Minimum Performance Testing with a Blended Candidate for Aircraft Powerplant Halon Replacement

Presented to:

8TH Triennial International Aircraft Fire & Cabin Safety Research Conference

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Date: 25Oct2016



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Presentation Content...

- Brief Review, Halon-Replacement Testing in the Civilian Powerplant Fire Zone (MPSHRe)
 - ★ Test Process★ FAATC NFS Test Article
- Review, this MPSHRe Project
 - ★ Descriptions of Various Aspects
 - ★ Project Progression
 - ★ Outcomes

FAATC = FAA Technical Center NFS = nacelle fire simulator MPSHRe = Minimum Performance Standard for Halon Replacement in the Civilian Engine Nacelle

Service &/or product identifications made in this presentation are not endorsements.



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Brief Review / Test Process

- Process is fully described in MPSHRe
 - In part, candidate equals halon 1301 in a NFS
 - Candidate faces several NFS challenges
 - "High"- & "low"-ventilation rates
 - Pool & spray combustion modes
 - Multiple fuel types burned in spray combustion
 - Observe/compare flame suppression behaviors
 - Visually-determining a fire extinction duration (RTD)
 - Comparing all observations to determine efficacy
 - Measure candidate distribution in non-fire flows



Brief Review / Test Process

- Outcome(s) =
 - A "recommendation for certification" = the largest candidate quantity attaining equivalence
 - A report of all applicable observations
- Optional requirement of a "real-world" demonstration for atypical candidates



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Brief Review / Test Article

MPSHRe describes test article & abilities

- Concentric annular duct
- Channels internal forced-flow through annulus
- Contains 2 representative fire threats
- Allows candidate injection into internal forced-flow
- Monitored/recorded with visual/numerical telemetry



Brief Review / Test Article





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Brief Review / Test Article



Some Dimensional Information. Inlet Diffuser Exit Flange to Exhaust Nozzle Entrance Flange, $3.1 \text{ m x } 1.22 \text{ m outside diameter x } 0.6096 \text{ m inside diameter, volume} \approx 2.74 \text{ m}^3 (96.6 \text{ ft}^3)$



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Owners

- Airbus
- Meggitt Safety Systems Inc. (MSSI)

Responsibilities

- Industry team: candidate; its preparation, packaging, conditioning, & delivery; concentration measurement
- FAA Fire Safety Branch: operational NFS, data measurements, histories, & indications (thermal, pressure, visual), procedural assistance



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- Candidate assessed = MSSI Blend A
 - Blend of CO_2 & FK-5-1-12
 - Defined CO₂/FK-5-1-12 mass-based proportion
 - Blend species are notably different
 - Super-pressurized with nitrogen
- Intended usage characteristics
 - Stored in "traditional" fire extinguisher bottle
 - Delivered/injected with "traditional" plumbing
 - Statham-derivative gas analyzer measures distribution



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- Additional considerations
 - No fire extinguishment testing with hydraulic fluid
 - CO₂ acceptably recognized by FAA AC 20-100/1977
 - FK-5-1-12 acceptably tested per MPSHRe rev03/2006
 - Possible measurement ambiguity for Stathamderivative gas analyzer sensing Blend A distribution
 - Industry team identified issue at beginning
 - Analyzer can only measure varying binary gas mixtures
 - FAA sampled/NDIR-gas analyzed NFS stream @ 4 points
 - Occurred occasionally during MPSHRe testing



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Completion Schedule

- Preliminary activities: June 2013 August 2014
- MPSHRe testing:
 - "High"-ventilation testing: October November 2014
 - "Low"-ventilation testing: November 2014 January 2015
- Follow-on testing: January February 2015



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Project Review, Progression

- Regarding testing progress...
 - Employed "typical" experiential-learn-&-adjust cycling
 - Bracketed "high"-ventilation/spray; superior/inferior
 - Found equivalence at "high"-ventilation/pool fire
 - Delivered equivalence to "low"-ventilation challenges
 - Acceptably tested for "low"-ventilation challenges



Project Review, Progression

- Performed occasional grab-sampling & NDIR gas analysis for CO₂/FK-5-1-12 proportion in the NFS stream
- Observed abnormal smoke/flame releases
 - From internal flow to test bay via atmospheric gap
 - Spawned a need for additional tests
- Accomplished additional testing to further characterize smoke/flame releases



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Project Review, Outcomes

- Completed MPSHRe project with Blend A
- Recommendation for certification = 30.6%v/v Blend A for ½ sec
- Affirmed validity of Statham-derivative use during the MPSHRe assessment
- Regarding flame/smoke releases...
 - departure from halon 1301 behavior
 - inconsequential outcomes in this setting



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Recognizing those supporting...

<u>Airbus :</u>

Mssrs. Thibault Pelletier, Stephane Pugliese, Pierre-Emmanuel Arnaud <u>MSSI :</u>

Dr. Ian Campbell, Mr. Cris Sevilla, Mr. Kurt Mills

<u>FAA :</u>

Ms. Louise Speitel, Mr. Rick Whedbee, Mr. Tom Carmen, Mr. Wayne Eichner, Mr. Larry Fitzgerald, Mr. Tim Smith, Mr. Steve Happenny

Technology and Management International, LLC :

Mr. Paul Scrofani, Mr. Mark Materio, Mr. Mike Donio



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References...

Internet Links

- MPSHRe rev04 http://www.fire.tc.faa.gov/pdf/systems/MPSErev04_MPSeRev04doc-02submtd.pdf
- FAA Advisory Circular 20-100 http://www.faa.gov/documentLibrary/media/Advisory_Circular/AC20-100.pdf
- Presentations regarding FK-5-1-12 & MPSHRe rev03 http://www.fire.tc.faa.gov/pdf/systems/Oct06Meeting/Ingerson-1006-HalonReplacement.pdf http://www.fire.tc.faa.gov/pdf/systems/Oct06Meeting/Ingerson-1006-observations.pdf



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Appendix Slides



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Pacific Scientific Halonyzer 02 (V)



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