International Aircraft Materials Fire Test Working Group Meeting

Seat Cushion Test Method Update

Presented to: International Aircraft Materials Fire Test Working Group

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Federal Aviation Administration

Previous Meeting Items

- **Information regarding flame retention head and overview of initial test data**
- **Leather seat cushion restraints**
- **2012 sonic burner seat cushion round robin**
- **Initial test results of TC readings using sonic burner compared to TC calibration unit results**

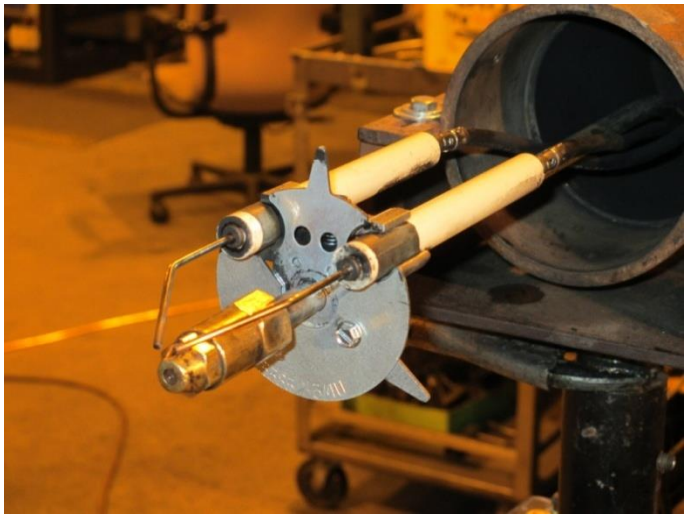
Summary for this Meeting

- **Flame retention head**
  - Design and burner assembly
  - Settings
  - Burner development process
  - Data results

- **Plans for upcoming sonic seat burner round robin utilizing the flame retention head**

Flame Retention Head (FRH)

- Eliminates the need for a stator and turbulator
- Fits on end of burner draft tube with minimal modification
- Parts purchased from local heating supply store for less than $50
- Initial testing showed potential for improved test result repeatability as compared to stator and turbulator configuration



Function of the Flame Retention Head

- **Flame retention head (FRH) mounts to the end of the burner draft tube G**
- **Generates a swirling motion of air and fuel exiting the burner draft tube**
- **Flame burns closer to the burner tube and is more efficient in combusting air and fuel mixture as compared to stator/turbulator setup**

FRH vs. Stator and Turbulator

Flame Retention Head

Stator and Turbulator

Flame Retention Head (FRH) and Static Plate

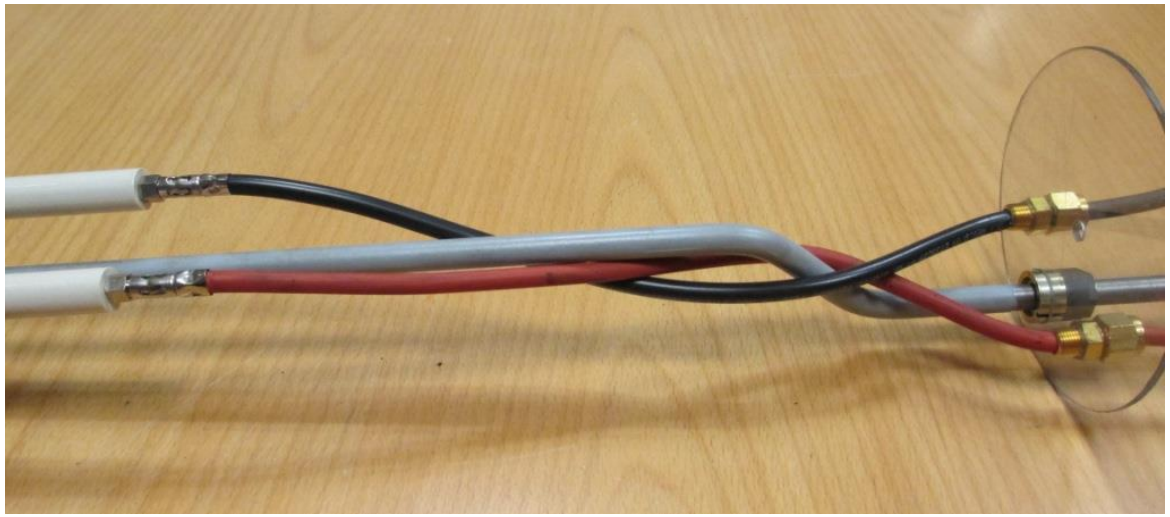
- **F31 Flame Retention Head**
  - Combusts air and fuel mixture in a swirling, efficient flame
  - Replaces turbulator

