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Examination of ITER Central Solenoid prototype joints

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The ITER Magnet System will be the largest and most challenging integrated superconducting magnet system ever built. For the Central Solenoid (CS), cable – in – conduit – conductors (CICCs) of nearly one kilometre length are produced, but still, it will be necessary to connect several lengths together to wind the gigantic 110 tonnes coils. The creation of these superconducting joints is one of the most delicate parts of the assembly.

There are three types of ITER CS joints: sintered joints, coaxial joints and twin – box joints. US ITER, the ITER Domestic Agency of the USA produced a prototype containing all three types of joints. The goal is to test the performance of the joints in the SULTAN facility of the Swiss Plasma Center, capable of reproducing close – to – service conditions: high magnetic field (up to 11 T background field), high current (up to 100 kA) and high mass flow rate of supercritical helium for cooling.

The paper describes the results of a comprehensive examination campaign aimed at understanding the relation between fabrication and performance of the CS prototype joints. The test campaign combines advanced image analysis for the assessment of the void fraction of the conductors and dimensional measurements performed at different cross-sections of the joints, scanning electron microscope (SEM) and energy dispersive x-ray spectroscopy (EDX) to evaluate the quality of the contact between the strands and the sleeve / sole, as well as a full assessment of the welds according to the most stringent acceptance levels of the standards in force.

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