Forced-flow Fire Testing with “cold”-soaked FK-5-1-12

Presented to: International Aircraft Systems Fire Protection Working Group

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Presentation Overview
Major Discussion Points

• Purpose
• Test Conditions
• Test Fixture Modifications
• Status, Halon Replacement/Engine Nacelle
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• Purpose
  – To present circumstances for fire extinguishment assessment of FK-5-1-12 in the Nacelle Fire Simulator (NFS)
  – Circumstances related to
    • JP8 pool- and spray-based fire threats
    • “cold” conditions analogous to civil transport aircraft operations
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• Test Conditions
  – NFS
    • same geometry of previous MPSe testing descriptions
    • relatively “clean” cross section
    • single air flow; ambient temperature, ≈ 1.4 kg/s
    • partial external boundary; ambient- or “cold”-soaked temperature
    • 2 fire threats presented; JP8-based spray & pool fire behaviors
  – Fire extinguishing (firex) agent
    • varied firex agent storage temperature; ambient-, “hot”- or “cold”-soaked
    • varied firex agent storage pressure
    • varied firex agent mass
    • varied injection configuration
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- ADDED COMPARTMENTS ON NFS EXTERIOR TO ACCEPT DRY ICE SO THE INTERIOR DOOR SURFACES COULD BE “COLD”-SOAKED
- ADDED 10 COMPARTMENTS TO 5 DOORS; 2 COMPARTMENTS/DOOR; RIGHT/FWD 3 DOORS & LEFT/1ST & 3RD DOORS
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MODIFICATIONS - TEST SECTION TO PRODUCE “COLD” WALLS

NFS DOORS WITHOUT DRY ICE COMPARTMENTS

NFS DOORS WITH DRY ICE COMPARTMENTS

DRY ICE COMPARTMENT (typical)

sta453  sta551  sta502

sta551  sta502  sta453
MODIFICATIONS – ADDITIONAL TELEMETRY IN THE TEST SECTION

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COMPLIMENTED EXISTING TELEMETRY WITH ADDITIONAL SENSORS TO CAPTURE BEHAVIORS

- THERMOCOUPLES: CERTAIN WALL & FIRE EXTINGUISHER THERMAL BEHAVIORS
- HOT-WIRE ANEMOMETERS (HWAs): RELATIVE FLOW-FIELD SPEED IN SELECT LOCATIONS
- LASER-EXCITED OPTICAL RECEIVER: RELATIVE AEROSOL DENSITIES IN SELECT LOCATIONS

TELEMETRY PLACEMENT, SPRAY FIRE THREAT (typical)

OPTICAL RECEIVER
12:00, sta473
(optical filters in place)

LASER SOURCE

ROTATIONAL FLOW, 12:00, sta477

HWA, FREE-STREAM

AXIAL FLOW, 12:00, sta477

sta453 CORE RIB

sta477 SHELL RIB

approximately 0.3 m
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THERMOCOUPLE PLACEMENT, INTERIOR NFS DOOR (typical)

Note: NFS door is supported in the OPEN position

sta440/LEFT DOOR, INTERIOR SURFACE

THERMOCOUPLE, INTERNAL NFS DOOR SURFACE, “pinch”-mounted, sta445/07:30

PLUMBING ASSEMBLY USED TO SENSE INTERNAL TEMPERATURE & PRESSURE

TELEMETRY, FIREX BOTTLE (typical)

THERMOCOUPLE, SURFACE MOUNTED

TAP FOR PRESSURE TRANSDUCER

THERMOCOUPLE TIP
Presentation Conclusion
Status, Halon Replacement/Engine Nacelle

• “Cold” FK-5-1-12 testing/analysis incomplete
  – Support paused
  – Report to be published; date indeterminate

• Solid aerosol testing/analysis incomplete
  – Support:
    • resuming
    • expected uninterrupted through conclusion
  – Report to be published; date indeterminate
Presentation Conclusion
Status, Halon Replacement/Engine Nacelle

• Further change to MPSe rev04 not expected

• Plan to author/release publicly-available reports
  – 1\textsuperscript{ST} report : MPSe development history & latest revision
    • developmental history up to & including MPSe rev04
    • detailed NFS descriptions
    • MPSe rev03 testing outcomes
  – 2\textsuperscript{ND} report : MPSe rev04 outcomes for a given solid aerosol
  – 3\textsuperscript{RD} report : “cold” FK-5-1-12 testing
• Acronyms, short-hand notations

APU = Auxiliary Power Unit
fwd = forward
FK-5-1-12 = 3M Novec 1230
MPSe = Minimum Performance Standard for Halon Replacement in Civil Aircraft Engine Nacelle & APU Compartments
NFS = nacelle fire simulator for the MPSe, located at the FAA WJ Hughes Technical Center
OD = outside diameter
rev = revision
sta = station number, longitudinal position in the NFS
vent = ventilation