VFP Update

Presented to: IAMFTWG

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Date: March 7 2017

Federal Aviation Administration

Introduction

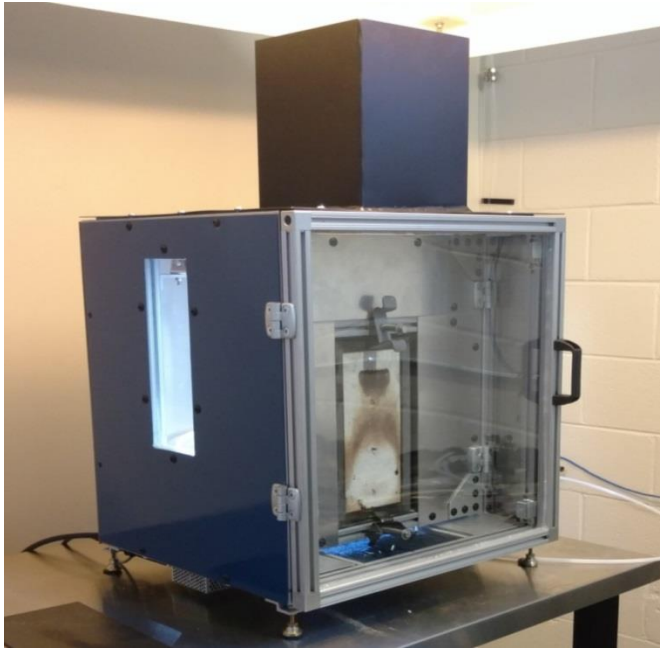
- Carbon fiber composites are being used more frequently in aerospace applications
  - Increased strength
  - Lower density
  - Better corrosion resistance

- 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

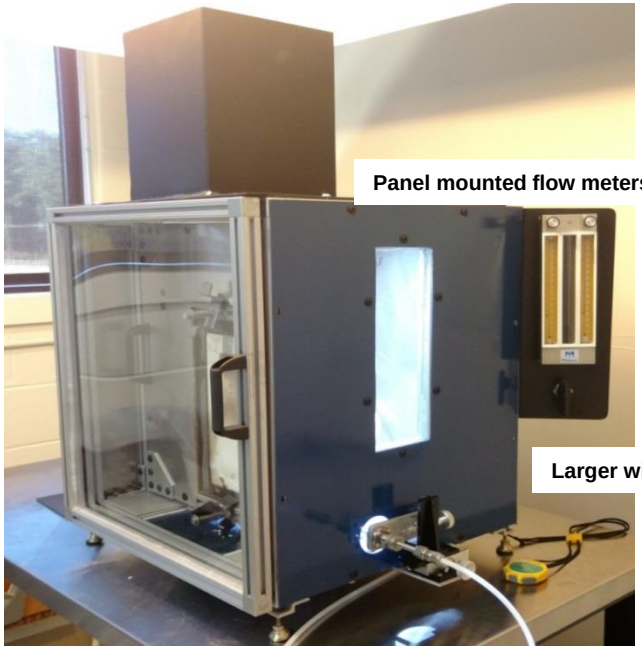
- To continue with the FAA's efforts to enhance in-flight fire safety, materials in inaccessible areas of the cabin should meet a flammability test based on the "block of foam" fire source

Introducing VFP 3.0



- New and improved VFP
- Features:
  - Smaller footprint
  - Controlled air inlet
  - Double-door system to keep backside smoke out of lab
  - Larger viewing windows

