International Aircraft Materials Fire Test Forum Meeting

Sonic Oil Burner Testing
&
Sonic Burner Video Update

Presented to: International Aircraft Materials Fire Test Working Group

By: Tim Salter, FAA Technical Center

Date: October 29-30, 2018, Atlantic City, NJ

Federal Aviation Administration

Presentation Outline

- **Cargo Liner Test Air Shroud Development**
  - Initial concept and shroud design
  - Refined design and test results
  - Round robin interlab study plans
- **Sonic Seat Cushion Air Shroud Study**
  - Shroud design and test results
  - Round robin interlab study plans
- **Sonic Burner Video Update**
  - Assembly and Operation of the Sonic Burner

Sonic Burner Cargo Liner Test: Air Shroud Development and Round Robin Study

Shroud Study Background

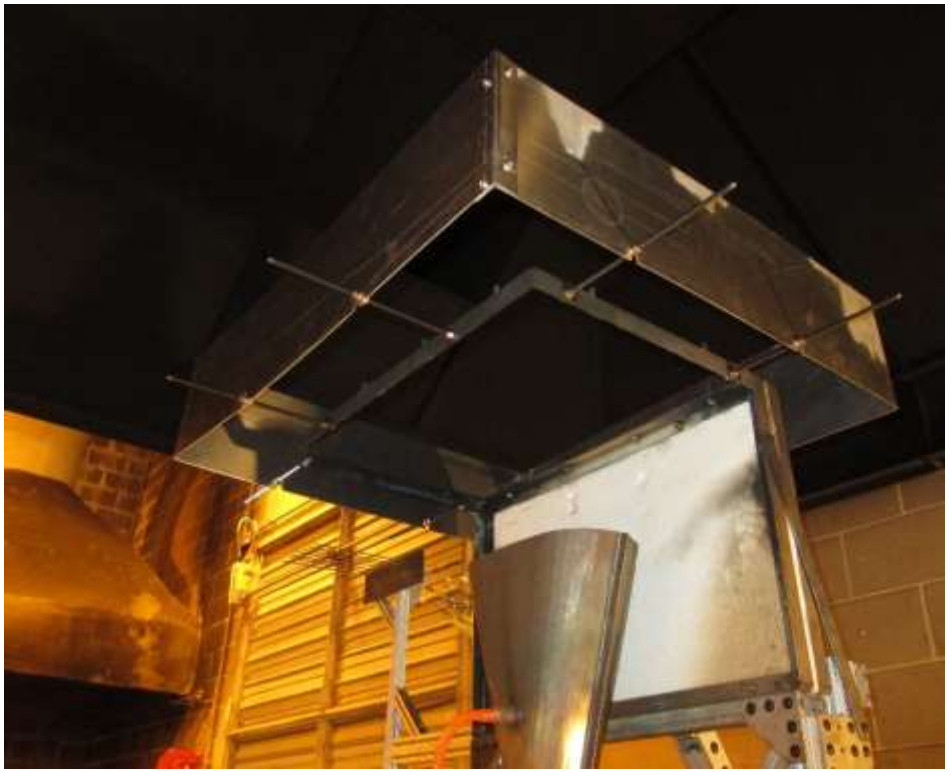
- **What is the purpose of the study?**
  - Reduce test result disparities among burn labs
- **How are we trying to address this issue?**
  - Design an air shroud which will surround the test sample and minimize the influence of airflow on sample thermocouple temperature measurements
- **What is the anticipated outcome?**
  - Incorporate the shroud into the cargo liner test method which will increase test result repeatability and reproducibility among burn labs

Shroud Concept #1

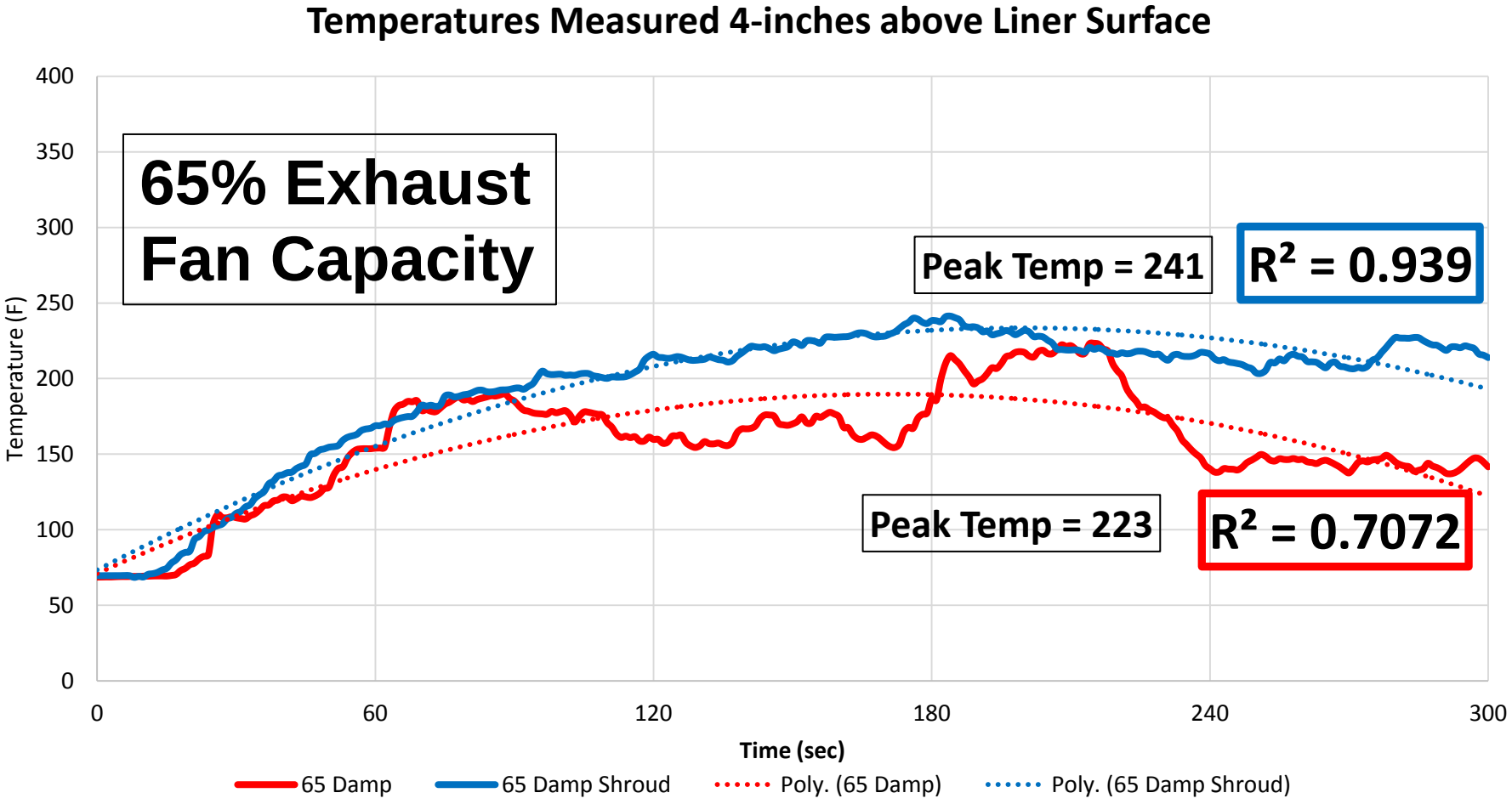
- **Design**
  - 18-gage aluminum sheet
  - Mounted on upper test frame
  - Four sides closed to block horizontal airflow
  - Open top to allow venting of combustion byproducts
- **Test Results**
  - Peak TC temperature readings increased to near failure of point of 400°F
  - Insufficient airflow to allow smoke and hot air to escape
  - Reradiated heat from sidewalls

