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Successful demonstration of the first CORC® cable insert solenoid in 14 T background magnetic field operating at currents exceeding 4 kA, current densities of over 250 A/mm2, and 275 MPa source (JBR) stress

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Advanced Conductor Technologies has been developing high-temperature superconducting (HTS) Conductor on Round Core (CORC®) cables and wires wound from ReBa2Cu3O7-□ coated conductors for use in high-field magnets that would ultimately operate at fields exceeding 20 T. CORC® cables and wires have matured into practical high-current and high-current density magnet conductors that are being produced at long length and high quality. To demonstrate the maturity of CORC® cables for use in high-field magnets, a CORC® cable insert solenoid was developed and successfully tested in a 14 T background magnetic field. The CORC® cable solenoid was designed to operate at high current, high current density, and high Hoop stress; a combination that is essential in the development of low-inductance high-field cable magnets.

The 4-layer, 45-turn, CORC® cable insert solenoid was wound from a 19 meter long CORC® cable, containing 28 tapes of 3 mm width, and had an inner diameter of 100 mm. The CORC® solenoid was successfully tested in liquid helium in background magnetic fields of up to 14 T. The highly stable operation of the CORC® solenoid allowed for current to be increased into the superconducting transition, followed by a slow current ramp down, without causing a quench. The CORC® insert solenoid demonstrated a critical current of 4,404 A in a 14 T background field, resulting in a combined central magnetic field of 15.86 T and a peak magnetic field on the conductor of 16.77 T. The winding current density was 169 A/mm2, while the engineering current density was 282 A/mm2, which would result in a peak Hoop stress of 275 MPa. No significant degradation in critical current was measured after 16 high-current tests in high magnetic field, clearly demonstrating the robustness of the CORC® cable in high-field magnet applications.

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