Federal Aviation Administration

International Aircraft Materials Fire Test Working Group Meeting

Airflow Study (Burner Test Cell)

Presented to: International Aircraft Materials Fire Test Working Group

By: Tim Salter, FAA Technical Center

Date: October 19-20, 2015, Atlantic City, New Jersey

Introduction

- **Airflow Study Overview**
  - Reasoning and Purpose
- **Airflow Study Testing**
  - Baseline tests, cell environment changes, results
- **Future Work**
  - Follow-up airflow study with seat cushion test
  - Written guidance material concerning airflow

Airflow Study Overview

Airflow Study: Reasoning

- **Efforts have been concentrated on developing and improving the NexGen burner in recent years since its conception**
- **Three major round robin studies have been conducted focusing on three different internal design configurations**
- **Igniterless stator configuration final design**
  - Eliminates internal wiring and airflow disruptions
- **All NexGen burners designed/built the same**

Airflow Study: Reasoning

- **Test results within a lab are consistent, but differ when compared to other test labs**
  - Oil burner originally thought to be the cause
  - If all NexGens identical, results should be the same
- **Round robin results suggest the test environment may be of greater importance than originally thought**
  - Focus has turned toward test cell conditions and influence on test results

Airflow Study: Purpose

- **Produce written guidance for suggested ventilation airflow rate for a particular cell configuration**
- **Help decrease differences in data among test labs**
- **Changing airflow may offset differences in test cell size, shape, hood proximity to sample, ambient temperature, etc.**

Airflow Study: Purpose

- **Difficult to reconfigure a test cell, but airflow can be adjusted by varying ventilation fan speed or using baffles in the vent system**
- **Questions to be answered:**
  - What effect does airflow have on results?
  - Is it possible to provide guidance on ventilation airflow rates to suit a particular lab?
  - Can adjustments in airflow help reduce the test results differences among labs?

Airflow Study: Example Plan

- **<u>Example</u> variations in the test environment**
  - Airflow rate within the test cell
    - Different fan speeds (low, medium, high)
  - Distance between the hood and test sample
    - Temporary hood extension (low hood, high hood)
  - Size of the test cell (small, medium, large)
    - Test in different sized cells at FAA Technical center
- **3 x 2 x 3 = <u>18 different scenarios</u>**
  - 18 for cargo liner, another 18 for seat testing

