Common Methodology for Calculating Fuze Reliability

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Overview

• Problem – How can performance reliability of a fielded fuze system be evaluated across fuzes from different DoD Services.

• A look at reliability over the product life cycle
  Concept/Feasibility ➔ Design/Development ➔ Production ➔ Operation/Support

• Methodology Approaches:
  • Army (Artillery)
  • Navy (Air-Ground Bomb Fuzes)
  • Air Force (A-G)

• Brief descriptions of positive and negative aspects of the different approaches

• Consideration for a Joint Services approach
Problem Statement

- Air Force, Navy, and Army collect similar types of data to determine fuze reliability:
  - Ultimately the data is used differently by the Services to track and report reliability
    - Can pose problems, especially for Joint Fuze Programs.
Product Life Cycle Phases & Reliability Data

Life Cycle Phases
- Concept/Feasibility
- Design/Development
- Production
- Operation/Support

Reliability Data
- Reliability Predictions
- Developmental Testing
- Lab Testing
- Operational Testing
- Acceptance Testing
- Factory Testing
- Training Missions
- LCST
- Combat Usage
- Reported Failures

Amount of Data vs. Life Cycle Phases
Accuracy & Relevancy of Reliability Data

The reliability of interest is that which uses the most accurate data indicating the fuze is successful in performing its required functions, over the duration of the mission, in an operationally relevant environment.
Methodology Approach – Army

- Army Fuze Reliability (AR-702-6) includes data from:
  - Lot Acceptance Testing
  - Stockpile Reliability Pgm
  - Qual. & FAAT
  - Malfunction Inv. Pgm
  - Operational Testing
Methodology Approach - Navy

- Navy (Air-to-Ground) Fuze Reliability includes data from:
  - Operational Tests
  - Qual. & FAAT
  - Combat Usage
  - LCST
  - Conventional Ordnance Performance Evaluations
  - Lot Acceptance Testing

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Methodology Approach – Air Force

- Air Force (Air-to-Ground) Fuze Reliability includes data from:
  - LCST
  - Qual. & FAAT
  - Combat Usage
  - Operational Testing
  - Lot Acceptance Testing
  - Weapon System Evaluation

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All Methodologies: Positive Aspects

+ FAAT & Qual Testing – Verifies production representative fuze meets requirement.
+ Operational Testing/Training Testing – Environment is controlled and operationally relevant.
+ Lot Acceptance Testing (LAT) – When long term trends have been established, it is an Indicator of consistency that was established during FAAT.
+ Deficiency Reports – Documented problem or failure.
+ Life Cycle Surveillance Testing (LCST) – Indicator that aging inventory is still reliable.
+ Combat Usage – When available, it is the most operationally relevant information of fuze reliability.
All Methodologies: Negative Aspects

- Operational Testing/Training Testing – System may be tested outside of design limits to assess military utility.
- Lot Acceptance Testing (LAT) – Intended as a business agreement between buyer and seller.
- Deficiency Reports – Difficult to determine if fuze system or other system failed.
- Life Cycle Surveillance Testing (LCST) – Goal is to determine aging inventory affects.
- Combat Usage – Too many variables in an uncontrolled environment.
• Successful FAAT establishes the baseline reliability requirement is met.

• For reliability reporting post-FAAT, qualify reliability reporting:
  
  – Reliability \( \text{Reliability}_{\text{Lat(AQL)}} \) = \( \frac{\# \text{ Lots Passed}}{\# \text{ Lots Tested}} \) * 100
  
  • Indicate number of LATs conducted for L/T trend evaluation

  – Reliability \( \text{Reliability}_{\text{OT/Training Msns}} \) = \( \frac{\# \text{ Successes}}{\# \text{ Drops}} \) * 100

  – Reliability \( \text{Reliability}_{\text{Combat Usage}} \) = \( \frac{\# \text{ Successes}}{\# \text{ Drops}} \) * 100

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A Joint Services Approach – Roll Up

- Standardize a reliability calculation that can be used by all Services as a “snapshot” of available data.
  - Especially important for Joint fuze programs

- Calculate a weighted average reliability that includes:
  - LAT @ 20% weighting
  - OT/Training Testing @ 40% weighting
  - Combat Usage (when available) @ 40% weighting
    - Account for documented fuze failures that are directly attributable to the fuze