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M3Or3B-08: AC loss in MgB2 and Bi-2212 wires excited by a permanent magnet rotor

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Electrified aircraft are being developed to address climate change by reducing the fuel burn and emissions of aircraft. The large majority of aviation's impact on the environment is caused by large transport aircraft, or those that can carry about 150+ passengers. At this scale, megawatt-class electrified propulsion systems are required. Superconducting and cryogenic electric machines are an attractive technology for such applications due to their very high specific power and, often more importantly, their very high efficiency. Most of these electric machines employ superconductors only in a machine's field winding (typically on its rotor) where the superconductor is only excited by direct current and essentially constant magnetic field. Improved specific power and efficiency can be achieved if superconductors are also used in the machine's armature winding (typically on its stator). However, doing so requires superconductors with low AC loss. In the past 5 years, promising progress in the development of low AC loss superconductors has occurred, but experimental validation of the loss is still lacking, especially under magnetic loading that is representative of electric machines.

This paper will present measurements of the AC loss in unpowered MgB2 and Bi-2212 superconducting wires excited by a permanent magnet rotor. Data for two different MgB2 and one Bi-2212 wires will be included. Each wire was designed to achieve state-of-the-art levels of AC loss. Details on the construction of each wire will be included in the final paper. Losses are measured using two methods: (a) conventional calorimetry of the gaseous helium coolant and (b) null calorimetry. Losses are measured for a range of temperature and a magnetic field with fixed strength but variable frequency (0 to 400 Hz). Predictions of the temperature difference between the wires and helium gas will be included to refine the reported temperature. Data will be compared to AC loss calculations based on equations available in the literature.

The test rig used to obtain the measurements will be commissioned in January. A number of the rig's check out tests have been completed. The wire specimens and coil pack hardware is in hand. The test articles will be assembled in early January. This will leave more than enough time to troubleshoot any issues, complete the testing, complete the paper, and receive internal approval to release the presentation before the May 18 upload deadline.

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