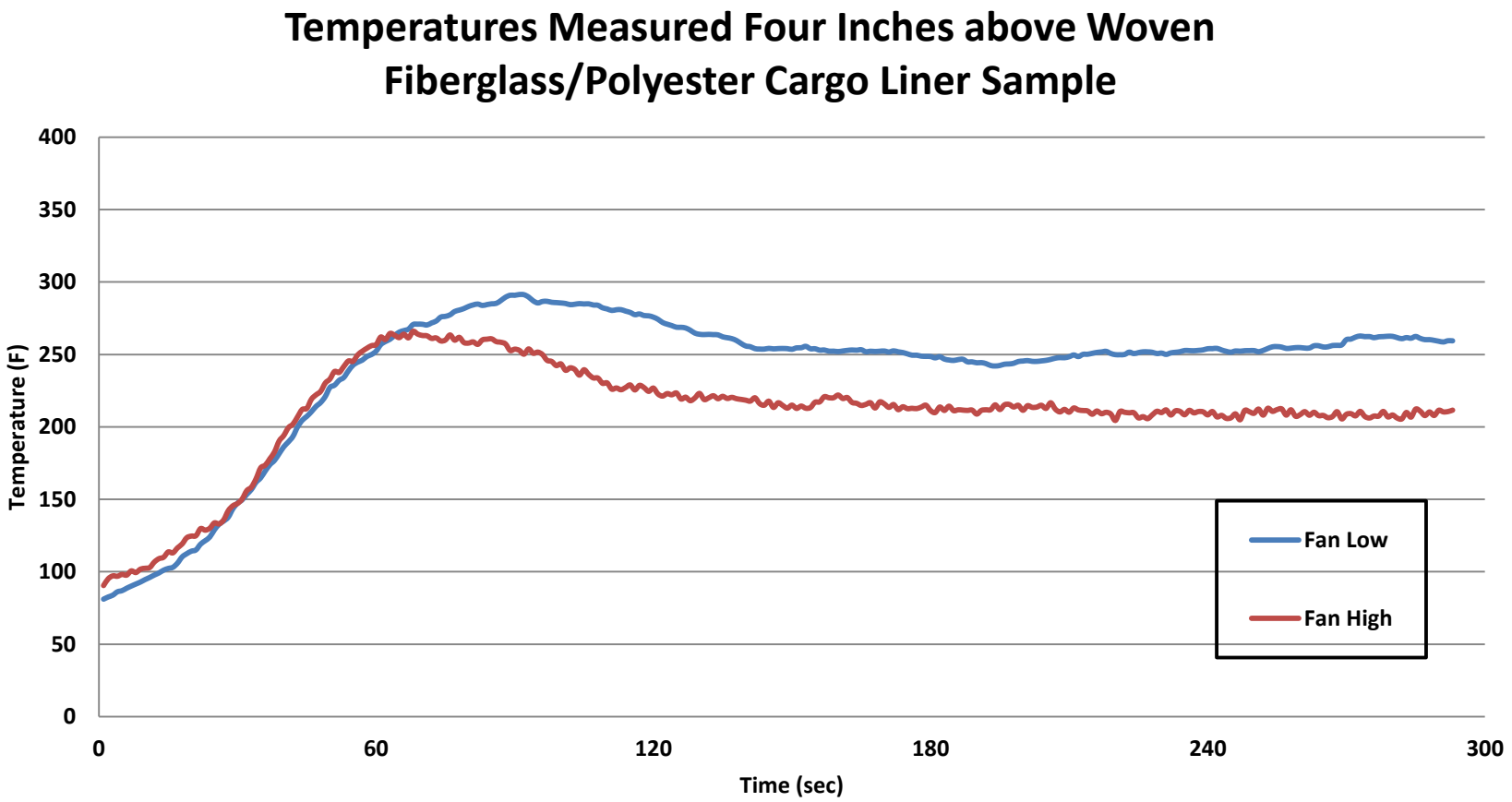
Airflow Study Testing

Airflow Study: Cargo Liner Tests

- **Begin study using cargo liner test method**
  - Easier to modify and relocate than seat apparatus
- **Establish baseline results in FAA test cell**
  - Typical configuration, no modifications
- **Run tests using both the low and high ventilation fan speeds (airflow change)**
  - Easily change cell conditions by flipping a switch
- **Same cargo liner type used for all tests**
- **NexGen burner will be the same for all tests**

