HEAT FLUX CALIBRATION STUDY

2010 June Materials Meeting
Koeln, Germany

Federal Aviation Administration

Materials Working Group

Michael Burns, FAA Tech Center

June 23rd & 24th, 2010

AGENDA

- Comparison Of Variations In Paint Systems
- Schmidt-Boelter Gages
- NIST Full Range Vs. Single Point Calibration
- Next Steps

Comparison Of Variations In Paint Systems

- Comparison Of A Vatell And Medtherm NIST Calibrated Gage (of the same range) In Radiant Panel Tester

- The Radiant 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 And Recorded As Baseline

- Gage Was Removed And Entire Face Was Painted Black To Match The Vatell Paint System

Comparison Of Variations In Paint Systems

- Gage Was Recalibrated Using Vatell And Medtherm NIST Calibrated Gage (of the same range) via Graphite Plate Method

(Unsure If The Newly Painted Face Sensor Would Respond Like A Vatell Gage Or A Medtherm Gage)

- The Radiant 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 The Two New Calibration Factors Were Entered Into The Software And Recorded

- Data Shows That Painting The Entire Face Of The Medtherm Heat Flux Gage Increased The Reading By Approximately 15% Using The Vatell Gage As The Standard

* (N)=NIST (V)=Vatell as Standard (M)=Medtherm as Standard

Comparison Of Variations In Paint Systems

Medtherm Gage As Found (Paint In Center Portion Only)

	MV	Heat Flux	CF.	% Delta
Vatell (N)	3.5	1.49	0.430	
Medtherm (M)	2.2	1.15	0.521	23% Low

Medtherm Gage (Entire Face Painted)

	MV	Heat Flux	CF.	% Delta
Vatell (N)	3.5	1.50	0.430	
Medtherm (V)	2.8	1.38	0.497	8% Low
Medtherm (M)	2.8	1.21	0.435	19% Low

Schmidt-Boelter Gages

- FAA Tech Center Purchased Four New Schmidt-Boelter Heat Flux Gages From Vatell (2), Medtherm (1) & Hukseflux (1)

- Gage Were Recalibrated Using Vatell And Medtherm NIST Calibrated Gage (of the same range) Via Graphite Plate Method Then Tested In Radiant Panel Tester

- Gages Will Then Be Sent To NIST For Calibration

Schmidt-Boelter Gages

- The Radiant Panel Heat Flux Was Set To 1.5 BTU/ft^2*sec Using A Vatell Gage With The NIST Calibration Factor Installed In The Software

- Below Is % Difference In Readings Using Both Calibration Factors

SCHMIDT-BOELTER HEAT FLUX GAGES

Standard	$Vatell_1$	$Vatell_2$	Medtherm	Hukseflux
Vatell	Same	Same	6% Low	4% Low
Medtherm	11% Low	12% Low	17% Low	19% Low
Manufacturer	5% High	10% Low	3% Low	3% Low

NIST Single Point Vs. Full Range Calibration

- NIST Calibration Report Gives BTU/ft^2*sec vs. Mv's For 9 Data Points.

•The Calibration Factor For Each Point Is Calculated Then The Average For The 9 points Is Reported

•The Following Chart Shows 1.3, 2.2 and 3.1 BTU/ft2*sec Data Points Vs. Mv's And The Calculated Calibration Factor For Each Heat Flux Level Using The Single Point (SP) Calibration And Full Scale (FS) Calibration Factor For Each.

NIST Single Point Vs. Full Range Calibration

	1.3 BTU/ft²*sec Setpoint			Change In Heat Flux Gage Output	
	SP Cal.	FS Cal.	% Difference	FS Cal. (Mv)	SP Cal. (Mv)
$Vatell_1$	0.4110	0.4302	-4.5%	3.49	3.65
$Vatell_2$	0.3959	0.4125	-4.0%	3.64	3.79
Medtherm	0.5576	0.5269	5.8%	2.85	2.69
	2.2 BTU/ft²*sec Setpoint				
	SP Cal.	FS Cal.	% Difference	FS Cal. (Mv)	SP Cal. (Mv)
$Vatell_1$	0.4158	0.4302	-3.4%	5.81	6.01
$Vatell_2$	0.3987	0.4125	-3.3%	6.06	6.27
Medtherm	0.5500	0.5269	4.4%	4.75	4.55
	3.1 BTU/ft²*sec Setpoint				
	SP Cal.	FS Cal.	% Difference	FS Cal. (Mv)	SP Cal. (Mv)
$Vatell_1$	0.4211	0.4302	-2.1%	8.14	8.31
$Vatell_2$	0.4039	0.4125	-2.1%	8.48	8.67
Medtherm	0.5360	0.5269	1.7%	6.64	6.53

NEXT

- Send Schmidt-Boelter Gages To NIST For Calibration

- Once Returned, Install Calibrated Gages Into OSU / RP & NBS For Validation Study

- Research Use Of Single Point Calibration VS. Full Range Calibration

- Continue Work On Straw man Calibration Outline For FAA Heat Flux Calibration Method