2012 OSU Round Robin
&
HR2 Updates

2012 October Materials Meeting
Indianapolis, IN

Materials Working Group

Michael Burns, FAA Tech Center

October, 2012

Federal Aviation Administration

AGENDA

2012 Round Robin

- Issues
- Data Analysis

HR2 Update

Next

2012 Heat Release Round Robin

36 Participating OSU's

4 Samples Tested (3 Specimens Each)

2 Honeycomb Panels

(Dark Brown & Light Brown)

2 Thermoplastic Panels

(Black, Tan or Blue)

2012 Heat Release Round Robin

Issues / Problems Found

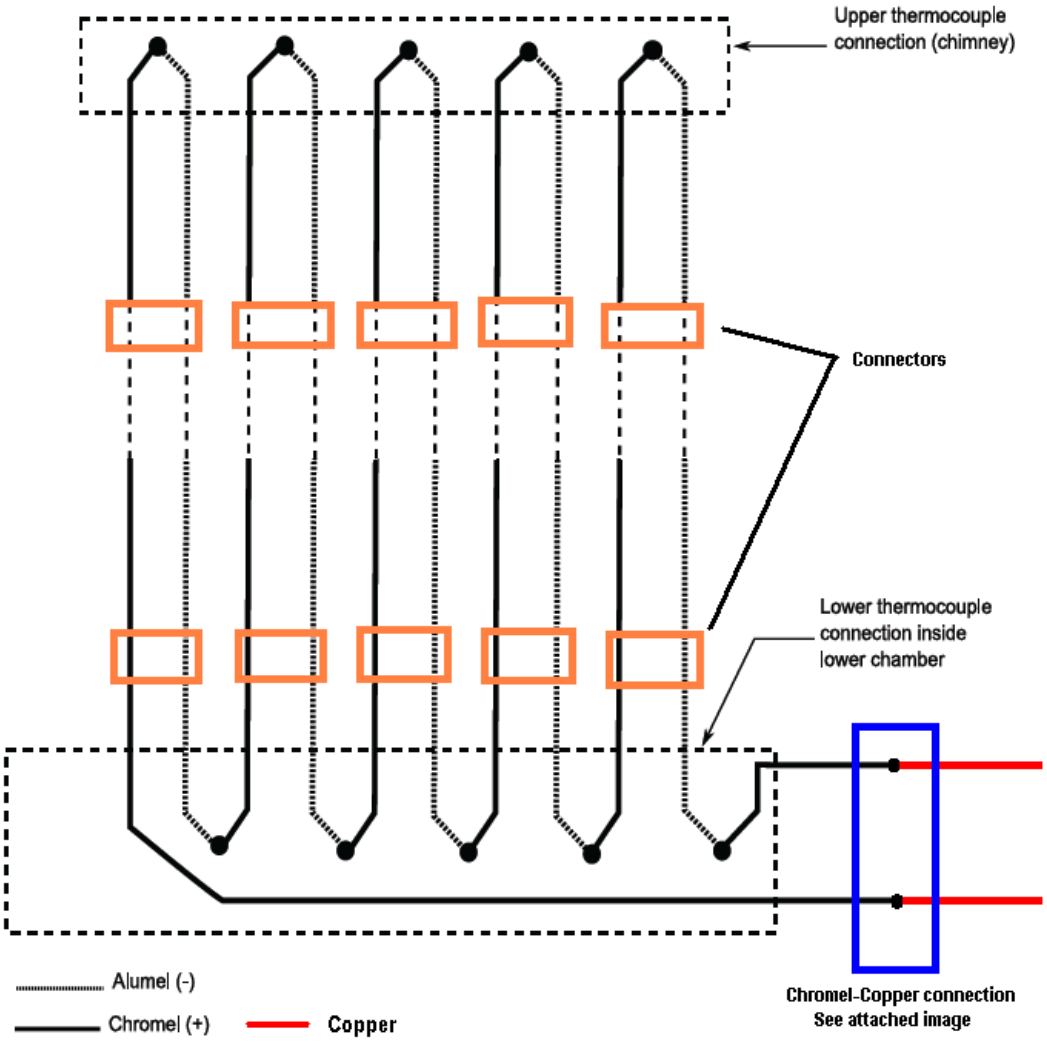
- Thermopile Wiring

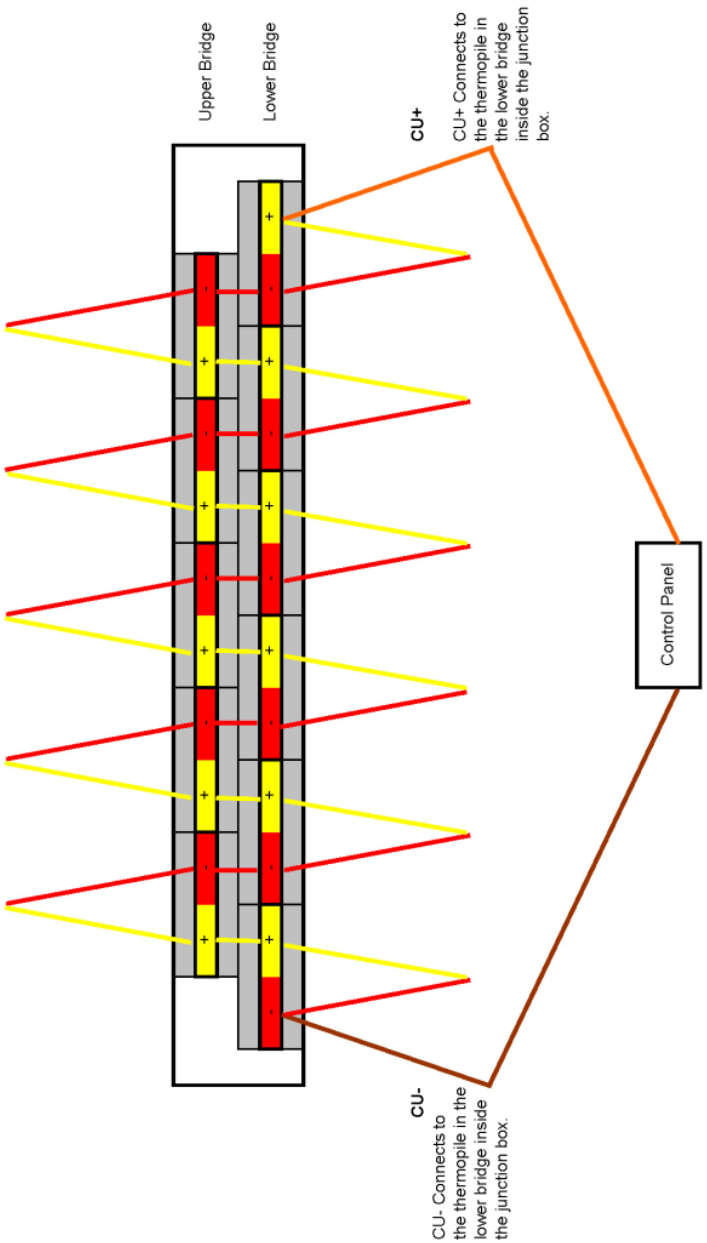
  21 Total Responses

  9 - Incorrectly Wired

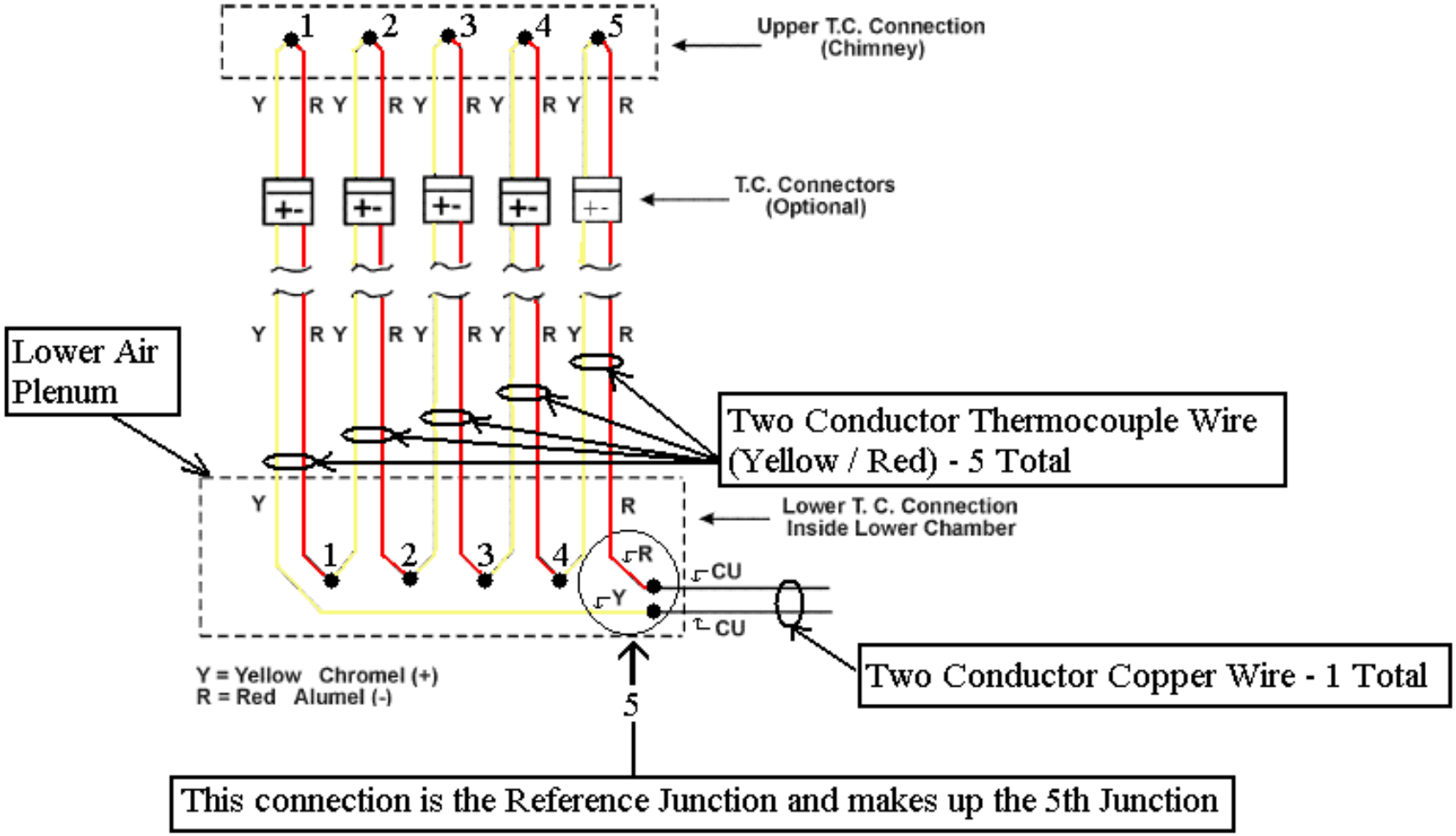
  4 - Unsure

- Air Leaks

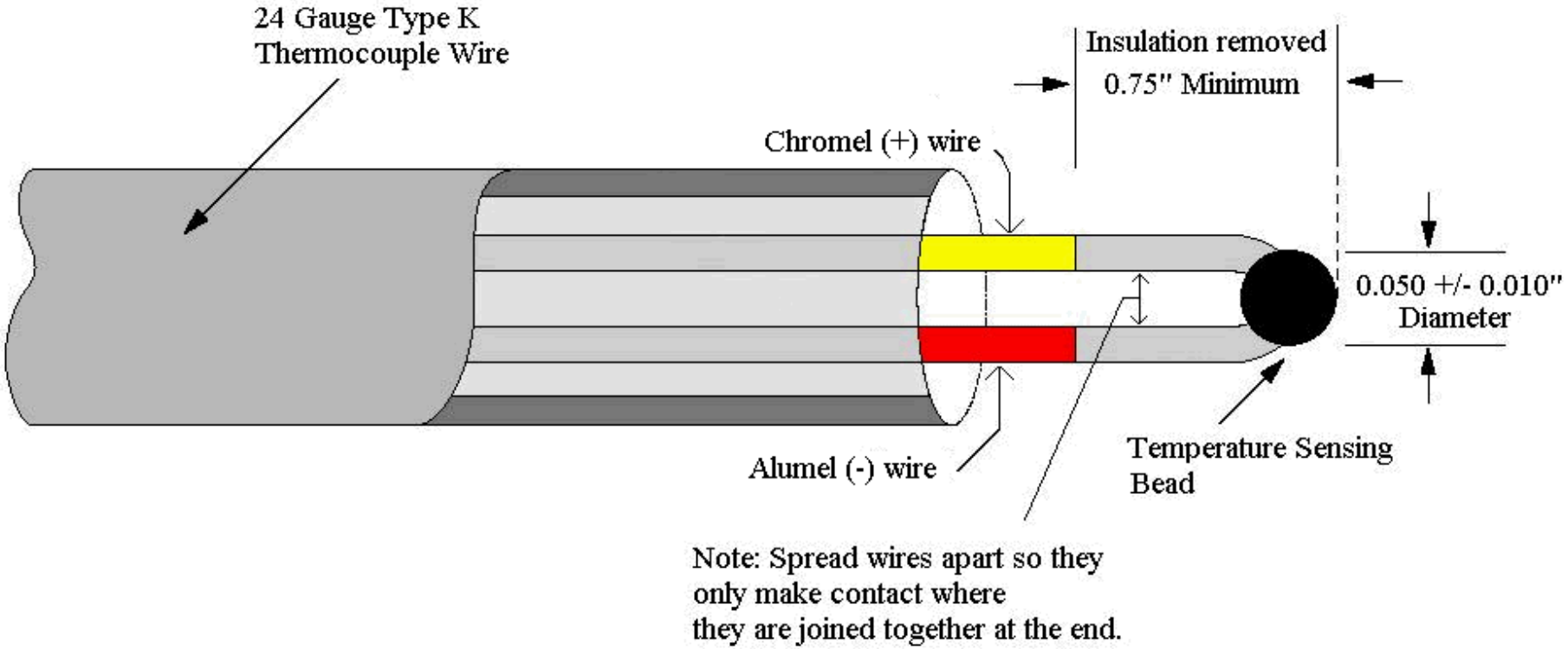

Upper thermocouple connection (chimney)
Connectors
Lower thermocouple connection inside lower chamber
Alumel (-)
Chromel (+)
Copper
Chromel-Copper connection
See attached image


Upper Bridge
Lower Bridge
