

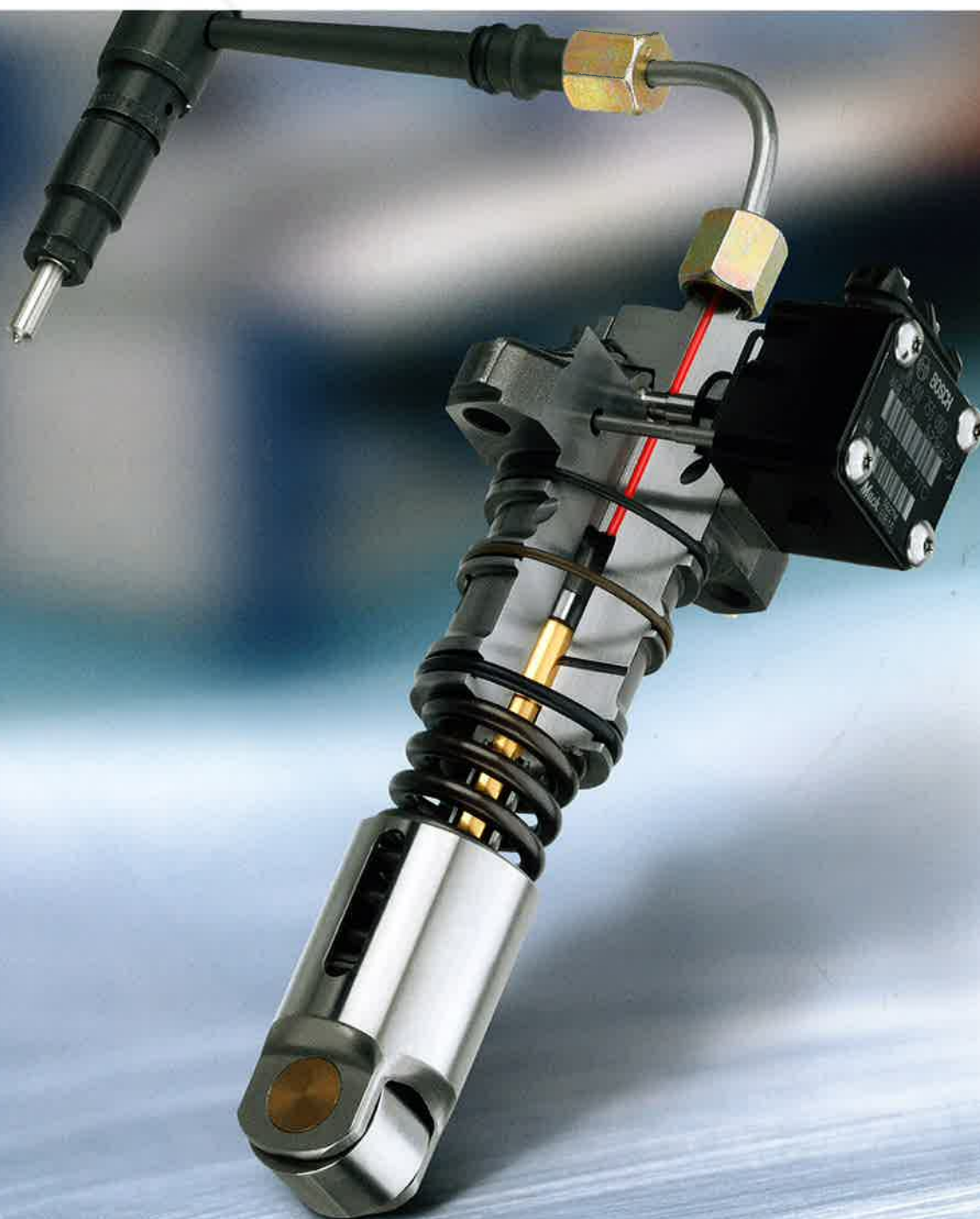
Diesel Systems

# Unit Pump System for commercial-vehicle diesel engines



**BOSCH**

Invented for life



## High pressure for **improved fuel economy** and **lower emissions**

The Unit Pump System UPS relies on an electronically controlled injection concept featuring an individual pump assigned to each of the engine's cylinders. This Unit Pump consists of the high-pressure pump with its integral solenoid valve, a short injection line, an injection line fitting, and a conventional nozzle-holder assembly. This design provides the following advantages:

