Piezo Injectors Garner German Innovation and Advanced Tech Award

Clean and economical diesel injection developed for series production

Since 1997, the German Federal President has honored outstanding technological innovations with the Deutsche Zukunftspreis. The award recognizes developments of high scientific maturity. The new generation of common-rail injection systems by Bosch is four to five times faster. This minute dimension therewith falls far short from the lift required for the switching valve. For this reason, the actuator of a piezo injector consists of 350 stacked layers of piezo crystals whose combined expansion at 150 volts adds up to roughly 40 µm. This is sufficient to effect reliable injector valve switching.

More leeway for injection strategies

The major reason for the development of piezo injectors was the promise of the short switching intervals, which permit a more accurately measured injection. In search for uncompromising performance, Bosch exploits this benefit in its piezo inline injectors, which were first introduced in 2003 with the third-generation common-rail injection technology. In this injector, the piezo actuator transfers its expansion lift directly to the switching valve inside the injector. Compared to conventional electromagnetic injectors, the piezo injector is four to five times faster. Because the fuel injector’s opening or closing internal has shrunk to a mere 100 µs, up to seven injections per cycle are feasible at an injection pressure of 1800 bar (26,107 psi) (planning for 2020 bar is underway). Even very small fuel volumes of only 1 mm³ per lift are easily accomplished with piezo injectors.

The piezo inline injectors in current automotive use allow for improved combustion as a consequence of the increased accuracy of metered post-injections. Compared with conventional injectors, this reduces emissions by up to 20 percent. At the same time, diesel engines using piezo injectors not only run cleaner, but they are audibly quieter. The required smooth progression of the pressure increase is accomplished through precision pre-injection of minute fuel volumes. In the history of diesel technology that has lasted well over 110 years, Bosch makes intensive use of the ETAS ETK real-time operating system for the life of a given injector. The first point of contact is the programming either EPROM or flash memory, and manages calibration data. Across the board, ROM, flash, or EPROM are being replaced by RAM. In terms of memory emulators, Bosch makes intensive use of the ETK by ETAS. The device is vehicle-compatible and can be adapted to a host of microcontrollers. Due to its compact dimensions, it is easily accommodated without necessitating modifications, even on ECUs that are production-ready.

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On November 11, 2005, red-carpet treatment was lavished on the four nominated R&D teams who had made the shortlist of the prestigious Zukunftspreis award. It was the first time that the EUR 250,000 prize went to the research teams of two automotive suppliers – Bosch and Siemens VDO – that directly compete in the market. The new generation of common-rail injection systems by Bosch (Bosch photo).