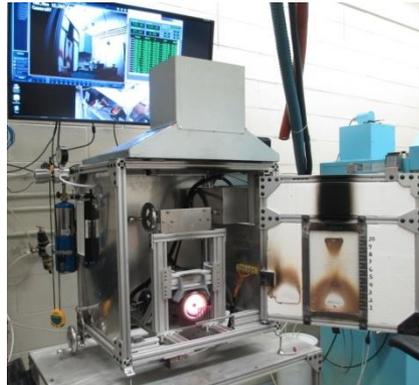


Development of a Flame Propagation Test Apparatus for Inaccessible Area Materials



Federal Aviation
Administration



Presented to: IAMFTWG

By: Robert I. Ochs

Date: October 19-20, 2015, Atlantic City, NJ

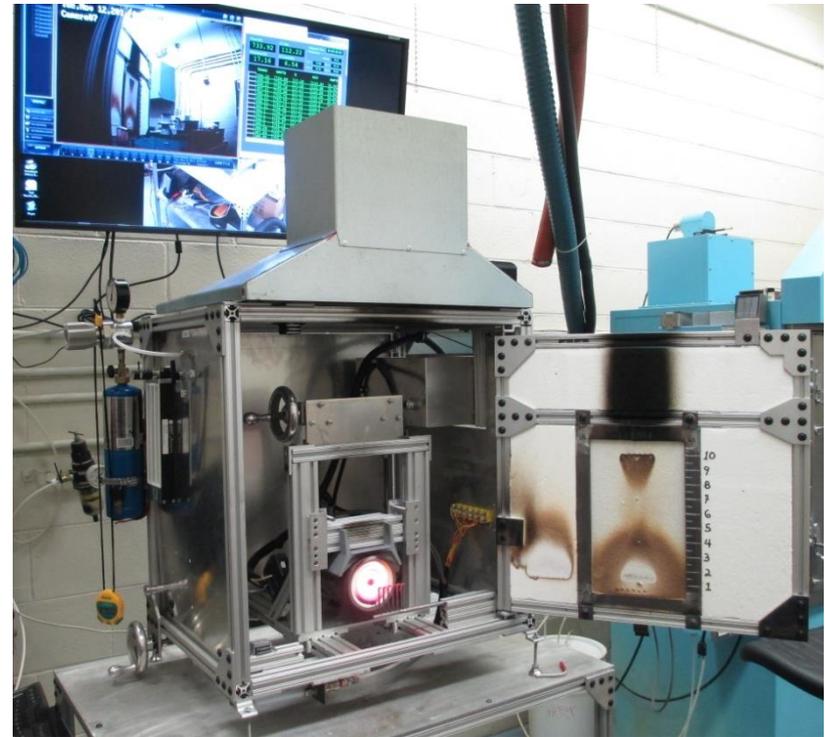
Introduction

- Carbon fiber composites are being used more frequently in aerospace applications
 - Increased strength
 - Lower density
 - Better corrosion resistance
- New designs of commercial transport airplanes include primary and secondary structure constructed from carbon fiber composites
- Current FAR's do not require flammability testing for fuselage skins or structures, as traditional designs are inherently non-flammable
 - Special Conditions for certification of fire resistance of composite fuselage
 - Must demonstrate level of safety equivalent to or better than traditional constructions
- To continue with the FAA's efforts to enhance in-flight fire safety, materials in inaccessible areas of the cabin should meet a flammability test based on the "block of foam" fire source

