Federal Aviation Administration

International Aircraft Materials Fire Test Working Group Meeting

Seat Cushion and Cargo Liner Oil Burner Update

Presented to: International Aircraft Materials Fire Test Working Group

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Date: June 3-4, 2015, Bremen, Germany

Introduction

- Air Pressure Regulator Update
- Sonic Burner Cone Alloy Study
- Cargo Liner Round Robin
- Seat Cushion Round Robin
- Test Cell Airflow Study
- Plans for Future Work

Air Pressure Regulator

- **Constant air pressure control is crucial for repeatable burner test results**
- **Many regulators commercially available not suitable for use with the NexGen burner due to inconsistent air pressure regulation**
- **Handbook requires air pressure maintain 45 +/- 1 psi**

Air Pressure Regulator

- **Previously recommend McMaster-Carr regulator part # 49305K23 with an operating range of 0-55 psi (shown right)**
- **Testing revealed this regulator is not suited well for use with the NexGen burner**
- **Air pressure readings measured at the ¼” NPT port on the side of the regulator differed from readings measured downstream of the regulator but before the sonic orifice as much as 7 psi**

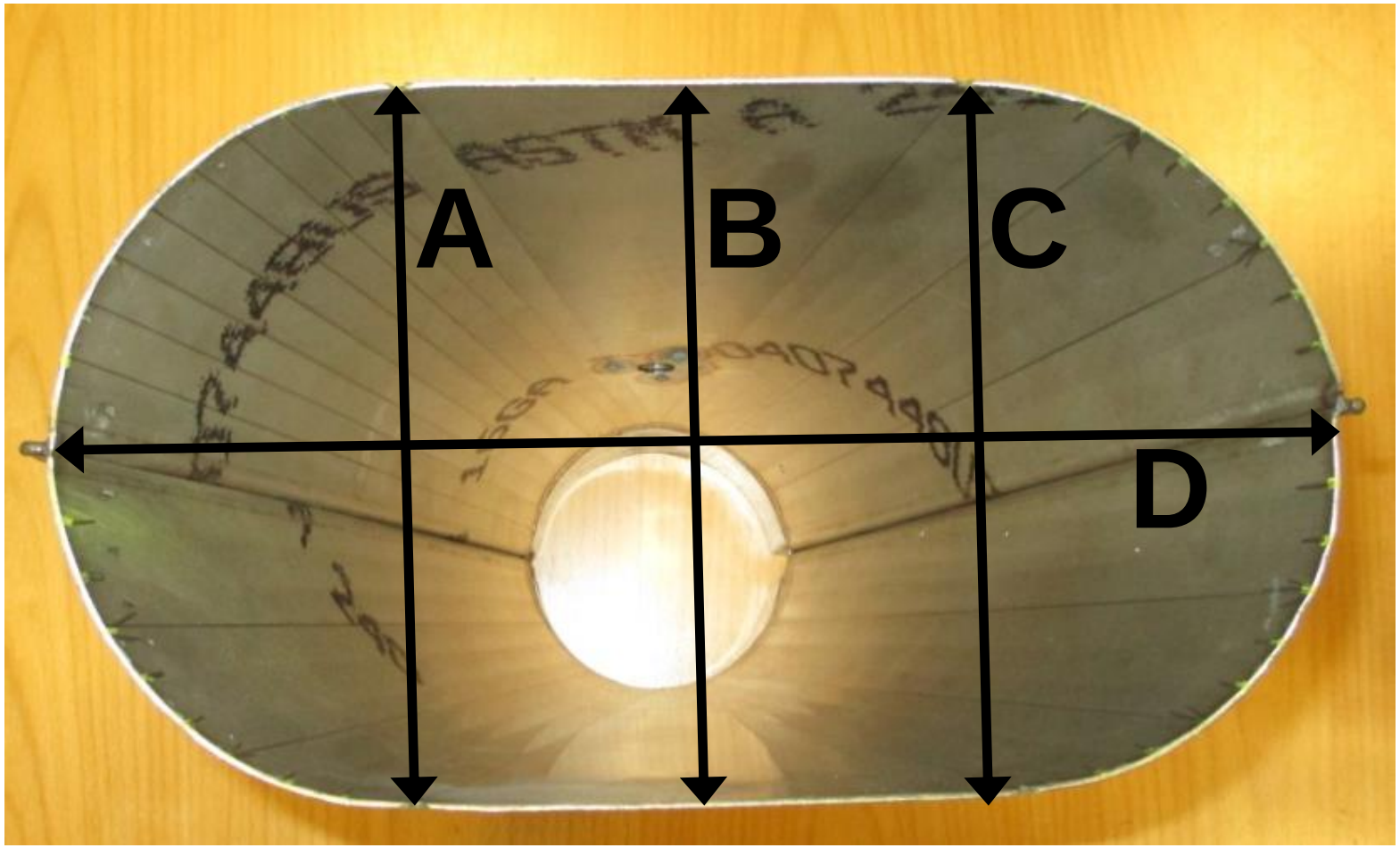
Air Pressure Regulator

- **Air pressure at the sonic orifice will determine the mass flow rate of air**
- **Air pressure measurement taken at the sonic orifice and pressure regulator should be identical**
- **A more suitable regulator is available from MSC.com having part # 73535627, Parker 1” heavy duty regulator model R119-08CG/M2 (shown right)**

Cone Alloy Study

- **Current rule for burner cone alloy is 16Ga, 310 stainless steel**
- **SS cones have deformed up to ½ inch after only one heat cycle**
- **Recent study involved testing 625 Inconel and Hastelloy X alloy cones**
- **Testing involved running the burner for 5 minutes, cool-down for 5 minutes with burner air on, then measure the cone in four different locations (A, B, C, D), and repeat for 10 heat cycles**

