Source: ESA/CNES/Arianespace

The weld seam quality of the bulkheads of the European carrier rocket Ariane 5 is tested with Ehr's Tivis software.

Surveying and documentation of welding seams in the aerospace industry

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Components for the aerospace industry must meet high requirements. Welds are particularly critical. In contrast to the design of components for the automotive industry, the tolerances for process fluctuations are far lower so that welds at critical points in particular must be tested extensively.

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The European Space Agency ESA is the European gate to the outer space. By order of ESA Ariane 5 was developed. This is a European carrier rocket from the Ariane series and since 1996 in operation. This rocket carries heavy payloads in the earth orbit.

This is also the case for MT Aerospace, a leading company in the aerospace industry and a part of the listed European aerospace and technology group OHB SE (Prime Standard, ISIN:) DE0005936124) in Augsburg. In addition to ultrasound and X-ray examinations, the laser triangulation method in combination with the Tivis software by EHR GmbH & Co. KG is also used at MT Aerospace to monitor the quality of the weld during the process and to be able to intervene in the process where necessary.

The component types to be tested include the bulkheads (tank bottoms, bosses) on the European launcher Ariane 5. In contrast to ultrasonic or X-ray procedures, the components can be tested in process with laser triangulation for all parameters visible from the outside. Regulatory intervention is still possible at this production stage. Errors found later can no longer be corrected. Such components can have a value of over 1 million euros after welding and must be scrapped if the worst comes to the worst.

The extensive documentation options of the systems are another aspect that speaks in favour of using in process optical test systems. All welds including the associated process parameters can be fully documented. As the process-relevant physical values are known, conclusions can be drawn on the root cause in case of deviations during the process. The relevant parameters are adjusted in this case. The Tivis software package is a standard solution for measuring welds of various weld types and component geometries. Fillet welds, fillet welds on flanged joints, stringer beads (zig-zags, circles, other weaves) and butt welds can be tested. In addition, the weld deformation as well as an inci-

pient gap can be detected with a two-sided test. The configurable parameters differ depending on the type of weld and underlying component geometry. Flexible parameterability for a wide range of component types is important as there is no such thing as the „perfect“ weld, as described in the respective standards, under practical conditions. In practical applications welds are located in radii or on component edges. It must be possible to cover these cases with a practical system. In addition to applications in aerospace, the Tivis system is used worldwide in the automotive industry in more than 150 fully automatic welding systems for measuring welds on the body in white. Besides the geometry dimensions, the software can also evaluate the surface finish of a weld (pores, cavities and spatter).

Viewing a weld in various 3D views

The large number of existing interface implementations and configuration options enable communication with parent control systems and industrial robots by various manufacturers. In the project described here, the Tivis system by EHR is used to measure following parameters over the entire length of the weld: Weld width, weld height, convex bead profile, weld angle, weld misalignment, concave bead profile, undercut.

The laser triangulation sensor is installed in a distance of around 30 mm to the welding source. The system communicates with the system via a Profinet interface. The test system automatically detects the start of the weld. Measurement of the above parameters starts automatically and continues until the end of the welding process. All values are stored and also permanently displayed to the operator in a live display. After completion, the weld can be viewed and analysed at any time using a variety 3D views with enlargement. At any point of the weld, the respective section with all of the parameters relevant to the evaluation can be displayed.

The Tivis system by EHR is programmed so that adjustments to reflect customer-specific requirements are possible at any time (customising). Customising predominantly relates to special component geometries or communication interfaces. As a factory standard, the system is equipped with extensive communication features, for example, interfaces for displaying errors at discharge stations. The Tivis system can be extended to include a variety of options, for example, an extra sensor for simultaneous control of material top and undersides. This keeps the system flexible and suitable for universal use.

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