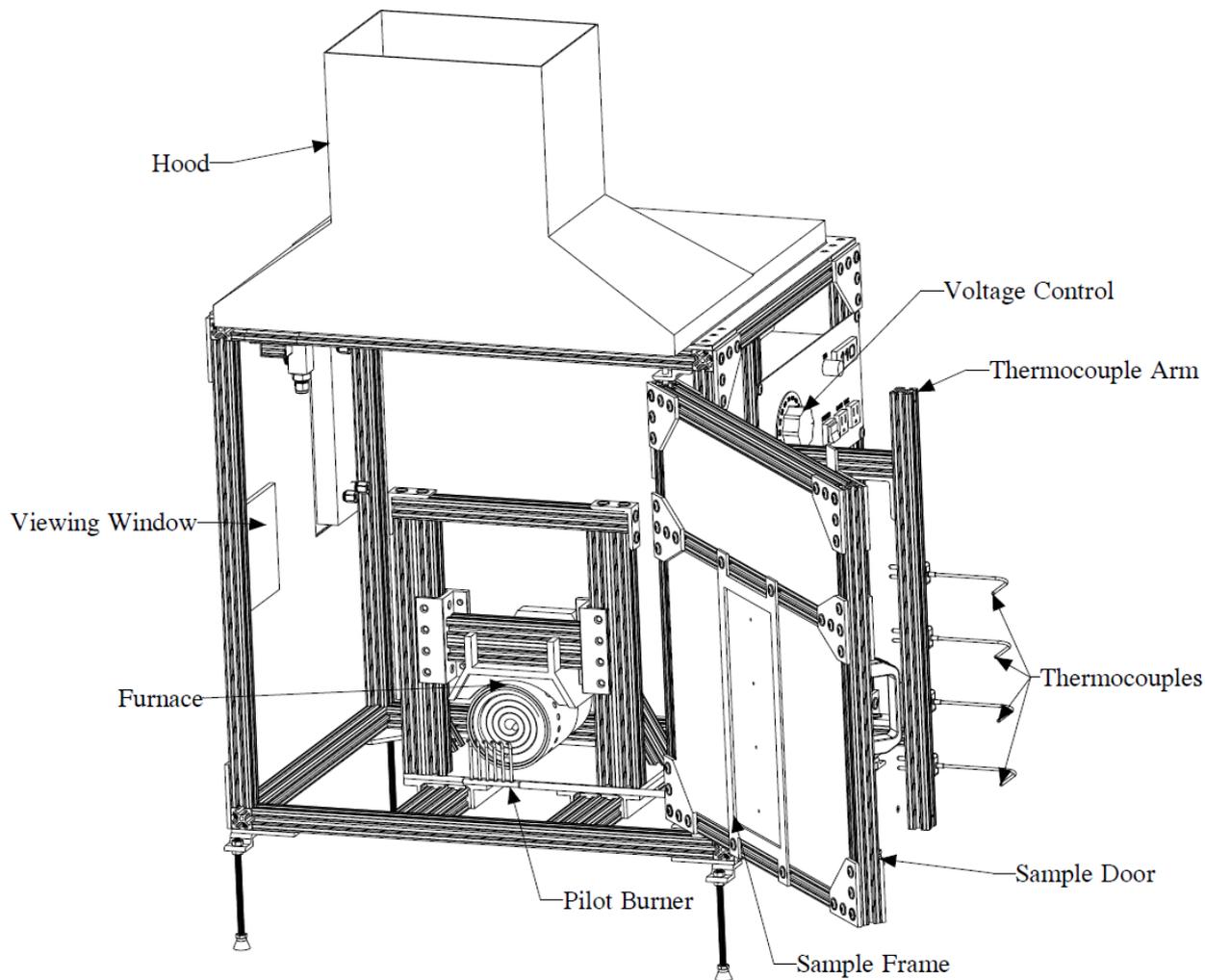


Objective

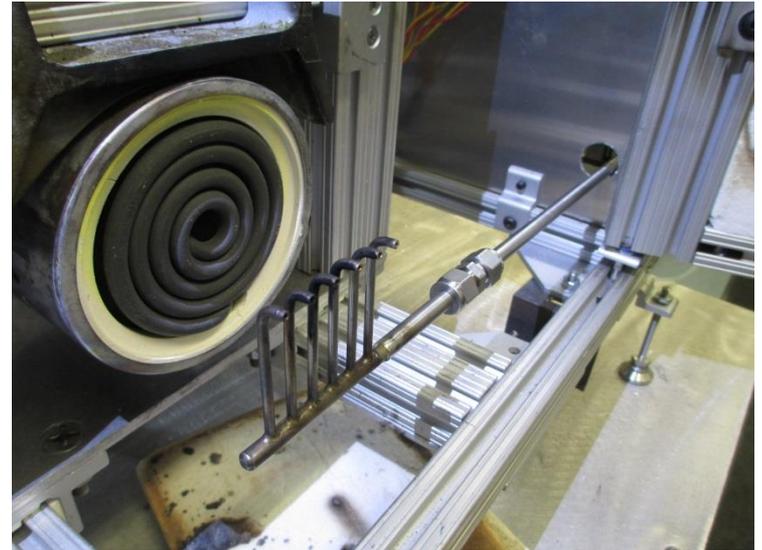
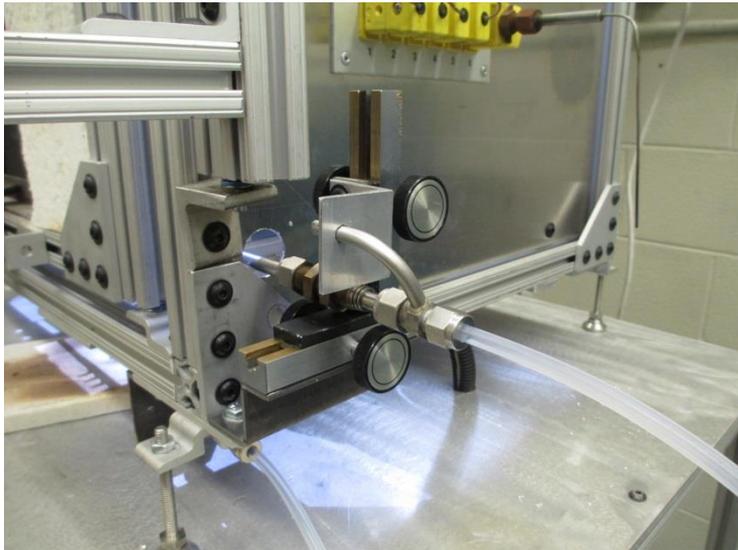
- Design, construct, and evaluate a new flame propagation test method
 - Determine effectiveness of evaluating flame propagation
 - Determine level of repeatability and reproducibility
- Deliver new test method to FAA Transport Directorate for use in certification of novel design airplanes
 - Inclusion in next-generation fire test requirements
 - Possibly replace current Special Conditions requirements
- Attempt to test other inaccessible area materials on same apparatus
 - Wire insulation
 - Ducts, hoses