- ▶ High injection pressures extending up to 2,200 bar
- ▶ No need to redesign cylinder heads originally conceived for use with injection systems featuring in-line or distributor pumps
- ▶ Simple pump replacement translates into ease of service



The pump is driven directly by a lobe on the engine's camshaft. A roller tappet transfers the lobe's lift to the pump's plunger. Because the system dispenses with rocker arms, it provides extremely rigid and positive force transfer.

The pump plunger's high delivery rate generates an ongoing pressure rise that continues throughout the entire duration of the injection.

The fuel is metered by integral high-speed solenoid valves. The solenoid valve's closing point defines injection timing (beginning of injection), while its activation duration determines the injected fuel quantity. The engine-mounted ECU processes and analyzes all engine and environmental data of relevance for system operation and triggers the solenoid valves.

The following system assets contribute to environmentally-friendly and extremely economical engine operation:

- ▶ Variable injection timing (start of injection)
- ▶ Variable injection duration
- ▶ Extreme latitude in adaptation to a wide range of engine operating conditions
- ▶ Adaptive correction capabilities for individual cylinders

In addition to the Unit Pump with its high-pressure supply line and nozzle-holder assembly, this inexpensive system also includes:

- ▶ The low-pressure fuel-supply circuit with its supply pump, fuel filter and pressure-control valve
- ▶ The ECU with its sensor network and diagnosis facilities

# Electronic Diesel Control EDC



## The ECU

- ▶ Freely selectable start of injection: Low fuel consumption, and low levels of exhaust and noise emissions in all engine-load ranges
- ▶ Real-time control: Start of injection
- ▶ Auxiliary functions: Exhaust-gas recirculation, boost pressure control, cylinder shutoff, vehicle-speed control, immobilizer and others
- ▶ Extensive safety concept with several redundant control loops

- ▶ Flash-EPROM for version-specific EOL programming
- ▶ Integration in the vehicle-diagnosis system complies with OBD On-Board Diagnosis and EOBD (European OBD) regulations
- ▶ Integrated diagnosis: Sensor monitoring, malfunction recognition
- ▶ CAN interface
- ▶ Processing of analog, digital and pulse-shaped input signals

