



## Performance Data for Discovery Xenon Flash (DXF) Thermal Diffusivity System

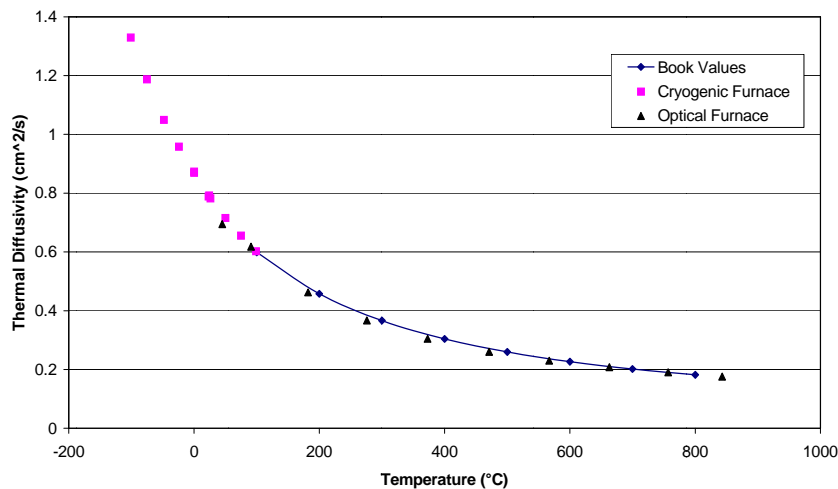
An often asked question regarding the Discovery Xenon Flash (DXF) system, and more specifically of the use of High Speed Xenon-pulse Delivery (HSXD) is how its performance compares to that of traditional laser-based flash devices. There is no better way to answer this than with test data obtained using reference materials, and for a broader interpretation, materials whose characteristics have been amply described in the literature.

The difficulty is often with proper choice of such materials and the sparseness of available references in this field. The following pages demonstrate the data obtained using a variety of materials, bracketing the entire range of thermal diffusivity for which the method is generally considered applicable.

### NIST Graphite

NIST<sup>1</sup> supplies SRM8426, a high diffusivity material as a thermal conductivity standard. With the knowledge of specific heat capacity and density, and careful attention to details surrounding the samples [1], a set of “book values” for thermal diffusivity were derived. Figure 1 shows the data obtained using the FL3000 High-Speed System (IR heated) in a multisample configuration, and the Cryogenic System in a single sample configuration, as it compares to the book value.

Thermal Diffusivity of NIST Graphite



<sup>1</sup> National Institute of Standards and Technology, Gaithersburg, MD

It should be noted that each point plotted is an average of at least 3 tests on each of 3 samples, in all 3 positions of the sample holder. The scatter in all cases was within a  $\pm 2\%$  band, for all data.

## OFHC Copper

Copper, due to its very high thermal diffusivity is considered to be a difficult material to test. Figure 2 shows that the FL-3000 had no problems whatsoever to stay within  $\pm 1.3\%$  of the best available literature values.

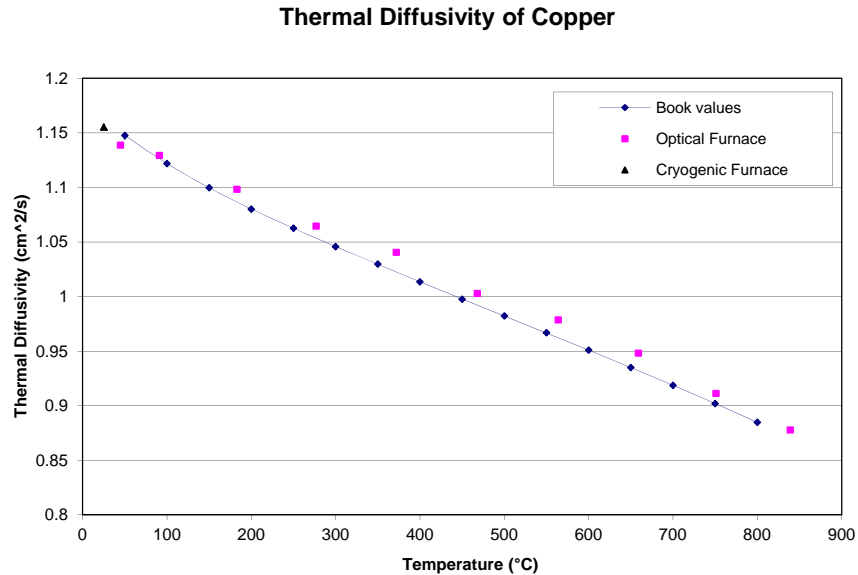


Figure 3 shows the specific heat capacity as measured with this system. The  $\pm 1\%$  agreement with published data makes this system a rival or even a superior to DSC, especially since most DSC systems can not even reach  $1000^{\circ}\text{C}$ . It should be noted that such accuracy and high reproducibility is attained by having the reference and unknown reside next to each other in the multiple sample holder, and be tested alternately a minute apart from each other. Single sample systems must test the reference over the temperature range first, cool down, replace it with a sample, and repeat the test over the range. It is often a practice to use one calibration run for subsequent tests stretching over weeks or even months. This, inevitably account for the 7-10% accuracy assigned to such data by our competition.

