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Unbreakable: Super-resilient cutting nozzle achieves a service life of 91 days

There is no such thing as a cutting nozzle that lasts forever; sooner or later they all have to be replaced. But Marcel Scalise from Benteler has found what might just be the next-best thing. A normal cutting nozzle is usually good for about two to three shifts. This one lasts for 273 shifts. Here's its secret.

Marcel Scalises' initial reaction was one of disbelief when Tim Hesse, head of R&D for laser applications at TRUMPF, first told him about a new-generation cutting nozzle known as the X-Blast Nozzle. Hesse claimed that the new nozzle could significantly improve machine availability by doubling the distance between the optics and the workpiece. "I've been working in laser technology for 20 years," says Scalise, "but to me that just sounded too simple. Increasing the working distance usually significantly reduces the quality of the work." Scalise is deputy plant manager at Benteler Laser Application GmbH, a company that specializes in laser cutting hot-formed components.

The nozzle problem

Everyone in the laser cutting business knows that cutting nozzles are consumables that wear and have to be replaced. This wear is due to surface variations on the workpiece because no workpieces are ever 100% identical. Because the cutting nozzle processes the component at such a close distance and high speed, any variations in shape can cause the cutter and component to come into contact or even collide. The risk is highest in critical areas, such as where there are curves in components with 3D geometries. If contact does occur, in most cases the nozzle has to be replaced. Normally, a nozzle lasts for about two shifts.

Scalise had been seeking a practical solution for quite some time but was unable to come up with the answer. "In theory, we could increase the working distance by increasing the cutting gas pressure. But that always has a negative impact on the quality." Anyone wanting to understand Scalise's preoccupation over such a small part needs look no further than Benteler's production situation. Components produced by the company are used primarily in the automotive industry, which means they are required in very high quantities – and as quickly and competitively priced as possible. "In a year, it's rare that we produce less than 100,000 parts," Scalise explains. Lasers are the only suitable and economically viable tool available for

processing hot-formed components in such high quantities.

This cutting nozzle completed a record 273 shifts before being replaced. The damage was caused by a minor operational glitch at the machine. Picture: Thorsten Doerk

At first, Marcel Scalise, deputy plant manager at Benteler Laser Application GmbH, didn't believe the claims about the X-Blast Nozzle. Now, he is totally convinced and has made it a permanent fixture in production operations. Picture: Thorsten Doerk

At its Paderborn and Siegen sites, Benteler operates a total of 30 TRUMPF cutting machines that speedily process the components in three shifts a day, seven days a week to produce the quantities required. Globally, the company deploys some 160 laser machines, and the count is rising. In 2019, the Benteler plans to reach the 200 mark. "Laser processing is incredibly fast and delivers outstanding results in terms of quality." But for such a small consumable, the cutting nozzles are constant source of irritation for the machine operators. During the inevitable change of nozzle, the machine unavoidably stands idle for up to half an hour and thirty minutes of valuable production time is lost. Machine availability is particularly critical in high-volume production, where time is of the essence and every second counts.

Scalise might not have been convinced about the X-Blast Nozzle at first, but he was curious enough to test it out. After all, if the nozzle was as good as TRUMPF claimed, Benteler would be able to make some big savings. The experiment was a success. "The nozzle lived up to expectation in every respect," says Scalise as he examines a nozzle. "It even set a new company record, completing 273 shifts." In other words, the nozzle lasted 91 days or almost three months before it had to be replaced.

» **Unfortunately we'll never know how long the cutting nozzle actually would have lasted, had it not been damaged following a minor operational glitch.**

Marcel Scalise, Benteler

So, what's the secret? From the outside, the new X-Blast Nozzle looks the same as any conventional nozzle; the revolutionary know-how is found inside. As Tim Hesse, head of R&D for laser applications at TRUMPF, explains: "In the past, we had always looked to increase the processing speed by boosting the power of the laser. Or, to use a car analogy, increase the horsepower. Now we wanted a chassis design that enables the vehicle to maintain the same speed regardless of terrain." The engineers studied the nozzle's fluid dynamics in depth. Their efforts cumulated in a flow design that keeps the cutting gas flow focused despite the greater distance from the workpiece. "We supply a software package containing the cutting data with the nozzle."

The resilience of the nozzle over 273 shifts, however, wasn't the only thing that surprised Scalise. "I'd expected the greater distance between the nozzle and workpiece to compromise quality. But the quality of cut is actually even better than before. Previously, it was not uncommon for machine operators to have to manually rework and deburr the part following processing. Now, with the X-Blast Nozzle, that's a thing of the past, even on parts with difficult-to-reach geometries." He does have one regret, though. "We'll never know how long the cutting nozzle actually would have lasted. Maybe it'd still be going today if it hadn't been damaged following a minor operational glitch."

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