BMW Technology

Valvetronic

The Valvetronic engine is the world's first engine without a throttle butterfly.

4 Cyl

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Information

Valvetronic engines use a combination of hardware and software to eliminate the need for a conventional throttle mechanism.

> Valvetronic varies the timing and the lift of the intake valves. The Valvetronic system has a conventional intake cam, but it also uses a secondary eccentric shaft with a series of levers and roller followers, activated by a stepper motor. Based on signals formerly taken mechanically from the accelerator pedal, the stepper motor changes the phase of the eccentric cam, modifying the action of the intake valves.

Valvetronic was introduced on the all-alloy 1.8-liter, 4-cylinder engine for the E46 316ti Compact, and it will subsequently be applied to most eight and 12-cylinder engines within a few years. The new E65 7 Series has Valvetronic engines.

The Valvetronic engine replaces the function of the throttle butterfly by using an infinitely variable intake valve lift. The Valvetronic

engine does not require a timing belt or chain. Valvetronic has its own computer housed in a separate unit away from the engine management system, networked with the digital engine management system incorporating a 40-megahertz, 32-bit computer.

A unique set of images from BMW showing how Valvetronic was designed. Click for a larger image

Valvetronic reduces maintenance costs, improves cold start behavior, lowers exhaust emissions, and provides a smoother running engine. Valvetronic does not need specific fuel grades or fuel qualities because of its fine atomization of fuel.

The entire Valvetronic system is pre-assembled and inserted as a module into its position in the cylinder head. Valvetronic engines are built at BMW's brand new engine plant at Hams Hall near Coventry, England.

Because Valvetronic allows the engine to breathe more freely, fuel consumption is reduced by 10%. The fuel savings are greatest at lower engine revs. Valvetronic is an important element in BMW's aim of meeting the 2008 carbon dioxide fleet requirements of 140 gm/km.

V-8

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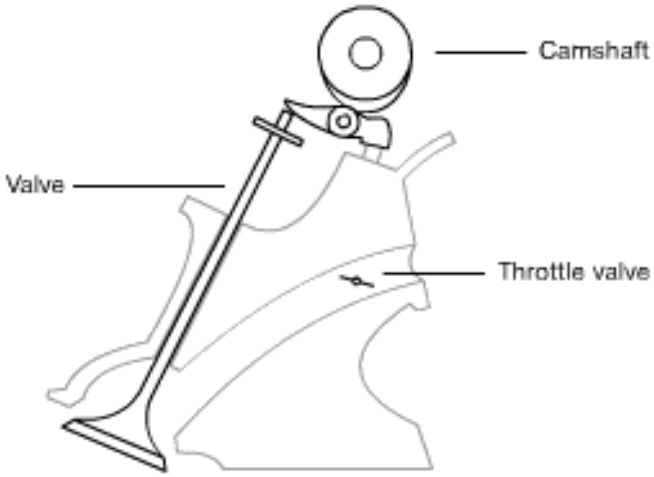
Here's how it works:

Fuel injection systems monitor the volume of air passing through the throttle butterfly and determine the corresponding amount of fuel required by the engine. The larger the throttle butterfly opening, the more air enters the combustion chamber.

At light throttle, the throttle butterfly partially or even nearly closes. The pistons are still running, taking air from the partially closed intake manifold. The intake manifold between the throttle and the combustion chamber has a partial vacuum, resisting the sucking and pumping action of the pistons, wasting energy. Automotive engineers refer to this phenomenon as "pumping loss". The slower the engine runs, the more the throttle butterfly closes, and the more energy is lost.

Intake valve with throttle plate.

The supply of the fuel/air mixture is controlled by the throttle plate. Valve lift is unchanged.



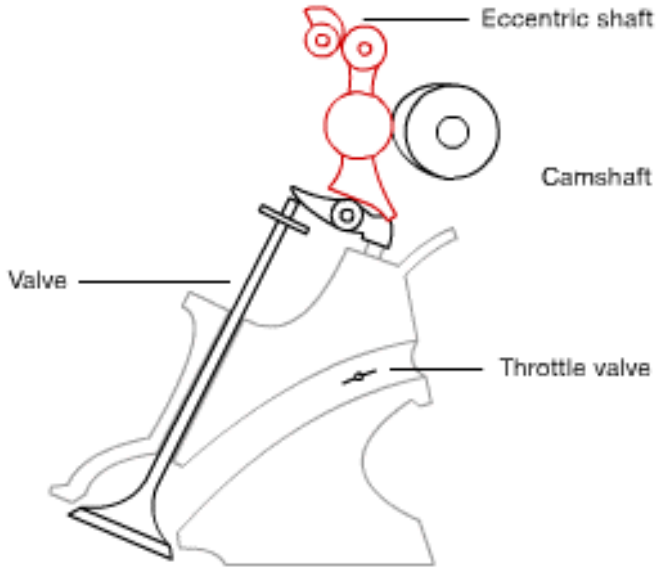
Valvetronic minimizes pumping loss by reducing valve lift and the amount of air entering the combustion chambers.

Compared with conventional twin-cam engines with finger followers, Valvetronic employs an additional eccentric shaft, an electric motor and several intermediate rocker arms, which in turn activates the opening and closing of valves. If the rocker arms push deeper, the intake valves will have a higher lift, and vice-versa. Thus, Valvetronic has the ability to get

deep, long ventilation (large valve lift) and flat, short ventilation (short valve lift), depending on the demands placed on the engine.

Intake valve with VALVETRONIC.

The fuel/air mixture is controlled by a variable valve lift, without a throttle plate.



Operating Parameters:

- Valve lift is variable between 0 and 9.7 mm.
- Adjustment of the worm gear from one extreme to the other takes 300 milliseconds.
- Combined with double-Vanos valve timing technology, the camshaft angle relative to the crankshaft can be adjusted by up to 60°.
- The intermediate arm is finished to a tolerance of 0.008 mm.
- The cams controlling the eccentric shaft are machined to tolerances of a few hundredths of a millimeter.

Additional Benefits:

- In Valvetronic engines coolant flows across the head, resulting in a temperature reduction of 60%.
- The water pump size is cut in half, reducing power consumption by 60%.
- The power steering fluid is warmed quickly, reducing the power used by the hydraulic pump.
- Mounting the water and power pump on the same shaft and a heat exchanger between coolant and engine oil reduces oil temperature by 30%.

The efficiency of Valvetronic engines drop rapidly at over 6,000 rpm since stronger valve springs are required. The stronger springs create higher friction losses. Don't expect to see Valvetronic in the "M" series engines any time soon.

Links

BMW Valvetronic 4-cylinder engine. Valvetronic article from AutoSpeed.

BMW Italy feature on the Valvetronic motor.

Green Engine Technology features engines from Honda, Mazda and BMW's Valvetronic engine.

BMW 3 Compact 4 Cylinder Engine reviews the 316ti and the world's first power unit with VALVETRONIC.

BMW's Valvetronic: how it works is a brief article from the Daily Telegraph.
