



Federal Aviation
Administration

HR2 & OSU Airflow & Pressure Data

2013 June Materials Meeting
Manchester, United Kingdom

Materials Working Group

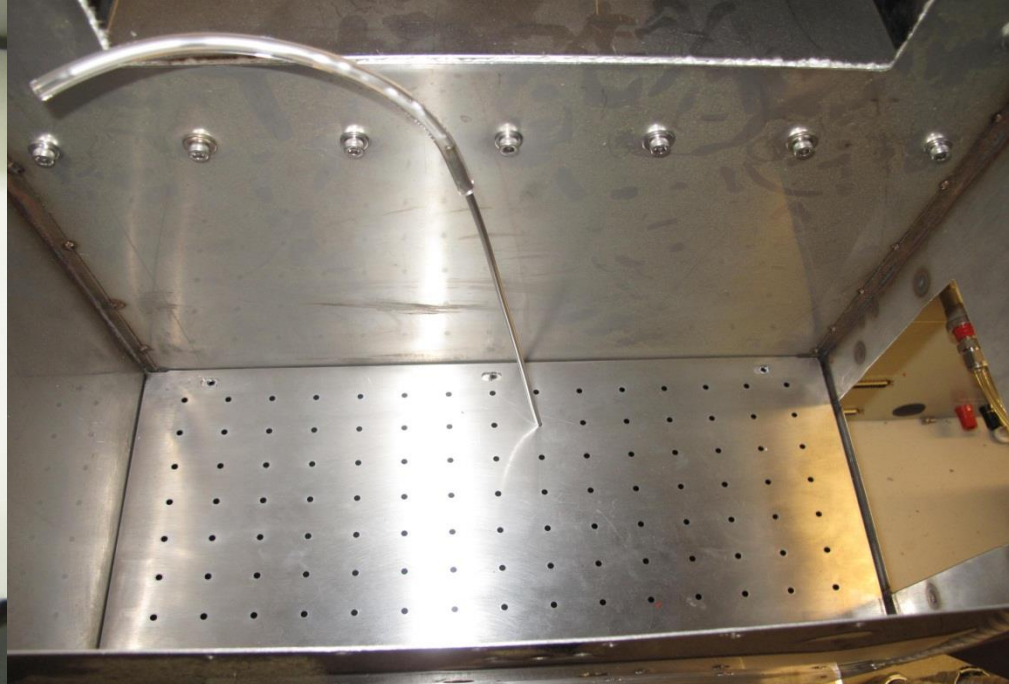
Michael Burns, FAA Tech Center

June, 2013



Agenda

- HR2 Data (Plenum Pressure / Thermopile mV)
 - Airflow Ratio (Changing % Airflow Split)
 - Total Airflow (Nominal +/- 15%)
 - Heat Flux (Nominal +/- 10%; no flames)
 - Calibration Parameters
 - Exhaust Gas Temperature (no flames)
- OSU Diagnostic Flow Chart (Based on HR2 Data)
- Summary / Next



Mass
Flowmeter

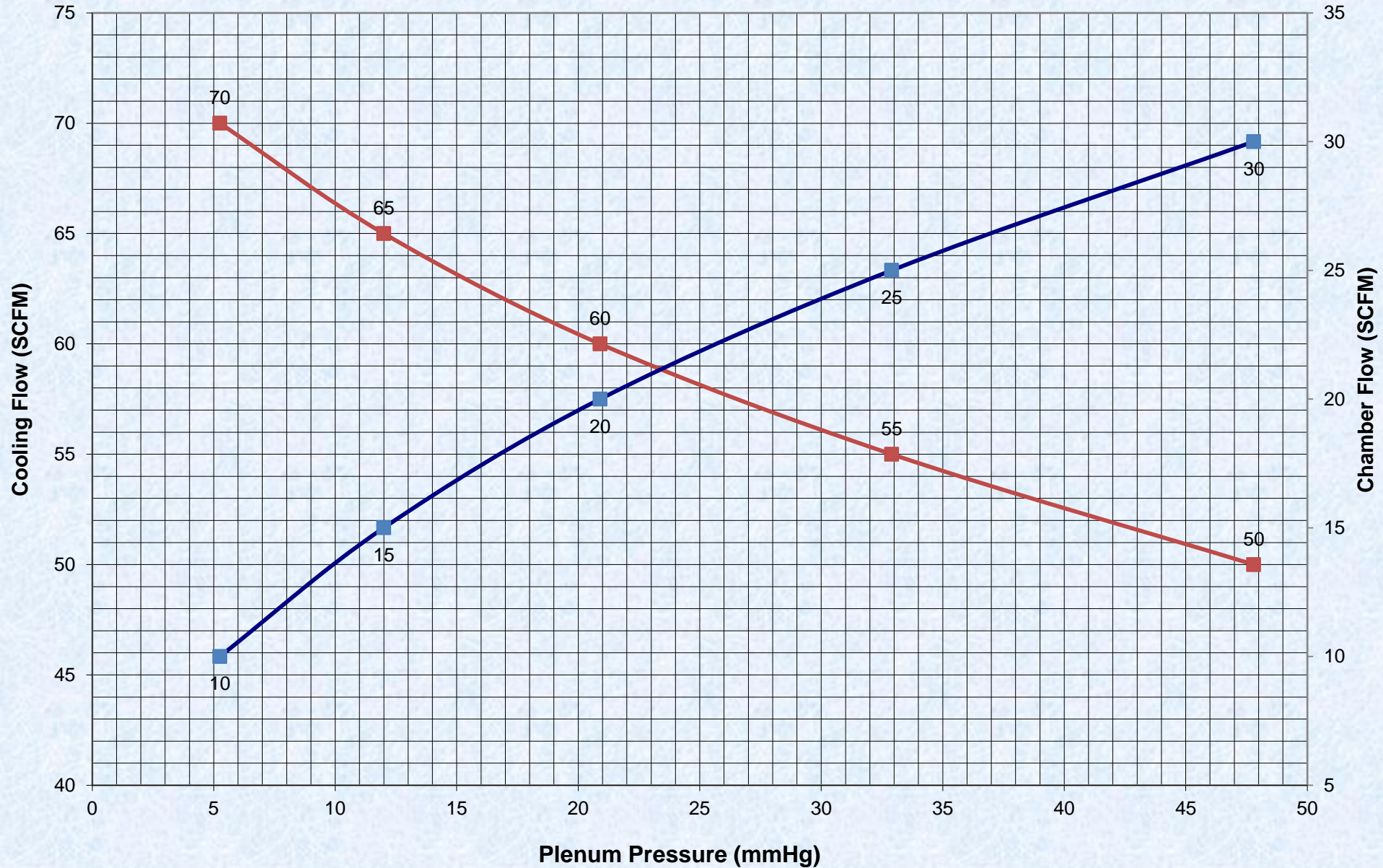
Pressure
Transducer

Lower Air
Plenum
Pressure
(mmHg)