Shroud Concept #2

- **Design**
  - 16-gage aluminum sheet
  - Mounted with threaded rod
  - 5-inch gap around sample frame
  - Increased ventilation
  - Reduced reradiated heat from shroud to thermocouple
- **Test Results**
  - Peak TC temperature readings reduced from previous design but still higher compared to tests performed with no shroud
  - Less fluctuation in temperature measurements with shroud



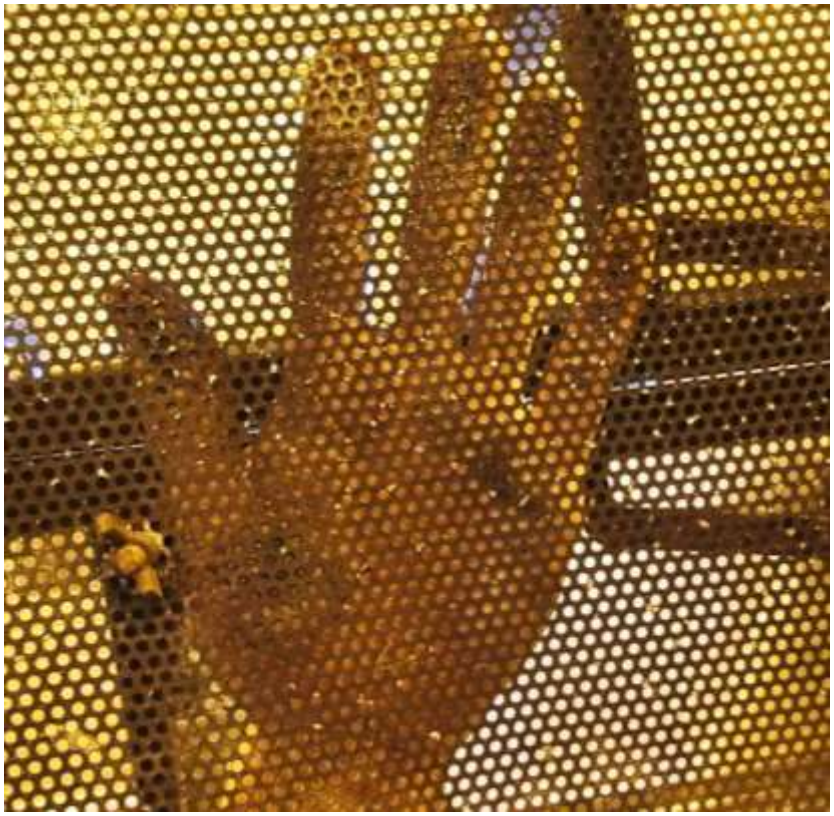
Example of Shrouded and Unshrouded Cargo Liner Sample Test Results



Shroud Concept #3

- **Design**
  - 18-gage perforated aluminum
  - Mounted with threaded rod
  - 5-inch gap around sample frame
  - Taller sidewall to shroud burner flame and liner sample
  - Improved ventilation
  - Reduced reradiated heat
- **Test Results**
  - Minimal temperature fluctuation
  - Measured peak temperatures equivalent to unshrouded tests

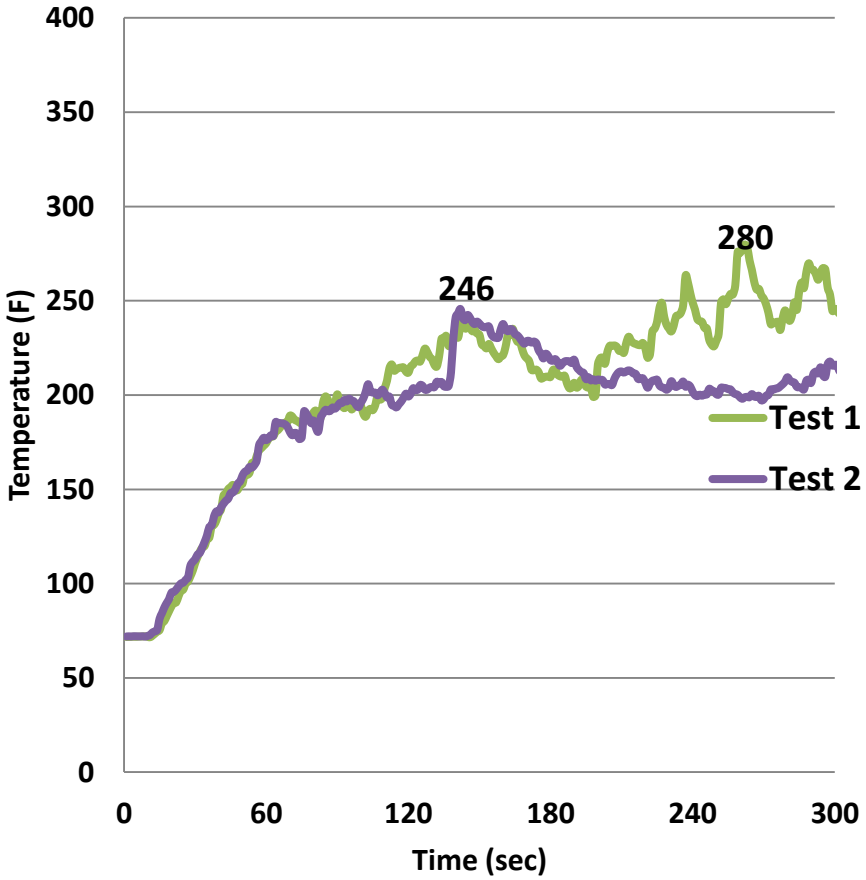
Shroud Concept #3



Shroud Concept #3 Testing

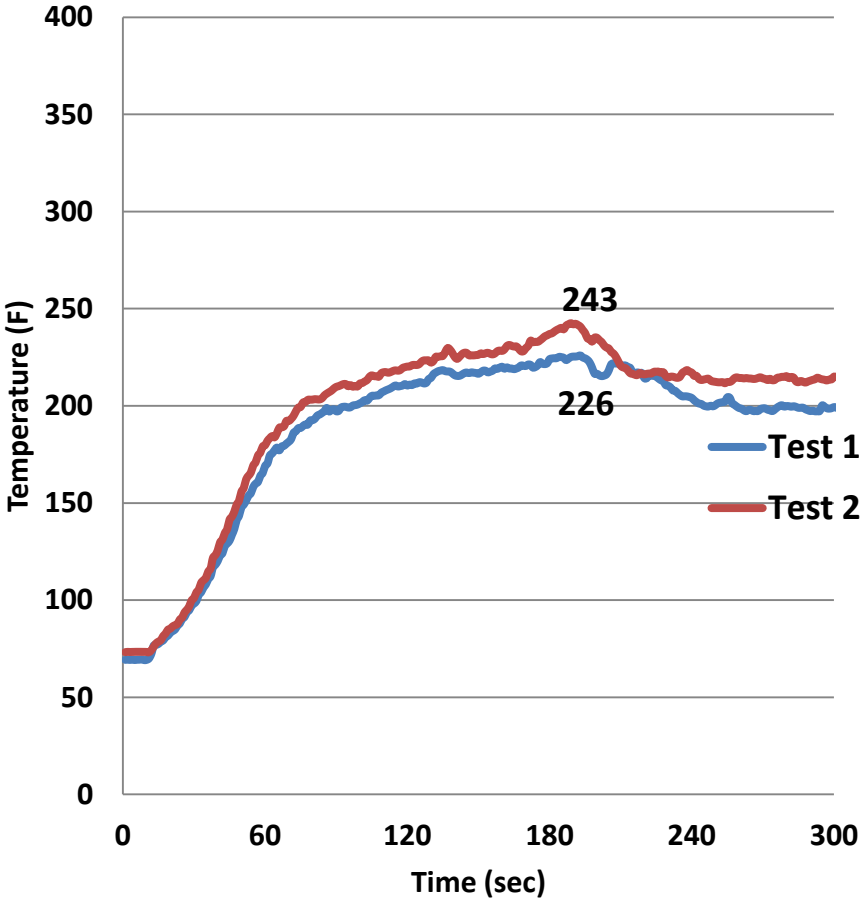
Temperatures Measured 4-Inches above Cargo Liner Samples

