A FAST COOK OFF ASSESSMENT OF U.S. NAVY LEGACY WEAPONS

Weapons Division

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Overview

- Objective
- History
- Approach
- Progress
- Summary
- Conclusions

Objective

- **Provide data to update document for shipboard aviation firefighting activities**
  - **Identify or generate fast cook-off (FCO) data for legacy energetics that are currently found on the aircraft carrier deck**
    - **Time to reaction**
    - **Severity of reaction**
    - **Placement of firefighters**


89
200

Approach

- **Identify ordnance items which might be found on the carrier deck for which there is no FCO data**
  - **Locate data where it exists**
  - **Test items where there is no data**

Question

- What ordnance items might be found on the carrier deck?
  - Initial list supplied by the office of aviation firefighters
    - 41 items
      - 16 not currently in fleet
  - Several versions not listed
    - Example = TOW missile
      - One on list but 10 versions in fleet
  - Supplemental list provided at NAVAIR WD
    - 201 items with greater than one pound energetic
  - Next step: Prioritize those items of greatest concern

Prioritization

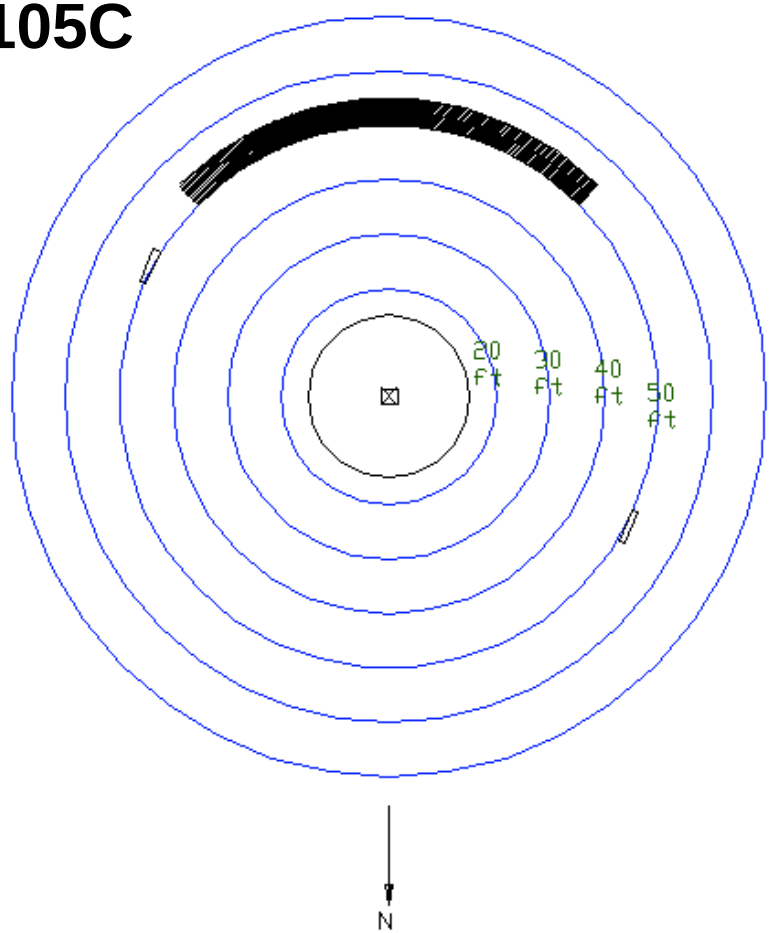
- **Consulted with aviation firefighters December 2003**
  - **Provided list of 37 priority items**
- **Acquired items through the Non-Combat Expenditure Allowance (NCEA)**
  - **Six week minimum lead time**
  - **Some items are not readily available**
- **Testing is determined by what is available**

Progress

- **FCO data located for many items**
  - **Document with references has been prepared**
- **Five items tested to date**
  - **Grenades**
  - **Various Marine markers**
  - **Two tests: 2.75-inch smoke warhead (4 per test)**

