Pierburg GmbH

Compact turbo bypass valve sets new benchmarks

Downsizing, a reduction in engine displacement coupled with unchanged or even higher output as a result of charging, is here to stay on today's engines. And it's not surprising since small exhaust-air turbocharged engines consume less fuel without any compromise in performance. Since back in 2004, a regular feature on turbocharged engines has been an electric “bypass” or “recirculation” valve developed by Pierburg GmbH as included nowadays on virtually every turbocharged engine. More than 15 million units have already been sold and in this time the product has repeatedly been fine-tuned. The present valve is now in its fourth development generation: smaller, lighter, longer lasting, and lower cost than its predecessors.

Since last year, a third automated production line at the Neuss location in Germany has been turning out around two million units annually. There are another two lines producing these components, too. In 2012, total output was in the region of 5 million, and the figure is rising. The valves are shipped out to virtually all the major OEMs, as well as directly to turbocharger manufacturers.

The bypass valve is a solenoid-type unit with built-in pressure compensation that allows the valve to largely work independently of the actual charge pressure of the turbocharger. This has the advantage that the magnetic force can be low in relation to pressure conditions and this, in turn, has cost advantages. Here, too, the newest generation again pushes the limits upward regarding charge pressure and temperature. It is compact, weighs about two-thirds less and is one-third smaller than its predecessors. The outcome: especially packaging advantages on this latest generation scheduled for series production in 2015.

Conceivable in future are variable recirculation valves on diesel engines for the purpose of properly proportioning pressure and air volumes for compressor mapping.

Regulating the turbocharger
The electric bypass valve goes into operation whenever the driver takes his foot off the accelerator and the throttle flap is closed. But for this regulating function, backpressure would cause damage to the turbocharger. If the sharp rise in pressure when the flap is closed is not diverted via a valve, the waste air can travel through the compressor and this results in a “pumping” action in the turbocharger. The air flow is released from the compressor blades and the pumping process is interrupted. The air flows backward through the compressor until pressure again stabilizes and the air flow reverts to positive. Pressure rebuilds and the sequence of events is repeated in rapid succession.
The sound that is caused gives rise to the term “pumping.” To avoid this, the electric bypass valve opens up a bypass around the compressor wheel. This must be big enough to allow pressure in the intake manifold to drop quickly enough to keep the turbocharger, at falling speed, away from the pump limits. The turbocharger can then freely continue to rotate, renewed pressure buildup is shorter and the outcome is faster acceleration of the turbocharger in favor of improved response after gear change.

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