CU+
CU+ Connects to the thermopile in the lower bridge inside the junction box.
Control Panel
CU-
CU- Connects to the thermopile in the lower bridge inside the junction box.

Reference Junction Errors



Thermocouple Bead Construction



2012 Heat Release Round Robin

Air Leaks (Areas to Inspect)

*** Important to remember air flow is metered and ANY leaks in system may effect results!**

- **Orifice Meter**

  Tubing and Fittings from Orifice Plate to Manometer (Upstream/Downstream)

  Joints in Piping from Orifice Plate to Lower Plenum / Cooling Manifold

- **Lower Plenum**

  ¼" Aluminum Air Flow Metering Plate

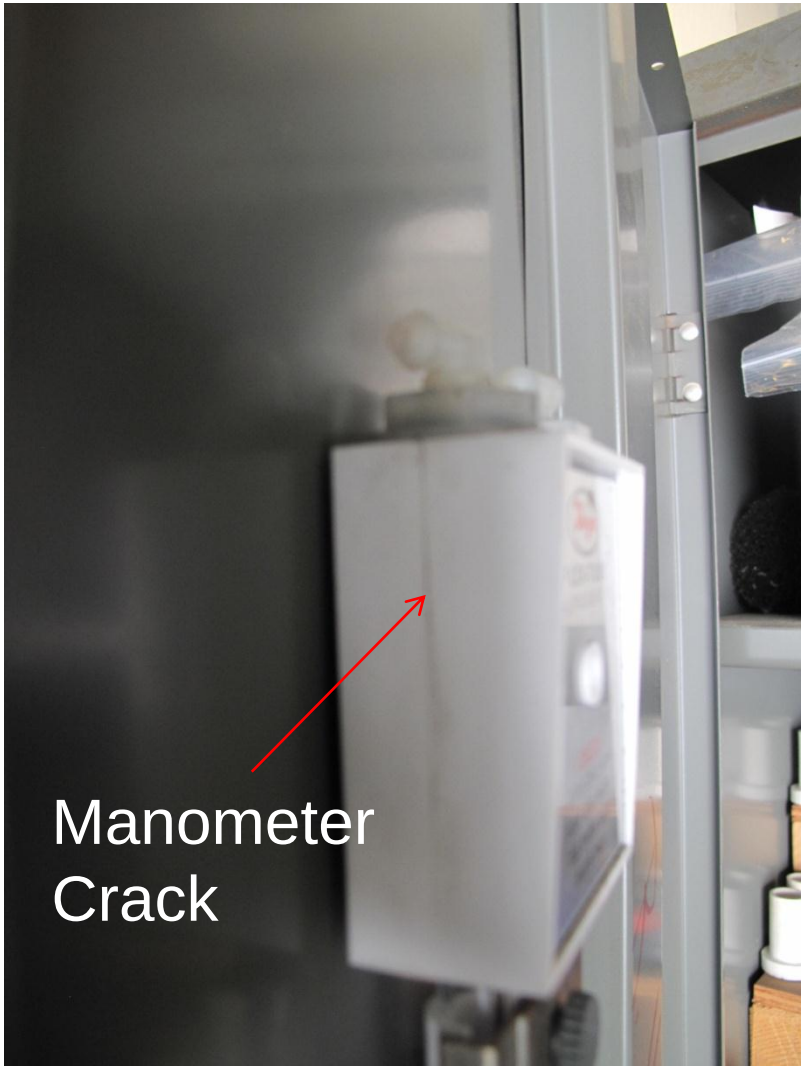
    Lower Seal (Lower Plenum to ¼" Aluminum Plate)

    Upper Seal (¼" Aluminum Plate to Lower Flange of the OSU)

  Wiring Pass Through(s) (Thermopile / Inlet air temperature probe)

  Access Covers

2012 Heat Release Round Robin



2012 Heat Release Round Robin

Air Leaks (Areas to Inspect)

