High Voltage Fireset Component Behavior at Elevated Temperatures

Presented to:
64th Annual NDIA Fuze Conference

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May 12, 2021

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Overview

• Background

• High Voltage Firesets
  – Applications
  – Components

• Technical Survey

• Testing Methodology
  – MIL-STD 331D
  – Things to consider

• Path Forward
Background

• **Technology Goal:** Determine the margin of survivability of existing and mature high voltage fireset technologies at elevated temperatures.

**Approach:** Survey/consult, obtain/build and test mature fireset designs at temperatures greater than MIL-STD 331D (failure).

Current efforts funded through Joint Fuze Technology Program.
High Voltage Firesets

Other electronics

Control Electronics (Safety Logic)

Environmental/Safety Sensors

High Voltage Electronics and Capacitive Discharge Unit (CDU)

EFI

Primary Focus:

Key Components:
- HV Capacitor
- HV Switch
- HV Converter (Transformer)

- Found in ESADs (non-interrupted or in-line)
- High voltage (>500V)
- Used in Ordnance systems
Typical Applications

• Precision guided munitions
• Air-to-Air Missile (AAM)
• Air-to-Ground Missile (AGM)
• Surface-to-Air Missile (SAM)
• Surface-to-Surface Missile (SSM)
• Light and Heavy Weight Torpedoes

Example of AAM

Non-Interrupted
• “In-line” systems
• Electronic Safe Arm Device (ESAD)
• High voltage system

Electronic based system, no moving parts required
HV Fireset Major Components

• Flyback Transformer
  – HV generation
    • Wire wound
    • Multilayer/Monolithic Ceramic

• High Voltage Storage Capacitor
  – Responsible for energy storage until ready to fire
    • Multi-layer Ceramic (MLCC)
    • Polymer Multi-Layer (PML)

• High Voltage Switch
  – Triggering mechanism that completes circuit upon fire command
Other Key Subsystems

- **Static Switches**
  - Upper/lower
  - Prevents fireset from charging

- **Dynamic Switch**
  - Provides pulse signal for transformer

- **High Voltage Feedback**
  - Maintains high voltage threshold
Technical Survey

- Surveyed/Received HV firesets from across the DoD/DoE agencies
  - Navy
  - Army
  - Air Force

- Key Components Analyzed/Compared
- MIL-STD 331 Requirements
- Temperature regimes
  - Note: Fuzes traditionally located along central may be less affected; however, it is important to understand the margin to which these HV firesets can survive
MIL-STD 331D

• Appendix C
  – Requires a bare, unpackaged fuze and its components to be able to survive temperature extremes up to 160°F or 71°C for 28 days.

• Intend to test to failure

No Standard or Requirement above 160°F or 71°C
Testing Methodology

• Variables to consider, included here but not limited to:
  – Potential cable failures at higher temperatures
  – Soak duration in order to thoroughly evaluate HV fireset performance
  – Isolation of non-key infrastructure
    • Conformal coat/potting
  – Potential redesign for instrumentation
  – Discrete vs. Non-discrete temperature testing
  – Avoid “re-inventing the wheel”
Path Forward

• Continue to develop testing methodology for FY21
  – Temperatures and duration
  – Locations for evaluation (leakage current, etc.)
  – Perform INERT tests in thermal chamber(s)
Questions?