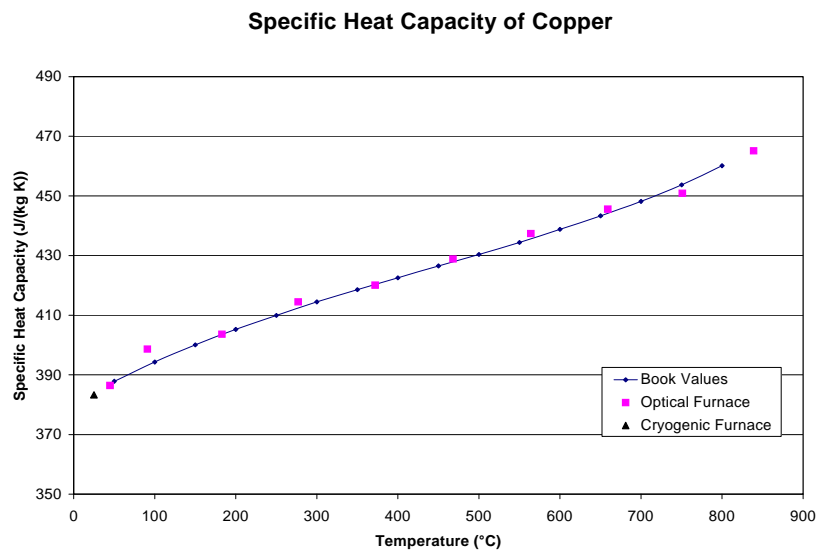


Figure 4 shows the values of thermal conductivity the system automatically calculates after the completion of the test (density data entered from external source). It is hard to find any direct thermal conductivity test method that can produce  $\pm 1\%$  accurate data near  $1000^{\circ}\text{C}$ , so this absolute method now is superior to most direct measurement due to the co-measured specific heat with multiple sample placement.

### Thermal Conductivity of Copper

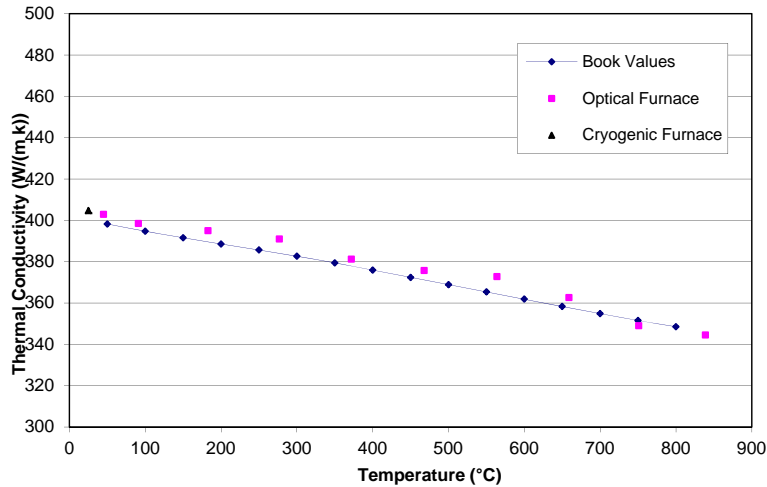
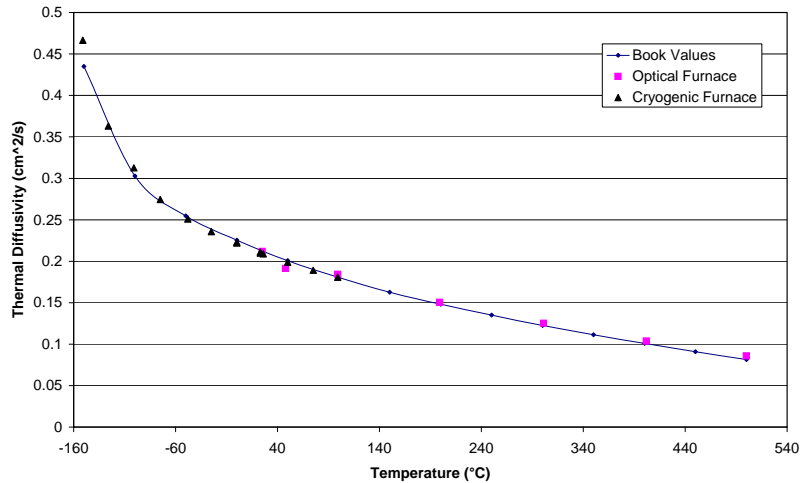


Figure 5 shows thermal diffusivity data obtained on electrolytic iron (in literature it has been historically called “Armco Iron”). The results are again within about  $\pm 2.0\%$  of some published data. It should be noted that reported Armco Iron data spans a 5-6% band by itself. Our least accurate point is at ambient due to the low radiant energy emission received by the IR detector. In this range, however, the solid state sensor employed by in the Cryogenic Furnace has shown perfect agreement. Thus, when very accurate room temperature measurements are of paramount importance one should use either the Room Temperature Station, or the Cryogenic Furnace. It is notable though that the worst data produced by the DXF system is still many times better than the published accuracy claim of the competition.

### Thermal Diffusivity of Electrolytic Iron



## References

[1] Hust, J.G. and A.B. Lankford, 1984, NBS Report of Investigation on Research Materials 8424, 8425 and 8426, Graphite, Gaithersburg, MD.

[2] Hust, J.G. and A.B. Lankford, 1984, NBS Report of Investigation on Research Materials 8420 and 8421, Electrolytic Iron, Gaithersburg, MD.

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