

Advanced mobility

Georg Fischer helps Bosch refine the diesel engine

When Rudolf Diesel hit on the bright idea of designing a thermal engine that ran on a self-igniting mixture of fuel and air, he laid the foundations for a highly effective propulsion system that is still unsurpassed today. The diesel engine offers mobility with less and lower-priced fuel. However, for a long time, it was not without its disadvantages, which were reflected in its “farm tractor” image – sluggish, noisy and dirty. Nowadays, good diesel-engined vehicles are as nippy and quiet as their petrol-powered counterparts. And, as the engine technology gets ever better, the lower the soot emissions become.

A lot of these refinements are down to how precise fuel injection is. Bosch, the world leader in diesel engine technology, is relying on special machines from GF Machine Tools, the Agie Charmilles Group, to manufacture diesel injector nozzles.



Perfectly made to measure

An injector nozzle is only as good as the tiny holes that it contains. Hans-Peter Gruber, Special Machines project manager at Agie Charmilles, won't give the precise dimensions of the holes because discretion is essential in partner projects, but he will say that they are “about half a hair's width.” Then, because he likes subtleties, he adds: “Or a full hair's width if your hair is very fine.”

EDM is used to machine the miniscule holes in the tip of the hardened-metal nozzles because it leaves no burrs or

bulging on the inside of the nozzles. But couldn't you just cut the holes with a laser? “Lasers are fine when you just have to pierce a material, but they're still inferior to EDM when it comes to special motions,” is Hans-Peter Gruber's firm belief. And making sure the fuel spray is just right requires a particular type of refinement. It goes without saying that a partner such as Bosch, who applies for around 3,000 patents every year, requires perfect solutions. “The ideal hole,” says Hans-Peter Gruber, “presents so many challenges that you could spend your entire life working on it.”

Four machines in one

Whereas EDM systems are normally used in tool and mould making, the special machines for injector nozzles are designed for high-output mass production. Thanks to miniaturization, the engineers have managed to squeeze four separate machines into one case. But why four separate power supplies and so on? Why not just use the same power supply for all four machining units? Because then the control system for all four units would always have to take its bearings from the weakest spark. Separation means that each unit can be controlled individually to within a fraction of a millimetre and a fraction of a second.

Rudolf Diesel would no doubt have been delighted by the tireless work that still goes into perfecting his invention.

The bottom line

You can't beat the best partnership

"During his entire life Robert Bosch believed that success is based on the trust of business partners and on product quality. With the seemingly simple mottos 'Sell the best of the best' and 'Your business partners' satisfaction is more important than short-term profit,' he turned his small workshop into a global business."

www.bosch.com on the partnership philosophy of the company's founder Robert Bosch (1861–1942)

The market trend

In the driver's seat

New registrations doubled in the last decade ...

Diesel vehicles now account for almost 40 percent of new registrations in western Europe. In 1991, they represented just 15 percent.

... further growth looks likely

According to the TV channel 3sat, "looking to the future, manufacturers are putting all their money behind spontaneous ignition engines because fuel can be extracted from biomass at relatively low cost."

Added value

More with every new generation

First the basics ...

In the first phase of partnership with Bosch, around 20 years ago, Agie Charmilles just delivered power supplies and Z-axes.

... then the control system ...

The scope of delivery for the predecessor to the current model was expanded to include the motion control system and PC user interface.

... then the complete machine

Today, Agie Charmilles supplies ready-to-use machines in significant numbers.

Reliability

More reliable than theoretically possible

Super-robust electronics

The power supplies and circuitry of the EDM systems that produce the injector nozzle holes are switched on and off 10,000 times every day. Going by the theoretically "normal" failure rates for such components, the systems "should" be breaking down time and again – but this scarcely happens.

"Adding Quality to People's Lives"

Biologically dynamic travel soon a reality?

Enhanced comfort

The more even the fuel injection, the more comfortable the ride.

Fewer emissions

Reduced fuel consumption reduces pollutant emissions in purely quantitative terms. The latest generation of diesel engines already complies with future European standards for soot particle emissions, even without a filter. According to a report by 3sat, diesel engines could even become "a paragon of environmental compatibility," especially in view of their potential to run on biomass-derived fuel, as referred to above. "Engines will then only emit the same amount of carbon dioxide as the plants took from the atmosphere to begin with."