Critical Current Measurement System for Short Sample REBCO Conductors at Varying Field Angle and Temperature

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Abstract
SuperPower manufactures high performance 2G HTS wire with exceptional in-field performance. In order to continue to develop and monitor improvements at varying temperatures and field angles, SuperPower has developed an in-house I,IBT measurement system. Routine production wire samples are tested under various temperature and field conditions to add confidence in performance beyond standard 77K self-field measurements. This presentation demonstrates the overall design, measurement concept and capabilities of the system. Data collected is compared to detailed data collected on select samples measured at national labs and other measurement systems. The implementation of this system advances the manufacturing capability to continue to monitor and provide uniform in-field performance which will meet requirements for many applications including motors, generators and high field coils.

Methods
Background Field Magnet
Uniform Background Field Across Sample
• Helmholtz Coil
• 3 Sets of double pancakes per side
• SCS4050 Co-wound with 304 stainless steel
• Dry wound for 65K LN₂ operation
• 30 mm ID x 36 mm OD
• Bridge splices between coils with SCS12050
• Mounted in rotatable support structure

Methods
Supplementary I,IBT Sample Holder
Minimized diameter to maximize Helmholtz coil effectiveness
• Capable of testing production 2, 3, and 4 mm samples
• 3 Lakeshore Cernox™ temperature sensors
• Distributed above, below, and at measure sample location
• Transverse cryogenic hall sensor located directly above sample
• Sample insulated from current leads by ceramic insert
• Current leads each have 3 parallel SCS4050 conductors soldered to back to minimize joule heating
• Sample holder anchored by insulated copper mass with heaters for temperature control
• Cool-down time less than 90 minutes to 30K

Results
Measurements on Internal I,IBT System

Measurements on External I,IBT System

Conclusion
The I,IBT system developed reliably and efficiently measures production samples at operating conditions beyond 77K self field.

Data collected from the internal I,IBT system is comparable to external sources. An ongoing effort to validate the system is underway. External data demonstrates a relationship between 4.2K 5T measurements and 4.2K 17T measurements. A key objective to this system is to validate correlations between high field low temperature data and other data points that can be measured more economically and frequently.

Acknowledgements
The authors wish to thank Randy Kelley, Mike Albertini and Sergey Repuzy for their support in the design, development and operation of this system.