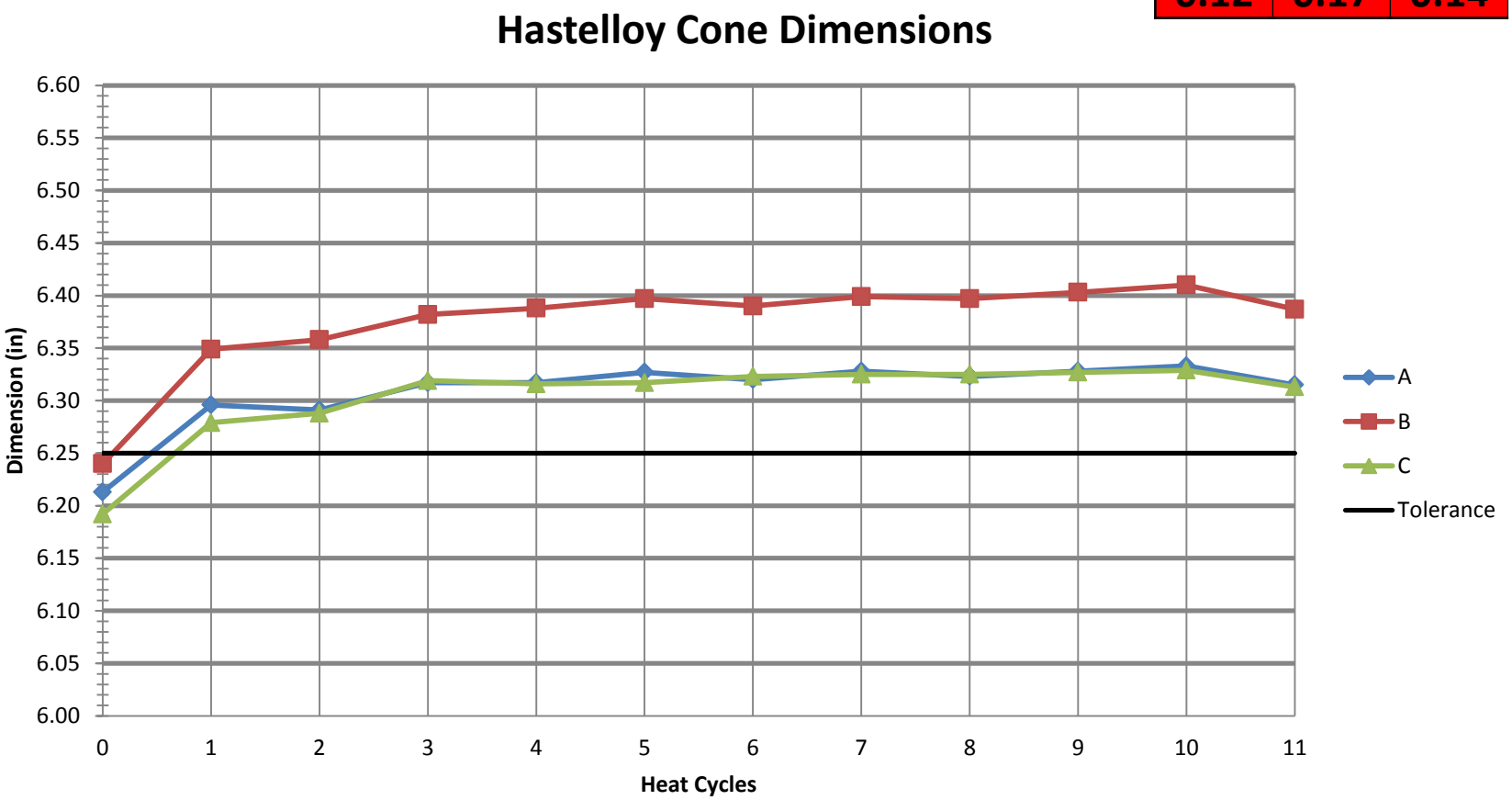
Cone Alloy Study



Cone Alloy Study

Maximum Deformation

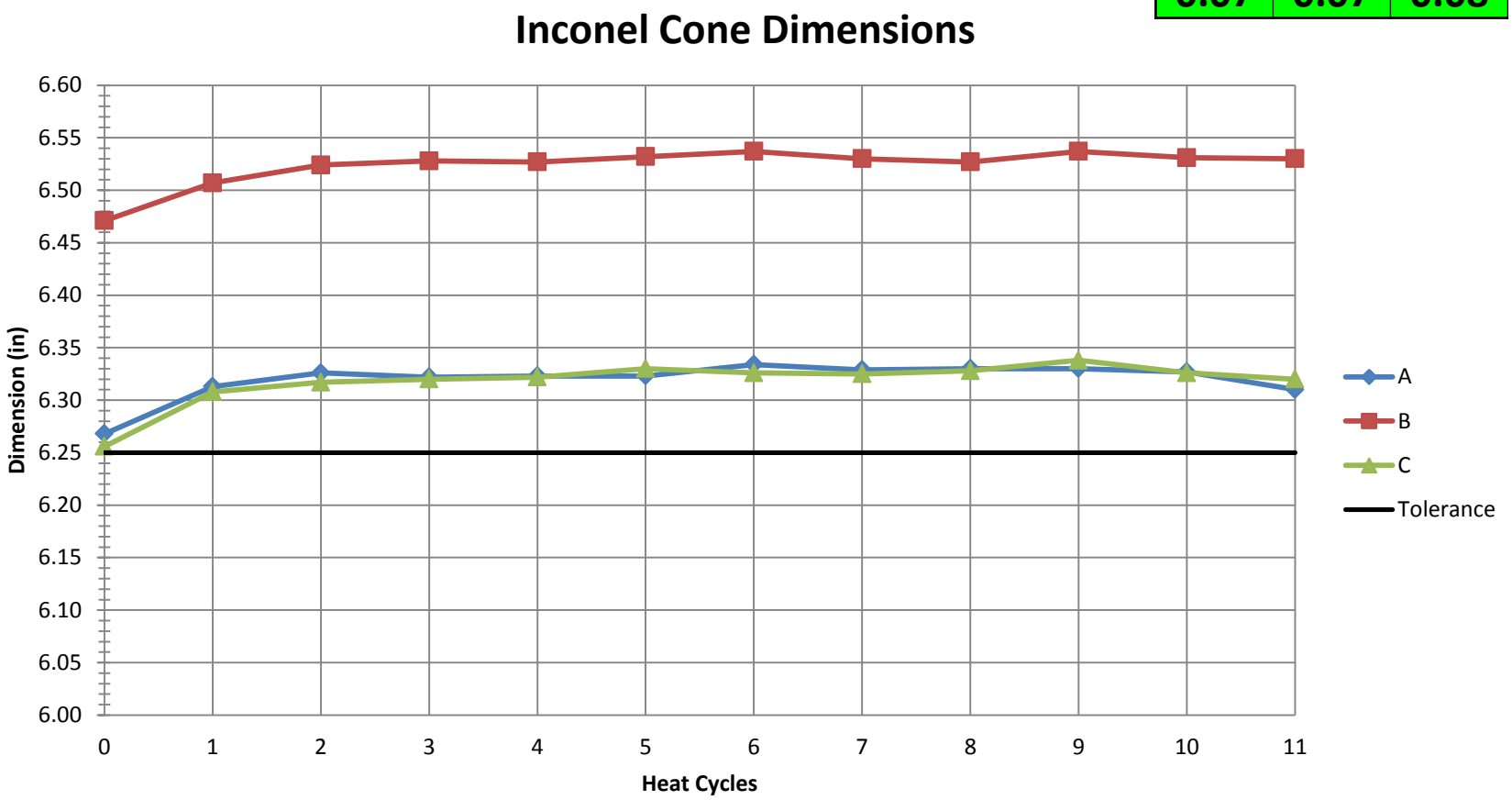
A (in)	B (in)	C (in)
0.12	0.17	0.14



Cone Alloy Study

Maximum Deformation

A (in)	B (in)	C (in)
0.07	0.07	0.08



Cone Alloy Study

Hastelloy Cone

- A: 6.213”→6.315”
- B: 6.240”→6.387”
- C: 6.192”→6.313”
- D: 11.000”→10.813”

Inconel Cone

- A: 6.268”→6.310”
- B: 6.471”→6.530”
- C: 6.256”→6.320”
- D: 10.938”→10.875”

Dimensions shown are initial measurements taken before exposure to flame and final