Injecting real-time quality into fuel injection nozzle manufacturing

Situation

The goals in producing today's modern vehicle engines are maximum fuel utilization, the production of a minimum of toxic emissions and the delivery of as much smooth, high torque power to the drive train as possible.

To meet all these requirements, the fuel must be continuously injected in just the right, precise doses. This sounds simple, but it is easier said than done. The manufacturing of critical injection nozzles is a precision task, and the tools used to make the injectors must be even more precise.

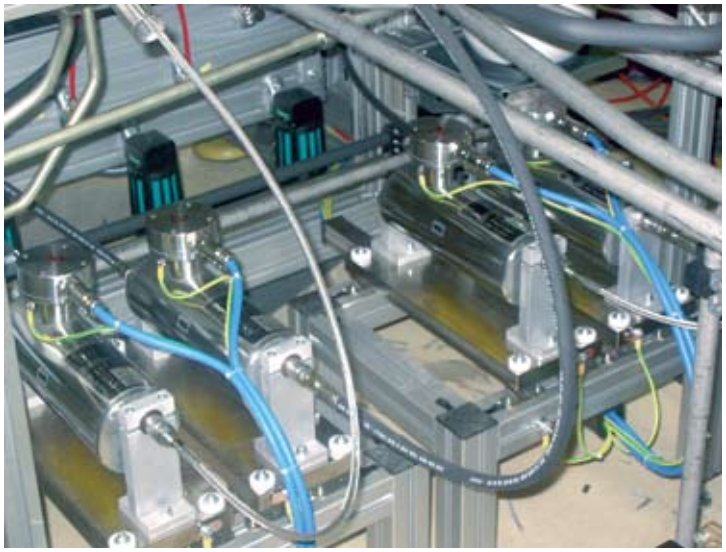
A Siemens customer supplies high-precision tooling that is marketed to the engine fuel delivery industry to manufacture fuel injection or F.I. nozzles. Their equipment is designed specifically for the highly specialized electro-chemical metalworking needed for F.I. nozzle manufacturing. Their key area of expertise is developing and producing tooling for industries needing extremely accurate trimming, milling, lathing, grinding, and honing of edges, along with the exact rounding of corners. These are the tasks needed in the manufacturing of fuel injectors.

Challenge

The challenge presented by the engine industry was to develop tooling which could machine raw fuel injection nozzles accurately from their first "rough" shape (drilled with a diameter of only 0.004 - 0.016 inches, depending on nozzle type).

There are three factors that are crucial to quality in this operation:

- The residual burr from drilling the injection holes must be removed.
- Raw injector nozzle flows must be flow tested. Deviations of even ±10% from the prescribed value for finished product are unacceptable.
- Injectors must be "run in" in order to eliminate a gradually rising flow due to the initial break in.



The break-in period eliminates the risk of rising fuel consumption during the nozzle's lifetime. These factors need to be taken into account with a newly developed process, focused on the manufacturing and calibration of precision injection ports.

The nozzles are processed in the plant using an electrolytic process. They are placed in tooling where a 15% saline solution is passed through them under high pressure. The metal is stripped from the item by a precisely measured electrical current, though the saline solution. Precise accuracy is needed for the final testing and calibration of the flow through the injection nozzles.

The solution

The customer has chosen the Siemens Coriolis flow sensor for their final testing and calibration to ensure that the electrolytic process is halted at exactly the proper flowrate, consistently.

For this application, accuracy was the key criterion for the choice of a measurement element and the Siemens MASSFLO 2100 series DI-3 flowmeter was the best choice for the critical calibration process.

Our customer commented, "We investigated the market for Coriolis flowmeters and found only two possibilities that met our requirements. Of the two Coriolis sensors evaluated, the Siemens flowmeter was the most accurate and repeatable. The Siemens sensor has a clear, stable signal that makes it possible for us to easily meet our tolerance target of better then ±1%." He also said, "If you do not have full and precise control of volume flow and pressure, then rejects will be unavoidable and rejects are not acceptable."

One of the greatest concerns for components used in this process is the aggressiveness of the salty water used for the removal of the material. The salt water has a tendency to oxidize many of the Ferrous materials it comes in contact with. Because the DI-3 sensor is made of high grade 316L stainless steel with Hastelloy C-22 as an option, it has demonstrated resilience to oxidation, an unparalleled robustness, and unfailing repeatability over the years.

This type of application is an important development, and our customers are well on their way to getting this process established in the world market. Tighter environmental restrictions are pushing the requirements for cleaner combustion, and the engine manufactures are being pushed even further to gain whatever fuel savings possible. There is a growing need for manufacturers of these fuel delivery systems to put a tight focus on improving injection nozzles by improving the tools and processes used to make them.

Benefits

- Compact sensor design
- Unsurpassed performance and accuracy of 0.1% of mass flowrate
- Large dynamic turndown range 100:1
- High accuracy on density measurement
- Corrosion resistant and optimized enclosure in stainless steel/Hastelloy
- Plug-and-play in less than 10 minutes
- Multiple communication interfaces: PROFIBUS PA/DP, Modbus, HART, DeviceNet

Siemens Industry, Inc.
3333 Old Milton Parkway
Alpharetta, GA 30005
1-800-964-4114

info.us@siemens.com

www.usa.siemens.com/ia

Subject to change without prior notice
Order No.: PICS-00035-0809