Flame Propagation Capability Analysis:

Alternative Small Scale Test

for Unfaced Microlite AA® Blankets

Johns Manville

Monroe Shumate 6/05

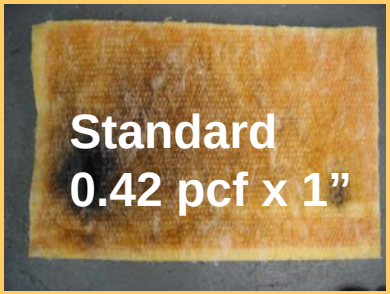
Purpose of Study

- Confirm/verify unfaced Microlite AA glass blankets comply with FAA flame propagation requirements

- Determine product capability

Scope of Product Tested

- Density 0.34 pcf to 1.5 pcf
- Thickness 3/8” to 1”
- Binder content 13% to 20%
- Top vs bottom surface
- Evaluate product from multiple production runs (5 code dates per product over 4 year period)



Test results

- Flame Propagation — No failures
- After Flame — No failures

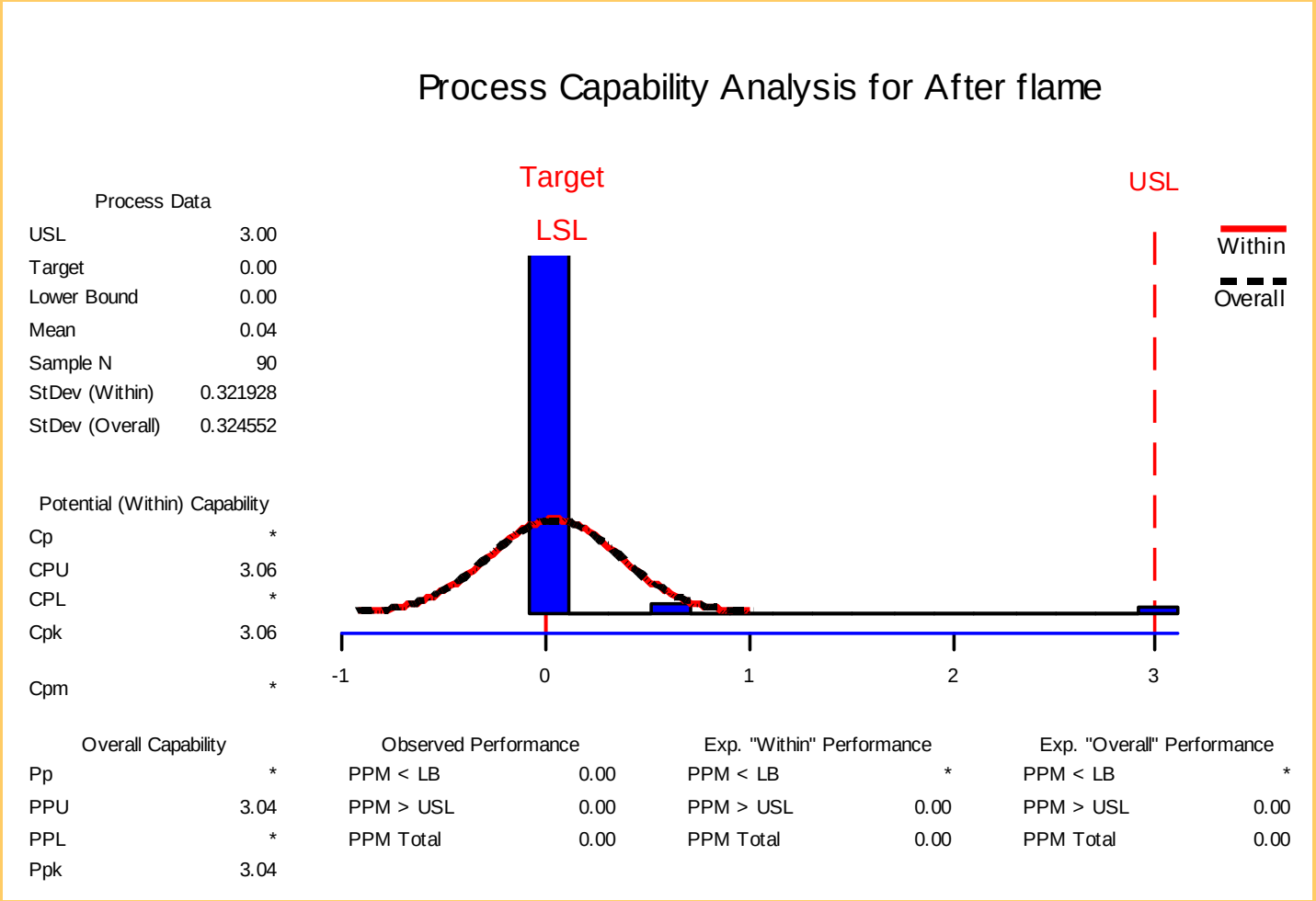
Test equipment – FAA test rig (gas & electric)

