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

By: Tim Salter, FAA Technical Center

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Introduction

- **Updated Chapters 7 and 8 of the Handbook**
  - Seat cushion and cargo liner burner configuration
  - Cargo burner test results
  - Seat cushion and cargo liner interlab studies
  - Muffler foam insert tests
  - Air pressure regulator

- **Planned Projects**
  - Cone alloy comparison
  - Test cell ventilation testing

Handbook Updates

NexGen Burner Background

- **The original concept was to retain the same internals from the Park burner for use in the NexGen burner in order to keep burner performance similar**
- **After trialing numerous stator/turbulator configurations with little success, other options were considered**
- **Oil burners on the market today no longer use stators and turbulators**
- **Flame retentions heads (FRH) are now used in their place**
  - Generate a more efficient and complete combustion
  - Simpler in design
  - Relatively easier to produce

Turbulator

Flame Retention Head

Stator

Static Plate

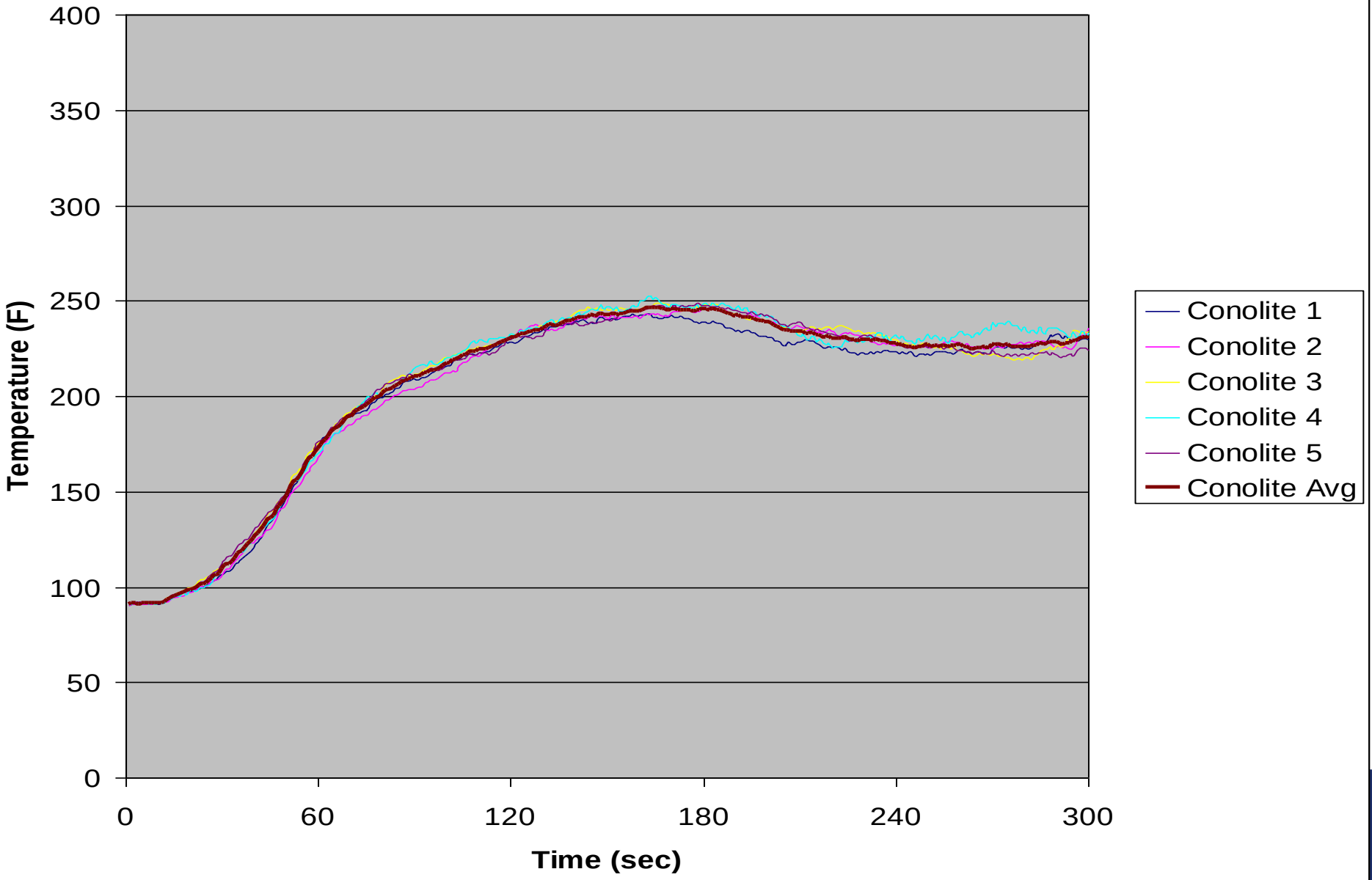
Current Burner Configuration

- **FRH proven to work for seat and cargo burner**
- **Goal to make all burners the same using new igniterless stator and spark plug configuration**
- **Disadvantages of FRH**
  - Stamped steel part (tolerance concerns)
  - Spacer tube required in draft tube
  - Static plate not a “tight” fit (fuel nozzle alignment issues)
  - Use of internal igniters and wires (airflow disruption)
  - No set method of positioning igniter wires
  - FRH and static plate may change in design or become obsolete in the future

