Diesel Systems
Downsizing of diesel engines

BOSCH
Invented for life

Turbocharger with Variable Turbine Geometry

Customer benefits: Downsizing
- Potential for 20% lower fuel consumption and subsequently reduced CO_2 output at identical engine power
- Potential for increased specific power

Customer benefits: Common Rail System
- Modular system program for all types of diesel engines
- Maximum injection pressure and minimal injection separation time

Customer benefits: Exhaust turbocharger
- Optimized acoustic characteristics
- High efficiency
- Good dynamic behavior
- High durability

Bosch Mahle TurboSystems

Numerous measures can help to meet the continually tightening requirements for emissions and fuel consumption of diesel engines. Direct measures focus on flexible injection systems and improved combustion methods which pave the way for effective indirect measures such as downsizing and downspeeding. This leeway can be utilized to achieve the desired reductions in fuel consumption and emissions. With the advanced Bosch EDC control functions, this is possible without penalties as regards performance and driveability.

Engine downsizing is the most important indirect fuel-economy measure in the powertrain. Downsizing means the reduction of displacement – either by making the specific cylinder displacement smaller or by reducing the number of cylinders. Compared with the reference engine, the downsized engine has a smaller displacement, which reduces friction, moving mass and thermal loss.

The increased specific maximum power due to engine downsizing is made possible by the appropriate redesigning of the air system (turbocharger, intercooler), combustion chamber (piston and cylinder head) and fuel-injection equipment (EDC, high pressure pump, injector and nozzle, sensors and actuators).

Bosch Diesel Systems is developing fuel injection equipment to meet downsizing requirements: higher injection pressures for increased maximum injected fuel quantity and improved accuracy for each single injection.

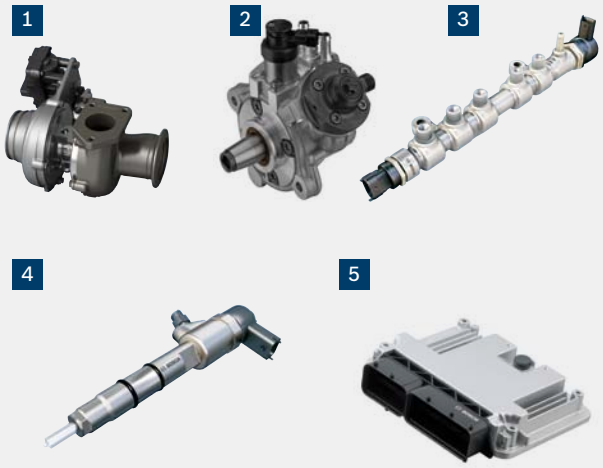
Bosch Mahle Turbo Systems, a joint venture of Robert Bosch GmbH and MAHLE GmbH, is developing and manufacturing turbochargers to meet downsizing requirements: increased boost pressure, high maximum exhaust temperature and maximum efficiency.

Possible applications

Downsizing is possible with gasoline or diesel passenger cars and with light commercial vehicles.

Technical specifications	
Engine cylinders	2...12
Specific engine power (NA/TC)	• < 45 kW/l wastegate • 45...75 kW/l VTG
Operating voltage	12/24 V
Lifetime PC/LD	≤ 300,000/400,000 km
Emission target equals	Euro 6
Applications	Passenger cars, light-duty vehicles, off-highway segment

Components of a diesel system with downsizing



1 Exhaust turbocharger
2 High-pressure pump
3 High-pressure rail
4 High-pressure injector
5 Control unit with additional functions

Bosch: Automotive competence from a single source

- Comprehensive range of services and know-how
- System and network competence
- Innovator and technology leader
- Warrantor for quality and dependability
- Worldwide presence
- Universal partner

Functional principle and system design

The turbocharger consists of a turbine and a compressor mounted on a shaft. The turbine is driven by the exhaust stream. The compressor in the intake tract delivers more air into the combustion chamber, increasing charge pressure. A wastegate valve can be used to control charge pressure.

Diesel engines will have to fulfill demands such as increased dynamic response, lower fuel consumption and compliance with stricter emission targets. This requires increased injection pressure and injection efficiency as well as higher exhaust turbocharger power. The latter can be achieved by Variable Turbine Geometry (VTG), two-stage turbocharging and new materials.

Variable Turbine Geometry (VTG) controls charge pressure using adjustable guide vanes. At low engine speed, turbine speed is increased by decreasing the inflow diameter – this leads to higher charge pressure. At higher engine speeds, the charge load requirement decreases. The vanes are therefore set to maximal inflow diameter.

Two-stage turbocharging employs an additional charger stage to reach a higher pressure level and faster pressure build-up.

Outlook

New lower-density materials in exhaust turbochargers will contribute towards improved performance and reduced emissions of the overall system.

Engine size will be reduced, while charge pressure will be increased. Accordingly, Common Rail Systems will generate increased injection pressure with compact injectors.

Additional fuel economy potential can be realized by combining the engine with hybrid technology.

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Printed in Germany
292000P0PJ-C/CCA-201108-En