



# Diesel Emissions and Their Control

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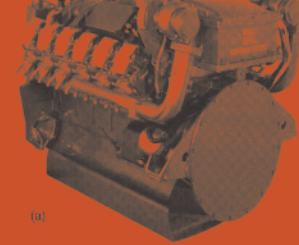
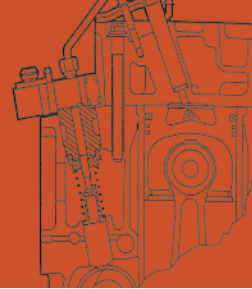
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...can be difficult to manage and may cause erratic injection behavior at the nozzle. In their desire to avoid line dynamics complications, designers strive to keep the total line length as short as possible. In many cases this objective may not be possible to accomplish. One such case is large marine and stationary power plants where the sheer size of the engine would prohibit the feasibility of short injection lines. Examples of this type of application are given in Figures 4.10a and b, which show the DDC/MTU Series 2000 and MTU/DDC Series 4000 engines, respectively [6]. In such cases unit pump systems are used to

maintain short injection lines between the pump and injector. Each unit pump is installed on the engine in proximity to the cylinder it serves and is driven by the camshaft of the engine. High-pressure pumping elements consisting of plunger and barrel combinations are made of high-strength tool steel, and extremely close tolerances are kept between the sliding rotating parts. Such high-precision machining is required throughout the mechanical components of the injection system to maintain accurate metering and injection timing within a 1-degree crankangle while maintaining extremely high pressures. The cost of such fuel systems is rather high and is difficult to justify

Figure 4.9 Bosch unit pump diesel fuel injection system. (Reprinted from Ref. 3, courtesy of Robert Bosch GmbH.)



Figure 4.10 Two large displacement engines with unit pump injection system: (a) DDC/MTU Series 2000; (b) MTU/DDC Series 4000. (Courtesy of MTU Diesel Engines.)

- 1 Pressure control valve, 2 Governor assembly, 3 Drive line section, 4 distributor based with high-pressure pump, 5 Tank-type fuel supply, 6 Timing device, 7 Fuel plunger, 8 electromagnetic shut-off valve

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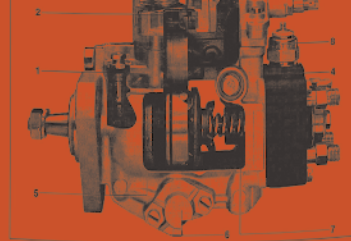
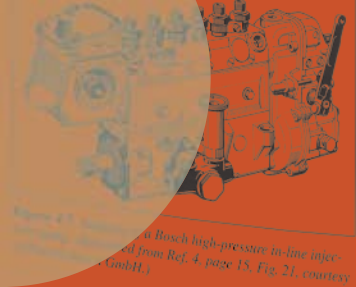


Figure 4.8 Details of a Bosch distributor injection pump. (Reprinted from Ref. 5, page 151, Fig. 3, courtesy of Robert Bosch.)

fuel is then introduced into a commutator heat or distributor assembly that diverts it to the proper injector and cylinder according to the engine firing order. Reducing the number of pumping elements for a multicylinder diesel engine application to only one reduces the cost of the expensive high-precision machined parts of the pumping element and, hence, makes its cost more reasonable for the small car market.

#### 4.4.1 The P-I-N In-Line Pump System

The in-line pump injection system is one of the oldest and proven systems for diesel engines. Reference is made to Figure 4.4 for the description of its components. To start with, the system is divided into low-pressure and high-pressure subgroups. The low-pressure side of the system includes the following components:

- Fuel filter
- Fuel decelerator

The fuel tank is a reservoir that holds the fuel and helps maintain its temperature at a level suitable for fuel pump operation. The fuel tank is also where heated oxygenated fuel passes through a fuel filter as well as the leak off fuel from a common rail system. The expanded surface area of the tank, along with its design, generally transfers heat away from the fuel. The fuel supply pump, often referred to as the lift pump, is responsible for drawing fuel from the tank and delivering it to the high-pressure pump. Although this may be its primary function, it is also capable of flowing a large quantity of fuel to maintain a constant temperature along its path through the galleries to the high-pressure pump. This feature is quite important since

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