Altitude -- Effect on Burnthrough Results
October 23, 2001

-or-

True Confessions from Laboratory E

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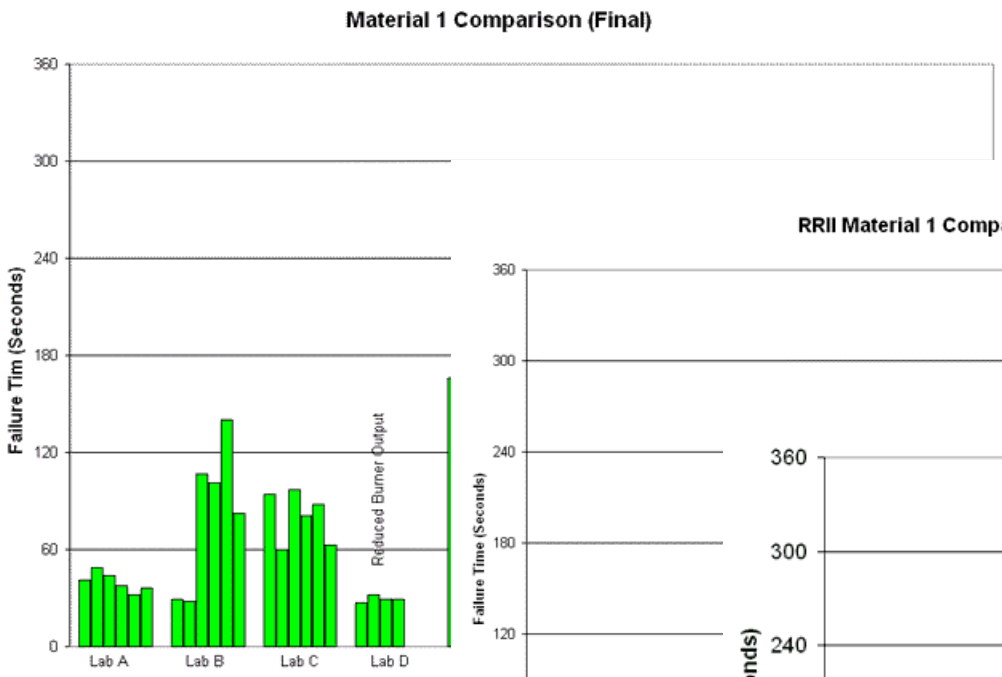
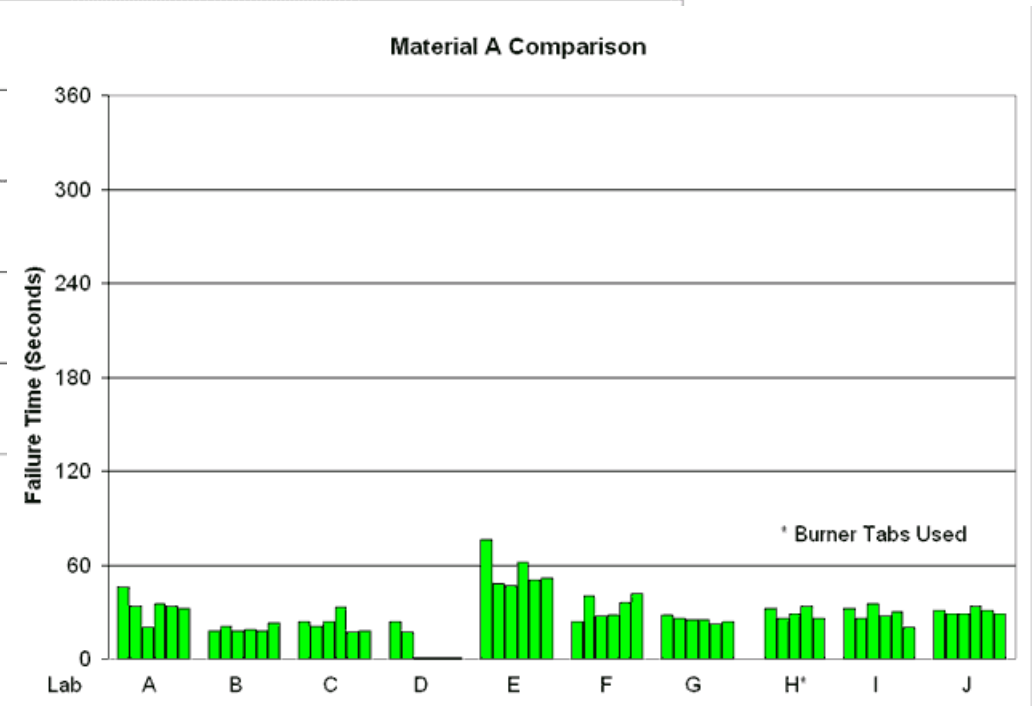
Laboratory E -- The History





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Effect of Altitude -- The Program

- Duplicate Testing
  - FAA Test Rig and Johns Manville Test Rig at the FAA Technical Center at Sea Level
  - Johns Manville Test Rig at 5,280+ feet
- Calibration Comparisons
- Four Sample Configurations / Three tests each

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Calibration Settings

- FAA Test Method Parameters
  - Fuel Flow: 6 gph +/- 0.2 gph
  - Air Flow: 2150 fpm +/- 50 fpm

- FAA Specified Calibrations
  - Heat Flux: 16.0 +/- 0.8 Btu/ft^{2}sec
  - Temperature: 1900 +/- 100ºF avg.

