FUSION FOR ENERGY

TECHNOLOGY OFFER





Immersion Ultrasonic Testing of High-Heat-Flux Monoblock Components

High-heat-flux components of tungsten–copper monoblock design rely on a defect-free bond between the tungsten armour, the copper interface and the CuCrZr cooling tube. Through its collaboration with Fusion for Energy (F4E), RTC Engineering verifies these joints by immersion ultrasonic testing (I-UT), applied both to complete HHF components and to the individual monoblocks.

The technology

- Immersion ultrasonic testing (I-UT) of HHF components with a tungsten–copper monoblock design, and of the individual monoblocks, in a water-filled tank with a motorised scanning bridge and a focused immersion probe.
- Water couples the ultrasound into the part, allowing high-resolution, contact-free scanning of the tungsten-to-copper and copper-to-tube interfaces along the full length of a monoblock string.
- Acquisition of A-, B- and C-scan data produces a full bond-quality map of every monoblock, quantifying the bonded area and locating any debonds or voids.
- Performed by qualified personnel and evaluated against the acceptance criteria applied to the diffusion-bonded and hot-radial-pressed joints (EN ISO 9712, EN ISO 16810).





Immersion ultrasonic scanning in the water tank: the left image shows testing of the bond between the flat W tiles and the copper from the outside, while the right image shows testing of the interlayer between the Cu-OF and the CuCrZr pipe from the inside.

Advantages and Potential Applications

- Volumetric, non-destructive bond-quality mapping of complete monoblock components and of individual monoblocks, without sectioning.
- Quantitative detection of debonds, voids and incomplete bonding at the tungsten–copper and copper–tube interfaces.
- Suitable for 100% serial inspection and acceptance data packages in quality-critical divertor and first-wall production.

Collaboration opportunities

RTC Engineering offers immersion ultrasonic inspection of high-heat-flux monoblock components and monoblocks, and is prepared to inspect parts, develop scan plans and qualify acceptance criteria for divertor, first-wall and other actively cooled assemblies.

Fusion for Energy Technology Transfer Programme

Email:technologytransfer@f4e.europa.eu