Airflow Study: Test Results

Typical test cell arrangement with no modifications



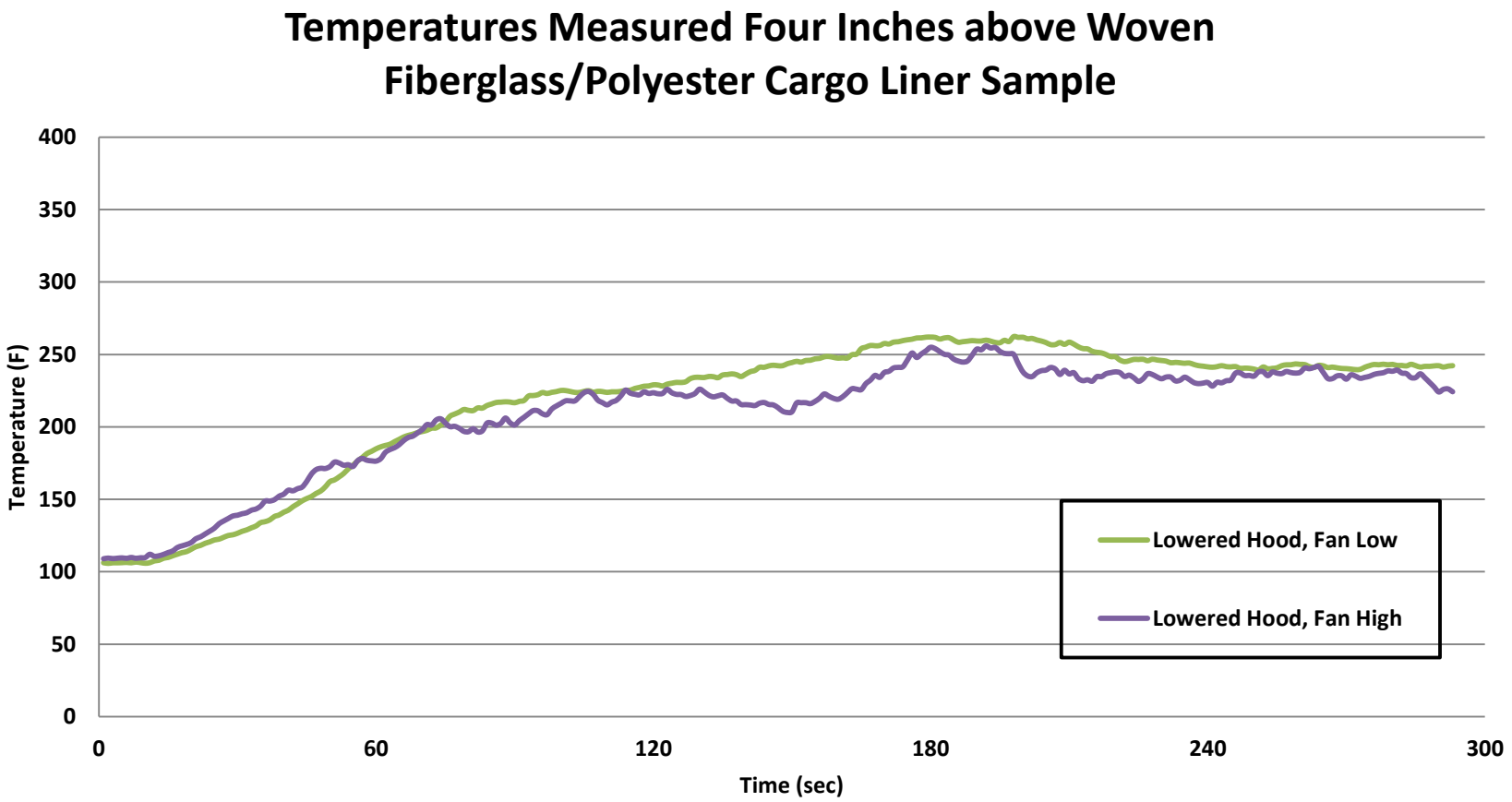
Airflow Study: Test Results

- **Increasing the airflow within the cell caused the measured temperatures to drop**
  - More airflow means more heat pulled from cell
- **Opposite is true when reducing fan speed**
  - Less airflow, less heat removed, higher temps
- **Addition of hood extension**
  - *If the distance between the test sample and ventilation hood is significantly decreased, should the temperature also decrease?*
    - Hood lowered approximately 5 feet

Airflow Study: Test Results

Airflow Study: Test Results

Test cell with addition of vent lowered vent hood (closer to test sample)

