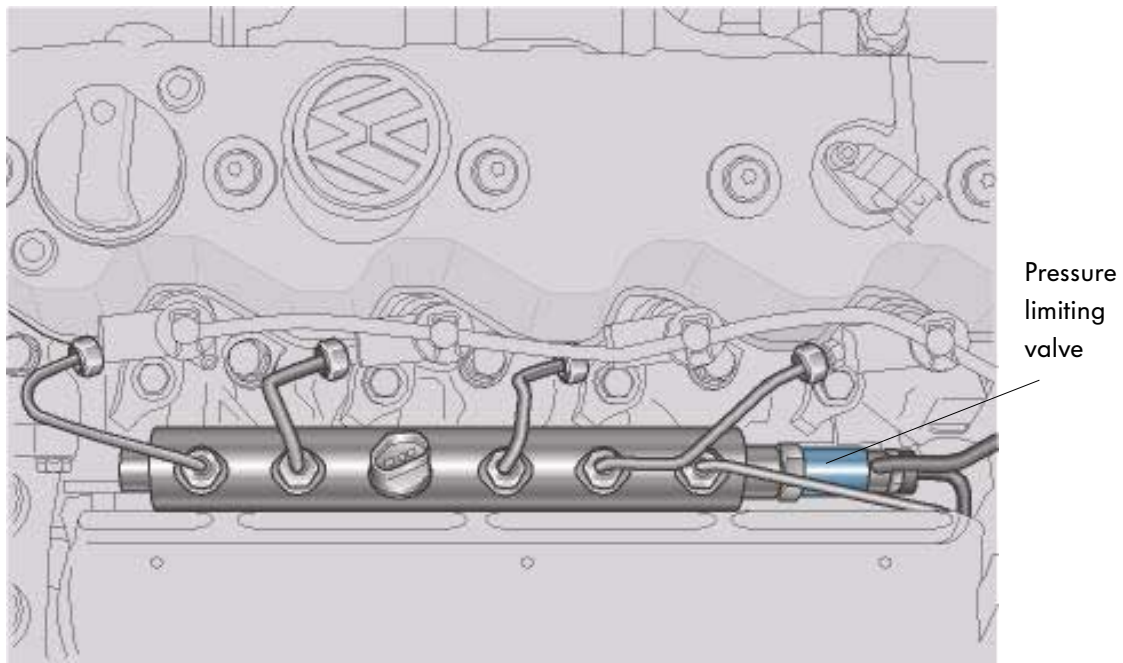
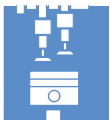


Common rail injection system

Pressure limiting valve

The pressure limiting valve is located directly on the high-pressure fuel rail. Its function is to limit maximum pressure in the high-pressure fuel rail and protect the high-pressure fuel rail from overload.



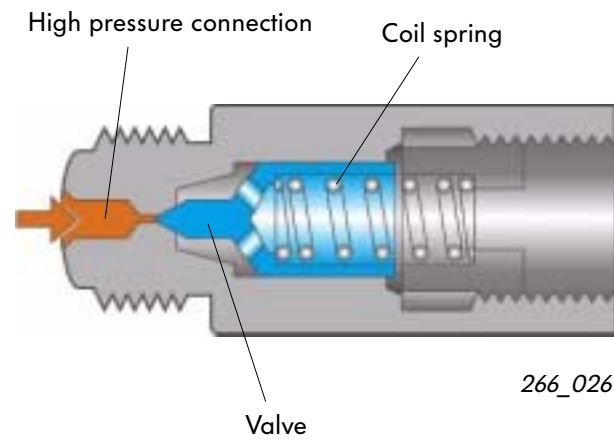
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If the pressure inside the high-pressure fuel rail exceeds the maximum pressure of 1450 bar, the pressure limiting valve opens and the excess fuel flows to the return line. Comparison: 1450 bar is the rough equivalent of the weight of a mid-range car pressing on a surface area of one square centimetre.

Design

The pressure limiting valve is a purely mechanical component. The connection to the high-pressure fuel rail is a threaded fitting. Inside is a valve with drillings. The valve is retained in its seat by a compression spring.

