OSU Calorimetry Test

Initial Results from 2016 Industry OSU Round Robin

[Data Current up to 01 MAR 16]

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Topics of Discussion:

- Motivation behind continued OSU study

- Quick summary of 2016 Industry Round Robin Data

- Discussion on the following parameters:
    - Airflow
    - Differential Pressures
    - Lab Conditions
    - Calibration Data
    - Heat Release Results
    - Correlations

- Next steps

Motivation Behind Study:

- **The Ohio State University Calorimetry (OSU) test used throughout the aircraft industry to determine the heat release of panels flown in the aircraft cabin interior**

  - Significant variation in round robin data acquired among industry labs has been noted

Goal: Establish an accurate baseline for the OSU tests industry-wide, by understanding and then controlling the possible variation due to airflow and other variables.

- **THANK YOU to all the industry-wide participants in the 2016 OSU RR and to Mike Burns [FAA] for compiling the data !**

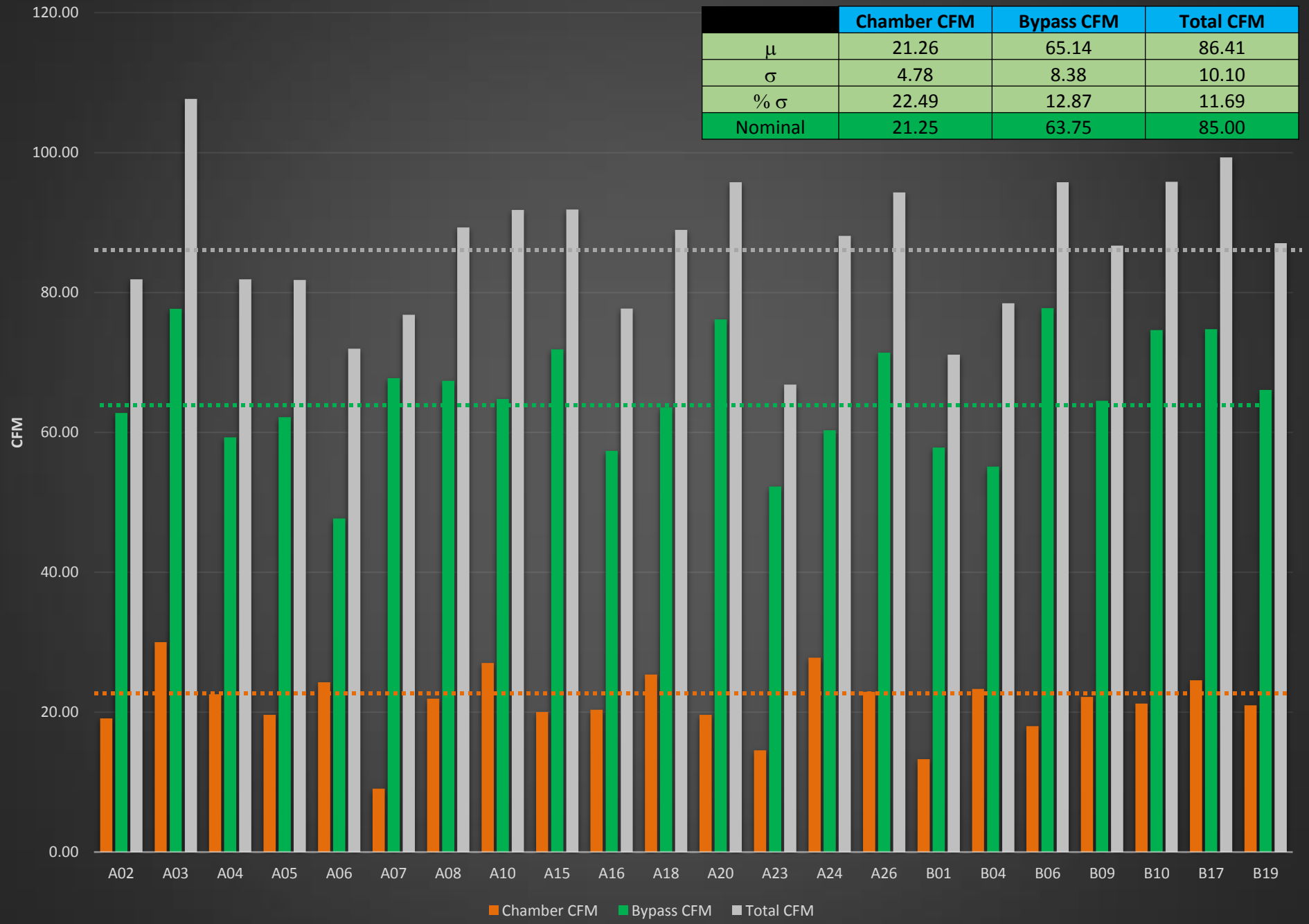
Initial Results from 2016 Round Robin:

- **News:**
  - As an industry, some critical OSU parameters are reporting the values below:
    - Total Airflow:
      - Average (μ): 86.41 CFM (Expecting 85 CFM)
      - Standard Deviation (σ): 10.10
      - Coefficient of Variation (% σ): 11.69%
    - Split Ratio:
      - Average (μ): 3.27 (Expecting 3.0)
      - Standard Deviation (σ): 1.14
      - Coefficient of Variation (% σ): 34.74%
    - Differential Pressure:
      - Average (μ): 106.68 in H2O (Expecting 107 in H2O)
      - Standard Deviation (σ): 3.23
      - Coefficient of Variation (% σ): 3.03%
- **More News:**
  - As an industry, the variability of several key parameters is high
  - More efforts in standardizing operating procedures & routine checks might be needed.
  - Correlation between airflow, calibration constant, and HRR was not observed in this Round Robin data when reviewing industry data as a whole. Discussion to follow.

Topic: Airflow

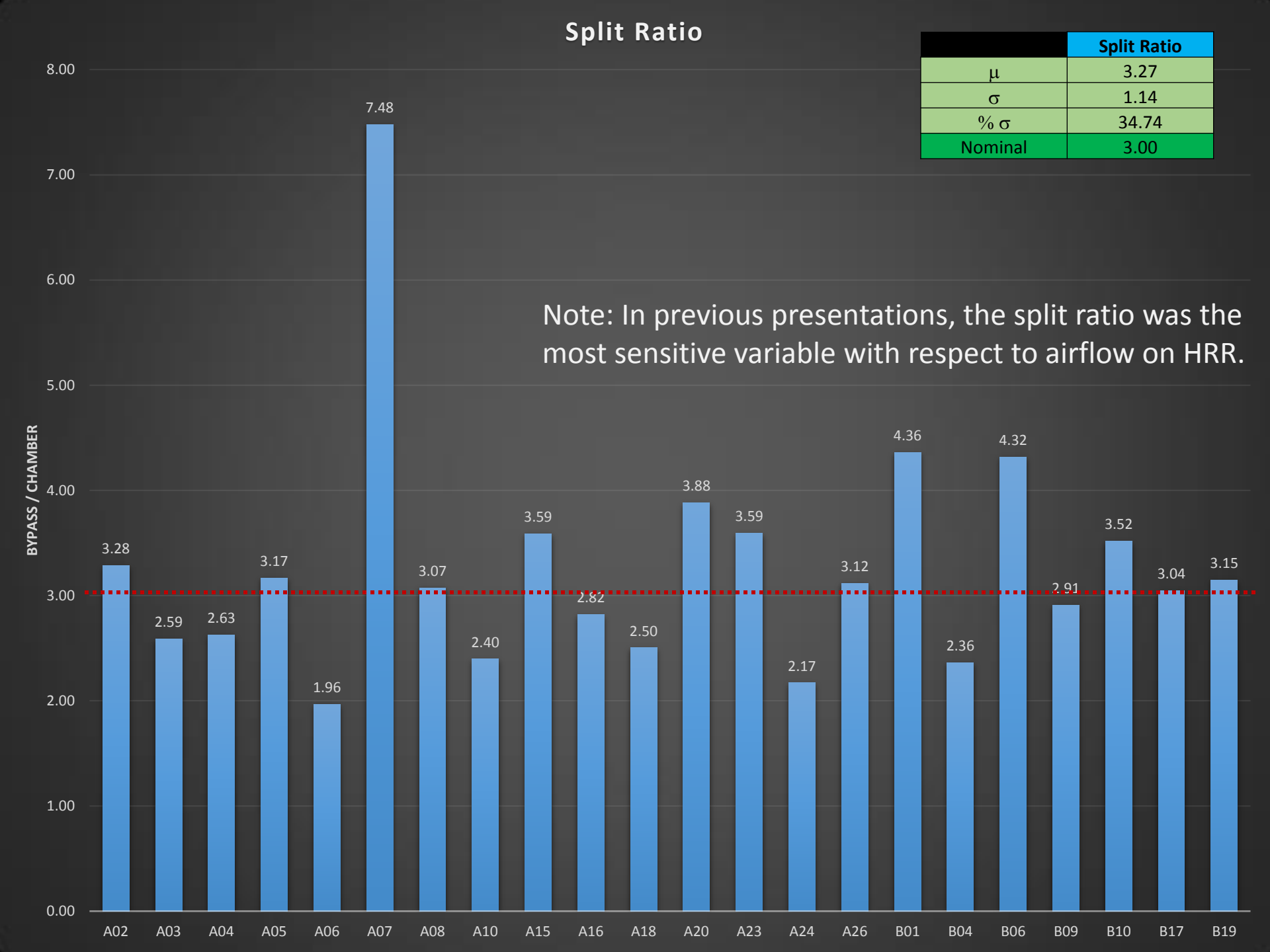
Airflow

	Chamber CFM	Bypass CFM	Total CFM
μ	21.26	65.14	86.41
σ	4.78	8.38	10.10
% σ	22.49	12.87	11.69
Nominal	21.25	63.75	85.00

