

International Aircraft Materials Fire Test Working Group Meeting Cargo Test Airflow Study & Seat Test Update

Presented to: International Aircraft Materials
Fire Test Working Group

By: Tim Salter, FAA Technical Center

Date: June 6-7, 2018, Montargis, France



Federal Aviation
Administration



Presentation Outline

- **June 2018 Cargo Liner Test Airflow Study**
 - Review from previous meeting
 - Shroud Concept Designs and test results
 - Refined Shroud Design and Test Results
 - Plans for Cargo Test Interlab Study (Round Robin)
- **Sonic Burner Video Update**
 - Assembly and Operation of the Sonic Burner
- **Planned Research and Work**



June 2018 Cargo Liner Test Airflow Study Update



Airflow Study Background

- **What is the purpose of the study?**
 - Determine a method of reducing test result disparities among test labs
- **How are we trying to address this issue?**
 - Measure air velocities at multiple points near the test sample and evaluate any influence on test results
- **What is the anticipated outcome?**
 - Define air velocities near the test sample or other means which may reduce test result disparities



Airflow Study Test Environment

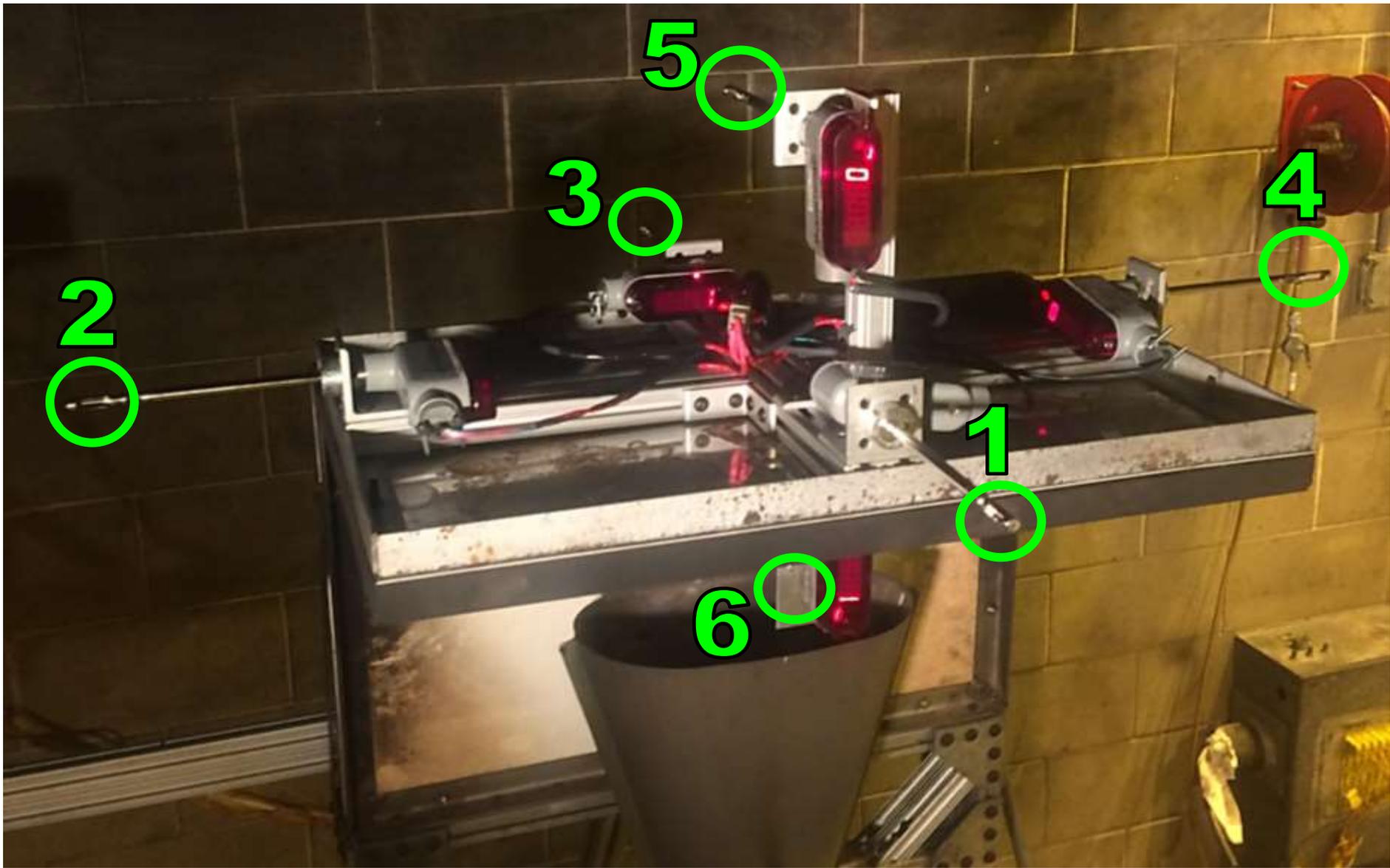
- **Test Cell Layout**

- Two different exhaust hood configurations to simulate different labs
- Wide range of exhaust airflow rates
- Digital control of exhaust fan
- Excellent repeatability of desired airflow