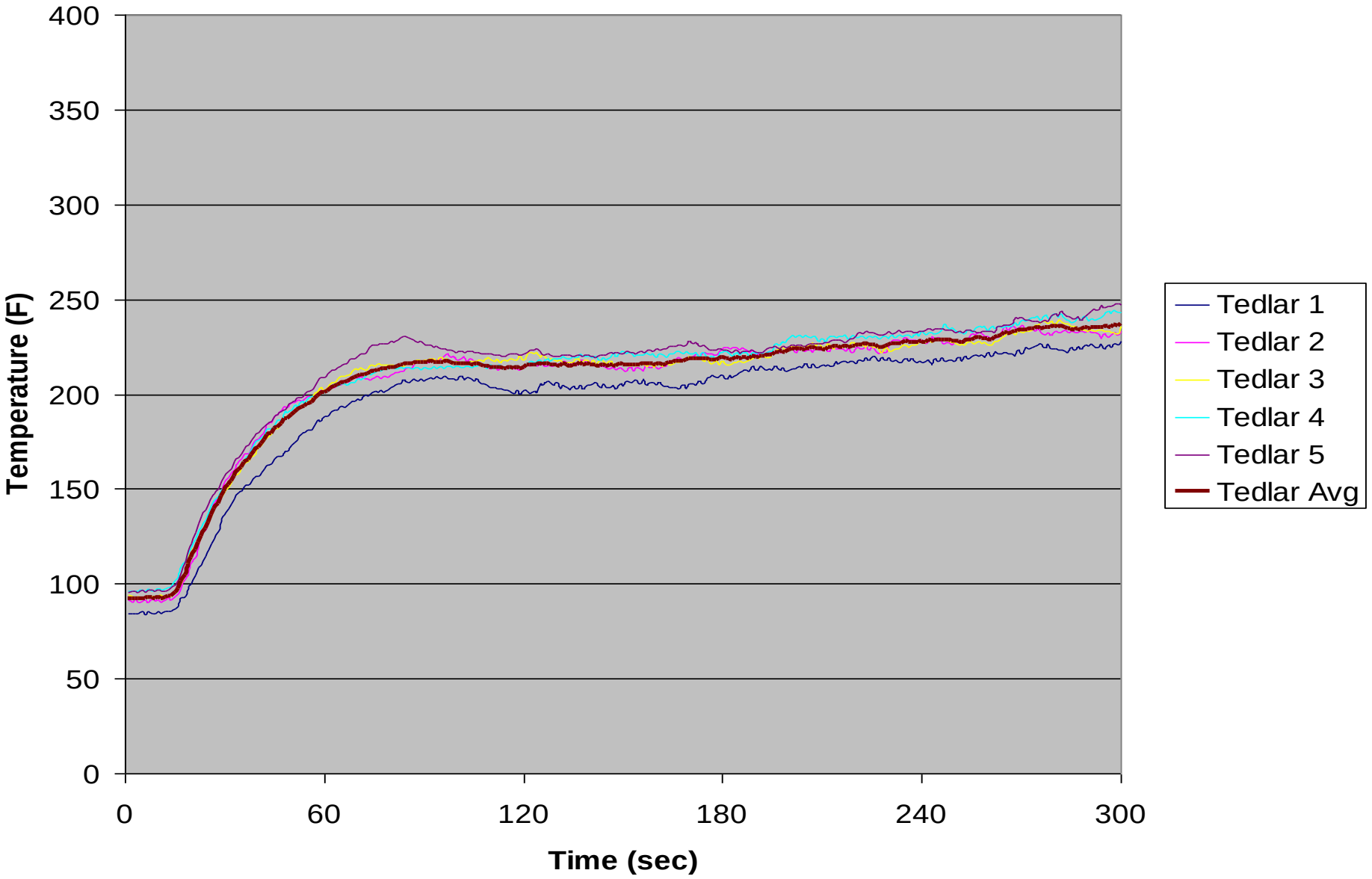
Current Burner Configuration

- **Igniterless stator configuration currently being tested for use with seat cushion and cargo liner oil burner test method**
- **Testing has shown using the igniterless stator for cargo liner is repeatable**
- **Will test igniterless burner for use with seat cushion test method when facilities become available (renovations currently underway)**
- **No machining required to convert to igniterless stator configuration except for adding threading boss for spark plug**

Temeprature Profiles 4 inches above Backface of Conolite Cargo Liner using Igniterless Stator Configuration



Temperature Profiles 4 inches above Tedlar Coated Cargo Liner using Igniterless Stator Configuration



Round Robin Studies

- **Currently have planned “mini” interlab study for both seat cushion and cargo liner oil burner test methods**
- **4 labs participating for seat cushion**
  - 3 different cushion types per lab (3 of each type)
- **3 labs participating for cargo liner**
  - 2 different liner types per lab (5 of each type)
- **Participating labs kept to a minimum due to time constraints and available burner stators/cones**
- **Materials to be shipped first week of March**

