COMPRESSION BENDING FINDINGS

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INTRODUCTION

The Pre/Post SOLDER operation was assigned the responsibility of addressing the deformation manifested in the bulging sections of the coil due to compressive forces by utilizing representative samples.

To fulfill this objective, three distinct samples were employed:

Sample 1:

Unprocessed High-Temperature Superconductor (HTS) incorporated with copper petals and a cooling tube.

Sample 2:

Soldered High-Temperature Superconductor (HTS) integrated with copper petals and a cooling tube.

Sample 3:

High-Temperature Superconductor (HTS) featuring copper petals and a cooling tube.

METHODOLOGY

For all samples, the 16.4 die was utilized in slot 44 on the compression bender.

The compression limit was established at 6000 PSI, with a hold duration of 5 seconds.

Sample 1 was subjected to bending at two equally spaced regions, with a single compression applied to each region.

Sample 2 underwent compression at three equally spaced regions, with two compressions applied to each region. Additionally, Sample 2 received a fourth compression, executed once.

Sample 3 was compressed at the regions a total of ten times to simulate continuous cold working over the course of a day prior to soldering.

KEY FINDINGS

KEY FINDINGS #1

HTS and solder contribute to maintaining the structural integrity of the cable; however, both materials exhibit deformation after one or two compression cycles.

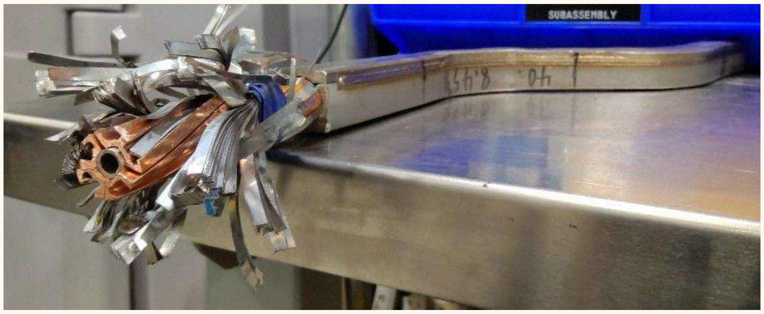
KEY FINDINGS #2

The exclusive use of copper petals results in significant distortion, resulting in the internal deformation of copper within the cable and yielding mechanical failures, even with minimal compression. Weak points are identified in each sample, exhibiting varying degrees of susceptibility depending on the infill material used.

KEY FINDINGS #3

As cable density increases, there is a corresponding increase in bending and twisting along the z-axis when subjected to identical PSI compression across all sample pieces, as illustrated in the images below.

VISUAL DATA



SAMPLE 1

SAMPLE 2

SAMPLE 3

CONCLUSION

Compression bending involves modifying multiple variables within the coil, necessitating additional assessments, including hardness testing resulting from cold working and strain aging analysis.

TAKEAWAY #1

The copper petals and high-temperature superconducting (HTS) material are being retracted from the interior of the jacket, resulting in modifications to the twist pitch and the 40 mm window designated for cable installation.

TAKEAWAY #2

Warping is a critical issue that directly impacts the cable integrity due to compression bending. The images indicate that the compression bending method currently employed by CFS may be a contributing factor to fiber breakage.

TAKEAWAY #3

The quantity of compressions necessary to attain accurate joggle locations is directly proportional to the degree of visual and mechanical distortion present in the cable.