Pulse Characteristics, HSXD Source Discovery Xenon Flash System

The Discovery Xenon Flash (DXF) System employs a High Speed Xenon-pulse Delivery source (HSXD) which is considerably lower cost than a laser and under most circumstances generates equally good results. TA Instruments (Anter) pioneered a reflective optic configuration that effectively harnesses the power of a Xenon flash tube (similar to the type used to pump pulse lasers), and with the aid of proprietary wave guides delivers it to the sample inside a furnace. A limitation of this solution is the distance the wave guide can span and the type of furnace it can operate with. It can effectively work in systems up to 1200°C, but not above where the sample is more deeply inside the furnace cavity. The tremendous advantage of the HSXD over the laser is that it is nearly 20 times more efficient, so for the same power pulse, the power supply is substantially smaller and less complex. Additionally, the absence of the laser rod and resonator cavity reduces both initial cost, and maintenance cost. Having fewer critical parts, the expense of operating the system is nearly one half of a comparable laser based unit.

The following are characteristics of the HSXD subsystem, as measured through the standard size wave guide.

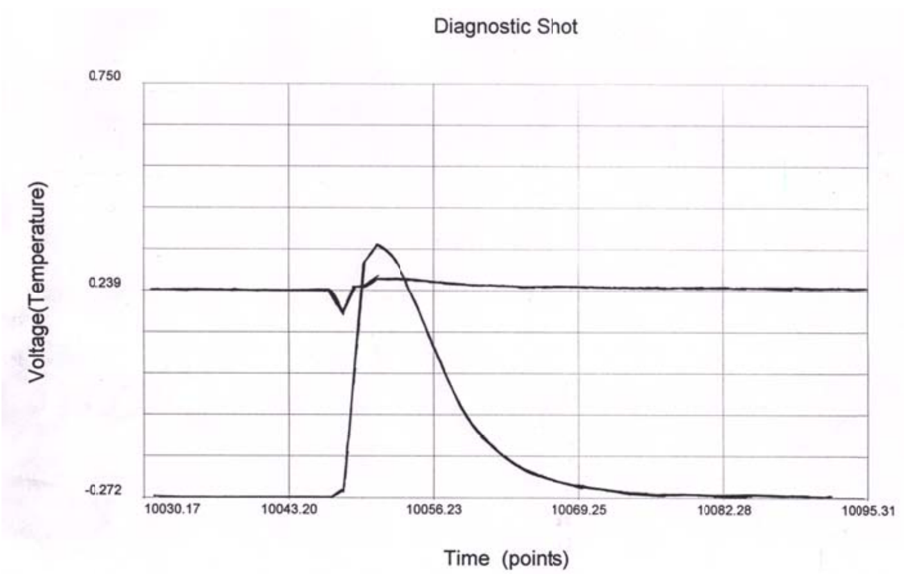


Figure 1 is a temporal record of the flash (large signal), and of the beginning of the trace for the rear face sample temperature, recorded concurrently. The small "V" shaped notch on the thermogram signifies the occurrence of the high voltage trigger pulse. Competitive systems always use this as the "start time" for the test, because they do not record the flash itself. It is obvious from Figure 1 that such practice is erroneous as the center of gravity for the pulse as recorded and shown on the trace is some 500µs later than the trigger pulse. This can be very detrimental when thin or highly diffuse samples are tested. When the $t_{1/2}$ time is below 10ms, this by itself, will cause a minimum of 1% error. In the FlashLine Systems, this error is totally avoided by the dual recording.

The pulse width at 50% of peak power is typically 600µs, varying very little with the amount of energy for the shot.

Figure 2 shows the same, but more in the perspective of the entire thermogram. This trace is a plot of the “as recorded” raw data.