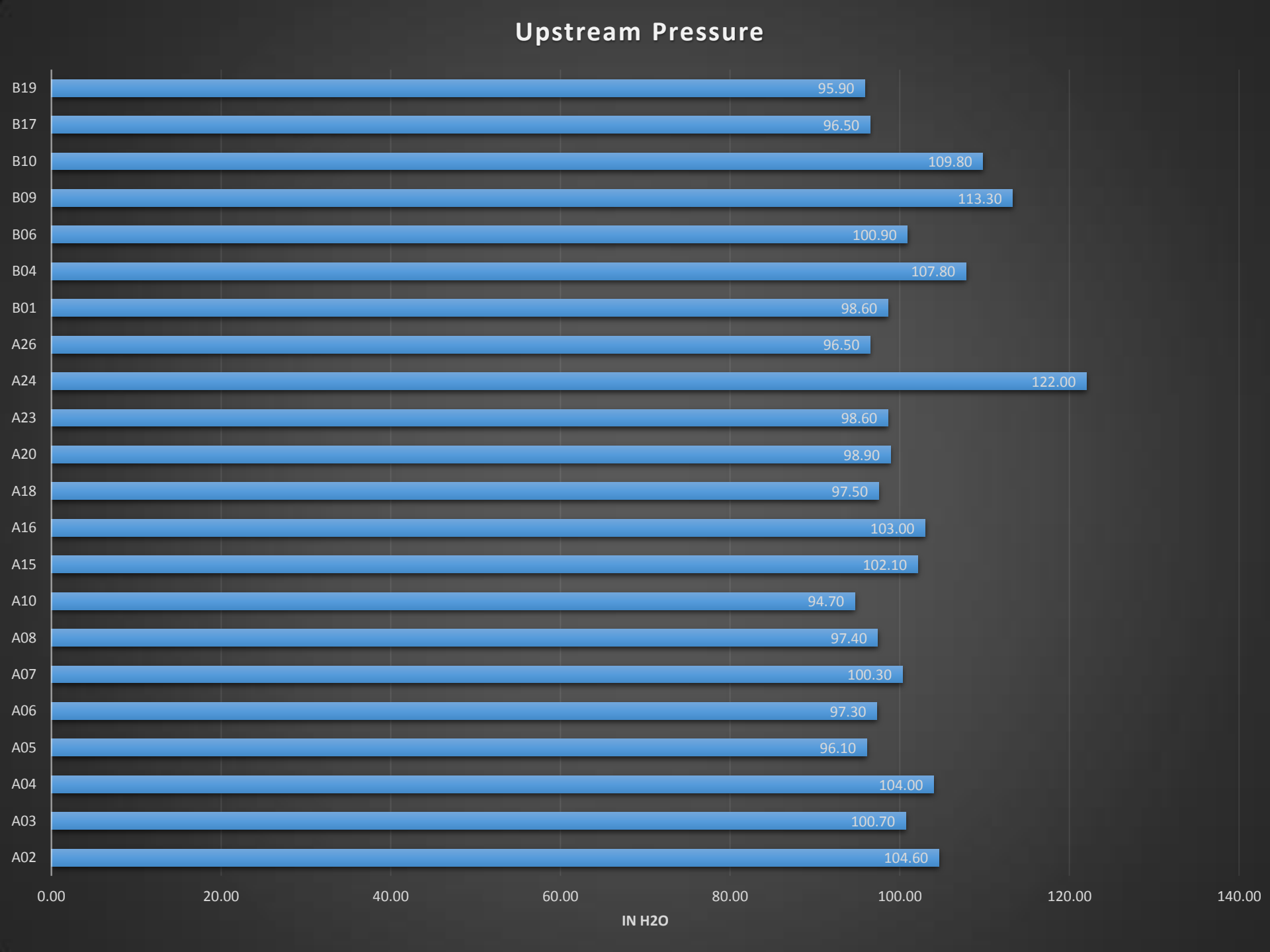


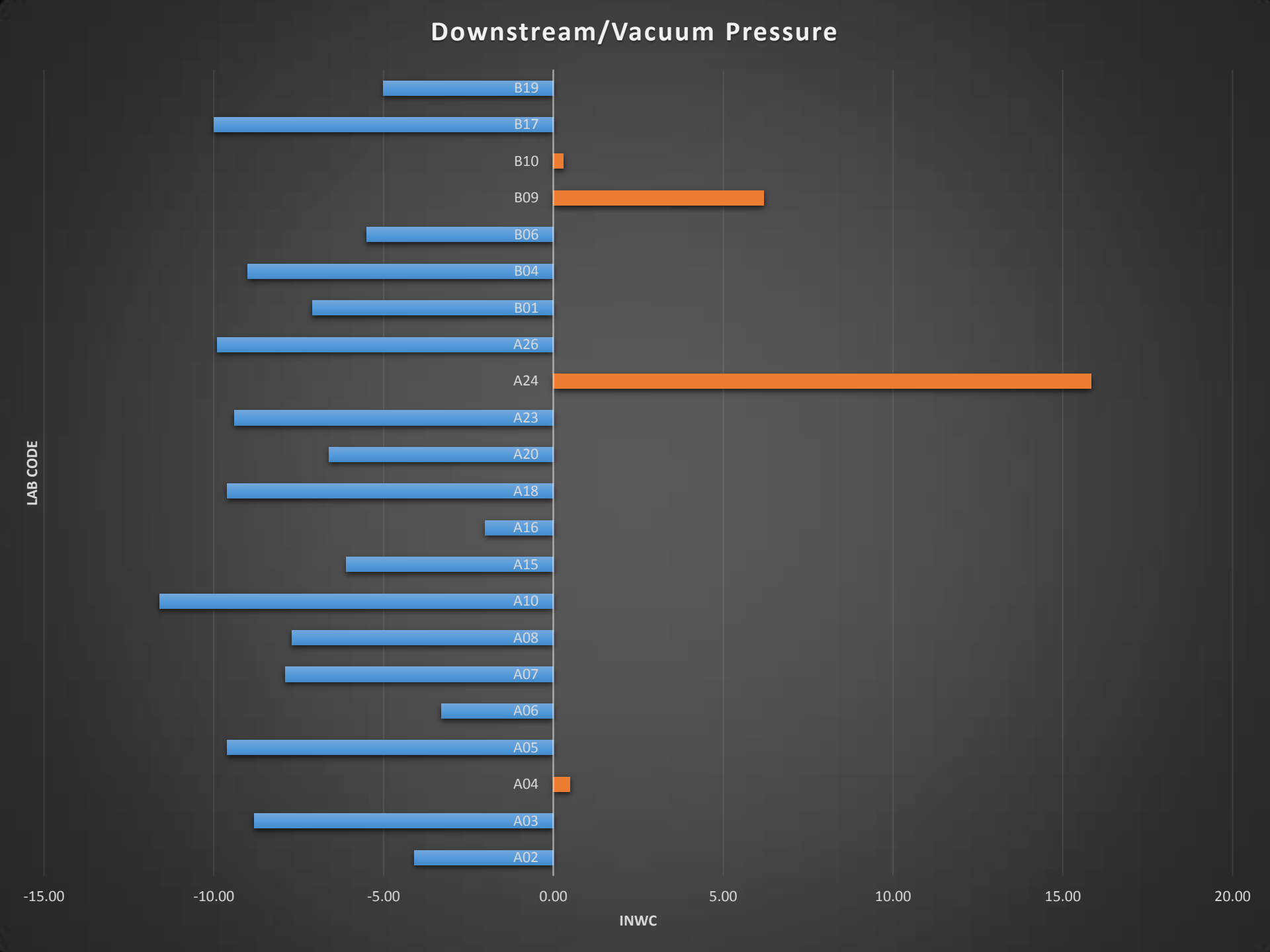
Split Ratio

	Split Ratio
μ	3.27
σ	1.14
% σ	34.74
Nominal	3.00



Topic: Differential Pressures

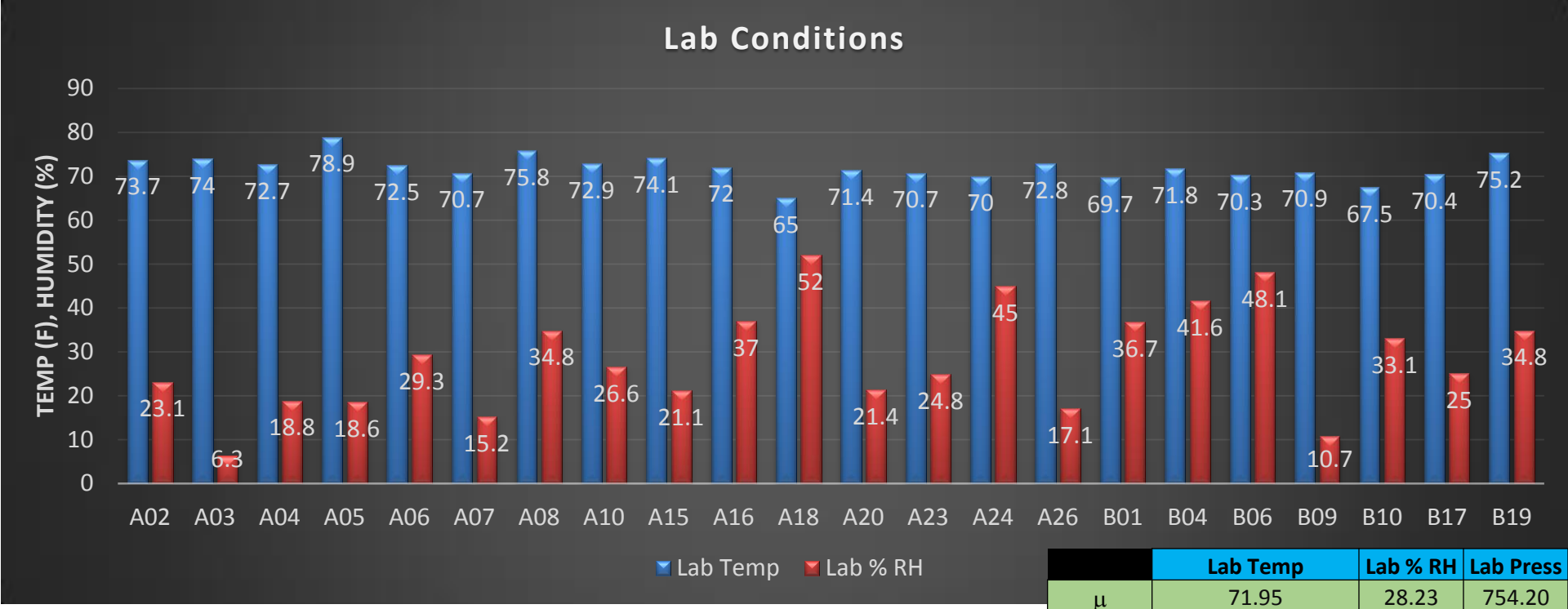

Upstream Pressure
B19
B17
B10
B09
B06
B04
B01
A26
A24
A23
A20
A18
A16
A15
A10
A08
A07
A06
A05
A04
A03
A02
95.90
96.50
109.80
113.30
100.90
107.80
98.60
96.50
122.00
98.60
98.90
97.50
103.00
102.10
94.70
97.40
100.30
97.30
96.10
104.00
100.70
104.60
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
IN H2O


Downstream/Vacuum Pressure
B19
B17
B10
B09
B06
B04
B01
A26
A24
A23
A20
A18
A16
A15
A10
A08
A07
A06
A05
A04
A03
A02
LAB CODE
-15.00
-10.00
-5.00
0.00
5.00
10.00
15.00
20.00
INWC