Air Velocity Measurement Device

- **6-Anemometor Air Velocity Test Rig**
 - 4 around the sample perimeter (1 per side)
 - 1 above the sample inline with the cone center point
 - 1 below the sample inline with the cone center point
- **Air velocities measured in the vertical and horizontal directions for each exhaust hood fan setting used for study**
- **Airflow allowed to stabilize for 5 minutes, measure air velocities for 30 seconds**



Test Lab Scenario: Hood 1

- **Positioned in a corner of the test cell**
- **Exhaust vent tube at the peak of the exhaust collection hood**
- **Inlet air comes from two directions open to the test environment**
- **Air is pulled upward to the outlet duct at the peak of the exhaust hood**



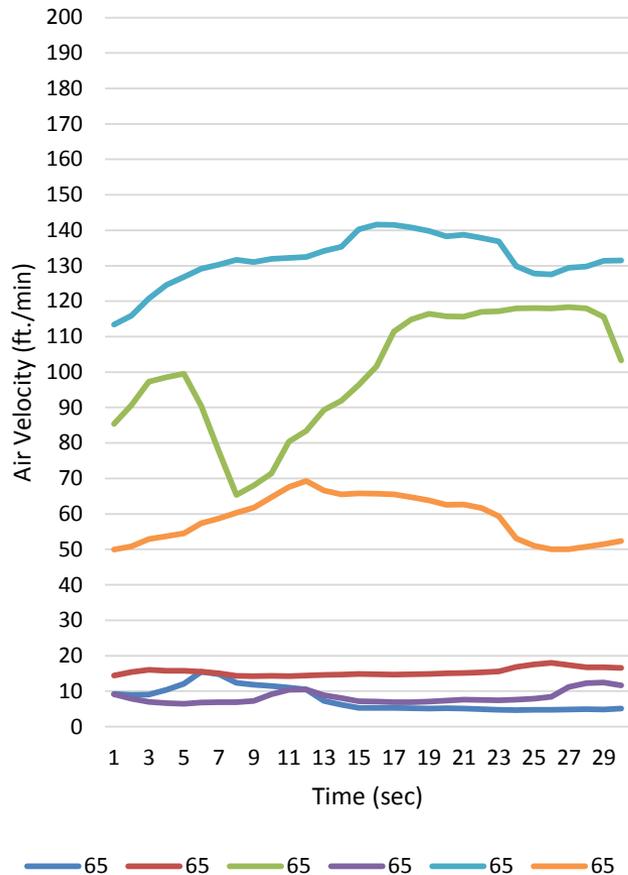
Test Lab Scenario: Hood 2

- **Positioned in the midpoint of the test cell against a wall**
- **Exhaust vent tube connected to the side of the exhaust hood**
- **Inlet air comes from three directions open to the test environment**
- **Air is pulled upward on an angle to the outlet**