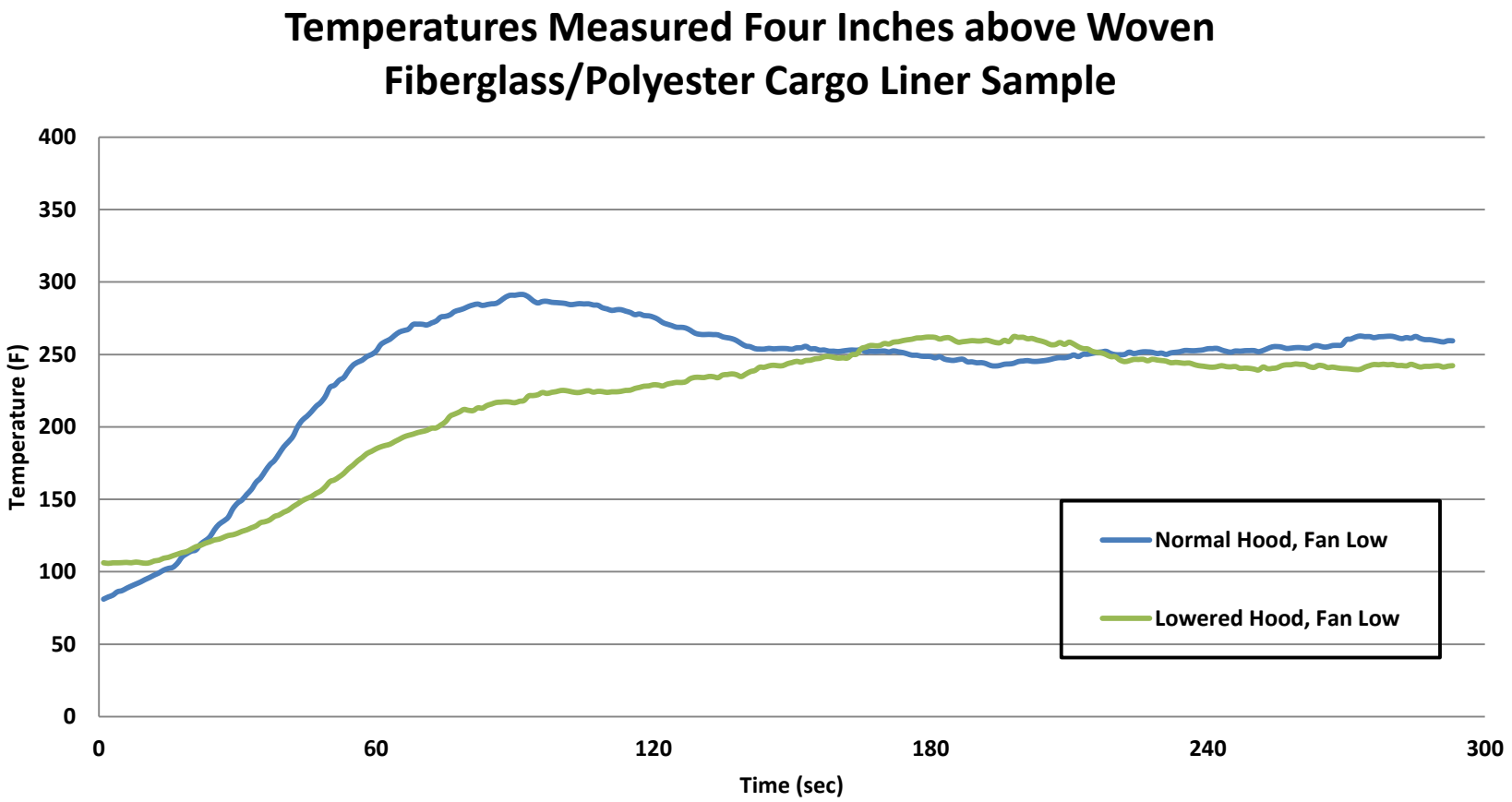


Airflow Study: Test Results

- **More airflow (fan on high) still produces lower temperatures as with baseline tests**
- **Peak temperatures were slightly reduced**
  - Moving vent hood closer to sample lowered temperatures but not as drastic as anticipated
    - Hood placement was chosen as an extreme example to demonstrate what could happen when there is insufficient distance between the hood and test sample leading to abnormally low temperature readings
- ***Unexpected change in temperature profile...***