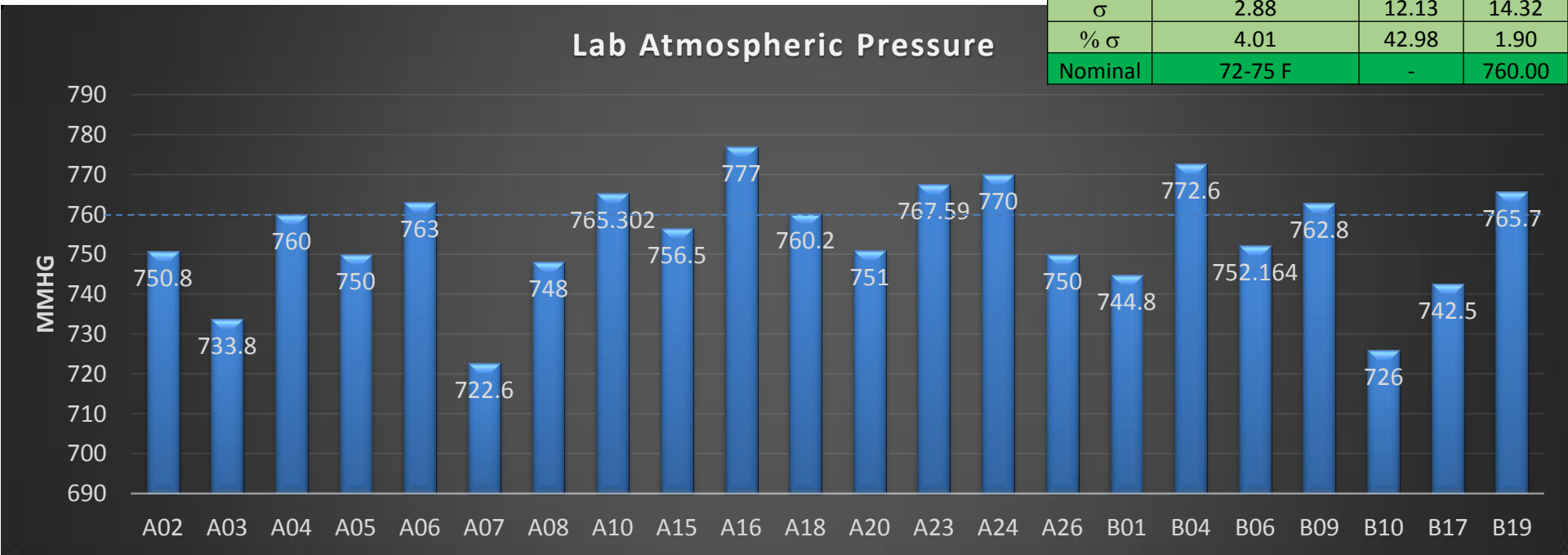
Orifice Meter Differential Pressure (107 INWC = 200 mmHg)

	Upstream Pressure	Downstream Pressure	Differential Pressure
μ	101.66	-5.02	106.68
σ	6.62	6.32	3.23
% σ	6.51	-126.09	3.03
Nominal	-	-	107.00

Topic: Laboratory Conditions



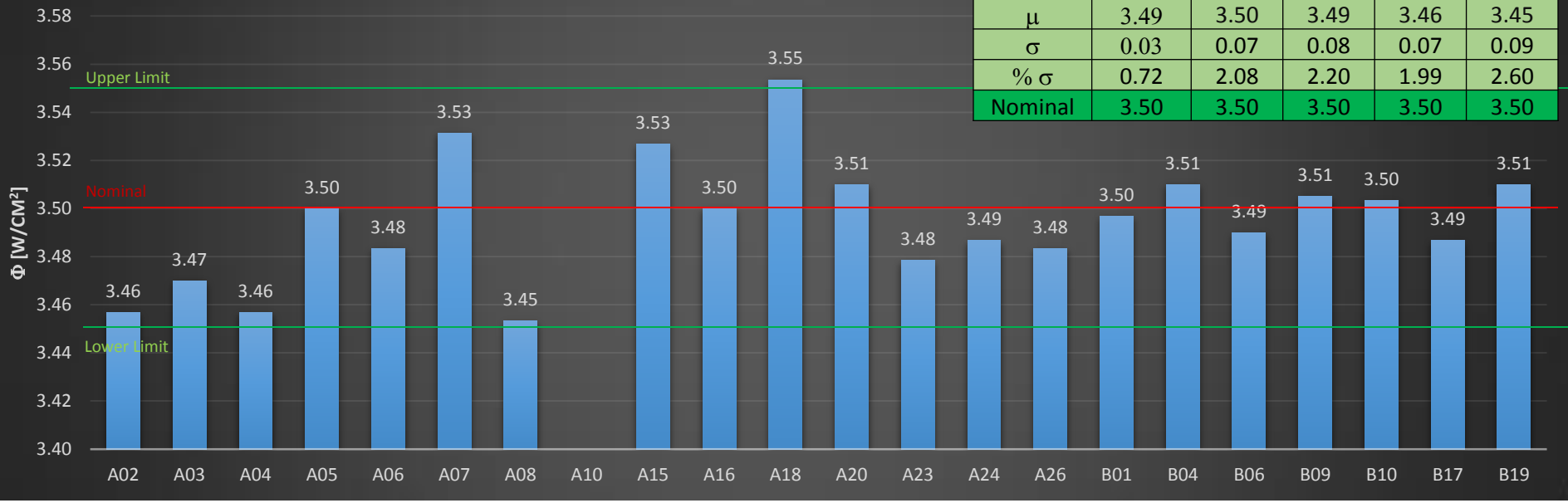
	Lab Temp	Lab % RH	Lab Press
μ	71.95	28.23	754.20
σ	2.88	12.13	14.32
% σ	4.01	42.98	1.90
Nominal	72-75 F	-	760.00



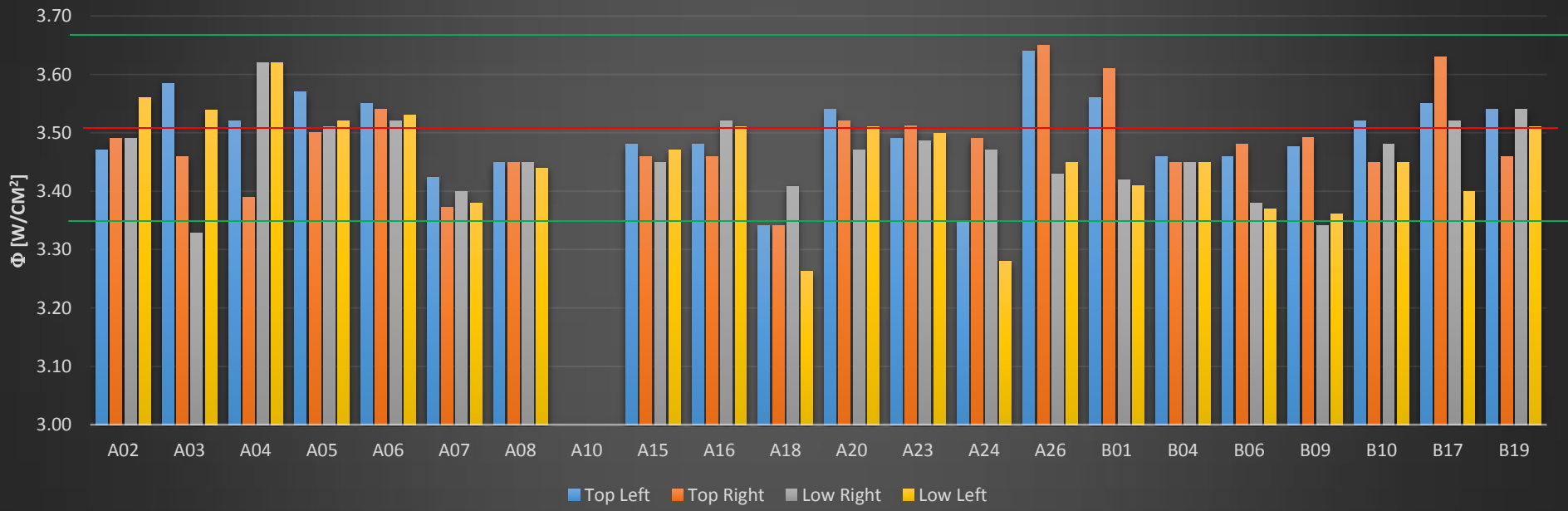
Topic: Calibration Data

Center Heat Flux

	Center HF	Top Left	Top Right	Low Right	Low Left
μ	3.49	3.50	3.49	3.46	3.45
σ	0.03	0.07	0.08	0.07	0.09
% σ	0.72	2.08	2.20	1.99	2.60
Nominal	3.50	3.50	3.50	3.50	3.50