- **Main Body**

  Second Stage Plate Perimeter (120 Holes)

  Holding Chamber Outer Door Seal

  Globar Insulators

  Seams (Main Body / Globar Pan)

  Access Panels

- **Pyramidal Section Seals**

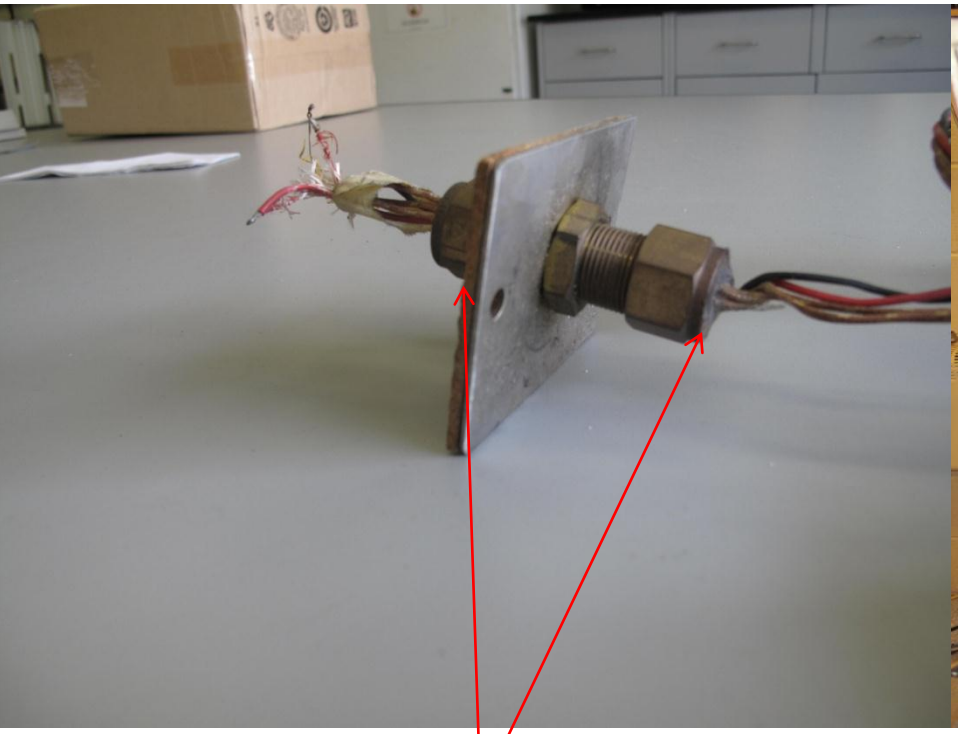
  Lower Seal (OSU Flange to Inner cone Flange)

  Middle Seal (Inner Cone Flange to Cooling Manifold)

  Upper Seal (Cooling Manifold to Outer Cone Flange)

  Exhaust Stack to Outer Cone

2012 Heat Release Round Robin



Thermopile Pass Through / Access Panel

Holding Chamber Outer Door Seal

2012 Heat Release Round Robin

Data Analysis

- Quantify Labs Overall Performance in Round Robin
- Assist Labs In Better Understanding Range of Data Being They Are Producing
- Develop Troubleshooting Guide?

2012 Heat Release Round Robin

Trend Analysis - Peak Millivolt Rise Data from Baseline

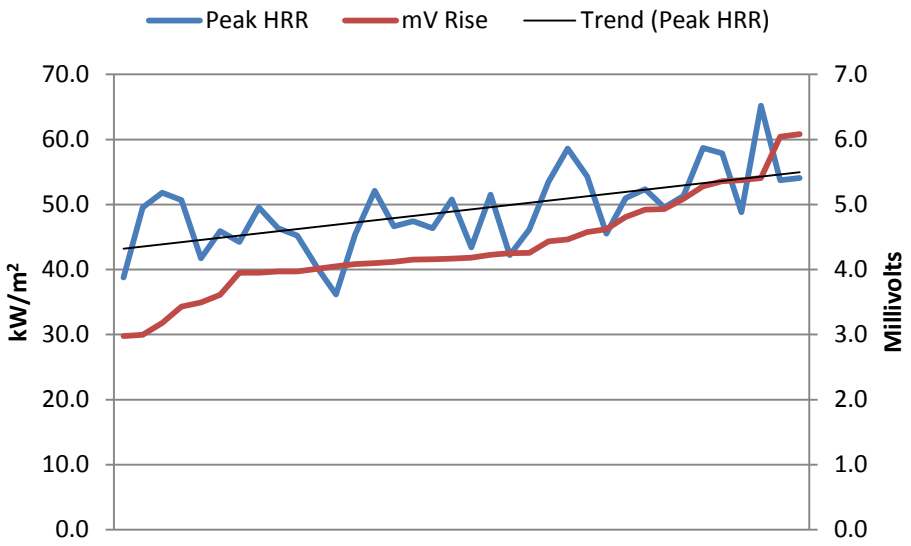
$$\textbf{mV Rise} = \left(\frac{1}{Cal.Factor}\right) * \textbf{PHRR}$$

