Safety and Interim Fatigue Testing of a Domestic RPG System

NDIA Armament Systems Forum
22 APR 2015

Christopher A. Perhala, P.E.
High Energy Group
Battelle
505 King Avenue, Columbus, OH 43201

Photo courtesy of Airtronic USA, Inc.

Briefing Outline

- Background
- Objective, Scope, & Constraints
- Project Tasks
  - Charge Establishment Tests
  - Proof Tests
  - Interim Fatigue Firing Tests
  - Drop Tests
- Summary
- Future Activities

Background

- US forces desire the capability to train with RPG systems
  - Limited availability of ammunition and launchers
  - Desire higher level of confidence in system safety
- Airtronic USA, Inc. produces an American-made RPG launcher, Model 7
  - Uses wrought vs. cast steel barrel (AISI 4140 / 4150)

- USG required suitable testing performed and documented before approving limited safety release

Objective, Scope & Constraints

- Objective
  - Develop data relevant to a limited safety release for the Airtronic Model 7 grenade launcher
- Scope
  - Perform inspections and proof tests on at least two launchers
  - Establish Interim Safe Fatigue Life estimate via live fire testing
  - Perform drop tests per MIL-STD-810G
- Constraints
  - Time (approx. 1 month)
  - Ammunition availability

Charge Establishment Tests

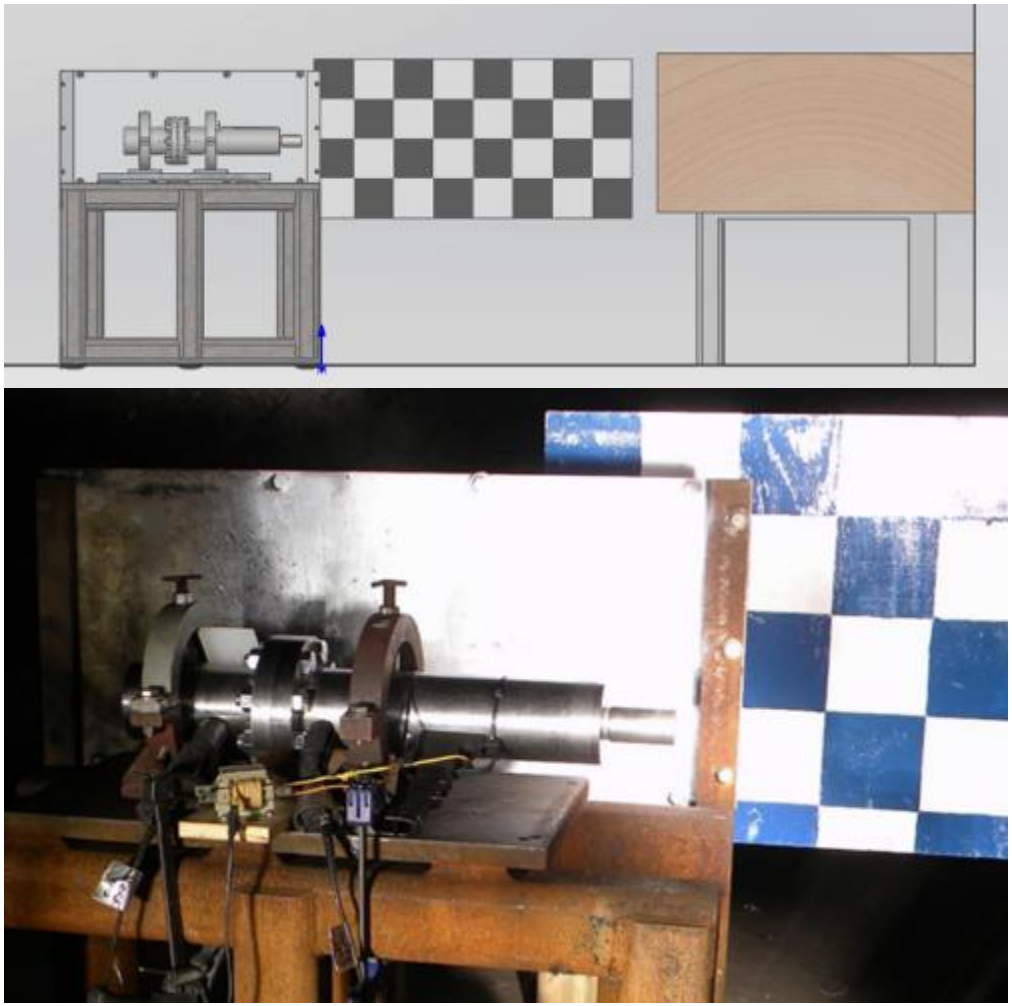
- ATEC recommended using ITOP 3-2-829, Cannon Safety Test as a guideline
- Proof tests require a proofing round
  - What pressure? Limited pressure data (i.e., P_{hot} + 3σ unknown)
  - It was agreed that Battelle would develop a double-pressure proof test to verify launcher integrity (i.e., $P_{peak} = 2 \times P_{nominal}$)
- Launcher with pressure instrumentation ports was available but, there was concern repeated high-pressure tests to establish proof charge would cause failure
- Battelle designed and fabricated heavy-walled Charge Establishment Fixture for repeated high-pressure tests