- **Static Disk**
  - Designed to control and even out air flow to the flame retention head
  - Replaces stator

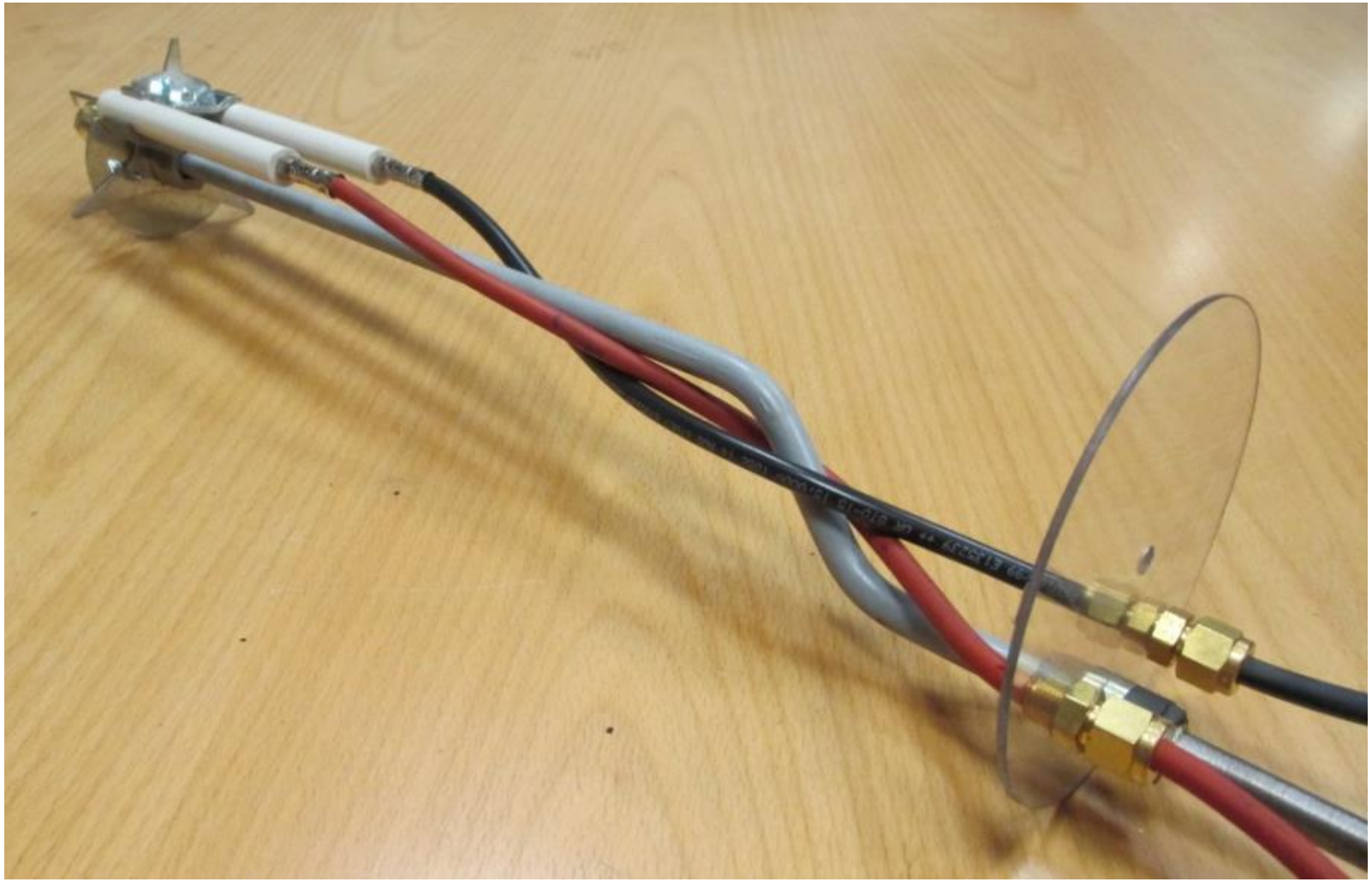
Ignition Wires

- **Wires should be wrapped tightly around fuel rod as shown in picture in order to minimize possible disruptions of airflow inside burner tube**

