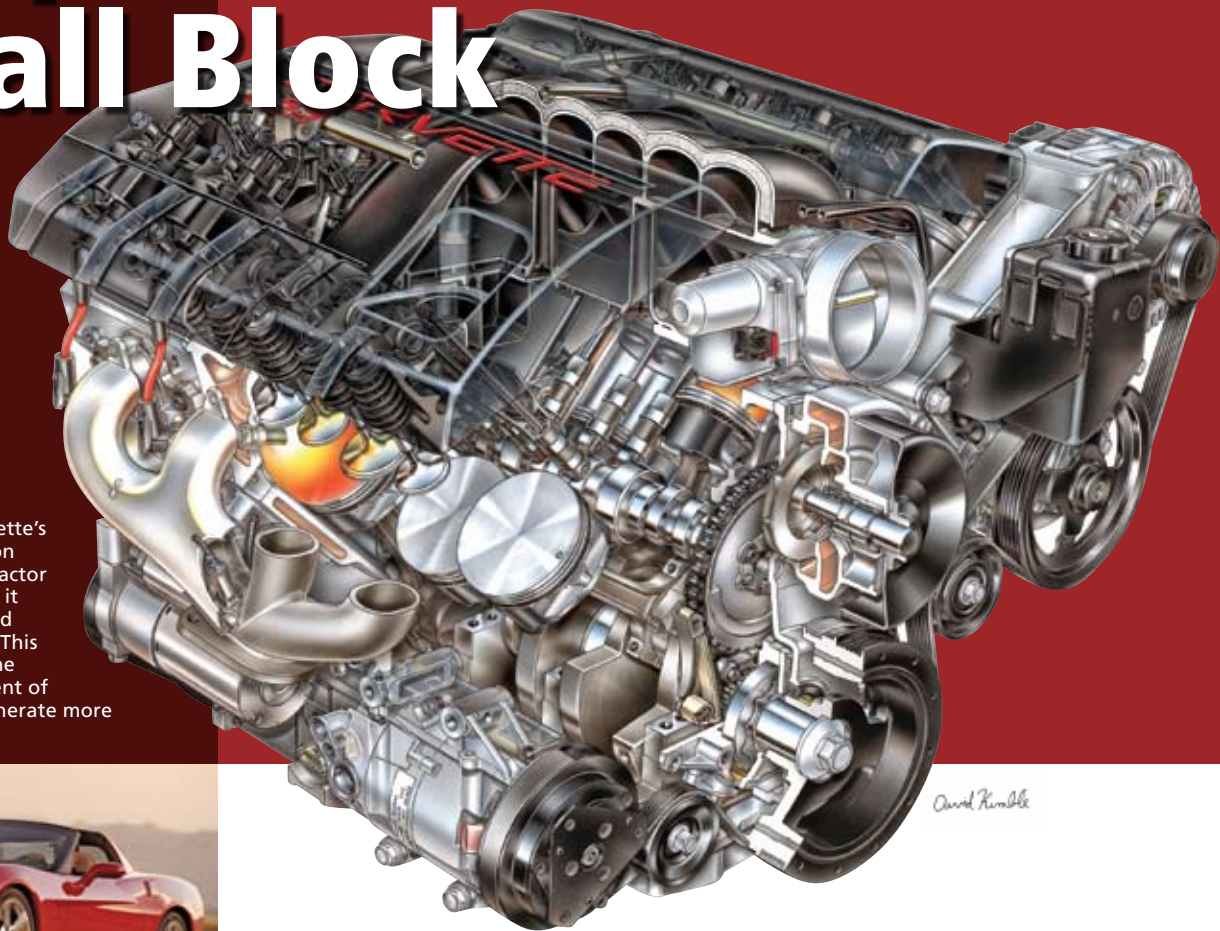


Big power from GM Small Block

FEA work on the Corvette's LS3 basically focused on increasing the safety factor of the block to enable it to handle the increased output of the engine. This was also inspired by the concurrent development of the LS9, which will generate more than 600 hp (447 kW).



David Kimble



Were he still with us today, the late **Chevrolet** Chief Engineer Ed Cole might not be surprised that **GM's** classic Small Block V8 will be offered in a 2009 production Corvette with a rating of more than 600 hp (447 kW). After all, Cole (who later became GM's president) was a visionary. When he and his assistant Harry Barr began sketching the new V8 in 1952, they designed in ample headroom for future development.

