

# Calculation of saturated coupling loss in Rutherford cables

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Inter-strand coupling loss in superconducting Rutherford cables subjected to weak transient operation is well understood, resulting in induced currents much lower than critical current of strands due to short enough twist-pitch and high enough transverse resistance. If these conditions are not fulfilled, the coupling loss saturates to hysteresis loss of an entire cable cross-section. Although such situation can barely be accepted for LTS cables due to their low temperature margin, it can actually be tolerable for high current / high field HTS cables, which are often designed using long twist-pitch or even straight strands and low transverse resistance. A dedicated study of the saturated coupling loss is performed using analytical and numerical network models. Impacts of cable design parameters (number of strands, twist-pitch,  $I_c$ ,  $n$ -value, transverse resistance) and operating conditions (transient external magnetic field and transport current) on the value of critical twist-pitch and coupling loss are investigated. Particular attention is given to the rapid transient operation commonly applied in central solenoid of fusion magnets, for which the induced currents can be affected by both saturation and screening effects.

## Category

Multi-scale and multi physics design methods

## Keywords

Rutherford cables, electrical network model, coupling loss

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