HRR^2 (OSU) Task Group Updates

2011 October Materials Meeting
Atlantic City, NJ USA

Materials Working Group

Michael Burns, FAA Tech Center

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Federal Aviation Administration

Agenda

- HRR^2 (OSU) Plan & Timeline
- Discuss What Data Was Generated Over The Past Year To Help Improve Test Apparatus
- Testing Summary And What Was Learned
- Next Steps

HRR^2 DEVELOPMENT PLAN

Sub Task Group #	Team Leader	Improvement Area
#1	**Martin Spencer** Marlin Engineering **Tim Earl** GBH International / FTT	**Thermopile** **Globar/Heater Box**
#2	**Segundo Vargas** Custom Scientific Inc.	**Upper Section, Lower Section/Insulation**
#3	**Ben Grogan / Bill Mountain** The Boeing Co.	**Airflow, Specimens** **Advance materials or materials that affect upper / lower pilot**
#4	**Fred Schall** Govmark Inc. **Nimisha Kaul** Weber Aircraft	**Heat Flux** **Methane Gas Calibration/Performance** **Material Baseline**
#5	**Michael Miler** Schneller, LLC.	**Standardized Checklist / Operating Procedures, Update /Rewrite Handbook - Chapter 5**

HRR^2 IMPROVEMENT PLAN TIMELINE

Phase I: Nov 2010 – Nov 2011 (Near Completion)

- Eliminate Or Reduce A Major Portion Of Variables In The Heat Release Rate Test Apparatus That May Have An Influence On Test Data.

Phase II: Nov 2011 – May 2012

- Standardize / Improve The Test Method & Procedures.
- Incorporate Changes Into Prototype(s) / Round Robin Testing

Phase III: May 2012 – Nov 2012

- Asses Impact On Pass / Fail Criteria As A Result Of Phase I & II.
- Re-write / Update Chapter 5 Of The FAA Fire Test Handbook.

Sub Task Group #1 – Data
Martin Spencer (Marlin Engineering) / Tim Earl (GBH Int.)

Thermopile

- Replace Type K Thermopile Wire With Type E.
- Replace Welded Bead Type Thermocouples With Exposed Bead (sheathed) 1/16” Thermocouples.
- Total Thermopile Resistance Data Gathered

Globar Replacement

- Prototype Radiant Panel Heater.
- 9” x 12” Panel Similar To Insulation Test.

Sub Task Group #2 – Data
Segundo Vargas (Custom Scientific Instruments Inc.)

Overlap Construction (Upper Section)

- Two Condition Explored: Overlapping Flanges And No Flanges In The Fabrication Of The Inner Cone, Outer Cone And Chimney In The Upper Section (The flanges Were 3/8” wide).
- All Other Conditions Kept Constant As Much As Possible, Including Insulation And Design Of Other Chamber Components.

Insulation (Upper Section Only)

- Four Configurations: No Insulation, Fiberglass Duct Board (Light Density), Organic Mineral Board (Dense), Kaowool Board (Very dense).

Sub Task Group #3 – Data
Ben Grogan / Bill Mountain (The Boeing Co.)

Airflow

- Separate Chamber / Cooling Airflow
  - Replace Orifice Plate / Mercury Manometer With Sonic Choke(s) / Pressure Gage(s).
- Improve Chamber Internal Laminar Airflow.
  - Standardize Secondary Plate Hole Configuration.
  - Installation Of Baffle Plate Between Lower Two Plates.

Specimens

- Develop Recommendations For Specimen:
  - Swelling (Covering Lower Pilot)
  - Shrinking / Popping / Delaminating / Exploding
  - Dripping / Melting Away From Holder
  - Fire Retardant (Effects On Pilot Flames)
  - > 1.75” Materials

Sub Task Group #4 – Data
Fred Schall (Govmark Inc.)
Nimisha Kaul (Weber Aircraft)

Heat Flux

- Standardize Method Of Setting Heat Flux.
  - Burner vs. No Burner In Position
  - In Situ (Steady State) vs. Intermittent Plunge
- Changes To The Methane Gas Calibration Procedure.
- Standardize Sample Preheat Location Prior To Testing.