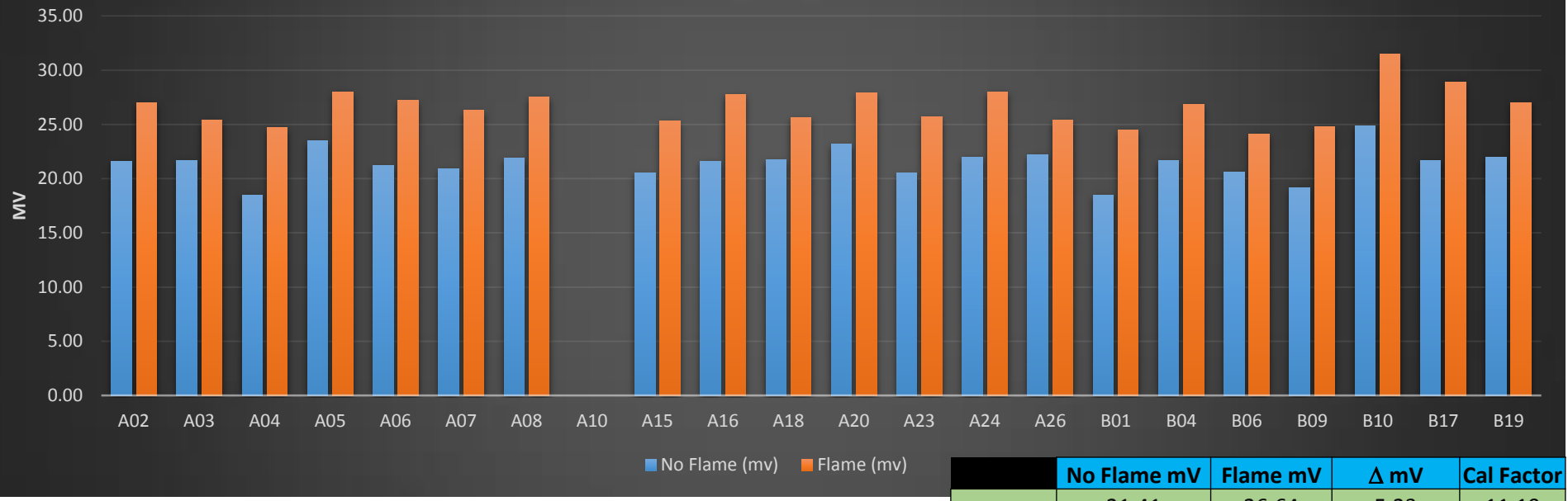
Corner Heat Flux



Steps

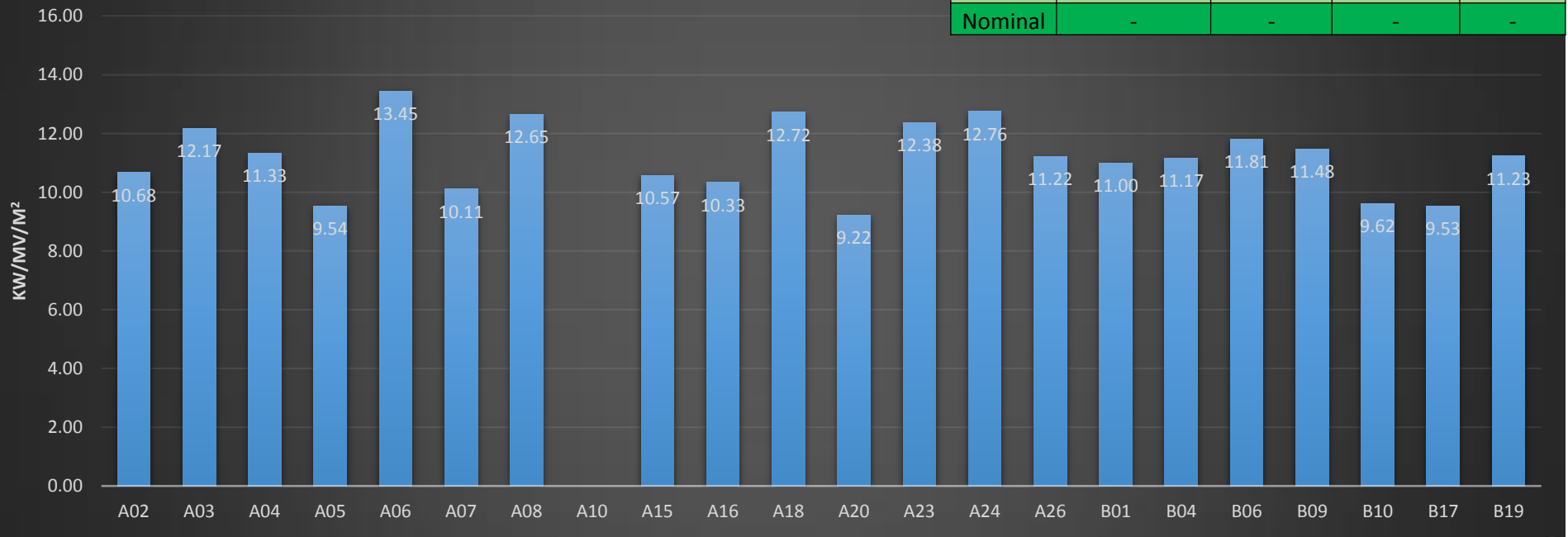
	1 to 4	1 to 6	1 to 8	1 to 6	1 to 4
μ	67.20	112.37	157.80	112.68	67.44
σ	1.78	3.23	5.32	3.00	1.63
% σ	2.65	2.87	3.37	2.66	2.41
Nominal	-	-	-	-	-

Baseline mV



	No Flame mV	Flame mV	Δ mV	Cal Factor
μ	21.41	26.64	5.23	11.19
σ	1.52	1.75	1.05	1.21
% σ	7.10	6.58	20.09	10.82
Nominal	-	-	-	-

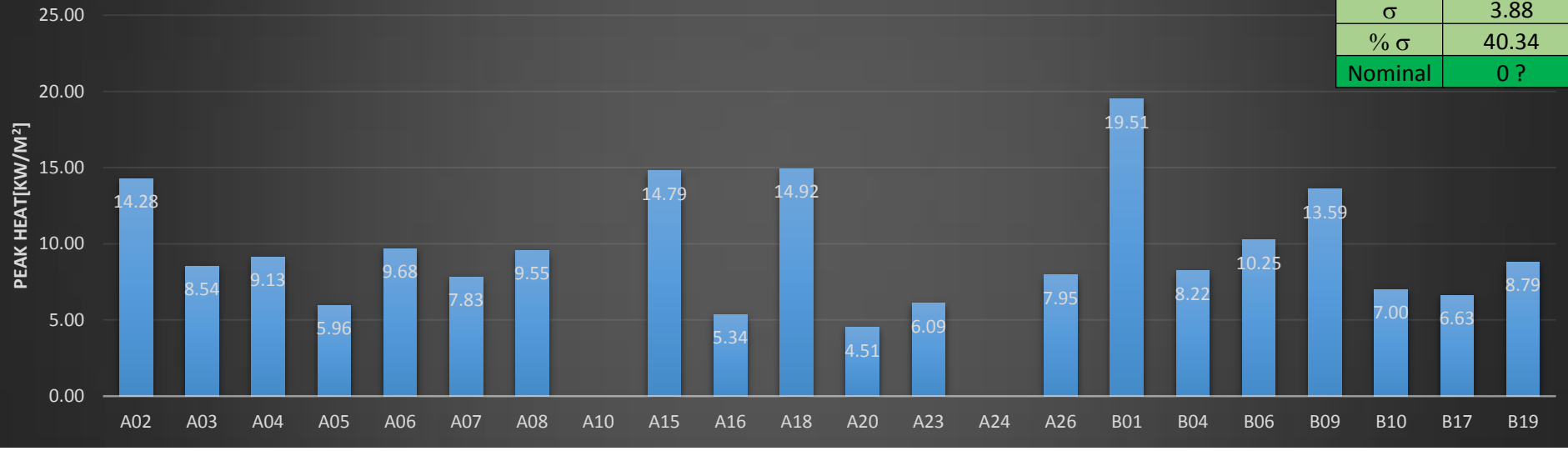
Calibration Factor



Topic: Heat Release Results

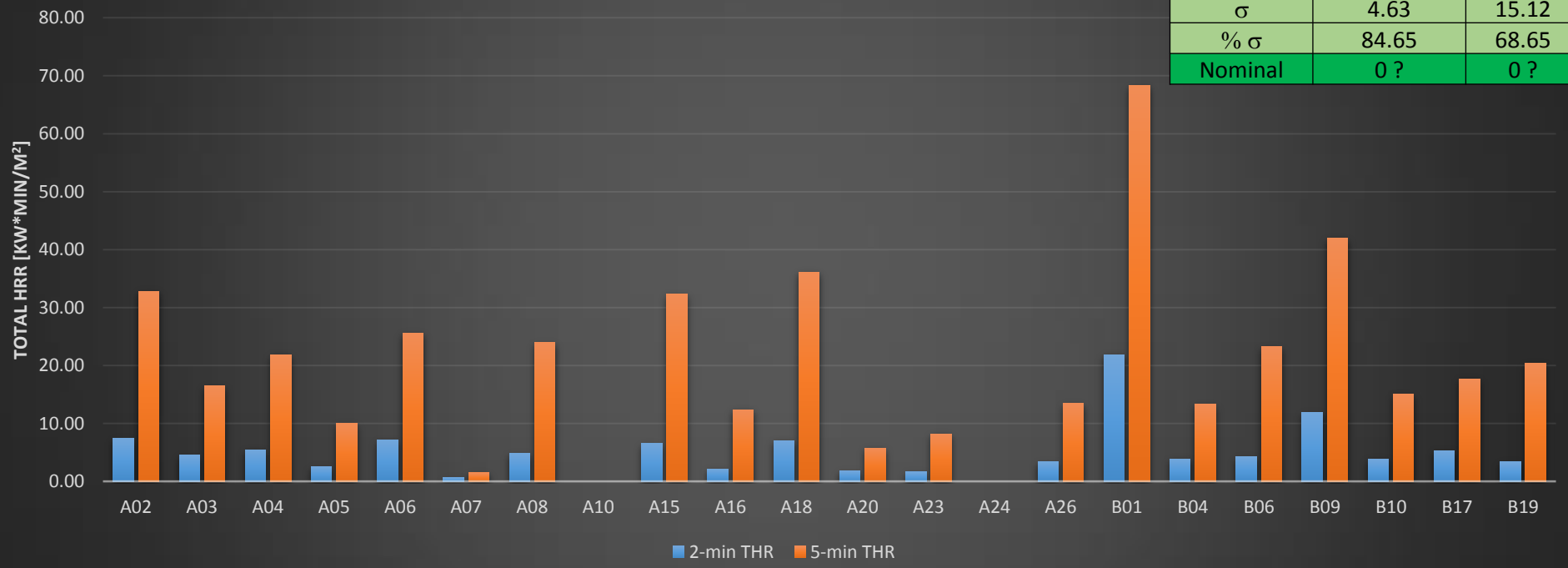
Peak Heat [Blank Test Run]

	PHR
μ	9.63
σ	3.88
% σ	40.34
Nominal	0 ?



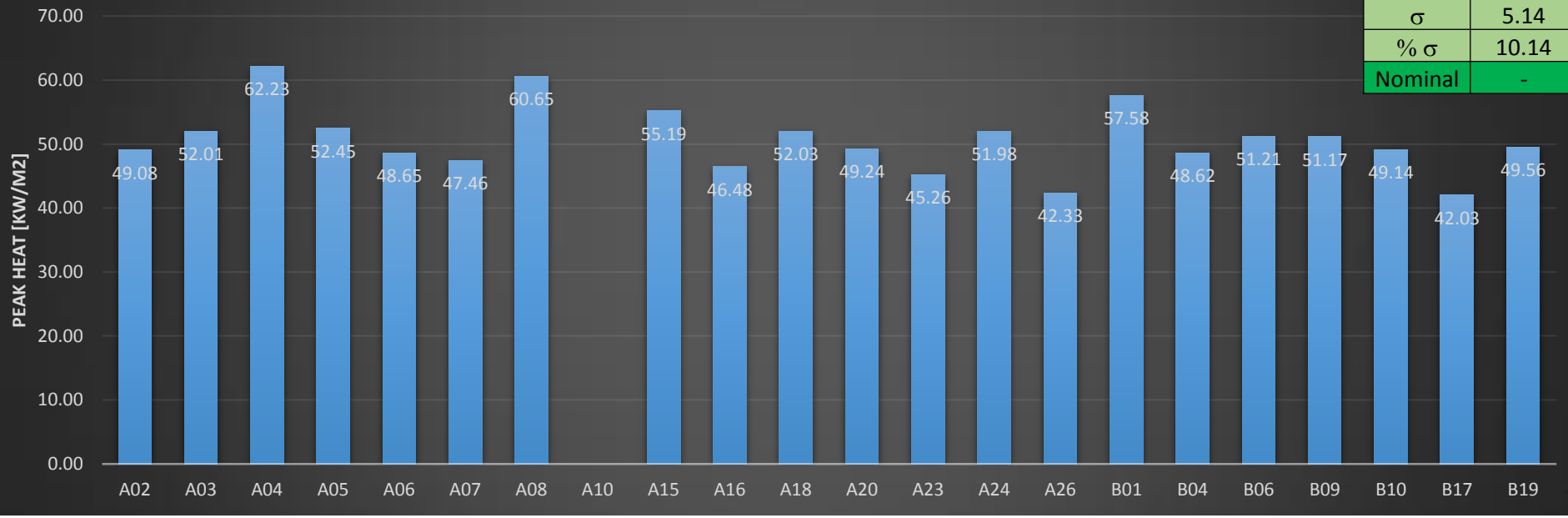
Total Heat Release [Blank Test Run]

	2-min THR	5-min THR
μ	5.47	22.02
σ	4.63	15.12
% σ	84.65	68.65
Nominal	0 ?	0 ?