measurements after 10 heat cycles after the cone was allowed to cool to ambient temperature

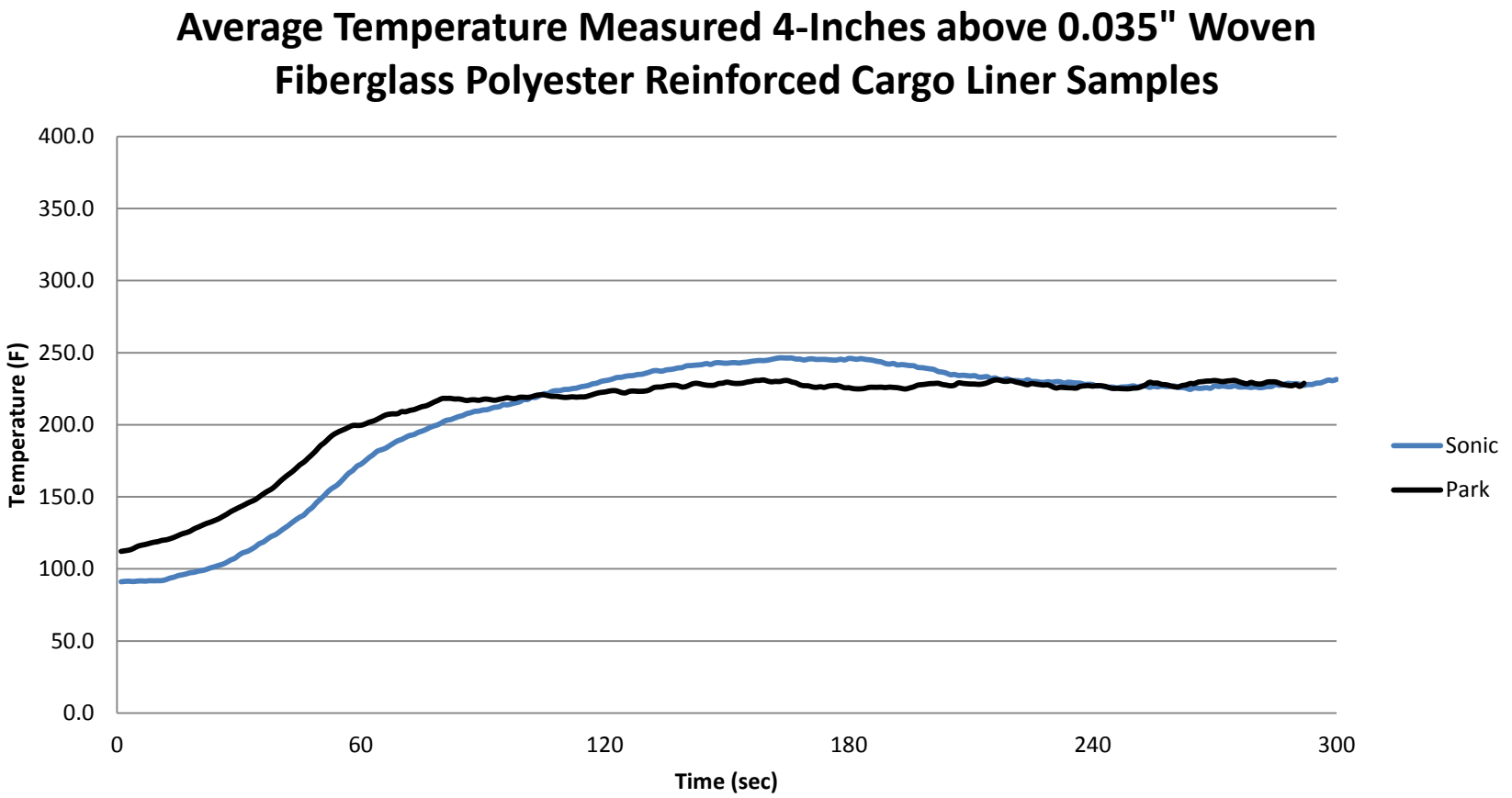
Cone Alloy Study

- **Most deformation occurs after only the first heat cycle**
- **It may be possible to alter the initial design of the cone in order to accommodate deformation**
- **Inconel tends to deform significantly less compared to 310 stainless steel**
- **The cost of an Inconel cone is approximately 25%-30% more compared to a 310 SS cone**
- **Initial cost may be offset by the working life span of the cone**