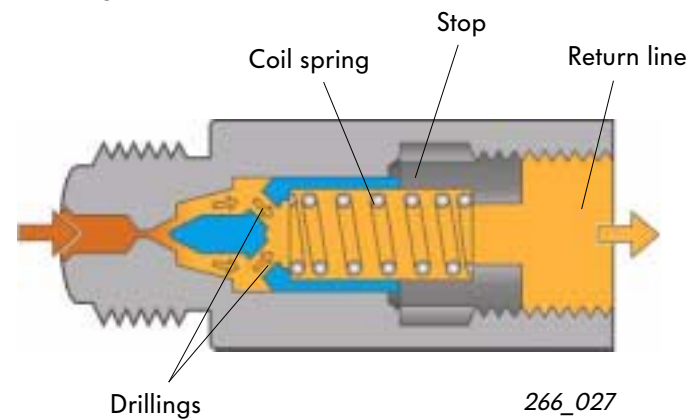
Valve closed



Function

If the fuel in the high-pressure fuel rail exceeds 1450 bar, the valve opens. Fuel can now escape from the high-pressure fuel rail and run into the return line via the drillings. Pressure in the high-pressure fuel rail drops.

Valve open



Common rail injection system

Injection

The fuel is injected in the combustion chambers by electromagnetically controlled injectors. To achieve the most efficient combustion possible, injection is divided into a preinjection phase and a main injection phase.

Preinjection phase

Before the pistons reach top dead centre (TDC), a small amount of fuel is first injected into the combustion chamber. This causes a rise in temperature and pressure in the combustion chamber.

The purpose of this is to shorten the firing delay of the main injection phase and therefore reduce pressure rise and pressure peaks.

The advantages of the preinjection phase are:

- low combustion noise
- low exhaust emissions

The injectors are actuated once for preinjection phase and once for the main injection phase by the diesel direct injection system control unit.

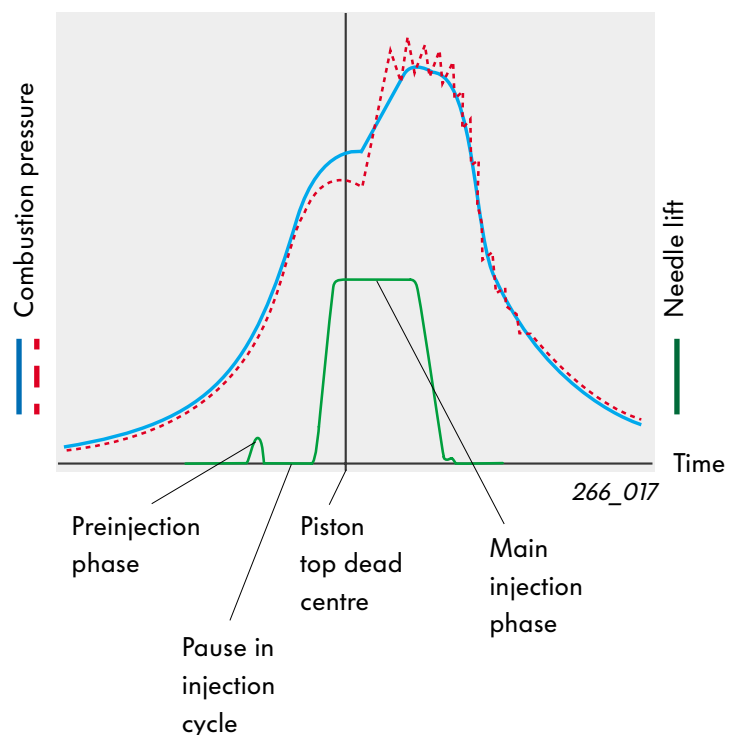
Main injection phase

After precombustion and after a short pause in the injection cycle, the main injection quantity is injected into the combustion chamber.

The level of the injection pressure remains almost identical during the entire injection cycle.

Difference in pressure curve of combustion with and without preinjection phase

- Pressure curve with preinjection phase
- - - Pressure curve without preinjection phase
- Needle lift with preinjection phase



Injectors

The injectors are fitted in the cylinder head.

Their function is to inject the right amount of fuel at the right time into the combustion chambers. They are therefore actuated by the diesel direct injection system control unit.

