Engine Engine applications

Engine power plus

Porsche Engineering benefits from the expertise acquired through the development and application of sports car engines for all engine projects

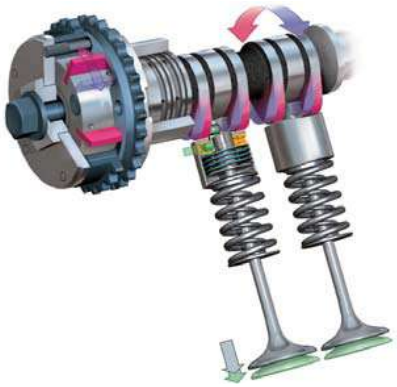
The requirements for modern valve train mechanisms – whether for cars, motorcycles, small or industrial engines – are becoming increasingly complex. The case study of VarioCam Plus illustrates the expertise acquired by Porsche Engineering through the development and application of high-performance engines for its parent company.

Porsche Engineering has developed the V-Rod engine together with Harley Davidson

The demands placed on a modern engine are greater than ever: an engine needs to be sporty, powerful, efficient, environmentally friendly and, equally important, economical to produce. These requirements mean that it is not only the control and regulation of systems that must be optimized, but the systems themselves also have to be developed further. As part of this process, engineers must keep pushing the boundaries of physics with intelligent technology.

Porsche Engineering does not exclusively concentrate on the development and application of sports car engines. Whether you are considering a mechanism for a motorcycle or an industrial engine, a one-cylinder, or multi-cylinder high-performance engine, Porsche Engineering is a competent partner in all areas.

Porsche's experience as a production manufacturer means that all requirements for modern large-scale or small-scale production are taken into consideration early in the development phase. The early integration of suppliers is just as important as compliance with the globally-applicable regulations on exhaust gases and emissions. The know-how and experience gained by Porsche in the development of its own high-



VarioCam Plus combines intake-side camshaft control and intake-side valve lift switchover

performance engines is naturally also incorporated in the development of engines for its customers.

The VarioCam Plus variable valve control is an excellent example of such an application for sports car engines. The valve timing – the synchronized opening and closing of the valves – has a decisive influence on the power and torque characteristics of the engine. VarioCam Plus combines intake-side camshaft control (VarioCam) and intake-side valve lift switchover (Plus).

The valve lift control system consists of switchable flat-base tappets on the intake side actuated by an electro hydraulic 3/2-way directional control valve. The intake camshaft provides two different cam profiles with cor-responding valve lift curves to act as required by selectively switching the relevant cams. The flat-base tappets have two nested lifters which can be locked together with a pin. The inner lifter is in contact with the small cam and the outer lifter with the large cam. A hydraulic compensation element takes care of any dynamic valve clearance adjustments. VarioCam Plus effectively offers two engine operation modes in one. Switching to the small cam with valve lift of, say, three millimeters and adjusting the valve timing for slight valve overlap when idling optimizes the gas charge cycle. The small valve lift reduces the friction loss and greatly increases the charge motion thanks to significantly-reduced opening times. The result is a reduction in consumption and emissions of up to 10% and significantly improved idle performance.

Under part load, internal exhaust gas recirculation is used to reduce the throttle effect and fuel consumption. The camshaft adjustment is set to a large overlap while the valve lift is kept small – the time available for sucking exhaust gas back in is increased.

At full load, maximum torque and power output are ensured by a charge

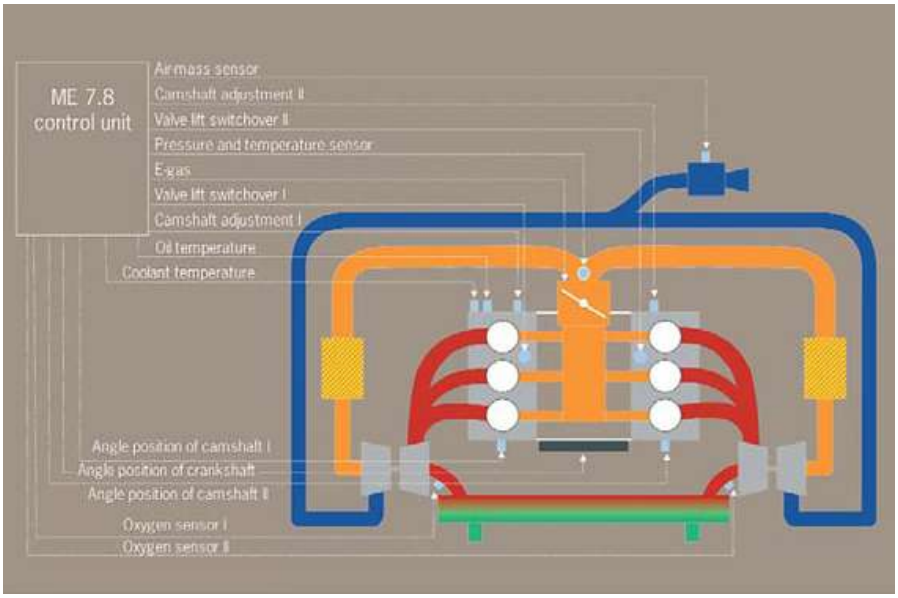
Engines with VarioCam Plus offer more power and at the same time a reduction in consumption and emissions

cycle with minimum losses
and an uncompromising cam profile
with increased valve lift of,
say, ten millimeters, and appropriate
duration of opening and
closing to suit the valve lift curves.

Both individual systems of the
VarioCam Plus are controlled via the
Motronic ME 7.8 control module.
The main input variables used in the
control of VarioCam Plus are
the engine speed, accelerator pedal
position, engine-oil and water
temperature, and gear selection.
The powerful computer
enables it to meet stringent demands.

The driver's commands for
torque and power are compared with
the control maps stored in the
memory. Decisions for VarioCam Plus
reactions are made in milliseconds,
and the engine performance remains
balanced and smooth despite the
dynamic changes being made
to the engine operation. These changes
will be imperceptible in the cockpit.

While optimized engine design means
that fuel can be saved with
VarioCam Plus, the strategy is taken
one step further for eight-
cylinder engines. “Cylinder shutoff”,
disables four of the eight com-
bustion chambers under partial load.
The remaining combustion
chambers can then be operated
more effectively to reduce
overall fuel consumption. The electro-
nics intervene to restore all eight



To control the VarioCam Plus lots of data is necessary. Therefore the powerful control unit ME 7.8 is necessary

cylinders to operation when more
power is required.

Even though none of the Porsche
models feature a diesel engine,
Porsche Engineering does not neglect
this method of combustion.
The complexity of control is comparable
to that of the Otto-cycle engine.
The more the Otto and diesel engines
are optimized in terms of exhaust
emissions and fuel consumption, the
more the techniques used
for these engines will converge.

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