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AC Loss and inter-tape resistance in various HTS cable configurations

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To achieve the required current capacity, superconducting cables are composed of numerous HTS tapes. In particular for application in fusion, those conductors have to operate in alternating current and magnetic fields, leading to AC loss and current redistribution. Besides the dimensions and geometry of the composed cable, an important parameter for the mentioned phenomena is the contact resistance between the tapes. The contact resistance affects the ability of current redistribution inside conductor and hence its stability. In this work the AC loss and contact resistance data is presented of HTS conductors manufactured according to three types of cabling methods - CORC (cable on round core), Roebel, and stacked tape including a full-size HTS CICC (cable in conduit conductor) and CroCo (Cross-Conductor) conductor. The AC loss was measured with a calibrated gas flow calorimeter by helium boil-off method and simultaneously by magnetisation with a use of a compensated pick-up coil set. The measurements were done at T = 4.2 and 77 K in an AC magnetic field with amplitudes up to 1.5 T. The inter-tape contact resistance was measured for samples at 4.2 and 77 K. We demonstrated that a short heat treatment of a CORC conductor with solder coated tapes activates tape soldering in the whole sample volume and decreases the contact resistance by two orders of magnitude. At the same time no coupling loss component was observed for the heat-treated CORC sample at 4.2 K while AC loss measurements at 77 K clearly demonstrated the presence of coupling loss. The analysis of AC loss and contact resistance data obtained at 4.2 K suggests that a strong shielding effect is present in CORC and Roebel conductors.

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