Fuel Injector Insertion Verification

In-Process Test & Monitoring Solutions

Automotive OEM analyzes digital process signatures to identify defects earlier in the assembly process.

Fuel rail defects for a leading automotive manufacturer were traced to the improper insertion of fuel injectors into the fuel rail. The recurring defects were not found until late in assembly and represented a potential warranty issue as the injectors and fuel rails would experience premature wear due to the improper insertion. This risk along with high teardown and repair costs led the manufacturer to look for an efficient, reliable and effective way to monitor the simultaneous insertion of the three fuel rail injectors into the fuel rail.

The Sciemetric sigPOD process monitoring solution using signature analysis addressed the requirement. In the test, each press head is coupled to the ram by a spring, and its position is monitored using an LVDT (Linear Variable Displacement Transformer) with load cells also monitoring the insertion force. A PLC (Programmable Logic Controller) controls the air cylinders. The system quickly generates and displays a profile of insertion force versus time, determines the maximum force applied and the total mechanical work done during the insertion process.

A missing O-ring is indicated if the results of the total work done are too low. If it is too high, it indicates high friction in the press process, which could be from a pinched or rolled O-ring or abrasive contamination in the fuel rail pump. The maximum press force is a key indicator of defective injectors. If the press force is greater than a present limit, it is likely that the fuel injector is defective. A high starting force indicates that the fuel injector is misaligned, which could greatly damage the O-ring. When the press is in motion and a low force is indicated, this means that the O-ring is missing or undersized; if it is too high, the O-ring may be caught in the press.

Key Features

- One system monitors three insertion operations simultaneously
- Immediate Pass/Fail indication to operators
- Decreased repair costs
- 100% part testing
- Finds defects as they occur rather than later in assembly: missing or undersized O-ring, injector misalignment, pinched or rolled O-ring and abrasive contamination in fuel rail cup

Once the fuel injector has been inserted and the retaining clip is in position, the system records the LVDT reading and the ram is then withdrawn. The new LVDT reading is compared with the previous one and if the fuel injector is properly engaged, the press head remains in position. The spring allows the ram to be withdrawn and the LVDT reading does not change. If the clip is not engaged, the injector is withdrawn by ¼ inch and the LVDT reading changes, which causes a failure indication. The test and analysis system alerts the operator of the failure mode in real-time and makes 100% inspection reliable and practical.

Results

By implementing sigPOD, the manufacturer was able to conduct 100% inspection of all parts to objectively identify previously undetectable defects early in assembly. This eliminated manual inspection, costly teardowns and potential warranty claims.

Contact Sciemetric to see how sigPOD could help you improve product quality while saving time and money on your line!

For more information on sigPOD, visit www.sigpod.com or email inquiries@sciemetric.com

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