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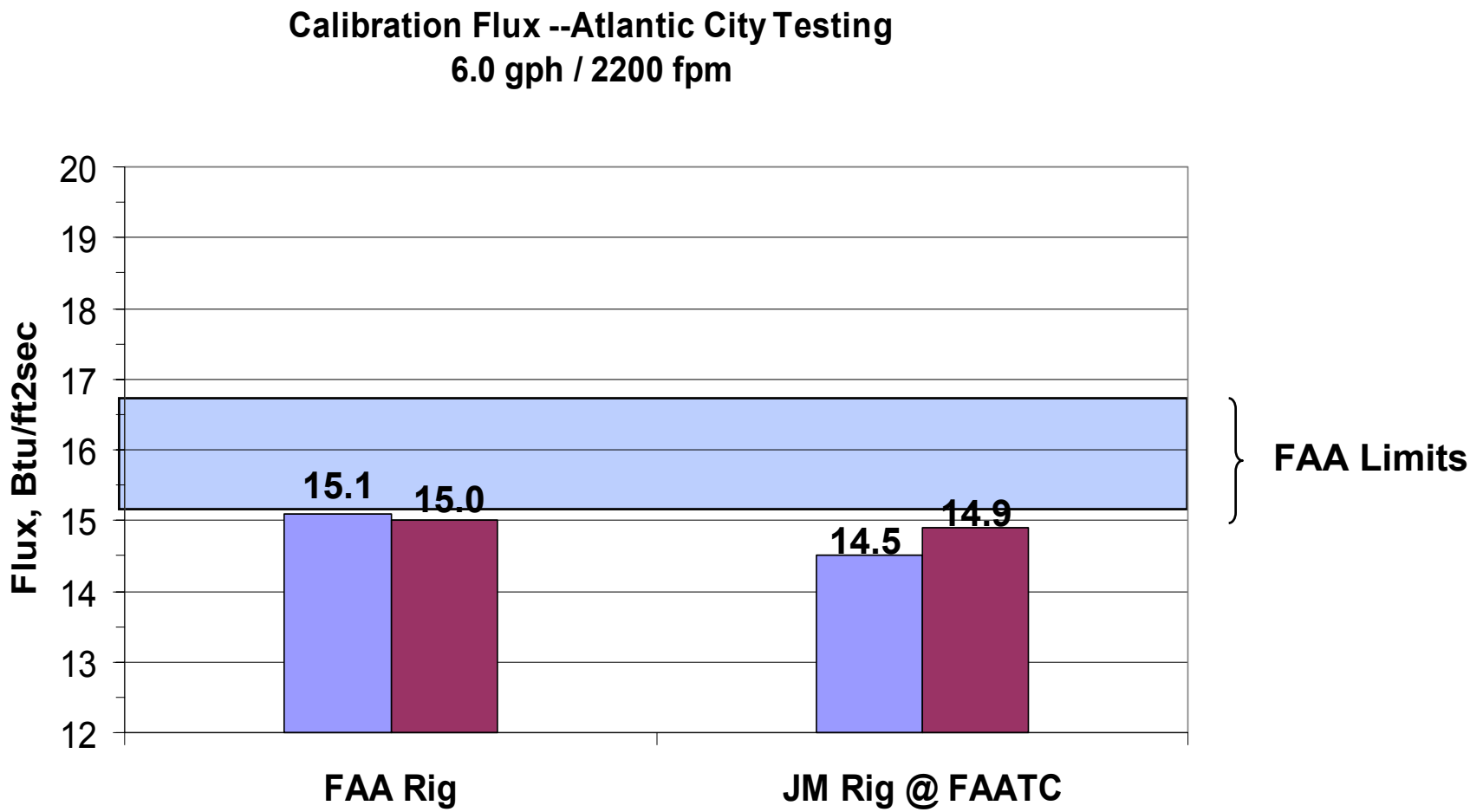
Calibration -- FAA Testing



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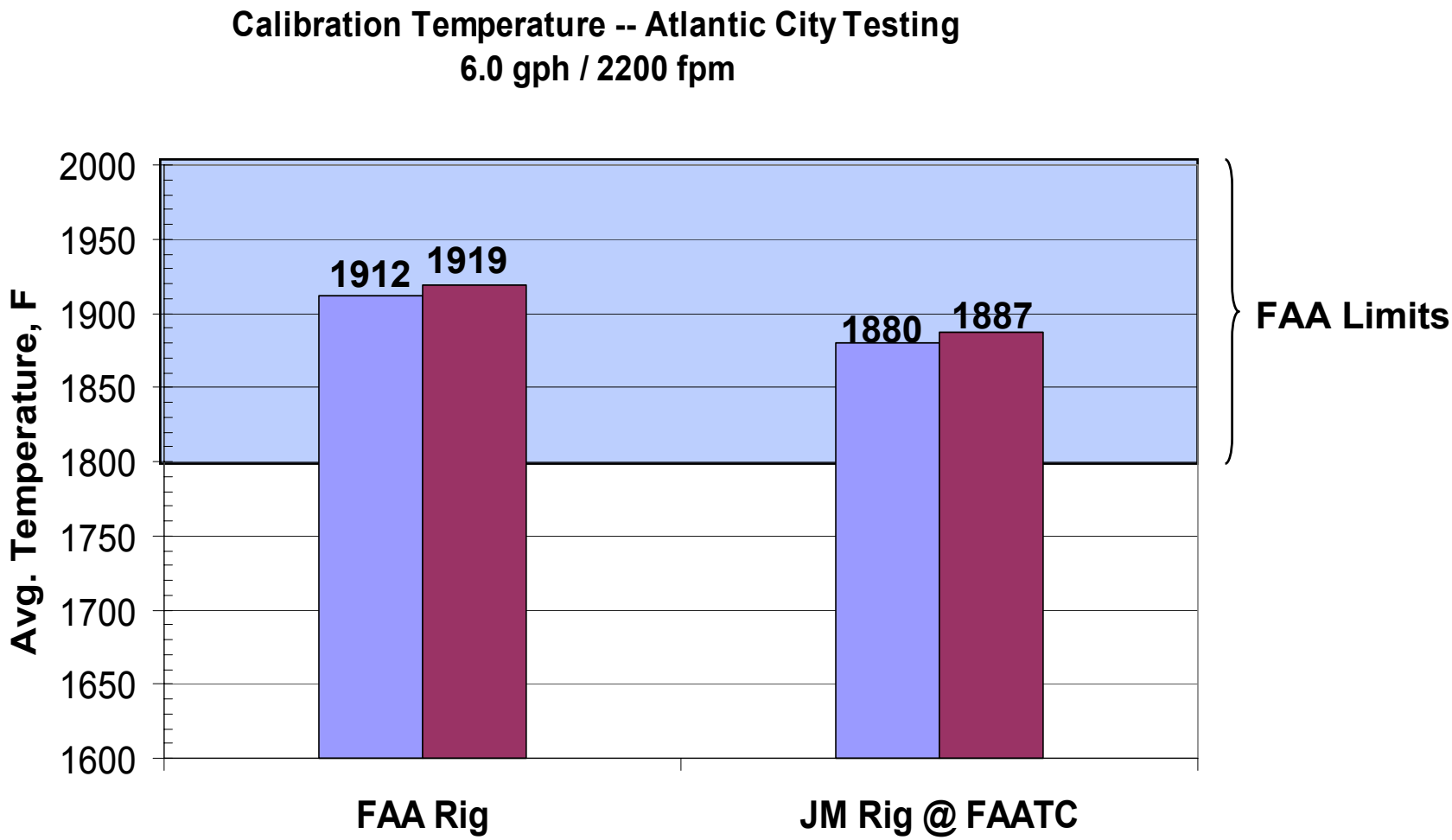
Calibration -- FAA Testing



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Calibration Analysis -- at Altitude

Purpose:

Determine fuel and airflow settings
within FAA guidelines
which result in heat flux and average temperature calibrations closest to those obtained at Sea Level

