

Diesel in-line fuel-injection pumps

Mobility in this day and age is not least of all a question of common sense and economy.

In future, the technology without which these considerations regarding individual mobility are meaningless will continue to be of decisive importance.

In the automotive sector, economical and quiet-running diesel engines are making history.

Bosch in-line and distributor injection pumps have played, and continue to play, a major role in these developments. The introduction of electronic controls (Electronic Diesel Control/EDC), together with increased injection pressures and even more precise fuel metering, has made it possible to further increase the diesel engine's service life, as well as reducing its exhaust-gas emissions, while at the same time even further improving its fuel-economy figures.

In this "Technical Instruction" manual, from the Diesel Fuel Injection series, you have access to a wealth of information on a variety of different fuel-injection pumps, as well as on important components and their functioning. These components include for instance, the delivery-valve assemblies and the plunger-and-barrel assemblies.

The appropriate governors for the PE in-line injection pumps are dealt with in the Technical Instruction manual "Governors for Diesel In-Line Fuel-Injection Pumps".

Combustion in the diesel engine

The diesel engine 2

Diesel fuel-injection systems: An overview

Fields of application 4
 Technical requirements 4
 Injection-pump designs 6

PE in-line fuel-injection pumps

Fuel-injection systems 8
 Fuel-injection techniques 9
 PE standard in-line fuel-injection pumps 16
 PE in-line fuel-injection pumps for alternative fuels 26
 PE in-line control-sleeve fuel-injection pumps 27
 Fuel supply and delivery 30
 Operation of the in-line fuel-injection pump 36
 Nozzles and nozzle holders 40

Single-plunger fuel-injection pumps

PF single-plunger fuel-injection pumps 48
 PF-MV solenoid-valve-controlled single-plunger fuel-injection pumps 52
 Innovative fuel-injection systems 54

Start-assist systems

56

PE standard in-line fuel-injection pumps

Design and construction

The standard PE in-line injection pumps incorporate their own camshaft, and a plunger-and-barrel assembly (pumping element) for each engine cylinder (Fig. 1).

The complete fuel-injection system is comprised of:

- A fuel-injection pump,
- A mechanical (flyweight) or electronic governor for control of engine-speed and injected fuel quantity,
- A timing device (if required) for varying the start of delivery as a function of engine speed,
- A fuel-supply pump for delivering the fuel from the fuel tank, through the fuel filter and the fuel line, to the injection pump,

- A number of high-pressure fuel-injection lines, corresponding to the number of engine cylinders, connecting the injection pump and the injection nozzles,
- The injection nozzles.

The injection pump's camshaft is driven by the diesel engine. Injection-pump speed and crankshaft speed are identical for 2-stroke engines. For 4-stroke engines, pump speed is the same as engine camshaft speed, in other words half crankshaft speed.

The drive between injection pump and engine must be as torsionally rigid as possible if today's high injection pressures are to be generated.

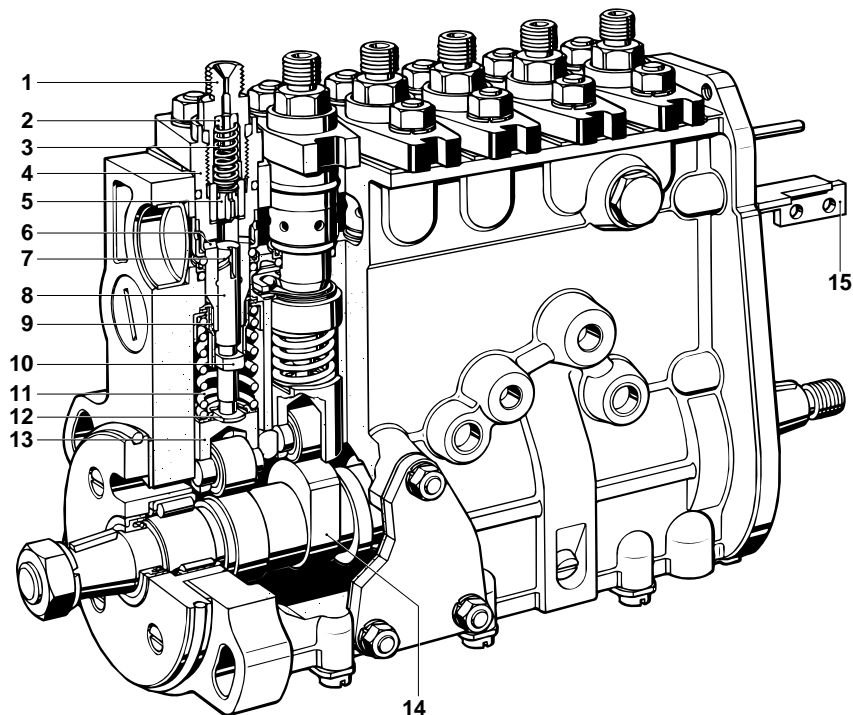
There are a number of different sizes of in-line injection pumps for the various engine outputs.

The injected fuel quantity depends upon the swept volume of the injection-pump barrel, and maximum (pump-side) injection pressures are between 400 and 1,150 bar.

Fig. 1

PES in-line fuel-injection pump

1 Delivery-valve holder, 2 Filler piece, 3 Delivery-valve spring, 4 Pump barrel, 5 Delivery valve, 6 Inlet port and spill port, 7 Control helix, 8 Pump plunger, 9 Control sleeve, 10 Plunger control arm, 11 Plunger return spring, 12 Spring seat, 13 Roller tappet, 14 Cam, 15 Control rack.



To lubricate the moving injection-pump components (e.g. camshaft, roller tappets etc.) there must be a certain amount of oil in the injection pump. The injection pump is connected to the diesel engine's lube-oil circuit, and oil circulates through the pump during operation.

Each pump type is allocated to a given type series, which in some cases overlap with respect to their power ranges. These will be described in the following chapters.

Two different construction principles are used for in-line injection pumps: The principle for the M and A pumps, and that for the MW and P pumps.

The power outputs of diesel engines equipped with in-line injection pumps range from 10 to 70 kW per cylinder. This broad power-output range is made possible by the availability of a wide variety of different pump versions. The pump sizes

A, M, MW, and P are manufactured in large batches (Fig. 2).

The pump sizes ZW, P9, and P10 are available for even higher cylinder power outputs.

Method of operation

Interaction between the components

The camshaft of the PE in-line injection pump is integrated in the aluminum pump housing. It is connected to the diesel engine either through a timing device, through a coupling element, or directly. A roller tappet with spring seat is located above each camshaft cam. The spring seat provides a positive-drive connection between pump plunger and roller tappet. The pump plunger moves up and down in the pump barrel, and together these two components form the plunger-and-barrel assembly (pumping assembly).

Standard in-line fuel-injection pumps

Tab. 1

Overview

Features	PE in-line injection pumps				
	M	A	MW	P1...3000	P7100...8000
Injection pressure in bar (pump side)	550	750	1100	950	1300
Application	Passenger cars and vans	Light to medium commercial vehicles, tractors, industrial engines.			Heavy commercial vehicles, industrial engines.
Output per cylinder in kW/cylinder	20	27	36	60	160

Fig. 2

