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Optimized and practical electrical joints for CORC type HTS cables

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Within the Physics Department of CERN the development of CORC (Conductor on Round Core) type HTS cables is pursued in view of possible application in future detector and fusion magnets. An important issue is the design and qualification of terminations that connect CORC cables mutually or to bus-bar systems. A termination design is envisaged which combines a simple manufacturing process with a lowest possible joint resistance in the few nano-ohm range at 4.2 K, first for a single CORC cable and subsequently for a six-around-one CORC based Cable-in-Conduit Conductor.

For the investigations a first 12 meter long single CORC cable of 38 tapes was manufactured at the company Advanced Conductor Technologies (ACT) in Boulder, Colorado that can carry 8 kA at 10 T and 4.2 K. Another 2 m long cable with 28 tapes was manufactured as well for testing joints. The investigation is on the effect of tapering the CORC cable within the joint to form a staircase like geometry on each end of the cable, which allows current to pass directly from the copper casing to the inner HTS tape layers within the CORC cable.

Simulations have shown a substantial decrease in joint resistance at operating current in the case both CORC cable and joint casing are tapered. Joint manufacturing has to cope with typical problems as delamination of the ReBCO tapes and the formation of gas-bubbles inside the joint as both cause an increase of electrical resistance between layers of ReBCO tapes and between the CORC cable and the copper casing. Various soldering alloys and filling techniques have been evaluated. The CORC cable samples and various terminations were tested at CERN.

In this paper, various termination designs, the manufacturing process and experimental results are summarized.

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