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Thu-Mo-Po.09-01: Development and Performance Assessment of a High-Field Superconducting Conductor Testing System

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Superconducting conductors and coils are critical components in high-field applications, requiring rigorous performance evaluation to ensure reliability and efficiency. This paper introduces the design and construction of a superconducting conductor testing apparatus, developed to assess the performance of superconducting conductors and coils under high magnetic fields. The apparatus consists of four key systems: a background magnet, a cryogenic system, a power supply system, and a measurement and control system. These systems collaboratively provide a 20 T background magnetic field, the necessary temperature range, testing currents, and data acquisition.

Finite element method (FEM) electromagnetic analysis shows that the influence of the background magnetic field and the self-field generated during current flow on the current-carrying capacity is negligible. Mechanical analysis validates that the structural design meets the anticipated performance requirements, and all components effectively fulfill their designated functions. The system demonstrates stable and safe operation.

Thermal stability analysis indicates that the cryogenic system, utilizing forced-flow helium, effectively maintains temperatures within the desired range, ensuring the apparatus meets the thermal requirements during testing. These results confirm that the testing apparatus is well-suited for reliable evaluation of superconducting conductors and coils, contributing to advancements in high-field applications.

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