Charge Establishment Fixture (CEF)

- CEF allows numerous high pressure tests
  - Mitigates concern about overstressing threaded ports in instrumented launcher
  - Two pressure ports to capture P-t data
  - Available for development of proof rounds for heavier projectiles
- Surrogate launch package
  - Inert ballistic slug (no energetic material launched downrange)
  - Same mass as PG-7 family (2 kg)
  - Same exterior profile as PG-7 to emulate launch blow-by flow
  - Percussion primer, 10 g FFFg black powder in piccolo tube, commercial propellant for ejection charge

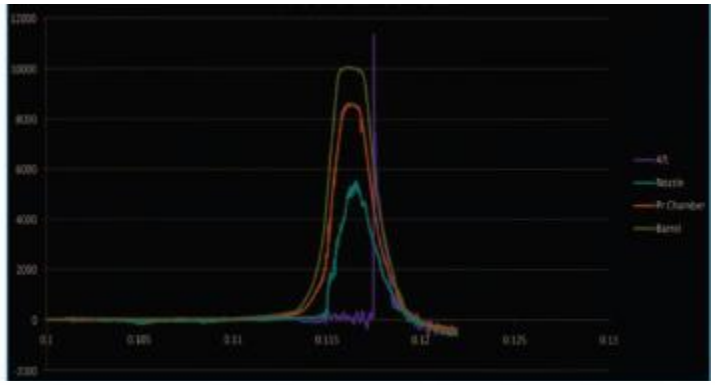
Charge Establishment Setup

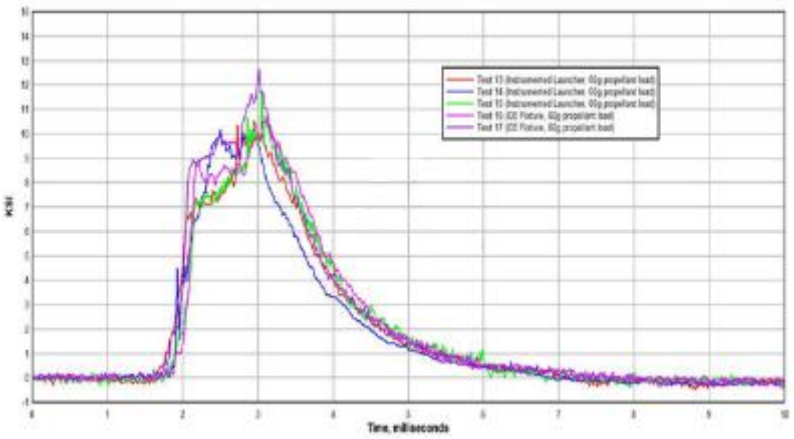
- CEF with surrogate launch package
- Fiducial board for high speed video
- Soft catch box (sand filled)