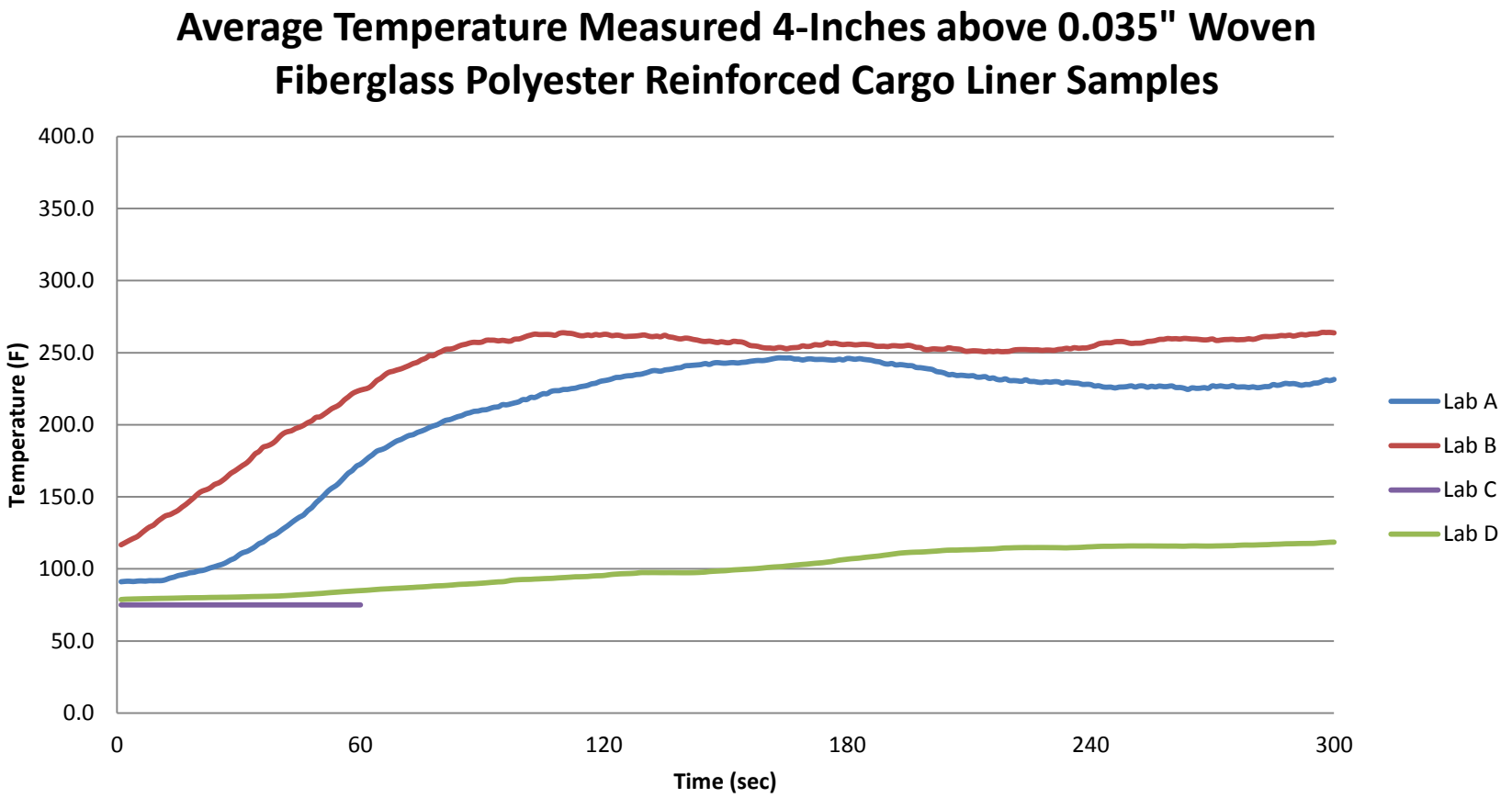
Cargo Liner Round Robin

- **The igniterless stator and turbulator NexGen sonic burner was used for this study**
- **4 labs currently participating**
  - 3 labs have completed testing and returned results
- **2 different cargo liner types supplied for testing**
  - 5 of each liner type for a total of 10 liner samples