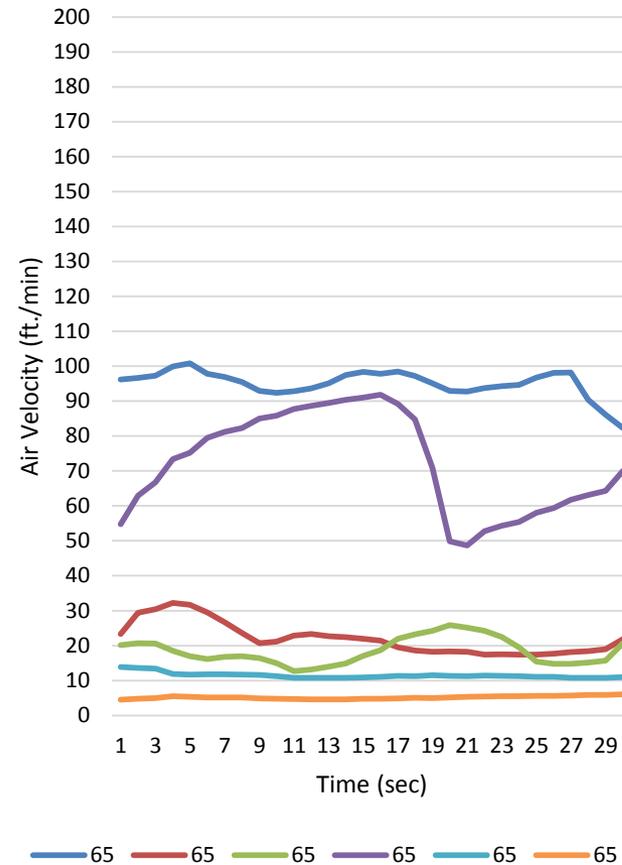


Hood 2: Example of Air Velocities

Horizontal Air Velocities at 65% Hood Exhaust Fan

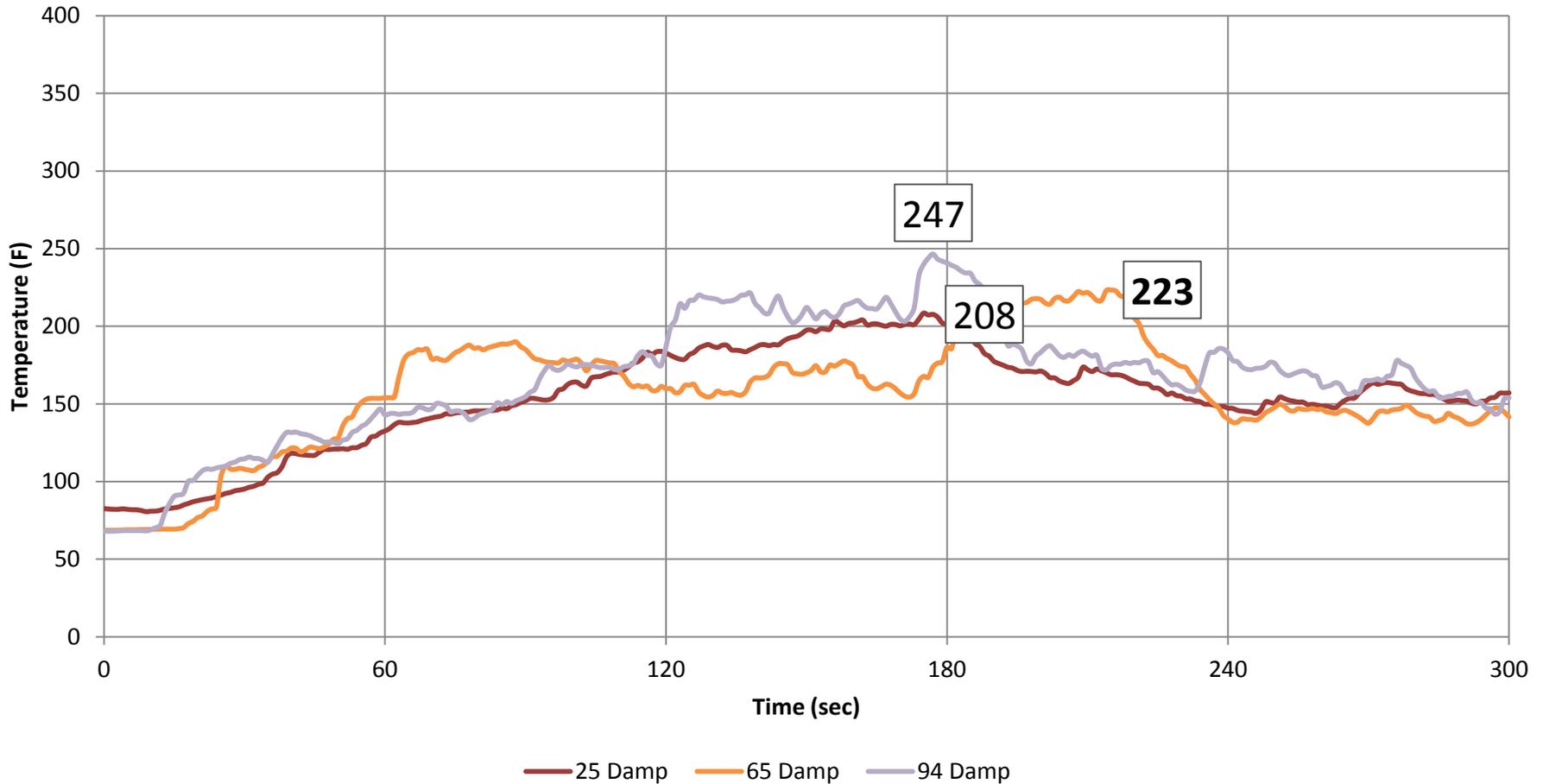


Vertical Air Velocities at 65% Hood Exhaust Fan



Hood 2: Test Result Examples

Cargo Liner Temperatures Measured 4-inches above Liner Surface



Concept for Airflow Shroud

- Initial shroud designed to minimize disruptions from airflow
- Shroud mounted directly on the test frame and only open at the top
- Sample test peak temperatures increased significantly
- Near failure of 400°F
- Redesign to reduce peak test temperatures



