



MARKET DEVELOPMENT



LEADING EDGE TECHNOLOGY

NON-CONDUCTIVE COATING FOR DELPHI INJECTORS

Efficiency in fuel consumption is the holy grail for injector manufacturers like Delphi. Geraldine Villain, coatings and materials process leader at Delphi: "For our new closed loop injector we needed a non-conductive coating and we looked in the market for existing solutions. When it became clear that good solutions don't exist yet, we started a development project with Hauzer."

Delphi is one of the largest automotive suppliers delivering advanced electrical and electronic, powertrain and safety technologies to vehicle manufacturers around the world. Enabling them to make vehicles that are safer, greener and better connected. Geraldine: “We are always looking to improve the injection systems of the future. We designed a new type of injector that will be better equipped to comply with the EURO 7 norm for CO₂ and NO_x emissions. This new type of injector needs a non-conductive metal oxide coating to insulate certain parts. This enables to detect when the needle is in contact with the nozzle body. At first we looked in the market if such a coating was available off the shelf. But that was not the case.”

Specific Coating

“There are many coating companies that deliver ready-made recipes in their machines,” Geraldine continues. “But when we really have a specific request and the solution doesn’t exist yet, Hauzer is our valued partner. We worked with them before, they are open in their cooperation and they have a broad technology portfolio to start with. In this case we could start with their existing metal oxide coating to provide non-conductivity and develop from there the specific coating we wanted. The first trials started two years ago and now we can see the finish line. We plan to be ready for production next year.”



Mechanical testing of a diesel injector system
(Photo: Shutterstock)

Simultaneous Development

In a development project like this one it all starts with trust. Process departments have to collaborate and speak the same industrial language. Geraldine: “As a first step we presented our component to Hauzer and asked them if they could solve the problem. They said: we might have something. In the beginning we just coated polished parts, but soon after we applied the metal oxide coating on the components. The problem in these kind of projects is that the component itself is also still a prototype and we have to develop product and coating simultaneously. We started with a few parts, went to tens and then to hundreds of parts to see how we could control the process. After every batch you know what you have to improve, such as adhesion or layer structure.”

Upscaling Issues

Dave Doerwald, CTO at Hauzer, adds: “The insulating properties of the coating are in this case most important. We started with a standard metal oxide coating of 1.5 µm thickness, but had to make it thicker to provide sufficient insulation. In such a development project we face upscaling issues, the stability of the process needs to be guaranteed and process control is very important. We had to take steps in hardware improvement and development of the recipe. And additionally the fixturing, the way the product is placed in the machine during coating, had to be developed. The right fixturing can make a major difference. Because of the flexible way we build our modular machines, the coating can be produced by all our systems, it just needs an upgrade of the hardware.”

Intense Collaboration

“I can only agree that such a project needs an active and intense collaboration,” says Geraldine. “We gained a lot of trust in each other. We combine deep knowledge of our respective fields of expertise so we need to have a good working atmosphere. From both sides we need to be honest and tell each other where we can improve. It is a complex project, because to come up with a good injector we need application specialists, material scientists, designers and coating specialists to all work together towards the goal. We are glad to have found the right team of Delphi and Hauzer specialists to make this work.” →

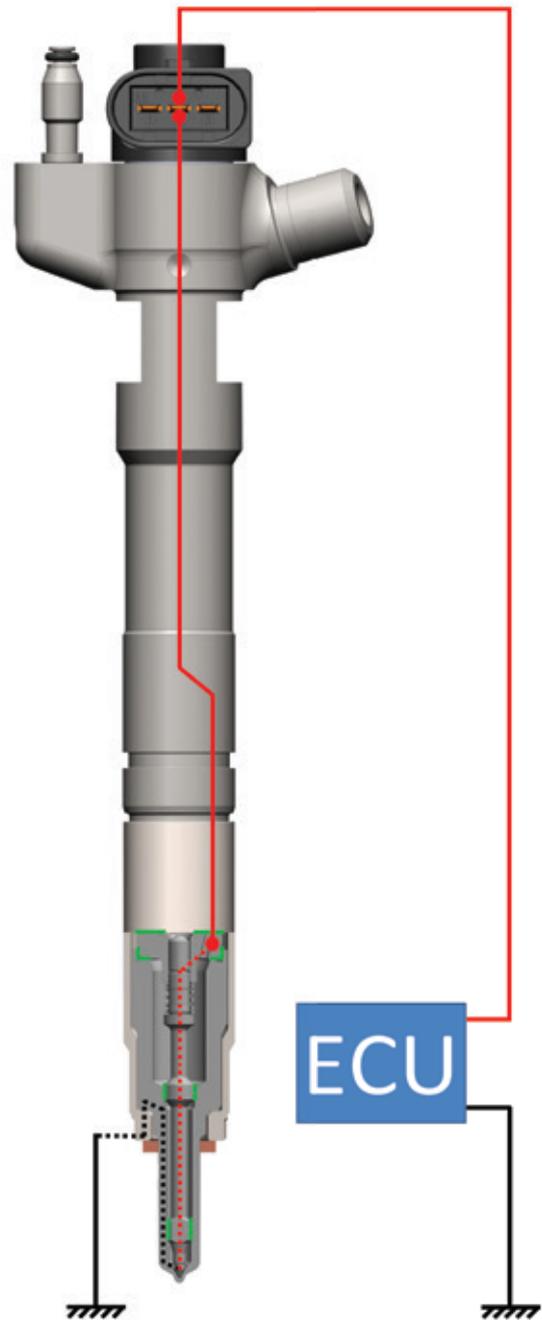
CLOSED LOOP SOLUTION BY DELPHI

Diesel engines still continue to offer best-in-class fuel economy. Continuous development on all types of engines will ensure that they remain in high demand in European and other markets.

In order to understand why the non-conductive coating is needed, Delphi explains about their closed loop system. As stated in an interview with Engine Technology International in June 2016, Delphi's closed loop control system using 'switch' technology is thought to be a world-first. It offers real-time control data that is more precise, more robust and provided by more cost-effective technology than any other existing closed loop solution. The Delphi system detects when the nozzle needle touches the seat or the lift stop, allowing the system to constantly recalibrate all fuelling events over the lifetime of the vehicle as well as compensating for any part-to-part variation. Rather than using pressure sensing systems which require complex data processing with several additional wires on each injector but which are not able to effectively detect multiple injections, the Delphi's technology is purely electrical using only one additional wire, sensing the needle contact on the nozzle body for each individual injection event.

Minimize Distractions

"We have to understand the fuel flow and spray patterns," says Geraldine. "At every specific moment we need to know where the needle is and we have to minimize the noise that makes detection difficult. A significant fraction of the fuel is injected while the needle is moving and at low needle lifts, but until now most research has been on fully open conditions. Not that we are able to make parts in the needle non-conductive we eliminate the distractions and are able to measure with a much greater degree of accuracy."



- Insulated surface
- Single Close Loop Wire
- Existing wire



Injector with insulated (coated) surfaces marked (photo courtesy of Delphi)