e-Valve System

green by nature

The e-Valve system replaces the traditional camshaft system.
It reduces fuel consumption and CO_2 emissions by 15%-20% while improving low end torque up to 15%.

>> Attractive concept

In the current context of global warming, reduced CO_2 emissions demanded of the automotive industry by governments worldwides are challenging targets - especially within the relatively short timeframe requested. Valeo's e-Valve technology allows automakers to reduce vehicle emissions and consumption by 15%-20% in a mixed driving cycle.

The opening and closing of valves is no longer controlled by a camshaft but by an electromagnetic system that operates each valve individually and independently of the crankshaft position. This total flexibility is similar to that available with very sophisticated variable valve actuation systems, allowing engine calibration engineers almost infinitely variable valve timing and valve opening duration. The e-Valve system also offers other advantages such as cylinder deactivation, offering additional fuel consumption benefits for the internal combustion engine.

It is now possible to design engines that optimize engine performance with respect to the demands of the driver, applying different engine strategies such as cylinder deactivation or Atkinson-Miller cycle based on actual driving inputs.

This flexibility in engine valve control also significantly increases low-end torque, enhancing driving comfort.

>> Operating principle

Each valve is controlled by two springs and two magnets. The two opposing springs provide alternating forces, one to open the valve, the other to close it. The two magnets catch the armature plate attached to the valve stem, the lower magnet to open the valve and the upper magnet to close it. The whole unit is controlled by an electronic management system (the Valve Control Unit) with an integrated 12/42 Volt converter and cooling system.

A benefit of the increased valve control flexibility is that the engine no longer requires an air throttle valve. This reduces or even eliminates the negative pressure in the intake combustion phase at low engine speed (also known as pumping losses), which therefore improves fuel consumption. As a result, idle speed can also be lowered. The e-Valve system gives engine calibration engineers a wide choice of settings that can favor low-end torque, engine performance and reduced emissions. For example, deactivating certain cylinders - by temporarily closing their valves - enables the active cylinders to work in a more efficient portion of the engine map. All these new options contribute to the reduction of fuel consumption and CO_2 emissions by 15-20%.

>> The e-Valve system in detail

An e-Valve system has one actuator for each pair of valves. Valve movement is controlled by two magnets that harness the energy released by two springs. At the start of the valve opening operation, the valve is released by the upper magnet - the valve is then driven open (down) by the energy stored in the upper spring. The lower magnet catches the armature plate, fully compressing the lower spring and keeping the valve open for the required time. Valve closure follows the identical procedure in reverse. The valve is kept closed by a locking strategy, reducing the energy being consumed by the magnets. The valves also remain closed while the engine is not running. Noise due to the opening and closing of the valves is managed by controlling the speed of the valve as it reaches the upper and lower limits of travel.

The Valve Control Unit (VCU), which is cooled by the engine cooling system, operates on a standard 12-Volt vehicle architecture. It is fitted with a voltage converter in order to locally power the actuators with 42 Volts.

The flexible e-Valve system allows infinitely variable valve timing and valve opening duration, along with the possibility to deactivate some cylinders. In addition, by opening and shutting valves faster than a cam system at low engine speeds, pumping-related losses are reduced and almost eliminated. In addition to improved thermodynamic performance and torque, it is also possible to use several different combustion strategies such as switching momentarily to a Miller cycle, or accelerating gas intake speed by opening one valve and so reducing the creation of pollutant gases.

Current tests on prototype vehicles are focusing largely on half-camless systems, which control inlet valves only and offer most of the benefits and an excellent cost-benefit ratio.

>> Advantages of e-Valve System

Advantages for the automaker

Valeo's e-Valve System represents a major technological advance in the design of internal combustion engines, and can offer many advantages to automakers.

- Pumping losses are reduced to virtually zero, which improves performance and lowers engine idling speed.
- Engine calibration engineers benefit from almost infinitely variable valve opening settings, with a positive effect on:
    - Torque, notably at low engine speeds
    - NOx and HC emissions
    - Ease of recycling exhaust gases
- The system is highly adaptable on:
    - A very wide range of engine displacements
    - Indirect and direct injection, atmospheric and turbocharged, even highly turbocharged, gasoline engines
    - Existing engines - those already in production equipped with traditional camshafts
- The system is compatible with all fuel blends and quality
- The deactivation of cylinders increases performance at low engine speeds.

Advantages for the user

Customers benefit from a more efficient engine, with lower fuel consumption and reduced CO_2 emissions. In addition, the customer benefits from enhanced driving comfort through increased low-end torque.

- Consumption is reduced by 15-20%.
- CO_2 emissions are reduced by 15-20%.
- Low-end torque is increased by 15-20%.