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M3Or3B-02: AC Loss in Round, Multifilamentary Superconducting Strands at High Frequencies

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This paper focusses on the AC loss of round multifilamentary superconductors over a wide frequency range, but with a focus on higher frequencies. We review the loss expressions for multifilamentary conductors and apply them to specific cases including several MgB₂ conductors (some intended for low loss) as well as a Bi:2212 conductor. The different critical frequency regimes (bounded by f_{c1} , f_{c2} , and f_{cs}) are described as well as the critical ramp rates for filamentary zone saturation ((B_c) and (B_{cs})). Cases considered include those with applied fields larger or smaller than the filamentary penetration field, as well as conditions where filamentary zone saturation occurs above or below f_{c2} or f_{c2} (depending upon B_0 and other parameters). The methods of properly combining coupling current and hysteretic loss are given in different regimes, and losses are compared for several low loss conductors over a large frequency range. The modifications required to account for the effects of flux creep (or power law behavior) on loss are included. The influences of magnetic permeability, as well as various conductor matrix regions, including the outer sheath, are also described. The loss contribution of transport currents are also given for a multifilamentary conductor, including both hysteretic and coupling terms, at low and high frequency. Finally, the loss expressions developed are used to evaluate loss from low amplitude, high frequency harmonic excitations of these conductors.

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