Uncommon fuel rails

ADVANCES IN THE DESIGN AND MANUFACTURE OF COMMON RAILS CONTINUE TO MEET THE DEMANDS OF AN ENERGY-CONSCIOUS WORLD, WHILE DELIVERING INNOVATIVE AND COST-EFFECTIVE SOLUTIONS

The demands of an energy-conscious world continue to drive advances in engine technology. Customers expect more for less and, in the case of IC engines, there is the added expectation of more from less. Increased regulation of emissions worldwide illustrates the importance of combustion engines in the global economy, and the growing concern about its ecological impact. As engine performance standards increase, raw materials and resources continue to stretch thin. Globalization continues to break down borders, creating new opportunities while increasing the field of competitors and manufacturers.

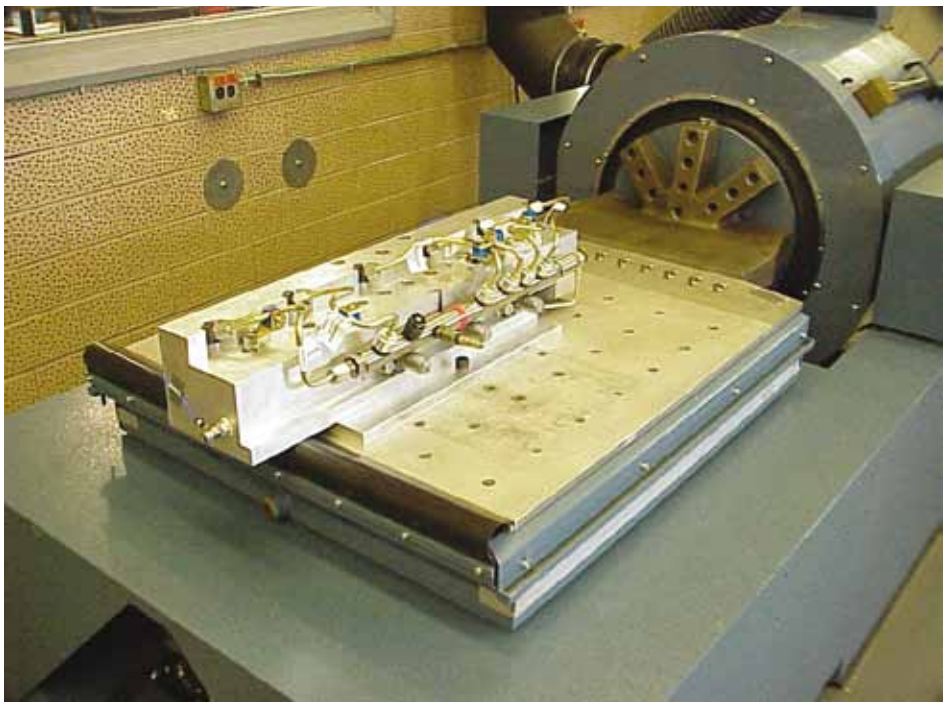
In such a complex environment, successful manufacturers must quickly adapt to stay ahead. The competitive edge resides in the manufacturer's ability to understand the customer and to take ownership of market drivers. With more than 100 years of experience in delivering innovative solutions, Senior Flexonics continues to demonstrate its ability to align resources and apply sound engineering to support common rail technologies in the automotive and diesel market.

Common rails play an integral role in fuel delivery systems for combustion engines. Senior Flexonics has developed forged and welded designs for applications ranging from small cars to heavy-duty trucks and off-road engine applications. Taking high-pressure fuel that can reach upwards of 3,000 bar, the common rails ensure fuel is readily available for delivery to the engine's injectors. Sensors on the rail link to the ECU provide feedback to regulate fuel flow and operating pressure. Fuel regulating valves are a failsafe feature of the rail that ensures the system does not over-pressurize and compromise other components or the engine.

Detailed design reviews

An effective customer-based approach is utilized by Senior Flexonics through each phase of product design, development and realization. In-depth design reviews ensure all requirements and variables are considered and vetted. CAD models are used to validate design intent and interactions within the fuel system. Advanced FEA techniques are employed to evaluate common rail designs against fatigue, loading, vibration and other environmental conditions. In its designs, Senior Flexonics balances theoretical analysis and simulation with physical laboratory analysis and prototype builds to deliver cutting-edge solutions for common rail technology.

Right: Common rail designs and failure analysis are validated within Senior's test laboratory

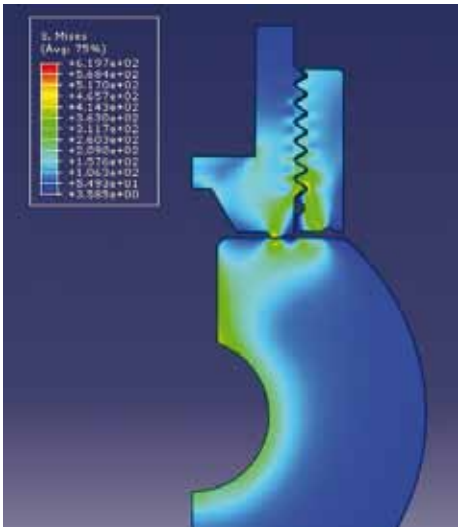


Below: Pressure fatigue testing

Above: Welding of line fittings to the rail

Left: The fittings are cooled post weld

Right: The common rail concepts are evaluated in high-tech modeling packages



Engineers and technicians draw from their extensive knowledge of the automotive and diesel industries, and new ideas and concepts for common rails play out in versatile prototype labs. Within these facilities, new designs must meet rigorous pressure pulsation evaluations and multiaxial vibration testing that simulate the engine environment. Tensile, bending, and torque evaluations simulate forces from other components, as well as installation forces. Common rails must withstand these demands, and sealability must be maintained as leak tests are performed to maintain fuel system performance. Resistance welders in the prototype lab and metallurgy lab support welded designs, and serve as a proving ground for production equipment and processes for common rails. Understanding the importance of investing in new technology and talent positions Senior Flexonics to continue to support the automotive and diesel industry.

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Lean manufacturing principles

Innovative common rail designs must also be flexible in order to support a variety of engine configurations. By integrating flexibility into the design and manufacturing process, design and prototype phases are more efficient, and result in a responsive structure that the customer can readily tap into. Design improvements are readily shared across common rail platforms, and similarly, improved manufacturing and testing processes can be implemented. This approach also leverages the common rail's supply chain, providing improved cost benefits for the customer. Flexible designs and responsive production cells reflect Senior Flexonics' commitment to lean manufacturing principles, which lay the foundation for continuous improvement and visual management.

Specific manufacturing cells such as resistance welding, turning operations, and clean room assembly and inspection, among other processes, comprise common rail production. Quality performance metrics are embedded into these processes to ensure responsive feedback. Understanding the importance of lean manufacturing, the production team for common rails at Senior Flexonics is led by a value stream manager with a fully integrated organization of engineers, supervisors and technicians. The result is a team driven by continuous improvement that fosters and cultivates lean manufacturing and delivers exceptional products.

Addressing complex problems requires an approach where all aspects of the business are innovative and driven by success. Creating this environment is what Senior Flexonics has been doing for the past century. Looking forward, guiding principles focused on technology and human capital will propel advancements in common rail technology.

As markets continue to raise the bar in engine performance, engineers and manufacturers will meet these needs with cost-effective solutions. Behind the scene, advancements in common rail technology and manufacturing process will continue to play out at Senior Flexonics, with the aim of making far-from-common rails for next-generation engines.