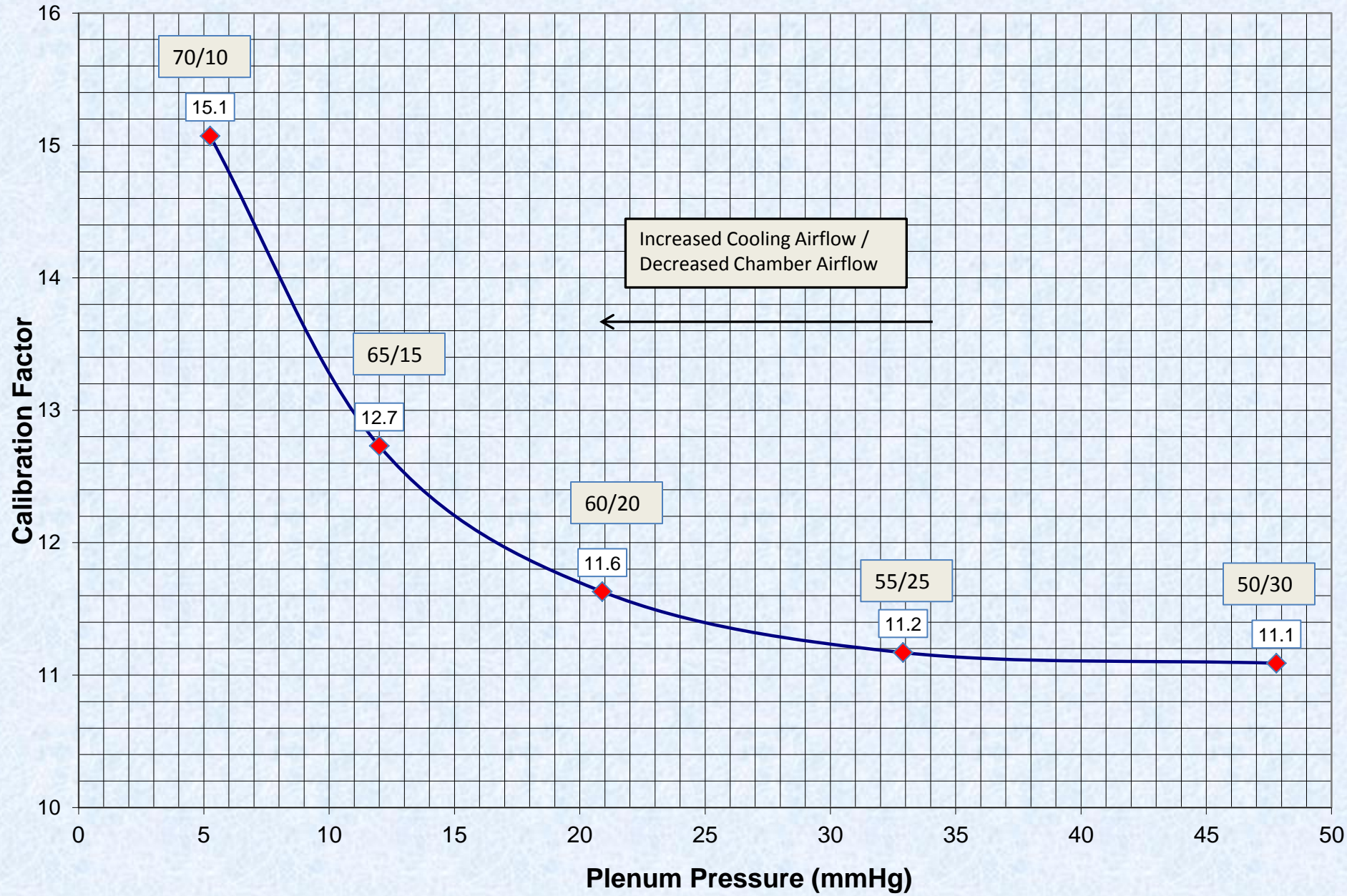


HR2 Plenum Pressure / Cooling Flow / Chamber Flow Correlation (Constant Total Flow of 80 SCFM)

—■— Cooling Flow —■— Chamber Flow

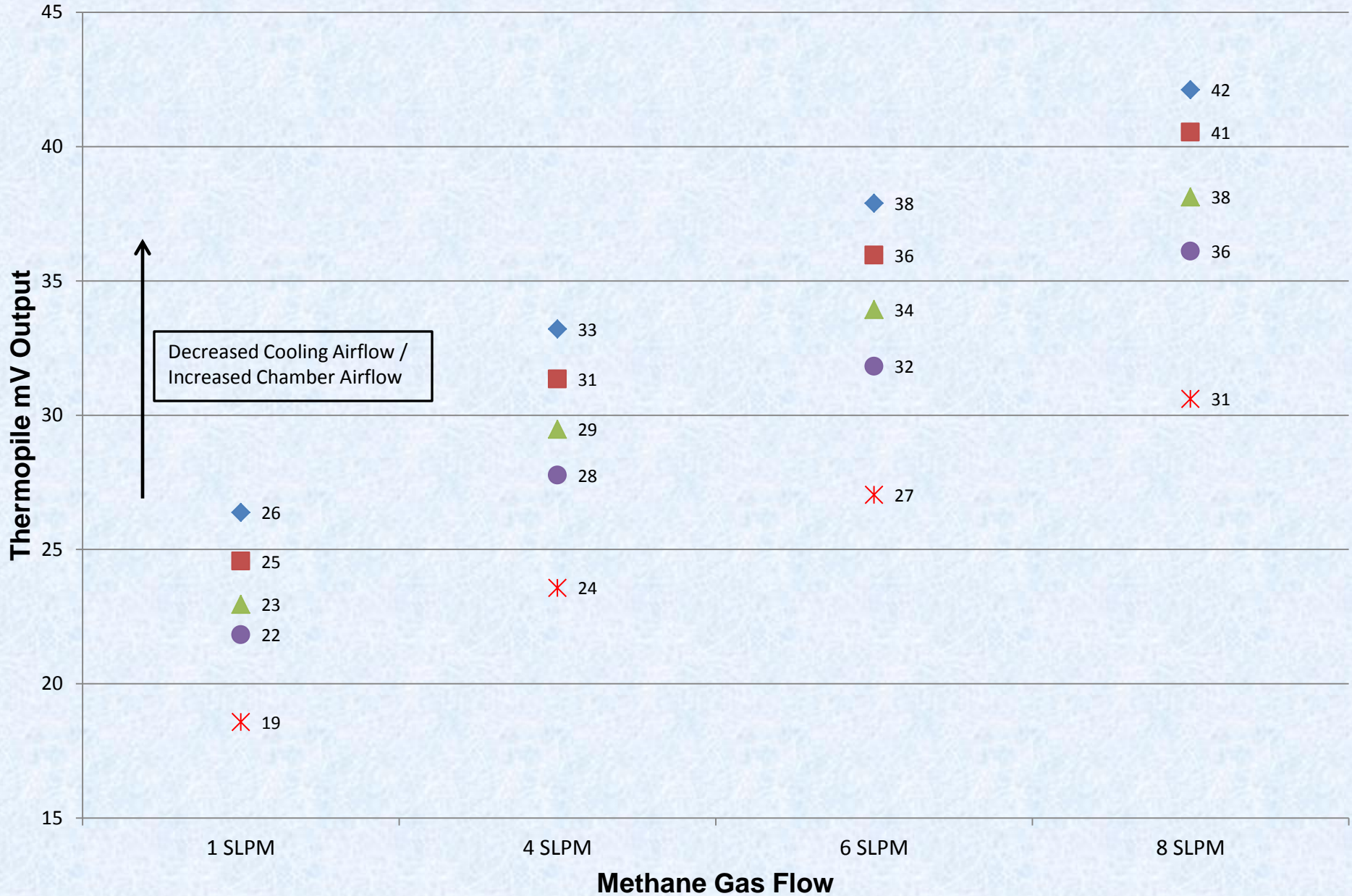


HR2 Plenum Pressure / Calibration Factor Correlation (Changing Airflow Ratio Only)

