COIL FABRICATION TECHNOLOGY DEVELOPMENT FOR COPPER NIOBIUM PULSED MAGNET CONDUCTORS

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Introduction

A new 75T pulsed magnet now in use at the NHMFL Pulsed Field Facility. The magnet is the first of its kind to use the high strength Cu-Nb nanocomposite conductors that are specified for the DOE 100T multi-shot magnet. A significant technology development effort has been completed to define the process for: (1) forming these stiff, high strength conductors into windings and (2) fabricating the structural components required for coil assembly. The technology development effort is described in this report.

Windings, Components Geometry and Processing

Each layer of wound conductor is helical, with a diameter specified by the magnetic design. The leads for each layer are axial, with a transition segment that is formed prior to winding the helix. (Figure 1.) Each layer is made with a set of tools unique to that layer. (Figure 2.) The windings are assembled in the relaxed state. The tool dimensions are therefore defined to compensate for the change in dimensions when the windings are released from the forming tool. These dimensions were determined by careful measurement of trial windings, and by iteration.

In the coil assembly, the windings are located by G-10 end spools that are slotted to conform to the leads and transitions. (Figures 1,3) A parametric description of the transition region is defined from measurement data collected from winding trials. The NC code used to mill the slots into the G-10 end spools is generated from this parametric description.

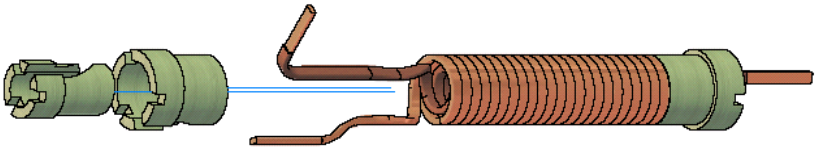

Figure 1. Exploded view of two nested coil windings with G-10 end spools

Figure 2. Side view of conductor winding tool

Fabrication Experience

With each subsequent pulsed coil design (65T prototype, 75T prototype, 65T production), the design, process methodology and tooling for making the windings have been refined. The present evolution provides repeatable and predictable coil geometries, with a significantly reduced number of rejected coils.

Figure 3. Finished conductor windings with end spools fitted