Common-rail injection systems

Diesel common-rail system CRS 2-25 with solenoid valve injectors for up to 2,500 bar

PRODUCT BENEFITS
- Cost-effective and versatile due to modular design
- Reduced fuel consumption and emissions thanks in part to idle stop/start (ISS) and hybrid capability
- Can be used in downsizing and downspeeding concepts
- Contribution to achievement of emission and CO₂ targets
- Closed-loop control of injection volume and timing
- Shorter injection intervals possible

1. High-pressure rail HFR:25
2. High-pressure pump CP4-25/1
3. Electronic engine control unit MDG1
4. Solenoid valve injector CRI 2-25
Common-rail injection systems

**High-pressure pump CP4-25**

*up to 2,500 bar*

for high engine power combined with low fuel consumption

**Solenoid valve injector CRI 2-25**

*up to 8 individual injections for quieter combustion plus reduced fuel consumption and emissions*

**High-pressure rail HFR-25**

*over 60,000 pressure checks a minute for optimum fuel injection control*

**Electronic engine control unit**

*reduced emissions supports compliance with current and future requirements of emissions legislation worldwide*

**PRODUCT BENEFITS**
- Increased hydraulic efficiency with electric suction valve
- Ideal for idling stop/start applications without the need for additional add-on components
- Less weight means reduced CO₂ emissions
- Enhanced performance and scalability for current and future customer requirements
- Supports safety requirements (ISO 26262) and offers new kinds of access and tuning protection

**TASK**
- The high-pressure pump delivers fuel at high pressure to the connected rail.

**VARIANTS**
- The system can be configured with different high-pressure pumps: the options are a fuel lubricated CP4 together with metering unit or electric suction valve, or else an oil-lubricated CP4i plug-in pump. The CP4 consists of a high-pressure element, which is integrated into a housing with its own camshaft. The belt- or chain-driven pump camshaft moves the pump plunger to generate the required high pressure. CP4i is a plug-in pump that does not have its own housing, it is integrated directly into the engine block and is driven, for example, by the engine’s camshaft or crankshaft. Using the optional spring-opened electric suction valve significantly improves filling of the high-pressure pump compared to the metering unit version, particularly in the upper speed range. This permits a reduction in inlet pressure, which enables energy demand to be reduced without affecting the required filling efficiency. A further advantage of the CP4 with electric suction valve is that, for start-stop applications such as restarting after having stopped at a traffic light, it can start even with pressure stored in the rail. This saves engine components from the high stresses to which they are otherwise subjected.

**FUNCTION**
- Thanks to its pressure-balanced solenoid valve, the CRI 2-25 injector enables system pressure to be increased to 2,500 bar. The valve’s fast switching times make it possible to achieve very short injection dwell times, facilitating highly flexible injection patterns for multiple injections. Optionally, a sensor can be integrated into the CRI 2-25, which can then measure characteristic injector variables such as the closing times of the nozzle needle. In addition, the CRI 2-20/-22/-25 injectors have an integrated fuel consumption and emissions.

**FUNCTION**
- The high-pressure rail communicates with the control unit via the attached rail pressure sensor. Its measurement values are used by the pressure control valve design to reduce the noise that can develop. Pressure pulsations are generated in the system during the injection process. The stored high-pressure volume reduces this to a minimum and thereby increases the accuracy of the injection quantity, which goes a considerable way toward reducing emissions and fuel consumption.

**FUNCTION**
- Software inside the electronic control unit processes the incoming system information and controls the various functional groups; the unit networks the individual functions to form an efficient overall system. To do this, it uses a new generation of high-performance microcontrollers. The software platform also guarantees maximum functional flexibility, as the previous-generation application software can be used with AutosarR4-compatible basic software.

**HIGH-PRESSURE PUMPS AVAILABLE**

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP4i</td>
<td>oil-lubricated, without housing</td>
</tr>
<tr>
<td>CP4 with metering unit</td>
<td>fuel-lubricated, with housing</td>
</tr>
<tr>
<td>CP4 with electric suction valve</td>
<td>fuel-lubricated, with housing</td>
</tr>
</tbody>
</table>
2,500 bar

Injection pressure is used by the CRS 2-25 for efficient combustion.

closed-loop control

For optimum combustion throughout the vehicle’s lifetime

**TASK**
Rising fuel prices and changing emissions limits have increased demand for diesel engines as efficient powertrain systems. Bosch’s modular CRS 2 common-rail systems offer performance-optimized solutions that reduce vehicles’ operating costs with their impressive fuel economy. The systems can be used in diesel engines with up to eight cylinders and a wide range of power and torque. In addition, they can be adapted to a large number of engine types. CRS 2 systems have proved themselves in practice, with millions currently in use. The CRS 2-25 system builds on the CRS 2-20 and uses up to 2,500 bar injection pressure. Through this increase and further technical modifications, the system plays an important part in helping vehicles meet current and future emissions targets.

**FUNCTION**
In the common-rail system, the fuel is always provided with the required pressure for injection. The system consists of a high-pressure pump, a high-pressure rail, an injector for each cylinder, and an electronic control system. Injection timing and fuel volume are calculated and controlled individually for each cylinder.

**TECHNICAL CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
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<tbody>
<tr>
<td>Number of engine cylinders</td>
<td>3 to 8</td>
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<tr>
<td>Max. system pressure</td>
<td>2,500 bar</td>
</tr>
<tr>
<td>Max. number of injections per power cycle</td>
<td>8</td>
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<tr>
<td>Min. injection interval</td>
<td>150 µs</td>
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<tr>
<td>Supply voltage</td>
<td>12 V</td>
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<tr>
<td>Contribution to emissions standards compliance</td>
<td>Euro 6 ff.</td>
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<tr>
<td>Service life</td>
<td>300,000 km</td>
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