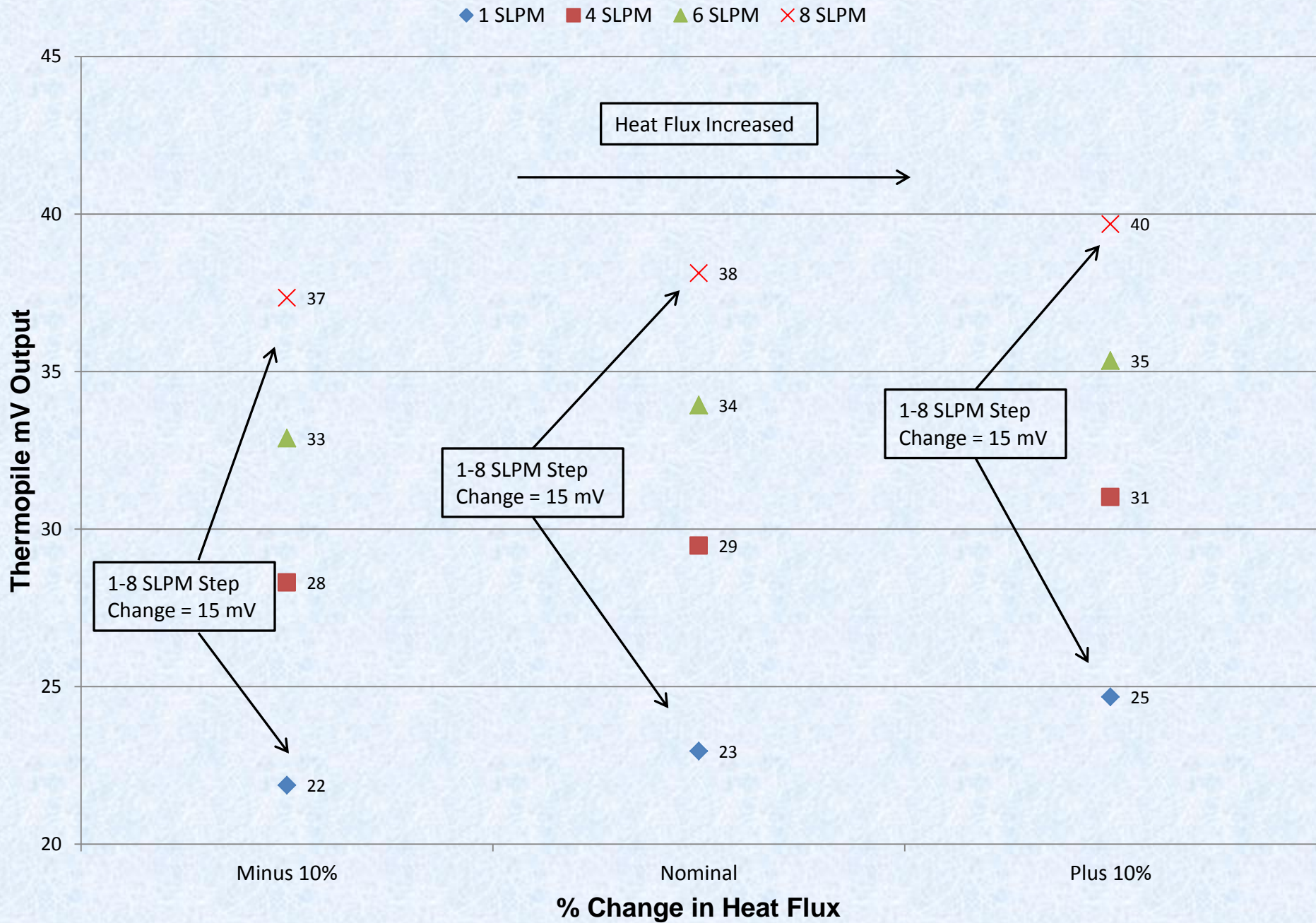


Calibration: Thermopile Output vs. Airflow Ratio (SCFM)

