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M2Or1C-08: The low temperature thermal expansion of materials used for superconducting magnets

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Although the low temperature thermal expansion properties of quite a few materials have been reported in the literature, the need for the confirmation of the relatively sparse data and the generation of new data for different and new materials is needed. Here we report thermal expansion measurement data on an array of materials ranging from neat resins to high strength super-alloys as well as composite superconductors. The thermal expansion (or contraction) is measured from the reference temperature of 293 K to 4 K (liquid helium temperature) using a classic tube type dilatometer. The dilatometer is capable of testing two bulk material specimens (about 50 mm long with 20 to 40 square mm cross section) at a time. The instrument is calibrated with tests on OFHC Copper reference material and the measurement accuracy is estimated to be 1 to 2 %. Tests are conducted by warming the sample from 4 K to 293 K, the thermal cycle is repeated a minimum of 3 times on each material to generate a trustworthy thermal expansion vs temperature curve. Interesting results are presented for the low thermal expansion material Invar along with data for high expansion materials such as Teflon. The data for two common superconducting magnet impregnation epoxies (NMHFL 61 and DGBEF/anhydride used for the ITER Central Solenoids) are also presented.

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