That legacy continues with the new 430-hp (321-kW) LS3, which is the standard powerplant for the 2008 Corvette, as well as the ultra-high-output LS9 (see sidebar) for the '09 ZR-1 Corvette unveiled this month at Detroit's North American International Auto Show.

Both all-aluminum overhead-valve V8s were derived from the 6.0-L LS2 of the MY2007 Corvette and the **Cadillac** CTS-V. They also share attributes with GM's truck V8s and the 7.0-L, 500-hp (373-kW) LS7 used in the Corvette Z06, said John Rydzewski, Assistant Chief Engineer for Small Block Car Applications.

"That's how we gain manufacturing cadence and take cost out of our budget

while providing more power, efficiency, and value to our customer," he said.

Rydzewski explained that the overall goal of the LS3 program, launched in late 2004, was to significantly boost power beyond the LS2 while maintaining the attractive cost/performance value for which Corvettes are famous.

With 430 hp (321 kW) at 5900 rpm and 424 lb-ft (575 N-m) at 4600 rpm (both parameters certified to **SAE** J1349), the LS3 is the most powerful Corvette base engine ever.

An additional 6 hp (4.5 kW) is available with the '08 Corvette's optional "active" exhaust system. A butterfly valve opens at high flow levels, enabling the gas to bypass the usual S-shaped exhaust tract. The active system also keeps exhaust noise to a minimum during part-throttle running.

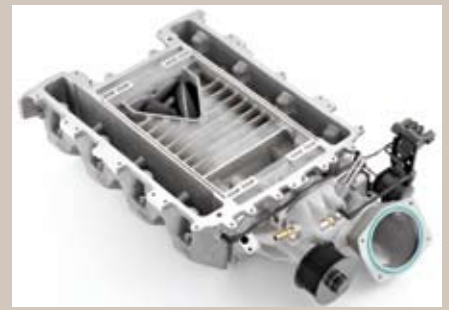
"The path to more power was by increasing displacement and airflow," Rydzewski said. The LS2's 101.6-mm (4.00-in) cylinder bore diameter was increased to (4.06 in) 103.25 mm. Crankshaft stroke remained at 92 mm (3.62 in).



New cylinder head design and casting allowed the LS3 to avoid any secondary machining as used on the 500-hp (373-kW) LS7 (shown).

Due in 2009: the supercharged LS9

The LS3 program shared development with a far more powerful variant. The LS9, which is expected to be rated at more than 600 hp (447 kW) when it debuts later next year, is slated for the limited-production 2009 ZR-1 super Corvette.

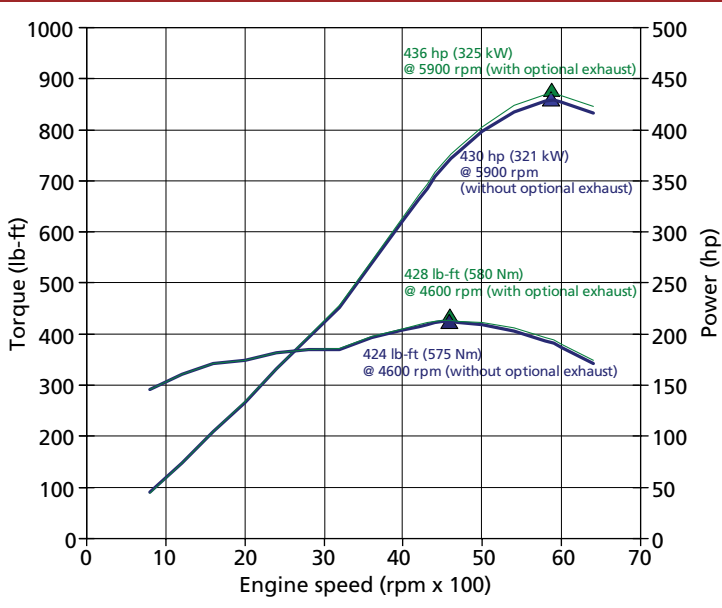


The LS9 marks the first application of Eaton's new TVS supercharger, shown here sans intercooler.