- NO SHROUD -

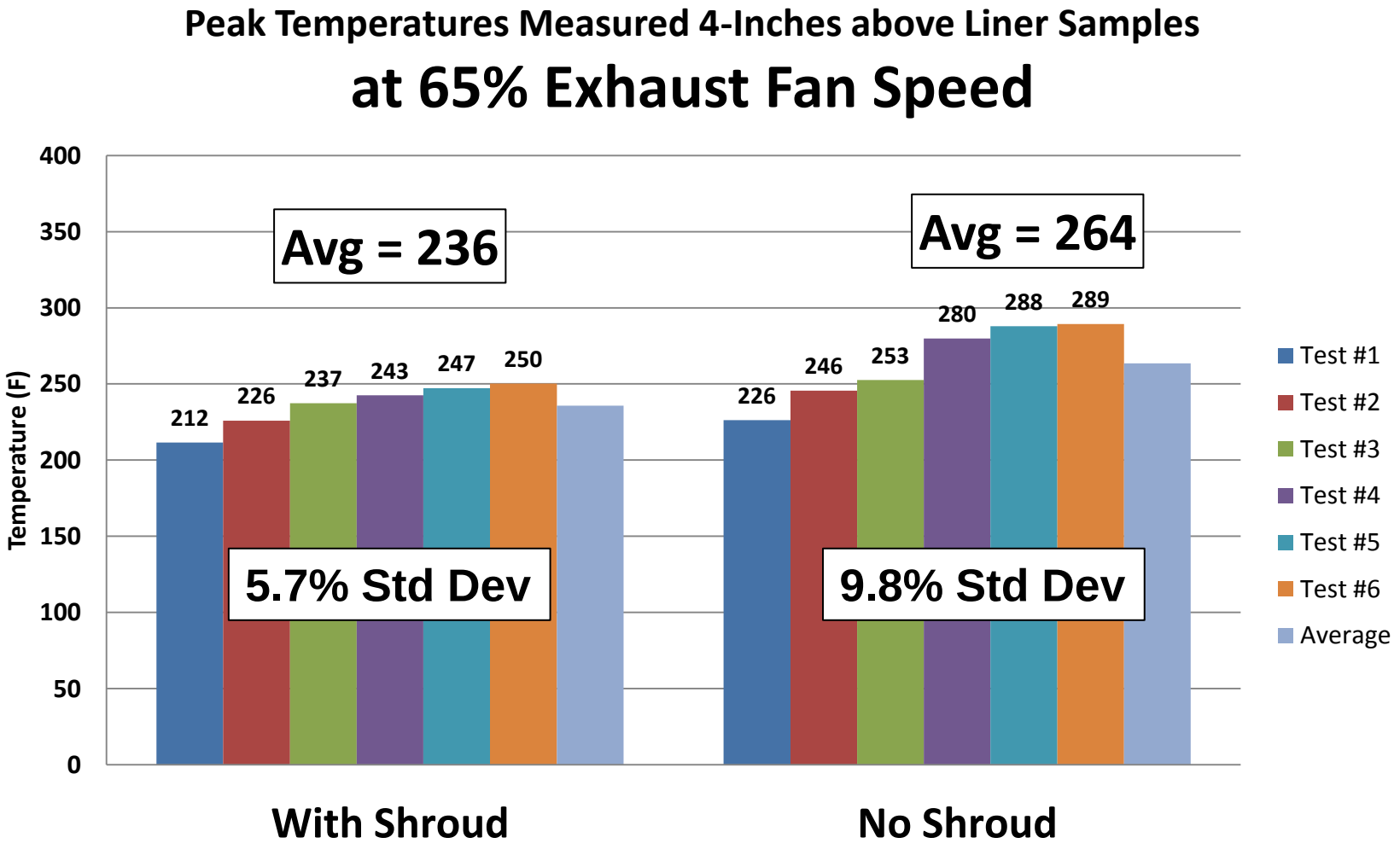


Temperatures Measured 4-Inches above Cargo Liner Samples

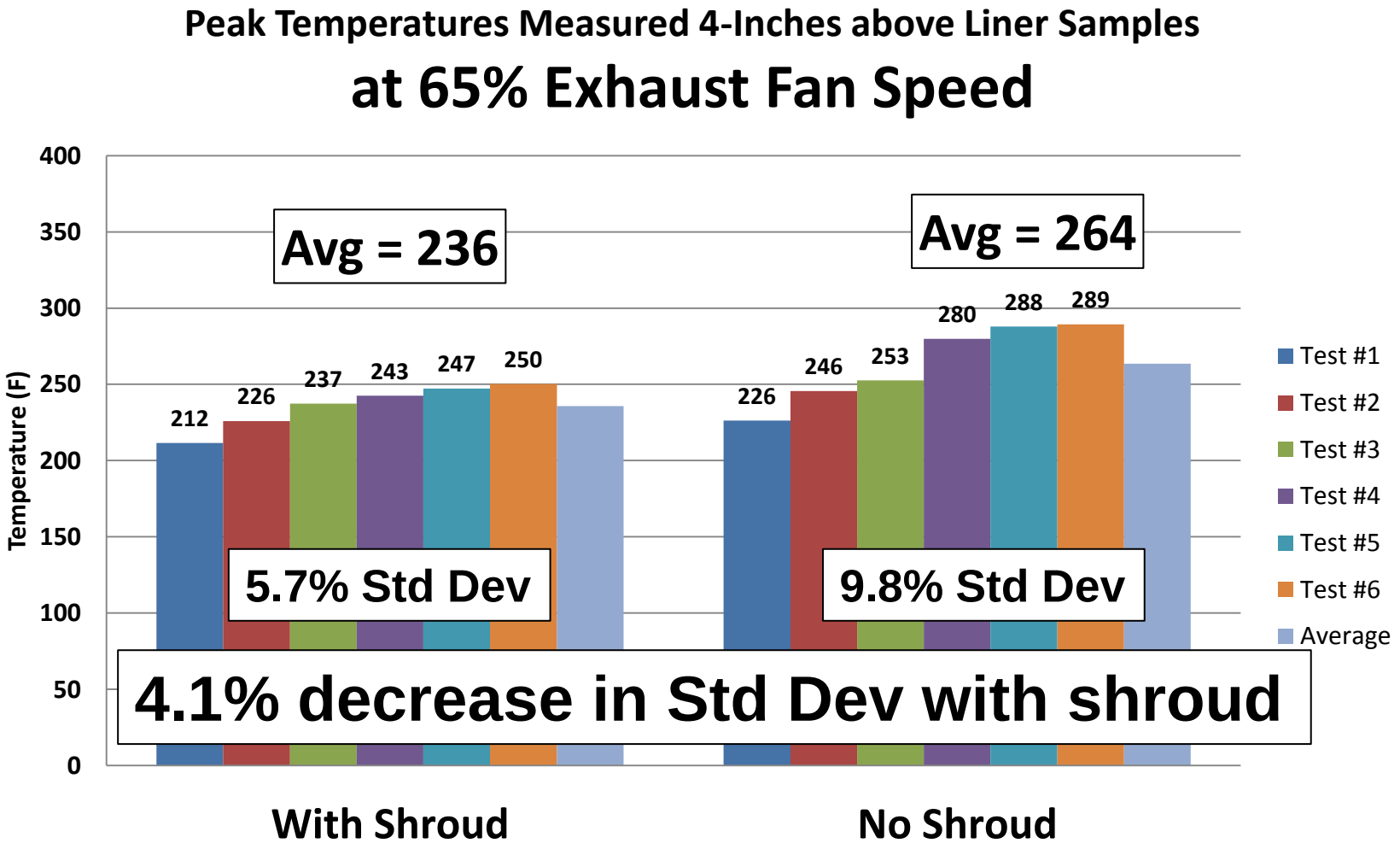
- WITH SHROUD -



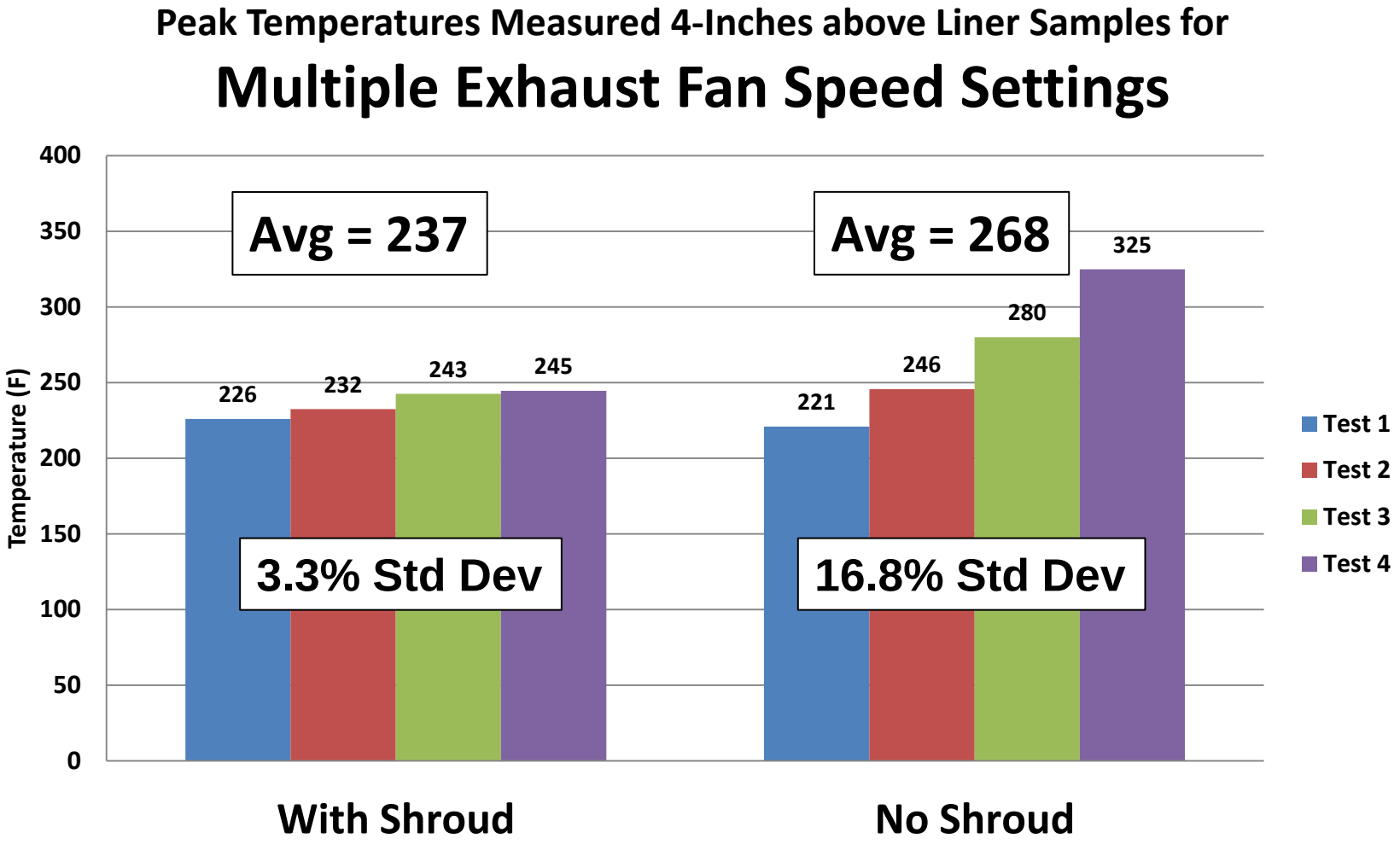
Shroud Concept #3 Testing



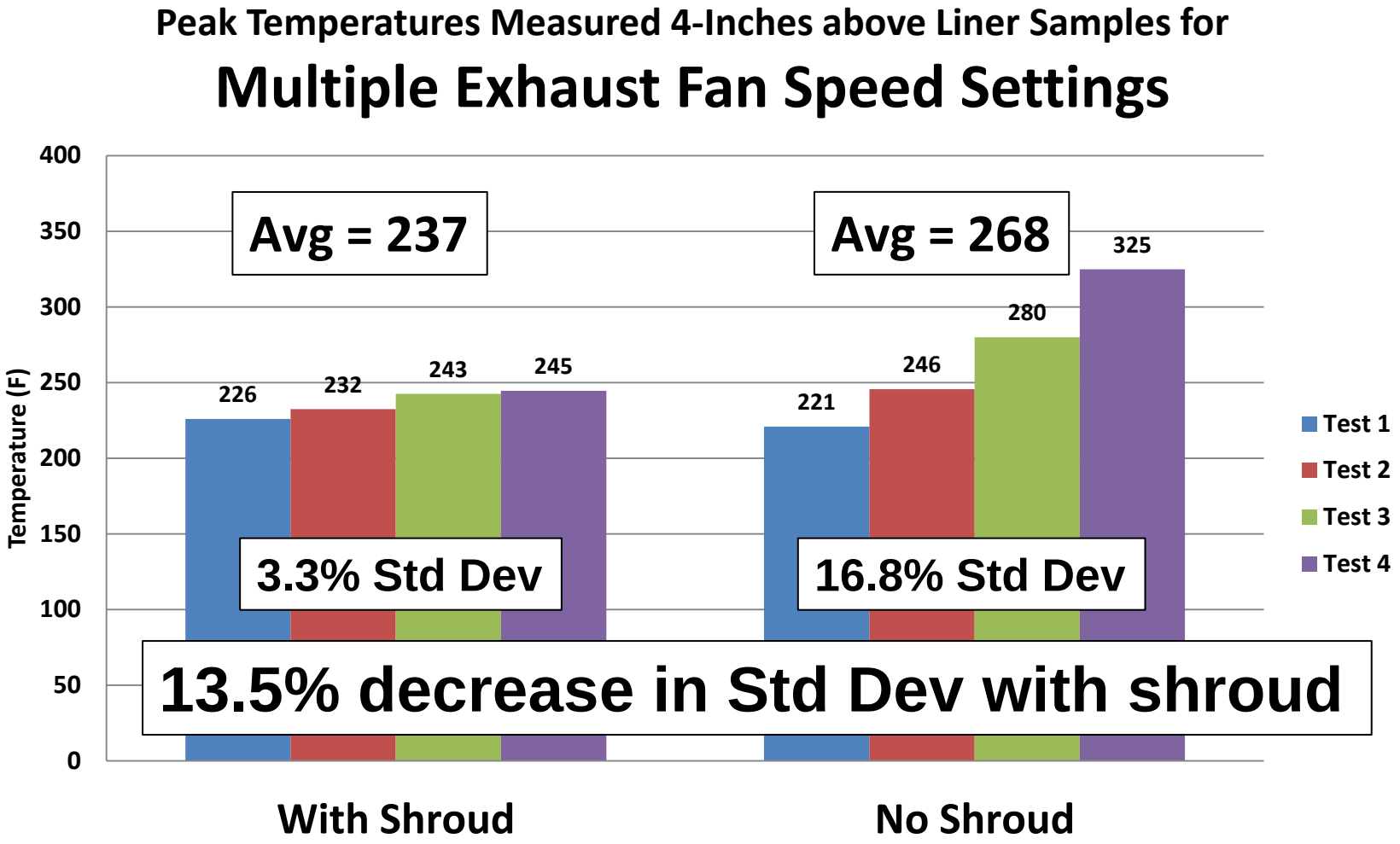
Shroud Concept #3 Testing



Shroud Concept #3 Testing



Shroud Concept #3 Testing



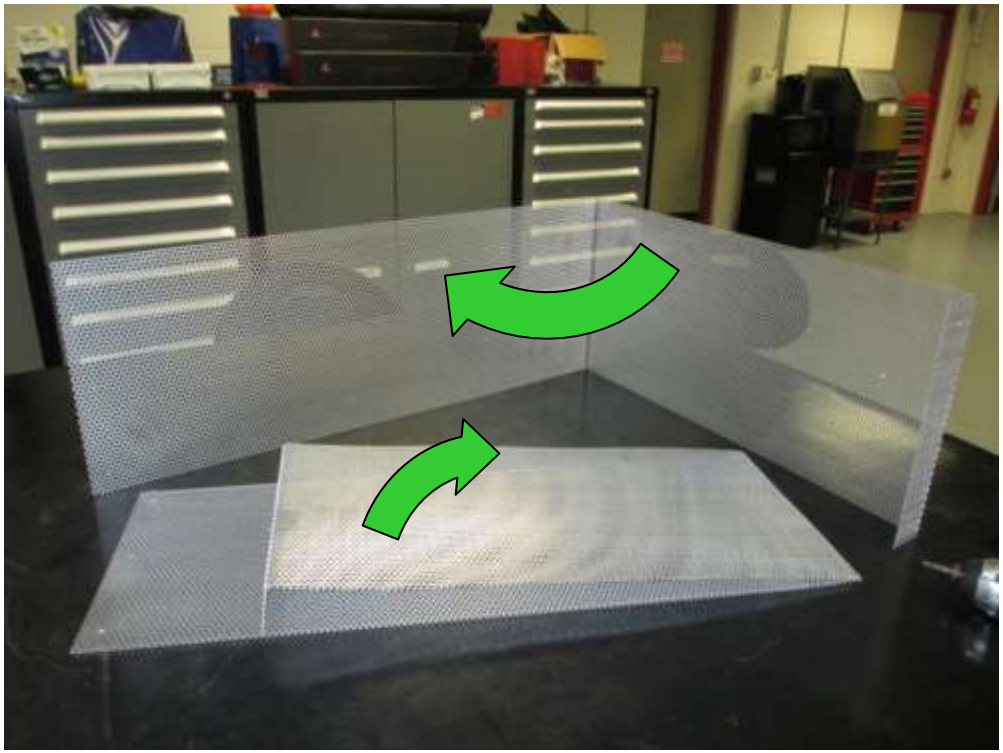
Cargo Shroud Round Robin Study

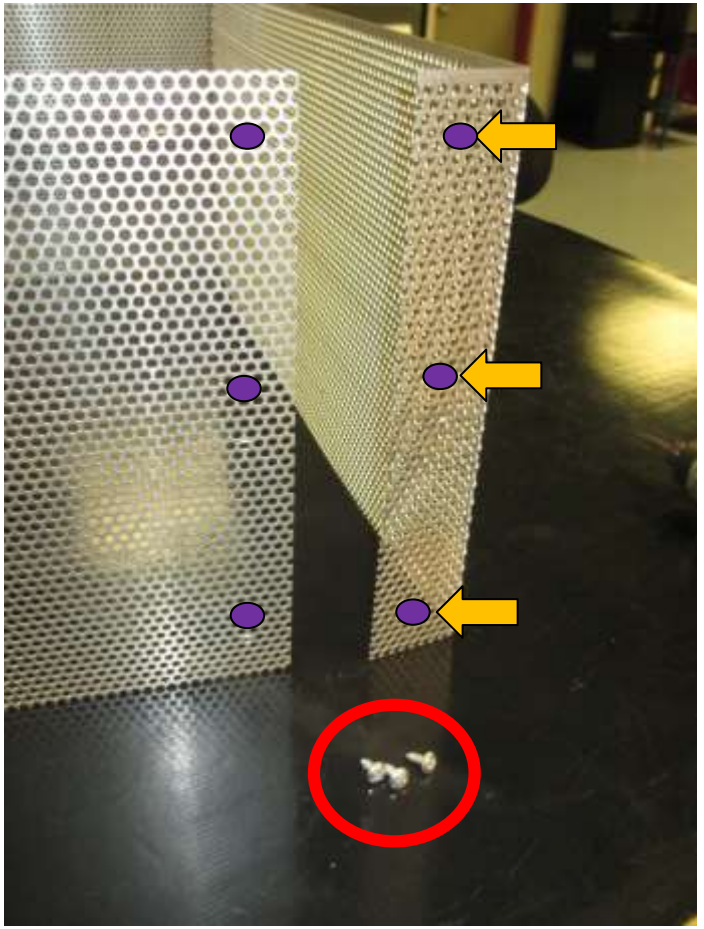
- **Test shroud in different lab environments to demonstrate shroud effectiveness**