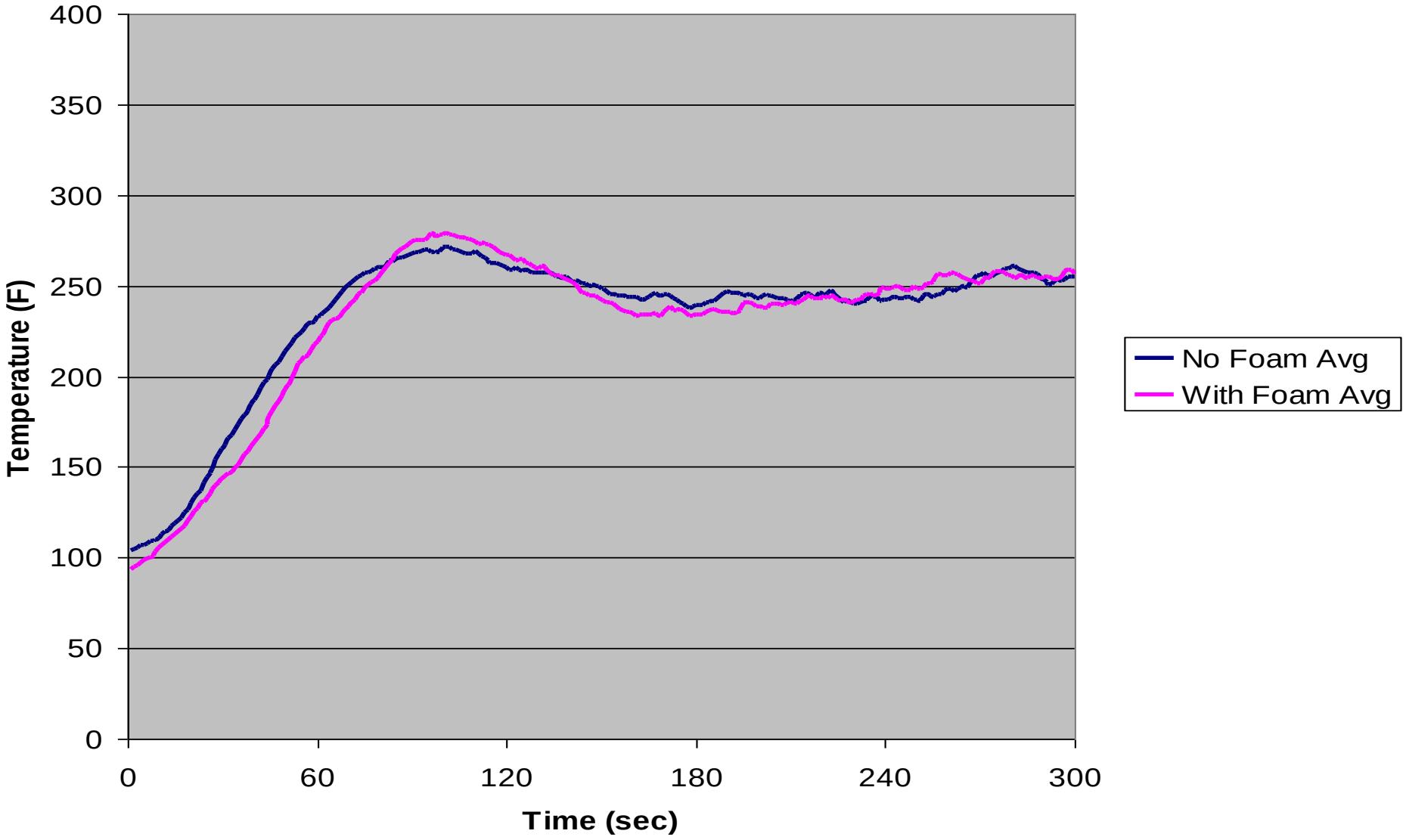
Round Robin Studies

- **Test results needed for seat and cargo before a decision can be made regarding final burner configurations**
- **Cargo liner tests have shown excellent repeatability within the FAA lab**
- **No seat tests have been performed as of yet**
- **Final copy of updated chapter 8 for cargo liner is currently under review**
- **Updated chapter 7 to be released when test data is available**

Muffler Foam Insert

- **A 3” diameter by 12” long reticulated foam cylinder is required to be used in the burner muffler**
- **Testing showed minimal effect on test results**
- **Reduce burner noise from ~95 to ~82 decibels**
- **Similar to light road traffic vs. a subway train**

Temperature Profiles for Burner with and without Foam Insert in Muffler



Muffler Foam Insert

- **Foam insert can have a tendency to discharge from the muffler into the burner tube**
- **Recommend using safety wire of a diameter of ~0.032 inches inside muffler in a cross-type pattern to restrain foam**

Muffler Foam Insert

- **New and old style mufflers have slightly different inner and outer diameters, although, still share the same McMaster-Carr part number**
  - Old 3” outer diameter
  - New 2 5/8” outer diameter
- **Testing planned to determine if this will impact burner performance**

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**
- **Quality concerns (even new)**
- **Some pressure regulators may vary by +/- 3 psi or more**
- **Handbook requires air pressure maintain 45 +/- 1 psi**
- **Recommend McMaster-Carr regulator part # 49305K23 with an operating range of 0-55 psi**
- **Alternative regulators planned for testing**

Planned Projects

Cone Alloy Comparison

- **Current standard for burner cone alloy is 310 stainless steel**
- **Cones have been found to deform by up to ½ inch or more after a moderate number of heat cycles**
- **Plans to test 625 Inconel and Hastelloy X alloy cones compared to 310 SS**
- **Burn for 2 minutes, cool for 10-15 minutes, repeat**

Cone Alloy Comparison

- Used cone (left) and new cone (right) show the difference in shape after testing
- Used cone changed from 11 x 6 in. to 11.375 x 5.5 in.