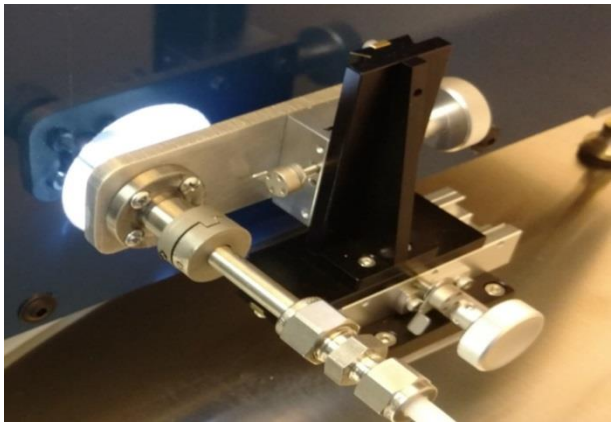
VFP 3.0 Features



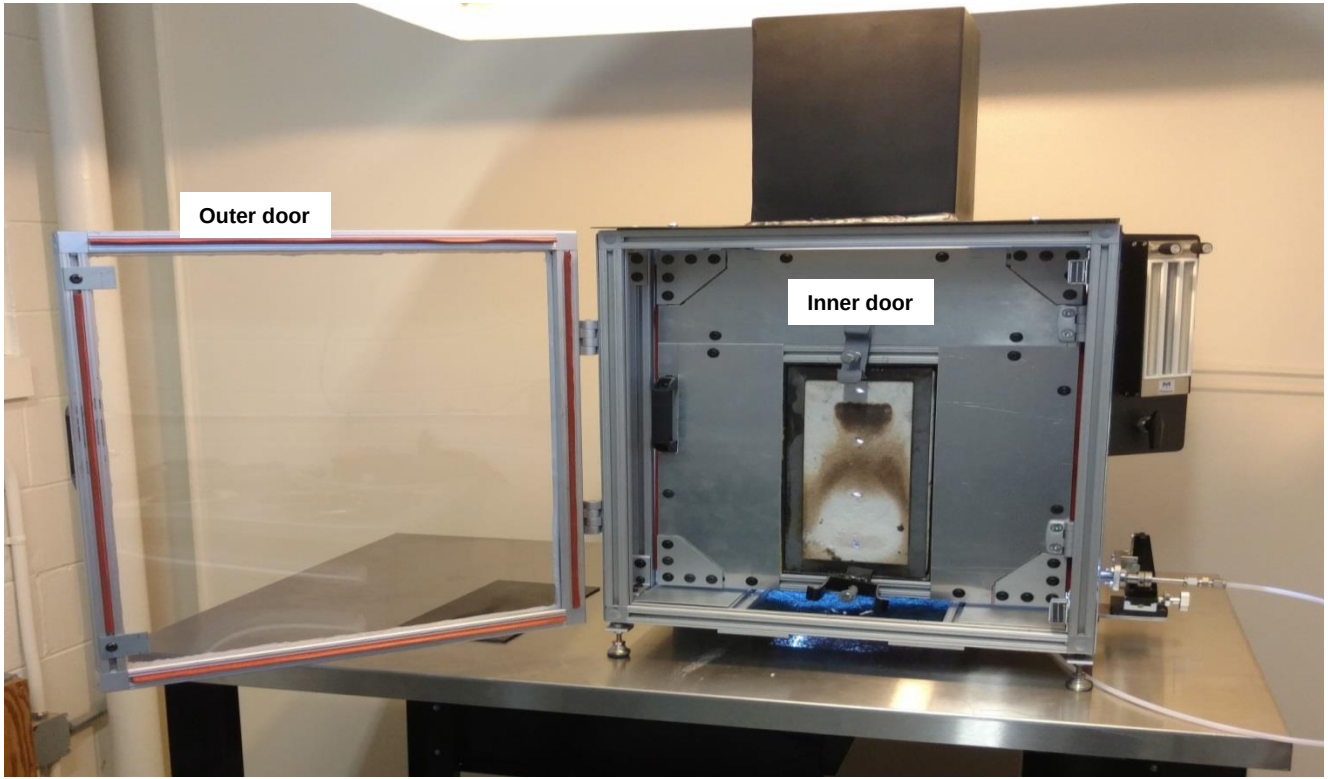
Panel mounted flow meters

Larger windows on both sides

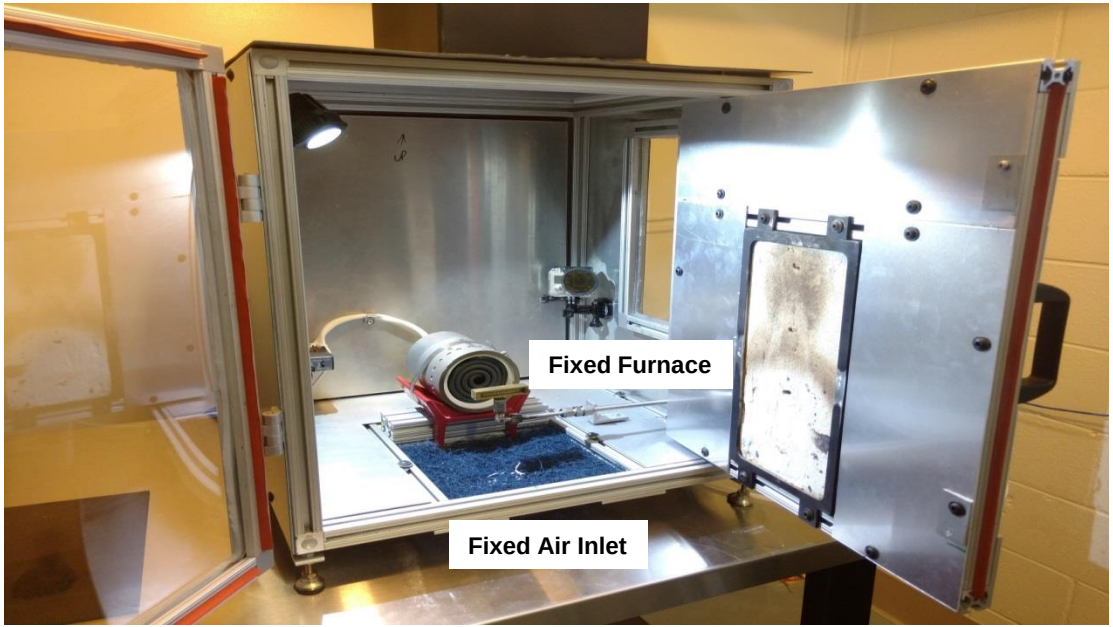
Traversing pilot flame mechanism



VFP 3.0 Features



VFP 3.0 Features



New Power Supply

- Keysight Technologies 6802A Basic AC Power Source
  - Max output power 1000 W
  - Max voltage 270 V
  - Max current 10 A
  - VFP requires 706 W, 112 V, 6.3 A
- Built-in accurate measurement of Voltage, Current, and Power
  - Accuracy:
    - Voltage ±0.25% of reading + 0.15V (typical)
    - Current ±0.25% of reading + 0.04A (typical)
    - AC Power ±01% of reading + 1W (typical)
  - Uses SCPI commands (Standard Commands for Programmable Instruments) to control and query measurements of voltage, current, and power

New Power Supply

- Keysight 6802A
  - **$4300**

OR

- Variac
  - $1077
- Keithley digital multimeter
  - $1940
- Keithley expansion board
  - $500
- Current transducer
  - $100
- Total Cost
  - **$3617**

Power Supply Calibration

1. Output rating AC mode