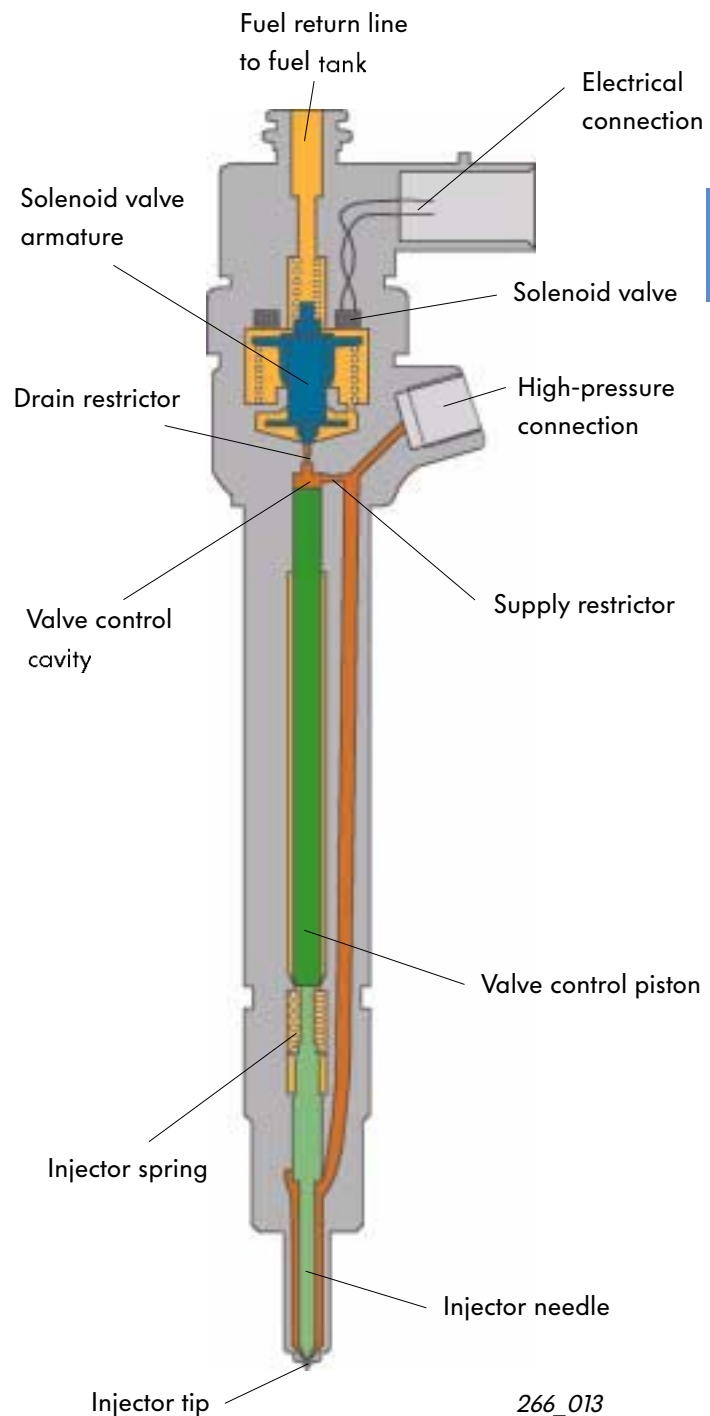
Resting position

In its resting position, the injector is closed.

The solenoid valve is not actuated.

The solenoid valve armature is pressed into its seat by the force of the solenoid valve spring. The injector needle is closed by the high pressure of the fuel due to the high ratio of the control piston surface area in relation to the injector needle.

Design



Any interruption in the electrical lead to an injector or in a solenoid valve will cause the engine to shut down.