GM Powertrain engineers decided to base the LS9 on the 6.2-L block, rather than the 7.0-L LS7, so various design features were incorporated to accommodate and additional 170 hp (127 kW) at least. These include more robust cylinder liners and an ultra-strong block and crankshaft.

As this issue went to press, *AEI* learned that the LS9 will be the first production application of **Eaton's** new twin-vortices series (TVS) supercharger. This ultra-compact blower, with air-to-water intercooler piggy-backed on top, compresses the intake charge using a pair of four-lobe rotors. The lobes of each rotor are twisted 160° and coated with a special graphite material. They spin at 18,000-22,000 rpm and help make the blower 70% efficient, claims Eaton. Look for a TVS story in an upcoming edition of *AEI*.

Lindsay Brooke



GM squeezed an additional 30-36 hp from the 6.2-L V8 while lowering its emissions to Bin 4—without changing the catalyst loading.

The LS3 cylinder head with revised port geometries was actually developed as part of the Z06/LS7 program, Rydzewski noted. But rather than use NC machining to optimize the ports and combustion chambers, as done on the LS7, the team opted for net-shape head castings designed for more efficient flow.

"We're very pleased with the shape and surface finish of these castings so, for example, we didn't have to enlist **Linamar** (LS7 supplier) for secondary machining," he said.

Complementing this arrangement are larger intake valves—55.0-mm (2.17-in) head diameter, vs. 50.8 mm (2.00 in) on the LS2, their hollow stems helping to reduce valvetrain mass by 13% and aiding the new V8's 6600-rpm capability. In an arrangement similar to the LS7's, the LS3's intake rocker arms are offset 6.0 mm (0.24 in) between the valve tip and rocker pivot; this has the same effect as moving the pushrods to one side, to help straighten the path to the intake port.

The LS2's 40.4-mm (1.59-in) diameter exhaust valves and springs carry over to LS3. Intake camshaft timing is revised, and lift increases to 14 mm (0.55 in) from the LS2's 13.25 mm (0.52 in).

Feeding the new heads is a structurally stiffer, high-flow, reinforced-plastic intake manifold adopted from the LS7, allowing

a straighter path into the intake ports.

While the LS3's 10.7:1 compression ratio is higher than on some of GM's truck applications, Rydzewski said that the design team avoided going up to 11:1 because it wanted to keep premium fuel a suggestion, not a requirement, for Corvette.

The new induction system, along with "a lot of work on electronic control and calibration," allows the LS3 to meet **EPA** Tier 2 Bin 4, the next cleaner level of EPA emissions standards (LS2 met the "dirtier" Bin 5) without any change to its after-treatment system or precious-metal loading. The engine also keeps Corvette free of the U.S. gas-guzzler tax.

The LS3 team did not have to add variable valve timing (VVT) to help stabilize the engine's idle characteristics to meet Bin 4. This helped keep costs down, Rydzewski said, adding that GM has various VVT investigations in the works for potential future deployment.

Various structural changes to increase strength and durability and to improve NVH were made in designing the LS3 architecture, according to Rydzewski.

Learnings from the LS7 included during machining, changing the hone-over travel radius to a radius very similar to what LS7 uses. That gave a 20% improvement in structure of the block's

bulkheads, which helped reduce NVH.

Another major change influenced by LS7 was increasing the joint capability (and thus the high-rpm safety factor) of the powder-metal connecting rods. Rydzewski's engineers specified a higher-grade connecting rod bolt—12.9 grade offering 176,000 psi (1210 MPa) tensile strength, vs. 10.9 grade on the LS2.

The larger-diameter cast pistons are heavier and feature four drilled oiling holes for improved high-rpm lubrication, as well as revised oil and compression rings. In the lower end, LS2 tweaks were carried over. "We maintained the same window, the same bay-to-bay breathing, basically the same PCV system, and we made some improvements on sealing. That's about it," Rydzewski noted.

A new acoustic package aimed at reducing or eliminating high-frequency (mostly valvetrain) noise is incorporated in a new multilayer "beauty cover" over the intake manifold and rocker covers.

The LS3 maintains a direct lineage to the original 1955 Chevy 265 in³ (4.3 L) and still offers the best combination of package efficiency and low mass of any V8.

"We have a lot of engineers who know where to find more improvements in this +50-year-old design," Rydzewski said. "We continue to learn more about it."

Lindsay Brooke