

BORGWARNER DEVELOPS 4TH GENERATION VTG TURBOCHARGER

Next generation turbo

Exhaust gas turbocharging is a key technology for lowering fuel consumption and emissions in internal combustion engines. Turbocharger specialist BorgWarner Turbo & Emissions Systems therefore works continuously on further improving its technologies. And the company is now presenting its latest generation of turbochargers with variable turbine geometry (VTG) for use in diesel engines.



The latest VTG generation from BorgWarner is characterized by its innovative S-vane design.

BorgWarner has been using variable turbine geometry for many years, in particular to optimize the response of turbocharged diesel units while also reducing fuel consumption and emissions values. VTG turbochargers employ adjustable turbine vanes which are arranged in a circle around the turbine wheel on a vane ring. This system allows the boost pressure to be adjusted flexibly to the engine speed. By varying the angle of the rotating vanes using an adjusting ring, the cross section exposed to exhaust gas flow can be adjusted based on the amount of boost pressure required. At low revs the cross section is smaller, and it then increases at high revs – offering optimum back pressure of the exhaust gas.

Optimized design, optimized materials

In developing the latest BV generation, the engineers at BorgWarner in Kirchheimbolanden were faced with the task of fulfilling the even stricter requirements of VTG turbochargers for future

engines – without sacrificing the well-respected key features of the 3rd generation units. This meant finding ways of further improving the thermodynamics, response and controllability while also lowering costs without compromising reliability.



Unlike the previous generation, whose turbine vanes were straight in shape, the engineers employed a patented S-vane design for the new 4th generation VTG units. These vanes are curved at both ends, with each end cambered in the opposite direction to its counterpart. This is what gives the vanes their characteristic S shape. The S shape offers both improved thermodynamics and controllability. Due to the innovative design, the turbine vanes open independently at a certain angle (specified by the actuator) when needed using the force of the exhaust gas. The new VTG turbocharger is designed for use with both pneumatic and electrical actuators, depending on the requirements of the engine manufacturer. The new VTG generation significantly improves the response of the engine and increases efficiency in the low rev band. This allows auto manufacturers to develop engines which offer greater driving pleasure and improved consumption figures and environmental friendliness.

Another new feature compared to the previous generation is the use of wear-optimized and heat-resistant materials.

BorgWarner thereby guarantees that the turbochargers offer both durability and reliability in the face of ever-increasing power density.

First series application

The first engine to be mass produced with a 4th generation VTG turbocharger is Renault's 1.5 liter (91.5 cubic inch) displacement K9K diesel engine. Since what is currently Renault's smallest turbodiesel was launched in 2000 as an EU3 version, BorgWarner Turbo & Emissions Systems has been the sole supplier of all the respective turbocharging systems. Following the EU4 version, which celebrated its premiere in 2008 in the Renault Laguna (see TurboNews 1/08), the engine is now being produced as the K9K EU5 unit.

The improvements in the 1.5 dCi unit in terms of fuel consumption, environmental friendliness and dynamics are thanks to a BorgWarner BV39 turbocharger with 4th generation VTG. The 109 bhp turbodiesel generates its maximum torque of 240 Nm (177 lb-ft) from just 1,750 rpm and consumes a mere 4.6 liters of diesel per 100 km in the Mégane (51 mpg US, 61 mpg UK). At the same time the engine, which is manufactured in the Spanish city of Valladolid, emits only 120g of CO₂ per km (0.42 lb per mile) and complies with the Euro5 emissions standard.

Other auto manufacturers are also currently developing engines with the latest generation of VTG turbochargers. Further series applications are set to follow later in the year.