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# Hydraulic characterization of conductor prototypes for fusion magnets

Mathematical models used in thermal-hydraulic analyses of superconducting cables, cooled by forced flow supercritical He (SHe), used in fusion technology, are typically 1D, and they require reliable predictive constitutive relations which characterize mass, momentum and energy transfer between different cable components. Momentum transfer is described in terms of friction factor correlations, which can be obtained from the pressure drop measurements.
Forced flow HTS conductors designed for the Winding Demonstrator (WD) or EU DEMO Toroidal Field (TF) and Central Solenoid coils consist of several CroCo or twisted stack monolithic strands, embedded in a stainless steel jacket. Such type of conductors have never been tested for pressure drop yet. On the other hand, Cable-in-Conduit conductors for the DEMO TF coils designed by ENEA have two low-impedance cooling channels, separated from the cable bundle by flat spirals, with the inner/outer diameter of about 5/7 mm, twisted together with the last cabling stage. Experimental pressure drop data for such small spiral ducts are also unavailable yet. Therefore, existing friction factor correlations cannot be validated (or new, ad hoc ones cannot be developed) before their use in predictive analyses supporting the conductor design.
To fill this gap, several dedicated short samples, namely dummy conductors with the layout similar to the DEMO HTS or WD, conductors and a small spiral-walled pipe, have been prepared and tested for pressure drop using distilled water at different temperatures. The experimental data have been used to develop experimental friction factor correlations for the considered ducts, which will be utilized in future thermal-hydraulic studies of the DEMO coils or WD.

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