



“Test Coil Zero” on the Path to 40T

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The MagLab has wound its first mid-sized high-temperature superconducting (HTS) coil using insulated Rare Earth Barium Copper Oxygen (REBCO) conductor wound with a two-in-hand technique. This mid-sized “Test Coil 0” was operated within a 12T background field and generated an additional 12T. Test Coil 0 is an important landmark on the path to a 40T HTS User Magnet.

Test Coil 0 consists of a stack of 8 double pancake modules that required new crossover, joint, and terminal technology able to withstand high strain operating conditions of a completed magnet. As the MagLab is a user facility and its users will sweep the future 40T magnet, magnet cycling lifespan is a crucial design criteria for the 40T magnet, unlike accelerator and NMR magnets that operate at a fixed field.

Test Coil 0 was designed to put the conductor into high strain ($>0.5\%$) over many cycles. Though other MagLab-built REBCO test coils have reached many thousands of cycles, those coils were significantly smaller, consisting of only 1.9m and 250m of conductor, respectively. Test Coil 0 was wound with over 1300m of conductor and was fatigue cycled 225 times with no signs of damage!

Test Coil 0 addressed many technical challenges. With an operating current of 500A ($\sim 250\text{A}$ in each tape), it nearly doubled the ratio of transport current to critical current, reaching 50%. (The 40T design targets a 70% critical current ratio.) In addition, all of the test coil components were proven to perform well up to a transport current of 550A.

Facilities and instrumentation used: HTS Winding Shop (MS&T) and the 14 T Cryogenic magnet (ASC).

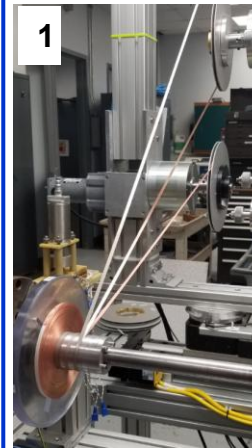


Fig 1: Reinforcement is co-wound between each pair of REBCO tapes.
Image: E. Bosque, MagLab

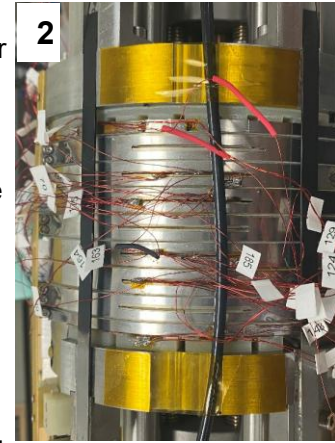


Fig 2: “Test Coil 0”, wound and instrumented just before being inserted into a 12T test bed magnet
Image: B. Jarvis, MagLab

Fig 3: (top) A sampling of ten rapid ($\sim 250\text{sec}$) fatigue cycles to 500A. Voltages (bottom) show a healthy coil.