Terms:

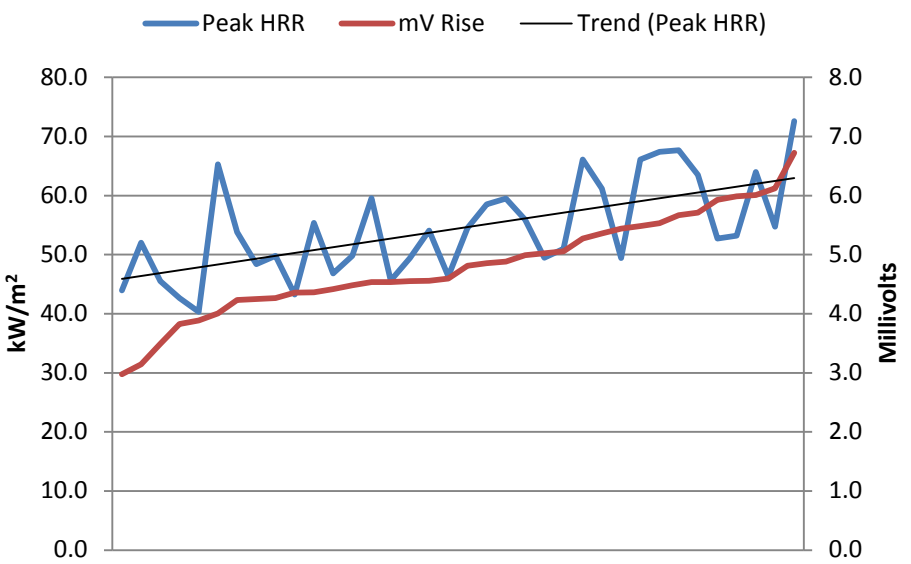
Cal. Factor = kW/mV*m^2

Peak Heat Release Rate = kW/m^2

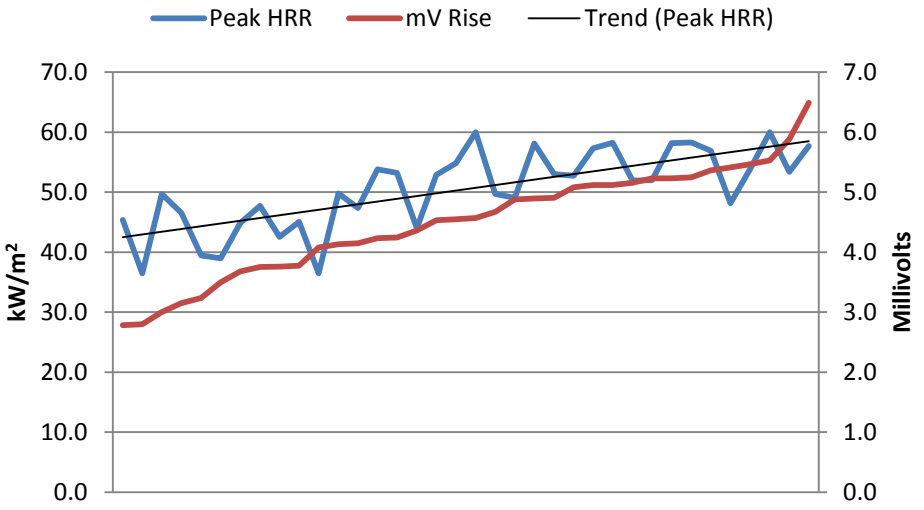
Dark Brown Honeycomb Panel



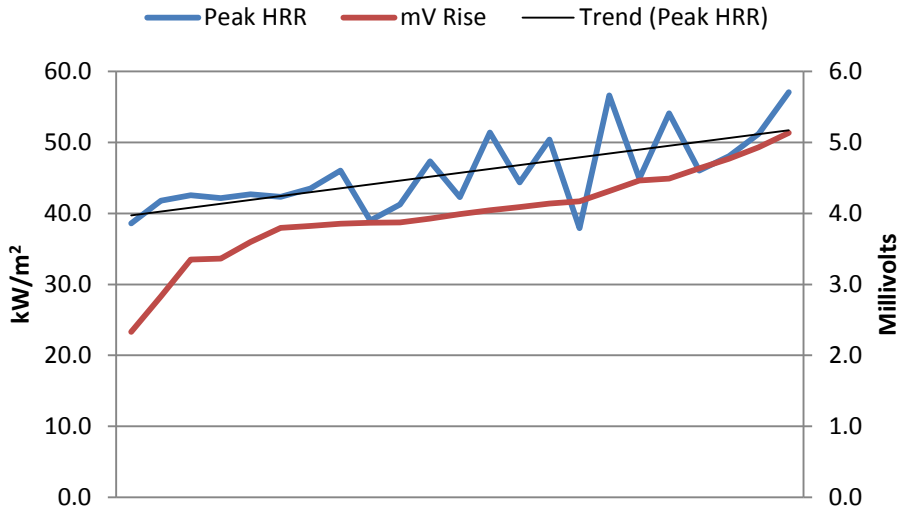
Light Brown Honeycomb Panel



Black Thermoplastic Panel



Light Thermoplastic Panel



2012 Heat Release Round Robin

Avg. Cal. Factor Range

10 – 13 kW/mV*m^2

↓ mV Rise ~ ↑ Cal. Factor

Low mV Rise Labs	kW/mV*m2
B07	16.5
B10	14.8
A18	12.7
B04	16.3
B14	13.0
Average	**14.7**

Note: Labs Who Reported Peak HRR values greater than 10% from the average 3 or more times (of 4 specimens tested)

High mV Rise Labs	kW/mV*m2
B09	8.9
B15	8.9
A07	11.1
A24	9.1
B06	10.8
Average	**9.8**

↑ mV Rise ~ ↓ Cal. Factor

Total HR (+/-10% from Avg)	Peak HRR (+/-10% from Avg)	mV Rise (+/-10% from Avg)	Rank #	Range
Low	Low	Low	1	1 to 9
		High	2	
		Average	3	
	Average	Low	4	
		High	5	
		Average	6	
	High	Low	7	
		High	8	
		Average	9	
Average	Low	Low	10	10 to 18
		High	11	
		Average	12	
	Average	Low	13	
		Average	14	
		High	15	
	High	Average	16	
		Low	17	
		High	18	
High	Low	Average	19	19 to 27
		Low	20	
		High	21	
	Average	Average	22	
		Low	23	
		High	24	
	High	Average	25	
		Low	26	
		High	27	

Ranking System Normal Operating Criteria: Average Range = 10 to 18, % STDEV = 60% or Less

Lab Code	D.H.P	L.H.P	BLACK T.P	TAN T.P	BLUE T.P	Avg	% STDEV	NOTES
A10	3	5	3		1	3.00	54%	INSPECTION OF EQUIPMENT/PROCEDURES ADVISED
A09	15	3	3	3		6.00	100%	INSPECTION OF EQUIPMENT/PROCEDURES ADVISED
B14	10	1	1		16	7.00	105%	INSPECTION OF EQUIPMENT/PROCEDURES ADVISED
B07	13	4	13	1		7.75	80%	INSPECTION OF EQUIPMENT/PROCEDURES ADVISED
B05	6	14	1		14	8.75	73%	INSPECTION OF EQUIPMENT/PROCEDURES ADVISED
A02	14	18	1	6	6	9.00	76%	INSPECTION OF EQUIPMENT/PROCEDURES ADVISED
B11	3	6	15	15		9.75	63%	INSPECTION OF EQUIPMENT/PROCEDURES ADVISED
A12	10	27	1	6		11.00	103%	INSPECTION OF EQUIPMENT/PROCEDURES ADVISED