  - No two burn labs are the same
    - Size and shape of test area
    - Proximity of walls or partitions to burner
    - Airflow at sample position
  - Unique test environments produce unique results
    - Demonstrated in previous round robin studies
  - Shroud reduces the influence of these factors
    - Serves as a standardized “miniature test cell” around sample
  - Improved test result repeatability and reproducibility

Cargo Shroud Round Robin Study

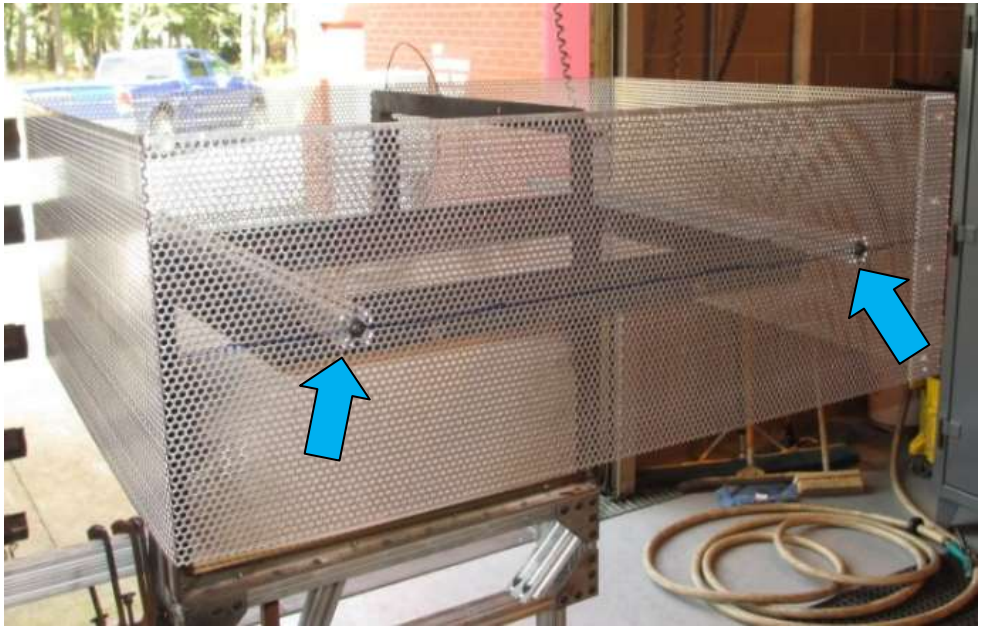
- **TEST BURNER**
  - Study to be performed using the Sonic burner
    - Configured as described in Chapter 8 of the FTH
  - Undecided to include legacy-type burners
    - Due to unique configurations
- **SHROUD**
  - Shipped in pieces for packaging purposes
    - Minor assembly required (may be able to ship complete)
  - Rests on top of ceiling panel mounting frame
    - No modifications to test frame are required
- **SAMPLES**
  - 10 epoxy resin infused liner samples
    - 5 samples to be tested **with** the shroud
    - 5 samples to be tested **without** the shroud
  - Sample tested in ceiling panel position only
    - Fire resistant board used in place of wall panel

