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Axial and transverse loading model of CORC® cable considering initial contact from cabling process

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The Conductor on Round Core (CORC®) cable or wire comprises several layers of helically wound HTS tapes on a round core with the winding direction reversed in each successive layer. This configuration can significantly reduce the AC loss while improving the bending flexibility. However, compared with traditional multi-filament cables, this structure also brings new challenges for predicting the CORC® mechanical behavior since it will be subjected to radial extrusion and circumferential stretching due to the electromagnetic force's action during operation. In this study, starting with the cabling process, the deformation of the tape, the normal contact force and friction distribution between the tapes are described. The effect of different winding parameters, such as core radius and winding helix angle, is obtained by combining theory and Finite Element Method (FEM) simulation. Detailed FEM and theoretical modeling of the REBCO tape strain state and the contact behavior between tape and core are performed to analyze the mechanical behavior of CORC® cables and wires, supported by experiments. The results describe the interaction between tapes in the cabling process, and when the contact is intensified during axial and transverse loading. The interlayer tapes are extruded and friction is generated, which affects the critical current degradation. The developed analytical and FEM models can predict the mechanical and electrical properties of CORC® cables and form a unique basis for CORC® optimization depending on its application.

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