FCO Experiment

Testing as described in MIL-STD-2105C



Note: Where practical, items are being tested as would be found on deck

FCO Experiment

- 29-foot (8.8-m) diameter pool filled with 1500 gallons (5.7 m^3) of JP-8 fuel
  - Eight gallons (0.03 m^3) of gasoline added as ignition aide
- Bikini gages at two locations, 50 feet (15.2 m) from item
  - 45 degrees from forward and aft end
- Four thermocouples
- Pre and post test digital images
- Four color video cameras
- List of recovered materials
- Post test debris map

Bikini Gages

Pretest

1 in. = 2.54 cm

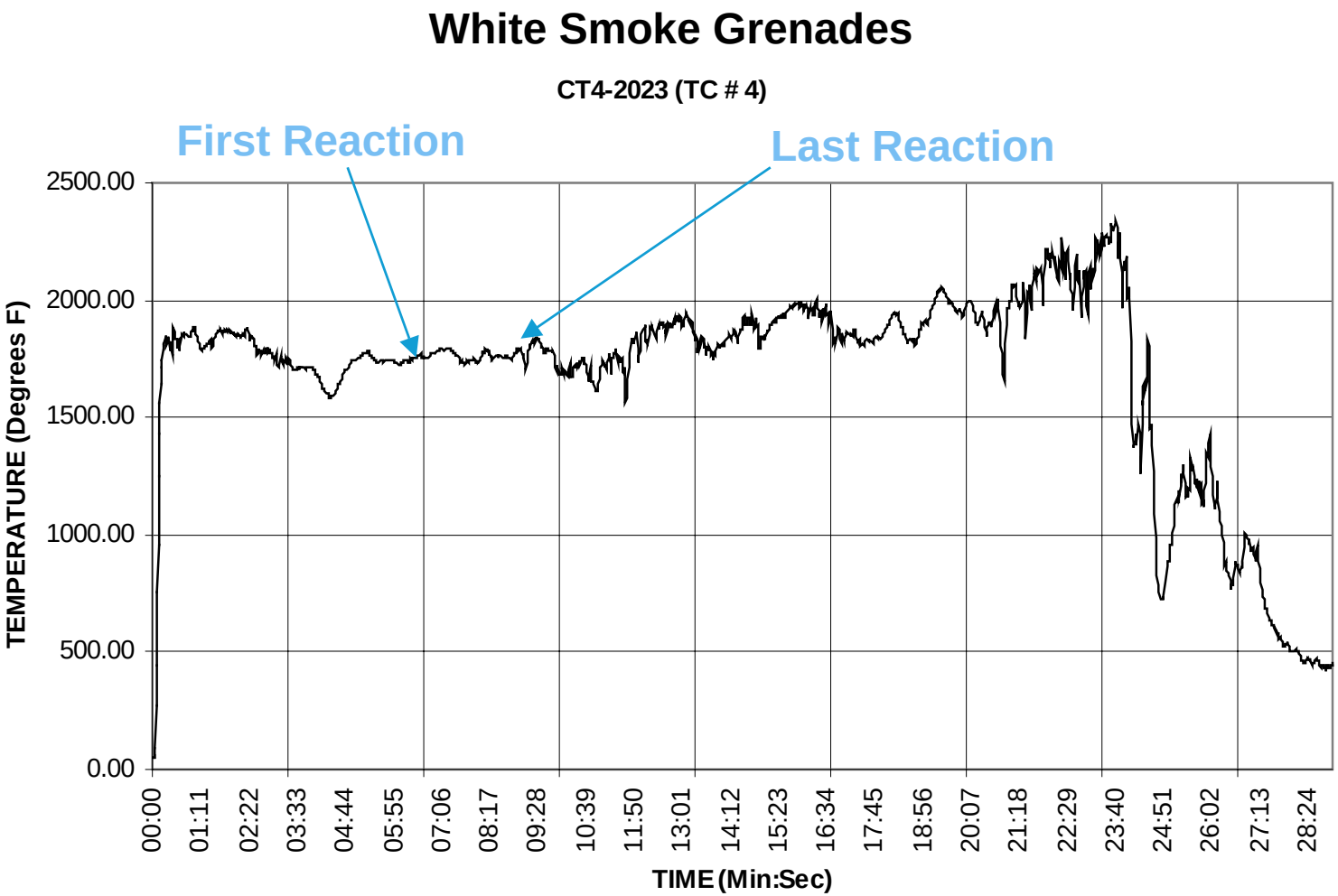
1 psi = 0.0068948 MPa

Bikini gage hole diameter – in. (cm)	Minimum pressure to rupture – psi (MPa)
10 (25.4)	0.95 (0.007)
4.5	1.9
2.75	2.8
2	3.7
1.5	4.6
15/16	6.9
43/64	9.1
19/64	18.0
11/64 (0.437)	28.0 (0.193)