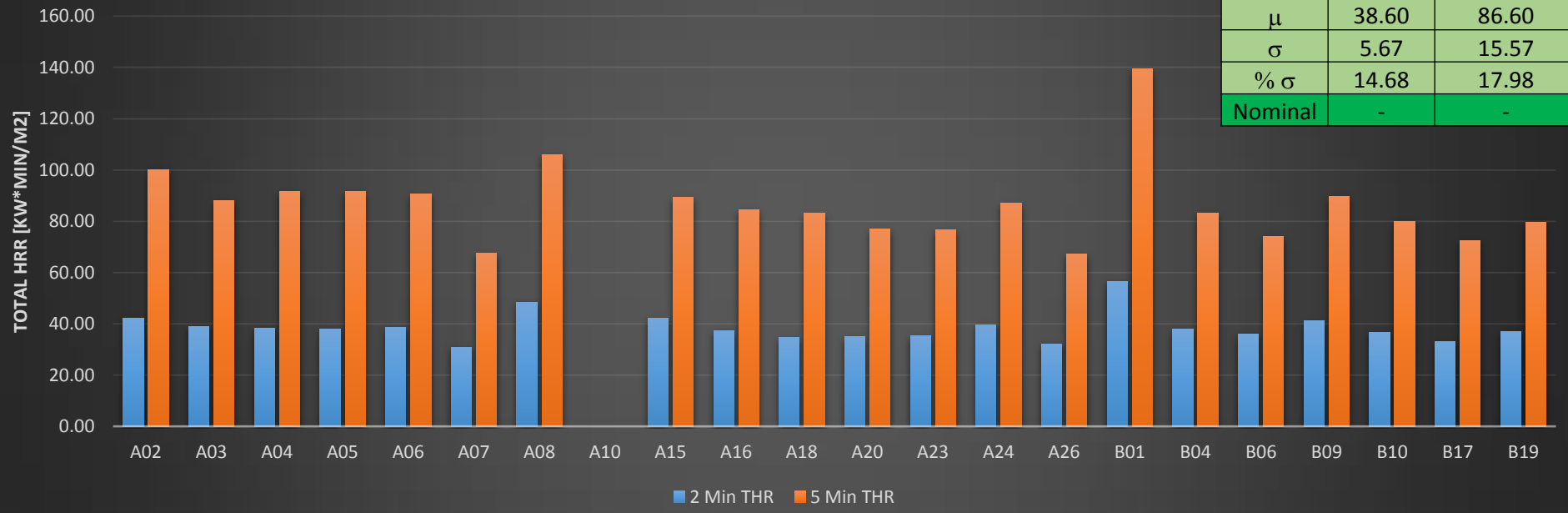
Peak Heat [Schneller Panel]

	PHR
μ	50.68
σ	5.14
% σ	10.14
Nominal	-



Total Heat Release [Schneller Panel]

	2-min THR	5-min THR
μ	38.60	86.60
σ	5.67	15.57
% σ	14.68	17.98
Nominal	-	-



Topic: Correlations

CORRELATION TABLE: An attempt at correlating the various parameters was made using the 'CORREL' function in Excel. Anything greater than 80% correlation is highlighted below. This data is inclusive of all laboratories reporting up to 01 MAR 16

	Bypass CFM	Total CFM	Chamber SCFM	Bypass SCFM	Total SCFM	Min	Max	Delta	Bypass %	Chamber %	Ratio (3:1)	Airflow Temp	Airflow % RH	Interspace Area	Lower Plenum	Press Ratio	Upstream Pressure	Downstream Pressure	Differential Pressure	Lab Temp	Lab % RH	Lab Press	WTM Water Temp	WTM WVP	Center HF	Top Left	Top Right	Low Right	Low Left	Cal Factor	CF Ratio	Kh (STP correction)
Chamber CFM	0.11	0.57	1.00	0.16	0.64	0.57	0.56	0.06	-0.85	0.85	-0.84	0.00	0.03	0.22	0.21	0.19	0.18	0.19	0.00	0.04	0.06	0.29	-0.34	-0.20	-0.20	0.01	0.01	0.00	-0.04	0.36	0.30	0.30
Bypass CFM		0.88	0.05	0.99	0.83	0.88	0.88	0.33	0.41	-0.41	0.29	0.09	-0.47	0.30	0.10	0.26	-0.09	-0.16	0.13	-0.03	-0.22	-0.60	-0.01	-0.03	0.09	0.18	0.04	-0.39	-0.14	-0.42	-0.32	-0.71
Total CFM			0.52	0.90	0.99	1.00	1.00	0.30	-0.06	0.06	-0.16	0.08	-0.38	0.36	0.18	0.31	0.01	-0.04	0.11	-0.01	-0.15	-0.36	-0.16	-0.12	-0.02	0.16	0.04	-0.33	-0.14	-0.18	-0.13	-0.46
Chamber SCFM				0.11	0.60	0.52	0.51	0.05	-0.88	0.88	-0.86	-0.03	0.05	0.19	0.20	0.15	0.20	0.22	-0.01	0.04	0.09	0.37	-0.33	-0.18	-0.18	-0.02	0.00	0.03	-0.05	0.39	0.31	0.37
Bypass SCFM					0.86	0.89	0.90	0.34	0.36	-0.36	0.22	0.04	-0.55	0.30	0.11	0.27	-0.06	-0.14	0.15	-0.04	-0.18	-0.51	0.00	0.00	0.10	0.14	0.05	-0.42	-0.18	-0.39	-0.31	-0.65
Total SCFM						0.98	0.99	0.30	-0.16	0.16	-0.26	0.01	-0.35	0.32	0.19	0.28	0.04	0.00	0.09	0.00	-0.09	-0.21	-0.16	-0.08	0.00	0.11	0.04	-0.30	-0.16	-0.13	-0.09	-0.35
Min							1.00	0.26	-0.07	0.07	-0.17	0.08	-0.37	0.36	0.19	0.29	0.02	-0.03	0.10	-0.02	-0.14	-0.36	-0.17	-0.13	-0.03	0.16	0.05	-0.32	-0.14	-0.18	-0.13	-0.45
Max								0.33	-0.06	0.06	-0.16	0.08	-0.38	0.36	0.17	0.32	0.00	-0.05	0.11	0.01	-0.16	-0.36	-0.17	-0.12	-0.01	0.16	0.03	-0.34	-0.13	-0.18	-0.13	-0.46
Delta									0.12	-0.12	0.08	-0.01	-0.27	0.10	-0.26	0.46	-0.24	-0.35	0.19	0.30	-0.34	-0.11	0.01	0.07	0.25	0.06	-0.23	-0.29	0.17	-0.04	0.03	-0.33
Bypass %										-1.00	0.93	0.07	-0.25	-0.04	-0.16	-0.01	-0.21	-0.27	0.09	-0.06	-0.19	-0.60	0.30	0.15	0.23	0.07	0.00	-0.25	-0.07	-0.54	-0.43	-0.64
Chamber %											-0.93	-0.07	0.25	0.04	0.16	0.01	0.21	0.27	-0.09	0.06	0.19	0.60	-0.30	-0.15	-0.23	-0.07	0.00	0.25	0.07	0.54	0.43	0.64
Ratio (3:1)												0.07	-0.24	-0.10	-0.22	-0.09	-0.16	-0.21	0.09	-0.11	-0.19	-0.61	0.32	0.08	0.31	-0.07	-0.13	-0.27	-0.15	-0.42	-0.33	-0.53
Airflow Temp													0.06	0.13	-0.24	0.36	-0.09	-0.02	-0.15	0.32	-0.22	-0.23	0.10	-0.02	-0.30	0.10	-0.06	0.22	0.30	-0.15	-0.10	-0.14
Airflow % RH														-0.43	-0.29	-0.22	-0.04	0.21	-0.50	0.10	0.37	0.26	-0.34	-0.27	-0.20	-0.14	0.03	0.28	-0.08	0.56	0.52	0.53
Interspace Area															0.69	0.64	0.31	0.20	0.25	-0.06	-0.18	-0.34	0.13	0.10	0.07	-0.11	-0.50	-0.07	0.09	-0.28	-0.26	-0.23
Lower Plenum																-0.09	0.49	0.47	0.08	-0.17	-0.11	-0.03	0.16	0.23	-0.04	0.10	-0.06	-0.09	0.04	-0.17	-0.18	-0.16
Press Ratio																	-0.12	-0.23	0.20	0.19	-0.08	-0.21	-0.02	-0.02	0.08	-0.25	-0.55	0.01	0.10	-0.12	-0.08	0.01
Upstream Pressure																		0.88	0.33	-0.29	0.13	0.16	0.33	0.23	-0.04	-0.48	-0.20	-0.13	-0.32	0.11	0.02	0.18
Downstream Pressure																			-0.16	-0.20	0.14	0.24	0.26	0.19	-0.13	-0.39	-0.12	0.09	-0.24	0.21	0.12	0.23
Differential Pressure																				-0.21	0.00	-0.14	0.16	0.09	0.17	-0.21	-0.16	-0.42	-0.18	-0.19	-0.19	-0.08
Lab Temp																					-0.45	0.08	0.48	0.58	-0.42	0.45	0.14	0.25	0.62	-0.12	-0.06	-0.05
Lab % RH																						0.38	-0.36	-0.33	0.25	-0.56	-0.18	0.10	-0.50	0.31	0.24	0.38
Lab Press																							0.05	0.26	0.00	-0.26	-0.02	0.33	0.03	0.39	0.27	0.75
WTM Water Temp																								0.92	-0.15	-0.04	0.04	-0.03	0.15	-0.38	-0.37	-0.12
WTM WVP																									-0.18	0.07	0.11	0.03	0.26	-0.35	-0.34	-0.04
Center HF																										-0.34	-0.32	-0.27	-0.52	-0.23	-0.29	-0.05
Top Left																											0.64	0.15	0.62	-0.33	-0.25	-0.41
Top Right																												0.03	0.07	-0.16	-0.13	-0.17
Low Right																													0.53	-0.19	-0.25	0.20
Low Left																														-0.22	-0.18	-0.16
Cal Factor																															0.98	0.58
CF Ratio																																0.46
Kh (STP correction)																																

Correlation Exists Between:

- Chamber Airflow & Bypass
- Total Airflow & Bypass

CORRELATION TABLE Continued

Unfortunate Note: Correlation between airflow and HRR has not been observed at this time.