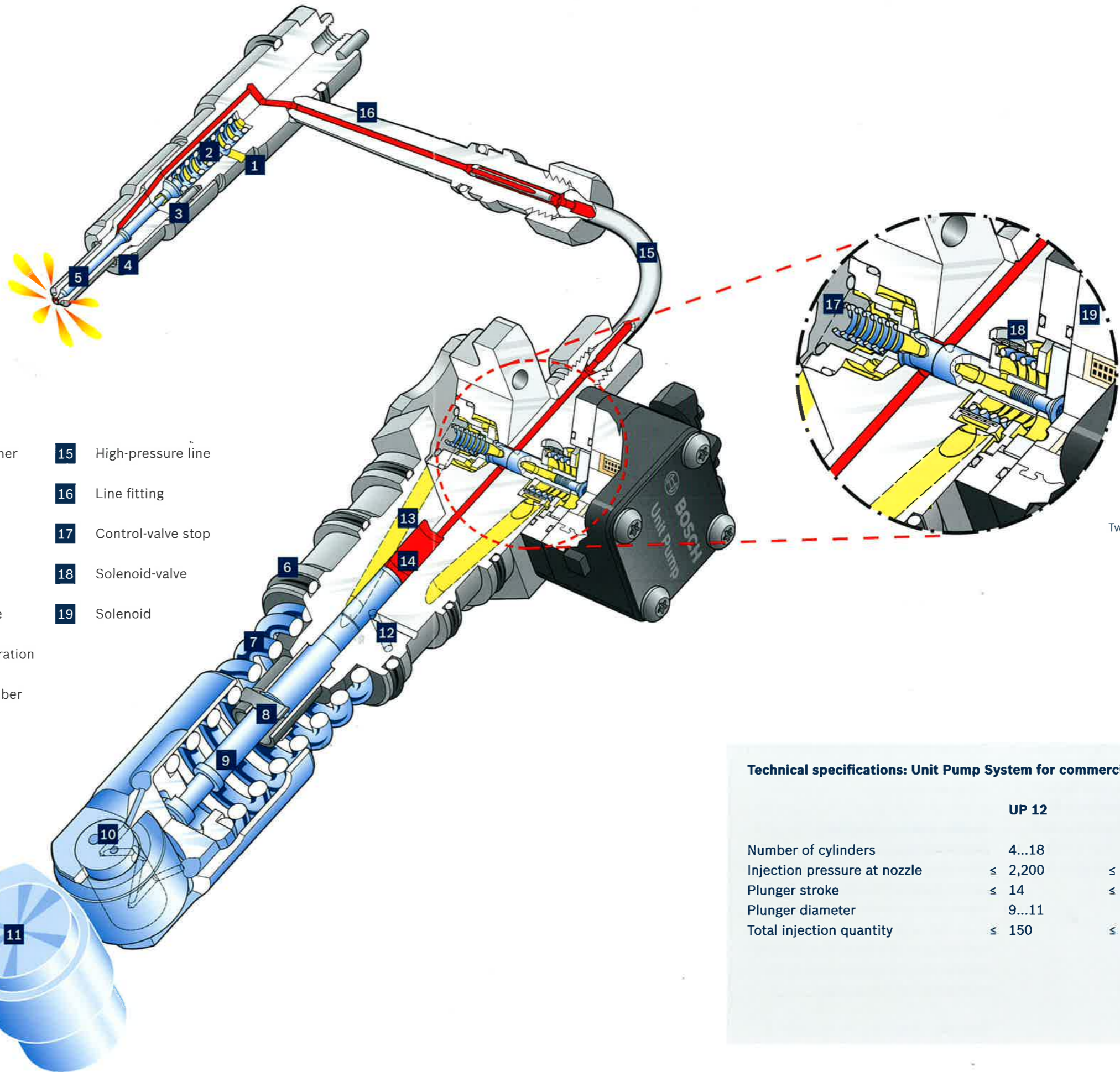
## The sensors

- ▶ Register all relevant operating and environmental conditions, as well as the driver's wishes



EDC 7 electronic control unit

# Unit Pump



- |                     |                             |                       |
|---------------------|-----------------------------|-----------------------|
| 1 Leak-fuel passage | 8 Pump-plunger retainer     | 15 High-pressure line |
| 2 Nozzle spring     | 9 Pump plunger              | 16 Line fitting       |
| 3 Locating pin      | 10 Roller tappet            | 17 Control-valve stop |
| 4 Retaining nut     | 11 Cam lobe                 | 18 Solenoid-valve     |
| 5 Injection nozzle  | 12 Fuel-supply passage      | 19 Solenoid           |
| 6 Seal              | 13 High-pressure generation |                       |
| 7 Tappet spring     | 14 High-pressure chamber    |                       |

Unit Pump for direct-injection commercial-vehicle diesel engines

## Technical specifications: Unit Pump System for commercial vehicles

	UP 12	UP 20
Number of cylinders	4...18	4...18
Injection pressure at nozzle	≤ 2,200	≤ 2,200 bar
Plunger stroke	≤ 14	≤ 18 mm
Plunger diameter	9...11	10...12 mm
Total injection quantity	≤ 150	≤ 400 mm <sup>3</sup> /stroke