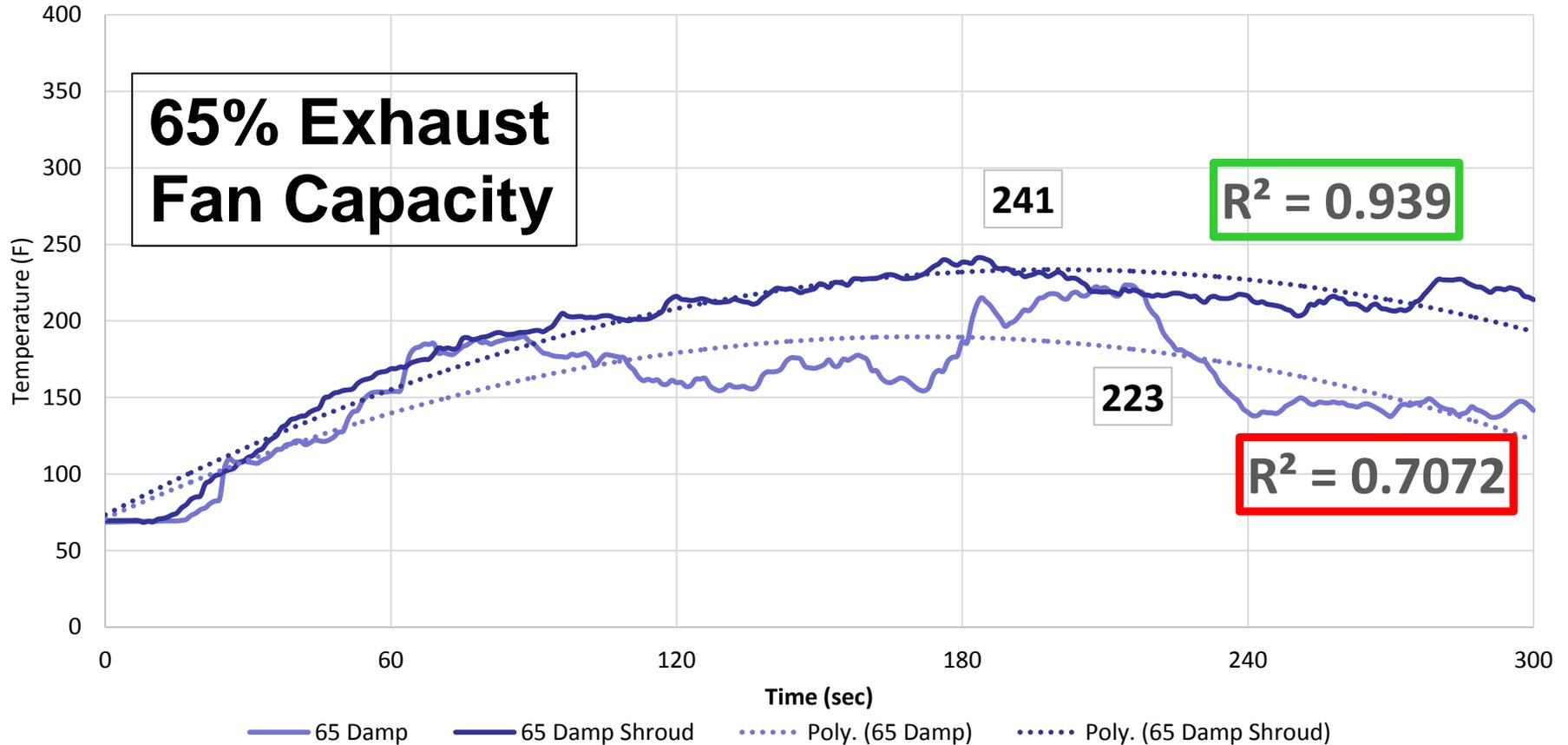
Shroud Concept #2

- **New shroud designed to reduce peak temperatures**
- **The shroud sides are spaced away from sample test frame**
- **Attached with threaded rod**
- **New design allows for vertical air flow around sample while limiting high horizontal velocity airflow disturbances**
- **Peak temperature still slightly elevated**



Example of Shrouded and Unshrouded Liner Sample Test Results

Temperatures Measured 4-inches above Liner Surface



Shroud Concept #2 Traits

- **Pros:**

- Reduced fluctuation in temperature data
- Increased test result repeatability and predictability
- Dampens influence of airflow surrounding sample
- Simple, inexpensive, easy to fabricate
- Fits all cargo liner test frames

- **Cons:**

- Increase in peak test result temperatures
- Blocks view of liner sample (flame penetration)
- Interference with sample mounting

Recent Work and Development of Testing with Shrouds



Shroud Concept #3

- **Similar to shroud #2**
- **Increased size to allow for greater distance between shroud and flame**
- **More airflow between sample and shroud**
- **Reduce heat reradiated within shroud**
- **Peak temperatures remain slightly elevated**



Shroud Concept #4

- **Basic shape unchanged from previous designs**
- **Constructed from thin gage perforated aluminum**
- **Taller sidewall to shroud flame and thermocouple from turbulent airflow**
- **Perforations allow for some airflow through sidewalls and may reduce entrapped or reradiated heat**
- ***Peak temperatures dropped significantly***