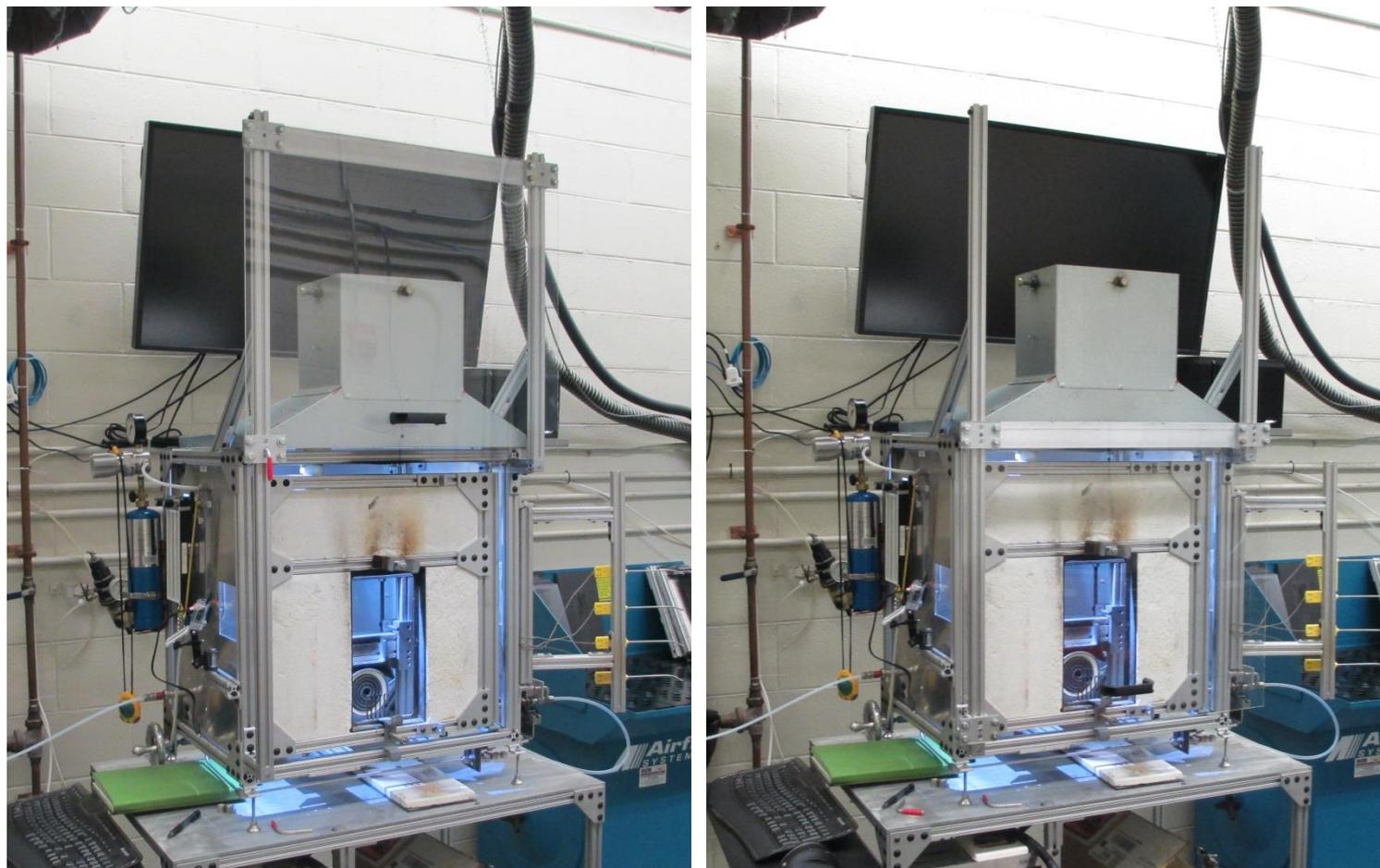
Vertical Flame Propagation Test Apparatus