Cargo Shroud Round Robin Study



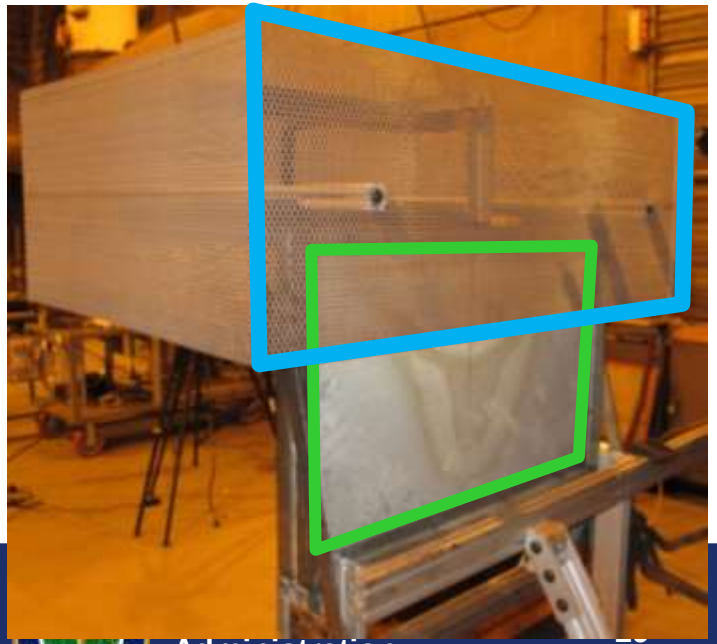


Cargo Shroud Round Robin Study



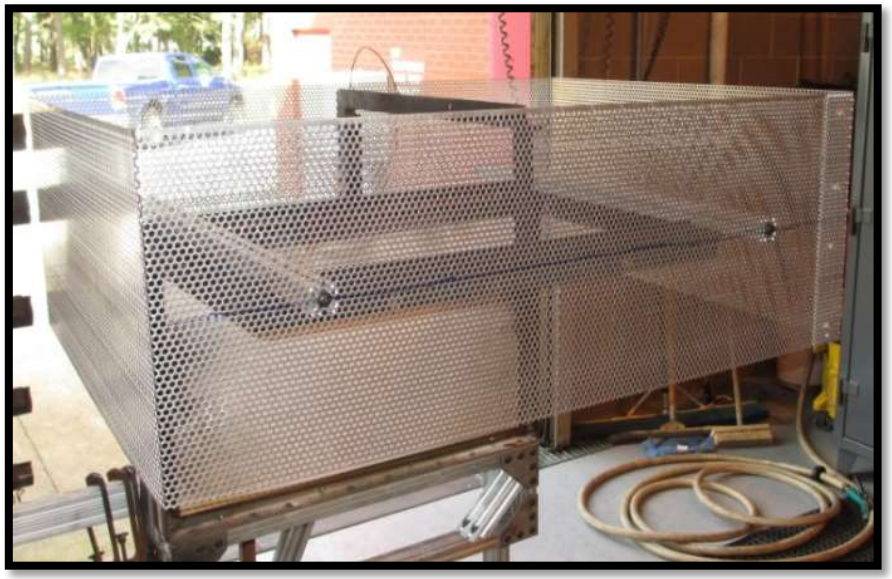
Cargo Shroud Round Robin Study

- **Anticipated outcome of round robin study**
  - May incorporate shroud into cargo liner test method
    - Based on round robin study test results
    - Feedback from working group members
- **Items to address prior to addition of shroud**
  - Update and improve shroud design
    - Eliminate possibility of dislodgement
    - Simplify sample replacement procedure
    - Prevent interference with clamping fixtures
  - Issues found during round robin
    - Based on feedback from participating labs



Sonic Burner Seat Cushion Test: Air Shroud Development and Round Robin Study

Seat Cushion Shroud Testing



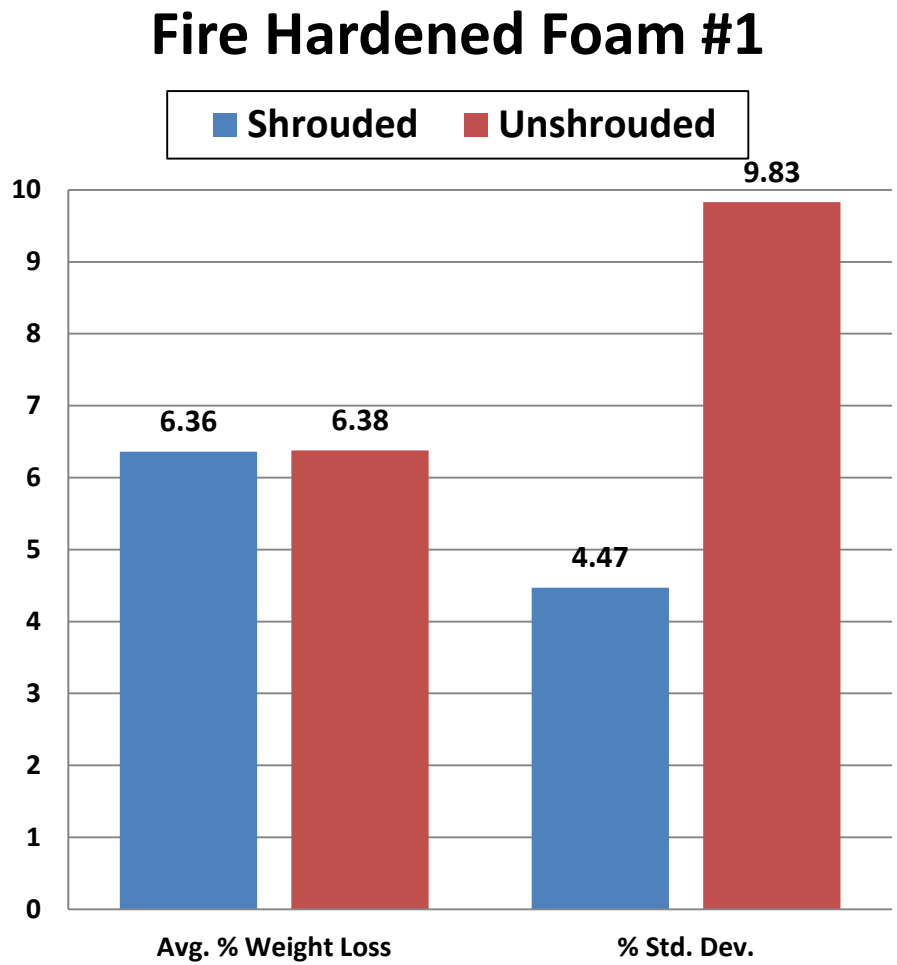
Seat Cushion Shroud Testing

- **Next step for shroud development**
  - Adapt shroud concept to seat test method
- **Same purpose as cargo shroud**
  - Reduce influence of airflow at sample
    - Affects sample burning
- **Modified cargo shroud design**
  - Perforated aluminum
  - Shrouded on three sides
  - Open on flame side
  - Does not interfere with sample mounting
  - Mounted to seat frame with threaded rods

