International Aircraft Materials Fire Test Working Group Meeting

Sonic Burner Cargo Liner Testing for Test Cell Airflow Study

Presented to: International Aircraft Materials Fire Test Working Group

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Introduction

- **Sonic Burner Cargo Test Cell Airflow Study**
  - Overview
  - Airflow study testing at FAA Technical Center
  - Round robin test cell airflow study for 2016
- **Proposed Changes to Handbook Chapter 8**
  - Easier to follow when using Sonic Burner
  - Other updates to Handbook
- **Cargo Liner Sonic Burner Instruction Video**
  - Video viewing during cargo task group
Test Cell Airflow Study
Test Cell Airflow Study

• All Sonic Burners configured identically
  – Sonic Burner capable of producing repeatable results within the same test lab

• All test cells are unique in design
  – The test environment can effect the test
  – Unique test cell design leads to unique test results

• Possible Solution:
  – Require all test labs to be constructed using a single design configuration specified by FAA
    • Industry unlikely to accept this proposal
Test Cell Airflow Study

• **Small Test Cell**
  – Heat reradiated from nearby walls or partitions
  – Test cell air temperature may rise quickly
  – Cell hot before test begins (burner warmup)
  – Contributes to a more severe test condition/result

• **Large Test Cell**
  – Heat less likely to reradiate from walls/partitions
  – Hot air and combustion byproducts have more space to dissipate away from test sample
  – Less likely to influence test result
• Hot air and smoke can quickly fill a small test chamber and influence test results
• Less of an issue in larger test cell
• Increasing exhaust airflow removes more hot air and smoke
• Baffles/ducting help direct intake air away from TC above sample
Test Cell Airflow Study

- Initial tests run in FAA Technical Center Sonic Burner cargo liner test cell
  - Test cell 10 x 10 ft. floor area, 10 ft. ceiling
  - Approximately 1000 cubic feet
  - Exhaust airflow rate kept to a minimum to avoid influencing TC readings (1000-1200 CFM)
  - Small cell size combined with low exhaust airflow rate resulted in considerably higher temperatures throughout test compared labs in past RR study
  - 107°F at time 0:00 in test cell (relatively high)
~1000 Cubic Feet
Test Cell Airflow Study

Heavy Fiberglass/Polyester Cargo Liner Average Test Results

- Initial: 107°F
- Peak: 257°F
- Final: 243°F
Test Cell Airflow Study

- **Test apparatus moved to Full Scale Facility**
  - Considered “infinite” space (~455,000 cubic feet)
  - Air velocity ~0 ft/min around test sample
  - Heat and combustion byproducts allowed to dissipate without the use of exhaust system

- **Significant drop in sample temperature**
  - Temperature measured 4 inches above the test sample in full scale test cell ~80°F lower after 2:00 into to test compared to small test cell results
  - 75°F at time 0:00 in full scale test cell (30°F lower)
455 times larger than cargo test cell
Test Cell Airflow Study

Heavy Fiberglass/Polyester Cargo Liner Average Test Results

- Original Test Cell
- Full Scale Test Cell

Temperature vs. Time Graph:

- Temperature at 33°F
- Temperature at 79°F
- Temperature at 91°F

ΔT = 33°F
ΔT = 79°F
ΔT = 91°F
Test Cell Airflow Study

- Apparatus returned to cargo liner test cell
- Test cell modified in attempt to replicate results obtained in full scale test cell
  - Intake air vents enlarged
  - Ducting added to route intake air past sample
  - Exhaust fan speed increase
    - 814 RPM increased to 1725 RPM (2.12 X RPM)
  - Exhaust airflow doubled after modifications