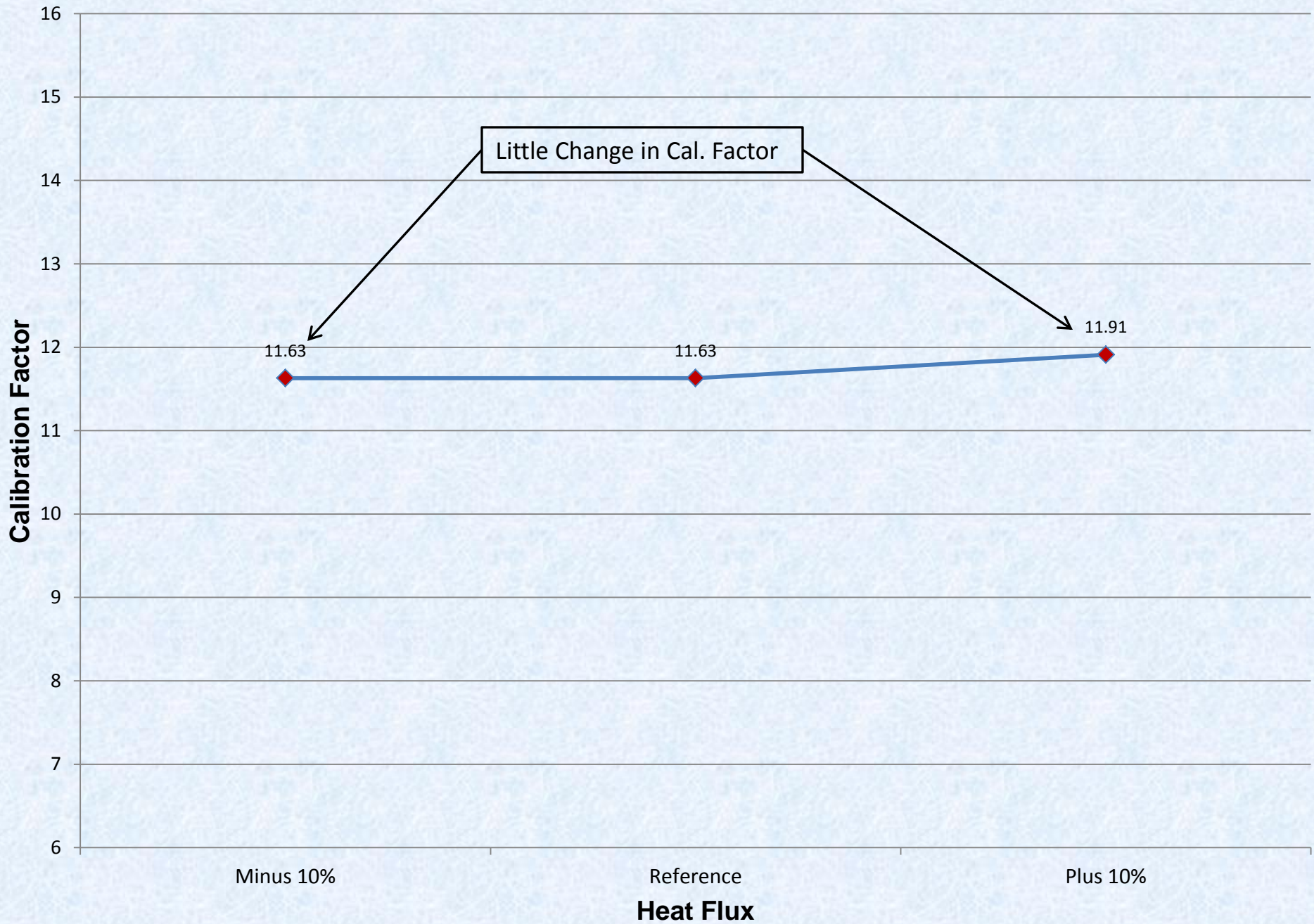
◆ 50/30 ■ 55/25 ▲ 60/20 ● 65/15 ✖ 70/10



Calibration: Thermopile output vs. Heat Flux Differences

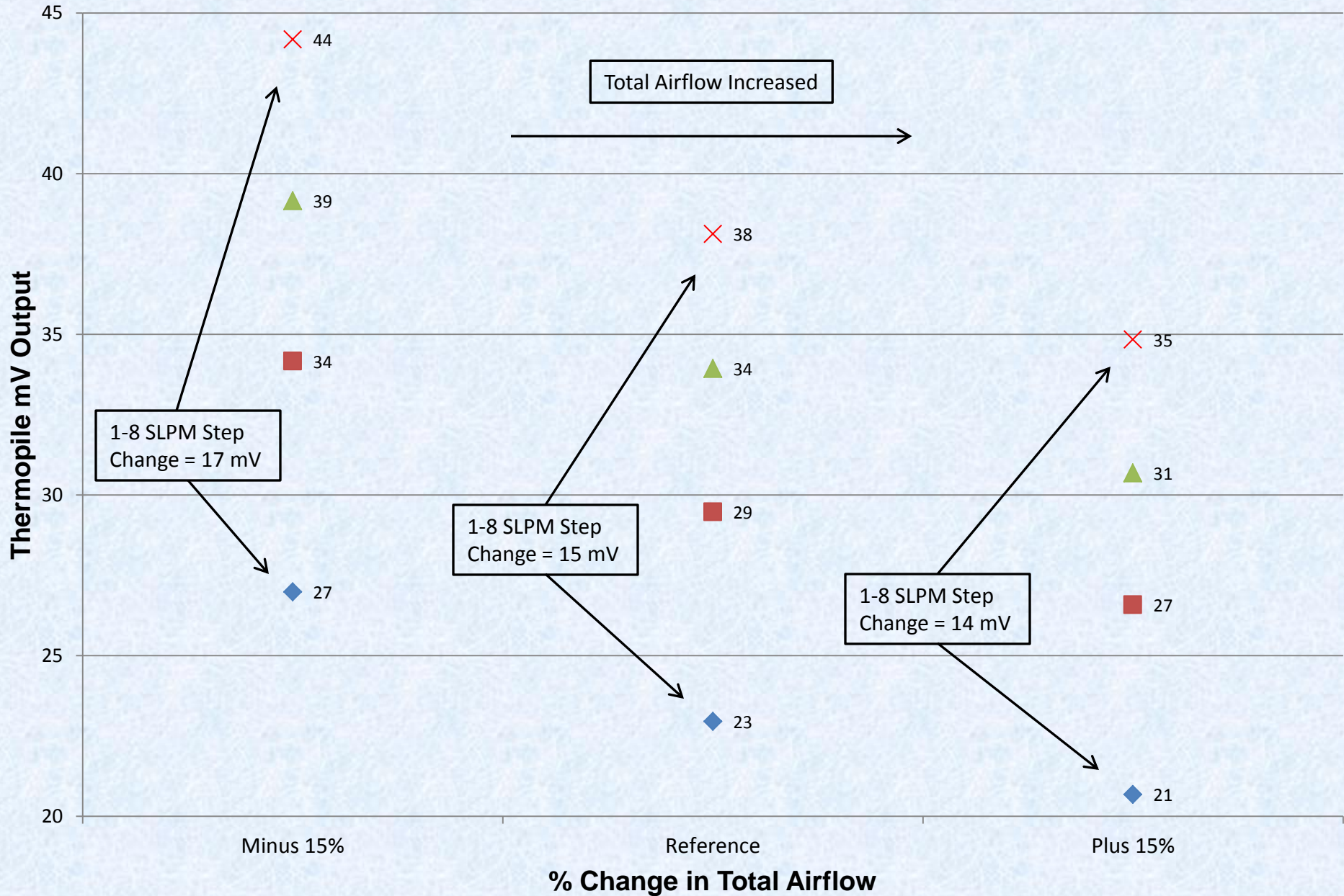