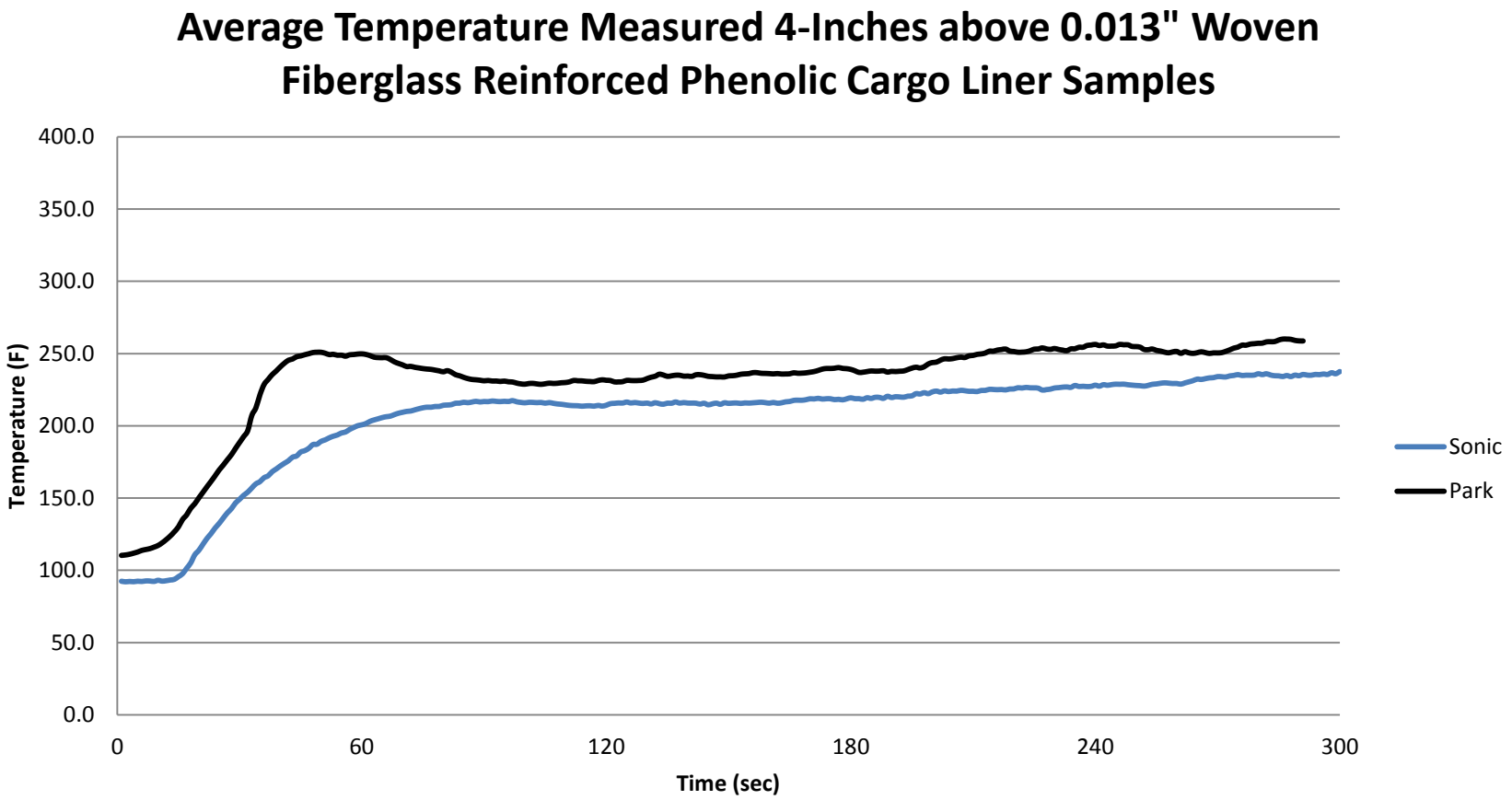
Sonic and Park Comparison



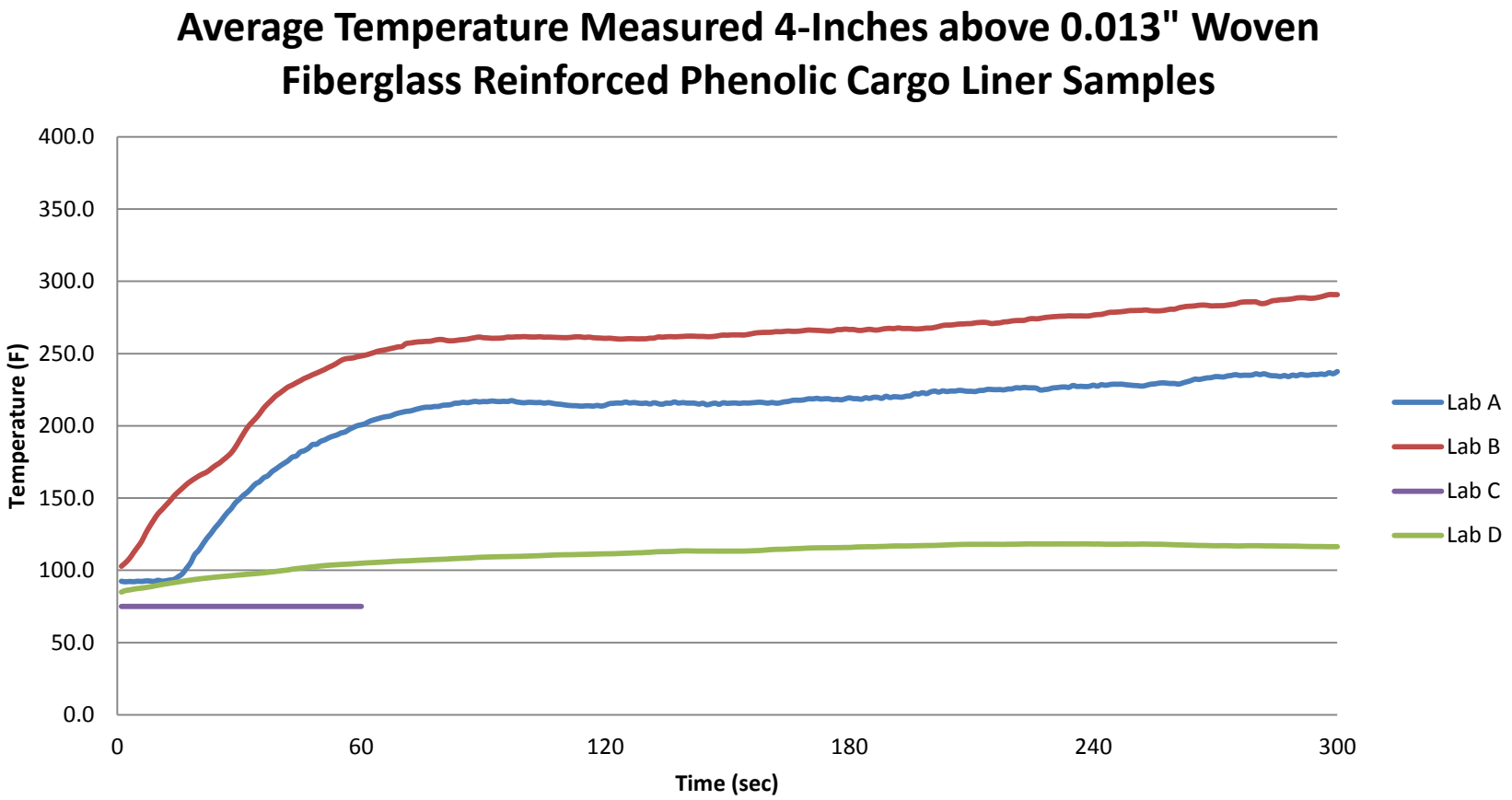
Cargo Liner Round Robin Results



Sonic and Park Comparison



Cargo Liner Round Robin Results



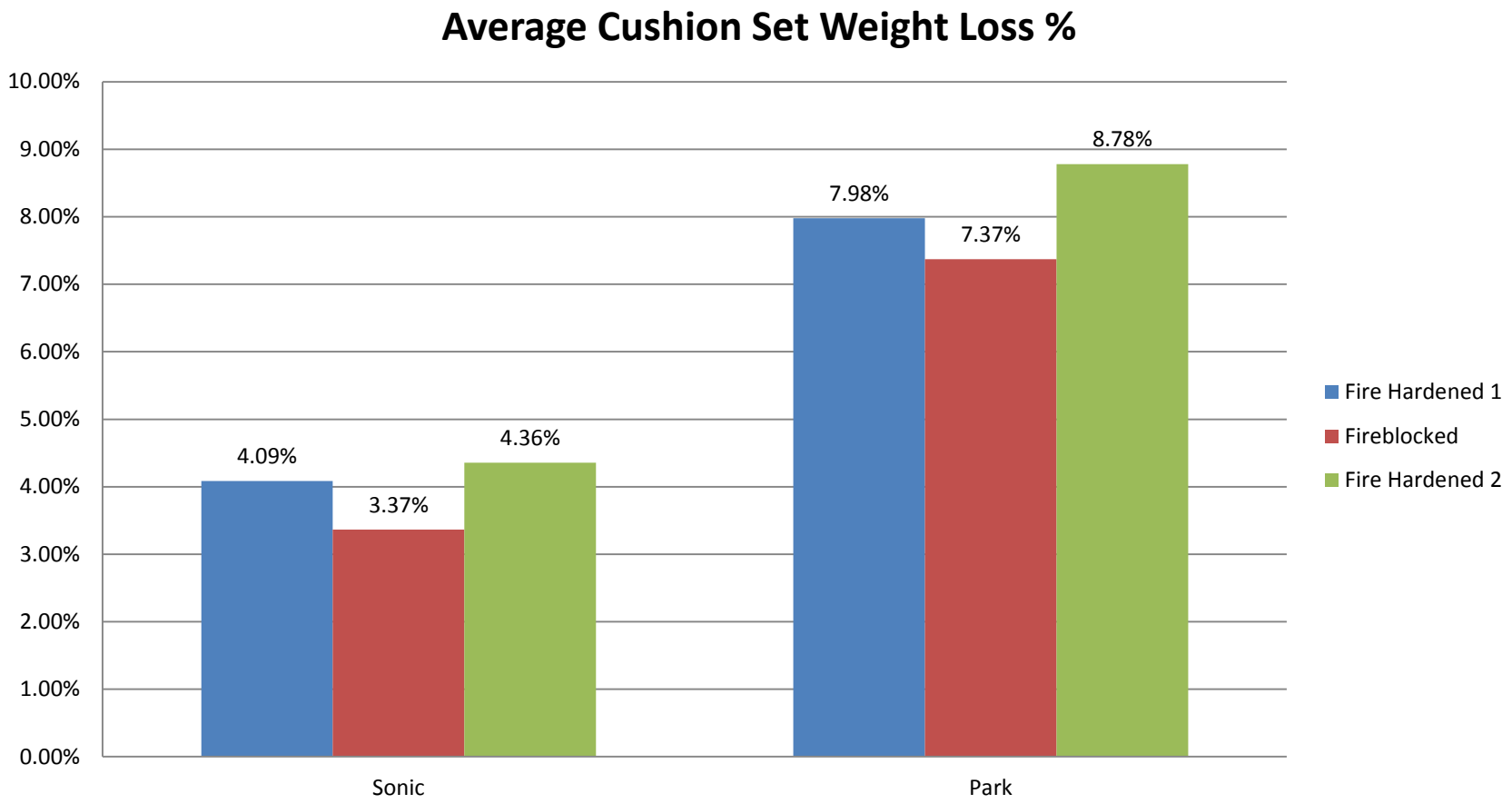
Cargo Liner Round Robin

- **The current cargo liner interlab study is on-going**
- **Additional materials will be supplied to participating labs for further testing and aid in burner and test cell research**
- **These additional supplied materials are intended to burn-through unlike the liner materials already tested**
- **The final results of this study will be presented at the materials working group meeting in Atlantic City, NJ on dates October, 19-20**