Heat Flux: 14.5 to 15.1 Btu/ft^{2}sec
Avg. Temperature: 1880 to 1919ºF

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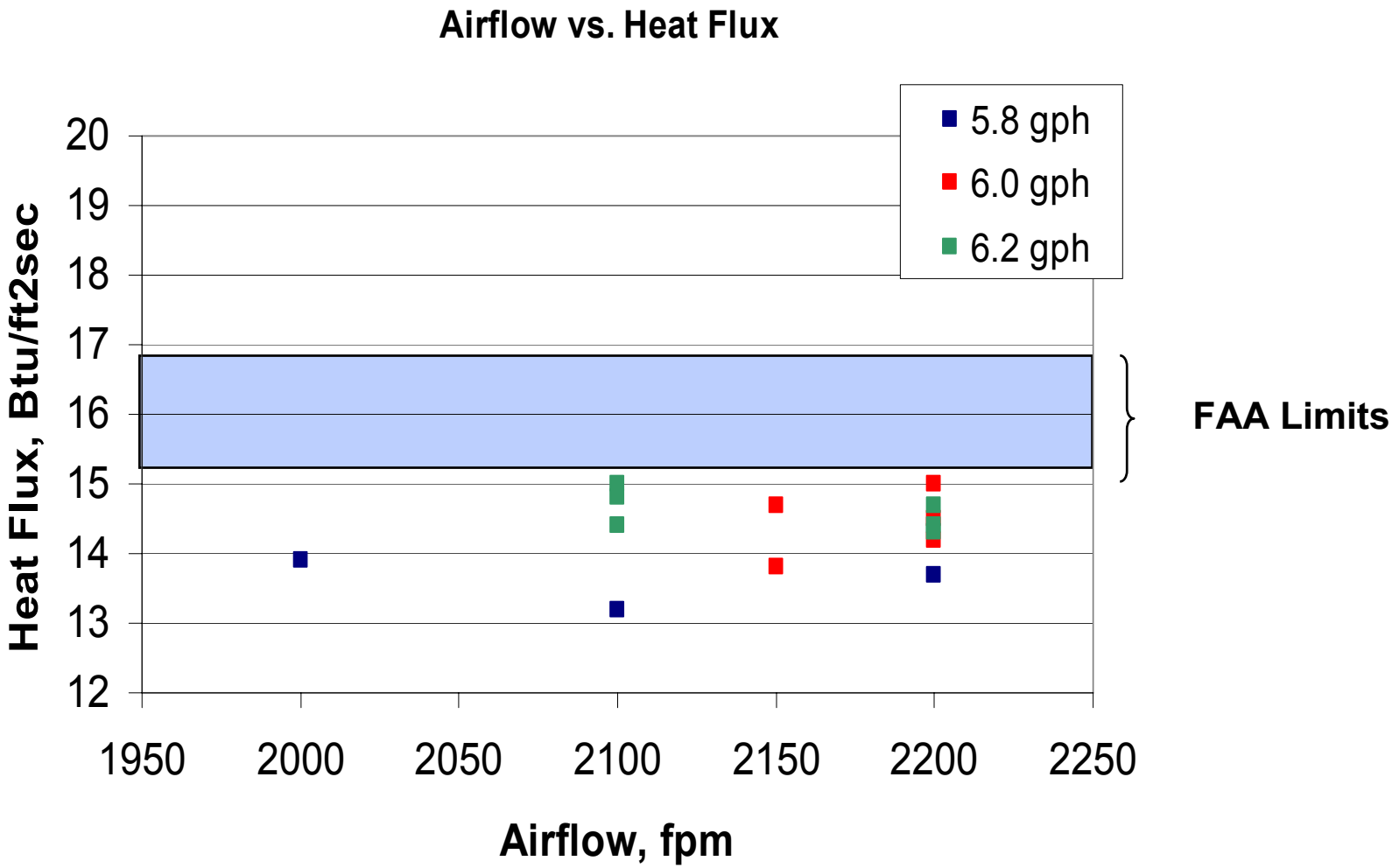
Airflow -- at Altitude



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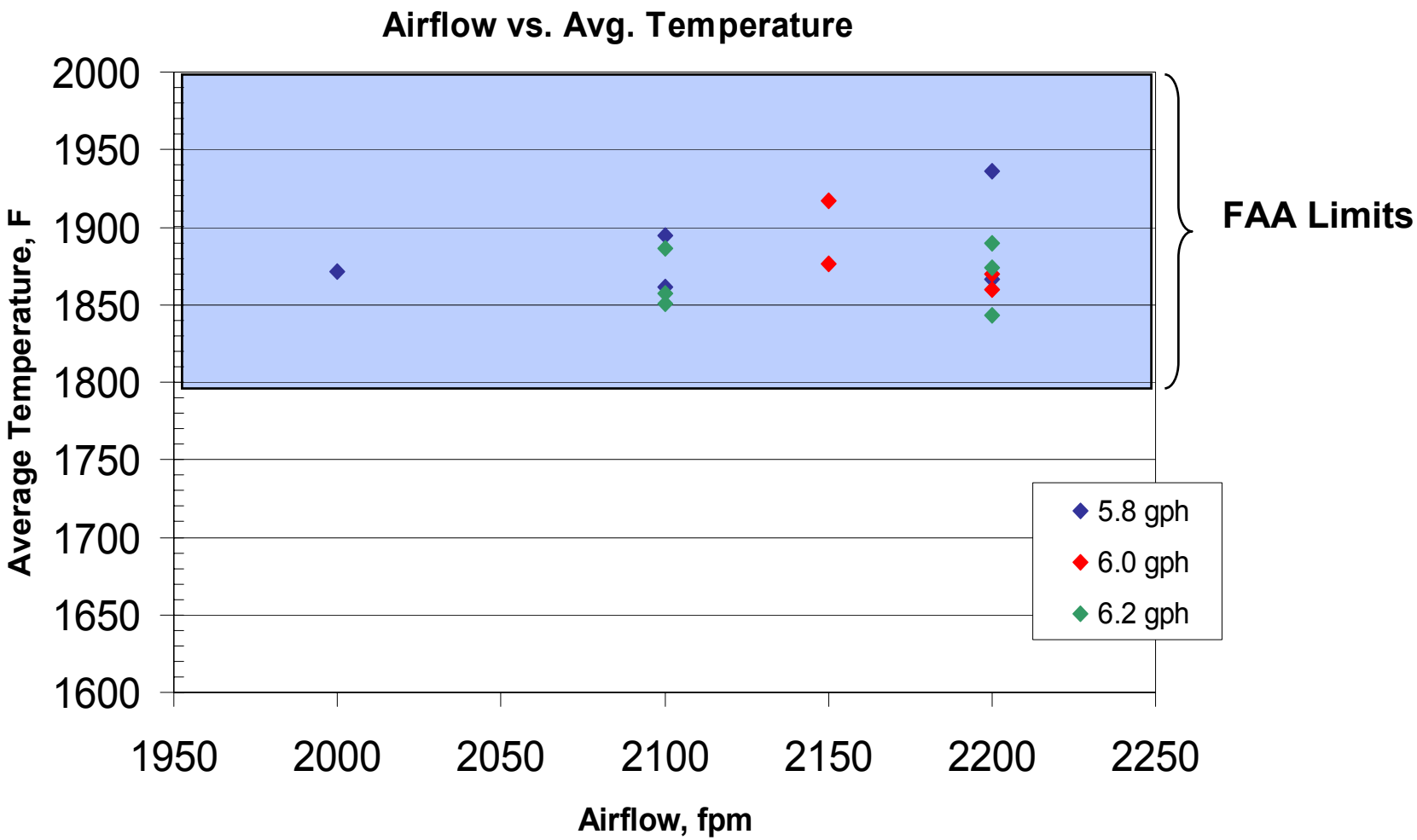
Airflow -- at Altitude