Traversing Pilot Burner



Built-On Sash Hood

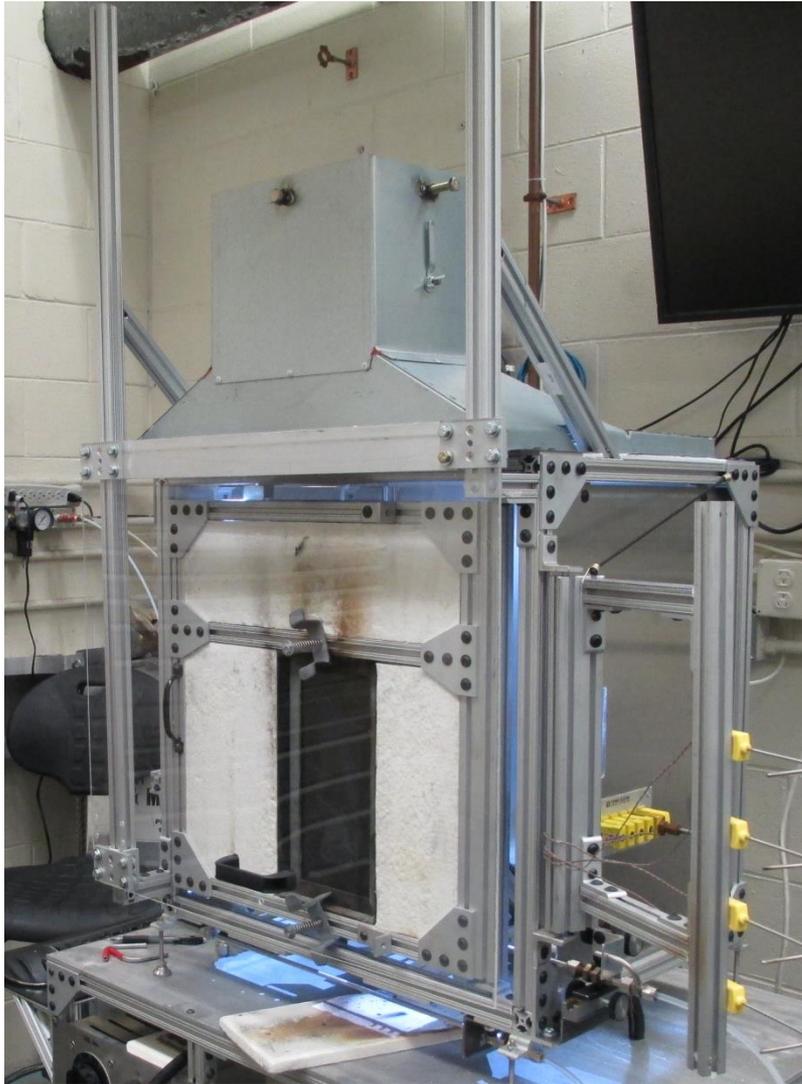


Vertical Flame Propagation Test Method Development
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Built-On Sash Hood



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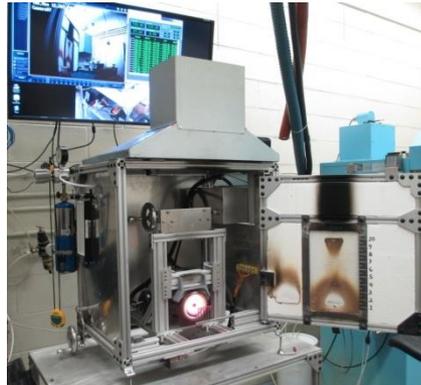


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What's New?



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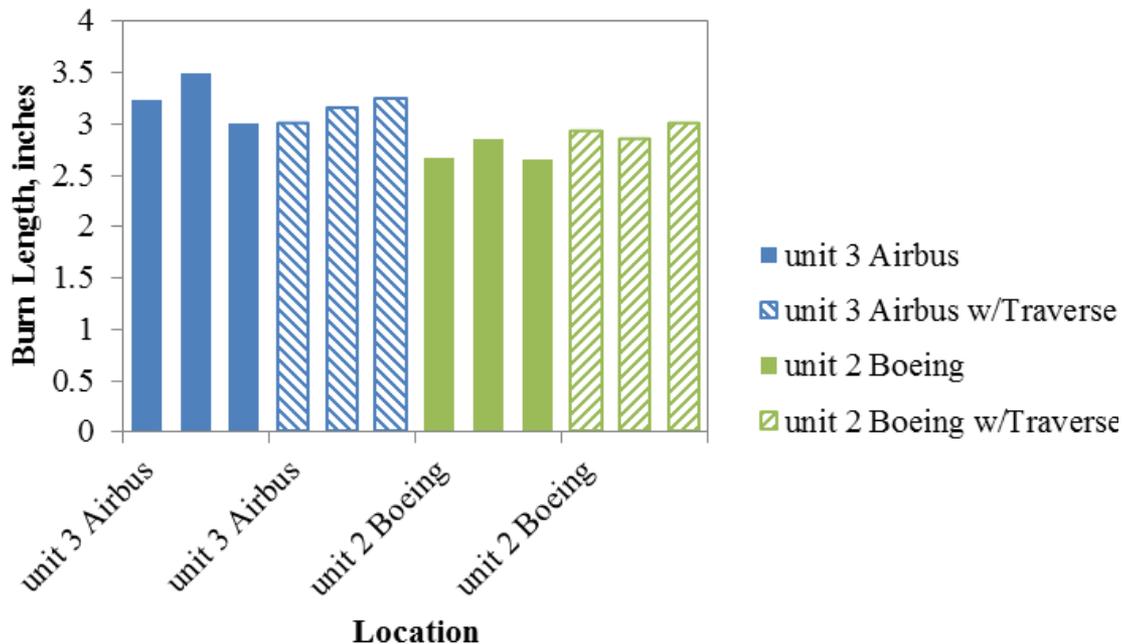
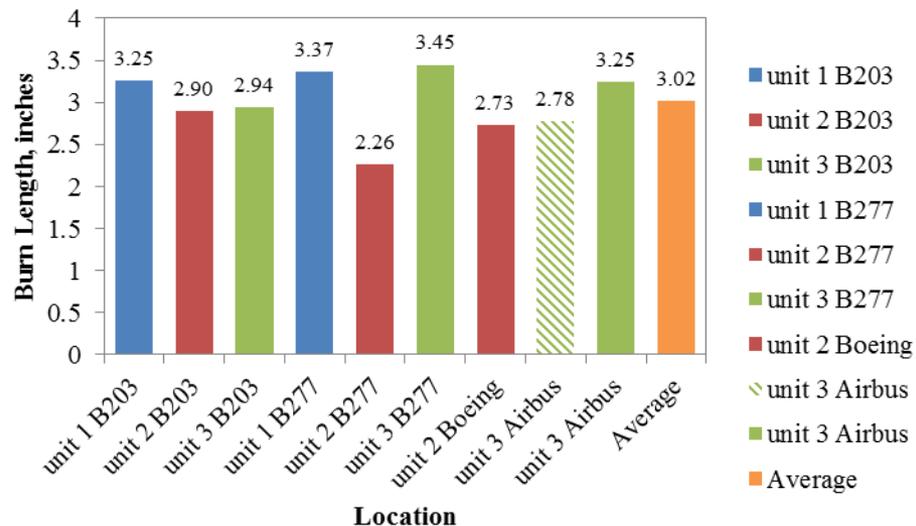
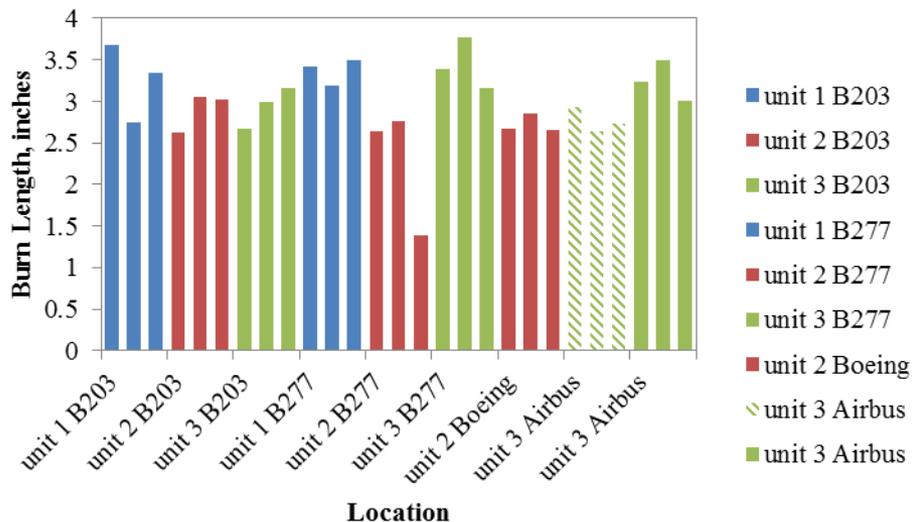
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Modifications to Boeing & Airbus Machines