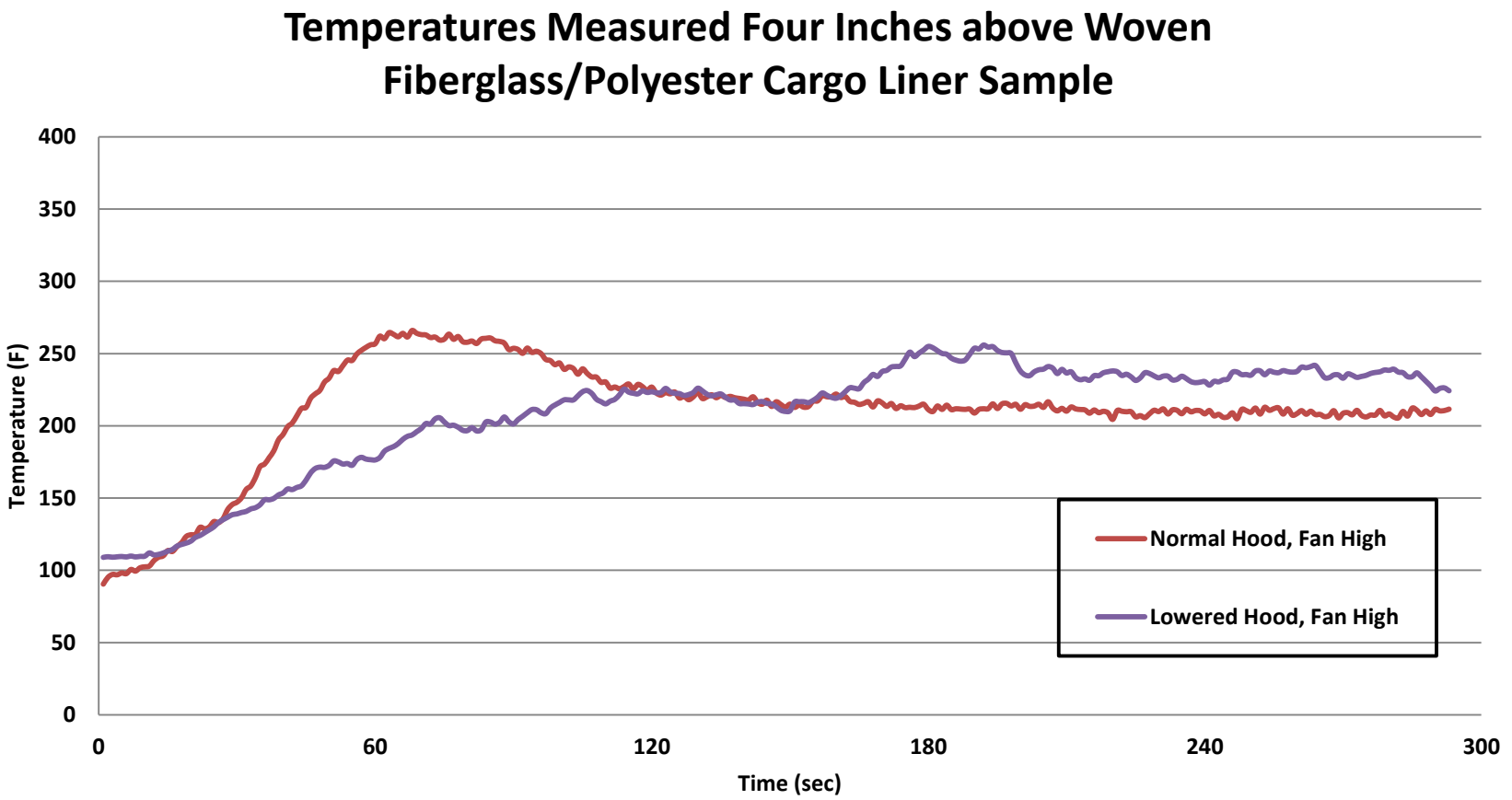
Airflow Study: Test Results

Test cell with lowered hood and fan on low speed



Airflow Study: Test Results

Test cell with lowered hood and fan on high speed



Airflow Study: Test Results

- **A drastic decrease in temperature readings was expected with the addition of the hood extension, as compared to the testing in the unmodified test cell**
- **However, there was an obvious change in the measure temperature profile over the duration of the 5 minute test period**
- **Final temperature readings nearly the same with and without hood extension**

Airflow Study: Test Results

- **Unexpected test results suggest further testing and analysis required**
  - What else do we not fully understand about the test cell environment and data result relationship?
- **Rule and Handbook are somewhat vague as to measuring airflow in test cell**
  - Vertical and horizontal measurements only
  - This is left wide-open to interpretation of test lab
  - How can this be more defined in guidance material?

Future Work

Planned Testing

- **Already baseline tests run while varying fan speed and adding hood extension**
- **Relocate cargo liner test apparatus to a larger test cell (Full-Scale Test Facility)**
- **Continue testing while varying multiple environment conditions/configurations**
- **Similar or same test conditions will be conducted with seat cushion test method**
  - Seat test is known to be even more susceptible to test cell conditions (particularly airflow)

Questions?

timothy.salter@faa.gov

(1)-609-485-6952