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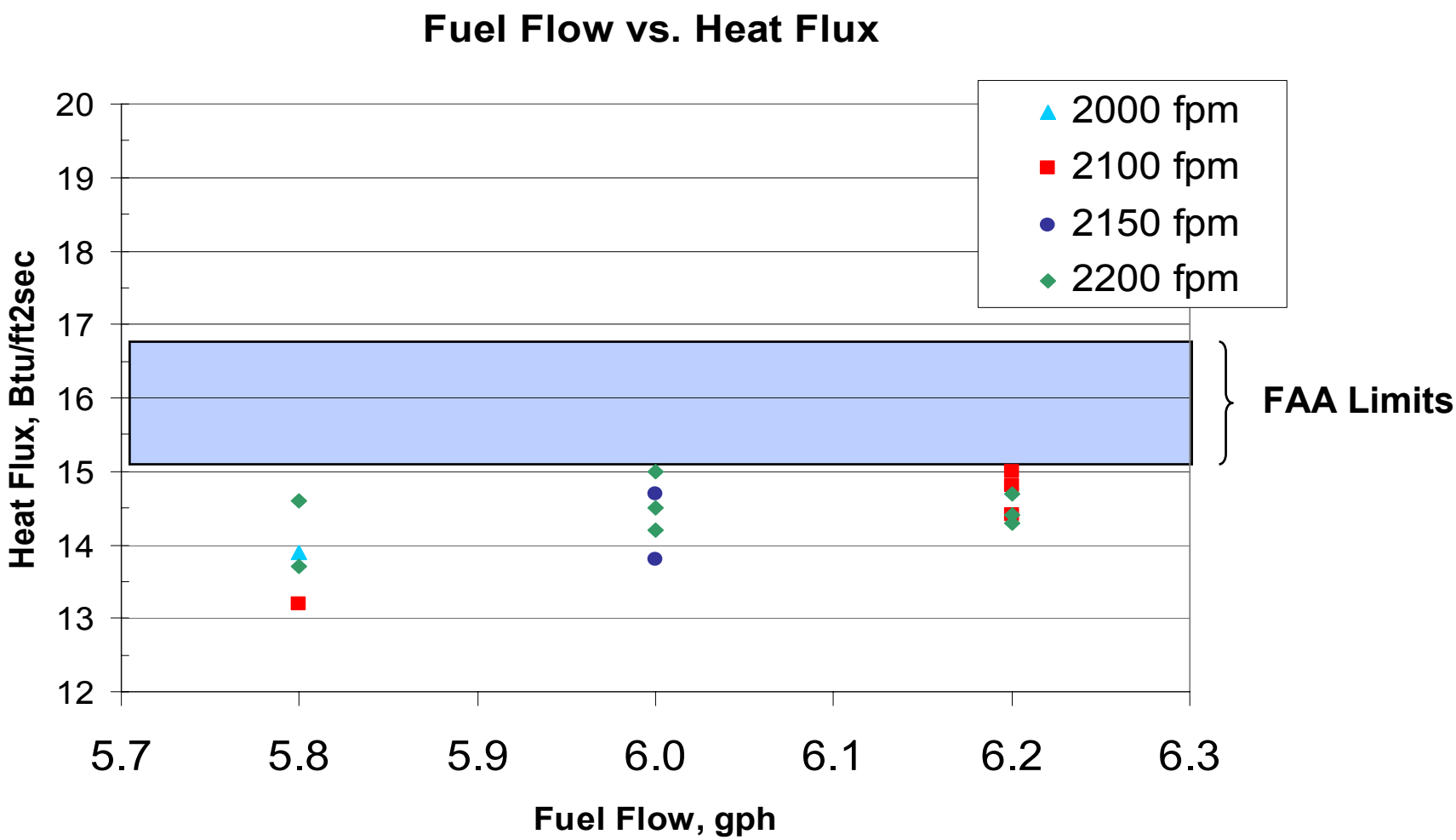
Fuel Flow -- at Altitude



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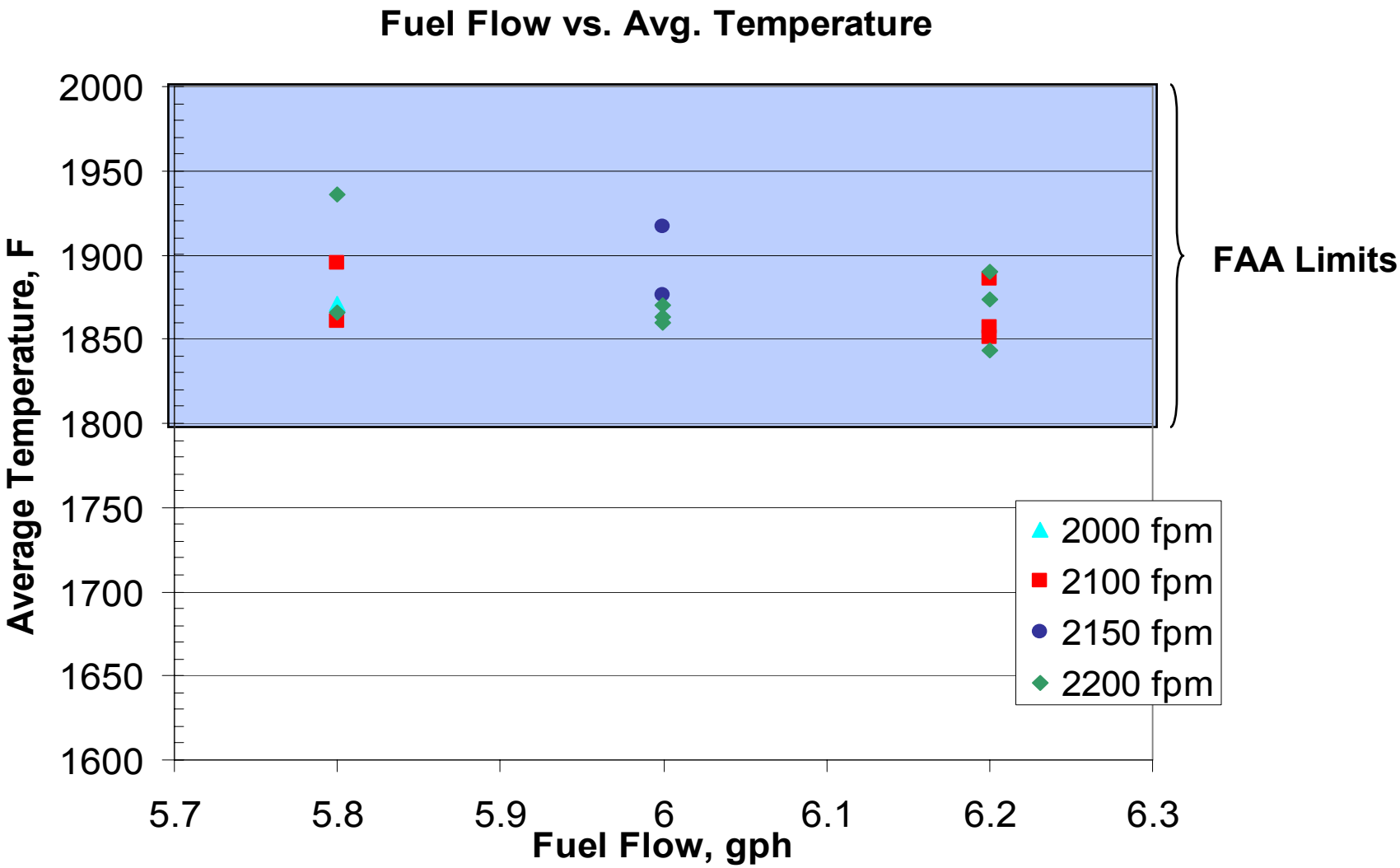
Fuel Flow -- at Altitude