1−1. Voltage setting

Accuracy : * ± 0.30% of Range / ± 0.25% of Range *(135 V Range/ 270 V Range)

Mode	Range	Voltage	Frequency	Lower limit	Measurement	Upper limit	Status
AC	135 V	13.5 V	55.0 Hz	13.10 V	13.50 V	13.90 V	PASS
AC	135 V	67.5 V	55.0 Hz	67.10 V	67.53 V	67.90 V	PASS
AC	135 V	135.0 V	55.0 Hz	134.60 V	135.03 V	135.40 V	PASS
AC	135 V	13.5 V	420.0 Hz	13.10 V	13.52 V	13.90 V	PASS
AC	135 V	67.5 V	420.0 Hz	67.10 V	67.56 V	67.90 V	PASS
AC	135 V	135.0 V	420.0 Hz	134.60 V	135.03 V	135.40 V	PASS

4. Voltage measurement

Accuracy : For 45 Hz to 65 Hz and DC: ±(0.5 % of reading + *0.3 V/0.6 V)
For all other frequencies: ±(0.7 % of reading + *0.9 V/1.8 V) *(135 V Range/ 270 V Range)

Mode	Range	Standard	Frequency	Lower limit	Measurement	Upper limit	Status
AC	135 V	13.50 V	55.0 Hz	13.2 V	13.5 V	13.8 V	PASS
AC	135 V	67.50 V	55.0 Hz	66.9 V	67.5 V	68.1 V	PASS
AC	135 V	135.00 V	55.0 Hz	134.1 V	135.0 V	135.9 V	PASS
AC	135 V	13.50 V	420.0 Hz	12.6 V	13.5 V	14.4 V	PASS
AC	135 V	67.50 V	420.0 Hz	66.2 V	67.4 V	68.8 V	PASS
AC	135 V	135.00 V	420.0 Hz	133.2 V	134.8 V	136.8 V	PASS

