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Hydraulic characterization of twin box joints for ITER magnets

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The ITER magnet system will be the largest superconducting magnet system ever built. The system, all inside a cryostat, is mainly composed by a central solenoid (CS) split in 6 modules, a set of 18 toroidal field (TF) D-shaped coils and 6 poloidal field (PF) coils. Each of these coils use variable type of cable-in-conduit-conductors (CICC) actively cooled by supercritical helium forced flow. Their electrical supply from the current feedthrough of the cryostat is done with main busbars (MB) using similar CICC. The electrical MB to coils as well as internal PF and TF coils connections rely on the twin box concept developed by CEA in the early R&D phase. After construction and electrical validation of joint prototypes for the PF and the MB conductors through full size samples, the question of their hydraulic behavior in the operating conditions arises. Two specific hydraulic characterization tasks were done through the Magnet Infrastructure Facility for ITER (MIFI) contract between ITER Organization (IO) and CEA devoted to develop, improve and qualify manufactured components and assembly processes. These support tasks, were done on the full size qualification samples by setting the samples on the CEA OTHELLO dedicated facility able to operate with gaseous N2 in a large Reynolds range at room temperature. The paper explains the way followed to get a full hydraulic characterization of the MB and PF5 half joint boxes. The pressure drop for the two flow directions was determined for both joints. The study of the flow distribution between parallel cooling channels inside the PF5 joint revealed a bypass of the active joint region. The paper reports on this hydraulic behavior in the relevant magnets operating conditions and outlines the design changes in the joints provoked by the results of this study.

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