Pressure Effects

- **1 psi (0.007 MPa): person knocked down**
- **5 psi (0.035 MPa): eardrum rupture**
- **200-250 psi: nearly 100% lethality**

Thermocouple Data

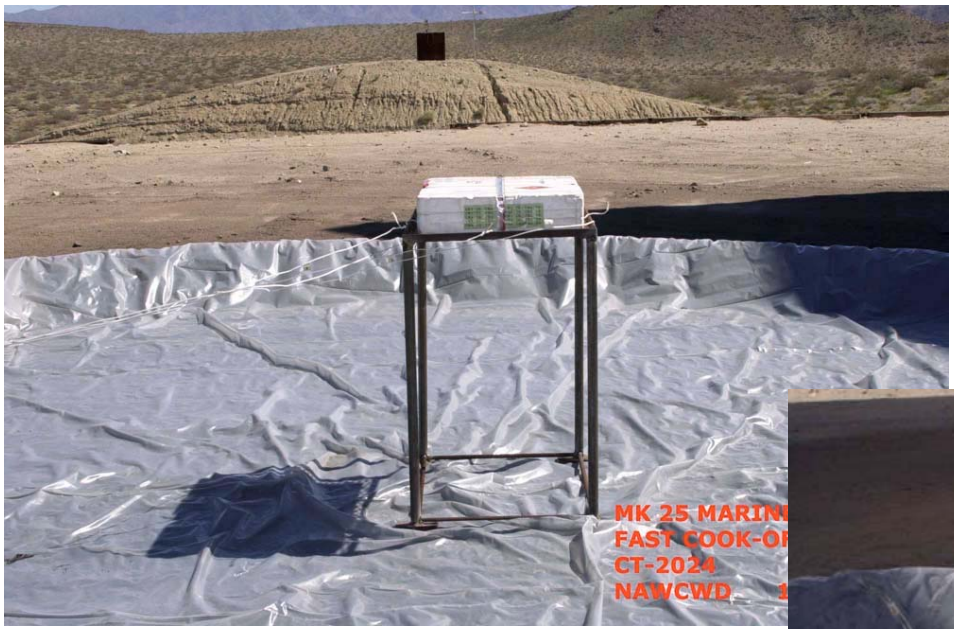


Crate Items

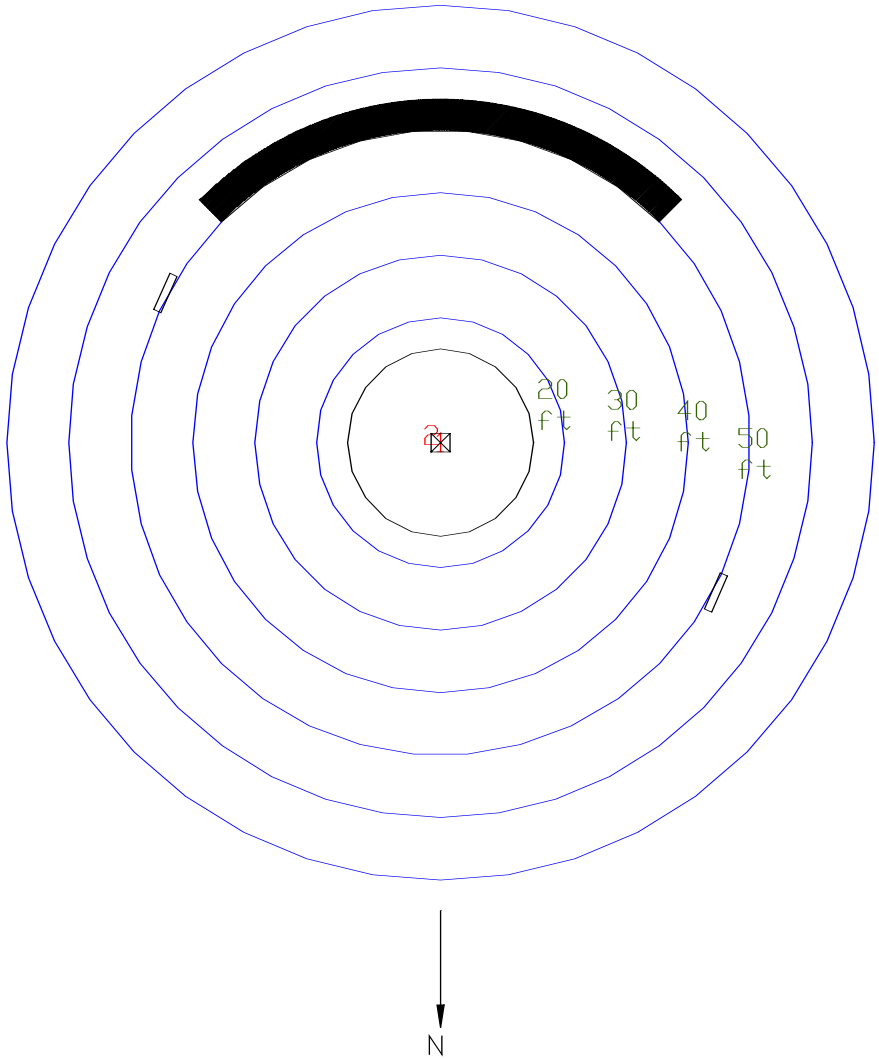
Crate Items: Test Configuration

- **Crate Items**
  - **Grenades**
  - **Marine markers**
- **Configuration**
  - **Ordnance within container facing barrier**
  - **Items placed on steel mesh catch table**
  - **Four thermocouples 4 inches from item**