Power Supply Calibration

5. Current measurement

Accuracy : For 45 Hz to 65 Hz and DC: ±(0.5 % of reading + *0.04 A/0.02 A)
For all other frequencies: ±(0.7 % of reading + *0.08 A/0.04 A) *(135 V Range/ 270 V Range)

Mode	Range	Standard	Frequency	Lower limit	Measurement	Upper limit	Status
AC	135 V	0.500 A	55.0 Hz	0.458 A	0.499 A	0.542 A	PASS
AC	135 V	5.000 A	55.0 Hz	4.935 A	4.987 A	5.065 A	PASS
AC	135 V	10.000 A	55.0 Hz	9.910 A	9.974 A	10.090 A	PASS
AC	135 V	0.500 A	420.0 Hz	0.417 A	0.498 A	0.583 A	PASS
AC	135 V	5.000 A	420.0 Hz	4.885 A	4.976 A	5.115 A	PASS
AC	135 V	10.000 A	420.0 Hz	9.850 A	9.961 A	10.150 A	PASS

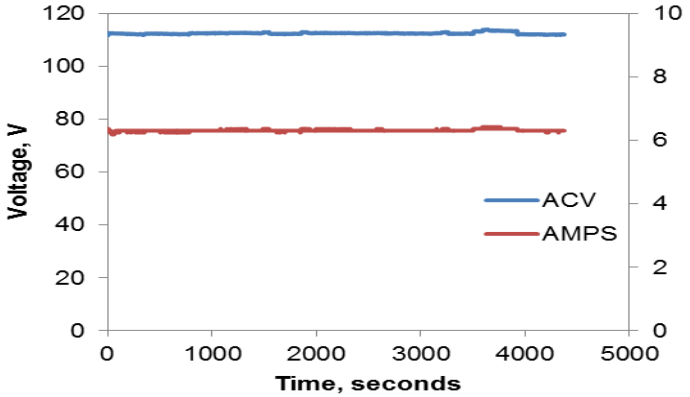
6. Power measurement

Accuracy : For AC: ±(2 % of reading + 1.0 W)
For DC: ±(2 % of reading + 1.0 W + *0.04 W / 0.02 W) *(135 V Range/ 270 V Range)

Mode	Range	Standard	Current	Lower limit	Measurement	Upper limit	Status
Frequency setting : 45Hz (135V) , 65Hz (270V)							
AC	135 V	250.00 W	5.00 A	244.0 W	249.3 W	256.0 W	PASS
AC	135 V	1000.00 W	10.00 A	979.0 W	997.0 W	1021 W	PASS
AC	270 V	62.50 W	1.25 A	60.3 W	62.5 W	64.7 W	PASS
AC	270 V	1000.00 W	5.00 A	979.0 W	997.6 W	1021 W	PASS

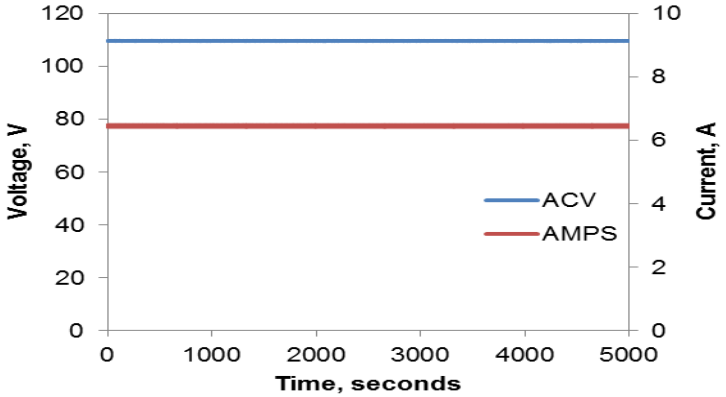
Variac vs. Keysight 6802A

Variac Manual Control



	Power, W	Voltage, ACV	Current, Amps
Average	709.23	112.46	6.31
Std Dev	4.9805	0.3746	0.03
%SD	0.7022	0.3331	0.42

Keysight 6802A



	Power, W	Voltage, ACV	Current, Amps
Average	705.28	109.57	6.44
Std Dev	2.9811	0.0322	0.03
%SD	0.4227	0.0294	0.42