# High-pressure generation and injection

## Injection

- ▶ High-speed, electronically controlled high-pressure solenoid valve
- ▶ Two-stage solenoid activation for shaping injection discharge rate
- ▶ Electronically controlled start of injection
- ▶ Ultra-rapid and precise switching for exact control of injected fuel quantities
- ▶ Pressurization initiated through activation of the solenoid valve
- ▶ Start of injection when the 300 bar nozzle-opening pressure is reached
- ▶ Pump plunger with high delivery rate: Continuous pressure rise throughout the complete injection process
- ▶ End of injection by switching off the solenoid valve
- ▶ Peak pressure is reached at the end of the injection

Unit Pump Systems permit precision injection, with variable duration, throughout the complete engine operating map. On the bottom line, the resulting injection discharge rate and high injection pressures lead to even more efficient combustion. This stands for more power, improved fuel economy, and lower exhaust and noise emissions.

## High-pressure generation

- ▶ Injection system with a modular injection pump for each cylinder
- ▶ Installation in the side of the engine block
- ▶ Pump plunger is driven directly by the engine camshaft and a roller tappet
- ▶ Pressure in the nozzle up to 2,200 bar
- ▶ Application for engines with up to 92 kW output per cylinder



# Bosch injection systems make the diesel engine **cleaner** and **more economical**

Bosch engineers never let up in their search for innovative system concepts. The success of these endeavors speaks for itself: With regard to patented inventions, Bosch has been one of the world's leaders for decades.

**Fuel-injection systems** – The extensive Bosch range of diesel injection systems has a precision-aligned injection system available for every application – for passenger cars, commercial vehicles, prime movers, ships, or agricultural machines.

**Mechanical and electronic control systems** – Whereas, for decades, mechanical (flyweight) governors proved their reliability and precision on inline injection pumps, the Electronic Diesel Control EDC has now come to the forefront in order to comply with requirements for minimum fuel consumption and emissions.

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**Distributor injection pumps** – Bosch is already producing its 4th generation of distributor injection pumps. Due to its compact design and low weight, this pump is ideal for small, high-speed diesel engines.

**Single-plunger pump systems** – Single-plunger pump systems guarantee precision metering of fuel to each cylinder. The Unit Injector System UIS combines pumping element and nozzle in a single unit. The Unit Pump System UPS connects pump and nozzle with a short injection line.

**Common Rail System** – Accumulator-injection, or Common Rail Systems CRS, open up new possibilities for the reduction of fuel consumption and emissions. Pressure generation and injection are decoupled from each other, so that the engine designer has more latitude in improving the combustion process.

**Nozzles and nozzle holders** – Bosch is continually improving injection nozzles as an essential component in the injection system. Here, the multi-orifice nozzle with optimized orifice shapes is a concept targeted for the future. The two-spring nozzle holder considerably reduces the combustion noise by injecting the fuel in two stages.

**Sensors** – Since the introduction of electronic engine management, Bosch has been pushing ahead with the development of cost-effective,

reliable, and highly accurate sensors. These provide the information needed for high-performance diesel control.

**Starting systems** – Employing starting systems from Bosch modern diesel engines start even faster while producing less noise and emissions. The new low-voltage systems adapt the heating exactly to the engine's requirements. The DuraSpeed ceramic glow system permits an immediate cold start similar to that of a gasoline engine even at temperatures of  $-28^{\circ}\text{C}$ . Combined with an optimized injection strategy this leads to an excellent engine smoothness of the cold engine.

**Fuel filters** – Even the most minute contamination in the fuel can impair the function of injection pump and nozzles. Bosch high-performance single-stage, multi-stage and parallel filters are precisely suited to every injection system.

**Emissions reduction** – SCR catalytic converters with the Bosch Denoxtronic reduction-agent metering system can reduce  $\text{NO}_x$  emissions by up to 85%. They allow for an engine design focused on fuel economy, saving up to 5% fuel compared to other EU 4 applications, and reducing  $\text{CO}_2$  emission accordingly. In combination with the SCR catalytic converter, combustion measures (increased combustion temperature) can reduce particulate emission with EU 4 applications by up to 40%.