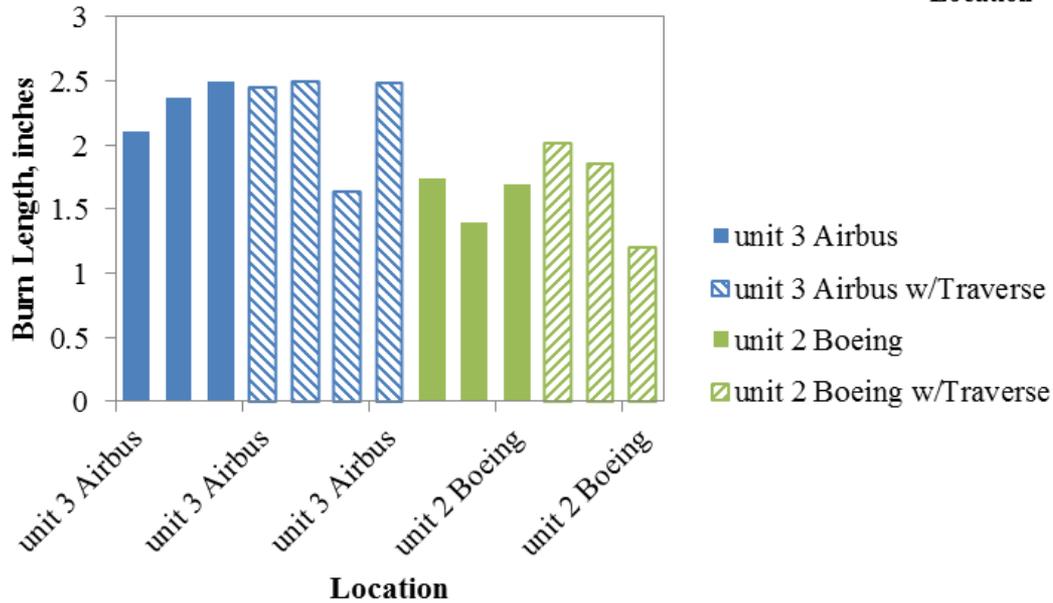
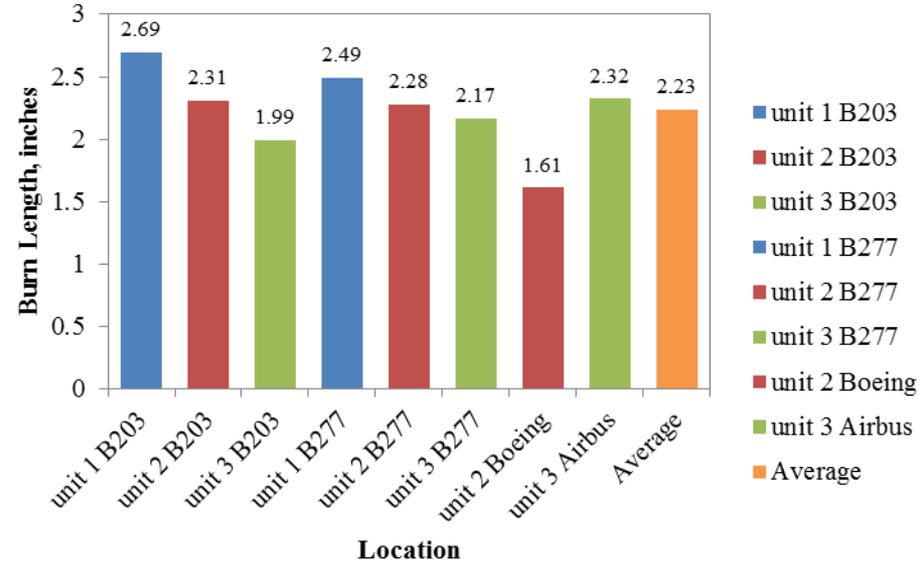
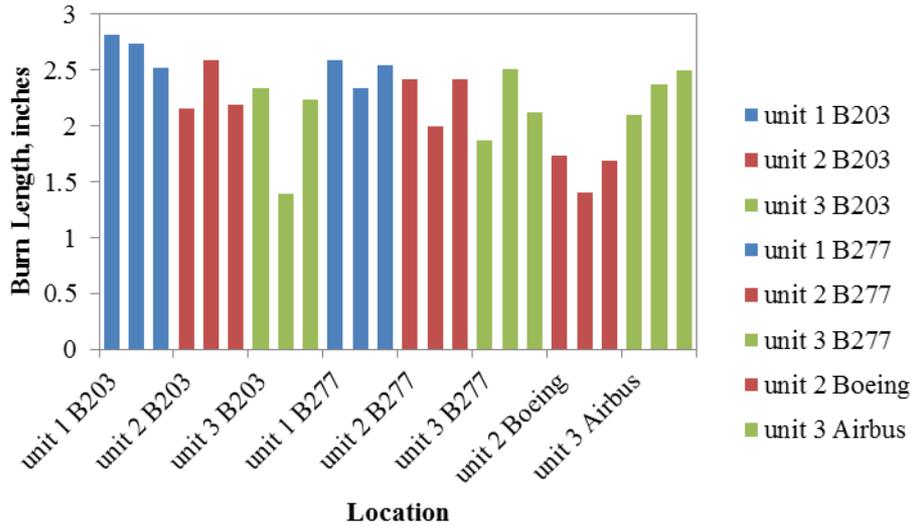
- Traveled to Boeing and Airbus to install traversing pilot flame on each machine
- Pilot flame settings:
 - 35 ccm propane / 70 ccm air
 - ½” distance from pilot burner to sample face



