, allowing greater engine speed with less vibration. Hydraulic roller lifters reduce friction for better fuel economy and wear resistance. Seven years after the Gen III Vortec V-8s were introduced, these technologies made them the best-selling light truck engines in the world.

Now comes the Gen IV Vortec V-8s. Launched in GM's 2005 mid-size sport-utility vehicles, the Gen IV truck engines deliver even greater efficiencies, with further refinement and more advanced technology. Once again they prove the doubters—the engineers and industry analysts who claimed the inherent advantages of cam-in-block engines could not be applied in the environmentally sensitive 21rst century—patently wrong. AFM cylinder de-activation delivers the power and performance of a V-8 engine with new levels of fuel efficiency, and its full potential has yet to be realized.

In that sense, the Gen IV is very much like the original small block. It uses appropriate technology for appropriate applications. It brings innovation to the mainstream, with wide application in a high-value package the typical consumer can afford.