



P R E S S R E L E A S E

EFFICIENT CLEANING OF DIESEL INJECTORS ENSURES THEIR RELIABILITY

A significant number of electronic fuel injectors for diesel trucks in use worldwide are produced in the Stonehouse, Gloucestershire factory of US-owned Delphi Diesel. Customers include Volvo, DAF, Daimler, John Deere and Asian commercial vehicle manufacturers. Delphi's global market dominance in the sector is underpinned by the reliability and robustness of its products.

High precision machining and rigorous quality control during manufacture of injector components is one reason for this success. Another is the efficient cleaning and degreasing of the components in automated, multi-stage, industrial washing machines prior to assembly of the injectors in clean room conditions. The match paired body and plunger, for example, are washed in ultrasonically assisted, aqueous cleaning machines purpose-built by FinnSonic, Finland, and supplied through UK agent, Turbex, based in Alton, Hampshire.

Tony Bray, a manufacturing systems engineer at Delphi Diesel's Stonehouse plant, explained that in 2004/05, two such washing machines were installed, a stage wash in the Body Hard (BH) area and a final wash in the Assembly and Test (A&T) area.

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Both cleaning systems are of similar design. The BH wash removes heavy soils from the injector bodies and plungers, including heat treatment scale, machining debris and cutting fluids, so that they are of the required cleanliness standard for a critical hydraulic test.

The A&T wash achieves a higher level of cleanliness, as it is processing parts already cleaned to an agreed standard. The final wash, which involves some changes in the process sequence and chemicals, ensures that the bodies and plungers are suitable for assembly, consistent with the extremely fine clearances between the mating injector parts.

The A&T wash includes automatic demagnetisation of components to ensure that any minute particles will not be attached by residual magnetism. Delphi was particularly pleased with this installation, as FinnSonic managed to incorporate the demag coils around the input conveyor without any increase in the overall footprint of the washing machine.

Tens of thousands of two main product lines are manufactured each week at Stonehouse – Electronic Unit Injectors (EUIs) and Electronic Unit Pumps (EUPs).

Matched body and plunger pairs for EUIs are mounted together, 32 at a time, on bespoke wash frames for their journey through the automated FinnSonic BH and A&T lines. In the case of the physically larger EUP components, the wash frames accommodate 16 component pairs.

Frames enter each cleaning machine one at a time on a motorised input chain conveyor and are picked up by a robotic arm that handles them through six stages: heated spray pre-wash in a 500 litre tank (with lid to prevent overspray), heated ultrasonic washing with pulsing jets on stages 2, 3 and 4, heated ultrasonic rinse with pulsing jets, double station recirculating hot air drying, and cooling using high flow, water-chilled air. The entire system is enclosed, with interlocked access doors and alarms, and is controlled by a Mitsubishi PLC with operator panel.

Cleaned and cooled parts emerge on their frames via the output conveyor. From the BH machine they are taken for back leak testing, whereas from the A&T machine they go directly to final assembly. Before they do, an operator lubricates the plunger, assembles the matched pair and attaches an identifying tag used for data collection.

Investment in the FinnSonic equipment was required due to forecast production increases and the need to replace older, spray-type cleaning machines. Cleanliness standards within the automotive industry are stringent and the introduction of more efficient cleaning systems was considered necessary.

Several suppliers were approached and FinnSonic equipment was finally selected following development of an effective cleaning process. Transducers impart ultrasonic agitation as close as possible to the critical areas of the components, which combined with sequenced underwater jetting, achieves the required cleanliness standard. The overall robustness

of the FinnSonic system, stainless steel construction and realistic price were other key considerations during the selection process.

Specifically, Mr Bray cited the configuration of the ultrasonics on the Finish-built machines, developed with Turbex, as being a significant improvement over other systems being considered. The transducers are mounted either side of the tanks, rather than underneath, imparting lateral ultrasonic agitation that he regards as more effective for cleaning these particular parts.

Development of the specific cleaning processes was provided as part of the turnkey service by Turbex at its cleaning technology centre in Alton. The optimised cycles currently being used at Stonehouse are based on that original work.

While the first automated FinnSonic machines were under construction, Delphi required an additional machine for cleaning low volumes of a different design of injector body. Turbex supplied a hire machine at short notice, a FinnSonic multi-stage, manually operated aqueous cleaning machine. This was subsequently purchased and is still in production use today.

In the last 10 years, Delphi has continuously grown in size and now employs 1,000 people at its Stonehouse factory. It continues to increase its market share within the fuel injection sector and has now reached the point where additional washing capacity is required. Consequently, two

further FinnSonic automated cleaning systems were supplied by Turbex in October 2008, one for BH and the other for A&T, each being of similar specification to the existing machines.

Mr Bray said that the output and reliability of the first FinnSonic machines, combined with the resulting component quality, made it likely that Delphi Diesel would return to the same supplier, but this was not a formality and the company researched the market again before reordering.

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The two FinnSonic cleaning lines in the BH (body hard) area of Delphi Diesel's Stonehouse factory.



An operator stacking matched pairs of EUI plungers and bodies onto a bespoke wash frame ready for cleaning in one of the BH cleaning lines at Delphi Diesel.



Matched pairs of EUP plungers and bodies ready to enter the A&T cleaning line at Delphi Diesel.



Having emerged from the A&T cleaning line, an operator checks the EUP plungers and bodies, lubricates the plunger and assembles the matched pair ready for injector manufacture.



A FinnSonic multi-stage, manually operated, aqueous machine cleaning small quantities of a different design of diesel injector at Delphi Diesel, Stonehouse.

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