Heat Flux Influence on Cal. Factor

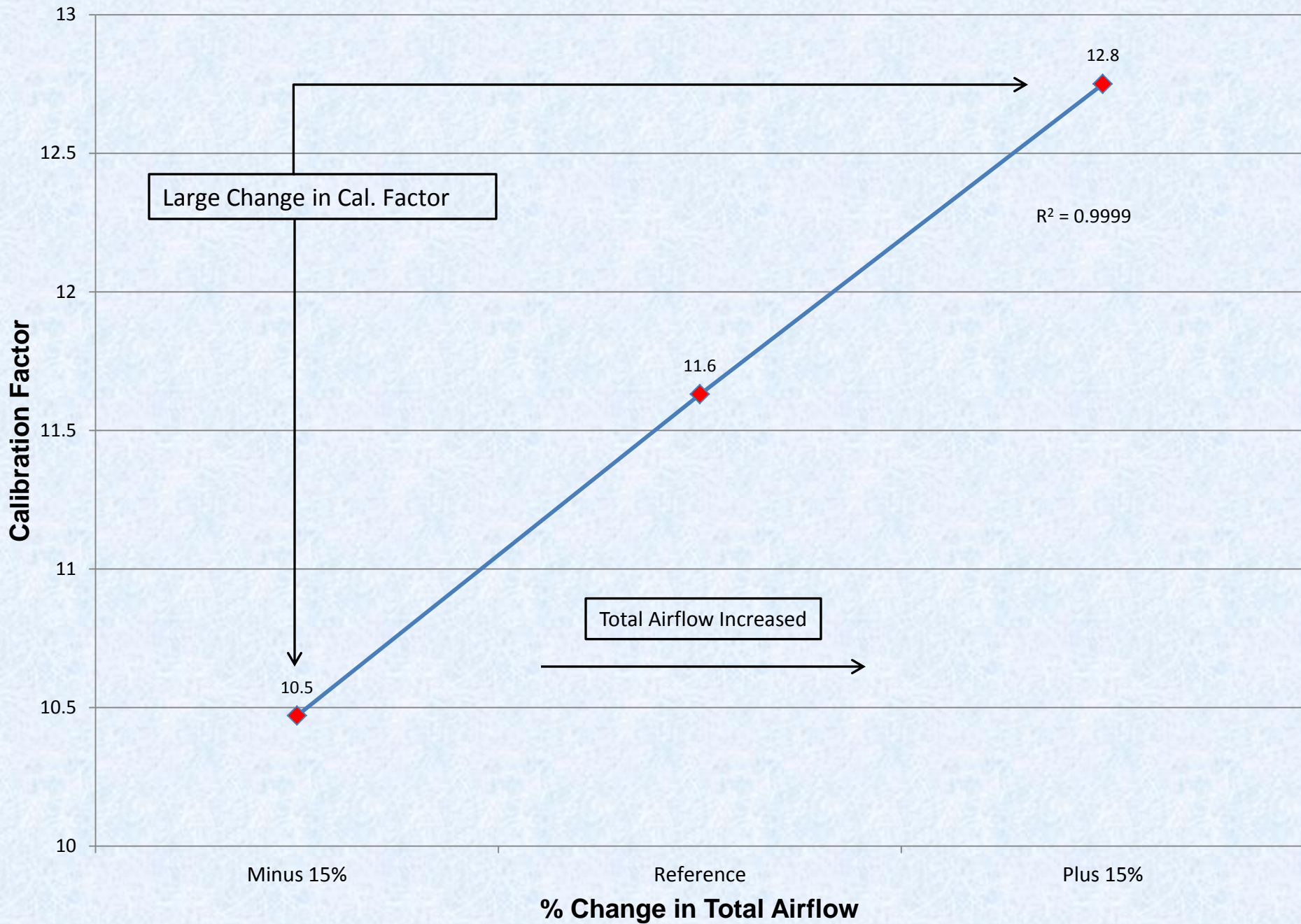


Calibration: Thermopile Output vs. Total Airflow Differences

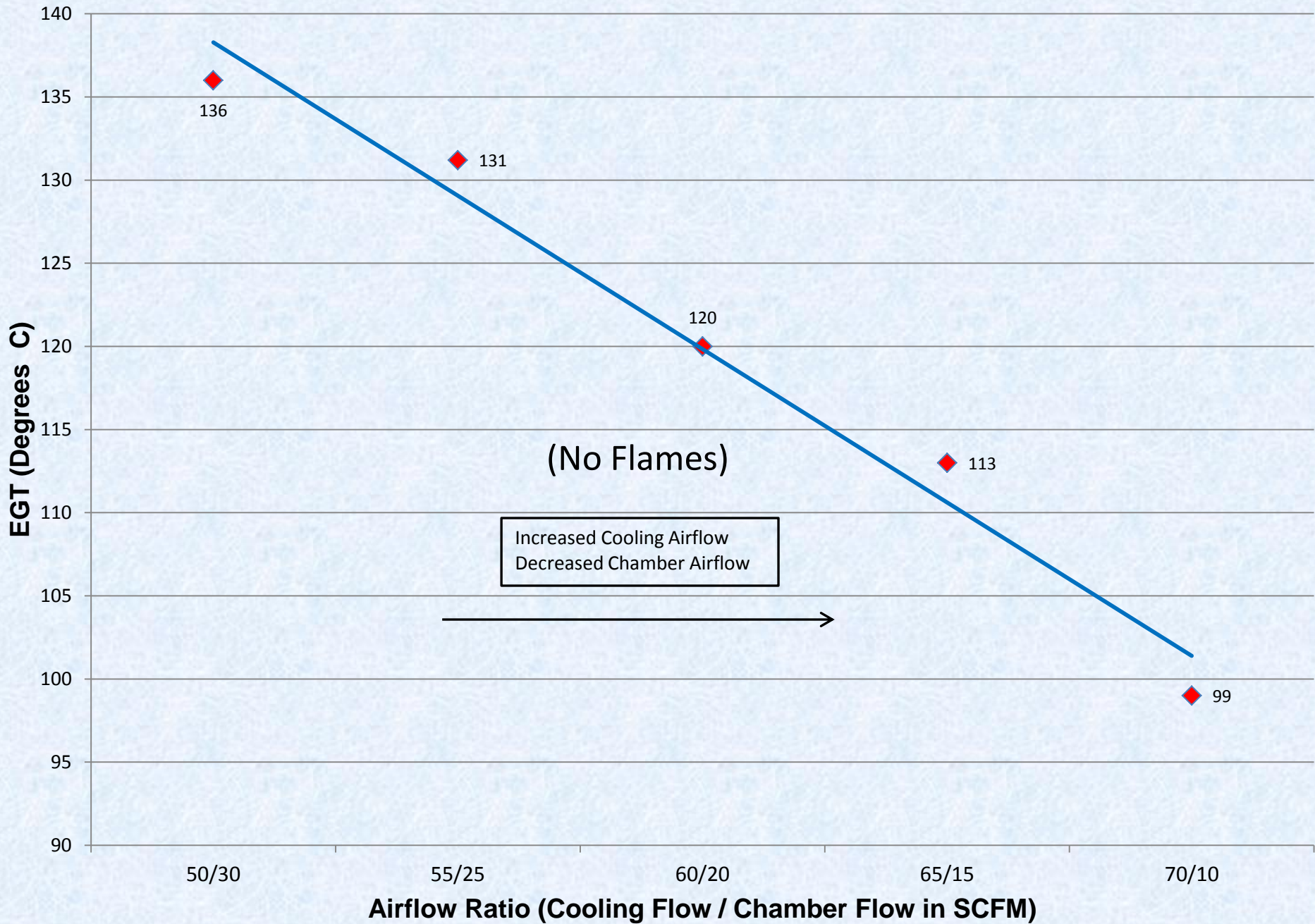
◆ 1 SLPM ■ 4 SLPM ▲ 6 SLPM ✕ 8 SLPM



