HRR² Task Group Updates

2012 February Materials Meeting Singapore

Materials Working Group
Michael Burns, FAA Tech Center
February, 2012
Agenda

• HRR\textsuperscript{2} Development Timeline
• Proposed Changes to Test Apparatus
• Chapter 5 Revision / Maintenance Schedule
• Prototype Development
• Ongoing Research
• 2012 Heat Release Round Robin
• Next
HRR^2 DEVELOPMENT PLAN TIMELINE

Phase I: Nov 2010 – Nov 2011 (Completed)

• Eliminate or reduce a major portion of variables that may have an impact on data in the test apparatus.

Phase II: Nov 2011 – Jan 2012 (Completed)

• Standardize / Improve the test method.
• Draft changes to Chapter 5 of the FAA Fire Test Handbook.

Phase III: Jan 2012 – May 2012

• Establish potentially new pass/fail criteria based on the improvements that were made that could have impacted data of current aviation materials.
• Finalize revision to Heat Release Chapter
Proposed Changes to HRR\textsuperscript{2} Apparatus

THERMOPILE

- Replaced current welded bead with 1/16” exposed bead / sheathed thermocouples
- Exact length and type wire on Extension Harness

OVERLAP CRITERIA

Seam weld construction is desired, however, should an overlap be necessary it shall not be greater than 3/8” on any component and kept to a minimum.
Proposed Changes to HRR\(^2\) Apparatus

INSULATION SPECIFICATION

- Low density, high temperature, flat duct insulation board
- Thickness of 1” (25mm) nominal
- Thermal conductivity of 0.033 W/m\(^2\), ºK (0.23 BTU-in/ft\(^2\), ºF, hr) +/- 15%

SPECIMEN LOCATION WITHIN HOLDING CHAMBER

- Sample face shall be located 9 +/- 0.5” from the inner radiation doors while in holding chamber prior to testing

CHANGES TO METHANE GAS CALIBRATION PROCESS

- Replacing wet test meter with mass flow meter
- Made changes to the equation (due to the use of mass flow meters)
- Replacing flow rate settings of 1 – 4, 1 – 6, 1 – 8, 1 – 6, 1 – 4 L/min with 1 – 2, 1 – 3, 1 – 4, 1 – 3, 1 – 2 SLPM
- Added 25°F range (tolerance) on upper thermocouples at baseline heat flux
Proposed Changes to HRR² Apparatus

AIRFLOW

• Replacing orifice plate/mercury manometer air flow control system with split flow, independent control:

  Chamber Flow @ 0.01 m³/s (600 FPM)

  Cooling Flow @ 0.03 m³/s (1800 FPM)

• Installing mixing plate or foam between the lower two air distribution plates (in progress)

SECOND STAGE PLATE

• Standardized hole pattern in second stage plate at 8 rows of 15 holes (0.1405 diameter) @ 1” x 7/8” centers.

• Added perimeter seal or gasket to prevent air leakage around edge.
SECONDARY PLATE - STANDARDIZED HOLE PATTERN

8 Rows of 15 Holes @ 0.1405 Diameter
(#28 Drill Hole)
SECONDARY PLATE - STANDARDIZED HOLE PATTERN
Proposed Changes to HRR$^2$ Apparatus

**HEAT FLUX – GAUGE, METHOD OF SETTING AND CORNER UNIFORMITY SPECIFICATION**

- Replacing the use of Gardon type heat flux gauges with Schmidt-Boelter type heat flux gauges.
- The lower pilot burner will remain in position while setting heat flux.
- The HFG calibration assembly will remain in place until a stable reading is obtained.
- The center heat flux range \( @ 3.65 \pm 0.05 \text{ W/cm}^2 \).
- All four corner heat flux range \( @ 3.65 \pm 0.10 \text{ W/cm}^2 \).
CHAPTER 5 REVISION

Scope

Definitions

Principle of the Method

Apparatus

• Heat Release Rate Apparatus
• Apparatus Components

Test Specimen

• Specimen Number
• Specimen Size
• Specimen Preparation
• Specimen Orientation
• Conditioning
CHAPTER 5 REVISION

Calibration Procedure of Equipment

- Heat Flux Calibration (Center)
- Heat Flux Uniformity Calibration (Corners)
- Determination of the Calibration Factor ($K_h$)

Preparation/Performance of Test

- Preparation
- Performance of Test
- Preparation of Further Test Runs

Presentation of Results

Requirements

Test Report
MAINTENANCE SCHEDULE GUIDANCE

COLD CHECKLIST

Daily, Weekly, Monthly, Quarterly, 5 year, 10 year, On Condition

HOT CHECKLIST

• Procedural checklist
• Uniformity requirement
FAA TECH. CENTER HRR$^2$ PROTOTYPE

- New Thermopile System
- Split-Airflow Measurement and Control (REF 0°C, 760 mmHg)
- New Second Stage Plate incorporating new hole pattern / seal / mixing foam
- Software changes incorporating new gas calibration parameters / equation
- Holding chamber preheat position established
- Insulation within specification
- Overlap areas within specification
- Mass Flow Meter used for gas calibration (REF 0°C, 760 mmHg)
- Schmidt-Boelter HFG’s (ordered)
ONGOING RESEARCH - AIRFLOW

Improvements to laminar airflow through environmental chamber using:

- Flat Plate
- Aluminum Core Honeycomb
- Flat Plate / Aluminum Core Honeycomb (Combined)
- Foam
- Flat Plate / Foam (Combined)

**Airflow Measurement** - Vane Type Anemometer / Hot wire anemometer

Inconsistent readings were improved by using a “Funnel” type adapter covering approximately 10 holes

**Results**

- Using Flat Plate located 2” from 8-hole plate - higher heat flux reading with no change in power setting
- Using Flat Plate / Aluminum Core Honeycomb (Combined) - even higher reading
- Airflow at sample face was dramatically worse with the lower and upper pilot flamelets dancing wildly and upper pilot occasionally extinguishing
- Foam – Somewhat same results
- Dramatic change to burn characteristics of a know panel configuration
### ONGOING RESEARCH - AIRFLOW

**Airflow measurements using Omega HH-30 anemometer - 20 hole combined flow (ft/min)**

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Heat Release Rate² - Part 25 Task Group
February 2012

Federal Aviation Administration
2012 Heat Release Round Robin

• Sponsored by FAA Tech Center
• Labs Will Be Contacted For Participation
• Materials To Be Shipped Out Shortly
• Data Presented At June Materials Meeting
NEXT

• Begin Testing using prototype HRR\(^2\) machine incorporating all changes

• Complete design change of Intermediate mixing plate / foam

• Complete Revision to Chapter 5 of the FAA Fire Test Handbook.

• Complete Maintenance Schedule Guidance Material