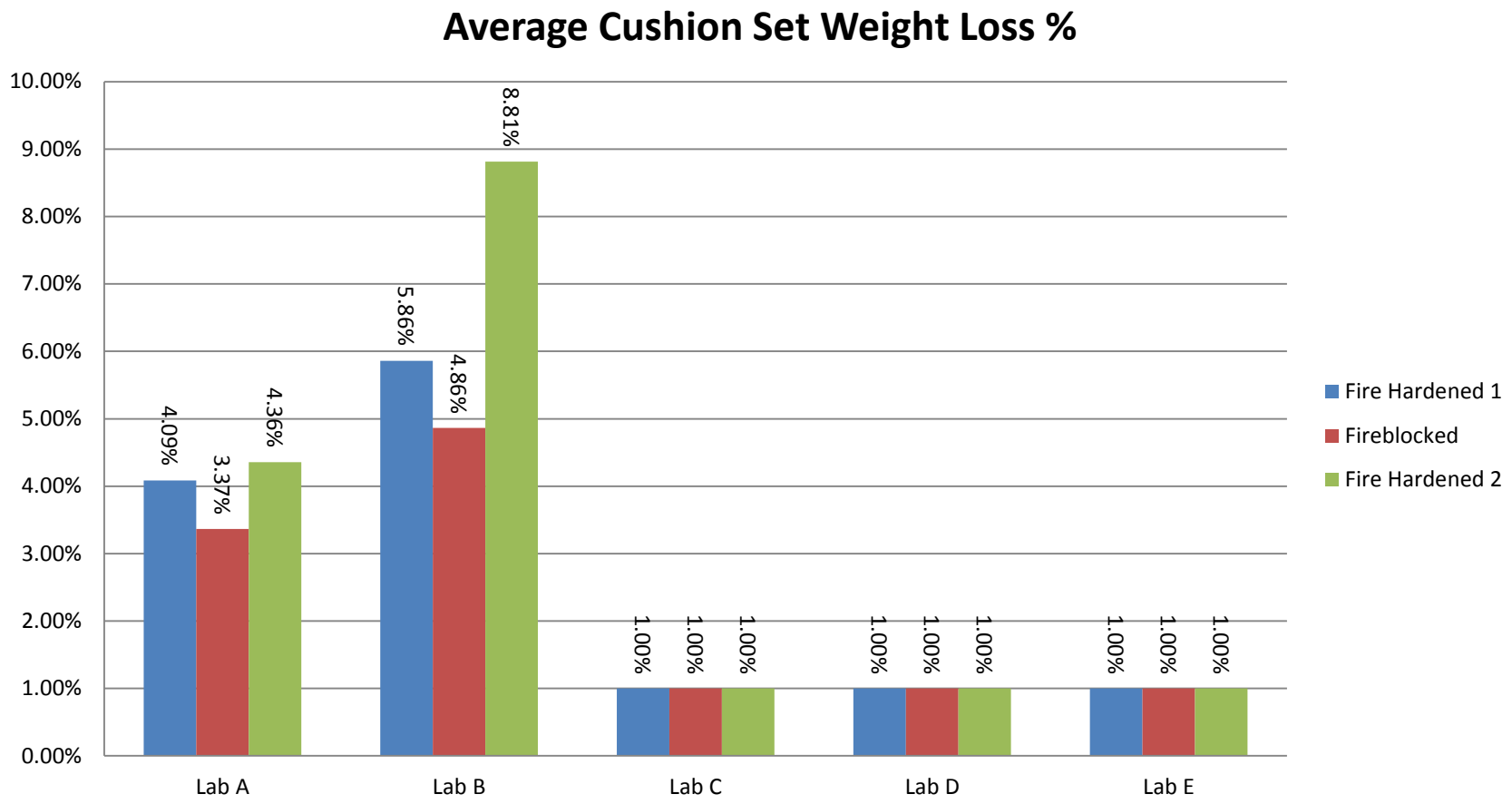
Seat Cushion Round Robin

- **The igniterless stator and turbulator NexGen sonic burner was used for this study**
- **5 labs currently participating**
  - 2 labs have completed testing and returned results
- **3 different cushion types supplied for testing**
  - 3 of each cushion type for a total of 9 cushion sample sets

Sonic and Park Comparison



Seat Cushion Round Robin Results



Seat Cushion Round Robin

- **FAA test results using the NexGen sonic burner configured with the igniterless stator resulted in weight loss % approximately half of expected result**
- **This may be due to less turbulent airflow using an igniterless stator and lack of internal ignition wires**
- **Testing will be repeated with another oil burner supplied by Marlin Engineering**

Test Cell Airflow Study

- **A pair of NIST certified hot-wire anemometers were recently acquired by the FAA Fire Safety Branch**

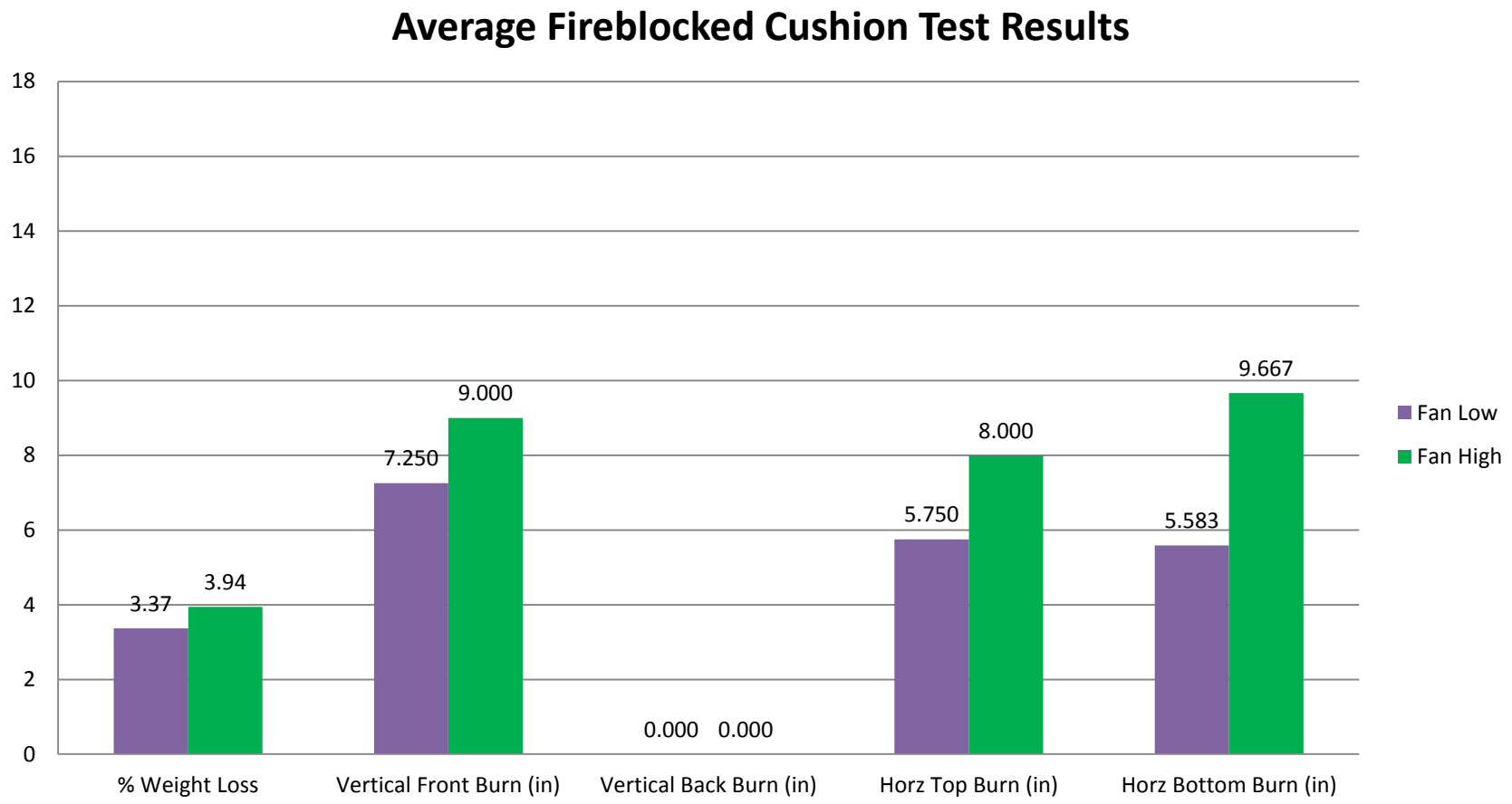
- **The new equipment will be used for an in-depth study of how test cell configuration and ventilation airflow may affect test results related to oil burner test methods**