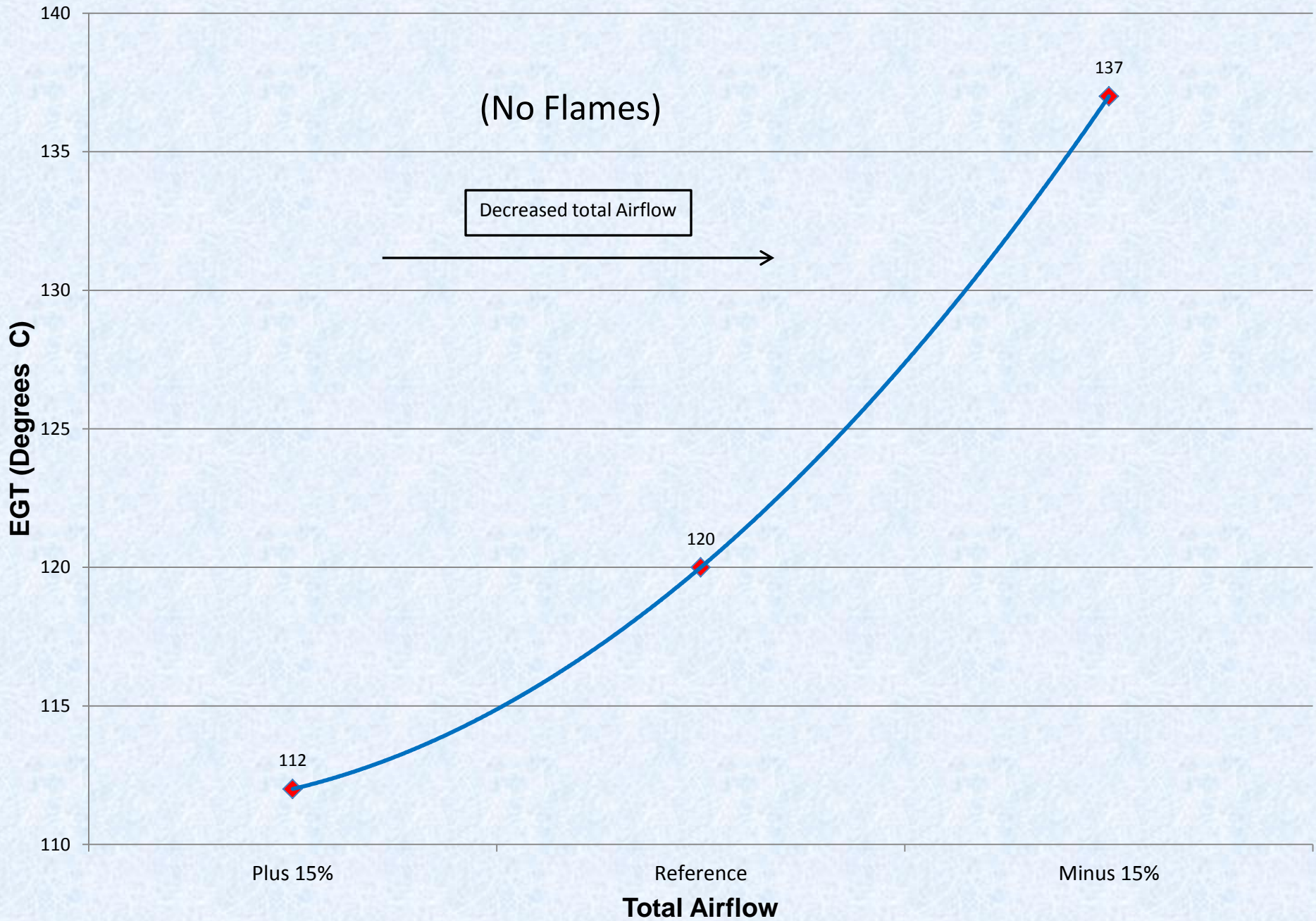
Total Airflow Influence on Calibration Factor



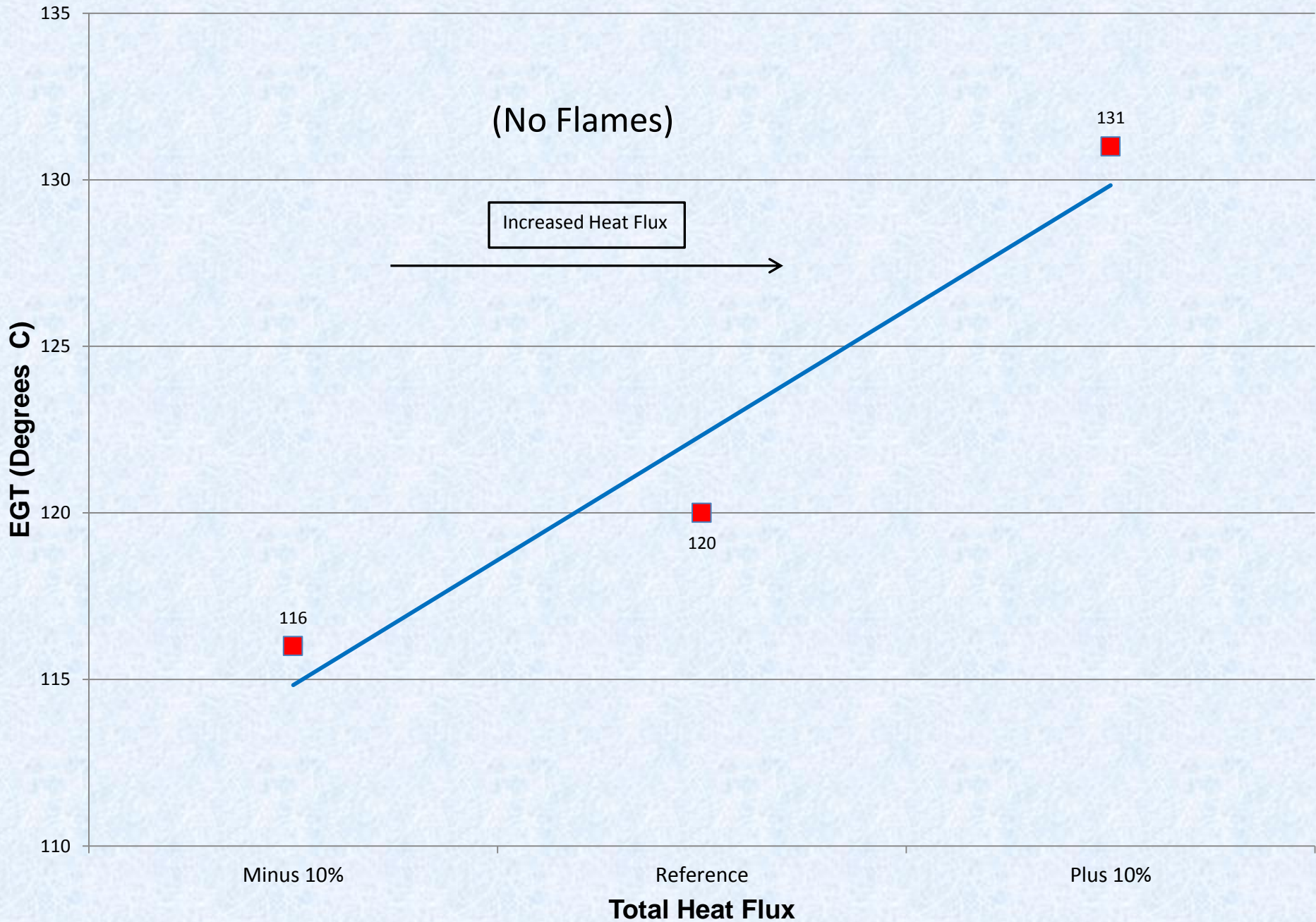
Exhaust Gas Temperature vs. Airflow Ratio



