Welding aluminum pressure-tight in series with a laser

Feinwerktechnik hago GmbH produces up to 95 percent of assemblies and parts for the automotive industry. With years of experience and established expertise, the production team can also handle highly complex requirements. A request for a cooling device made from aluminum for the thermal management of performance electronics in the battery management controller (BMC) of an electric car is challenging even for the specialists at hago. And they are doing what no specialist thought possible until recently: They are welding an almost meter-long cooling device consisting of two punched aluminum components and two VDA connectors using a laser - process-reliably and in series. The combination of BrightLine Weld technology and the Multifocus optics developed by TRUMPF makes this possible. After intensive collective trials and tests, hago and TRUMPF are proving that using this process, the cooling and protective aluminum cover of the BMC unit can be welded not only tightly, but also pressure-resistantly and even almost automated and in large series with a laser.

Feinwerktechnik hago GmbH

www.hago-ft.de

Feinwerktechnik hago GmbH is a generalist in the field of sheet metal processing. With a large variety of technology and vertical range of manufacturing as well as extensive expertise, the company based in Küssaberg, Baden-Württemberg has made a good name for itself in several industries since its foundation in 1970. Its main focus is the automotive industry. With a well-equipped development and construction department, as well as its own tool construction, hago supports customers from design optimization to further tool processing and even testing. hago delivers complex assemblies and prototypes made by hand or in large series - all according to customer requirements.

INDUSTRY

Automotive, electrical and furniture industry as well as medical technology

NUMBER OF EMPLOYEES

Over 700

SITE

Küssaberg (Germany)

TRUMPF PRODUCTS

- TruLaser Cell 7040 with BrightLine Weld and Multifocus optics

APPLICATIONS

- Laser welding

Challenges

The heart of electric vehicles is the battery and the battery management controller (BMC). It monitors, controls and optimizes the power, safety and service life of the battery, by regulating parameters such as charging status, temperature and cell voltage. The performance electronics installed convert the direct

current from the battery into the alternating current required for the drive. This generates heat that can impair the electronics. Modern cooling devices provide a remedy. They can be integrated as a medium-thickness "cover" in the BMC housing and connected to the vehicle cooling circuit. The cooling unit must be in direct contact with the performance electronics to ensure effective cooling. For this it is necessary that the cooling unit is completely flat. It should also be light so as not to unnecessarily increase the weight and should meet the pressure test requirements of the vehicle manufacturer.

"Our customer has requested a cooling plate made from drawn aluminum, measuring 900 x 200 millimeters - a real challenge, even for our most experienced specialists", explains Joseph Gampp, Head of Department for Product Management at Feinwerktechnik hago. But challenging tasks motivate the team. "After extensive trials and tests with TRUMPF we have found a process-reliable solution and can now produce the cooling device in series", Gampp proudly reports.

"When we received the request from our customer, nobody believed that the production was technically possible."

JOSEPH GAMPP
DIVISION MANAGER OF PRODUCT MANAGEMENT, FEINWERKTECHNIK HAGO

Solutions

With BrightLine Weld, TRUMPF has been offering a tried and tested laser welding process for years, which allows for fast, non-porous and gas-tight welding of stainless steel. The Multifocus optics developed in 2021 further increased application possibilities: In combination with BrightLine Weld it even allows for the pressure-tight welding of aluminum. To do so, the optics split the laser beam of a TruDisk laser into a ring and core beam, which are then split into four spots and positioned in such a way that a common weld pool is created. The resulting continuously open keyhole prevents the keyhole from collapsing, which enables a pore-free weld seam to be created without gas inclusions, even during the quick welding process.

Implementation

Initially, the team under Joseph Gampp tried to weld the aluminum cooling device using available machines. The sticking point: The first tight weld seams did not withstand the required application pressures and broke apart. "That was a crucial criterion for our customer, as the vehicle manufacturer insists on so-called pressure pulsation tests before approval", says Gampp and added: "The entire assembly must withstand a certain pressure at least 100,000 times. As soon as we tried it out with our test parts, our weld seams folded."

The hago specialists therefore worked meticulously with TRUMPF to create a stable process suitable for series production. In the TRUMPF laser application centre it quickly became apparent that all challenges could be mastered with the BrightLine Weld and Multifocus optics. The weld seam is so stable that it can

even withstand high pressures. This allows the parameters to be set flexibly so that the laser also welds long seams in a manner that is quick, process-reliable and distortion-free. This is important because the cooling device must be completely flat so that it is in direct contact with the performance electronics in the BMC and can be cooled effectively. "We now manufacture the component with a reproducible flatness of under a millimeter", says Gampp.

By investing in a TruLaser Cell 7040 laser welding system with BrightLine Weld and welding optics with Multifocus technology, hago has met the requirement for the series production of the cooling plate. The pre-series with around 3,000 components has been completed. Within the next six years, over 610,000 cooling devices should be produced by hago. "We have managed what many deemed impossible", says Gampp proudly adds. "That's what makes us special."

Forecast

The concept of integrated cooling in battery management controllers is relatively new, but has great potential. Joseph Gampp therefore hopes that knowledge acquired from working together with TRUMPF can also be used in further projects. "The technology fits perfectly into our strategic alignment", he says, and is confident that the time-consuming development project will be worth it.

Find out more about our products

BrightLine Weld

You can weld materials such as mild or stainless steel as well as copper and aluminum almost spatter-free thanks to TRUMPF's patented BrightLine Weld technology. The innovative 2in1 laser light cable (LLK) from TRUMPF combines an inner and outer fiber core. This design makes it possible to flexibly split the laser power between the core and ring. This allows the power distribution to be adjusted precisely for the respective material.

Zum Produkt

Multifocus optics

The new process was developed for the gas-tight welding of stainless steel and aluminum. The heart is the combination of Multifocus optics and BrightLine Weld technology. This divides the laser beam of a TruDisk laser with multi-core fiber between the ring and core and splits the optics into four individual spots. These merge together in a weld pool, where a continuously open keyhole is created. This prevents the keyhole from collapsing and prevents the formation of pores due to gas pockets.

Zum Produkt

TruLaser Cell 7040

With the TruLaser Cell 7040 laser system 2D or 3D components and tubes can be processed. The highly dynamic and accurate TruLaser Cell 7040 meets the central requirements for process-reliable, gas-tight welding of aluminum applications. The system makes it possible to change flexibly between cutting, welding and laser metal deposition. The modular setup of the machine, as well as the option of individual adjustment and retrofitting, make it possible to constantly optimally customize the TruLaser Cell Series 7040 to a modified production environment and to react to different requirements with flexibility.

Zum Produkt

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