HEAT FLUX CALIBRATION STUDY

2010 March Materials Meeting
Boeing Facility - Renton, WA

Materials Working Group

Michael Burns, FAA Tech Center

March 3rd & 4th, 2010

Federal Aviation Administration

AGENDA

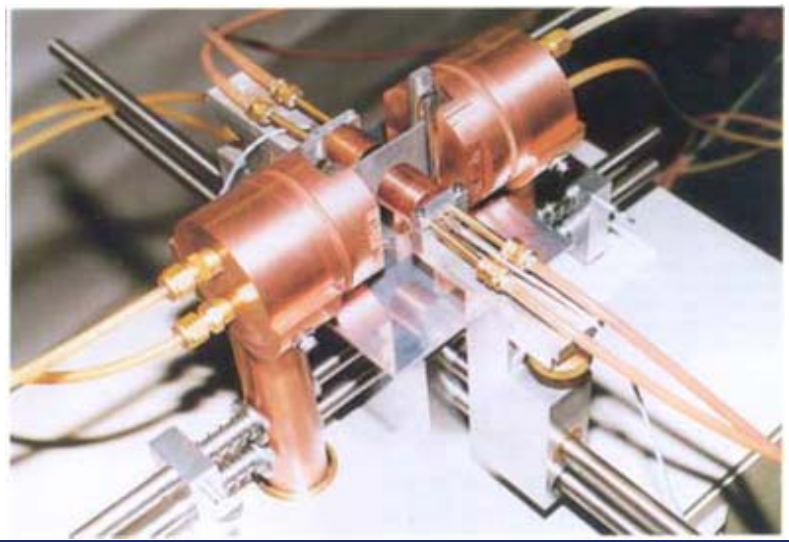
- FAA Tech. Center Calibration Results (NIST Cal.)
- Problems Getting A Repeatable Calibration Factor
- Solution To Problem
- New Method Data
- Calibration Results
- Radiant Panel Validation Study

Heat Flux Study – 4 NIST Calibrated Gages

Manufacturer	Type	Range (BTU)	S/N
VATELL	GARDON	0-5	V8174
VATELL	GARDON	0-5	V8175
MEDTHERM	GARDON	0-5	M160781
MEDTHERM	GARDON	0-20	M160782

Heat Flux Sensitivity Study

- Once Gages Were Returned To Tech. Center A Calibration Was Conducted Using “FAA” Gage As Standard
- The Transfer Method Was Made Using A Heated Graphite Plate



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Approx. % Difference From NIST Cal. Factor

Vatell Gages

Both FAA and Manufacturer Calibration Factors Were About 5% Lower

Medtherm Gages

Both FAA and Manufacturer Calibration Factors Were About 2% Higher

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It was discovered that when a calibration was conducted, and the sensors swapped and repeated, there was about an 8% difference in the FAA calculated calibration factor

Tried the following:

- **Replaced Graphite Plate**
- **Replaced FAA gage with a newly calibrated NIST gage (V8175)**
- **Switched Calorimeter holders**
- **Rotated Graphite Plate**
- **Covered everything (Stagnant air) – nothing seems to solve this 8% error**

Then

- **Increased gap from 1/8" to 1/4“ – began to see improvement in error**
- **Increased gap from 1/4" to 1/2“**
- **decreased gap from 1/2" to 3/8“ - had repeatability with less than 2% error**
- **Avg. left/right calibration values and was within 0.5% of the NIST Cal. Factor (using 2 NIST Gages)**

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Once Repeatability Problem Was Solved Calibration Was Repeated

- FAA Gage As Standard With It's New Calibration Factor
- New Method Of Swapping Sensor Locations
- Using Average Value (With Increased Gap Distance)

NOTE: FAA Gage is a 0-5 BTU Vatell

Approx. % Difference From NIST Cal. Factor

Vatell Gages

FAA Calibration Factor Improved to < 2% (From 5%)

Manufacturer Calibration Factor Approx. 5% Lower

Medtherm Gages

FAA Calibration Factor Grew to Approx. 16% Higher

Manufacturer Calibration Factor Approx. 2% Higher

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Approx. % Difference Between Calculated FAA Cal. Factor & NIST Cal. Factor When NIST Cal. Factor Is Used For The Standard

STD	V8174	V8175	M160781	M160782
V8174	N/A	0%	16%	19%
V8175	<1%	N/A	15%	18%
M160781	-13%	-13%	N/A	4%
M160782	-15%	-16%	-3%	N/A

Approx. % Difference Between Calculated FAA Cal. Factor & Man. Cal. Factor When NIST Cal. Factor Is Used For The Standard

STD	V8174	V8175	M160781	M160782
V8174	N/A	4%	13%	21%
V8175	8%	N/A	12%	19%
M160781	-7%	-10%	N/A	5%
M160782	-10%	-13%	-5%	N/A

Radiant Panel Heat Flux Validation Test

- **Comparison of a Vatell and Medtherm NIST calibrated gage (of the same range) in Radiant Panel Tester**
- **The Radian Panel Heat Flux was set to 1.5 BTU/ft^2*sec using the Vatell gage with the NIST calibration factor installed in the software**
- **The gage was swapped with the Medtherm and it's NIST calibration factor entered into the software**

	MV	Heat Flux	NIST Cal.	% Delta
Vatell	3.49	1.50	0.4302	
Medtherm	2.39	1.26	0.5269	-16%

NEXT

- A Medtherm Gage Will Be Calibrated Using A NIST Calibrated Medtherm Gage Of The Same Range
- The Radiant Panel Test Will Be Repeated To Get A Baseline For This Sensor
- The Medtherm Gage Will Be Stripped Of It's Paint And The Entire Face Will Be Coated With 3m Black Velvet Paint And Recalibrated
- Test Will Be Repeated
- Look Into Possible Use Of Alternative Type (Schmidt-Boelter [*Thermopile]*) Heat Flux Gage