



Feasibility of Improving UN Test Series 6(c) Bonfire Test

Research and Development Forum

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Why research improvements for the UN 6(c) Bonfire Test?

- Improve the UN 6(c) Bonfire Test by investigating new technologies and evaluate the reproducibility of the test results
- Current procedures present difficulties in measuring thermal output of energetic events (thermal flux)
- Research is necessary to identify if new technology or procedures can help quantify thermal events in the current test setup.





UN Manual of Tests and Criteria (MTC) Classification of Division 1.1, 1.2, 1.3, 1.4, 1.4S explosives

UN 6(c) Bonfire Test

0.15 m³ package volume, witness screens 4 meters from package edge





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UN 6(c) Bonfire Test

0.15 m³ package volume, witness screens 4 meters from package edge

–Division 1.1

- Does package mass explode?

–Division 1.2

- Perforations in witness screens or >20J projections?

–Division 1.3

- Fireball >4 meter, fiery projection >15m, **thermal effect criteria**

–Division 1.4 (not S)

- Fireball >1 meter, fiery projection >5m, screen dent >4mm, >8J projection, **thermal effect criteria**

- Division 1.4S (passes all other criteria)





Thermal Effect – 1.3, 1.4, or 1.4S?

- Thermal Effect:
 - based upon average thermal flux at various distances
 - may also be calculated as burn time of given mass, scaled for actual weight of material and specific heat of combustion
- Division 1.3 - average thermal flux $>4 \text{ kW/m}^2$ at 15 meters from package
 - burning time of product less than 35 seconds for 100 kg net explosive mass
- Division 1.4 – average thermal flux $>4 \text{ kW/m}^2$ at 5 meters from package
 - Burning time of product less than 330 seconds for 100 kg net explosive mass
- Division 1.4S – average thermal flux $<4 \text{ kW/m}^2$ at 5 meters from package
 - Burning time of product exceeds 330 seconds for 100 kg net explosive mass





Difficulties with Thermal Effect Measurement

- Direct measurement of average thermal flux with irradiometers may be difficult due to issues with calibration and baseline correction, especially with wood fires.
 - Newer irradiometer technology may be able to overcome this
- Burn time calculation only works if the mass of material burning in each “event” is known. Must see separate identifiable events.
 - High Speed camera might be able to identify separate events
- Propane fire may burn more evenly with less background noise.