Results – 3KPW-8 Ply

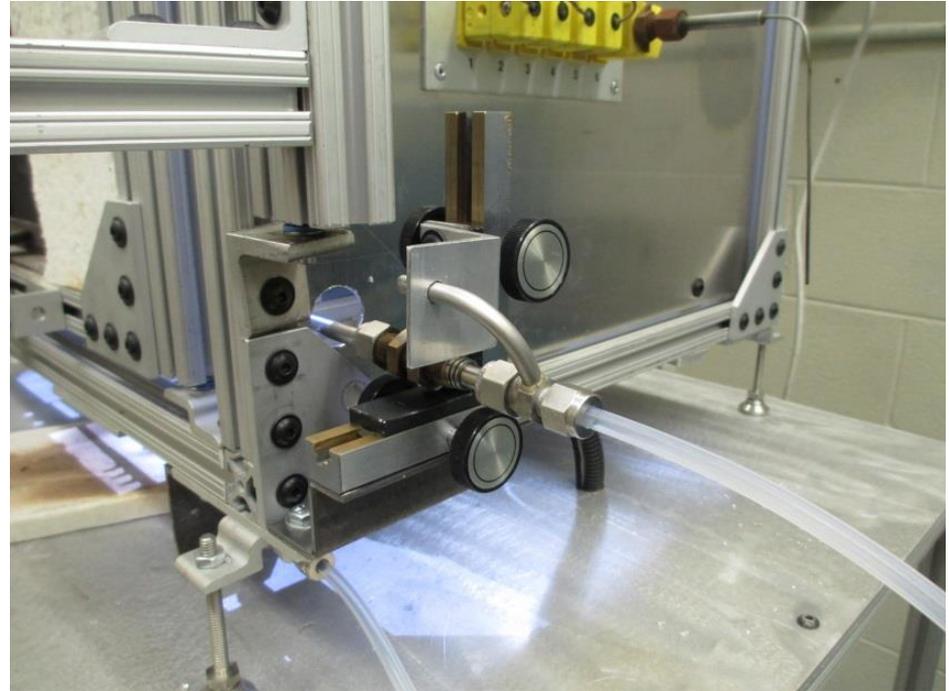


Results – TC350-8 Ply



Traversing Pilot Flame - Summary

- Adding traverse mechanism to pilot flame had no significant impact on burn length results
- Modification allows for fine adjustment of pilot flame to sample distance



Wire Sleeving & Heat Shrink Testing

- Preliminary testing to determine best way to test in VFP
 - Copper tube
 - No tube





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Next Steps

- Gather large quantity of composite samples for testing
 - Similar to original comparative test series
 - CFRP panels from 4-12 plies
 - Unidirectional tape and woven fabric layup
 - Obtain enough samples to adequately assess repeatability at different pilot flame distances and flame lengths
 - Once a distance and length is chosen, perform tests on other machines, determine reproducibility



Development of Advisory Circular



Advisory Circular

Subject: Flammability Requirements for Inaccessible Area Materials for Title 14, Category Airplanes

This advisory circular provides the requirements of Title 14, Code of Federal Regulations for inaccessible area

mm/dd/yy DRAFT AC 25.853-X

7.1.2 The type of test and the way the fire threat is resisted dictate the degree to which actual parts representation is needed.

7.2 Pass/Fail Criteria.

7.2.1 The pass/fail criteria at any time that at least three specimens minimum three specimens failure of one specimen tested to be able to record

8 VERTICAL FLAME PROPAGATION TEST

8.1 General.

8.1.1 Test Observation. It is important to visually observe the test to ensure that it is achieved by observing recommended that a video camera be used, if available, afterwards, to observe the test.