- **Wire lengths (tip of metal wire terminal to rear of draft tube)**
  - **Red: 12.5”**
  - **Black: 12.5”**

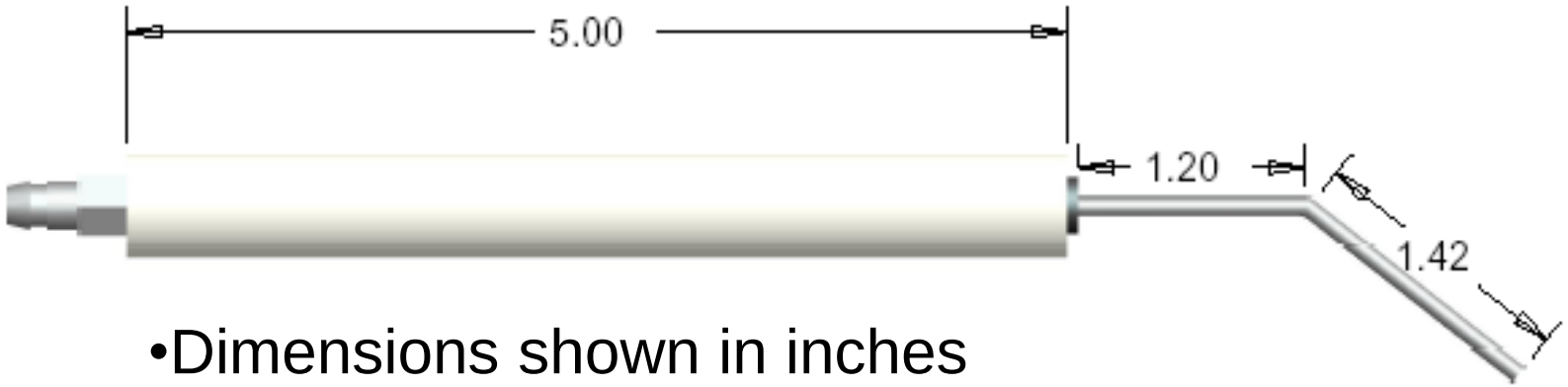


Ignition Wire Routing Method



Igniters

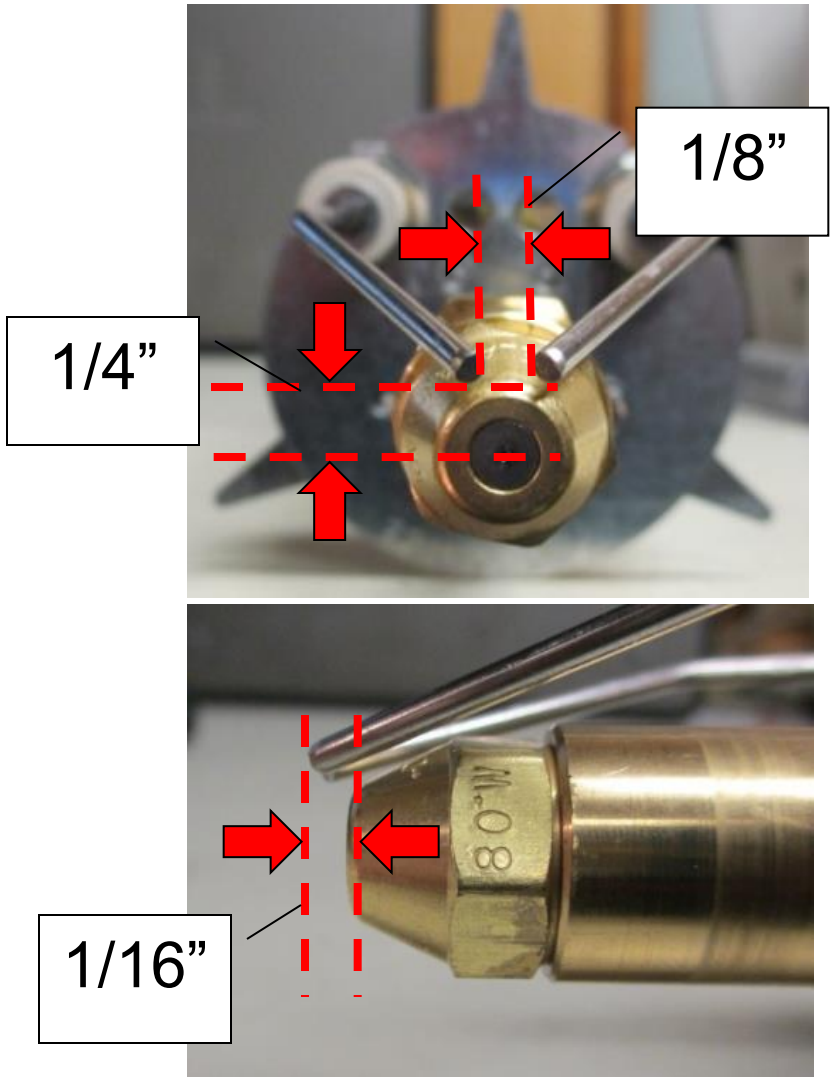
- **Igniter dimensions should be approximately the same as those shown in the pictures below**



