



# Record current density in superconducting CORC<sup>®</sup> magnet cables at 20 T

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High-field magnets that operate at magnetic fields exceeding 20 T, or at temperatures significantly above the boiling temperature of liquid helium, require the use of high-temperature superconductors (HTS). Accelerator magnets require high-current windings and very high engineering current densities  $J_e$  exceeding 200 A/mm<sup>2</sup> at the operating field. At the same time, the cable needs to be flexible, allowing it to be wound into the magnet shape without any degradation.

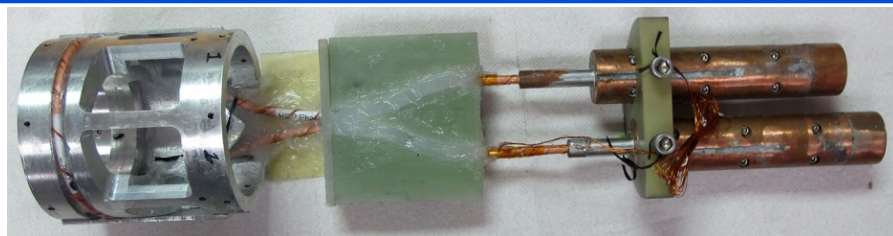
Advanced Conductor Technologies (ACT) is developing Conductor on Round Core (CORC<sup>®</sup>) cables by winding as many as 50 RE-Ba<sub>2</sub>Cu<sub>3</sub>O<sub>7-δ</sub> coated conductors in a helical fashion around a small core. The cable is bent to a diameter of 10 cm (figure 1a) and tested at magnetic fields as high as 17 T in the MagLab's Large Bore Resistive Magnet, while carrying currents in excess of 7,000 A (figure 1b). The MagLab is the only facility in the world that is capable of testing under these conditions.

A new record  $J_e$  at 17 T of 344 A/mm<sup>2</sup> was reached in a 5.1 mm diameter CORC<sup>®</sup> cable; 309 A/mm<sup>2</sup> at 20 T. This is triple the record held in 2012 and almost 50 % higher than the record set in 2014. The high- $J_e$  CORC<sup>®</sup> cable will allow for the next generation of accelerator, and other high-field, superconducting magnets that operate at fields above 20 T.

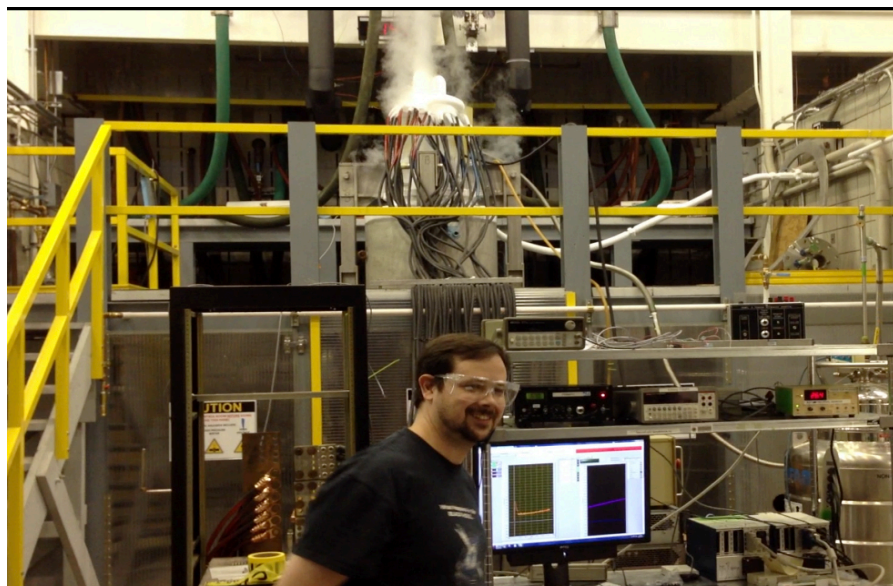
**Facilities:** Cell 4 (Large-bore resistive magnet), NHMFL

**Citation:** *Engineering current density in excess of 200 A/mm<sup>2</sup> at 20T in CORC<sup>®</sup> magnet cables containing RE-Ba<sub>2</sub>Cu<sub>3</sub>O<sub>7-δ</sub> tapes with 38 μm thick substrates*, D.C. van der Laan, L.F. Goodrich, P. Noyes, U.P. Trociewitz, A. Godeke, D. Abraimov, A. Francis and D. C. Larbalestier, **Superconductor Science and Technology** 28, 124001 (2015)

a)



b)



(a) CORC<sup>®</sup> cable installed in its sample holder with copper current leads attached. (b) A current of 7,000 A through the CORC<sup>®</sup> cable while in a background field of 17 T results in a smiling operator