Test Results – Partial List

Product		Prem .34 pcf x 1"			Std 0.42 pcf x 1"			Std 1.5 pcf x 3/8"		
Sample #	Blanket Orientation	AF* (Sec)	FP (In)	R P/F	AF* (Sec)	FP (In)	R P/F	AF* (Sec)	FP (In)	R P/F
ID.		**80402636**			**6246**			**90203630**		
1	Top	0	0	P	0	0	P	0	0	P
2	Top	0	0	P	0	0	P	0	0	P
3	Top	0	0	P	0	0	P	0	0	P
4	Bottom	0	0	P	0	0	P	0	0	P
5	Bottom	0	0	P	0	0	P	0	0	P
6	Bottom	0	0	P	0	0	P	0	0	P
ID.		**102202323**			**12212223 ½" thick**			**102212323**		
1	Top	0	0	P	0	0	P	0	0	P
2	Top	0	0	P	0	0	P	0	0	P
3	Top	0	0	P	0	0	P	0	0	P
4	Bottom	0	0	P	0	0	P	0	0	P
5	Bottom	0	0	P	0	0	P	0	0	P
6	Bottom	0	0	P	0	0	P	0	0	P

AF – after flame FP- flame propagation R - results

Capability Analysis



No capability analysis performed on Flame propagation since there were no failures.

Development small scale test

(In process test method for plain fiber glass)

- Simple/quick QA check
- Simple design/operation
- Short test cycle
- Quick start-up

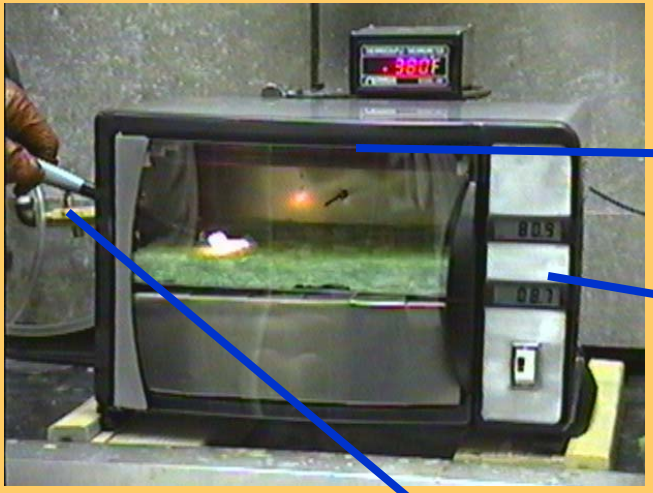
Reproducible

Correlation to FAA test

Methodology

- Multi-factorial DOE to generate samples with flame propagation or after flame
- Establish product standards utilizing FAA test rig
- Design and build small scale radiant panel
- Develop & verify test parameters
  - Establish robust test setting
  - Conduct Gage R&R (Reproducibility & Repeatability)