•Dimensions shown in inches

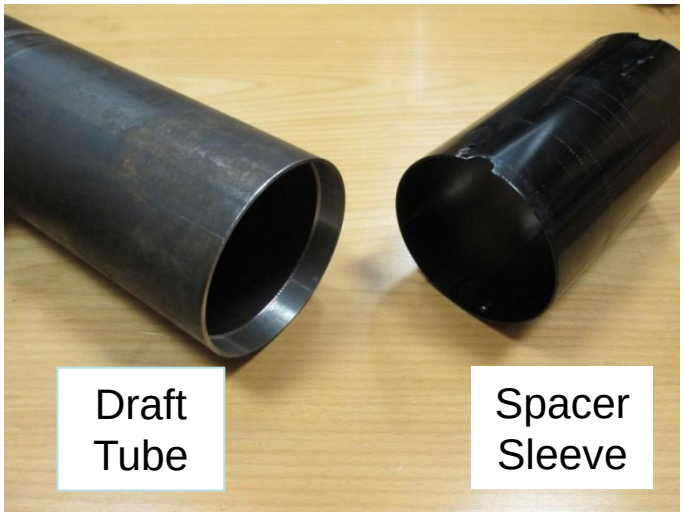
Standardized Igniter Position

- **Gap between igniters**
  - 1/8”
- **Nozzle center to igniters**
  - ¼”
- **Nozzle face to igniter tips**
  - 1/16”



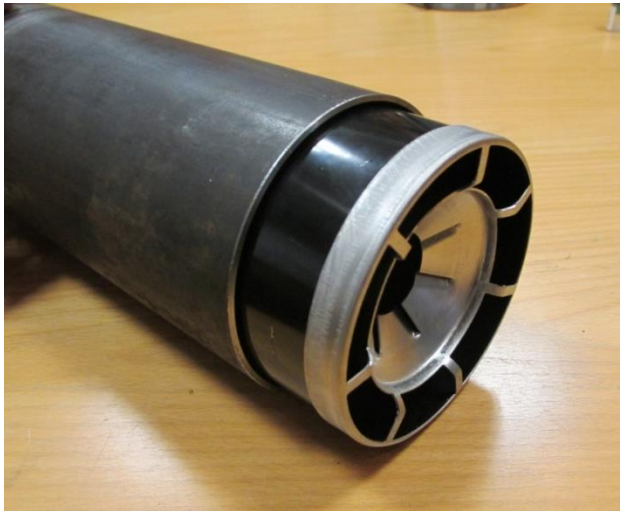
Draft Tube Assembly

- **Top: Modified draft tube shown with machined groove to allow for spacer sleeve and FRH**
- **Bottom: Spacer sleeve fits into draft tube to ensure static plate and fuel rod are centered in draft tube**