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Calibration Analysis -- at Altitude

Airflow Increase:

- Mixed effect on heat flux
- Mixed effect on temperature

Fuel flow Increase:

- Increase in heat flux
- Decrease in temperature average

Tests at JMTC: 6.0 gph / 2200 fpm

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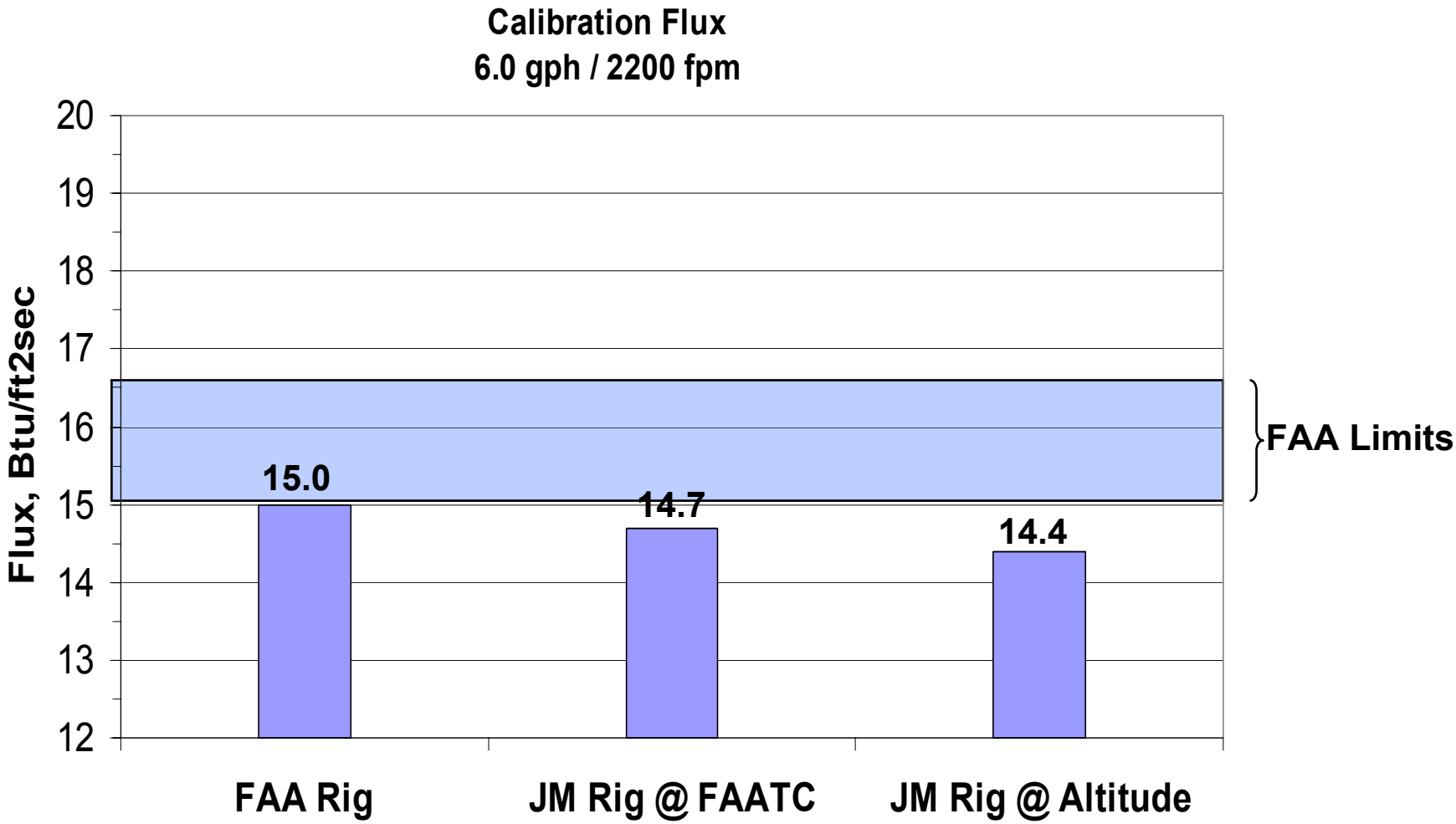
Calibration Comparison -- Flux