- Power calculation and current measurement repeatability limited by current transducer
- Once Keysight 6802A is used for data acquisition, power and current measurement accuracy will improve

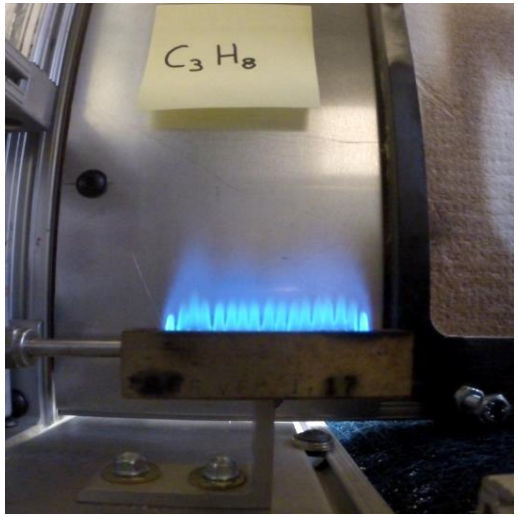
VFP 3 Demonstration Test

Propane vs Methane

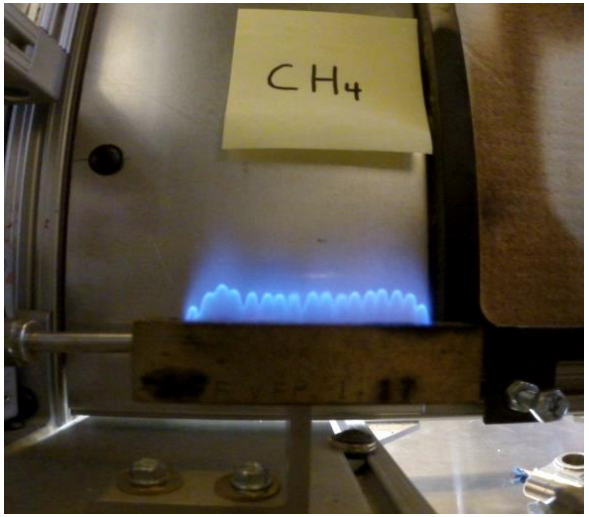
- It was requested to determine if methane could be used instead of propane
- 3 K-type exposed junction thermocouples used to quantify flame temperature
- Ceramic fiberboard used behind thermocouples to simulate test sample impingement
- TCs mounted 1” above burner face

