Diesel Systems

Common Rail Systems CRSN3 with 2,000 to 2,500 bar

In addition to emissions legislation, fuel consumption and specific engine performance are the main drivers behind the further development of commercial-vehicle engines. Combined with the SCR catalytic converters – which have become the prime source for achieving Euro VI emission standards, Tier 4, US10 or IMO 3 – the high injection pressures also provide advantages in fuel consumption. Only a one-percent reduction in fuel consumption helps to save 500–800 euros in annual operations costs.

For this reason, we are upgrading the Common Rail System CRSN3 series. The CRSN3-18 (1,800 bar) system was successfully launched for series production in 2005. Since 2010, the follow-up CRSN3-20 (2,000 bar) and CRSN3-22 (2,200 bar) generations have been available. The CRSN3-25 with a system pressure of 2,500 bar is scheduled to start series production in 2013.

Possible applications
CRSN3 systems are intended for use in medium- and heavy-duty as well as for off-highway and marine applications. They cover a wide range of engines of up to 16 cylinders.

Operating principle
Starting at 2,000 bar, the CRSN3 systems achieve a higher systems efficiency through their new injector concept, thus reducing fuel consumption. Inside the injector, the parts up to the control valve are charged with the rail pressure. This avoids a constant fuel flow between the high- and low-pressure area. Only while the solenoid is triggered, the valve opens and a small control quantity is fed into the fuel return line. In order to permit the opening and closing of the nozzle needle in this “pressure-balanced” internal injector volume, the needle is hydraulically coupled to the push rod.

Optimized injector-fuel maps allow for quantity correction throughout the useful lifetime of the entire system through the aid of software learning functions.
Technical features

- System pressure: 250 – 2,500 bar
- Max. number of injections: 7
- Hydraulic flow rate:
  - CRSN3-20, -22: 400 – 1,300 cm³/30 s
  - CRSN3-25: 400 – 1,000 cm³/30 s
- Operating voltage: 12 V/24 V
- Lifetime:
  - Medium-duty sector (MD): 750,000 km (on-highway), 10,000 h (off-highway)
  - Heavy-duty sector (HD): 1.6 million km (on-highway), 15,000 h (off-highway)
- Fields of application: MD, HD, OHW, marine
- Max. number of cylinders: 16
- Engine power/displacement: 20 – 35 kW/l
- Emission targets: Euro VI, US10, Tier 4, JPNLT, IMO 3

System design (typical configuration)

Three types of high-pressure pumps are available for various engine sizes and applications. The CP4 high-pressure pump is suitable for medium-duty applications with a system pressure of up to 2,500 bar.

The CPN5-22/2 high-pressure pump covers the heavy-duty requirements of up to 2,200 bar system pressure. It is based on in-line pump technology and includes a newly developed internal pre-supply gear pump. A further development of this pump will reach higher emission targets and achieve fuel-consumption benefits with pressures of up to 2,500 bar. This pump is very compact, robust and lightweight. Alternatively, up to 2,000 bar can be generated by a PF 45-20 camshaftless pump which is driven by the engine camshaft.

The forged high-pressure rail (HFRN) is fitted with drilled throttles, a rail-pressure sensor and a pressure-limiting valve (PLV) for applications up to 2,200 bar. Instead of the PLV, the 2,500 bar CRSN3-25 system is equipped with a pressure-control valve (PCVN). This ensures extended pressure reduction functionality as well as enhanced diagnostic functionality with active pressure control.

The CRIN3 injector with 2,000 to 2,500 bar is the heart of the system. It is compatible in installation with previous generations as its outer dimensions have been retained unchanged.

All system functions are controlled and monitored by the EDC17 Electronic Diesel Control. The EDC17 platform has advanced monitoring and safety functions such as limp-home functionality.

Outlook

Bosch engineers are already engaged in the further evolutionary development of this modular system. Future generations of the CRSN3 platform will use this strong foundation for system pressures over 2,500 bar.

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Printed in Germany
292000P0WJ-C/CCA-201302-En