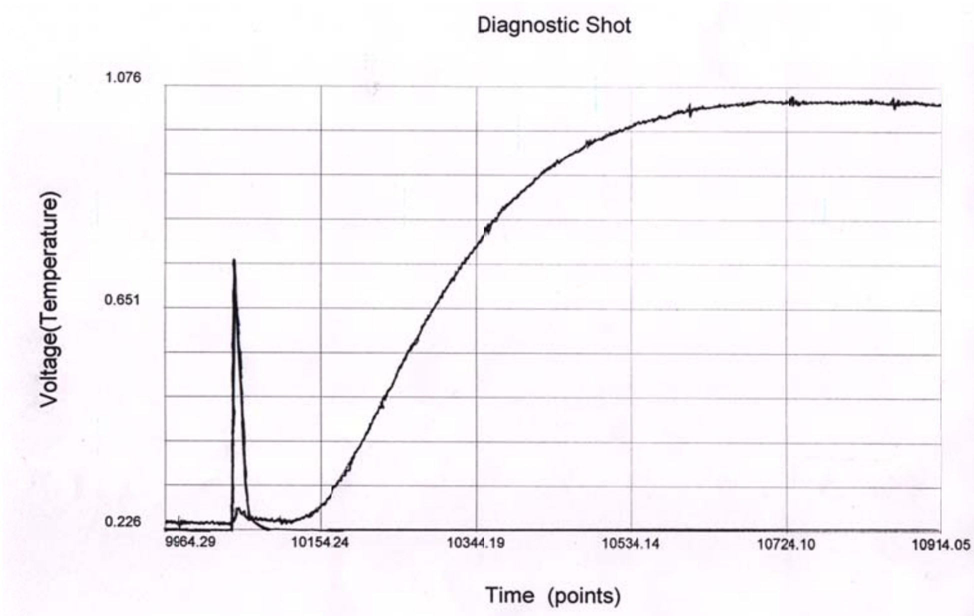
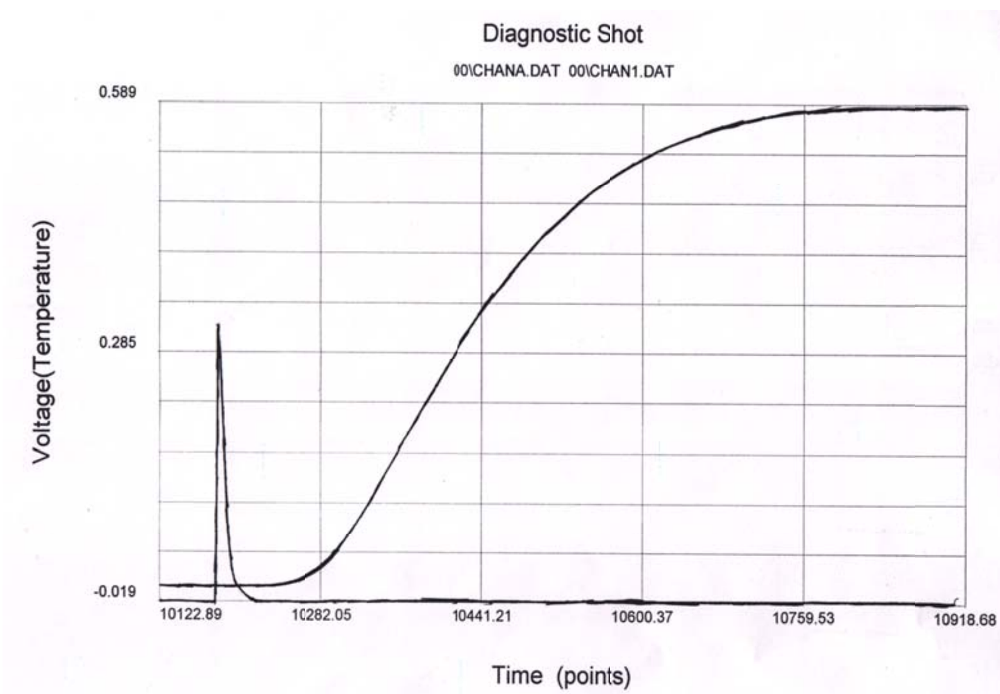


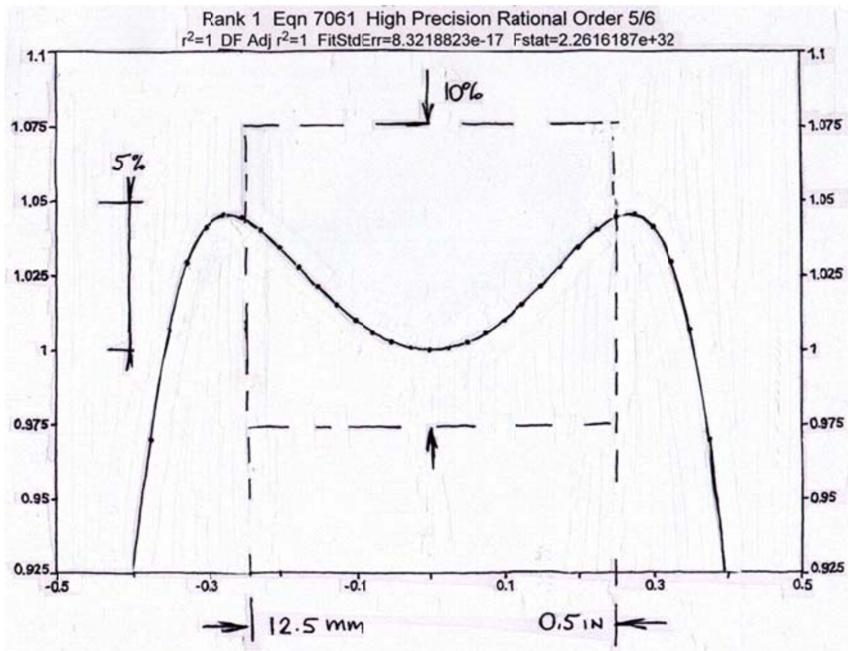
Figure 3 shows a similar data set as the one shown on Figure 2, but after active filter processing to remove noise from the thermogram without distortion to its shape.

It is critical to have uniform illumination of the sample over it’s entire front face. It has been shown[1] that nonuniformity, often a natural result of using straight laser shots, can lead to as much as 5% error. The HSXD pulse when it is passed through the wave guide is quite homogeneous.



[1] T. Baba et al, “Experimental Investigation of the nonuniform heating effect in laser flash thermal diffusivity measurements”, *Thermochim. Acta* Vol218 (1993) pp 329-339

Figure 4 shows the distribution of intensity measured across the beam, and the variations within the region (-.25 to +.25in) occupied by the sample. Approximate homogeneity is 95%, considerably better than what one may obtain from a direct firing laser, especially over time.



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