Flame Profile Comparison

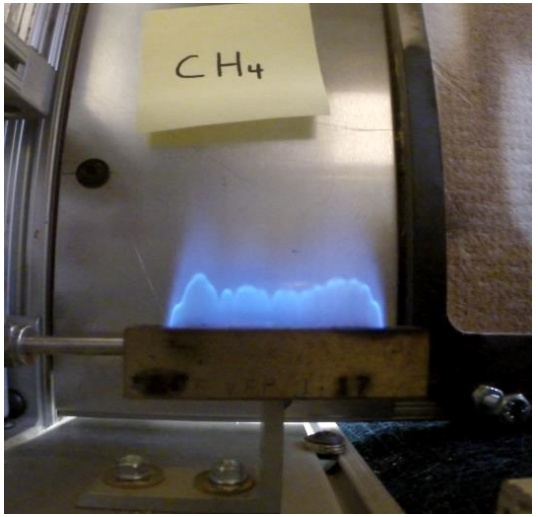
Propane 45/90



Methane 80/80

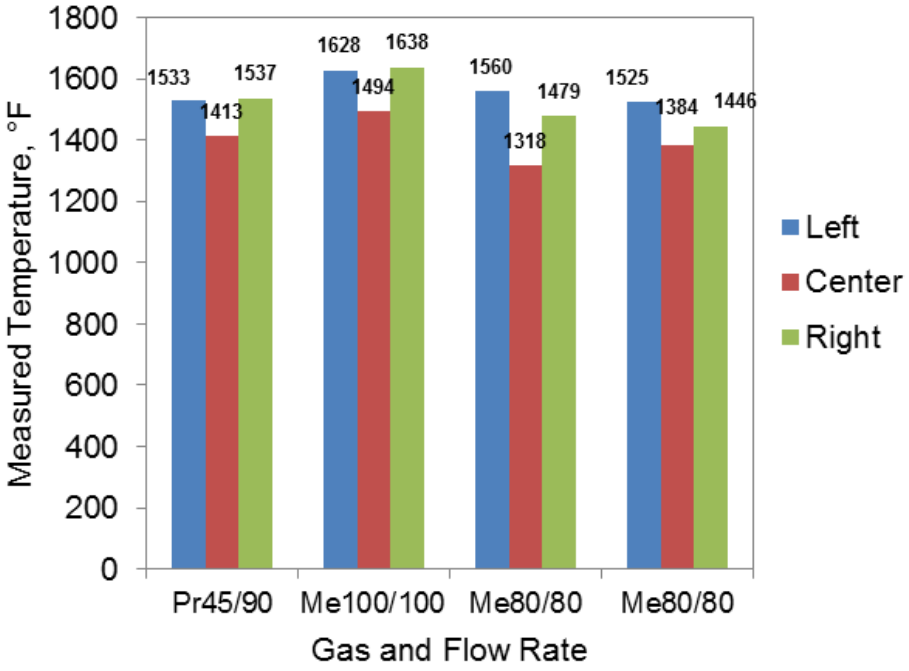


Methane 100/100



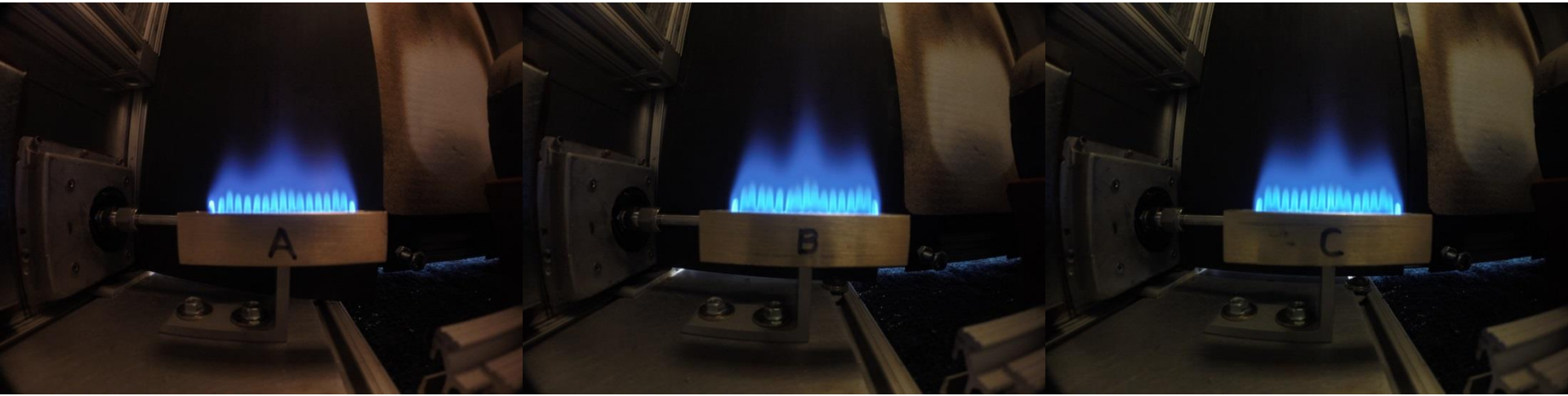
Propane vs Methane

- Initial test results indicate that similar temperatures and profiles can be achieved by increasing the flow rate when using methane
- Can not be certain that both gases are equivalent until burn tests are performed with both gases on the same materials



New Ribbon Burners

A B C

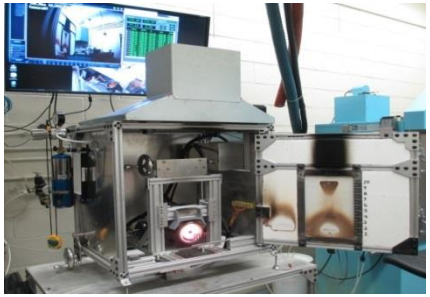


- Recently received 3 new ribbon burners
- Will loan one to Boeing, one to Airbus for installation in their current VFP 2 machines

Summary

- Continue development and testing of VFP 3
  - Work with equipment manufacturers to build commercial versions
  - Develop detailed drawings for VFP 3
  - Comparison testing with commercial versions once complete
- Develop better sample holding methods for panels, wires, and ducts
- Standardize test method procedure
- Find materials for comparative testing with new machines





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