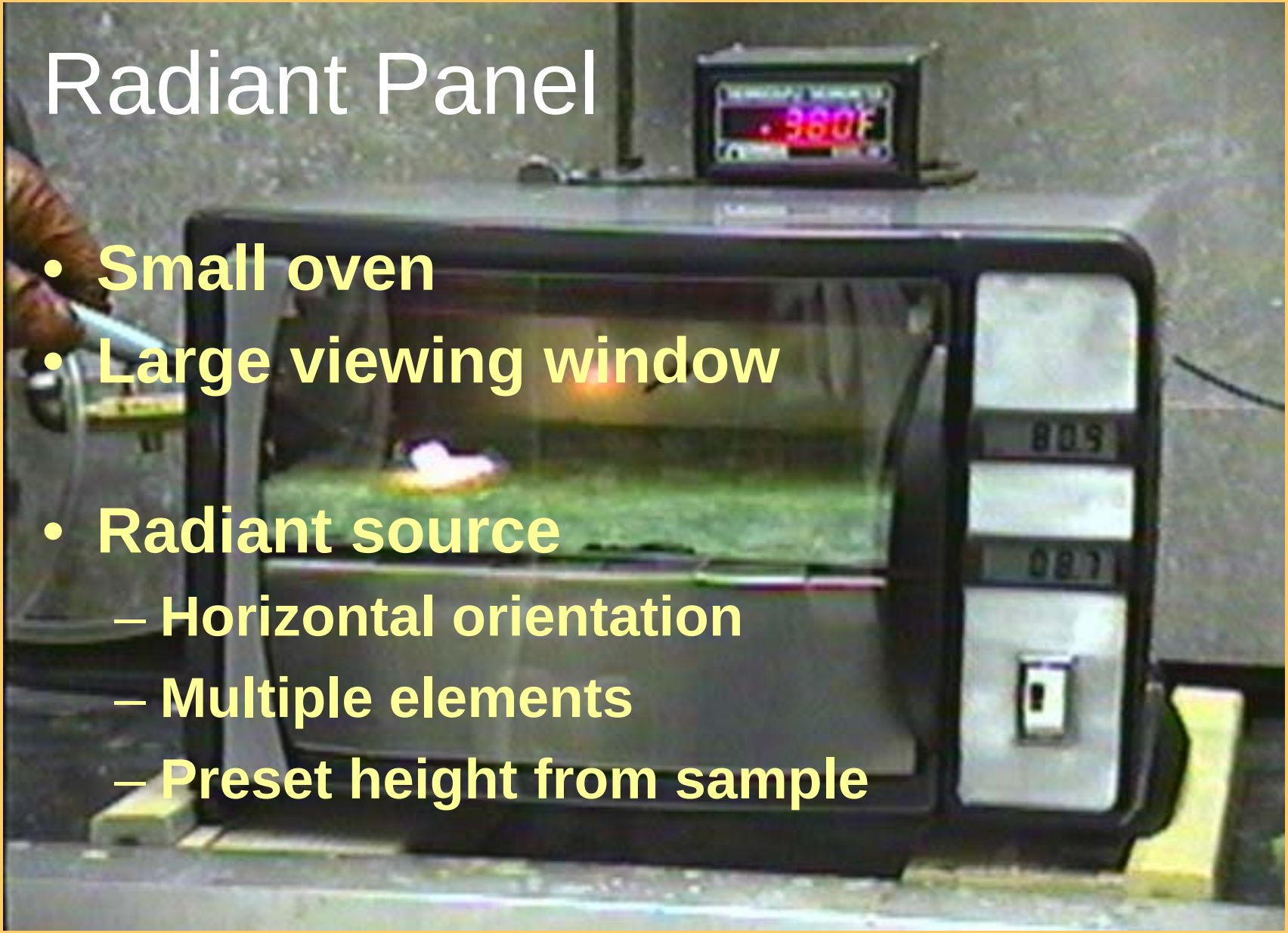
Equipment



- Radiant heat

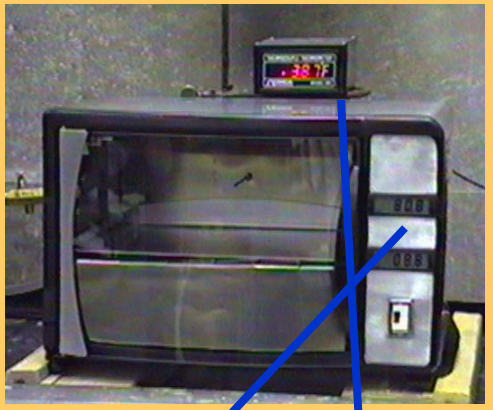
- Power control
- Flame source

Radiant Panel



- **Small oven**
- **Large viewing window**
- **Radiant source**
  - **Horizontal orientation**
  - **Multiple elements**
  - **Preset height from sample**

Power Control



- Heat flux control
  - Constant power
  - Variable voltage regulator
  - Preset input - (voltage/amp)