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Common rail injection system

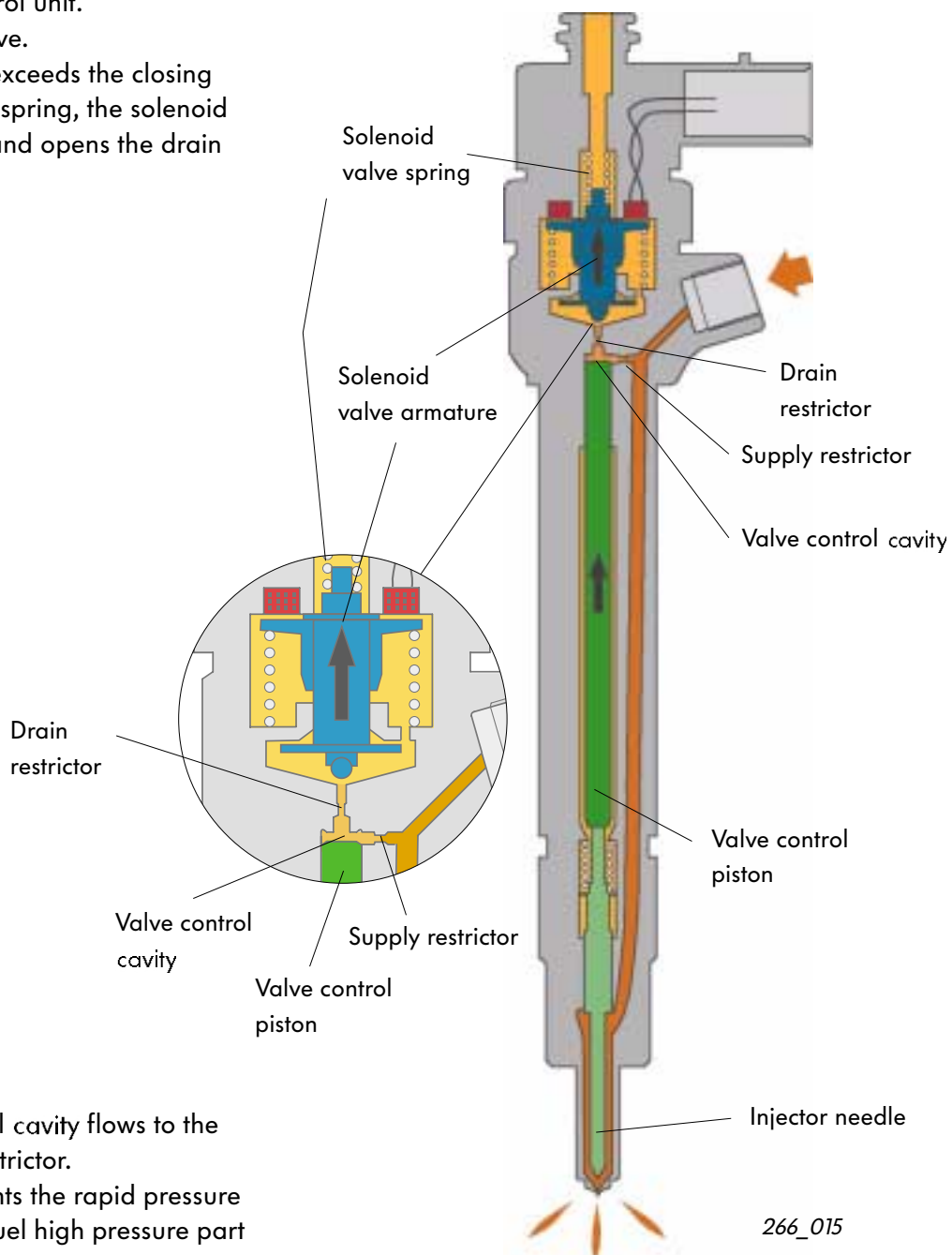
Function

Start of fuel injection

The start of fuel injection is initiated by the diesel direct injection system control unit.

It actuates the solenoid valve.

When the magnetic force exceeds the closing force of the solenoid valve spring, the solenoid valve armature moves up and opens the drain restrictor.



The fuel in the valve control cavity flows to the return line via the drain restrictor.

The supply restrictor prevents the rapid pressure equalisation between the fuel high pressure part and the valve control cavity

The pressure acting on the valve control piston is lower at this moment than the fuel high pressure that is acting on the injector needle.

This raises the injector needle and injection begins.