Material Baseline

- Establish Material Data Base (Baseline Data) To Be Used In Assessing Potential Impact To Pass / Fail Criteria As A Result Of This Improvement Plan.

Sub Task Group #5 – Data
Michael Miler (Schneller, LLC.)

Standardized Checklist / Operating Procedures

- Conformity Inspection Criteria
- Hot / Cold Inspection
- Validation Of Software
- Interval Recommendations
- Sample Preparation
- Testing

Rewrite Handbook - Chapter 5

Testing Summary And What Was Learned

THERMOPILE WIRE

- Replacing Type K with Type E wire results in an increase in signal gain of approximately 30%.

THERMOPILE TOTAL RESISTANCE ROUND ROBIN (12 labs)

- A range of 55 to 138 Ohms was observed.

THERMOCOUPLE - Replacing current welded bead with 1/16” exposed bead (sheathed)

- Closely mimics current bead type thermocouple performance.
- Slight shift in reaction time due to sheathing.
- Ease of locating in position more accurately with more stability at the sensor tip.
- Easier to cleaning.
- Can be purchased “off the shelf”.

GLOBAR REPLACEMENT RADIANT PANEL

- Very good left to right corner uniformity however inability to adjust upper and lower parameters (possibly an upper, center and lower zone system may work).
- Radiant Panel had inadequate wattage capabilities.
- Overall no significant benefit observed.

Testing Summary And What Was Learned

OVERLAP CONSTRUCTION (UPPER SECTION)

- The difference between the two construction configurations (Seam weld vs. all 4 corners) was about 5%.
- Design without flanges provides the more conservative test results.

INSULATION (UPPER SECTION ONLY)

- Data suggests that insulation type and density may have very little impact on the calibration factor as well as Peak HRR, Time to Peak and Total HRR.

AIRFLOW (REPLACING ORIFICE PLATE CONFIGURATION)

- Because back pressure has negligible effect on the performance of Sonic Chokes, improvement can be made by separating the Chamber and Cooling Airflow into two separate systems.
- Preliminary testing shows that improvements to chamber internal laminar airflow can be made by the addition of a baffle plate between the lower two plates.

CHANGES TO METHANE GAS CALIBRATION PROCESS

- During the calibration process the 6 and 8 L/min gas flow settings may be well beyond the current pass fail criteria (65/65).
- Replacing the flow rate settings of 1, 4, 6 and 8 L/min with 1,2,3 and 4 L/min will have little effect on the calibration factor and may be more representative of modern day aircraft materials.

Testing Summary And What Was Learned

HEAT FLUX – GARDON / SCHMIDT-BOELTER HEAT FLUX GAUGE

- Manufacturer suggests the use of Schmidt-Boelter type heat flux gauges to replace Gardon type as they are less impacted by airflow current and more durable.

HEAT FLUX – HOW TO VERIFY

- No standardize method of setting heat flux has been established to date.
- Testing shows that a steady state (in situ) reading of 3.65 W/cm2 would closely correlate to the Intermittent Plunge method of 3.50 W/cm2 and potentially be more reproducible throughout industry.
- Having the lower pilot burner in position will result in about a 2% higher center heat flux indication.

HEAT FLUX - FOUR CORNER UNIFORMITY

- Corner heat flux variation as little as 3% from the center could have an impact on the Total HRR values of more than 10% (current corner to center specification is 5%).

SPECIMEN LOCATION WITHIN HOLDING CHAMBER (PRIOR TO TESTING)

- No significant correlation between the location of a specimen within the holding chamber and Peak HRR, however, could impact Total HRR values by more than 5%.

NEXT

- Based On The Data That Was Generated, Recommendations Will Be Presented To The Task Group For Discussion And To Finalize Changes.
- Assemble Prototype HRR Machine(s) Incorporating All Changes.
- Conduct Round Robin Testing To Assess Potential Impact On Test Criteria And Requirements.
- Complete Re-write / Update Chapter 5 of The FAA Fire Test Handbook.

Questions / Comments?

“Even if you fall on your face, you're still moving forward.”