Development of an Alternative for the External Means of Initiation for Hazard Classification of Rocket Motors

Naval Air Warfare Center Weapons Division
China Lake, California

R.S. Henry
Air Force Safety Center
Kirtland AFB, New Mexico

J. Covino
Department of Defense Explosives Safety Board
Alexandria, Virginia

K.R. Carr
NNSA Service Center Department of Energy
# Development of an Alternative for the External Means of Initiation for Hazard Classification of Rocket Motors

## 1. REPORT DATE
JUL 2010

## 2. REPORT TYPE
N/A

## 3. DATES COVERED
-

## 4. TITLE AND SUBTITLE
Development of an Alternative for the External Means of Initiation for Hazard Classification of Rocket Motors

## 5. AUTHOR(S)

## 6. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Naval Air Warfare Center Weapons Division, China Lake, California

## 7. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

## 8. PERFORMING ORGANIZATION REPORT NUMBER

## 9. SPONSOR/MONITOR'S ACRONYM(S)

## 10. SPONSOR/MONITOR'S REPORT NUMBER(S)

## 11. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

## 12. SUPPLEMENTARY NOTES
See also ADM002313. Department of Defense Explosives Safety Board Seminar (34th) held in Portland, Oregon on 13-15 July 2010, The original document contains color images.

## 13. ABSTRACT

## 14. SUBJECT TERMS

## 15. SECURITY CLASSIFICATION OF:  
a. REPORT  
unclassified  
b. ABSTRACT  
unclassified  
c. THIS PAGE  
unclassified

## 16. SECURITY CLASSIFICATION OF:

## 17. LIMITATION OF ABSTRACT  
SAR

## 18. NUMBER OF PAGES  
22

## 19. NAME OF RESPONSIBLE PERSON

---

Standard Form 298 (Rev. 8-98)  
Prepared by ANSI Std Z39-18
Purpose

• Rewrite of TB 700-2 requires
  – Single Package Test
    • Sympathetic Reaction Test if expected outside reactions

• Large Diameter Rocket Motors
  – Not transported or stored in stack configuration
  – Alternate Test Used
    • Super Large Scale Gap Test
Background

• Harmonization of IM and HC
  – Shape Charge Threat

• New Alternate proposed in 2008
  DDESB seminar
  – Super Large Scale Gap Test with 81mm Shape Charge stimulus
Test Configuration
Vertical Configuration

- **RP-83 Detonator**
- **81 mm BRL Shape Charge**
- **Aluminum block**
- **Piezo-electric pins**
- **Witness Plate**
Example of Shock Velocity

Distance from Shaped Charge Impact (inches)

Average Velocity (mm/microsecond)
Horizontal Configuration

- **RP-83 Detonator**
- **81 mm BRL Shape Charge**
- **Aluminum block**
- **Test Asset**
- **Witness Plates**
- **Piezo-electric pins**
Samples
Samples

- **HD 1.1**
  - PBXN-109 – HTPB/RDX/Al
  - Critical Diameter less than 2.54 cm

- **HD 1.3**
  - AP/HTPB/Al
  - Critical Diameter > 213 cm
Test Configuration

• 6 Tests performed
  – 4 - PBXN-109
    • Vertical Orientation
      – Steel
      – PVC
    • Horizontal Orientation
  – 2 - HD 1.3 Propellant
    • Vertical Orientation
Results
<table>
<thead>
<tr>
<th>Photron</th>
<th>FASTCAM SA1.1 model ...</th>
</tr>
</thead>
<tbody>
<tr>
<td>100000 fps</td>
<td>1/100000 sec</td>
</tr>
<tr>
<td>Manual 559139</td>
<td>frame : 99997</td>
</tr>
<tr>
<td></td>
<td>192 x 192</td>
</tr>
<tr>
<td></td>
<td>+00:00:00.99997</td>
</tr>
</tbody>
</table>
HD 1.1 Vertical Configuration

SN-B6-0061

![Graph showing the relationship between position on specimen (inches) and average velocity (mm/microsecond).]
HD 1.1 Horizontal Configuration

**Photron**

- 100000 fps
- Manual 559139

**FASTCAM SA1.1 model**

- 1/100000 sec
- frame : 99995
- 192 x 192
- +00:00:00.99995
HD 1.1 Horizontal Configuration

SN-B6-0062

Velocity (mm/microseconds) vs. Position from the West End (inches)

West Pins — East Pins
HD 1.3 Vertical Configuration

**Photron**
- FASTCAM SA1.1 model
- 100000 fps
- 1/100000 sec
- Manual 62127
- frame : -11
- 192 x 192
- -00:00:00.00011
HD 1.3 Vertical Configuration

SN-B6-0065

Distance from Shaped Charge Impact (inches)

Average Velocity (mm/microsecond)
# Summarized Results

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Orientation</strong></td>
<td>Vertical</td>
<td>Horizontal</td>
<td>Vertical</td>
<td>Horizontal</td>
<td>Vertical</td>
<td>Vertical</td>
</tr>
<tr>
<td><strong>Energetic Material</strong></td>
<td>PBXN-109</td>
<td>PBXN-109</td>
<td>PBXN-109</td>
<td>PBXN-109</td>
<td>1.3 Propellant</td>
<td>1.3 Propellant</td>
</tr>
<tr>
<td><strong>Case Material</strong></td>
<td>Steel</td>
<td>Steel</td>
<td>Plastic</td>
<td>Plastic</td>
<td>Steel</td>
<td>Plastic</td>
</tr>
<tr>
<td><strong>Pins: Go/No Go</strong></td>
<td>Go</td>
<td>Go</td>
<td>Go</td>
<td>N/A</td>
<td>No Go</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Witness Go/No Go</strong></td>
<td>Go</td>
<td>Go</td>
<td>Go</td>
<td>No Go</td>
<td>No Go</td>
<td>No Go</td>
</tr>
</tbody>
</table>
Conclusions

• Differentiate between HD 1.1 and HD 1.3 in vertical configuration
  – HD 1.3 Large critical diameter
  – Did not detonate

• Confinement effect in horizontal configuration – PBXN-109
Future Work

• Continue Populating Database
  – HD 1.1, 1.2.X, and 1.3

• Refinement of Horizontal Configuration
  – Witness Plates to sides of item
  – Different Velocity technique
    • Crush Bar
Extra Slides
Pin Mixer Data

Amplitude (Volts)

Time (microseconds)