	1-4 HRR	1-6 HRR	1-8 HRR	1-6 HRR	1-4 HRR	No Flame	Flame	mV Delta	PHR	PHR CV	PHR mV Rise	TTP	TTP CV	Rate of Rise	Rate of Fall	2 Min THR	2 Min THR CV	PHR/THR Ratio	5 Min THR	5 Min THR CV	THR Delta	Ending Avg HRR	Ending Avg HRR CV	PHR	PHR mV Rise	TTP	2 Min THR	PHR/THR Ratio	5 Min THR	THR Delta
Chamber CFM	0.04	0.20	0.50	0.32	0.07	0.25	0.17	-0.08	0.03	-0.07	-0.28	-0.29	0.15	0.28	-0.07	-0.09	-0.07	0.04	-0.10	-0.12	-0.11	-0.11	-0.13	-0.10	-0.19	-0.29	-0.08	0.25	-0.01	0.02
Bypass CFM	-0.13	-0.45	-0.39	-0.38	-0.02	0.34	0.09	-0.34	-0.08	-0.24	0.27	-0.20	-0.18	0.21	-0.04	-0.24	-0.29	0.24	-0.34	-0.19	-0.39	-0.39	-0.10	-0.13	-0.05	0.26	-0.21	-0.15	-0.18	-0.17
Total CFM	-0.09	-0.28	-0.10	-0.[illegible]	[illegible]	[illegible]	[illegible]	32	-0.05	-0.24	0.10	-0.30	-0.08	0.30	-0.07	-0.24	-0.27	0.22	-0.33	-0.22	-0.37	-0.37	-0.14	-0.15	-0.13	0.09	-0.21	-0.02	-0.16	-0.13
Chamber SCFM	0.07	0.26	0.54	0.37	0.09	0.22	0.15	-0.07	0.03	-0.07	-0.30	-0.28	0.14	0.28	-0.07	-0.09	-0.06	0.04	-0.10	-0.10	-0.11	-0.11	-0.11	-0.09	-0.19	-0.30	-0.07	0.25	0.00	0.03
Bypass SCFM	-0.08	-0.38	-0.32	-0.32	0.02	0.31	0.05	-0.36	-0.07	-0.27	0.25	-0.21	-0.18	0.22	-0.03	-0.24	-0.28	0.24	-0.35	-0.18	-0.41	-0.41	-0.08	-0.12	-0.05	0.24	-0.21	-0.14	-0.16	-0.14
Total SCFM	-0.03	-0.18	0.01	-0.07	0.07	0.36	0.12	-0.33	-0.05	-0.25	0.05	-0.32	-0.09	0.32	-0.07	-0.24	-0.26	0.21	-0.34	-0.20	-0.39	-0.39	-0.12	-0.14	-0.13	0.06	-0.21	0.00	-0.14	-0.10
Min	-0.10	-0.27	-0.09	-0.17	0.01	0.41	0.17	-0.31	-0.06	-0.22	0.09	-0.29	-0.06	0.29	-0.07	-0.25	-0.27	0.22	-0.33	-0.21	-0.37	-0.37	-0.14	-0.16	-0.14	0.09	-0.21	-0.01	-0.16	-0.13
Max	-0.08	-0.28	-0.10	-0.17	0.02	0.40	0.15	-0.33	-0.04	-0.25	0.10	-0.29	-0.09	0.31	-0.06	-0.23	-0.27	0.22	-0.33	-0.21	-0.37	-0.37	-0.14	-0.15	-0.12	0.09	-0.21	-0.03	-0.16	-0.13
Delta	0.20	-0.14	-0.22	-0.11	0.22	-0.02	-0.25	-0.39	0.26	-0.47	0.25	-0.13	-0.32	0.25	0.10	0.11	-0.18	0.09	0.00	-0.07	-0.06	-0.05	-0.01	0.18	0.20	0.11	-0.08	-0.25	-0.01	0.03
Bypass %	-0.08	-0.40	-0.64	-0.46	0.05	-0.08	-0.13	-0.11	-0.06	-0.03	0.39	0.20	-0.22	-0.17	0.06	-0.02	-0.05	0.08	-0.06	0.03	-0.08	-0.08	0.08	0.04	0.17	0.37	-0.02	-0.31	-0.08	-0.10
Chamber %	0.08	0.40	0.64	0.46	0.05	0.08	0.13	0.11	0.06	0.03	-0.39	-0.20	0.22	0.17	-0.06	0.02	0.05	-0.08	0.06	-0.03	0.08	0.08	-0.08	-0.04	-0.17	-0.37	0.02	0.31	0.08	0.10
Ratio (3:1)	-0.07	-0.38	-0.56	-0.4[illegible]	[illegible]	[illegible]	[illegible]	36	-0.09	0.07	0.27	0.16	-0.22	-0.06	0.05	-0.12	-0.03	0.20	-0.13	0.06	-0.13	-0.13	0.10	0.01	0.11	0.38	-0.08	-0.37	-0.15	-0.18
Airflow Temp	-0.55	-0.34	-0.12	-0.26	-0.41	0.42	0.38	0.02	-0.11	0.06	0.04	-0.10	-0.03	0.09	-0.09	-0.13	0.15	0.04	-0.11	0.02	-0.10	-0.10	-0.04	-0.36	-0.32	0.01	-0.44	-0.44	-0.41	-0.39
Airflow % RH	0.01	0.33	0.39	0.35	0.03	-0.11	-0.07	0.05	0.33	0.19	-0.20	0.11	0.21	0.12	0.11	0.42	0.10	-0.21	0.46	0.01	0.47	0.46	-0.05	0.33	0.22	0.06	0.32	0.18	0.39	0.41
Interspace Area	-0.03	-0.27	0.00	-0.25	0.01	0.33	0.37	0.14	0.25	-0.17	0.43	-0.15	-0.11	0.04	0.17	-0.06	-0.06	0.29	-0.09	0.00	-0.10	-0.10	0.01	-0.11	-0.07	0.32	-0.17	-0.06	-0.13	-0.11
Lower Plenum	-0.13	-0.16	0.08	-0.21	-0.10	-0.08	0.10	0.28	0.12	0.09	0.22	-0.09	-0.09	-0.28	0.03	0.13	-0.31	-0.09	0.11	-0.29	0.09	0.10	-0.28	0.16	0.19	0.21	0.30	0.47	0.29	0.27
Press Ratio	0.16	-0.11	0.00	-0.04	0.21	0.47	0.31	-0.19	0.31	-0.41	0.36	-0.09	0.00	0.32	0.23	-0.10	0.19	0.40	-0.13	0.23	-0.14	-0.14	0.23	-0.23	-0.24	0.06	-0.47	-0.50	-0.37	-0.32
Upstream Pressure	-0.02	0.44	0.56	0.41	-0.10	-0.03	0.16	0.31	0.11	0.38	-0.01	-0.17	-0.09	0.00	-0.01	0.09	0.18	-0.07	0.02	0.26	-0.02	-0.01	0.27	0.14	0.19	0.13	0.15	0.18	0.13	0.12
Downstream Pressure	-0.19	0.40	0.57	0.35	-0.25	-0.10	0.15	0.40	0.20	0.30	-0.01	-0.20	-0.21	0.07	0.05	0.14	-0.05	-0.02	0.09	0.00	0.06	0.06	0.02	0.15	0.16	0.40	0.23	0.32	0.25	0.26
Differential Pressure	0.33	0.12	0.04	0.15	0.26	0.14	0.04	-0.14	-0.17	0.19	0.00	0.04	0.22	-0.13	-0.11	-0.07	0.44	-0.08	-0.12	0.52	-0.14	-0.13	0.51	0.01	0.07	-0.33	-0.09	-0.15	-0.13	-0.15
Lab Temp	-0.44	-0.28	-0.14	-0.23	-0.32	0.08	-0.01	-0.14	0.20	-0.49	0.26	-0.01	0.20	-0.21	0.11	0.17	-0.30	-0.10	0.13	-0.25	0.11	0.11	-0.21	-0.23	-0.20	-0.13	-0.23	-0.17	-0.22	-0.22
Lab % RH	0.31	0.33	0.29	0.28	0.11	0.11	0.12	0.05	0.09	0.26	-0.20	-0.05	0.22	0.21	-0.05	0.14	0.23	-0.08	0.12	0.24	0.10	0.09	0.24	0.20	0.13	0.07	0.11	0.03	0.24	0.28
Lab Press	0.28	0.63	0.62	0.59	0.20	-0.25	-0.20	0.03	0.00	-0.01	-0.33	-0.06	-0.01	0.01	-0.02	0.05	0.22	-0.14	0.03	0.20	0.02	0.02	0.17	0.01	-0.07	-0.30	0.00	0.03	0.10	0.13
WTM Water Temp	-0.29	-0.10	-0.13	-0.15	-0.33	-0.07	0.08	0.23	-0.07	-0.17	0.26	-0.13	-0.09	-0.29	-0.11	0.04	-0.15	-0.15	-0.05	0.05	-0.10	-0.10	0.13	-0.22	-0.11	0.02	-0.17	-0.18	-0.24	-0.27
WTM WVP	-0.18	-0.04	-0.08	-0.09	-0.21	-0.10	0.01	0.17	-0.03	-0.33	0.26	-0.14	-0.06	-0.35	-0.12	0.13	-0.21	-0.27	0.03	-0.03	-0.02	-0.02	0.05	-0.16	-0.06	-0.08	-0.09	-0.05	-0.11	-0.12
Center HF	0.58	0.16	0.00	0.08	0.57	0.14	0.01	-0.19	-0.21	0.05	0.05	-0.08	-0.13	0.37	-0.15	-0.29	0.19	0.25	-0.26	0.13	-0.24	-0.24	0.09	0.14	0.17	0.08	-0.03	-0.21	0.01	0.03
Top Left	-0.54	-0.52	-0.49	-0.48	-0.34	0.08	0.01	-0.10	-0.20	-0.18	0.13	0.06	0.01	-0.28	-0.10	0.02	-0.34	-0.22	0.04	-0.40	0.05	0.06	-0.40	-0.27	-0.21	-0.14	0.06	0.28	-0.09	-0.16
Top Right	-0.43	-0.17	-0.27	-0.15	-0.29	0.00	0.05	0.09	-0.41	0.20	-0.18	-0.08	0.12	-0.19	-0.43	0.16	-0.15	-0.61	0.13	-0.25	0.11	0.11	-0.26	-0.02	0.04	-0.20	0.31	0.48	0.17	0.11
Low Right	-0.20	0.12	0.13	0.08	-0.38	0.09	0.38	0.51	0.06	-0.27	0.23	0.14	-0.05	-0.10	0.23	-0.10	-0.09	0.16	-0.01	-0.11	0.04	0.03	-0.12	-0.33	-0.29	0.11	-0.23	-0.05	-0.22	-0.21
Low Left	-0.41	-0.36	-0.30	-0.35	-0.43	0.00	0.05	0.08	0.11	-0.45	0.29	0.06	-0.09	-0.27	0.16	0.04	-0.29	0.01	0.09	-0.23	0.12	0.13	-0.20	-0.35	-0.31	-0.02	-0.24	-0.10	-0.28	-0.30
Cal Factor	0.14	0.37	0.50	0.44	0.16	-0.33	-0.41	-0.21	0.25	0.22	-0.65	-0.11	0.06	0.21	0.06	0.20	0.17	-0.05	0.17	0.14	0.15	0.14	0.12	0.32	0.10	-0.06	0.18	0.10	0.28	0.32
CF Ratio	0.06	0.23	0.38	0.32	0.12	-0.34	-0.45	-0.26	0.27	0.17	-0.62	-0.11	0.03	0.18	0.07	0.23	0.11	-0.07	0.17	0.10	0.14	0.14	0.10	0.32	0.11	0.01	0.17	0.07	0.27	0.31
Kh (STP correction)	0.37	0.66	0.72	0.68	0.37	-0.15	-0.11	0.03	0.11	0.19	-0.40	0.08	0.19	0.15	0.09	0.05	0.45	0.00	0.11	0.39	0.14	0.13	0.31	-0.01	-0.16	-0.44	0.00	0.01	0.04	0.05

