

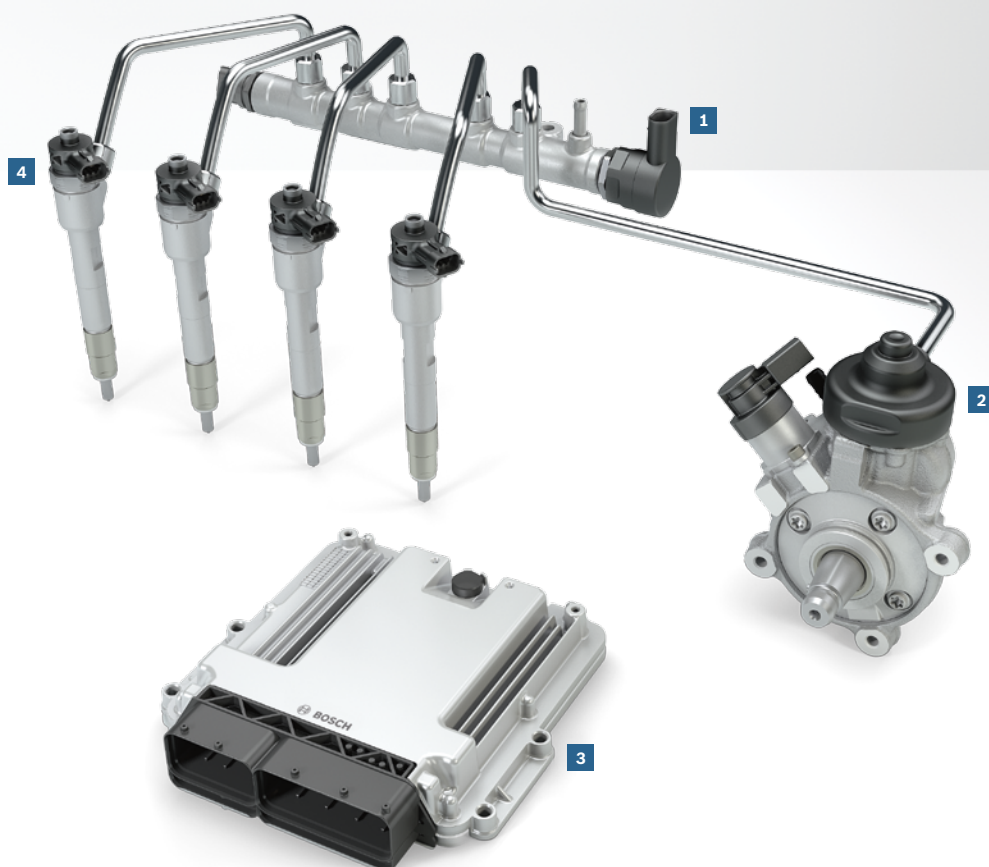
Common-rail injection systems

CRS2-25 diesel common-rail system with solenoid valve injectors and 2,500 bar



BOSCH

Invented for life



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
- ▶ Suitability for Euro 6 ff. and equivalent standards
- ▶ Closed-loop control of injection volume and timing
- ▶ Shorter injection intervals possible

Vehicle segments



- 1** HFR-25 high-pressure rail
- 2** CP4-25/1 high-pressure pump
- 3** MDG1 electronic engine control unit
- 4** CRI2-25 solenoid valve injector

CP4-25 high-pressure pump

up to **2,500** bar

for **high engine power** combined with low fuel consumption

Product benefits

- ▶ Increased hydraulic efficiency with electric suction valve
- ▶ Ideal for idle stop/start applications without the need for additional add-on components

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.

High-pressure pumps available

CP4i	Oil-lubricated, without housing
CP4 with metering unit	Fuel-lubricated, with housing
CP4 with electric suction valve	Fuel-lubricated, with housing

CRI2-25 solenoid valve injector

up to **8**

individual injections for quieter combustion plus reduced fuel consumption and emissions

Product benefits

- ▶ Extremely short injection dwell time possible
- ▶ Lower fuel consumption and emissions
- ▶ Reduced noise

Task CRS2-25 are built around fast-switching solenoid valve injectors with short injection dwell times, which inject the optimum amount of fuel for the driving situation into the cylinders, thereby ensuring clean and economical combustion. The second-generation, high-performance solenoid valve injectors allow a high degree of freedom when designing the injection pattern and permit up to eight individual injections per power cycle. These multiple injections reduce the engine's fuel consumption as well as its CO₂, pollutant, and noise emissions.