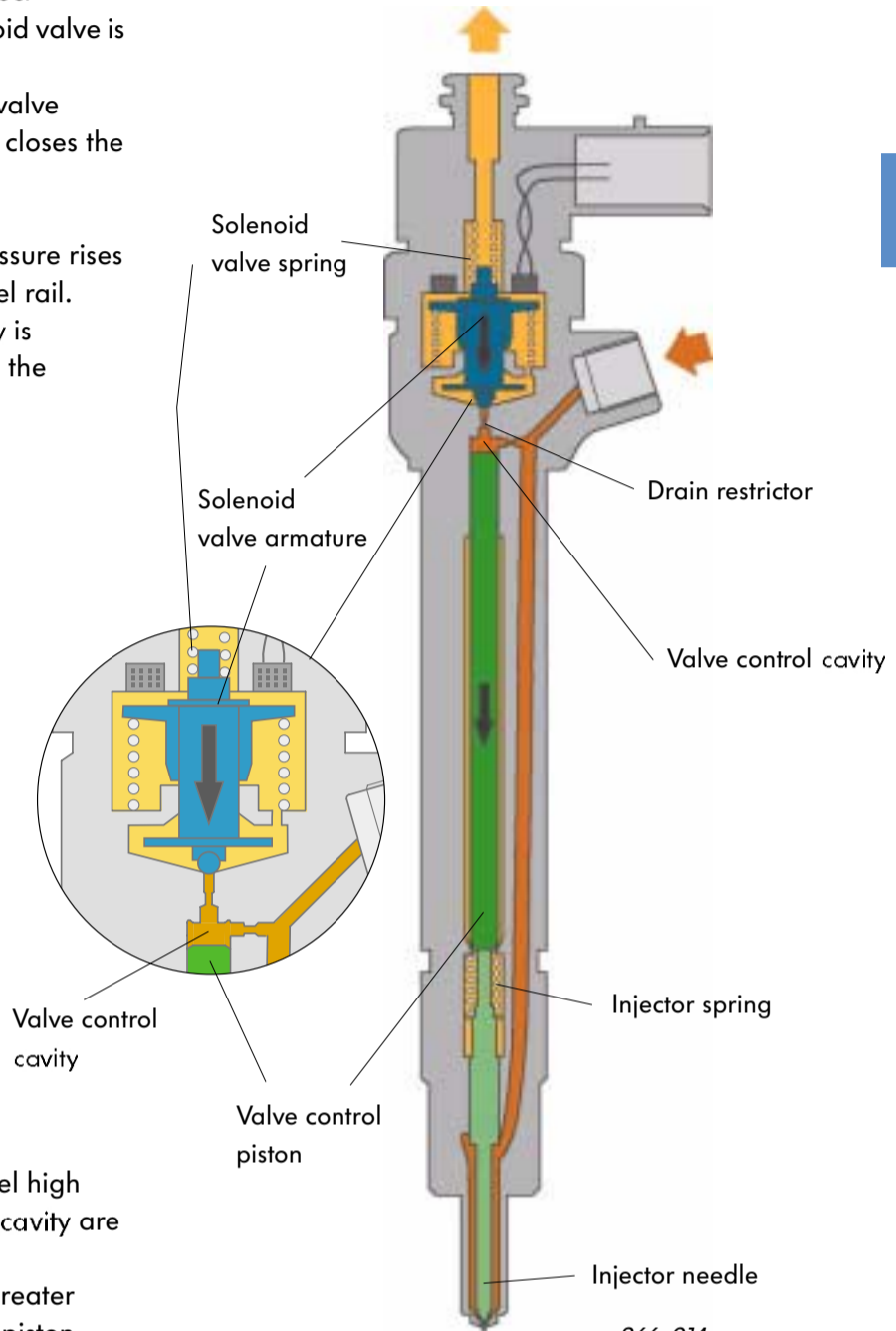
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End of injection

The injection cycle ends when the solenoid valve is no longer actuated by the diesel direct injection system control unit. The solenoid valve is deenergised.

The valve spring presses the solenoid valve armature back into the valve seat and closes the drain restrictor.

In the valve control cavity the fuel pressure rises to the pressure in the high-pressure fuel rail. The pressure in the valve control cavity is therefore exactly the same again as in the injector needle.



This means that the pressures in the fuel high pressure part and in the valve control cavity are again equal.

The injector needle closes due to the greater surface pressure acting on the control piston. The injection cycle ends and the injector reverts back to its resting position.



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