Exhaust Gas Temperature vs. Total Airflow Differences



Exhaust Gas Temperature vs. Heat Flux Differences



OSU Diagnostic Flow Chart

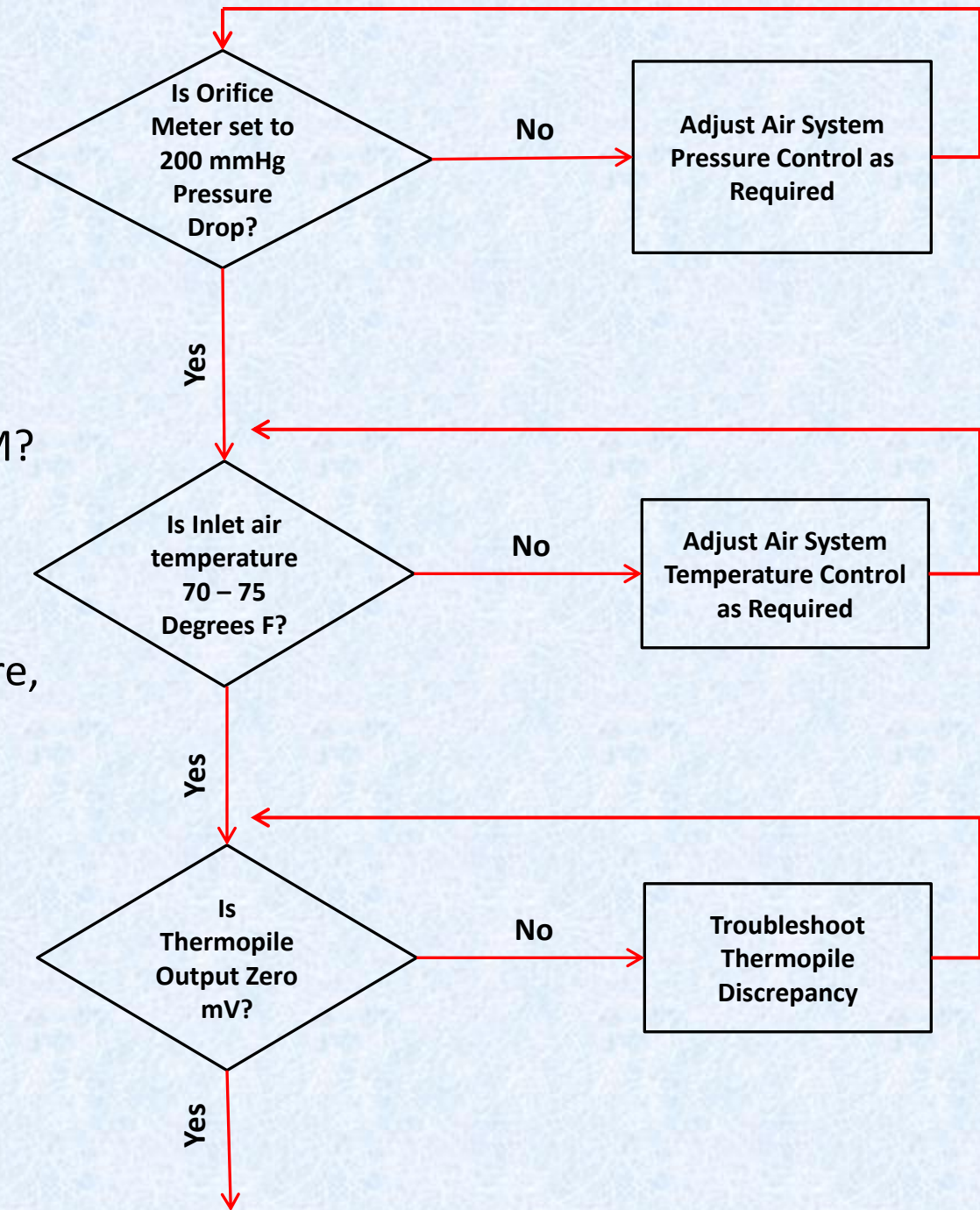
1) Airflow Determination

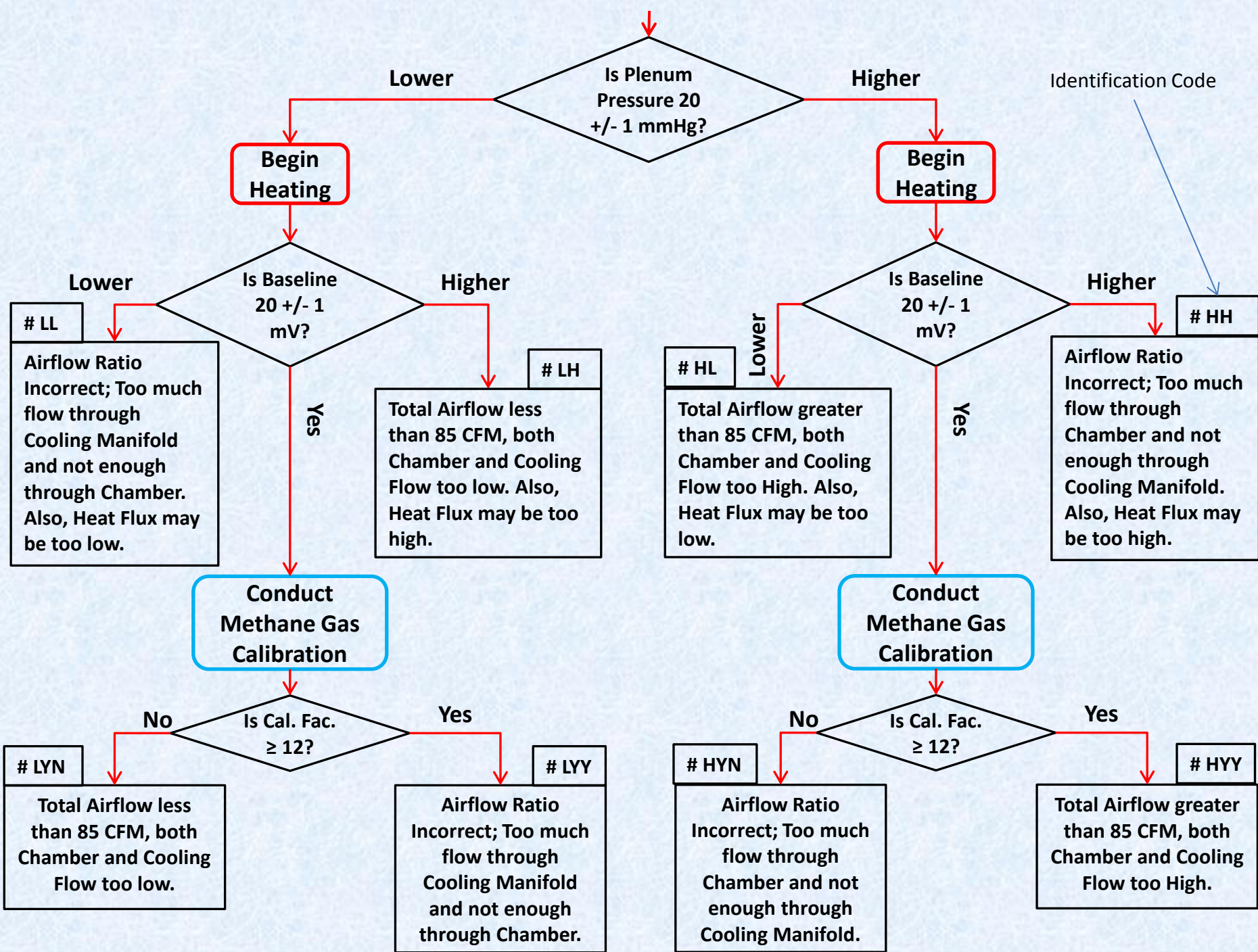
- Total Airflow @85 CFM?
- Airflow Ratio (Split)?
75% - Cooling Flow
25% - Chamber Flow