CORRELATION TABLE Continued

	1-4 HRR	1-6 HRR	1-8 HRR	1-6 HRR	1-4 HRR	No Flame	Flame	mV Delta	PHR	PHR CV	PHR mV Rise	TTP	TTP CV	Rate of Rise	Rate of Fall	2 Min THR	2 Min THR CV	PHR/THR Ratio	5 Min THR	5 Min THR CV	THR Delta	Ending Avg HRR	Ending Avg HRR CV	PHR	PHR mV Rise	TTP	2 Min THR	PHR/THR Ratio	5 Min THR	THR Delta
1-4 HRR		0.56	0.30	0.51	0.84	-0.18	-0.24	-0.15	0.06	-0.12	-0.07	0.17	0.06	0.15	0.11	-0.08	0.30	0.19	-0.02	0.30	0.01	0.01	0.27	0.32	0.26	-0.23	0.12	-0.02	0.21	0.25
1-6 HRR			0.81	0.98	0.46	-0.15	-0.11	0.03	-0.01	0.14	-0.30	0.11	0.09	0.08	0.10	-0.11	0.57	0.10	-0.09	0.52	-0.07	-0.08	0.46	0.09	0.02	-0.34	0.01	-0.04	0.07	0.09
1-8 HRR				0.85	0.38	-0.10	-0.13	-0.06	0.15	0.29	-0.31	0.06	0.19	0.15	0.23	-0.10	0.46	0.22	-0.08	0.32	-0.07	-0.08	0.25	0.12	0.01	-0.21	-0.05	-0.04	0.07	0.13
1-6 HRR					0.47	-0.08	-0.10	-0.05	-0.03	0.14	-0.38	0.08	0.11	0.13	0.09	-0.15	0.63	0.13	-0.14	0.57	-0.14	-0.14	0.51	0.01	-0.08	-0.41	-0.09	-0.10	-0.02	0.01
1-4 HRR						-0.12	-0.40	-0.49	0.00	0.08	-0.15	0.17	0.15	0.24	0.09	-0.15	0.43	0.23	-0.10	0.27	-0.07	-0.07	0.19	0.33	0.26	-0.23	0.10	-0.09	0.19	0.23
No Flame							0.80	-0.11	-0.39	-0.15	0.01	-0.53	0.17	0.49	-0.46	-0.40	0.27	0.08	-0.41	0.30	-0.40	-0.40	0.29	-0.56	-0.52	0.00	-0.57	-0.40	-0.57	-0.55
Flame								0.51	-0.31	-0.16	0.13	-0.42	0.00	0.24	-0.40	-0.21	0.09	-0.08	-0.20	0.19	-0.19	-0.19	0.19	-0.53	-0.44	0.06	-0.38	-0.10	-0.43	-0.44
mV Delta									0.06	-0.05	0.21	0.07	-0.24	-0.31	0.00	0.23	-0.24	-0.26	0.25	-0.13	0.26	0.26	-0.11	-0.05	0.02	0.10	0.21	0.41	0.12	0.08
PHR										-0.14	0.57	0.45	0.03	-0.17	0.78	0.66	-0.36	0.12	0.65	-0.29	0.63	0.62	-0.27	0.46	0.42	0.19	0.40	0.26	0.47	0.48
PHR CV											-0.30	0.16	0.27	-0.02	-0.12	0.13	0.38	-0.23	0.19	0.14	0.21	0.21	0.03	0.39	0.38	-0.02	0.42	0.22	0.35	0.31
PHR mV Rise												0.43	-0.02	-0.28	0.55	0.34	-0.42	0.15	0.37	-0.34	0.37	0.37	-0.31	0.08	0.23	0.20	0.16	0.12	0.12	0.10
TTP													0.27	-0.66	0.77	0.28	0.05	0.17	0.41	-0.12	0.46	0.46	-0.21	0.24	0.27	-0.34	0.35	0.23	0.29	0.25
TTP CV														-0.27	0.03	0.14	0.19	-0.15	0.25	-0.04	0.31	0.31	-0.12	0.17	0.15	-0.40	0.16	0.15	0.16	0.15
Rate of Rise															-0.35	-0.36	0.14	0.29	-0.41	0.21	-0.42	-0.42	0.25	-0.16	-0.23	0.37	-0.39	-0.42	-0.30	-0.25
Rate of Fall																0.21	-0.14	0.52	0.27	-0.17	0.29	0.28	-0.18	0.15	0.14	0.03	0.12	0.04	0.14	0.15
2 Min THR																	-0.36	-0.65	0.96	-0.32	0.91	0.91	-0.31	0.67	0.67	0.00	0.79	0.64	0.78	0.76
2 Min THR CV																		0.12	-0.33	0.87	-0.31	-0.31	0.76	-0.25	-0.29	-0.37	-0.36	-0.48	-0.35	-0.34
PHR/THR Ratio																			-0.59	0.12	-0.53	-0.53	0.13	-0.38	-0.41	0.21	-0.58	-0.56	-0.53	-0.49
5 Min THR																				-0.37	0.99	0.99	-0.40	0.67	0.67	-0.07	0.82	0.67	0.79	0.76
5 Min THR CV																					-0.38	-0.38	0.98	-0.40	-0.43	-0.26	-0.47	-0.56	-0.49	-0.48
THR Delta																						1.00	-0.43	0.65	0.65	-0.11	0.81	0.66	0.77	0.73
Ending Avg HRR																							-0.43	0.66	0.65	-0.11	0.81	0.67	0.77	0.73
Ending Avg HRR CV																								-0.42	-0.45	-0.16	-0.51	-0.58	-0.52	-0.51
PHR																									0.97	0.23	0.84	0.55	0.93	0.94
PHR mV Rise																										0.26	0.84	0.55	0.90	0.90
TTP																											0.02	-0.11	0.11	0.15
2 Min THR																												0.86	0.96	0.91
THR/PHR Ratio																													0.78	0.73
5 Min THR																														0.99

Disappointed Engineer briefs team that little to no correlation is evident.

Data reduction suggested; focusing on individual manufacturers of OSU

Updated Correlation Table Isolated by Manufacturer

Code	Manufacturer	Chamber CFM	Bypass CFM	Total CFM	Chamber SCFM	Bypass SCFM	Total SCFM	Min	Max	Delta	Bypass %	Chamber %	Ratio (3:1)	Airflow Temp	Airflow % RH
Ax	A	19.63	62.18	81.81	19.21	60.84	80.05	81.47	82.33	0.85	0.76	0.24	3.17	72.70	18.23
Ay	A	20.35	57.35	77.70	20.56	57.95	78.51	77.70	77.70	0.00	0.74	0.26	2.82	74.40	8.00
Az	A	27.79	60.31	88.10	27.95	60.67	88.62	88.06	88.21	0.15	0.68	0.32	2.17	72.00	38.00

	Bypass CFM	Total CFM	Chamber SCFM	Bypass SCFM	Total SCFM	Min	Max	Delta	Bypass %	Chamber %	Ratio (3:1)	Airflow Temp	Airflow % RH	Interspace Area	Lower Plenum	Press Ratio	Upstream Pressure	Downstream Pressure	Differential Pressure	Lab Temp	Lab % RH	Lab Press	WTM Water Temp	WTM WVP	Center HF	Top Left	Top Right	Low Right	Low Left	Cal Factor	CF Ratio	Kh (STP correction)
Chamber CFM	0.05	0.89	1.00	0.38	0.98	0.90	0.86	-0.43	-0.98	0.98	-0.96	-0.67	0.91	-1.00	-0.39	-0.77	0.98	0.98	0.75	-0.73	0.79	0.34	-1.00	-0.99	-1.00	-0.94	0.20	-0.96	-1.00	0.99	0.99	0.90
Bypass CFM		0.51	-0.01	0.94	0.27	0.48	0.55	0.88	0.16	-0.16	0.22	-0.78	0.45	-0.13	-0.94	0.60	-0.13	-0.16	0.70	0.65	-0.58	-0.92	-0.13	-0.16	-0.13	0.28	0.99	-0.31	-0.09	-0.11	-0.11	-0.40
Total CFM			0.85	0.77	0.97	1.00	1.00	0.04	-0.77	0.77	-0.73	-0.94	1.00	-0.92	-0.77	-0.39	0.79	0.77	0.97	-0.33	0.41	-0.13	-0.92	-0.93	-0.92	-0.68	0.63	-0.98	-0.90	0.80	0.80	0.59
Chamber SCFM				0.32	0.96	0.87	0.83	-0.48	-0.99	0.99	-0.98	-0.62	0.88	-0.99	-0.33	-0.81	0.99	0.99	0.70	-0.77	0.82	0.40	-0.99	-0.99	-0.99	-0.96	0.14	-0.94	-0.99	1.00	1.00	0.92
Bypass SCFM					0.57	0.74	0.80	0.67	-0.18	0.18	-0.12	-0.94	0.73	-0.45	-1.00	0.29	0.21	0.17	0.90	0.35	-0.27	-0.74	-0.45	-0.48	-0.45	-0.05	0.98	-0.61	-0.42	0.23	0.23	-0.07
Total SCFM						0.97	0.95	-0.22	-0.91	0.91	-0.88	-0.81	0.98	-0.99	-0.58	-0.61	0.92	0.91	0.87	-0.56	0.63	0.13	-0.99	-0.99	-0.99	-0.85	0.41	-1.00	-0.98	0.93	0.93	0.78
Min							1.00	0.01	-0.79	0.79	-0.75	-0.92	1.00	-0.93	-0.75	-0.42	0.81	0.79	0.96	-0.36	0.44	-0.10	-0.93	-0.94	-0.93	-0.71	0.60	-0.98	-0.92	0.82	0.82	0.62
Max								0.09	-0.74	0.74	-0.69	-0.95	0.99	-0.90	-0.80	-0.34	0.76	0.73	0.98	-0.28	0.36	-0.18	-0.90	-0.91	-0.90	-0.64	0.67	-0.97	-0.88	0.77	0.77	0.55
Delta									0.60	-0.60	0.65	-0.39	-0.02	0.35	-0.67	0.90	-0.58	-0.61	0.28	0.93	-0.89	-1.00	0.35	0.33	0.35	0.70	0.80	0.17	0.39	-0.56	-0.56	-0.78
Bypass %										-1.00	1.00	0.50	-0.81	0.96	0.19	0.89	-1.00	-1.00	-0.59	0.86	-0.90	-0.53	0.96	0.95	0.96	0.99	0.01	0.89	0.97	-1.00	-1.00	-0.97
Chamber %											-1.00	-0.50	0.81	-0.96	-0.19	-0.89	1.00	1.00	0.59	-0.86	0.90	0.53	-0.96	-0.95	-0.96	-0.99	-0.01	-0.89	-0.97	1.00	1.00	0.97
Ratio (3:1)												0.44	-0.77	0.94	0.12	0.91	-1.00	-1.00	-0.54	0.89	-0.92	-0.58	0.94	0.93	0.94	1.00	0.07	0.86	0.95	-0.99	-0.99	-0.98
Airflow Temp													-0.91	0.73	0.94	0.04	-0.52	-0.49	-0.99	-0.02	-0.06	0.47	0.73	0.74	0.73	0.38	-0.86	0.84	0.70	-0.54	-0.54	-0.27
Airflow % RH														-0.94	-0.73	-0.44	0.82	0.80	0.95	-0.39	0.46	-0.07	-0.94	-0.95	-0.94	-0.72	0.58	-0.99	-0.93	0.84	0.84	0.64
Interspace Area															0.46	0.72	-0.97	-0.96	-0.80	0.67	-0.73	-0.27	1.00	1.00	1.00	0.91	-0.28	0.98	1.00	-0.97	-0.97	-0.86
Lower Plenum																-0.29	-0.21	-0.18	-0.90	-0.35	0.27	0.73	0.46	0.48	0.46	0.06	-0.98	0.62	0.43	-0.23	-0.24	0.06
Press Ratio																	-0.87	-0.89	-0.15	1.00	-1.00	-0.86	0.72	0.70	0.72	0.94	0.47	0.57	0.74	-0.86	-0.86	-0.97
Upstream Pressure																		1.00	0.61	-0.84	0.88	0.51	-0.97	-0.96	-0.97	-0.99	0.02	-0.90	-0.98	1.00	1.00	0.96
Downstream Pressure																			0.59	-0.86	0.90	0.54	-0.96	-0.95	-0.96	-0.99	-0.01	-0.88	-0.97	1.00	1.00	0.97
Differential Pressure																				-0.09	0.17	-0.37	-0.80	-0.81	-0.80	-0.48	0.80	-0.90	-0.77	0.63	0.63	0.38
Lab Temp																					-1.00	-0.89	0.67	0.65	0.67	0.92	0.52	0.52	0.70	-0.83	-0.83	-0.96
Lab % RH																						0.85	-0.73	-0.72	-0.73	-0.95	-0.45	-0.59	-0.76	0.87	0.87	0.98
Lab Press																							-0.27	-0.24	-0.27	-0.64	-0.85	-0.08	-0.30	0.49	0.49	0.72
WTM Water Temp																								1.00	1.00	0.91	-0.28	0.98	1.00	-0.97	-0.97	-0.86
WTM WVP																									1.00	0.90	-0.30	0.99	1.00	-0.96	-0.97	-0.85
Center HF																										0.91	-0.28	0.98	1.00	-0.97	-0.97	-0.86
Top Left																											0.14	0.82	0.93	-0.98	-0.98	-0.99