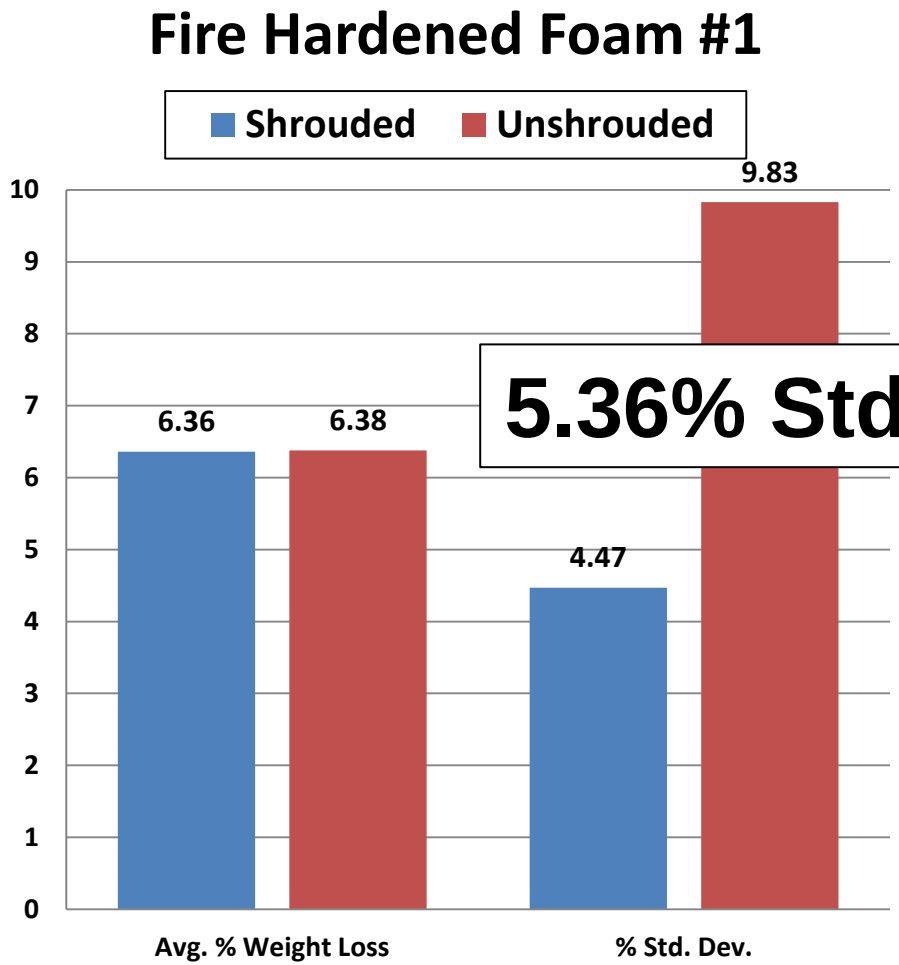
Seat Cushion Shroud Testing

- **FAATC seat shroud study**
  - Shrouded vs. unshrouded samples
    - Evaluate shroud effectiveness
- **Sample construction**
  - 2 foam types
    - Both fire hardened
    - Same dress covers
- **Sample number**
  - 3 samples per set
    - 1 set tested with shroud
    - 1 set tested without shroud