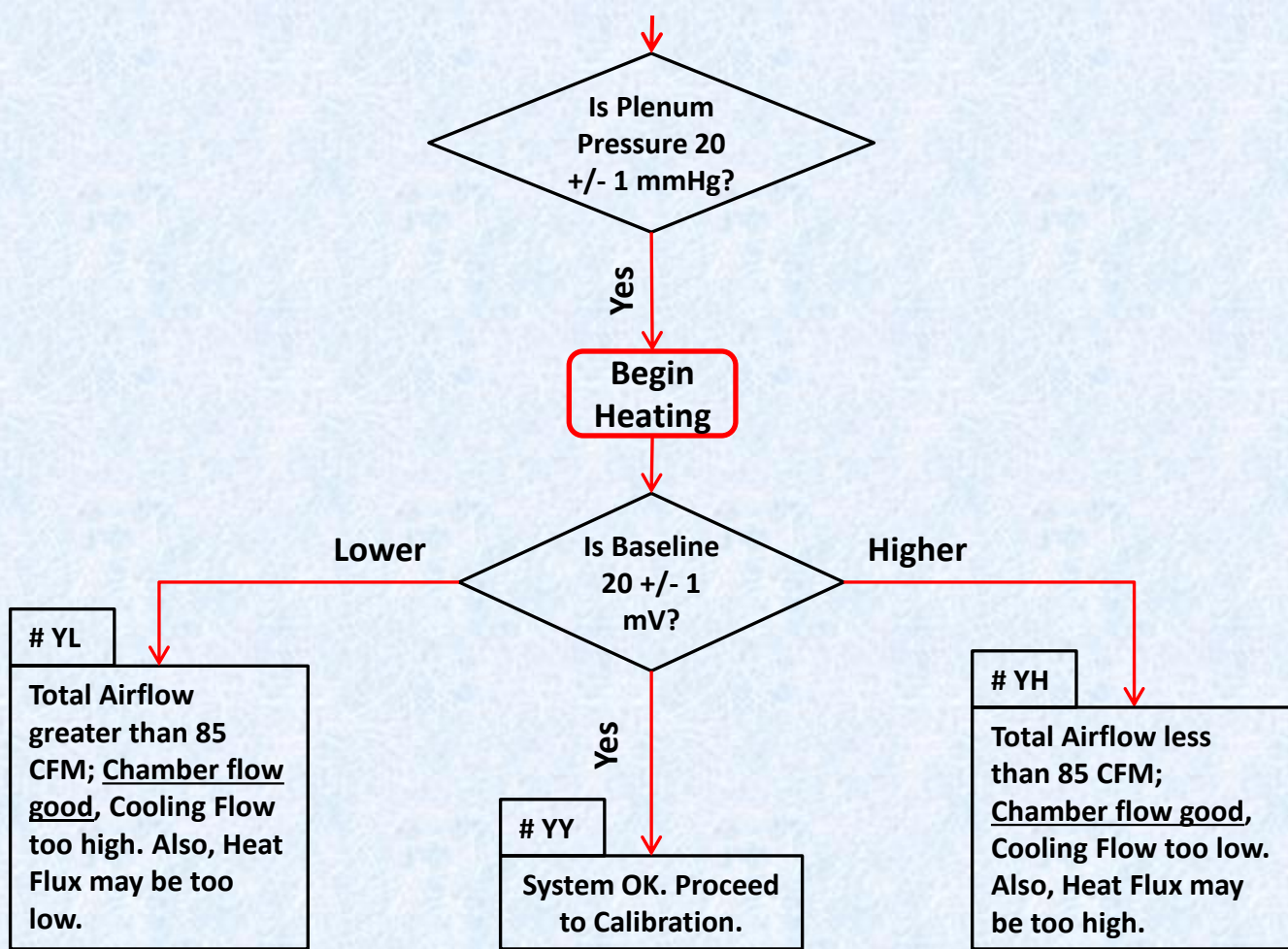
→ Looking at Plenum Pressure,
Thermopile Output at
baseline heat flux of 3.5
W/cm² (no flames) &
Calibration Factor.

2) Harmonized Baseline mV

→ Once step #1 is validated.







HR2 Prototype

CALIBRATION PARAMETERS

METHANE FLOW (SLPM)			THERMOPILE OUTPUT (mV)		
Low Range	TARGET	High Range	Low Range	TARGET	High Range
0.98	1.0	1.02	22.8	24.0	25.2
3.92	4.0	4.08	28.5	30.0	31.5
5.88	6.0	6.12	32.3	34.0	35.7
7.84	8.0	8.16	36.1	38.0	39.9
CALIBRATION FACTOR RANGE					
Low Range		TARGET	High Range		
0.232 kW/mv		0.267 kW/mv	0.302 kW/mv		
10 kW/m ² /mV		11.5 kW/m ² /mV	13 kW/m ² /mV		

Summary

- Differences in airflow conditions between OSU's may be a contributing factor in poor reproducibility (Round Robins).
- Changes in airflow (ratio/total) had a very large impact on heat flux levels.
- OSU Diagnostic Flow Chart may be a good indicator of system total airflow, airflow ratio and heat flux (OSU Standardization effort).
- OSU test labs may want to evaluate their equipment comparing:
 - Plenum Pressure / Thermopile output at baseline (no flames)
 - Exhaust gas Temperature (if equipped, no flames)
 - Thermopile mV values obtained from calibration
 - Calibration factor
- Cal. factor may be a misleading representation of heat flux in itself.
- More data is needed to ensure the 75%/25% airflow split is an accurate estimate of current systems.

Next

- Continue Research On Repeatable Heat Release Test Specimen
- Continue Airflow Ratio / Heat Flux Testing Looking At Impact On Data
- Develop International Round Robin Criteria Looking Into Plenum Pressure, Airflow And Thermopile Output (OSU)
- Continue OSU Standardization Effort (Current Machines)

Questions?