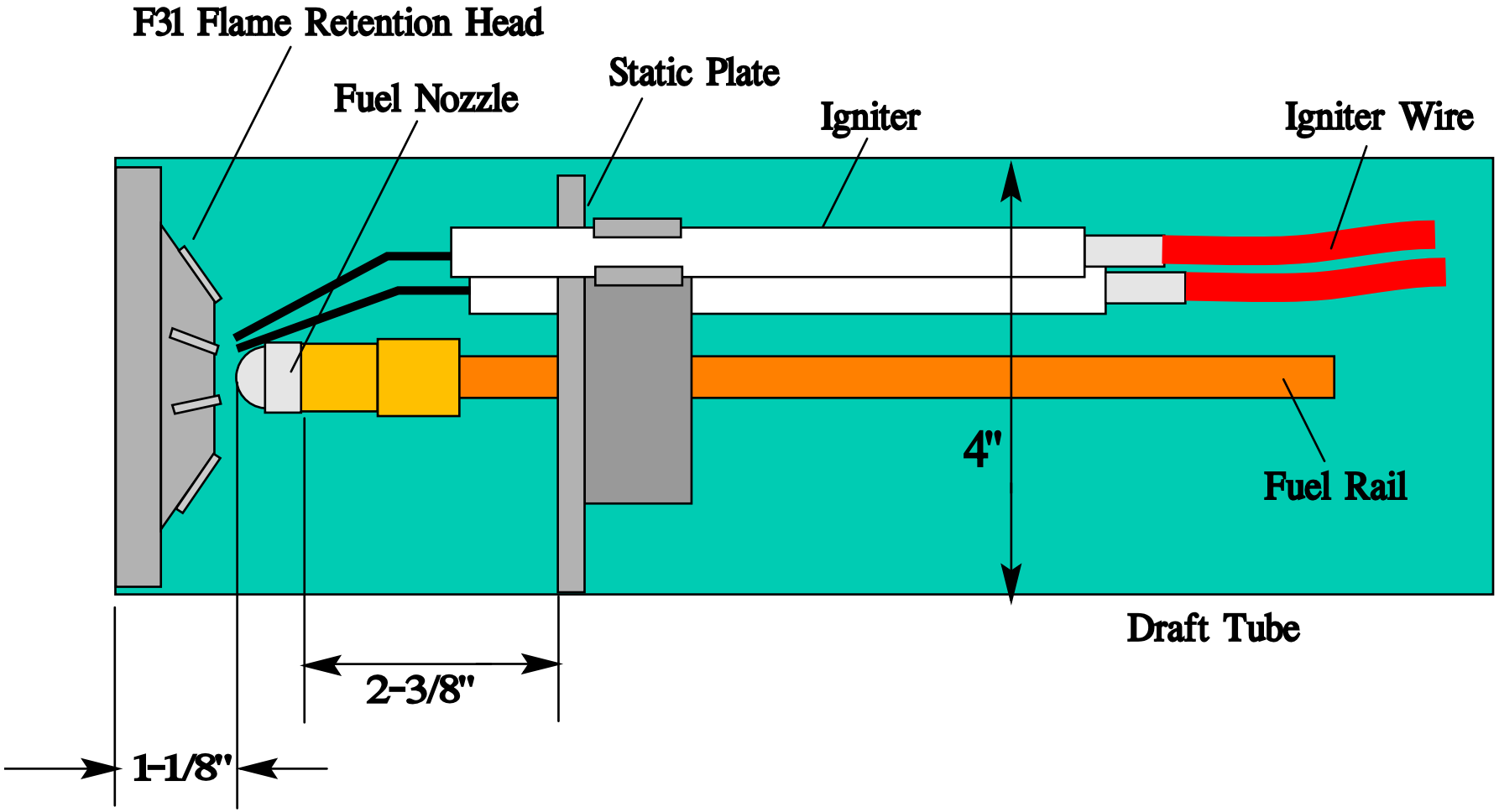


Draft Tube Assembly

- **Top: FRH is press fit onto the spacer sleeve**
- **Bottom: The FRH and spacer sleeve assembly is pressed into the burner draft tube until the face of the FRH and end of the draft tube are flush**



Burner Settings



Seat Burner Settings

- **Fuel Nozzle:** Delavan 2.0 gal/hr 80° spray pattern W “all purpose”
  Face of FRH to nozzle tip: 1-1/8”
- **Fuel nozzle adapter to static plate: 2-3/8”**
- **Static Plate Angle: centerline of igniters at 0°**
  - Looking into the cone of the burner from above, the centerline between the igniters will be at 0° on the burner reference plane
- **Fuel pressure: 108 psi (+/- 4 psi)**
  - Pressure used as a starting point when checking fuel flow rate
- **Air pressure: 45 psi**
- **Air Temperature: 40-60°F**
- **Fuel Temperature: 32-52°F**

