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Novel Insulation Designs for Nb₃Sn Rutherford Cables for Particle Accelerator Magnets

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The strain sensitivity of Nb₃Sn is considered one of the main challenges that has to be solved to use the full potential of this conductor in particle accelerator magnets application. In these applications, significant forces are applied to the superconducting coils both during the assembly and cooldown to cryogenic temperatures, and then during powering. The composite coil reacts to these forces, that are distributed between the insulation and the cables. In most common designs, the cable insulation is made of impregnated glass fiber, which can be significantly damaged during the coil reaction. This paper presents novel stiffer heat resistant insulation designs, that might allow to reduce the stresses applied on the conductor. The performances of the novel designs were tested on impregnated 10-stacks. The turn-to-turn resistance was measured at cryogenic temperatures, and the mechanical properties at room temperature. Finally, the potential impact on magnet performances was numerically demonstrated on a reference dipole magnet.

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