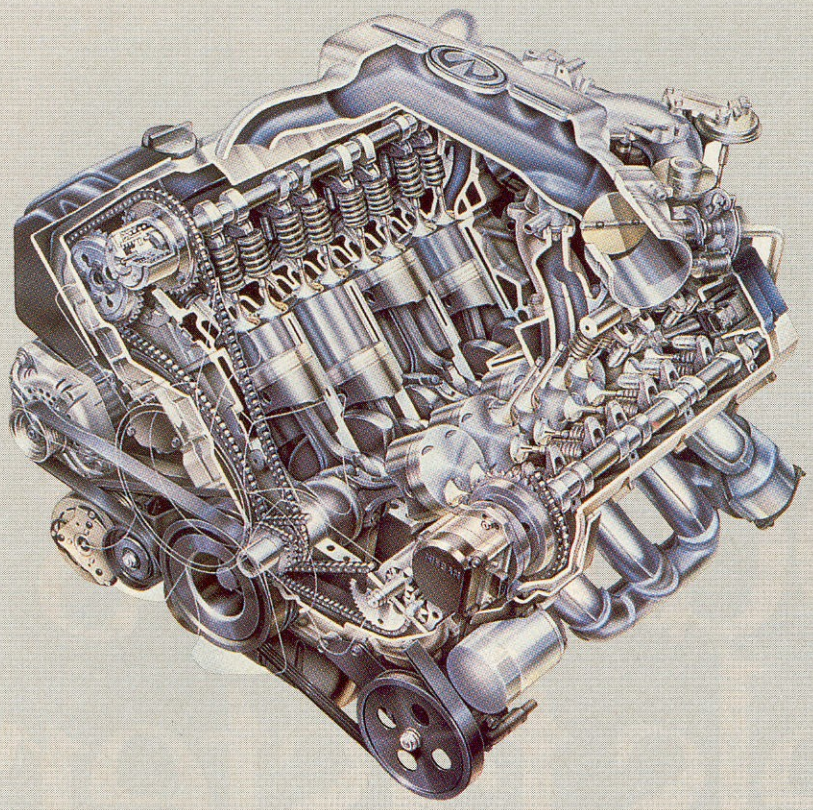
TECHNICAL HIGHLIGHTS



• An engine's performance is directly linked to its breathing efficiency. Increase the amount of air flowing into the cylinders and you increase the engine's specific output. This is the major benefit of switching from two valves per cylinder to four. But now Nissan and some other makers are enhancing their four-valve engines with variable-valve-timing systems. These VVT systems, such as the one found in the new Infiniti Q45, improve the performance of four-valve engines even further.

At every engine rpm, there exists an optimum timing for the opening of the intake and exhaust valves that produces the best cylinder filling (and thus the most power) at wide-open throttle. But because the optimal valve timing varies with engine rpm, the fixed valve timing on most engines is a compromise over much of the rpm range. A variable-valve-timing system, however, keeps the valves operating near their optimal timing over a wider rpm band.

For mechanical simplicity, Nissan's variable-valve-timing mechanism operates only on one set of valves. Nissan designed its system around the intake valves, because laboratory tests showed that varying the intake-valve timing produced greater benefits than altering the exhaust timing.

The main component of Nissan's system is a mechanism that allows the intake camshaft to twist relative to its drive pulley. By altering the orientation of the camshaft and its pulley, the system is able to alter the timing of the intake valves.

The mechanism consists of a small, annular piston-and-cylinder assembly extending from the pulley's center. The outer surface of the cylinder is fixed to the pulley; the inner surface is formed by an extension of the intake camshaft. The cylinder has helical splines, similar to the rifling in a gun barrel, running along both surfaces—though in opposite directions. The ringlike piston, which moves in the cavity formed by the cylinder's inner and outer surfaces, has helical grooves that match these splines.

When oil pressure is applied to the head of the piston, it moves inside the cylinder and, like a nut working its way down a bolt, forces the inner and outer surfaces of the cylinder to twist. This results in a phase shift between the timing pulley and the camshaft. When the oil pressure is released, a return spring forces the piston back into its normal position and the camshaft to its original timing.

The oil pressure on the piston is varied by a control valve and a solenoid. In the Q45, these components are located ahead of the pulley. (In a similar VVT system on the 300ZX, these components are positioned at the aft end of the camshaft.) The engine-control computer actuates the solenoid at 4600 rpm, causing the intake camshaft to retard twenty degrees—thereby improving high-rpm breathing. When rpm falls below 4600 rpm, the system returns the camshaft to its advanced position for better low-rpm operation.

Nissan had to surmount several problems when designing and refining the VVT system. Factors such as packaging, response time, noise, vibration, and wear were all hurdles to overcome. Despite the complexities, however, Nissan says that it has achieved significant gains in performance. The VVT system is said to improve low-speed torque by ten percent in the Q45's 4.5-liter V-8—without compromising high-end output.

The advantages of variable-intake-valve timing systems aren't lost on other manufacturers. Alfa Romeo has used a similar system for years. Mercedes has applied VVT systems to its new four-valve engines. And Honda is advancing the technology one step further by offering a domestic-market Integra engine that varies intake timing, exhaust timing, and valve lift.

Expect to see VVT technology become even more common on four-valve heads within the next few years. —*Nicholas Bissoon-Dath*