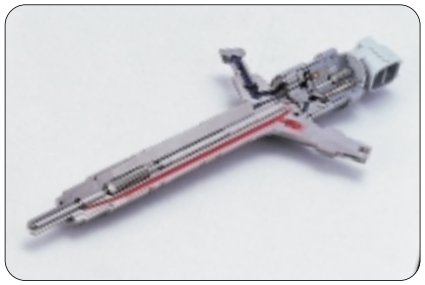
Diesel Common Rail Systems for Passenger Cars

Common rail technology is the future of diesel, both in passenger cars and in trucks and buses. The technology appeared first in trucks and buses, but DENSO and other manufacturers since have adapted common rail technology to diesel engines for passenger cars. DENSO leads the industry in maximizing the precision of injection timing and quantity. That leadership underlies the systems under development at DENSO to comply with increasingly stringent regulations in Europe and elsewhere.



Injector

In the marketplace

Excellent fuel economy and power underlie the popularity of diesel engines in trucks and buses around the world. But stubborn issues in controlling emissions of nitrogen oxides and other pollutants have limited the use of diesel power in passenger cars. Only in Europe—where public concern about fuel economy and global warming is especially strong—are diesel-powered passenger cars common. And even in Europe, increasingly stringent emissions regulations soon will be impossible to meet with conventional diesel systems.

Common rail injection systems will be instrumental in engineering diesel engines that will comply with future European regulations. Those systems use multiple injections per combustion stroke to control emissions. And they allow for controlling the injection quantity, injection timing, and injection pressure independently. That supports better performance than is available with gasoline vehicles.

DENSO developed the world's first common rail injection system for trucks and began supplying the system to Hino Motors in 1995. Since then, we have supplied about 20,000 common rail injection systems to Hino, Isuzu, and Mitsubishi for trucks sold in Japan, the United States, and Taiwan.

We followed our common rail system for trucks with one for passenger cars: the ECD-U2P. That system debuted in Toyota cars for the European market in September 1999. We supplied ECD-U2P systems for about 78,000 passenger cars in 2000.

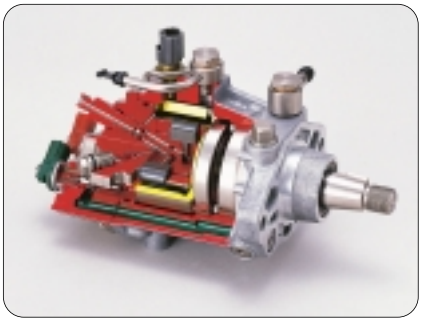
In comparison with competitors

Our systems have an edge over competitors in controlling combustion—and emissions—precisely. That reflects our industry leadership in shortening the interval between the pilot and main injections. It also reflects the outstanding precision of our injectors in controlling the quantity of fuel injected. The on-demand pumping capability of our supply pumps helps ensure optimal fuel pressure at all times.

Issues and outlook

Common rail technology is a prerequisite for the continuing viability of diesel-powered passenger cars in Europe and elsewhere. We are upgrading our common rail technology to comply with Europe's upcoming EURO-4 emissions regulations. Our efforts include increasing the number of injections per combustion stroke to five, from the present two, and raising the maximum pressure to 180 megapascals, from the present 135 megapascals. We also are taking a close look at the possibility of adopting piezoelectric actuators for the injectors. By 2003, we are aiming for a production volume of one million common rail systems a year.

We expect European demand for diesel power to reach 12 million vehicles a year by 2010. Increased unit volume will heighten the importance of ensuring the best possible reliability and service. We also will need to lower costs to accommodate the "commodification" of common rail systems.



