Delphi Multec Diesel Common Rail

In the Multec system, the pressure level of the rail is electronically regulated by a combination of inlet metering to the high-pressure pump and fuel discharge by bleeding the pressure off quickly via the injector solenoid return. The rail pressure operates independently of engine speed or load, so that high injection pressure can be produced at low speeds if required. A series of injectors is connected to the rail, and each is opened and closed by a solenoid driven by the electronic control unit (ECU). Delphi has further enhanced the multi-injection capability of its previous system by introducing a hydraulically optimized rail, which in combination with a software compensations strategy allows for unprecedented accuracy of each of the five injections delivered in one cylinder event.

Typical Applications – Multec DCR helps customers exceed the requirements of Euro IV when used with existing oxidation catalysts on small/medium size vehicles with high-power density potential. On larger vehicles, a particulate filter may also be required to help meet Euro IV requirements.

Multec DCR systems are available in tubular shape as well as an innovative spherical rail design more appropriate to small engine size. Multec 1600 DCR is currently in production, while Multec 1800 DCR is scheduled for production in 2007.

Performance Advantages – Multec DCR offers significant simplification of fuel and control systems. The injectors operate at battery voltage with the lowest energy requirements of any common rail system, allowing a less complex, more cost-effective electronics design. In addition, the injectors perform the pressure relief function in conjunction with the inlet metering system. This allows for elimination of the high-pressure discharge valve, further reducing system cost and simplifying packaging.

The enhanced performance of Multec DCR is a result of:

- 2V pressure balanced solenoid valve: With this pressure balanced valve, the force required to move the solenoid remains constant regardless of the prevailing injection pressure. This helps eliminate the space and cost of larger solenoid valves or retention springs.
- Accelerometer pilot control (APC): In order to help keep the noise and emissions within small tolerances during vehicle life, the APC technique is used on all Multec DCR systems. In this closedloop system, an accelerometer attached to the engine block “listens” to the combustion, allowing the engine management system to automatically optimize its calibrations as conditions change. The

Features	Benefits
Injectors	- Driven by pressure -balanced 12V solenoid valve - Small packaging, with 17 mm, 19mm diameter from top to bottom - Multiple injection capable - Performance enhanced through individual injector characterization (I2C) - No high-pressure valve required with innovative fast rail pressure discharge strategy via injector - No fuel backflow cooler (low back leak injector and no high-pressure valve)
High-pressure pump	- Capable of 1800 bar pump pressure - Modular pump design 0.6 to 1.2 cm3/rev - Includes integrated inlet metering valve, pressure limiter, temperature sensor and transfer pump
Rail	- Available in tubular or spherical shape - Hydraulically optimized to dampen waves, allowing for unprecedented precision of each of the five multiple injections
Filter	- Validated with DCR system - Customized to match application requirements
Electronic control unit (ECU)	- 32 bit processor - Euro IV capable - Accelerometer pilot control (APC) “listens” to engine and corrects minimum drive pulse over life of the engine

result helps enable a consistently clean, quiet, and smooth-running engine with greater durability.

- Individual injector characterization (I2C): This system records precise individual injector characteristics on the injector body using a bar code label. When the engine is installed, this information is read optically and programmed in the ECU to optimize performance. This feature provides superb accuracy for each injector while simultaneously helping reduce manufacturing costs and improving quality since the injectors do not need to be repaired or tweaked to achieve the desired accuracy.

Advanced Diesel Technology – The popularity of diesel vehicles is growing globally. In Europe, approximately one of every three new cars sold is powered by a diesel engine. There are many reasons for this surge in popularity. Consumers are discovering that diesel engines offer:

- **Better fuel efficiency:** Light-duty diesel engines use 30-40 percent less fuel than gasoline engines of similar power under similar circumstances

- **More torque:** Diesels produce more drive force at low engine speeds than gasoline engines under similar circumstances, making diesels fun to drive.

- **Lower greenhouse gas emissions:** Less fuel consumed translates to lower emissions of carbon dioxide

To continue to offer consumers these advantages, manufacturers are required to meet stringent diesel emission standards. These standards vary throughout the world and are one factor driving development of advanced diesel technology.

Increasing injection pressure is one way to help increase the power density of diesel engines and help decrease emissions. Increased power density also allows for smaller engine sizes—and enhanced fuel economy—without sacrificing power. Two areas of improvement to meet new demands of increased pressure include strengthening the injector to withstand increased cycling and introducing a new pump family capable of handling fuel pressures up to 2000 bar. Delphi is also optimizing the injector and hydraulic system to minimize any restriction of flow.

