

# Testing Common Rail Fuel Systems

Whenever Common Rails develop a problem, it's vital to check their high- and low-pressure circuits. To this end, the diesel specialists at Bosch have developed a whole number of test instruments.



Measuring return quantities exposes defective Common Rail injectors.  
Photo: Linzing

As with every electronically controlled vehicle system, service diagnostics on diesel engines with Common Rail injection begin with readouts of the fault store and analyses of their data. If electrical problems are detected, they need to be checked for plausibility and fixed in line with manufacturer specifications.

Symptoms and fault recordings indicating a malfunction in the fuel system require tests of the low- and high-pressure circuit prior to component replacements. These tests prove helpful in the majority of cases, even when an ECU shows no fault entries at all despite poor engine performance. Determining which part of the system to test first – the high- or the low-pressure circuit – depends on the nature of the problem and on

accessibility to the fuel system. Either way, the specialist should always remember that irregularities in the low-pressure circuit directly affect the generation of high pressure. Prior to opening the fuel system, workshop experts also need to observe all sanitary guidelines regarding the treatment of high-pressure diesel systems. That's because even the tiniest of dirt particles entering a fuel system can result in costly damage.

## Testing Low-pressure Circuits

The low-pressure circuit comprises the fuel line from the fuel tank to the high-pressure pump and fuel return. The first step is to check all lines for air tightness or damage, as well as the condition of the fuel filter. If the

pressures measured before and after the filter show a difference greater than 0.3 bar, then the fuel filter needs to be replaced.

The next step for the specialist is to test the pressure in the forward delivery and return of fuel by means of a proper manometer and to compare them to manufacturer specifications. The forward-delivery pressure is measured in the line between the fuel filter and the high-pressure pump. Electric fuel pumps have to supply pressure ranging from 2.0 to 2.5 bar during the start-up. Systems using gear pumps (CP1 H and CP3) should deliver pressure between -0.10 and -0.20 bar in forward delivery. In first-generation Common Rails, the fuel return pressure is the decisive factor in opening the safety valve in



Diesel Set 1 contains dial gauges and a variety of adapters for testing the low-pressure circuit.  
Photo: Bosch

the high-pressure pump. It is measured between the return collection pipe and the fuel tank and should deliver between 0.6 and 0.9 bar. Third-generation Common Rails with Bosch piezo injectors deliver a return pressure of 10 bar. This pressure determines the proper operation of the injectors.

For all low-pressure circuit tests, Bosch offers Diesel Set 1. This very universal test box provides workshop experts with a variety of testing adaptations for low-pressure circuits of virtually all Common Rail systems on the market. The Y-adapters of the test set have a transparent fuel line allowing workshop experts to see whether fuel is sent to a high-pressure pump without any bubbles.

### High-pressure Testing

In order to allow vehicle specialists at the diesel service to diagnose the condition of high-pressure pumps and Common Rail pressure sensors without removing them in the course of diesel service, Bosch has developed Diesel Set 3. It enables them to test the performance of high-pressure pumps during start-up in real conditions. They can also use it to measure Common Rail pressure regardless of ECU diagnostics when the engine is running. Diesel Set 3 consists of a pressure sensor module, a pressure sensor and a digital pressure display. The set also comes with special high-pressure test lines and numerous flexible adaptations

for virtually all systems on the market. Testing the high-pressure pump during start-up is especially useful when dealing with start problems. In this case, a test line is used to connect the pressure sensor module directly to the outlet of the high-pressure pump and then the engine is started. After a few seconds, the workshop expert can read the actual pressure on the display unit. An intact high-pressure pump by Bosch should have a pressure greater than or equal to 250 bar. The pressure sensor module has an overflow valve limiting pressure to 500 bar. Along with the overflow valve, the module also comes with an installed calibrated leakage throttle simulating the fuel intake of



Diesel Set 3 makes it possible for vehicle experts to measure Common Rail pressure. That way, they can even detect defects not captured by self-diagnosis.  
Photo: Bosch

the injectors as the engine is started. That way, the module measures not only the pressure of the high-pressure pump, but also its pump capacity at starting speed.

Testing Common Rail pressure with Diesel Set 3 involves removing the high-pressure delivery line of an easily accessible injector and connecting the pressure sensor directly to the Common Rail via a test line. A pressure connection for the injector is available as an option. After starting the engine, the workshop expert can compare the displayed pressure readout with the corresponding actual value from the ECU diagnosis and thereby test the high-pressure sensor. If the actual value and the measured Common Rail pressure differ from each other, then the Common Rail pressure sensor needs to be replaced.

#### Comparing Leak-fuel Quantities

The software of the KTS Diagnosis Testers of Bosch contains very practical functional tests that workshop experts can utilize for customer requests to diagnose defective injectors. Before an injector is replaced, however, the results of the ECU diagnosis always have to be checked for plausibility by performing a leak-fuel quantity comparison test. For the latter, Bosch offers a leak-fuel-quantity measuring device for easy

mounting in the engine compartment. This device comprises small double-tier test tubes embedded in a solid plastic block. Bosch piezo injectors require an additional special adaptation with pressure-holding valves that maintain a pressure of ten bar in the return lines.

The quantity-measuring device is directly hooked up to the return connection of the injectors. When removing the return line on the injector, be careful not to damage the connection. Disconnecting the line to the fuel injector also requires proper means of doing so without damaging it. Once the return-quantity measuring device is hooked up, the engine is started and the return quantity is measured on all cylinders. Here it is important that the quantities of the individual cylinders increase at the same rate. Bosch systems compensate for any difference of up to about 24 ml by means of solenoid valve injectors. Any difference higher than that requires the injectors with the largest return quantities to be either repaired or replaced.

#### Diesel Test Systematic Testing

One result of the increasing market share of diesel vehicles is that car service centres are paying more and more attention to the diesel business. Especially newer diesel systems also offer general repair centres many opportunities to confidently locate problem sources and to give diesels new lives by the simple exchange of individual components.

As the leading developer of modern diesel technology, Bosch offers all workshops a comprehensive product range of test technology, tools, workshop software, training and consulting. Furthermore, close collaboration with the maintenance specialists of Bosch Diesel Centers gives workshops the advantage of offering their customers repairs in line with the age of the vehicle. Given that range of products, workshops are in the position to perform all test procedures plus the replacement and maintenance of both classic and state-of-the-art diesel technology on the vehicles of their customers.



The pressure sensor module allows the specialist to test Common Rail pressure during start-ups under real conditions.

Photo: Linzing