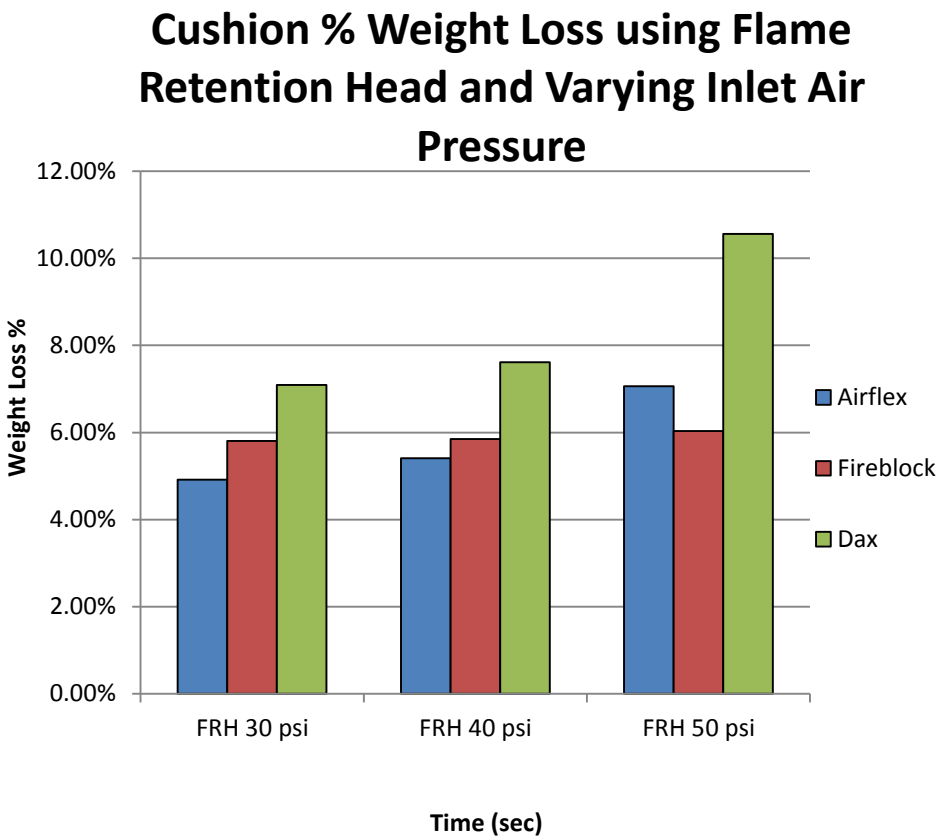
- **Internal settings identical to the cargo sonic burner**

