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Testing Capabilities and Instrumentation Strategies

TDW, Christian Euba

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NDIA, 58TH Fuze Conference
1) TDW’s legacy in smart hard target fuzing

2) ESAD based Hard Target Fuze

3) Simulation of Hard Target Fuze Shock Environment

4) Component level testing

5) Conclusion & Final Hard Target Fuze verification
TDW’s legacy in smart hard target fuzing

PIMPF - The German
Hard Target Fuze is ready

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Schrobenhausen, GERMANY
THE WORLD OF FUZING
THE 46TH ANNUAL FUZE CONFERENCE
April 29 - May 1 2002
San Antonio, Texas

MEPHISTO – The MWS for TAUROUS

Distance Sensor
Precursor
Shaped Charge
Penetrator Charge

Taurus Systems GmbH
PIMPF
TDW GmbH
Successful Execution of the PIMPF
Foreign Comparative Test for

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PIMPF’s second Application:

NSM - The new Anti-Ship Missile from KONGSBERG
Repackage the Programmable Intelligent Multi-Purpose Fuze (PIMPF) into a 3-inch form factor compatible with US weapon fuze wells

**call it “Void Sensing Fuze” (VSF)**

- Program Sponsor – DTRA
- Industry
  - TDW (German Fuze Manufacturer)
  - Kaman Fuzing (TDW’s US partner)
- Subject Matter Experts
  - NAWC-WD
  - AFRL-MN
  - Northrop Grumman
  - SAIC
- Government Test Planning
  - DTRA
  - NAWC-WD
  - AFRL-MN
  - PMA-280
1) TDW’s legacy in smart hard target fuzing
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The task of a **hard target fuze** is to **initiate** the Warhead inside of the target at the **desired location**.

The key requirement on components in a hard target fuze is to **survive and operate during** the shock or even the sequence of multiple shocks.

Extensive testing at components level is necessary to determine the shock characteristic and shock sensitivity (and even shock limit).
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### Component level testing - Comparison of TDW acceleration / shock facilities

<table>
<thead>
<tr>
<th>Facility</th>
<th>(Centrifuge*)</th>
<th>(Shaker*)</th>
<th>Drop Table*</th>
<th>Gas gun*</th>
<th>Explosives</th>
<th>Sled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shock</td>
<td>30g</td>
<td>500g</td>
<td>20000g</td>
<td>20000g</td>
<td>100000g</td>
<td>Real harsh high-g working environment</td>
</tr>
<tr>
<td>Number of tests</td>
<td>unlimited</td>
<td>unlimited</td>
<td>15 per hour</td>
<td>3 per hour</td>
<td>1 per day</td>
<td>2-3 per week</td>
</tr>
</tbody>
</table>

*) Easy testing with powered devices

**Number of tests**

**Cost**
High test frequency
  (up to 15 drops per hour)
Low costs
Low maintenance effort

**Flexible component testing in white color**

- Testing with powered units
- Testing with integrated shock sensors
- Extreme reproducible shocks
- Extreme easy instrumentation
Gas Gun

High firing frequency
  (up to 3 shot per hour)
Low costs (gas, working hours)
Low maintenance effort
Highly variable

Flexible component testing in white color

Increased shock duration.

- Powered device
- Velocity measurement at muzzle
- Velocity measurement near target via electric eye
- High speed video
- Integrated sensors
**Sled**

- Low test frequency (up to 3 per week)
- High costs
- High maintenance effort

**Real high-g working environment**

**Testing in blue color**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceleration distance</td>
<td>160 m</td>
</tr>
<tr>
<td>Mass of system including sled</td>
<td>60 kg (up to 190 kg)</td>
</tr>
<tr>
<td>Transport of high explosive</td>
<td>5 kg</td>
</tr>
<tr>
<td>Target dimension</td>
<td>4x4x4m</td>
</tr>
<tr>
<td>End diagnostic</td>
<td>High speed video and/or flash x-ray</td>
</tr>
</tbody>
</table>
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Component level testing means the focusing on the functionality of the component.
(without considering how it works with others).

(Sub)System level testing means that you are verifying the Hard Target Fuze against requirement at the top level.
(and looking for the harmony with all different components).
Test at component level

Test Component A (capacitor of technology A)

Test Component B (capacitor of technology B)

**Test objective:**
- Determination of shock characteristic and shock limit of the new component when powered (under real condition).
- Two capacitors (A and B) are charged and shocked.
Components shocked stepwise from 2000g to 18000g.

**Part A** survived each shock. The capacitor was charged prior, during and after the impact.

**Part B** survived the shock till 4000g. By shocks higher than 4000g was the capacitor discharged after the shock. → **Part B** is now classified as “shock sensitive”.
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The presentation gives an overview of the basics and techniques testing on component level prior integration these components into the fuze.

- This approach allows to analyzing the characteristic of a component level performance **without interface restriction** and verifies at the same time that the component survives the shock.

- In the case of a detected shock limitation the design could be **adapted and considered in simulation models** or the component could be sorted out.

- This strategy also helps in the context of a **fault localization** and to **shorten the development cycle**.
  (deducing of a component observation to a system observation)

- Increase the reliability and durability of the design.
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