Lab Variables

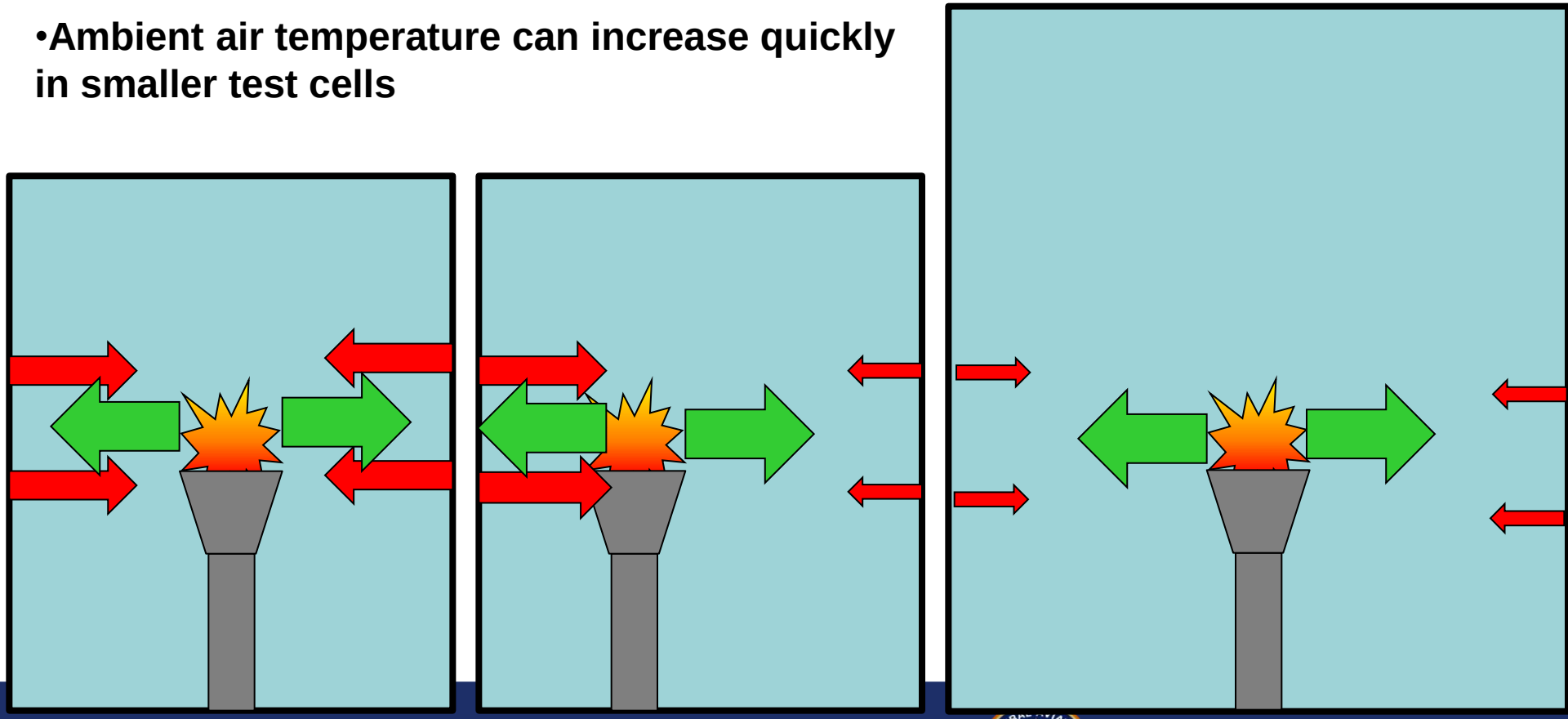
- **NexGen should always perform the same if assembled and operating correctly**
- **Differences in the test lab setups are likely the cause of data discrepancies among test labs**
- **Test cell size, ventilation hood height, airflow in the test cell are can impact burner test results**

Test Cell Size

- Heat from the flame can be reradiated back toward test sample from nearby walls
- Larger test cells would show less of this effect
- Ambient air temperature can increase quickly in smaller test cells