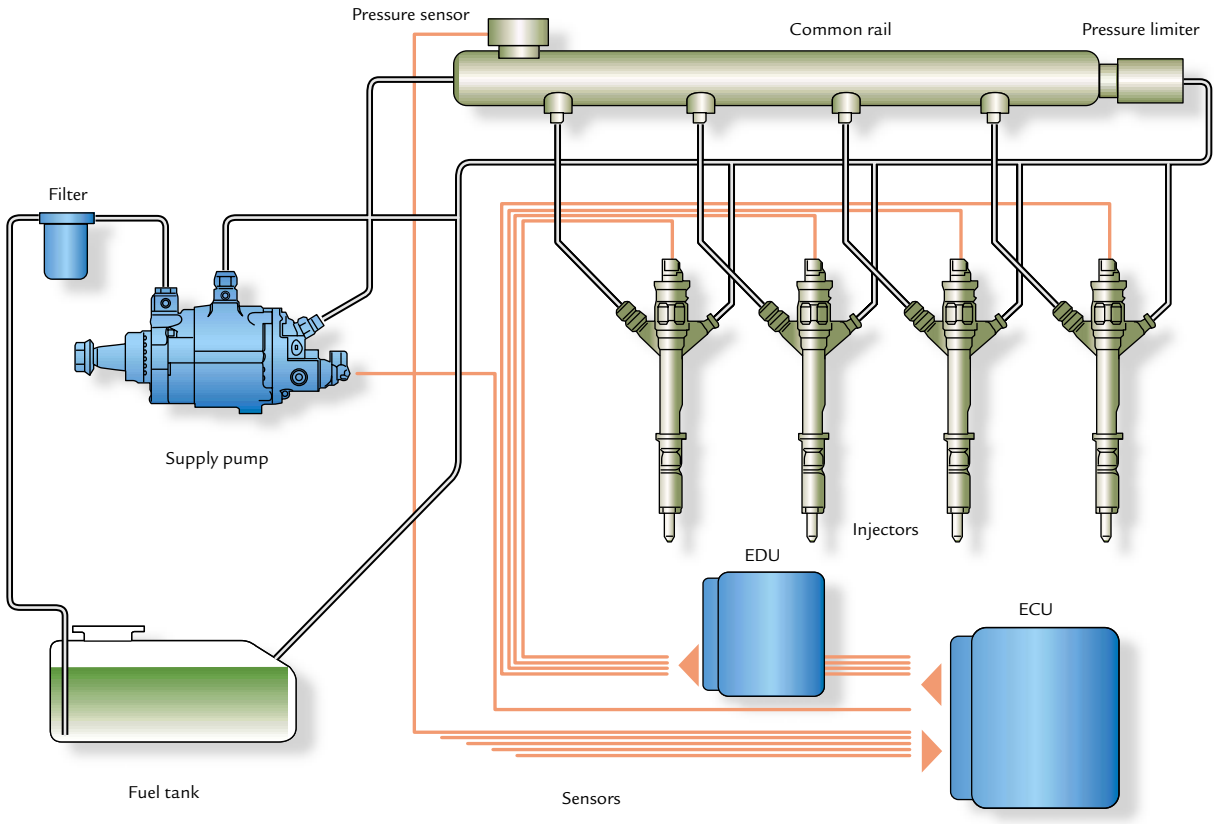
Supply pump

Technical highlights

The atomization by the ***fuel injectors*** is excellent, which promotes thorough combustion at all engine speeds. And the interval between the end of the pilot injection and the start of the main injection—at 0.7 milliseconds—is the industry's shortest. That is a tribute to our engineers' success in designing the injectors to activate and deactivate the high-response solenoid valve quickly. The ECD-U2P's valve seats are ceramic, which helps minimize the size of the armature.

Our injector connectors contain chip resistors of different resistances. We measure the operational characteristics of each injector as it comes off the production line and install a chip resistor of the appropriate resistance to compensate for any deviation from the target characteristics. That compensation helps achieve an exceedingly accurate injection quantity.

A pair of inlet metering valves on the ECD-U2P's ***supply pump*** provide high-pressure fuel precisely on an on-demand basis. Also distinguishing the supply pump is a built-in feed pump, which draws fuel from the fuel tank.



EDU: electronic driver unit
ECU: electronic control unit

Common rail fuel system