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# Analysis of AC losses in coated conductor stack cables for fusion magnets

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High current cables for large fusion magnets can be composed of hundreds of tapes. A convenient way to deal with such large number of tapes is multi-stage cabling. The stack of tapes is a basic element for the first stage of various high current cables designs. AC losses have been evaluated analytically in the limits of very low and very high sweep rates, providing a global overview of losses over the entire sweep rate range of interest for fusion magnets. It can be easily shown that a twisted stack has almost the same AC loss than a non-twisted stack. However, when several stacks are assembled in large cables, transposition and/or twisting provides a moderate reduction of losses. Both round and flat cables were studied, the number of stacks varying from four up to twenty. Eddy current losses in copper components are also evaluated and it was found that eddy current losses could represent a significative fraction of the total loss, when the copper is present as a single, large component. Moderate loss reduction (about one order of magnitude) can be obtained by the combination of: twisting and/or transposition of the stacks, stack cross section reduction and introduction of resistive barriers in the copper elements. Some of these techniques are less effective than in fine multifilamentary cables (NbTi and Nb3Sn), simply because a wide tape has intrinsically much higher losses than a fine filament. Therefore, all cables made with tapes (twisted or not) have higher losses than cables made with fine multifilamentary wires.

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