A06	3	1	15	27		11.50	105%	INSPECTION OF EQUIPMENT/PROCEDURES ADVISED
B17	14	10	1	22		11.75	74%	INSPECTION OF EQUIPMENT/PROCEDURES ADVISED
A24	15	15	15	3		12.00	50%	APPARATUS APPEARS TO BE OPERATING NORMAL
A01	4	14	14	16		12.00	45%	APPARATUS APPEARS TO BE OPERATING NORMAL
A14	14	16	14	4		12.00	45%	APPARATUS APPEARS TO BE OPERATING NORMAL
A23	15	18	14	3		12.50	52%	APPARATUS APPEARS TO BE OPERATING NORMAL
B15	15	15	15		5	12.50	40%	APPARATUS APPEARS TO BE OPERATING NORMAL
A20	12	3	15	24	14	13.60	55%	APPARATUS APPEARS TO BE OPERATING NORMAL
A21	14	10	27	6		14.25	64%	INSPECTION OF EQUIPMENT/PROCEDURES ADVISED
A26	22	22	10		4	14.50	62%	INSPECTION OF EQUIPMENT/PROCEDURES ADVISED
A05	27	14	6	14		15.25	57%	APPARATUS APPEARS TO BE OPERATING NORMAL
A16	6	14	24		18	15.50	49%	APPARATUS APPEARS TO BE OPERATING NORMAL
A18	14	23	13	13		15.75	31%	APPARATUS APPEARS TO BE OPERATING NORMAL
A25	10	14	18	22		16.00	32%	APPARATUS APPEARS TO BE OPERATING NORMAL
A22	15	12	14	24		16.25	33%	APPARATUS APPEARS TO BE OPERATING NORMAL
A17	15	12	27	14		17.00	40%	APPARATUS APPEARS TO BE OPERATING NORMAL
B10	23	10	13	23		17.25	39%	APPARATUS APPEARS TO BE OPERATING NORMAL
A04	14	27	14		14	17.25	38%	APPARATUS APPEARS TO BE OPERATING NORMAL
B04	23	26	13		10	18.00	43%	APPARATUS APPEARS TO BE OPERATING NORMAL
B08	22	13	22		22	19.75	23%	INSPECTION OF EQUIPMENT/PROCEDURES ADVISED
A03	14	14	27	27	22	20.80	31%	INSPECTION OF EQUIPMENT/PROCEDURES ADVISED
B09	27	15	27		15	21.00	33%	INSPECTION OF EQUIPMENT/PROCEDURES ADVISED
A07	27	27	18		14	21.50	30%	INSPECTION OF EQUIPMENT/PROCEDURES ADVISED
B03	14	22	27		25	22.00	26%	INSPECTION OF EQUIPMENT/PROCEDURES ADVISED
B06	27	27	14		27	23.75	27%	INSPECTION OF EQUIPMENT/PROCEDURES ADVISED
A11	25	22	25	25		24.25	6%	INSPECTION OF EQUIPMENT/PROCEDURES ADVISED
A13	22	27	22	27		24.50	12%	INSPECTION OF EQUIPMENT/PROCEDURES ADVISED