  Before: 1000-1200 CFM
  After: 2300-2500 CFM
Test Cell Airflow Study

Heavy Fiberglass/Polyester Cargo Liner Average Test Results

***Temperatures still higher than full scale facility test results***
Test Cell Airflow Study

Heavy Fiberglass/Polyester Cargo Liner Average Test Results

ΔT = 45°F

ΔT = 56°F

ΔT = 13°F
Test Cell Airflow Study

• **Observation**
  – Increasing the exhaust airflow in the test cell reduced test result temperatures

• **Hypothesis**
  – Possible correlation between test cell size and required exhaust airflow rate to prevent overheating test cell and increasing severity of test

• **Sonic Burner Cargo Liner Round Robin**
  – Conduct interlab study to confirm
Test Cell Airflow Study

• Seven labs participating (including FAA)
• Same sample materials provided to all labs
• Conduct tests using Sonic Burner setup
• Replicate FAA full scale test cell results
  – Begin by testing a sample using typical lab configuration/airflow to establish baseline data
  – Replicate FAA full scale facility test results by adjusting exhaust airflow in test cell (trial and error)
  – Report back with exhaust airflow rate change, test cell dimensions, and exhaust system description
Test Cell Airflow Study

• Round Robin Final Outcome
  – Labs will return test results and information requested regarding test cell design
  – Intend to produce guidance information regarding recommended exhaust airflow rate based on size and design of the test cell
  – 3 of 7 labs have returned data at this point in time
  – Important that all participating labs complete testing and return data on time
  – Possible similar round robin for seat test method?
Handbook Chapter 8 Update
Handbook Chapter 8 Update

• Current Chapter 8 of the Handbook
  – Includes the Park and sonic burners for use in the cargo liner oil burner test method

• Industry Feedback
  – Difficult to follow Chapter 8 when using sonic burner

• Proposed Update to Chapter 8
  – Park burner and test method in main chapter only
  – Sonic burner information in supplement
  – Other information from original supplement is now included in the main chapter
Handbook Chapter 8 Update

Proposed Chapter 8

Scope and Definitions → Apparatus → Test Samples and Conditioning → Preparation of Apparatus → Calibration → Test Procedure

If using Sonic Burner

Apparatus → Preparation of Apparatus → Flame Validation Procedure

Return to Chapter 8

Proposed Chapter 8 Supplement: Sonic Burner
Handbook Chapter 8 Update

• No changes to the test method or configuration of the Sonic Burner

• All Sonic Burner information now appears in Chapter 8 Supplement

• Chapter 8 of the Handbook will be updated to this simplified layout following the meeting pending working group approval
Handbook Chapter 7 Update
Handbook Chapter 7 Update

• Chapter 7 of the Handbook
  – The current seat cushion oil burner test method does not include the sonic burner for testing purposes
  – FAA has proposed to update Chapter 7 of the Handbook to allow use of the sonic burner
  – Sonic burner information will appear in the supplemental information of chapter 7
  – Same format as updated Chapter 8

• Inclusion of sonic burner into Chapter 7 pending working group approval
Proposed Chapter 7 Update

Proposed Chapter 7

Scope and Definitions → Apparatus → Test Samples and Conditioning → Preparation of Apparatus → Calibration → Test Procedure

If using Sonic Burner:

Apparatus → Preparation of Apparatus → Flame Validation Procedure → Return to Chapter 7

Proposed Chapter 7 Supplement: Sonic Burner
Cargo Liner Sonic Burner Video
Cargo Liner Sonic Burner Video

• FAA has been producing updated instructional videos for test methods
  – Recently completed instructional video for Sonic Burner and the cargo liner test method
  – Video will be shown during cargo task group meeting for those interested
  – Includes test method and Sonic Burner information
  – Ask those attending task group to provide feedback so as to improve video before final release
Future Work
Future Testing and Development

• Complete Round Robin Study
  – Produce guidance information based on results

• Updated Handbook
  – As described in this presentation

• Sonic Burner Seat Cushion Video
  – Coming soon

• Sonic Burner Support Information
  – Maintenance and/or troubleshooting checklist
Questions?

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