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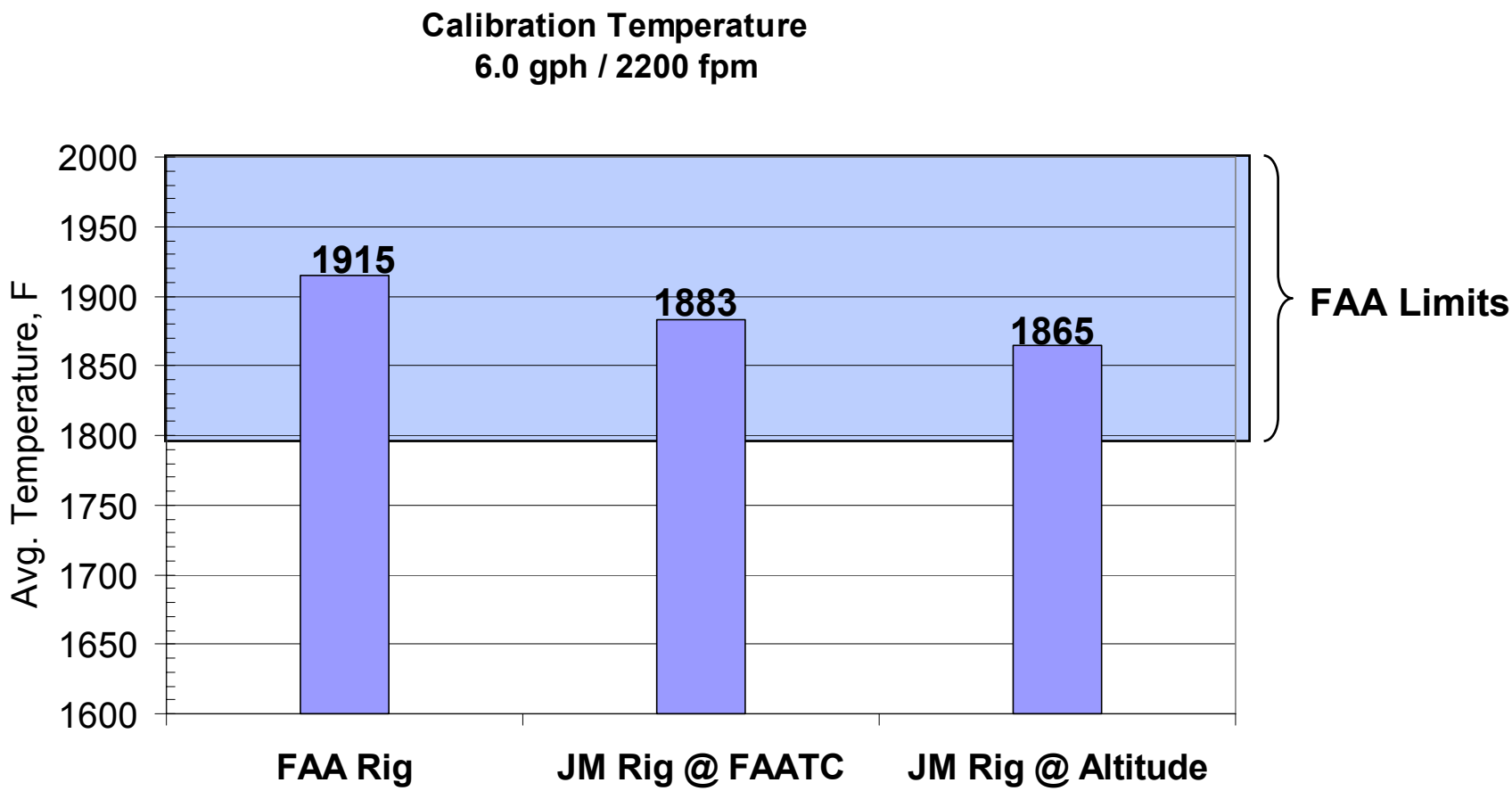
Calibration -- Temperature



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Sample Configurations

- Sample 1:
  - 2 layers 0.6pcf fiber glass in metallized pvf film
    - Expected burnthrough time: 30 to 40 seconds
- Sample 2:
  - 2 layers 0.42pcf fg w/ PAN felt barrier
    - Expected burnthrough time: 90 to 110 seconds
- Sample 3:
  - 2 layers 0.42pcf fg w/ ceramic mat barrier
    - Expected burnthrough time: None
- Sample 4:
  - 2 layers 0.42pcf fg w/ Aramid paper barrier
    - Expected burnthrough time: 120 - 210 seconds

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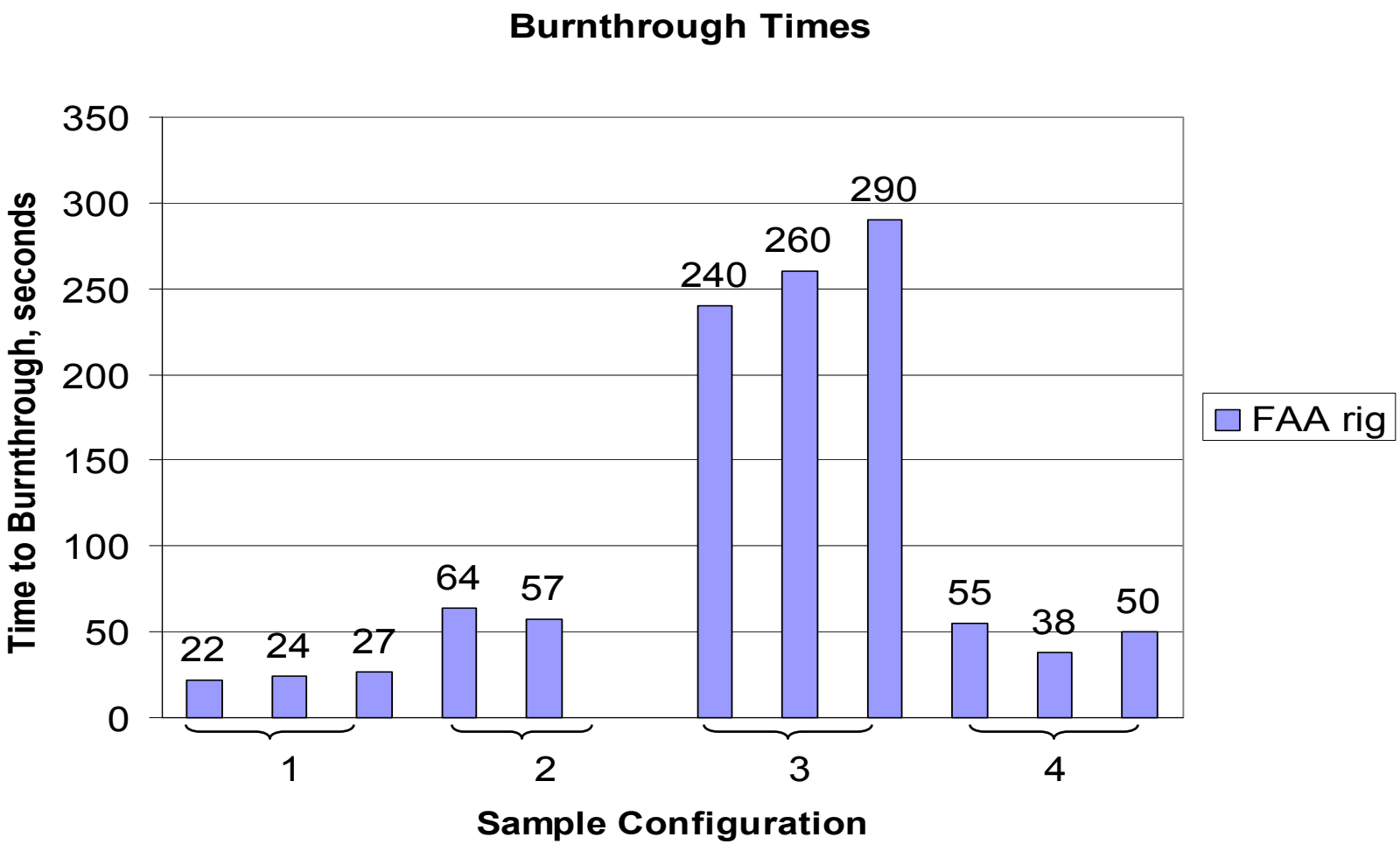
Burnthrough Results