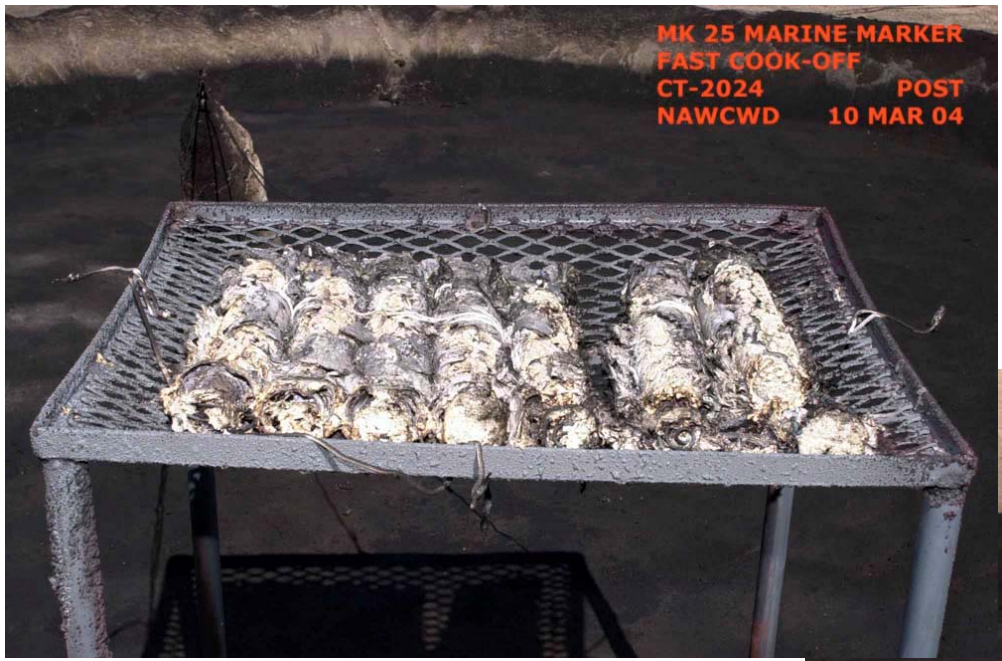
Crate Items: Test Configuration



Crate Items: Debris Map



Crate Items: Post Test Debris

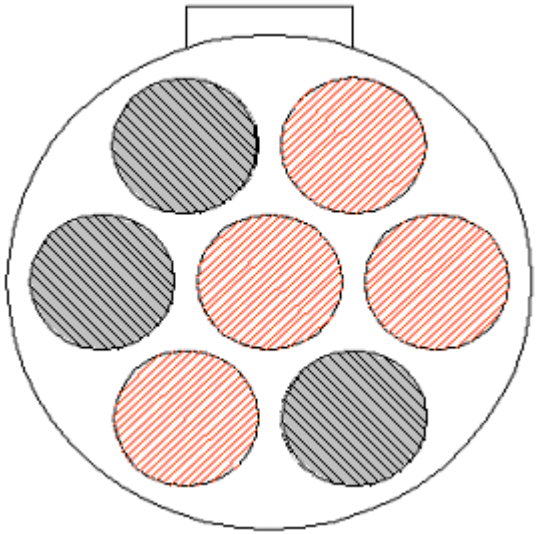


NAVAIR

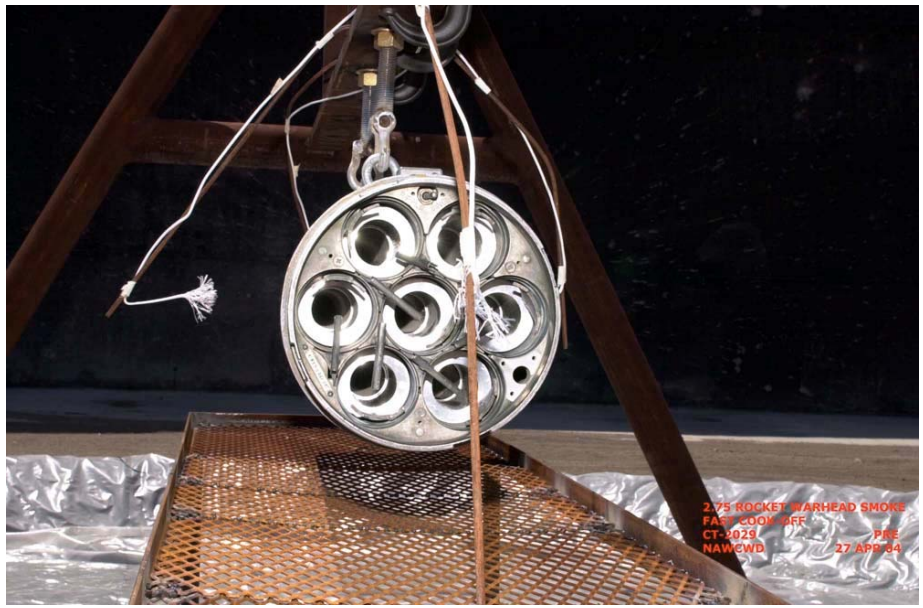
2.75” Rocket Warhead, Smoke

2.75” Smoke Warhead: Test Configuration

2.75” Smoke Warhead
4 live and 3 inert warheads
Mock rocket motors

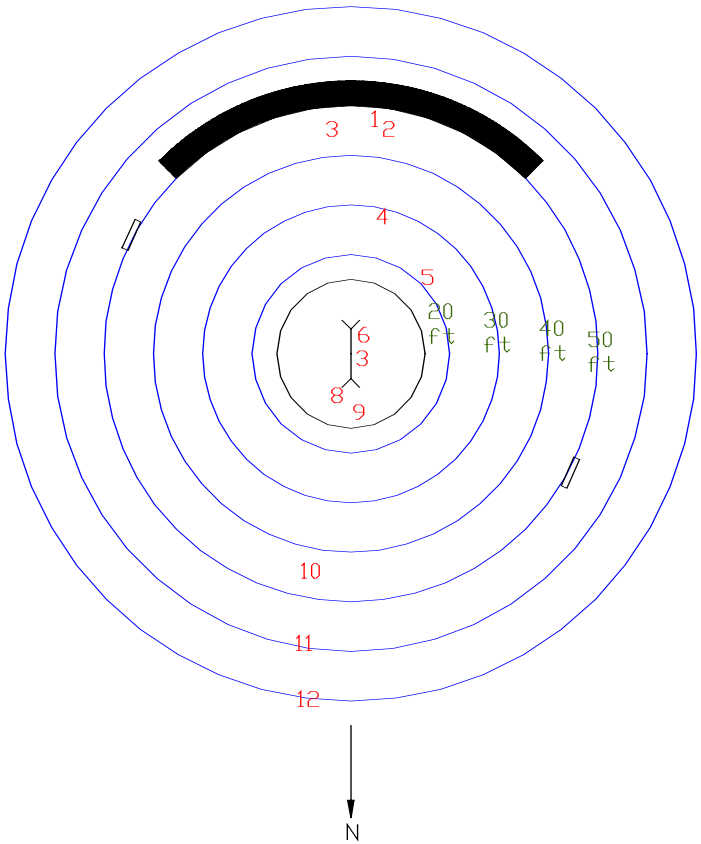


Aft View

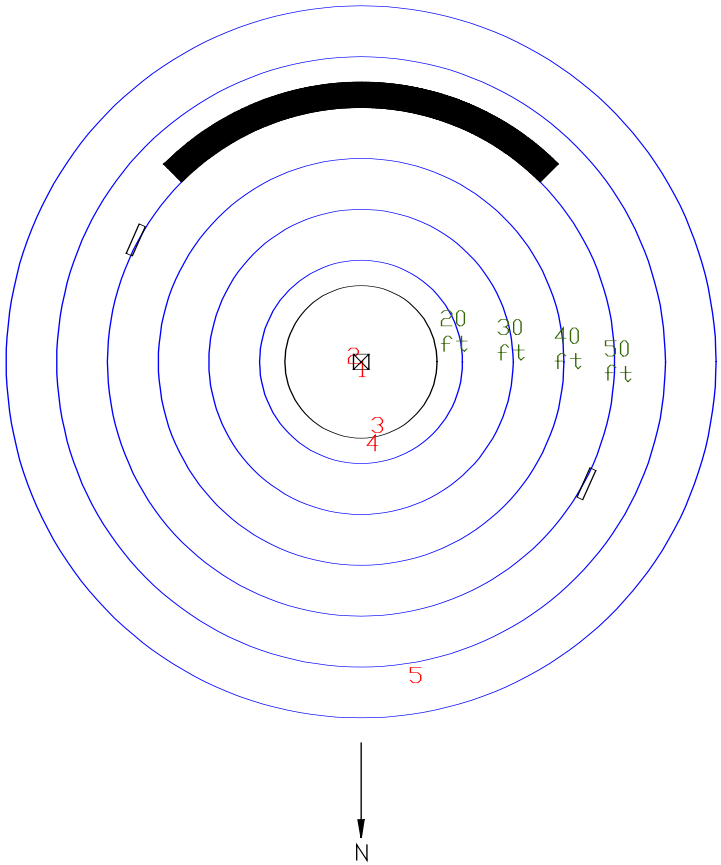


2.75” Smoke Warhead: Debris Maps

CT-2022



CT-2029



2.75” Smoke Warheads: Expended

Collected from Test 1

Collected from Test 2

Summary

- ~ 200 legacy ordnance items which can be found on carrier have been identified
  - Initial source from aviation firefighting community
  - Additional source from NAVAIR WD
- FCO data has been located and referenced for ~110 items
  - Data to be reviewed for specific needs
- Testing has been initiated where data cannot be located
  - Priority established by the aviation firefighting community and what is available

Summary (cont'd)

- **FCO testing according to MIL-STD-2105C completed for five items**
  - **No detonations**
  - **No over pressures observed for items tested to date**
  - **No fragments recovered outside the test stand for these items – mild burn**
    - **Grenades**
    - **Marine markers**

Summary (cont'd)

- **2.75" Rocket Warhead, Smoke**
  - **Fragments thrown > 50 feet**
    - **Hazardous residue**
  - **Tests indicate a reaction violence consistent with at least a deflagration reaction with propulsion**
  - **Relative repeatability observed in behavior, not necessarily time to reaction**

Conclusions

- Test data provides preliminary basis for informed decision-making
- Proceed with caution with data implementation
  - Test parameters subject to variability
  - Understanding the limitations of data
  - Lack of statistical representation
- Testing alone is not enough
  - Useful in conjunction with modeling and simulation