THERMAL OUTPUT FROM ENERGETIC EVENTS – A THERMODYNAMIC APPROACH

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There are a number of methods for predicting the thermal output from an energetic event (such as in RISKWING or AASTP-1). As the hazard is considered greatest from large amounts of deflagrating propellant or pyrotechnics these models tend to compute the heat dose over a long duration (>5 seconds).

We have measured thermal output from fast energetic events with surface mounted heat flux gauges. We have adopted a thermodynamic approach to the heat output, assuming that a certain percentage of the total available heat must leave the arena as radiation and pass through a surface at the distance of interest. This allows us to predict heat dose at that distance. We can also correct for atmospheric humidity, which allows us to give a better estimate of the effect of distance than the simple inverse square rule.

The percentage output as radiation varies from about 2% of the theoretical thermodynamic output (as heat of explosion or combustion as appropriate) for heavily cased weapons through 15% to 20% for oxygen deficient bare explosives to 20-30% for lightly cased explosives and general fires. We have studied deflagration of explosives, pyrotechnics, fuel-fires and the contribution of hydrocarbon fuels to the thermal load in weapons containing both explosives and kerosene. We have observed afterburning effects from oxygen deficient explosives that add to the thermal output.

Our gauges also enable us to measure convection from hot reaction products which can more than double the heat dose downwind, especially if the wind speed is greater than 5 m/s.

This paper will describe the instrumentation developed, the experimental data recorded for various explosives and munitions and our findings.