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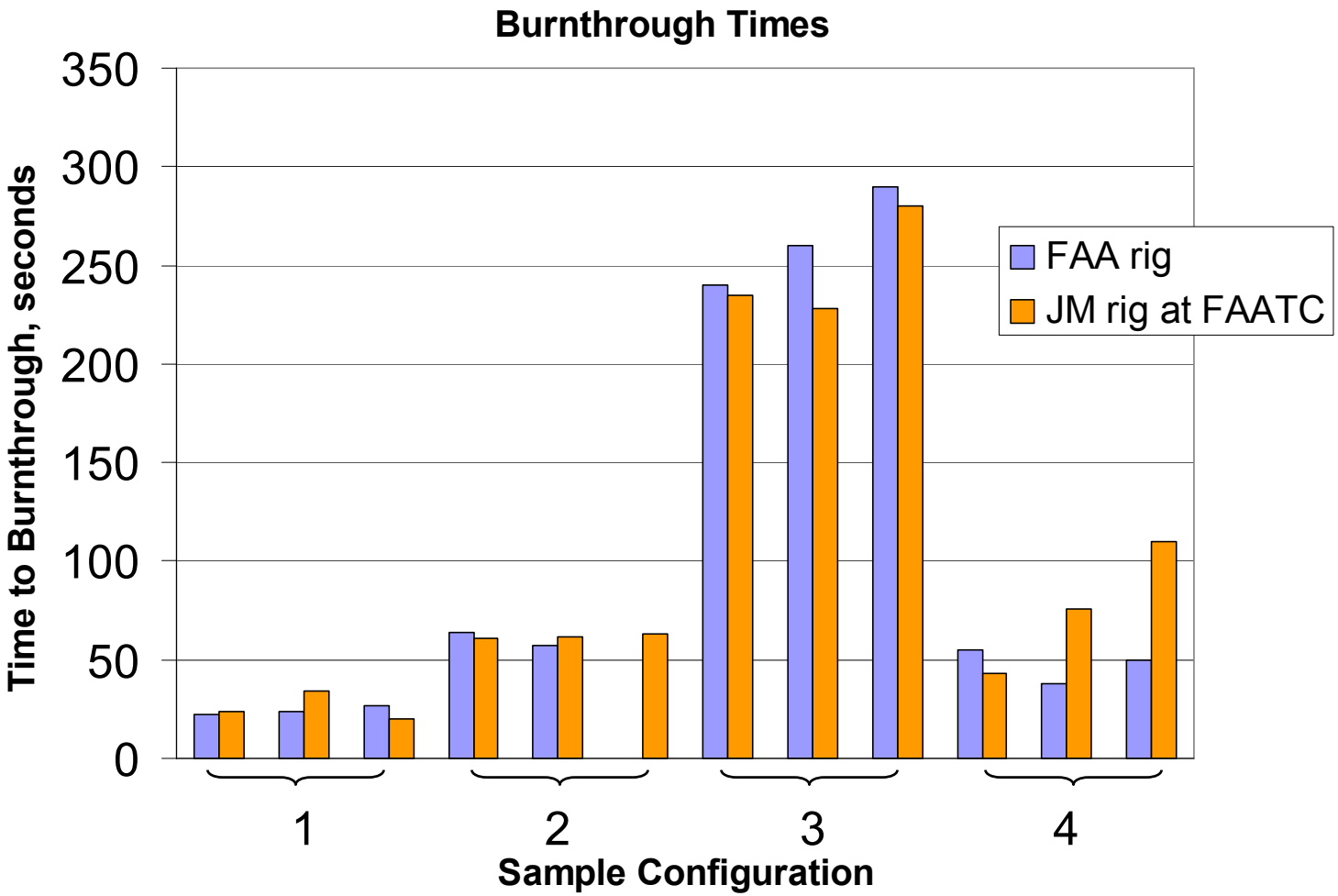
Burnthrough Results



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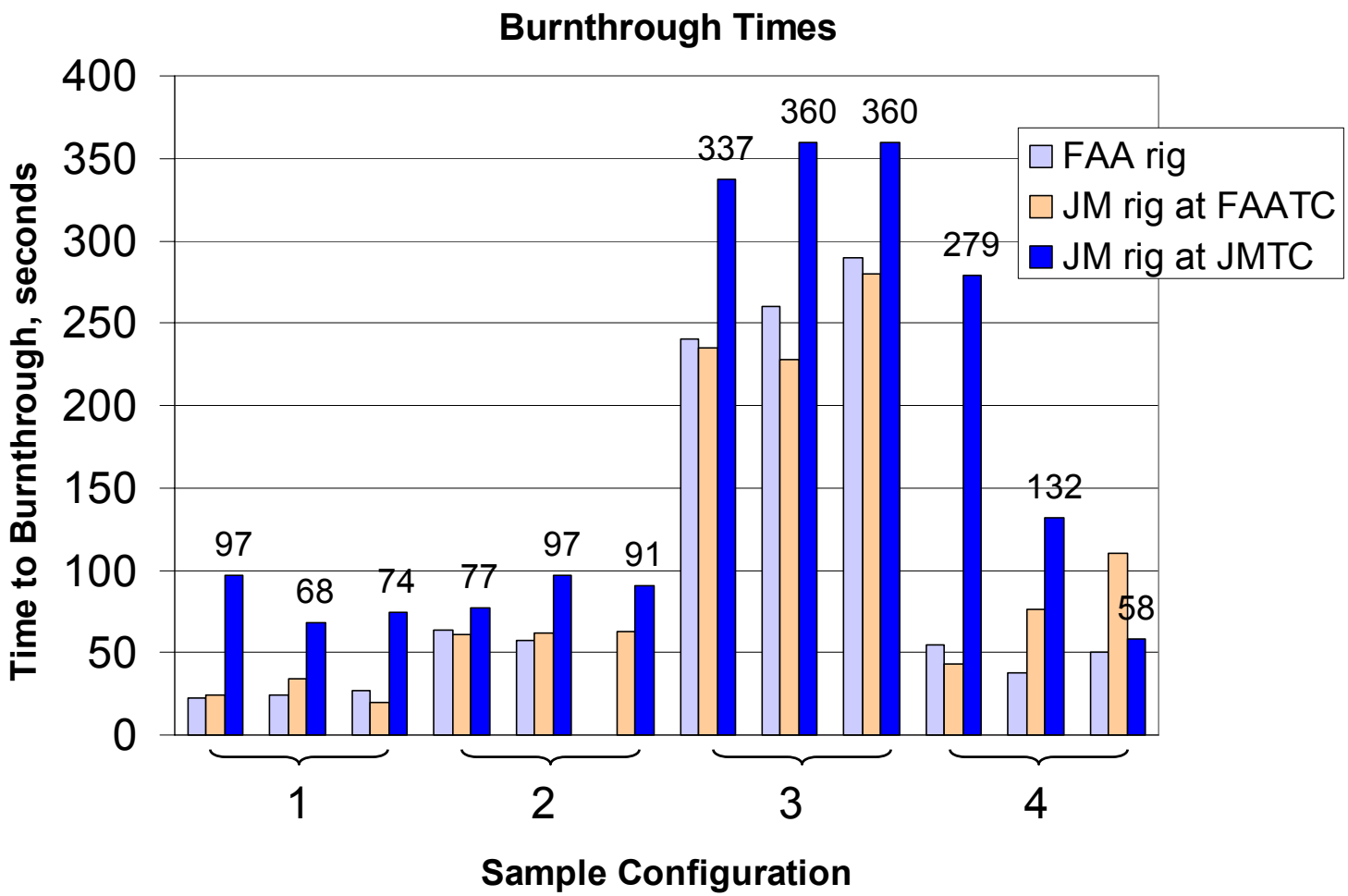
Burnthrough Results



