Engine Nacelle, Halon Replacement

Reconsidering Carbon Dioxide as a Fire Extinguishant ~ Status

Presented to: FAA International Aircraft Systems Fire Protection Working Group

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Presentation Overview

- Review nacelle fire simulator [FAATC NFS]
- Describe :
 - Fire extinguisher [VV02/C]
 - CO2 being used
 - Gas analyzer [Hal02 RBLT]
- Show CO2 test results to date
- Identify future plans.



FAATC NFS





FAATC NFS

TEST SECTION DIMENSIONS 48 INCH (1.22 m) OD SHELL 24 INCH (0.61 m) OD CORE ~ 10.25 FEET (3.12 m) LONG







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This is a schematic view. Not drawn to scale.



Fire Extinguisher : VV02/C



3 x 1 kW BAND HEATERS



VV02/C STORAGE VESSEL

VV02/C MOUNTED IN FRAME FOR TEST STRADDLING THE INLET DIFFUSER

[VV02 IS MANUALLY DISCHARGED]



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Local CO2 Being Used

1. VV02 purged with UHP-air



- 2. CO2 drawn from local "low"pressure bulk source
- 3. Pump used to fill VV02 with CO2 to needed test weight.



Other Notes

A.Only using PURE CO2 in VV02 for this testing.

B. Chilling VV02 to fill.



- 1. Local Gas Analyzer is "Hal02 RBLT"
- 2. Modified Pacific Scientific Halonyzer 2; a Statham-derivative gas analyzer.
- 3. Analyzer is locally maintained.
 - A. Recently cleaned & calibrated for CO2 in air.
 - B. Used a local gas dilution system to create mixtures of 1, 3, 7, 18, 28, 34, 37, & 45%v/v CO2 in air; also exposed to 100%v/v CO2.

4. Currently installed for use in FAATC NFS.



EXPOSING THE GAS ANALYZER TO CO2 & AIR MIXTURES

GAS DILUTION SET-UP TO CREATE CO2 & AIR MIXTURES





GAS ANALYZER INSTALLED FOR USE TO SAMPLE FAATC NFS





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Recent CO2 Fire Suppression Results

1. Working @:

- A. "high" ventilation : ≈ 2.5-3.0 lbm/s @ 125°F
- B. JP-8/Jet-A spray fire : ≈ 0.25 US gal/min @ 150 °F
- C. CO2 injected at 38 °C & its vapor pressure

2. FAATC NFS fire suppression threshold

- A. Spot-checked baseline in Oct 2016
- B. Final outcomes to be based on thorough review

3. Recent CO2 results bracket threshold



Recent CO2 Fire Suppression Results





















Near-term plans

1. Finish "high"-vent CO2 distribution testing.

2. Work with CO2 vs "high"-vent/pool fire.

- A. Establish acceptable fire suppression conditions.
- B. Capture associated CO2 distribution.

3. Review collected information & determine if further testing will occur.



APPENDIX.

References.

- 1) Advisory Circular 20-100, 1977, "General Guidelines for Measuring Fire-Extinguishing Agent Concentrations in Powerplant Compartments," United States Department of Transportation, Federal Aviation Administration, Washington, D.C. http://www.faa.gov/documentLibrary/media/Advisory_Circular/AC20-100.pdf
- 2) Ingerson, D., 2010, "Minimum Performance Standards for Halon 1301 Replacement in the Fire Extinguishing Agents/Systems of Civil Aircraft Engine and Auxiliary Power Unit Compartments, revision 04", <u>draft/working document</u>, United States Department of Transportation, Federal Aviation Administration, W.J. Hughes, Technical Center, Atlantic City, NJ. http://www.fire.tc.faa.gov/pdf/systems/MPSErev04_MPSeRev04doc-02submtd.pdf
- 3) Zabetakis, M. G., "Flammability Characteristics of Combustible Gases and Vapors," Bulletin 627, U.S. Department of the Interior, Bureau of Mines, Washington, DC, November 1965.



APPENDIX. Basic Justification for Reconsideration.



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Initiated by: AFS-140

AC No. 20-100

Examples of minimum concentrations sufficient to extinguish fire and prevent its recurrence are as follows:

	AGENT	CONCENTRATION BY WEIGHT	IN PERCENT BY VOLUME	RELATIVE CONCENTRATION PERCENT
	⁰⁰ 2	49	37	40
	CH3Br	30	11	15
	CH2BRCL	36	11	25
	CF2Br2	26.5	5	15
	CF3Br	22	6	15
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 \thickapprox 28 %v/v CO2 per BoM Bulletin 627 < 37%v/v CO2 per FAA AC 20-100

