Qualification and Replacement
M113 0.3 second delay initiator
(Cessna A/T-37)

NSN: 1377-00-222-9062

IHEOTD CAD/PAD IPT
Hill AFB, UT
Quinn Tidwell
May 2016
Overview

- Issue/Background
- Engineering Analysis/Plan
- T-37 M113 Design Overview
- T-38 MG48 Dual Delay Overview
- Device Comparison/Analysis
- Fit Check
- Item and System Testing
- Final Actions For Release to Service
- Conclusion/Summary
- Questions
Issues/Background

• Routine procurements occasionally lead to various challenges
  – Obsolete materials and ingredients
  – Energetic material attributes, suitability and processing issues
  – Older/outdated drawing packages
  – Manufacturing expertise or techniques that are lost over the years
  – Infrequent procurements & low buy quantities can drive pricing
  – Overriding schedules & other priorities
  – Limited customer budget(s)

• This project encountered, and overcame all of these issues through a structured approach & collaboration at HAFB & IH!
Engineering Analysis/Plan

• Structured Engineering Approach Applied to Problem
  – Design replacement feasibility conducted (comparison of A to B)
    • Dimensions, Performance Requirements
  – System Requirements Review
    • Environmental Requirements
    • Qualification Matrix
    • Critical Interfaces
  – Fit Check on Aircraft/Seat
  – Breadboard/System Initiation Tests
  – Service Release process
  – TO updates
A/T-37 M113 Time Delay Design

- Gas input
  - Actuation pressure = actuate w/M3A2 (550 – 1450 psig)
- 0.30 second delay
  - 0.30± 0.15 seconds @ Hot/Cold
  - 0.30± 0.05 seconds @ Ambient
- Gas output
  - M104 initiator (300 psi minimum)
  - 6.5 in³ closed bomb or 15 ft hose + 0.62 in³ bomb
F-5/T-38 MG48 Dual Delay Design

- Gas input
  - Actuation pressure (400 – 600 psig)
- 0.30 second delay
  - 0.25 – 0.38 seconds @ all temps
- Gas output
  - 500 – 1750 psig
  - 15 ft. hose + 0.50 in$^3$ bomb
# Comparison Analysis

## M113 to 1139-5/6161100 (MG48) Comparison

<table>
<thead>
<tr>
<th></th>
<th>M113</th>
<th>MG48</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit cost</strong></td>
<td>~$3350</td>
<td>~$360</td>
</tr>
<tr>
<td><strong>Shelf/service life (months)</strong></td>
<td>(246/222)</td>
<td>(84/72) / (60/36)</td>
</tr>
<tr>
<td><strong>Total length</strong></td>
<td>4.42 in (max)</td>
<td>4.68 in (max)</td>
</tr>
<tr>
<td><strong>Max height</strong></td>
<td>1.48 in</td>
<td>1.14 in</td>
</tr>
<tr>
<td><strong>Input port to center of mount holes</strong></td>
<td>1.0 in</td>
<td>1.06 in</td>
</tr>
<tr>
<td><strong>Input port to bracket back edge</strong></td>
<td>1.29 - 1.30 in</td>
<td>1.31 in</td>
</tr>
<tr>
<td><strong>Bracket hole spacing</strong></td>
<td>2.25 + .005 in</td>
<td>2.25 + .005 in</td>
</tr>
<tr>
<td><strong>Mounting hole diameter</strong></td>
<td>0.259 - 0.267 in</td>
<td>0.255 - 0.262 in</td>
</tr>
<tr>
<td><strong>Bracket thickness</strong></td>
<td>0.25 in</td>
<td>0.125 in</td>
</tr>
</tbody>
</table>
# Comparison Analysis

## M113 to 1139-5/6161100 (MG48) Comparison

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<tr>
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<th>MG48</th>
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<tr>
<td><strong>Output pressure</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.5 in³ bomb</td>
<td>300 psi (min)</td>
<td>423-1480 psi*</td>
</tr>
<tr>
<td>5.5 in³ hose/bomb</td>
<td>355 psi (min)*</td>
<td>500-1750 psi</td>
</tr>
<tr>
<td><strong>Acutation pressure</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.0 in³ hose/bomb</td>
<td>550-1450 psi**</td>
<td></td>
</tr>
<tr>
<td>1 ft hose</td>
<td></td>
<td>400-600 psi</td>
</tr>
<tr>
<td><strong>Delay time</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hot/cold</td>
<td>0.30 ± 0.15 sec</td>
<td>0.25-0.38 sec</td>
</tr>
<tr>
<td>Ambient</td>
<td>0.30 ± 0.05 sec</td>
<td>0.25-0.38 sec</td>
</tr>
</tbody>
</table>

*Calculated equivalent

** Typical output from M3A2 initiator
Fit Check

• 17 May 2011 - Davis-Monthan AFB seat shop
• Good clearance and fit for initiator and all hoses and connectors
• Mounting bolt grip too long
  – Replacement bolt recommended for use with T-38 MG48 and M113 initiators
  – Eliminates mounting slop
    • Part Number NAS428-4A7
Hill AFB 582 MMXS/MXDTA Test

- Dec 2011 - T-38 MG48 test in M113 LAT configuration
  - 6.5 in$^3$ closed bomb (actual LAT bomb from Indian Head)
  - Initiated with M3A2 initiators
- T-38 MG48 output pressure nearly double that of M113

<table>
<thead>
<tr>
<th></th>
<th>Initiation Pressure (psig)</th>
<th>Delay Time (ms)</th>
<th>MG48 Output Pressure (psig)</th>
<th>Typical M113 Output Pressure (psig)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limits (M113)</td>
<td>M3A2</td>
<td>150-450</td>
<td>&gt;300</td>
<td>&gt;300</td>
</tr>
<tr>
<td>Max</td>
<td>647.5</td>
<td>360.7</td>
<td>1034.4</td>
<td>621</td>
</tr>
<tr>
<td>Min</td>
<td>483.5</td>
<td>280.0</td>
<td>798.4</td>
<td>428</td>
</tr>
<tr>
<td>Average</td>
<td>556.1</td>
<td>319.2</td>
<td>903.7</td>
<td>504</td>
</tr>
</tbody>
</table>
Indian Head System Testing

- Breadboard test of existing aircraft hoses, elbows and CKU-8 catapult breech to prove system can withstand increased output pressure of the T-38 MG48 initiator
  - 9 firings across -65F, Ambient, +200F
  - System initiation pressures ranged 4,452 psi to 5,425 psi
  - No evidence of burst, leakage, erosion or hot spots
Final Actions for Release to Service

- 28 Aug 2014 - Type IV Release to Service signed
  - Type IV release indicates that a previously qualified Cartridge has demonstrated acceptable performance for use in a new application

- 26 Sep 2014 Proven Aircraft Chief Engineer formal approval

- 22 Oct 2014 T.O. 1T-37B-4 & 1A-37B-4 update submitted

- Hill AFB CAD/PAD Call letter updated
Conclusion/Summary

- Project emerged out of necessity to find solution
- “Outside of the Box” solution already existed
- System Requirements Review identified “suitable alternate”
- Fit check and system testing proved out solution viable
- Type IV Release to Service coordinated with aircraft SPO
- Issue resolved for future Foreign Military Requirements!
Questions?