Shroud Concept #4

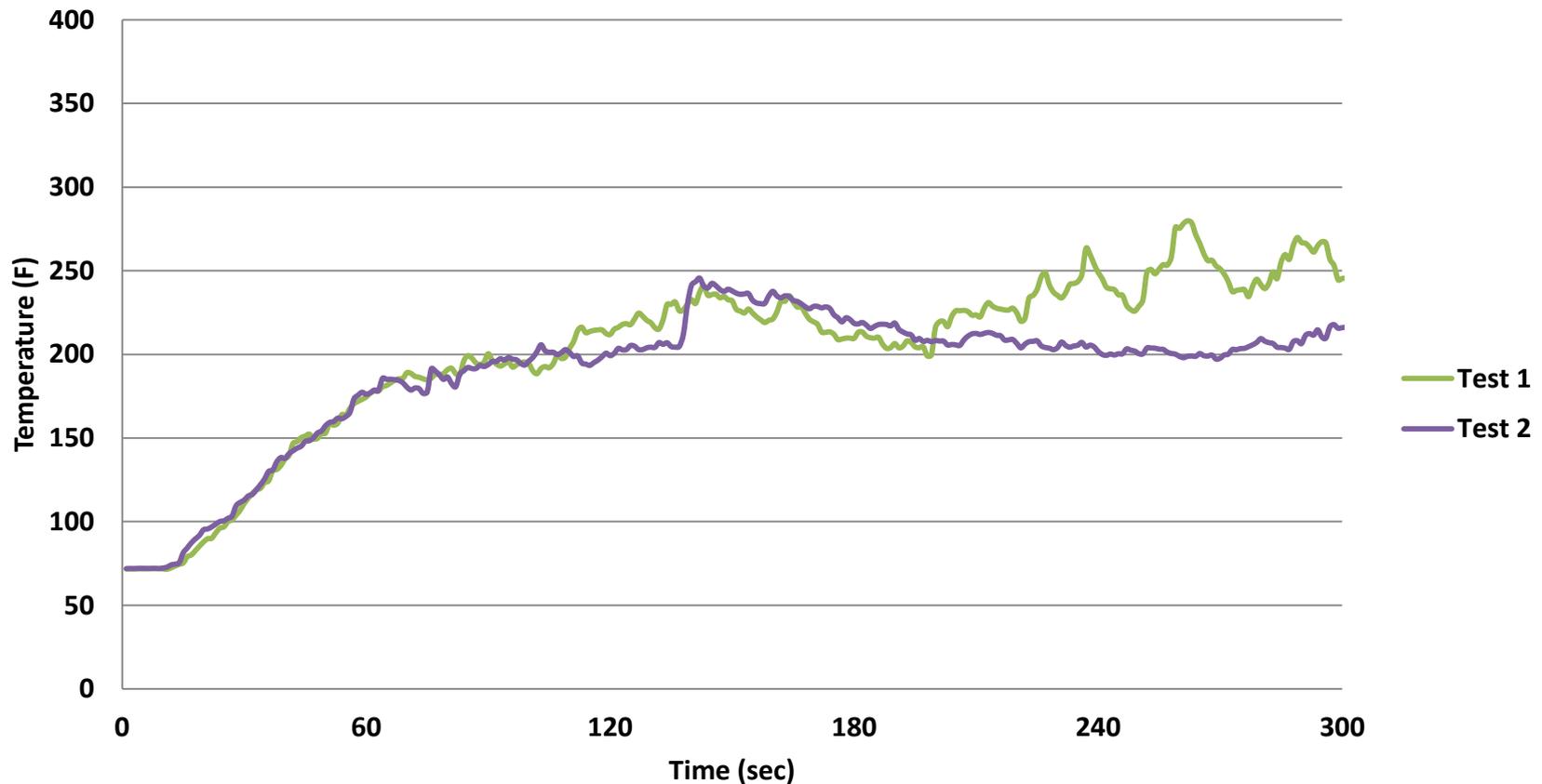


Shroud Concept #4



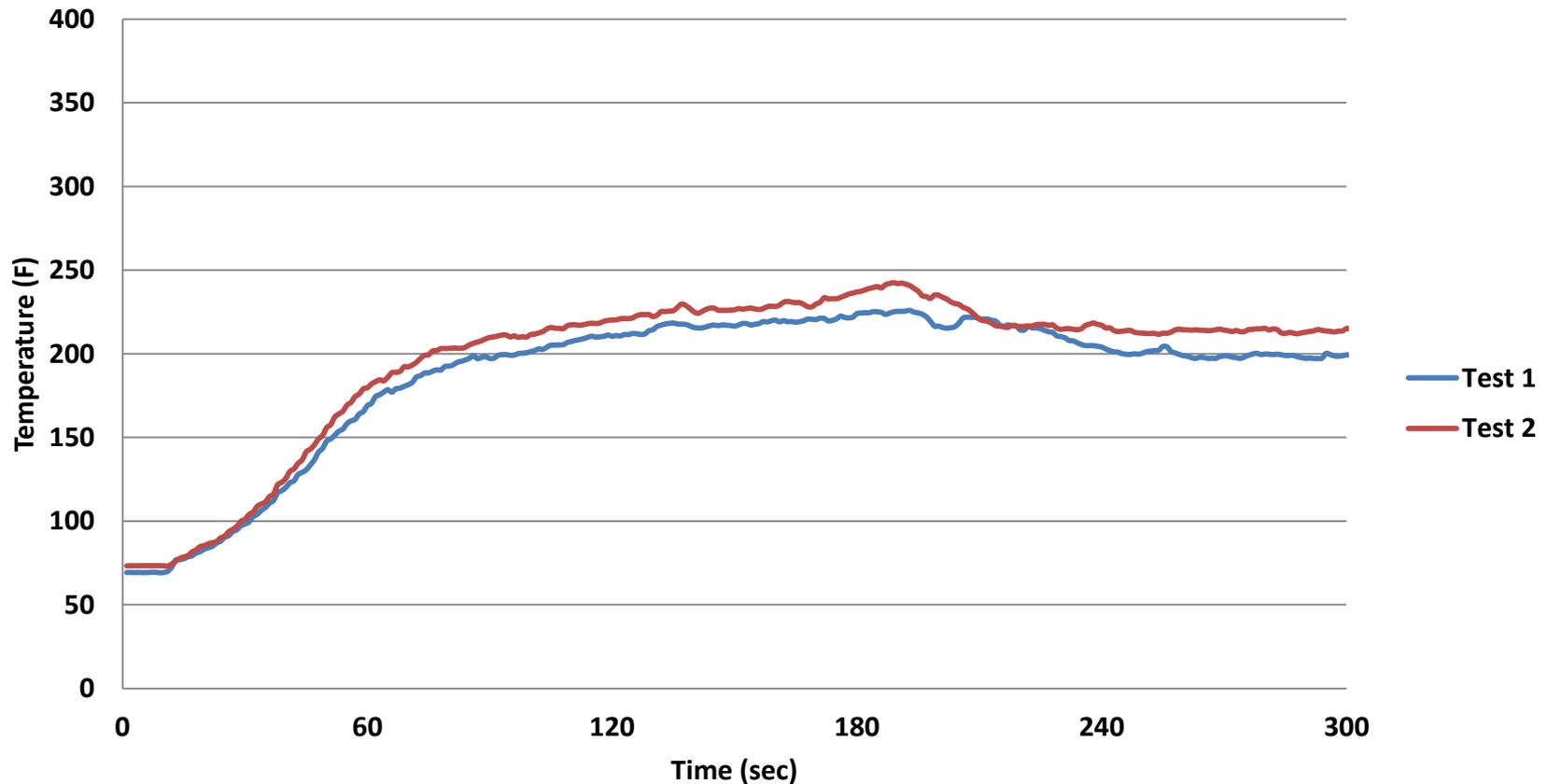
Shroud Concept #4 Testing

Temperatures Measured 4-Inches above Cargo Liner Samples
- NO SHROUD -



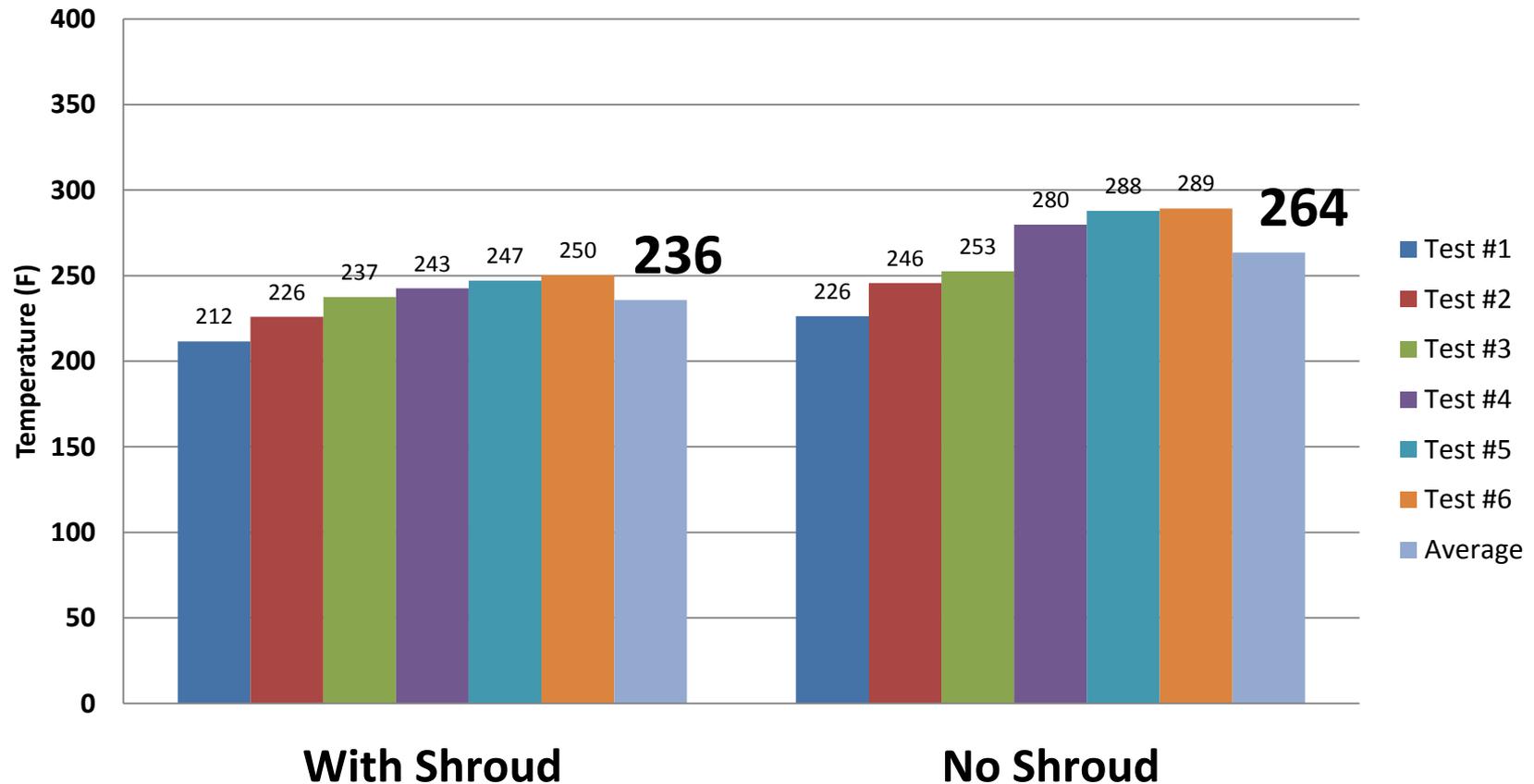
Shroud Concept #4 Testing

Temperatures Measured 4-Inches above Cargo Liner Samples
- WITH SHROUD -



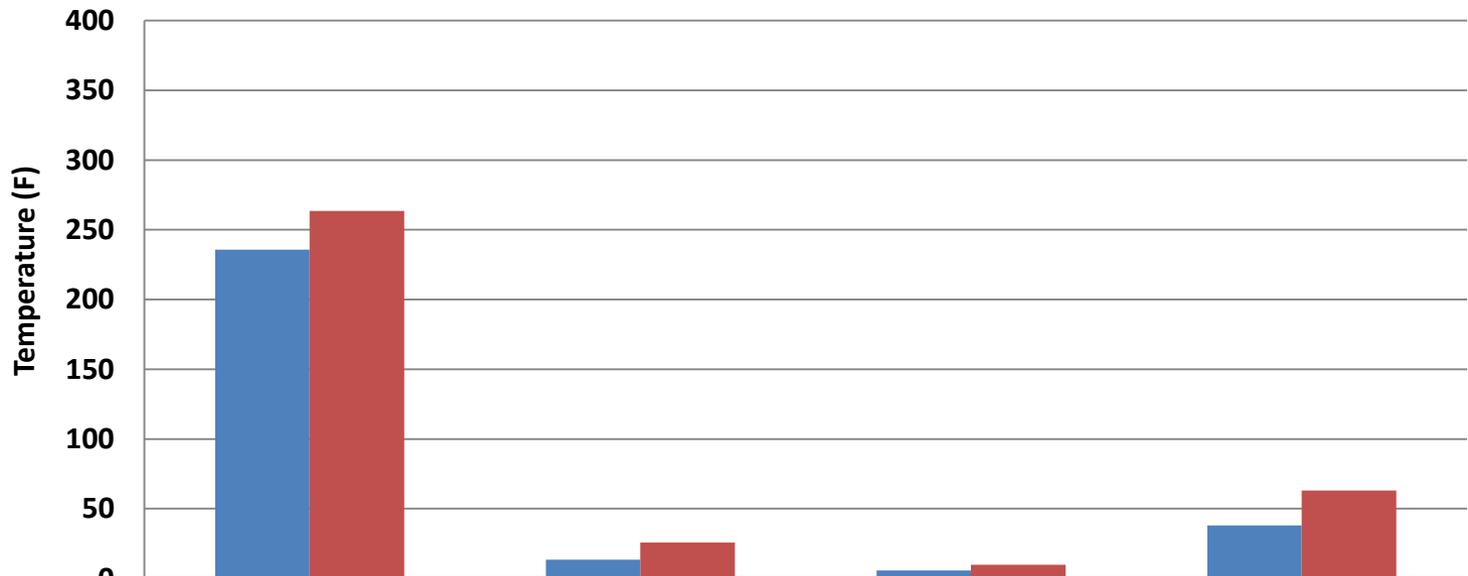
Shroud Concept #4 Testing

Peak Temperatures Measured 4-Inches above Liner Samples
at 65% Exhaust Fan Speed



Shroud Concept #4 Testing

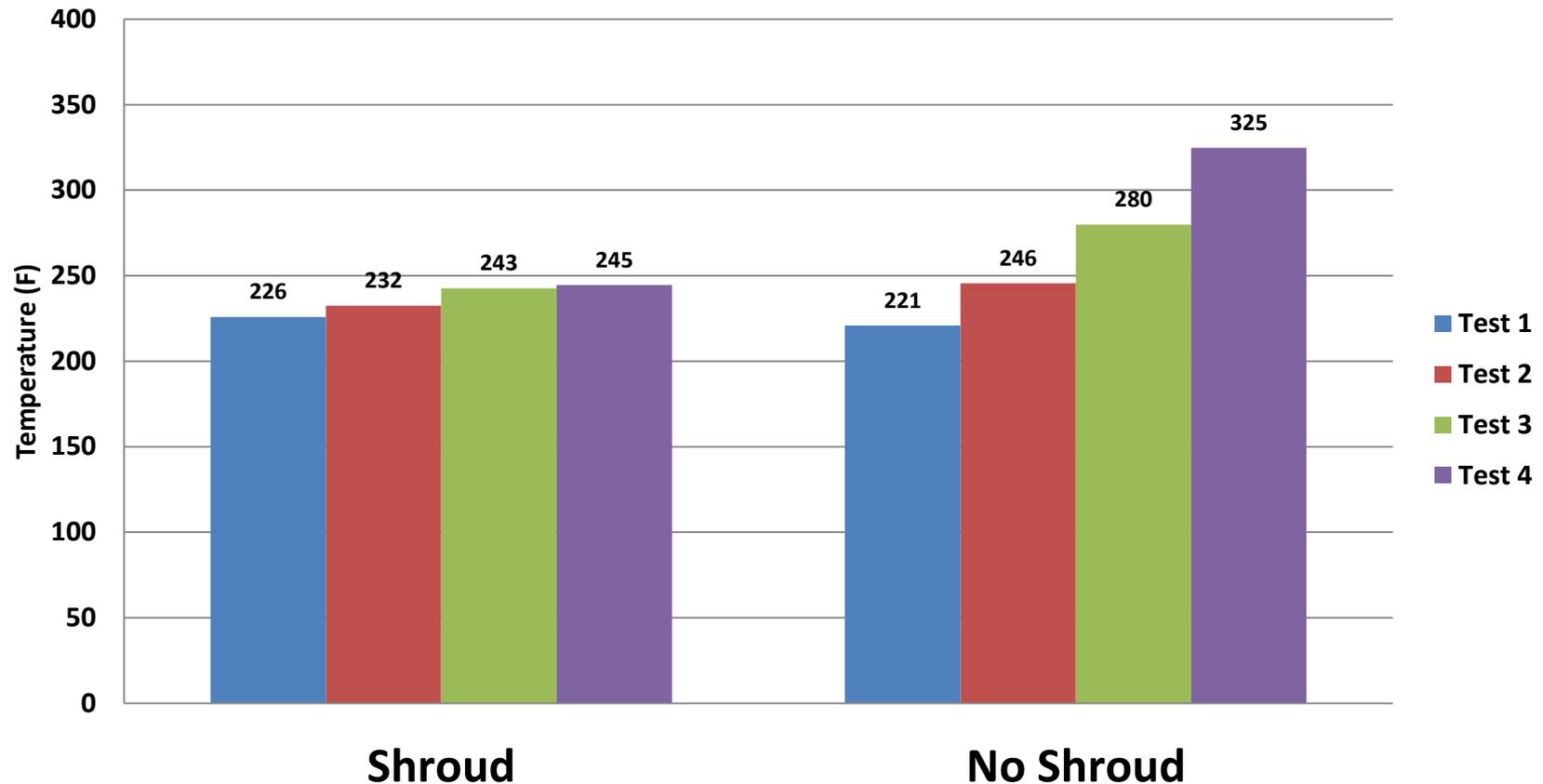