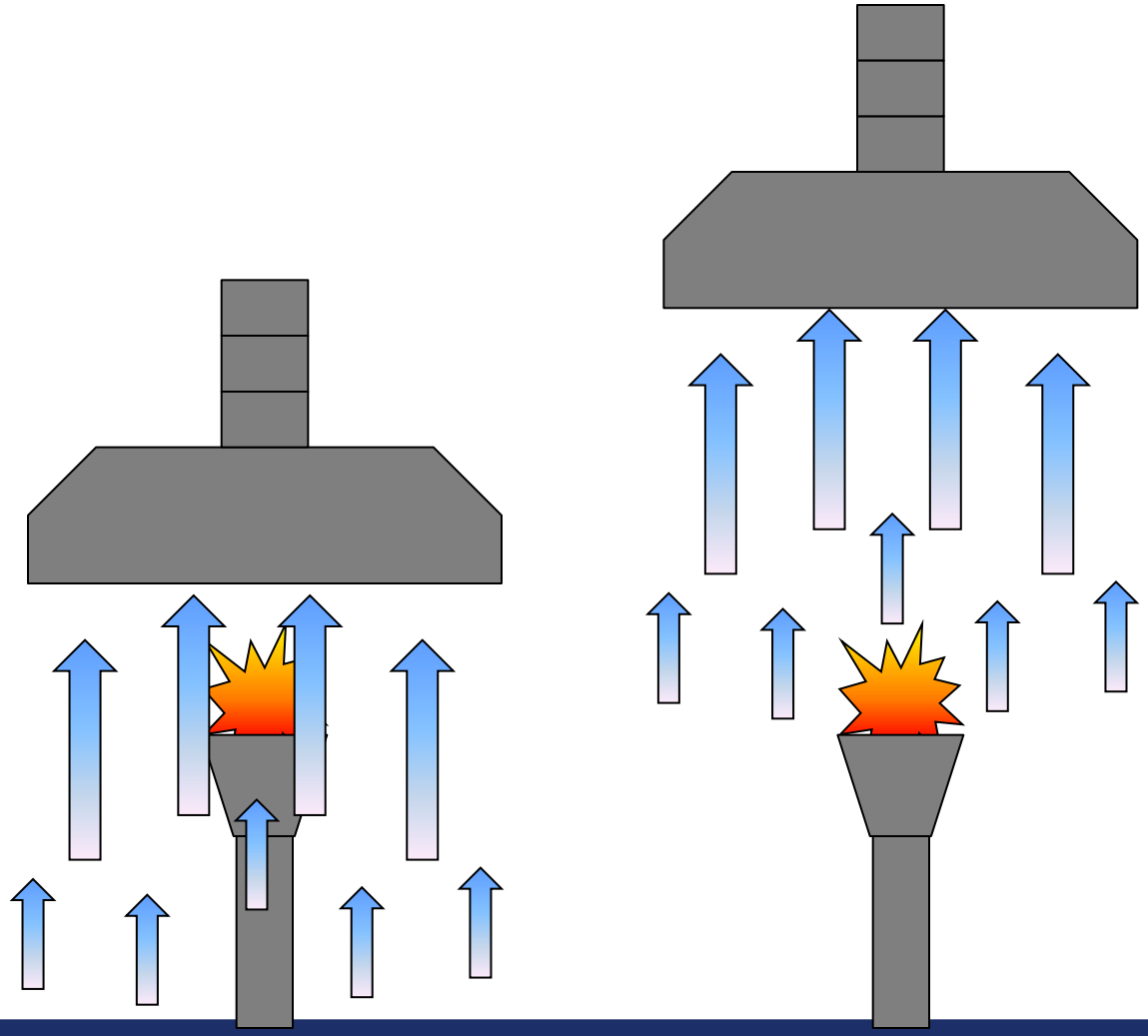
Radiant Heat from Flame:

Reradiating Heat from Walls:



Ventilation Hood Height

- **The height of the ventilation hood can impact on test results**
- **A hood located close to the sample can pull more hot air and heat away from the sample resulting in a lowered temperature reading**
- **Hood should be close enough to remove smoke but not too close as to affect test results**



Test Plan

- **Recently purchased two NIST traceable Dwyer Instrument model 641-6-LED anemometers for use in ventilation airflow testing**
- **Minimize test cell volume using partitions**
- **Maximize test cell volume in full scale lab**
- **Test cell sizes in between**
- **Vary ventilation fan speed**
- **Recommend ventilation airflow for labs based on test results**

Handbook Discussion

Summary of Handbook Updates

- **Incorporate NexGen burner into Handbook**
- **Recent burner changes**
  - Igniterless stator and cone-mounted spark plug
  - Flame temperature “check” (1700° F +/-100° F) using 1/8” thermocouples
  - Fuel and air pressure gauges required to be NIST approved (or equivalent) and have an accuracy of +/-2% or less
  - Muffler foam insert required

- **Discussion regarding suggestions or concerns during task group meetings**

Questions?