Much more correlation exists than when reviewing industry as a whole

Updated Correlation Table Isolated by Manufacturer

Code	Manufacturer	Chamber CFM	Bypass CFM	Total CFM	Chamber SCFM	Bypass SCFM	Total SCFM	Min	Max	Delta	Bypass %	Chamber %	Ratio (3:1)	Airflow Temp	Airflow % RH
Bw	B	21.93	67.37	89.30	21.40	65.74	87.14	88.65	89.84	1.18	0.75	0.25	3.07	72.76	35.37
Bx	B	27.03	64.76	91.79	27.05	64.81	91.86	90.69	92.50	1.81	0.71	0.29	2.40	71.48	2.21
By	B	24.55	74.76	99.31	23.89	72.74	96.63	99.20	99.38	0.19	0.75	0.25	3.04	70.34	1.55
Bz	B	20.99	66.06	87.05	21.07	66.30	87.37	86.47	87.62	1.15	0.76	0.24	3.15	70.21	43.05

	PHR	PHR CV	PHR mV Rise	TTP	TTP CV	Rate of Rise	Rate of Fall	2 Min THR	2 Min THR CV	PHR/THR Ratio	5 Min THR	5 Min THR CV	THR Delta	Ending Avg HRR	Ending Avg HRR CV	PHR	PHR mV Rise	TTP	2 Min THR	PHR/THR Ratio	5 Min THR	THR Delta
Chamber CFM	-0.63	0.86	-0.26	0.91	0.82	-0.99	-0.44	-0.49	-0.67	-0.55	-0.45	-0.80	-0.41	-0.42	-0.83	-0.87	-1.00	-0.98	0.86	1.00	-0.65	-0.84
Bypass CFM	-0.71	0.80	-0.37	0.86	0.75	-1.00	-0.54	-0.59	-0.76	-0.45	-0.55	-0.86	-0.52	-0.52	-0.89	-0.92	-0.99	-0.95	0.79	0.99	-0.73	-0.90
Total CFM	-0.69	0.82	-0.34	0.87	0.77	-1.00	-0.52	-0.56	-0.73	-0.48	-0.52	-0.85	-0.49	-0.49	-0.88	-0.91	-0.99	-0.96	0.81	0.99	-0.71	-0.88
Chamber SCFM	-0.74	0.78	-0.40	0.84	0.73	-1.00	-0.57	-0.62	-0.78	-0.42	-0.58	-0.88	-0.55	-0.55	-0.91	-0.94	-0.98	-0.94	0.77	0.98	-0.75	-0.91
Bypass SCFM	-1.00	1.00	-1.00	1.00	1.00	-1.00	-1.00	-1.00	-1.00	1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	1.00	1.00	-1.00	-1.00
Total SCFM	-0.82	0.69	-0.52	0.76	0.63	-0.99	-0.67	-0.71	-0.85	-0.30	-0.68	-0.93	-0.65	-0.65	-0.95	-0.97	-0.94	-0.89	0.68	0.95	-0.83	-0.96
Min	-0.70	0.81	-0.35	0.87	0.76	-1.00	-0.53	-0.57	-0.74	-0.47	-0.53	-0.85	-0.50	-0.51	-0.88	-0.92	-0.99	-0.96	0.80	0.99	-0.72	-0.89
Max	-0.69	0.82	-0.34	0.88	0.77	-1.00	-0.51	-0.56	-0.73	-0.48	-0.52	-0.84	-0.49	-0.49	-0.87	-0.91	-0.99	-0.96	0.81	0.99	-0.71	-0.88
Delta	0.82	-0.68	0.53	-0.76	-0.63	0.99	0.68	0.72	0.86	0.29	0.69	0.94	0.66	0.66	0.96	0.98	0.94	0.88	-0.67	-0.95	0.84	0.96
Bypass %	0.15	-1.00	-0.26	-0.99	-1.00	0.80	-0.07	-0.01	0.21	0.90	-0.06	0.39	-0.10	-0.09	0.44	0.51	0.89	0.95	-1.00	-0.88	0.18	0.46
Chamber %	-0.15	1.00	0.26	0.99	1.00	-0.80	0.07	0.01	-0.21	-0.90	0.06	-0.39	0.10	0.09	-0.44	-0.51	-0.89	-0.95	1.00	0.88	-0.18	-0.46
Ratio (3:1)	0.15	-1.00	-0.26	-0.99	-1.00	0.79	-0.07	-0.02	0.21	0.90	-0.06	0.39	-0.10	-0.10	0.44	0.50	0.89	0.94	-1.00	-0.88	0.17	0.45
Airflow Temp	0.90	0.30	1.00	0.20	0.37	0.34	0.97	0.96	0.87	-0.69	0.97	0.76	0.98	0.98	0.72	0.67	0.17	0.03	0.32	-0.19	0.89	0.71
Airflow % RH	0.69	-0.82	0.34	-0.87	-0.77	1.00	0.51	0.56	0.73	0.48	0.52	0.85	0.49	0.49	0.88	0.91	0.99	0.96	-0.81	-0.99	0.71	0.88
Interspace Area	0.92	0.26	1.00	0.16	0.33	0.38	0.98	0.97	0.89	-0.66	0.98	0.79	0.99	0.99	0.75	0.70	0.21	0.07	0.27	-0.23	0.91	0.74
Lower Plenum	-0.75	-0.55	-0.95	-0.46	-0.61	-0.07	-0.87	-0.84	-0.70	0.86	-0.87	-0.56	-0.89	-0.89	-0.51	-0.44	0.11	0.24	-0.56	-0.08	-0.73	-0.50
Press Ratio	0.90	0.29	1.00	0.19	0.36	0.35	0.98	0.96	0.87	-0.68	0.97	0.77	0.98	0.98	0.73	0.68	0.18	0.04	0.31	-0.20	0.89	0.72
Upstream Pressure	0.68	0.62	0.92	0.54	0.68	-0.02	0.83	0.79	0.63	-0.90	0.82	0.48	0.84	0.84	0.43	0.36	-0.20	-0.33	0.63	0.17	0.66	0.41
Downstream Pressure	0.36	-0.98	-0.05	-0.99	-0.96	0.91	0.14	0.20	0.42	0.78	0.15	0.58	0.12	0.12	0.62	0.68	0.97	0.99	-0.97	-0.96	0.38	0.64
Differential Pressure	-0.13	1.00	0.28	0.99	1.00	-0.78	0.09	0.03	-0.19	-0.90	0.08	-0.37	0.12	0.11	-0.42	-0.49	-0.88	-0.94	1.00	0.87	-0.16	-0.44
Lab Temp	0.86	-0.63	0.58	-0.71	-0.57	0.97	0.73	0.77	0.89	0.22	0.73	0.96	0.71	0.71	0.97	0.99	0.92	0.85	-0.62	-0.92	0.87	0.98
Lab % RH	0.81	-0.71	0.50	-0.78	-0.65	0.99	0.66	0.70	0.84	0.32	0.66	0.93	0.63	0.64	0.95	0.97	0.95	0.90	-0.70	-0.96	0.82	0.95
Lab Press	0.12	-1.00	-0.29	-0.99	-1.00	0.78	-0.10	-0.05	0.18	0.91	-0.09	0.36	-0.13	-0.13	0.41	0.48	0.87	0.93	-1.00	-0.86	0.14	0.43
WTM Water Temp	0.87	0.36	0.99	0.26	0.43	0.28	0.96	0.94	0.84	-0.73	0.95	0.72	0.97	0.96	0.68	0.63	0.11	-0.03	0.37	-0.13	0.86	0.67
WTM WVP	0.78	-0.73	0.47	-0.80	-0.68	0.99	0.63	0.67	0.82	0.35	0.64	0.91	0.61	0.61	0.93	0.96	0.96	0.91	-0.72	-0.97	0.80	0.94

Much more correlation exists than when reviewing industry as a whole

Recommended Next Steps:

- Excellent work by FAA/Industry teams capturing individual OSU data for 2016 Round Robin. However, at the time of authoring this presentation, no definitive conclusion can be made.

- Observation that significant variability still exists among machines; perhaps due to manufacturing or operational differences.

- Recommend to complete 2016 Round Robin testing and continue data analysis.

- Discussion for next steps to follow in task group

Merci pour votre attention et la participation !