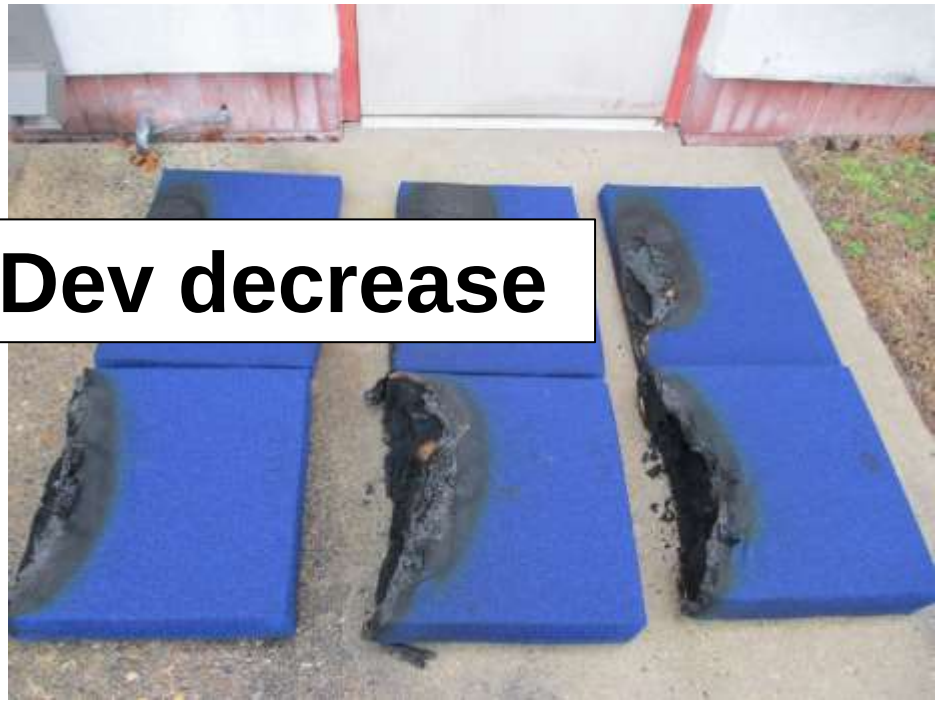
Seat Test Shroud Testing



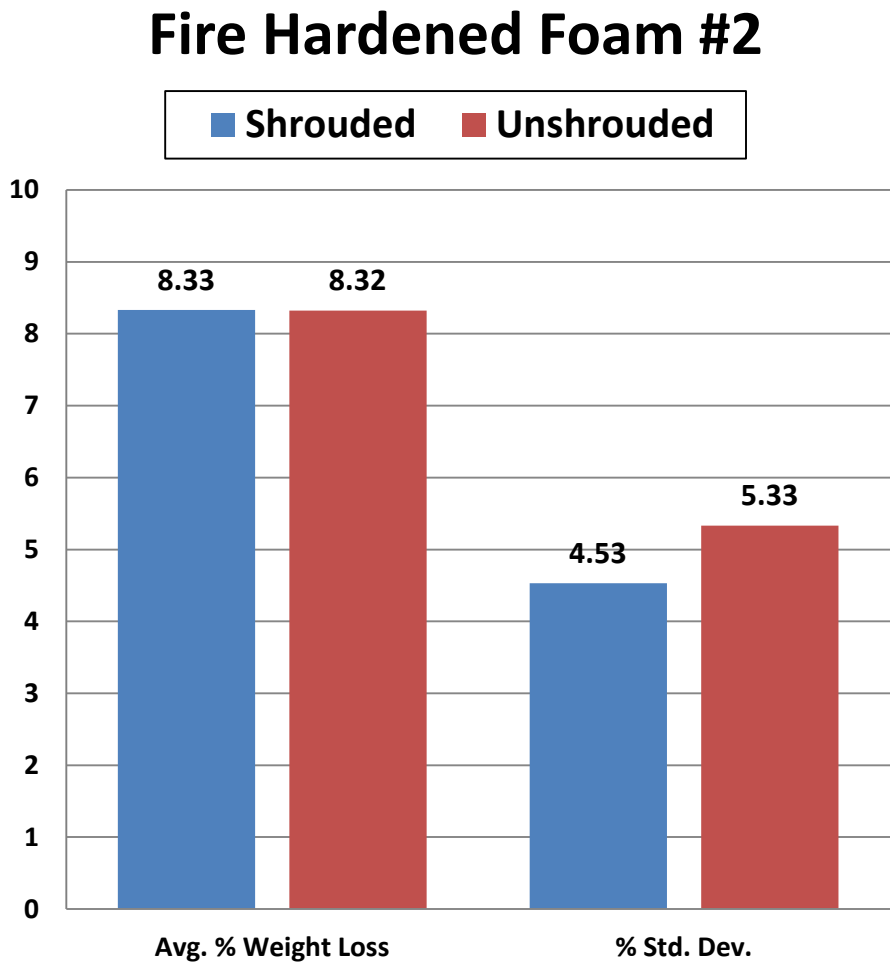
Seat Test Shroud Testing



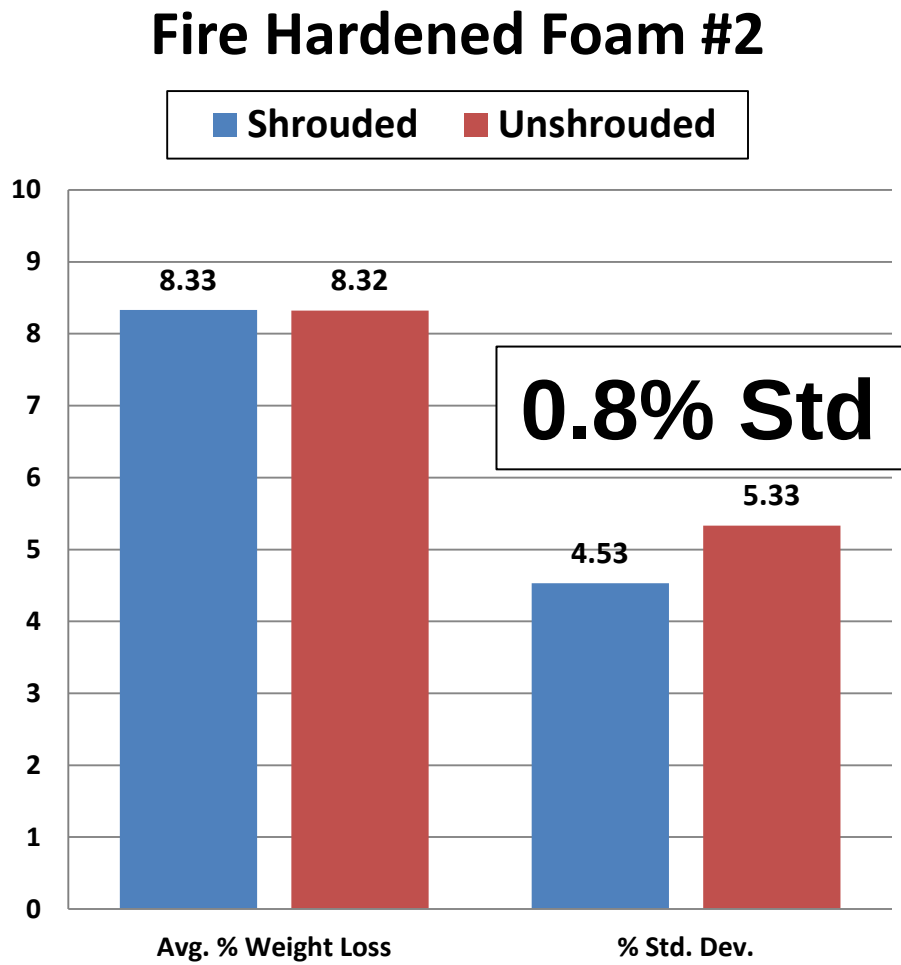
5.36% Std Dev decrease



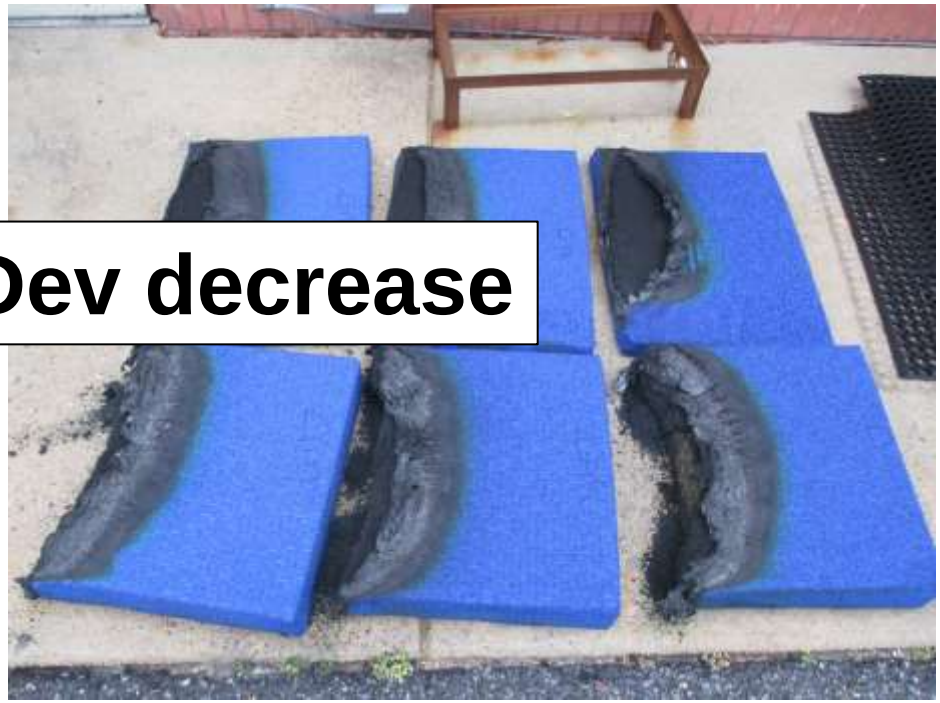
Seat Test Shroud Testing



Seat Test Shroud Testing



0.8% Std Dev decrease



Seat Shroud Round Robin Study

- **TEST BURNER**
  - Study to be performed using the Sonic burner
    - Configuration in Chapter 7 of the FTH
  - Undecided to include legacy-type burners
    - Due to unique configurations
- **SHROUD**
  - Shipped in pieces for packaging purposes
    - Minor assembly likely required
  - Method of mounting to be determined
    - No modifications to test frame will be required
- **SAMPLES**
  - To be determined
    - Current supply of samples insufficient for study

Sonic Burner Assembly and Operation Instructional Video

Sonic Burner Video Update

- **A first cut of the video has been completed**
- **Addresses topics not previously documented**
  - Burner assembly, setup, flame validation thermocouples, etc.
- **Viewing planned for seat task group meeting**
  - Approximately 45 minute run time
- **Looking for feedback from audience**
  - To be added to final video
- **Final cut to be released following this meeting**
  - Video will be posted on Fire Safety website

https://www.fire.tc.faa.gov

Planned Research and Work

Planned Research and Work

- **Cargo liner shroud round robin**
  - Conduct round robin study using perforated shroud
  - Looking for labs to participate
- **Seat cushion shroud round robin**
  - Conduct round robin study using perforated shroud
  - Looking for labs to participate
- **Publish Sonic burner video**
  - Post video to Fire Safety website
- **Additional items from task group meetings**
  - Based on task group meeting discussion
- **New POC for Powerplant burner test**

Questions?

timothy.salter@faa.gov

(1)-609-485-6952