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Effect of Altitude -- Conclusions

- Is there an Effect?

YES

- Is it reflected in heat flux or temperature measurements?

NO

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Effect of Altitude -- Recommendations

- New laboratories -- Round Robin correlation with the FAA, not just calibration measurements

- Johns Manville -- future testing at new location

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NPRM -- Burnthrough Developments

Responses to NPRM:

- "The purpose of this requirement is to better protect the passenger cabin from fire from burnthrough of a post-crash fuel-fed fire…"
- "... sidewall panels and ceiling panels…could be considered as part of the fire barrier."

  -- Aerospace Industries of America (AIA)

- "As a general remark, we consider that an "objective orientated" requirement should be preferred to a "design orientated" requirement."

  -- European Association of Aerospace Industries (AECMA)

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Trim Panel Burnthrough Evaluation

FAA Burnthrough Test:

- Modified test stand
  - -- stringers and center frame removed for closer flame impingement
  - -- flame 5-¾ inches from cold side calorimeter -- 6-¼ inches closer than current test set-up
  - -- “window” masking frame fabricated to accommodate smaller specimen size

- Calibration:
  - Heat Flux: 15.7 BTU/ft²sec
  - Avg. Temperature: 1935ºF
    - (Range 1922 to 1958ºF)

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Burnthrough Set-Up

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Control -- Standard 1/8-inch Trim Panel

2-sided phenolic / crushed honeycomb core

Burnthrough:
38 seconds

Panel Weight:
1040 g/m^3

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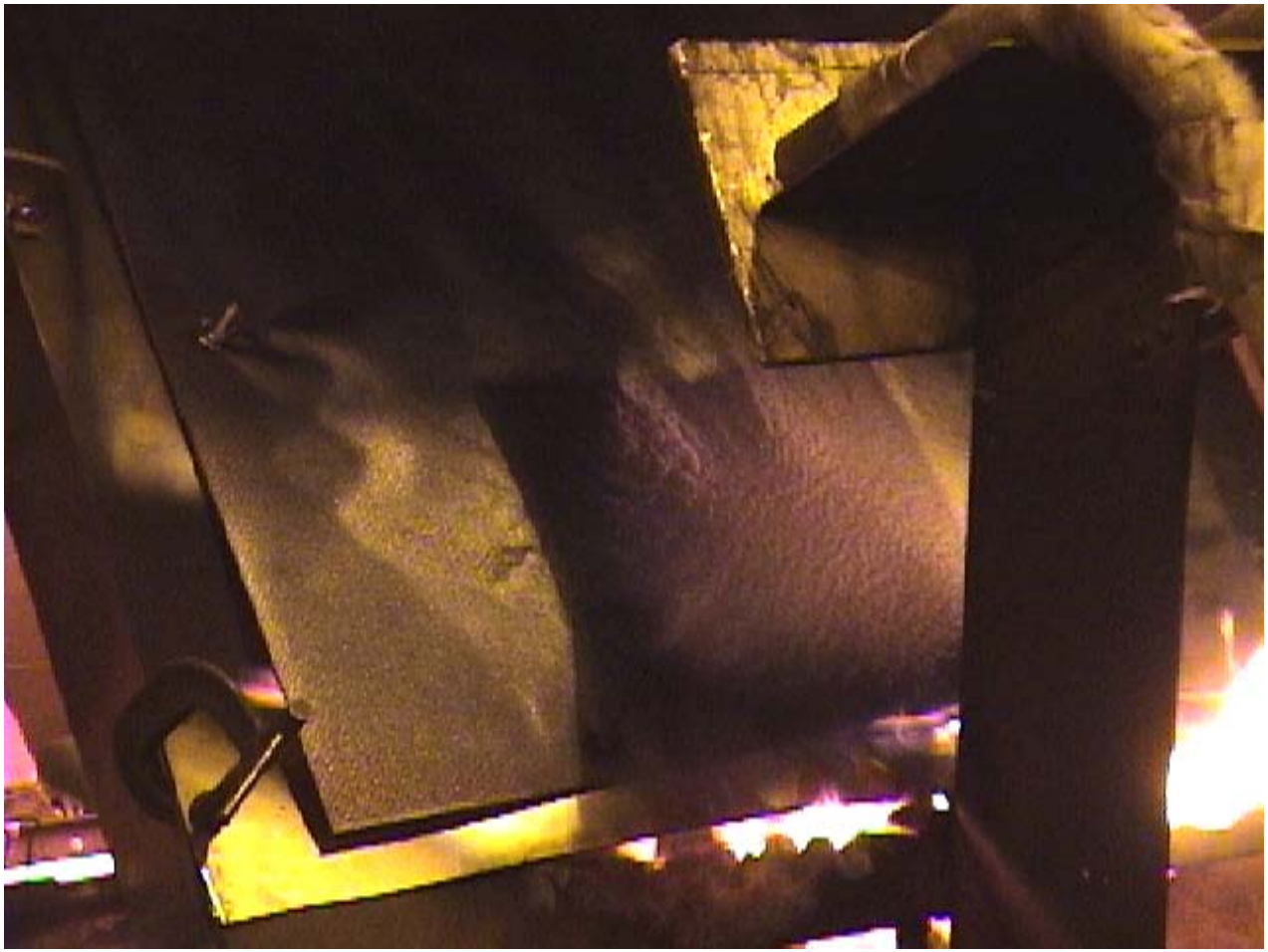
Single faced Maralon® Trim Panel



Test discontinued
6.5 minutes
No burnthrough
2.1 BTU/ft²sec
cold side flux

Panel Weight:
1040 g/m³

AkroFireguard Maralon® Type 102 Fireproof Panel
1/8-in. thickness / crushed honeycomb core

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Trim Panel Burnthrough Evaluation

Advantages:

- No weight penalty
- Attachments and joints may be easier to adapt
- Doesn't require acoustical re-design
- Technically feasible