8.1.2 Pilot Flame Length. Research has indicated that it is important to monitor the flame length to ensure that they remain within the specified limits.

8.1.3 Furnace Power. Research has indicated that the power fluctuates and deliver more repeatable test results.

8.1.4 Backside Effects. Research has indicated that the test sample greatly affects the back surface, as well as the front surface. Shrouding of the test sample will result in increased backside effects.

8.1.5 Re-ignition System. Some composite materials can burn, resulting in bursts of flame that can extinguish all pilot flame. This can be installed below the pairs of electrodes to ensure that the burners quickly re-ignite the burners quickly they must be re-ignited with a flame.

mm/dd/yy DRAFT AC 25.853-X

Table 1. Flammability-Rated Wire Types.

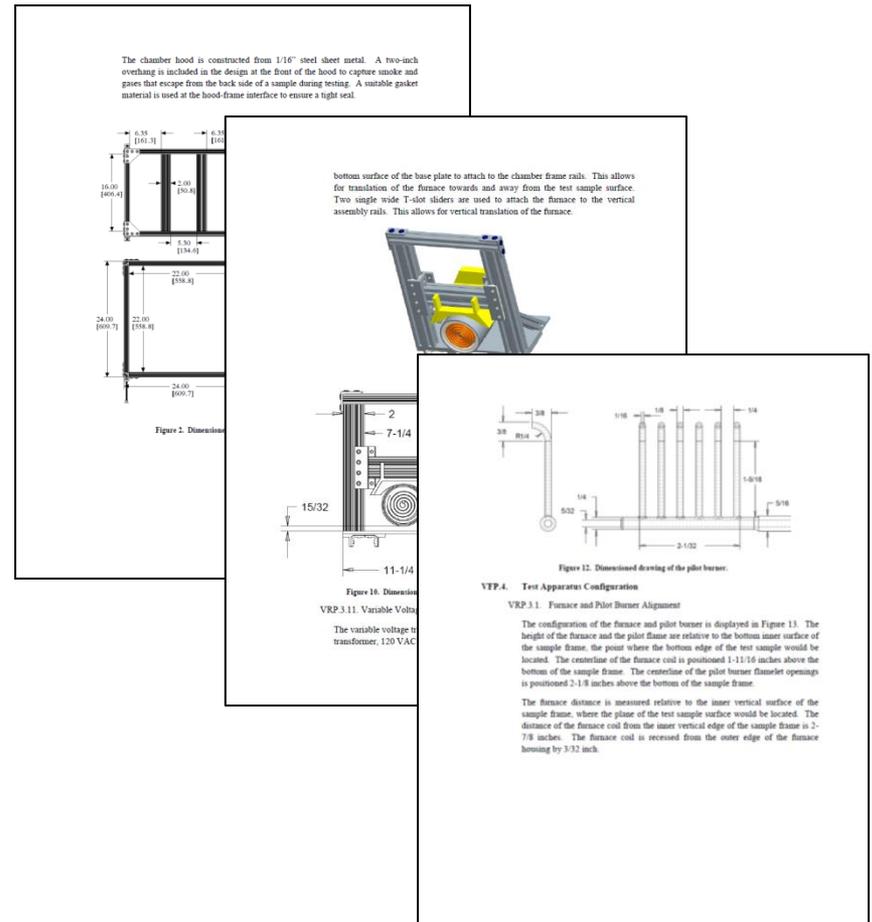
Document	Voltage Rating (maximum)	Rated Wire Temperature (°C)	Insulation Type	Conductor Type
MLL-W-227591	600	200	Fluoropolymer insulated TFE and TFE coated glass	Silver coated copper
MLL-W-227592	600	260	Fluoropolymer insulated TFE and TFE coated glass	Nickel coated copper
MLL-W-227593	600	260	Fluoropolymer insulated TFE-glass-TFE	Nickel coated copper
MLL-W-227594	600	200	Fluoropolymer insulated TFE-glass-TFE	Silver coated copper
MLL-W-227595	600	200	Fluoropolymer insulated extruded TFE	Silver coated copper
MLL-W-227596	600	260	Fluoropolymer insulated extruded TFE	Nickel coated copper
MLL-W-227597	600	200	Fluoropolymer insulated extruded TFE	Silver coated copper
MLL-W-227598	600	260	Fluoropolymer insulated extruded TFE	Silver coated copper
MLL-W-227599	1000	200	Fluoropolymer insulated extruded TFE	Silver coated copper
MLL-W-2275910	1000	260	Fluoropolymer insulated extruded TFE	Silver coated copper
MLL-W-2275913	600	153	Fluoropolymer insulated FEP PVDF	Tin coated copper
MLL-W-2275916	600	150	Fluoropolymer insulated extruded E TFE	Tin coated copper
MLL-W-2275917	600	150	Fluoropolymer insulated extruded E TFE	Silver coated high strength copper alloy
MLL-W-2275920	1000	200	Fluoropolymer insulated extruded E TFE	Silver coated high strength copper alloy
MLL-W-2275921	1000	260	Fluoropolymer insulated extruded E TFE	Nickel coated high strength copper alloy
MLL-W-2275934	600	150	Fluoropolymer insulated crosslinked modified E TFE	Tin coated copper
MLL-W-2275935	600	200	Fluoropolymer insulated crosslinked modified E TFE	Silver coated high strength copper alloy
MLL-W-2275941	600	200	Fluoropolymer insulated crosslinked modified E TFE	Nickel coated copper
MLL-W-2275942	600	200	Fluoropolymer insulated crosslinked modified E TFE	Nickel coated high strength copper alloy
MLL-W-2275948	600	200	Fluoropolymer insulated crosslinked modified E TFE	Silver coated copper