Development of Burner Settings

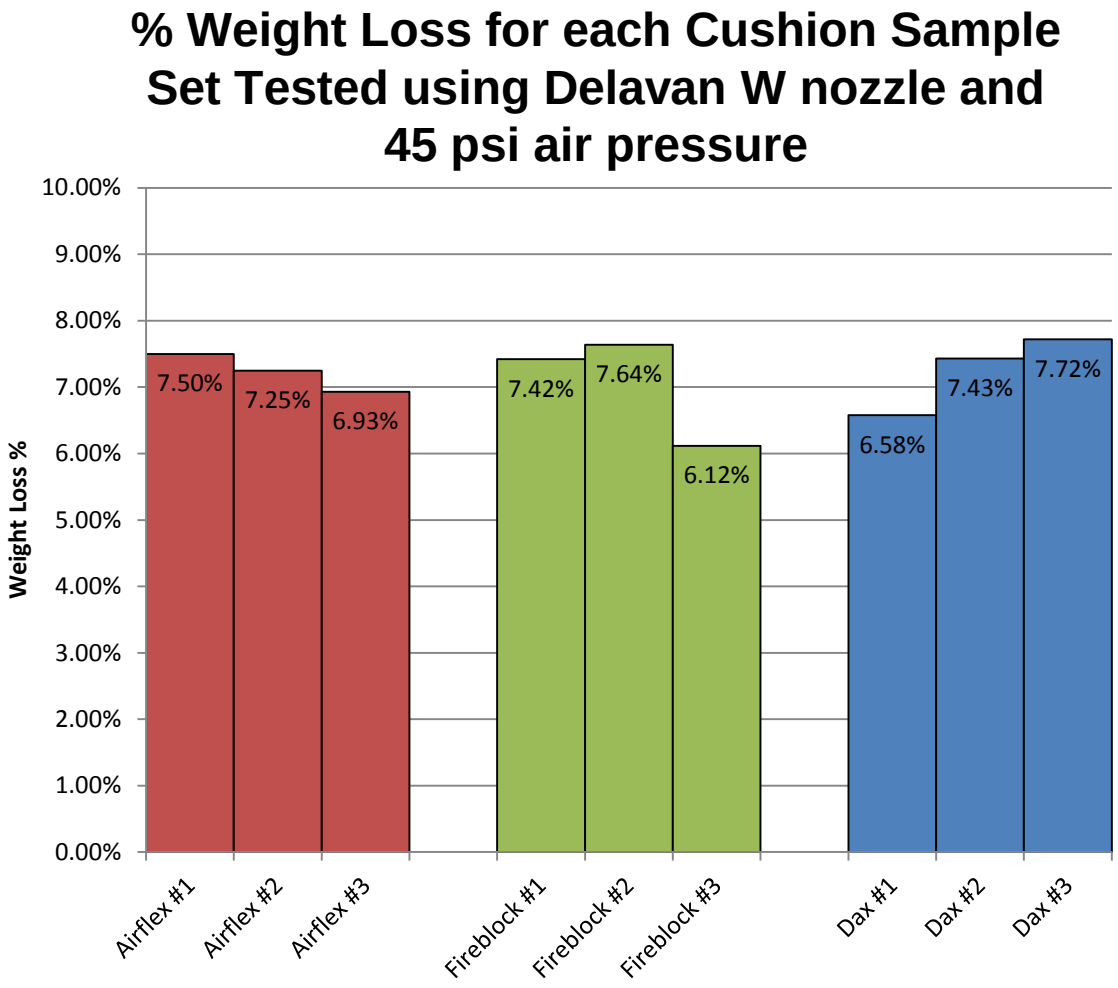
- **Began with manufacturer's recommend settings for placement of static plate and igniters**
- **Air pressure**
  - 30 40, 50, psi tested initially
  - 45 psi produced the most repeatable results which were consistent with Park burner results
  - Same air pressure used on cargo burner
- **Nozzles**
  - Delavan B (solid spray pattern)
  - Delavan A (hollow spray pattern)
  - Delavan W (all purpose spray pattern)
  - W nozzle selected based on cargo and seat burner test results

Initial Testing Results

- **Initial tests show that increasing air inlet pressure tends to increase percent weight loss**
- **Different combinations of air pressures and fuel nozzles were tested**
- **Initial tests using the solid spray pattern nozzle at different air pressures did not produce desirable results**



Final Testing Results



	Airflex	Fireblock	Dax
Sample #1	7.50%	7.42%	6.58%
Sample #2	7.25%	7.64%	7.43%
Sample #3	6.93%	6.12%	7.72%
Average	**7.22%**	**7.06%**	**7.24%**
Stdev	**0.287**	**0.82**	**0.594**
%Stdev	**3.97**	**11.67**	**8.20**

2012 Round Robin Update

- **Round robin began April 2012**
- **FAA provided each lab with a fuel nozzle, burner setup instructions, and seat cushion test specimens**
- **6 labs returned data results**
  - Goal was to meet or exceed the repeatability of the Park burner
  - Wide range of different results between the labs
  - Other factors besides burner impacting results? (ventilation?)
- **2012 RR considered completed at this time**

2013 Seat Test Round Robin using FRH

- **Initial FRH testing completed at FAA lab**
- **RR will need to be conducted to confirm repeatability of FRH between different labs**
- **Parts needed to convert current sonic burner design to use FRH will be provided by FAA**
  - Test cushions will also be supplied
- **Need willing participants for upcoming 2013 seat burner round robin!**

Planned Activities

- **2013 seat sonic burner RR using FRH**
  - Ship parts and samples to labs willing to participate
- **Finalize FRH Settings**
  - Burner settings can be finalized when all RR results are returned to FAA
- **Finalize leather seat restraints**
  - To be completed when burner settings are finalized
- **Thermocouple degradation**
  - Continue testing for methods of limiting inaccurate readings due to thermocouple heat cycling

Questions?