Test Cell Airflow Study

- **Initial testing was performed with one anemometer attached to the seat cushion test frame**
- **The hot-wire portion of the measurement device was located 3 inches forward from the upper corner of the seat test frame, and approximately centered under the ventilation hood**
- **Airflow measurements were taken in the vertical direction**

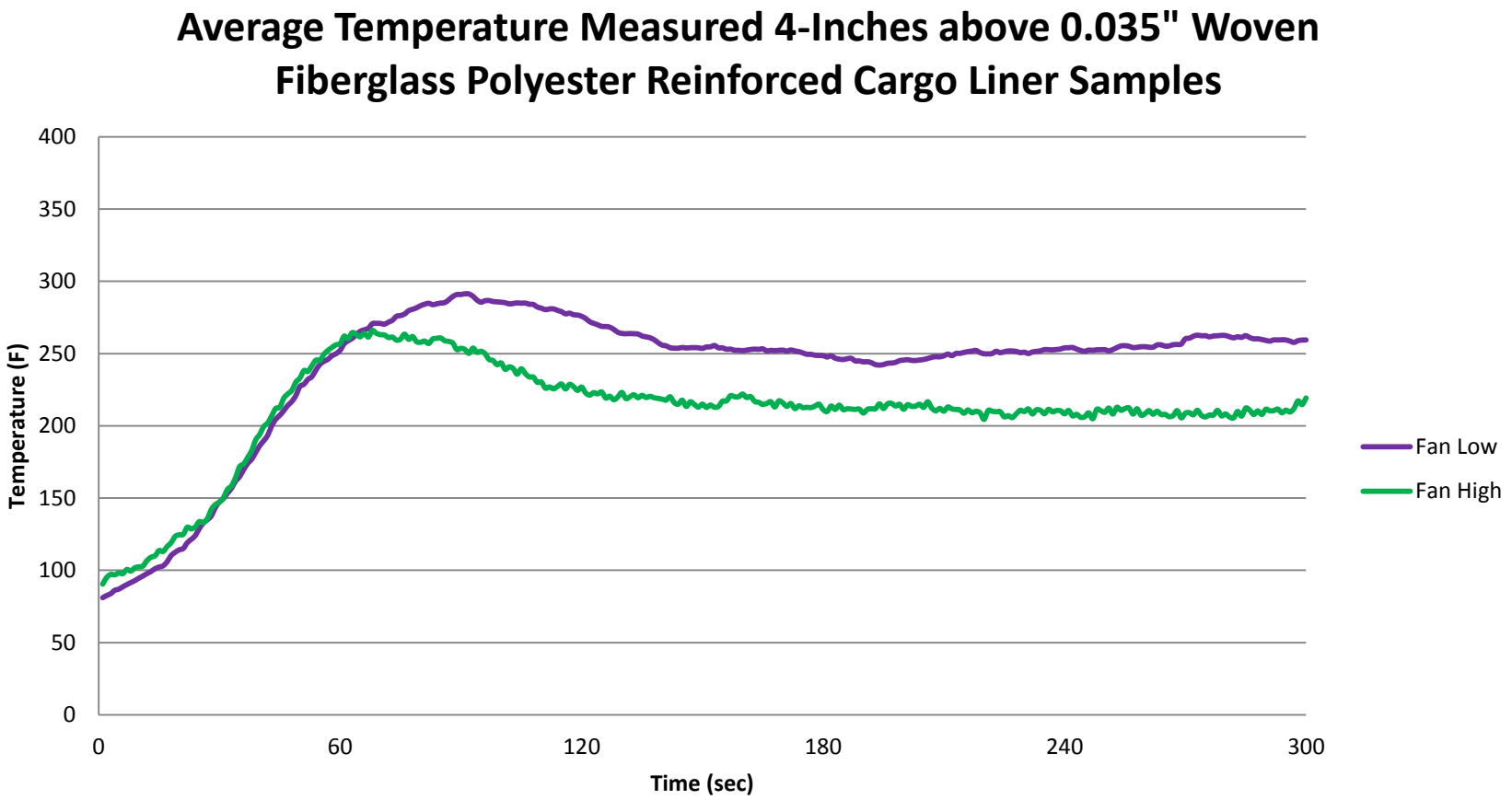
Test Cell Airflow Study

Fan Low = ~75 ft/min
Fan High = ~125 ft/min



Test Cell Airflow Study

Airflow in the cargo liner test cell has not yet been measured using the hot-wire anemometers

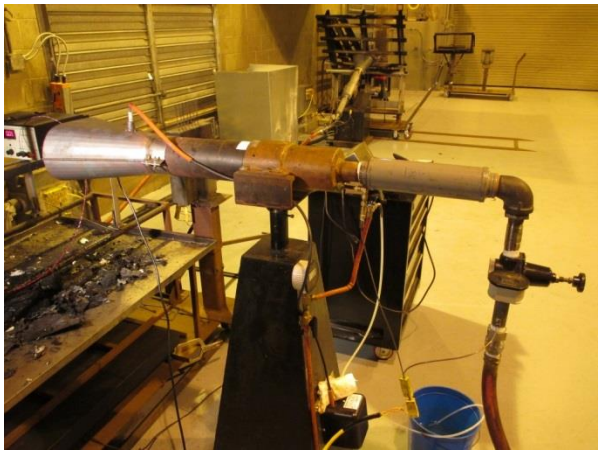


Test Cell Airflow Study

- **Test results for seat cushion indicate increased weight loss and burn lengths when airflow is increased**
- **Test results for cargo liner indicate decreased temperatures measured 4-inches above the liner sample**
- **These test results suggest ventilation airflow may significantly impact test results for oil burner test methods**

Future Work

- **Provide additional test materials to participating cargo liner RR labs, and complete testing**
- **Complete seat cushion RR**
  - FAA will run additional tests using Marlin Engineering burner
- **Begin study of test cell configuration and airflow**
  - Purpose of study is to provide guidance to test labs based on test cell configuration and ventilation hood airflow
- **Updated chapter 7 in the Handbook will be available in the near future**



Questions?