Heat Release Round Robin Summary

- Low mv Rise / PHRR Trend Observed In Data
- High / Low Cal. Factor Seem To Correlate With mV Rise
- Ranking Number Based on Total HR, PHRR and mV Rise Appears To Be a Reasonable Assessment

  Possibly Include Other Parameters?
- Labs Should Investigate Cause Of High / Low Ranking (e.g. Thermopile Issues, Air Leaks etc.)

Chapter HR Updates

I. Chapter HR
Test Method

II. Chapter HR Supplement
Support documentation such as video's, photo's and examples pertinent to this test method.

Periodically updated document

III. Chapter HR Appendix
Informational material pertinent to this test method such as manufacturer's, part numbers and suppliers of products that have been found suitable.

Periodically updated document

IV. Advisory Circular
Guidance material on what / how to test. It describes acceptable means, but not the only means, for demonstrating compliance with the applicable regulations.

Chapter HR Updates - ADDED

HR.2.9 NIST Traceability
A calibration entity using NIST traceable calibration instrumentation.

HR.2.10 Stability

The term "stable" as it relates to heat flux density and chamber equilibrium is expressed in terms of % standard deviation over a defined time period.

Heat flux
Heat flux gauge millivolt signal that varies less than 5.0% standard deviation over the last 60 seconds.

Chamber equilibrium
Thermopile millivolt signal that varies less than 5.0% standard deviation over the last 15 minutes commencing no sooner than 30 minutes after turning the power to the globars on.

Tolerance Table (From Supplemental Section)

Chapter HR Updates - REMOVED

Section 4.1
“flat duct board” from the performance description of the insulation.

HR.2.7 Methane Gas (CH4)

“and adjusted to a supply pressure of 20 ± 2 psig”.

“Air used to mix with Methane gas for the upper and lower pilot flamelets shall be adjusted to a supply pressure of 30 ± 2 psig”.

*** Need to put dimensional tolerances on drawings.**

Chapter HR Supplement Update

- Replaced “or equivalent” with “this product or product of similar specification or function has been found suitable.”
- List of manufacturers and manufacturer’s part numbers will be included in appendix for this test method and not in the supplemental section.
- Removed subjective language concerning the aluminum foil, e.g. the word “household”
- Removed specification of setting of device specific items, e.g. pressure setting of gas to mass flow controller, and other such references.

  Note: The rational is the inlet pressure to the mass flow controller is dependent on the manufacturer of the MFC recommendation.
- Moved tolerance table to main Chapter HR document (Section 4)

NEXT

- Complete Chapter HR, Supplemental Section and Appendix
- Continue to Develop Round Robin Ranking System (Analyzing Tool) Within Task Group
- Continue Long Term Repeatability Testing of Prototype

Brain Teaser

What fruit has its seeds on the outside?

Answer: Strawberry