In addition to increasing the fuel injection efficiency, Delphi is researching and developing enhanced closed-loop controls for diesel engines. By providing that the engine management system (EMS) delivers air, recirculated exhaust gas, and fuel at the correct quantities and timing the diesel engine can be made to perform closer to the limits of its capability, helping result in more power and torque at consistently low emissions and fuel consumption. Both the APC and I2C have been improved to help better maintain Euro IV emission standards. Delphi plans to make available linear oxygen sensors to help better control the air/fuel ratio and combustion feedback so that the combustion takes place at the correct time. With these improvements in fuel injection, control, and combustion technology, an engine of 65 to 70 kw/liter power density can be produced that can adapt and withstand the different fuel quality standards found around the world.

The Delphi Advantage – Delphi is the only fuel injection equipment supplier with a large exhaust aftertreatment, air and recirculated exhaust gas, and sensors product lines. Delphi can integrate air and fuel management systems, exhaust aftertreatment, and the associated electronic controls and sensors, helping provide complete end-to-end diesel engine control systems that meet emission requirements worldwide.

Because of their higher air-to-fuel combustion ratio, diesel engines naturally run “lean,” helping lead to better carbon monoxide (CO), hydrocarbon (HC), and carbon dioxide (CO2) emission performance. However, diesel engines do tend to generate higher levels of nitrogen oxides (NOx) and particulate matter (PM) than gasoline engines. Higher NOx levels are a result of the higher temperatures and excess oxygen of the lean combustion process. Higher PM levels are a result of incomplete combustion caused by low oxygen levels around individual fuel droplets. (This is a result of an incomplete air/fuel mixture in the injection system

due to the fact that diesel fuel is far less able to vaporize.) The higher levels of these two substances in the diesel exhaust stream has prompted extensive research on how to minimize them.

Delphi is developing Diesel NOx Particulate Traps (DNPT) and already produces Diesel Catalyzed Particulate Traps (DCPT) that together have the potential to nearly eliminate the NOx and PM coming out of the tailpipe. Delphi's research is focused on both perfecting design and manufacturing of these components, along with the control strategy to best utilize the devices as part of the EMS. With its extensive aftertreatment knowledge, Delphi has the know-how to help achieve Euro V and U.S. Tier II Bin V standards set to come in the later half of the decade.

Delphi has two common rail development centers, five diesel applications facilities in Europe, Asia- Pacific, and the United States, and nearly 8,000 employees working to further advance diesel technologies. Delphi has 12 manufacturing facilities that produce diesel systems components in seven countries, enabling high on-time delivery performance.

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DE-P&M/009-Jan004

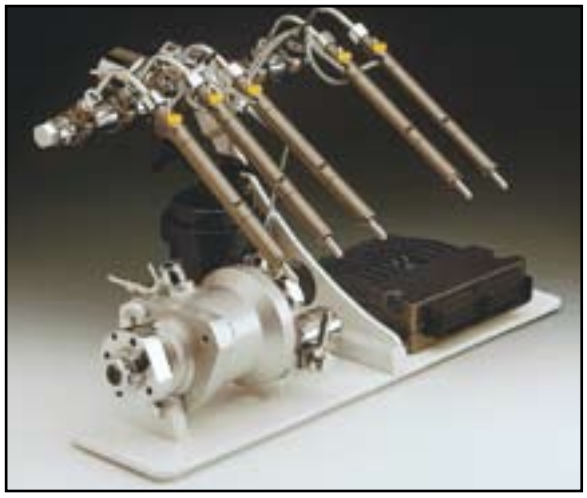
Delphi Multec Diesel Common Rail

Delphi is an industry leader in diesel common rail fuel injection technology and is actively involved in the development of advanced diesel technology to help create fuel injection equipment that continues to meet stringent emission requirements while enhancing fuel economy and performance. Extensive experience in high-pressure fuel injection technology has helped Delphi develop several innovative design and control strategies to meet customer needs for cost-competitive, high-value fuel injection systems that provide accurate injection over the life of the vehicle, helping minimize emissions while providing robust performance and low noise.

Description – Delphi Multec™ diesel common rail (DCR) is a modular diesel fuel injection system, with models capable of 1800 bar system pressure. It uses a unique solenoid injector design to optimize fuel rate, spray shape, and accuracy. The highly innovative Multec common rail system provides the smallest injection quantities in the smallest injector package, and along with closed-loop strategies, delivers the most precise fuel quantities over the life of the vehicle, which helps result in cost-effective robust low emissions and acoustics performance.

Multec DCR actually helps customers exceed the requirements of Euro IV through in-depth optimization of the nozzle and injector behavior. The system can deliver up to five injections per cycle, allowing high flexibility for combustion optimization.

Spherical Rail



Tubular Rail

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