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10 kA joints for Multi-Tape HTS Cables

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Abstract— Future HTS high field magnets using multi-tape HTS cables need 10 KA low resistance connections. The connections are needed between the poles of the magnets and at the terminals in a wide operating temperature range, from 77 - 1.9 K.

The EuCARD-2 WP10 Future Magnets collaboration aims at testing HTS-based Roebel cables in an accelerator magnet. Usually, LTS cables are jointed inside a relatively short soldered block. Powering tests at CERN have highlighted the high internal resistance of a joint following classical LTS joint design.

The HTS Roebel cables are assembled from meander-shaped REBCO-coated conductor tapes in a transposed configuration. Tapes are mechanically stabilized by a highly resistive stainless steel substrate layer. Tape-to-tape contact resistance remains high, and varies between tape manufacturers, which limits the current redistribution through the tapes.

A low-resistance joint requires a sufficiently large interface area for each tape. Within one twist pitch length, each tape is located at the surface of the cable over a relatively short distance. This geometry prevents making a low resistance joint in a compact length along the cable. To minimize the effect of the tape internal resistance, the soldered joint connection must be on the superconducting side of each tape, and not on the steel substrate side.

This paper presents a compact joint configuration for the Roebel cable overcoming these practical challenges. The transposed configuration of the cable is opened and the tapes are connected individually to copper fins in a stacked assembly, called Fin block. The Fin block is clamped to the terminal with adaptor pieces. The joint resistance is estimated computationally. Finally we present test results as a function of current and temperature.

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