Charge Establishment Data

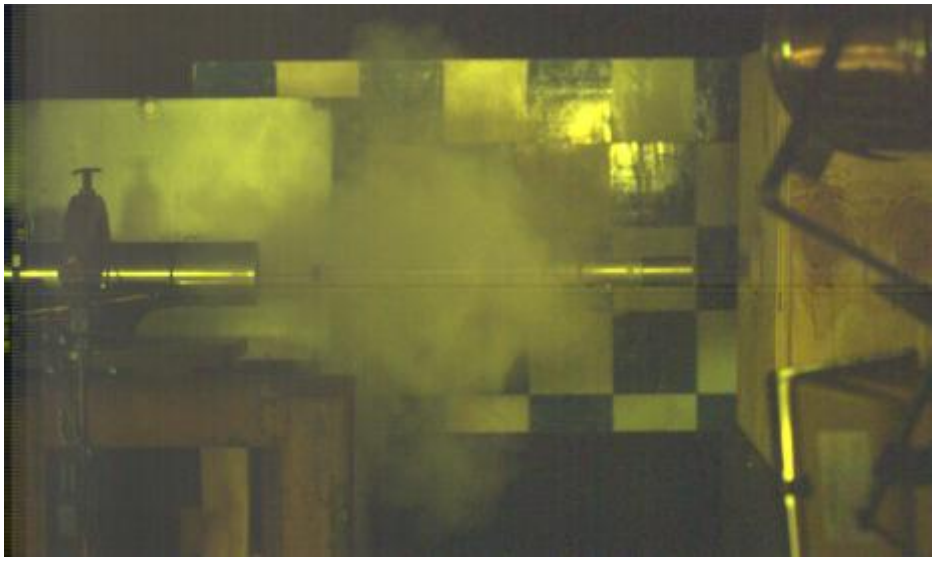
- Instrumented launcher with PG ammo (top)
- Instrumented launcher and CEF with surrogate launch package (bottom)
  - Good agreement between PG ammo and surrogate launch package
    - Peak pressure
    - Pulse width
  - Excellent agreement between CEF and launcher





Proof Tests

- Double-pressure proof test to verify launcher integrity
- Surrogate launch package fired into soft catch box (sand)
- Magnetic particle and bore gaging inspections before and after proof test – no issues



Interim Fatigue Firing Tests

- Series of live firings to assure no low-cycle fatigue issue
  - 150 tests fired in 6 days
  - Peak firing rate: 8 per hour for several hours
  - Average rate: ~5 per hour
- Magnetic particle inspection after series showed no damage, wear, or cracking anywhere in launch tube

Drop Tests

- Conducted IAW: MIL-STD 810G1 Method 516.7 Procedure IV: Tactical Transit Drop
  - Unpackaged Handling Test for Man Carried Munitions
- 1 series of 3 drops each on 5 different sides of the system
  - Ventral (grip and firing mechanism)
  - Lateral (+90° right hand line of action)
  - Fore Edge-Ventral
  - Aft Edge-Dorsal
  - Nose

- Used surrogate launch package (primer only)

Summary

- Fabricated Charge Establishment Fixture for development of double-pressure proof round
- Developed double-pressure proof round for verifying launcher integrity
- Established interim fatigue life (≤150 rounds)
- Passed drop test series
- All tests complete in less than one month
- Limited safety release for use by US troops subsequently granted based on the data generated in this effort

Future Activities

- Testing of Airtronic Model 7 launcher by US troops in various experiments
- Environmental testing of Model 7 (i.e., dust, vibration, accuracy, etc.)
- Development of proof rounds for heavier projectiles
- Extended live fire testing to establish fatigue life (1000+ rounds)
- Similar testing of lightweight version (Model 777)

Contact Information

Christopher A Perhala, P.E.
Principal Research Engineer

Battelle
505 King Avenue
Columbus, OH 43201

perhalac@battelle.org
614-424-7789