Average Peak Temperature Statistics Comparing Tests Conducted with Shroud and without Shroud



	Average	Standard Deviation	% Standard Dev.	Maximum Delta_T
Shroud	236	13.4	5.7	38.0
No Shroud	264	25.9	9.8	63.0

Shroud Concept #4 Testing

Peak Temperatures Measured 4-Inches above Liner Samples for Multiple Exhaust Fan Speed Settings



Shroud Concept #4 Testing

- **Conduct interlab study to confirm results of perforated shroud in other labs**
- **Shrouds will be constructed and provided to labs with samples and instructions**
- **Redesign mounting fixture so sample test frame does not need to be altered**
- **Improve design based on RR results and feedback from labs**

Next Phase of the Airflow Study

- **Design, construct, and test new shrouds**
- **Alter size, shape, configuration**
- **Combine shroud and defined air velocity ranges to reduce lab result disparities**
- **Working group feedback on shroud concept**
- **Repeat study and implement shroud design for seat cushion test method**

Sonic Burner Assembly and Operation Instructional Video: Status Update



Sonic Burner Video Update

- **Video production has been taking longer than originally anticipated**
- **Finalizing script for video**
- **Begin video shoot following meeting**
- **Present completed video at next meeting**
- **Input form task group members on footage or instruction not in Fire Test Handbook or videos currently available**
 - Undocumented Sonic burner related topics

Planned Research and Work



Planned Research and Work

- **Continue cargo liner airflow study**
 - Conduct round robin study using perforated shroud
 - Improve design of shroud
- **Design shroud for seat test**
 - Conduct airflow study for seat test method
- **Sonic Burner Video**
 - Finish production of video
- **Additional items from task group meetings**
 - Based on task group meeting discussion

Questions?

timothy.salter@faa.gov

(1)-609-485-6952

