The high temperature superconducting CORC® cabling technology

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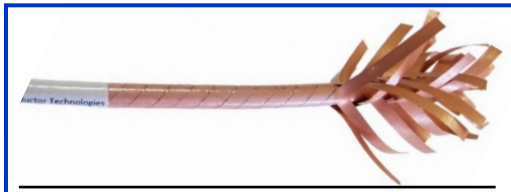
Conductor on Round Core (CORC®) technology is a cable structure with multiple layers of helically wound high-temperature-superconducting REBCO tapes. *The CORC® cable design aims to mitigate potential degradation or failure in any individual tape because current can bypass imperfections by transferring to other tapes*. This flexibility in current path reduces the risk for conductor burnout in large magnets. The tape-to-tape contact resistance, R_c, plays a critical role in the CORC® cable's ability to share current.

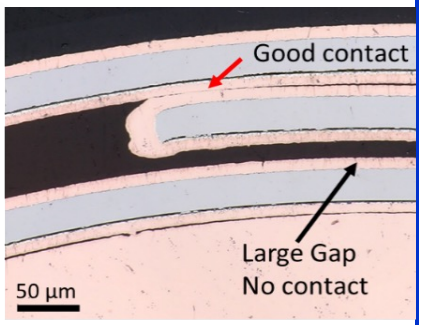
Researchers investigated the contact topography for various tape coatings intended to give the cable flexibility. *A remarkable finding was relatively large regions with no contact between layers for lubricant coatings, which explains the undesired high contact resistance. In contrast, electroplated solder was found to fill in contours between the conductors, producing a more uniform contact surface between layers, resulting in R_c values that are two to three orders of magnitude lower.* Interestingly, heating the tinned wires to flow the solder resulted in only a small further decrease in R_c, suggesting that wires need not be made inflexible to achieve low contact resistance.

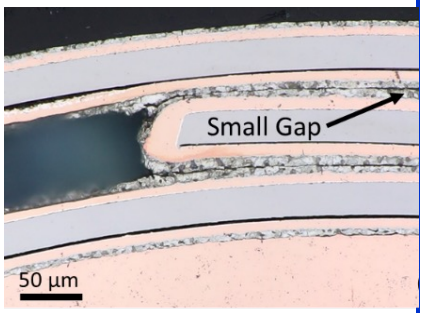
One key feature of CORC® is an ability to achieve tight bends without degradation, making magnet winding straightforward. *These results indicate that electroplated solder not only ensures good contact topography, R_c is also low enough to permit current transfer over lengths comparable to the helical winding pitch of the tapes, accomplished while maintaining wire flexib*ility.

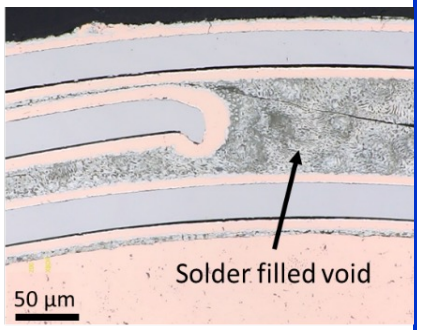


CORC® wire coating type	Contact Resistance ($\mu\Omega$ cm^2)
Teflon-like lube	1300 ± 1000
Bare (no coating)	160 ± 80
Graphite-like lube	41 ± 25
Electroplated PbSn	2 ± 0.4
Electro. PbSn plus 200 °C for 5 min	0.7 ± 0.4

Top left shows CORC® wire with shrink wrapping removed and tapes unfurled. At right are photos of the wire cross-section for (top) Teflon-like lubrication, (middle) electroplated solder, and (bottom) electroplated solder after heating. The table above shows results of contact resistance measurements for multiple configurations of current feeding and contact crossing. Hundreds of measurements were performed.







Facilities and instrumentation used: MagLab's Applied Superconductivity Center, in collaboration with CORC® cable fabrication at Advanced Conductor Technologies, Boulder CO.

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