- Currently developing guidance material
 - General VFP Guidance
 - Composite Fuselage & Structure
 - Ducts
 - Wire Insulation
 - Approved wire list from AC 43.13-1B
- Received input from task group
 - Thanks!
- Currently reviewing comments and incorporating into document

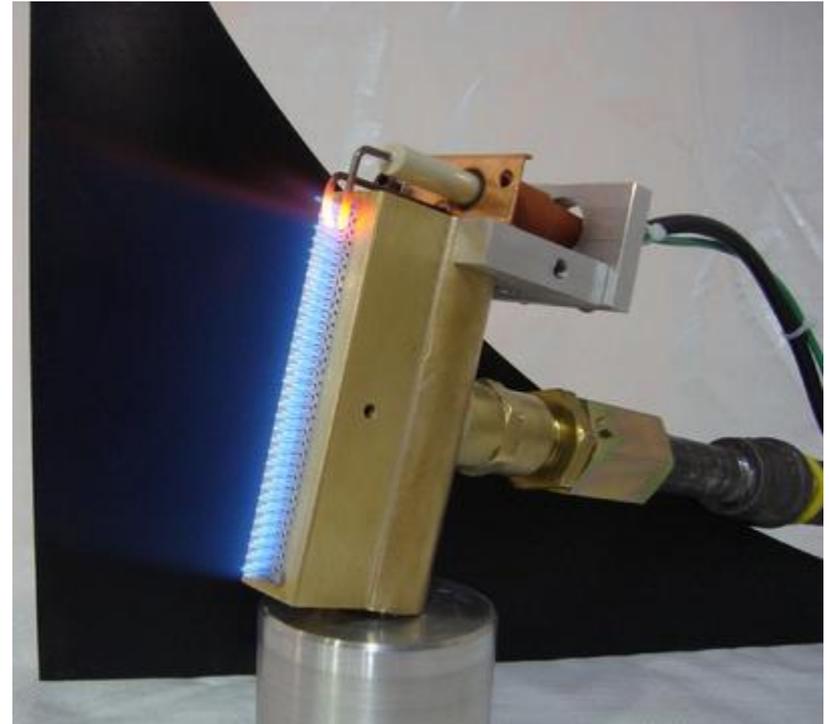
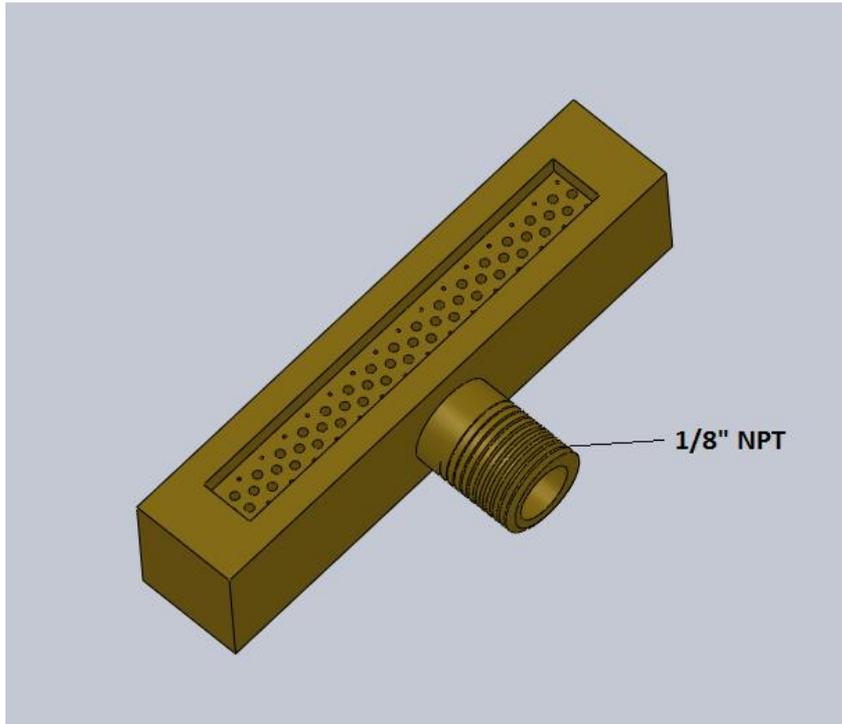


Draft Handbook Chapter with Drawings

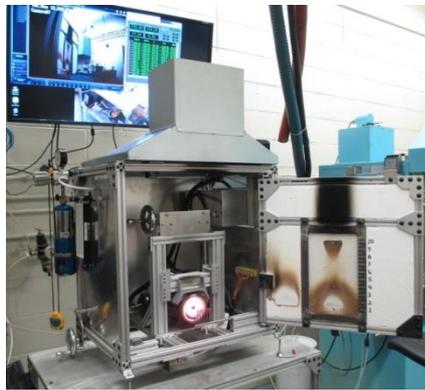
- Draft Handbook chapter was shared with task group
- Comments are encouraged and appreciated
- Still in draft form and not fully complete



Ribbon Flame Pilot Burner



- In task group, Boeing Flammability Lab found ribbon burner online
- Ribbon burner could provide a more uniform, consistent flame less sensitive to alignment
- FAATC hosted a visit by burner company, they will design a compact ribbon burner that can be easily swapped into VFP
- May have comparative results to current burner by March meeting



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