- Temperature measurement
  - Type “K” thermocouple

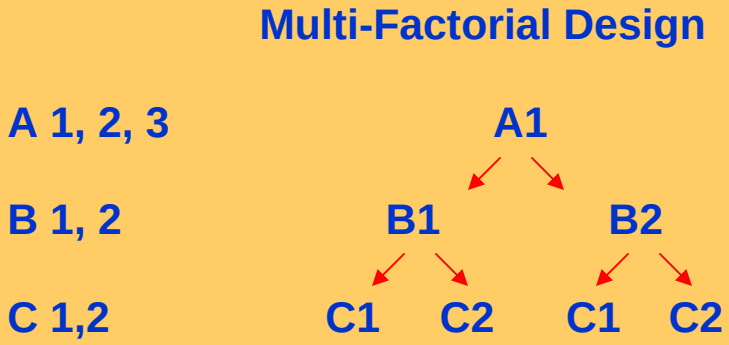
Flame source

- Butane flame
- Self igniting
- Flame length 1” to 1 ½”
- Flame angled – 20 degrees
- Burner ¼” - ½” from sample

Multi-factorial DOE design

Produce samples to show flame propagation or after flame

- Design layout - 3 factor – multi-variable
- Conduct plant trial to produce samples
- Evaluate samples at FAA
  Identify which samples show
  flame propagation and/or after flame

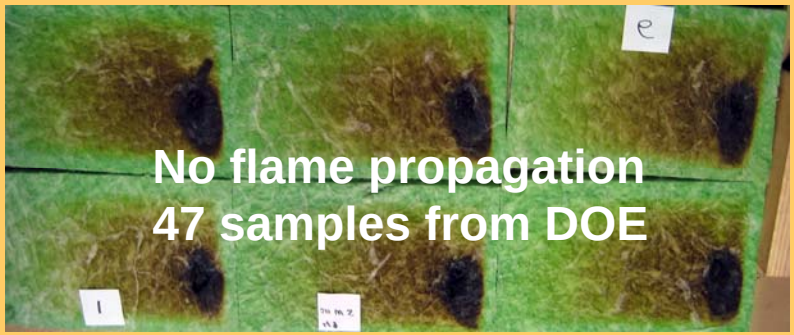


FAA Radiant Panel tests (Electric Panel)

- Evaluate samples from DOE
- Check for Flame propagation
- Check for After flame

Results:

- One sample showed Flame propagation
- No samples showed After flame



Develop test parameters for small scale test

- Use results from FAA Test Rig as control
- Goal – Provide similar results as FAA test rig
- Establish test parameters
  - power setting
  - temperature
  - time
  - measurement technique

Robust test setting

- Flame Propagation – Parameters provide similar results to FAA tests:
  - Power settings - voltage & amperage
  - Temperature (Start Temp 385F)
  - Flame length (1 “to 1 1/2”)
  - Test time (7-10 seconds)
- After Flame
  - No after flame was observed
  - <u>Results same as FAA</u>

Gage R&R
Reproducibility & Repeatability

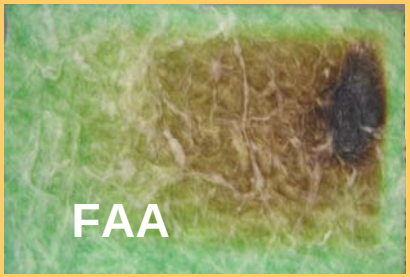
- Gage R&R was < 23%
  Meets criteria for use as test method for process control

- < 2% for Reproducibility – operator factor
- < 23% Repeatability - equipment

Statistical baseline gage R&R allows for process control < 30%

Comparison of FAA Radiant panel to Small scale test

- Results same for either method
- FAA radiant panel is primary test standard
- Small scale test method considered secondary standard
- Small scale test acceptable for use as process monitor for testing unfaced fiber glass



Recap

- Capability analysis <1 chance in a million for Microlite AA failure for after flame or flame propagation (for product tested using FAA radiant panel)
- JM continue to certify to FAR 25.853 Appendix F part I standard for flame spread and punking (standard used for all product tested for study)
- JM implement use of small scale radiant test panel as part of quality assurance program
- Test Report E436-T-03973
  Available for Review (shumatem@jm.com)

Johns Manville