Function Thanks to its pressure-balanced solenoid valve, the CRI2-25 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 CRI2-25, which can then measure characteristic injector variables such as the closing times of the nozzle needle. In addition, the CRI2-20/-22/-25 injectors have an integrated high-pressure volume that reduces pressure pulsations and also increases hydraulic efficiency through reduced return flow.

HFR-25 high-pressure rail

over **60,000**

pressure checks a minute for optimum fuel injection control

Product benefits

- ▶ Less weight means reduced CO₂ emissions
- ▶ Extreme pressure resistance thanks to high-tech manufacturing technologies

Task As a key hydraulics component connecting the pump and the injectors, the high-pressure rail lends its name to the common-rail system. It stores the fuel and supplies it to the solenoid valve injectors.

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 to regulate system pressure. A new pressure control valve design reduces 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.

Electronic engine control unit

Reduced **emissions**

to meet current and future requirements of exhaust gas legislation worldwide.

Product benefits

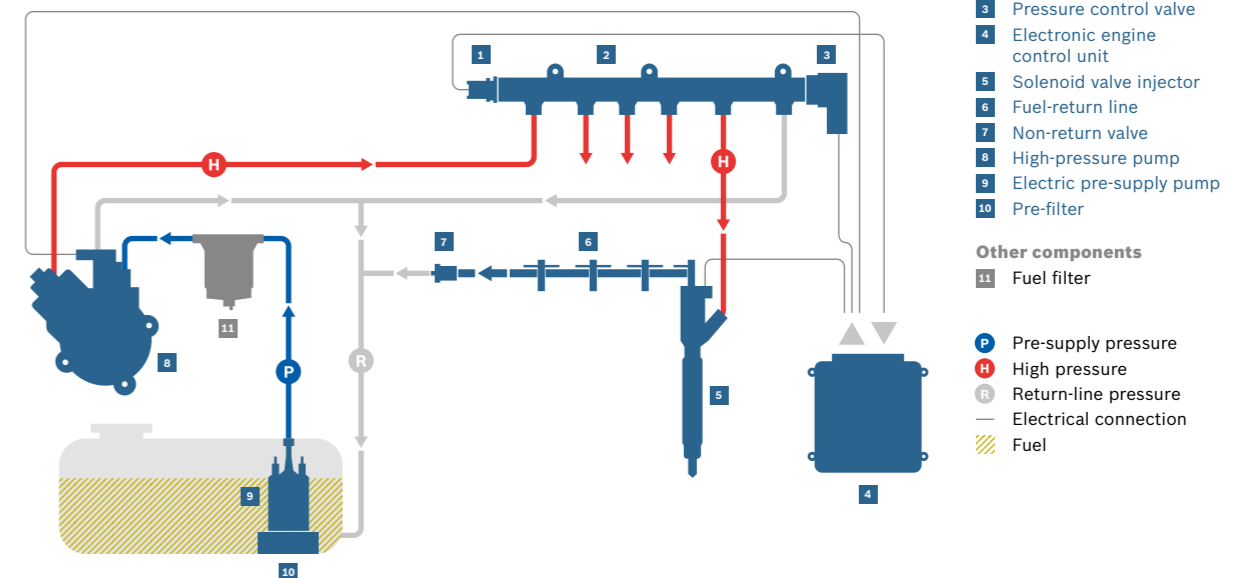
- ▶ Enhanced performance and scalability for current and future customer requirements
- ▶ Supports safety requirements (ISO 26262) and offers new kinds of access and tuning protection

Task The electronic engine control unit is the heart of the engine management system. It controls fuel supply, air control, fuel injection, and ignition. In addition, it is able to actuate the exhaust system, the gears, and/or vehicle functions. The electronic engine control unit was developed for use in diesel and gasoline engines as well as for those using alternative fuels.

Function Software inside the electronic engine 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.

CRS2-25 common-rail system

The individual components in a networked system



2,500 bar

injection pressure is used by the CRS2-25 for efficient combustion.

Closed-loop control

for **optimum combustion** throughout the vehicle's lifetime

Task Rising fuel prices and more stringent emissions limits have increased demand for diesel engines as economical, environmentally friendly drive systems. Bosch's modular CRS2 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. CRS2 systems have proved themselves in practice, with millions currently in use. The CRS2-25 system builds on the CRS2-20 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

Number of engine cylinders	3 to 8
Max. system pressure	2,500 bar
Max. number of injections per power cycle	8
Min. injection interval	150 µs
Supply voltage	12 V
Emissions standards compliance	Euro 6 ff.
Service life	300,000 km