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Intra-strand resistance and current transfer length in multifilamentary NbTi, Nb3Sn, MgB2, BSSCO and ReBCO conductors

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The intra-strand resistance and current transfer length of multifilamentary NbTi, Nb3Sn, MgB2, BSSCO and ReBCO superconductors has been measured with a direct four-probe voltage-current method at various temperatures. With the aid of Finite Element Method simulations, the filament-to-matrix contact resistance and effective transverse resistivity are derived from the intra-strand resistance measurements. The effective transverse resistivity values are verified with those analytically derived from AC coupling loss measurements in transverse applied field. Furthermore, the current transfer length is measured for several conductors and the correlation with the extracted resistances is evaluated by simulations with a numerical multi-filamentary 3D strand model.
An overview is given of a wide range of measurements and analysis on intra-strand resistance and current transfer length for various state-of-the-art commercial superconductors. The extracted experimental database can be well utilized to understand and quantify strand performance in combination with the detailed multi-filament 3D model. It enables to quantify the impact of locally varying strain conditions, filament fracture and current distribution process between matrix and superconducting filaments occurring at current injection points in relation to strand internal architecture.

Primary author: ZHOU, Chao (University of Twente, Faculty of Science & Technology, 7522 NB Enschede, The Netherlands)

Co-authors: NIJHUIS, A. (University of Twente, Faculty of Science & Technology, 7522 NB Enschede, The Netherlands); KROOSHOOP, H.J.G. (University of Twente, Faculty of Science & Technology, 7522 NB Enschede, The Netherlands); Dr DHALLÉ, M. (University of Twente, Faculty of Science & Technology, 7522 NB Enschede, The Netherlands)

Presenter: ZHOU, Chao (University of Twente, Faculty of Science & Technology, 7522 NB Enschede, The Netherlands)

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