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DEVELOPMENT OF A STANDARDIZED RADIANT HEAT SOURCE FOR THE VERTICAL FLAME PROPAGATION FLAMMABILITY TEST

Presented to:
The 9th Triennial International Aircraft Fire and Cabin Safety Research Conference

By:
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on behalf of
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Representing:
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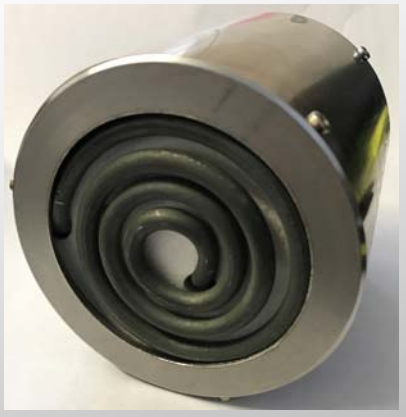

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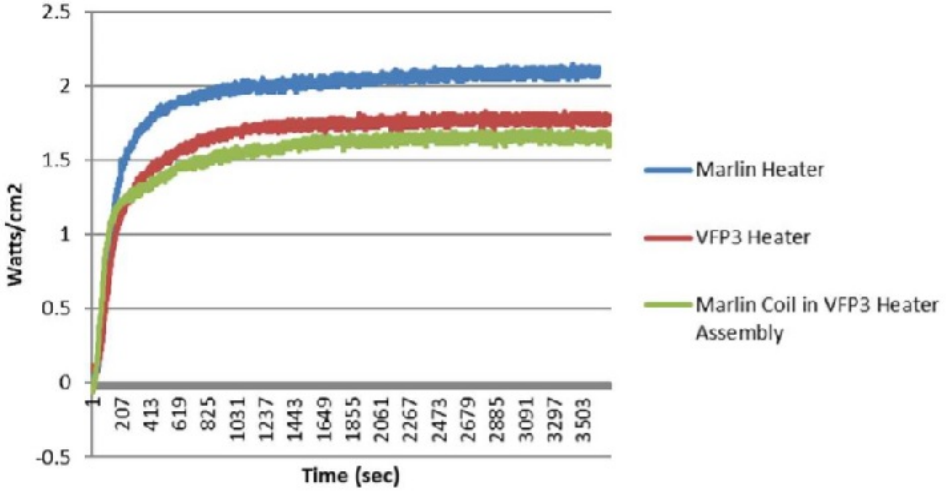
BACKGROUND

- At the last meeting in Savannah, Tina & Rick presented this graph from tests that showed differences in heat flux at the sample surface, between the two FAA furnaces and the Marlin production VFP Furnace.
- The plot opposite showed a 15.25% difference between the VFP3 furnace, in red and Marlin's furnace, in blue when set to 706 Watts.



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- In the task group discussion, there were various concerns about being able to achieve consistent irradiance from the furnace to the sample, using a fixed power setpoint only.
- Different designs and packaging of the furnace would very likely give differing radiant heat exposures to the sample.

FAA VFP3 MARLIN ENG. CONCEPT EQUIP. DEATAK INC.

- VFP3 element was open at front, loose and vented. Marlin's furnace was more securely packaged. Concept's furnace was similar with 3" aperture and fired ceramics backing disc. Deatak's element was recessed in an alumina carrier. All except VFP3 were nom. ¼" dia elements. FAA's were bigger dia.
- Aperture size, baffle plates, venting features material type and densities etc. would also have an affect on the real output of the furnace radiating to the sample.

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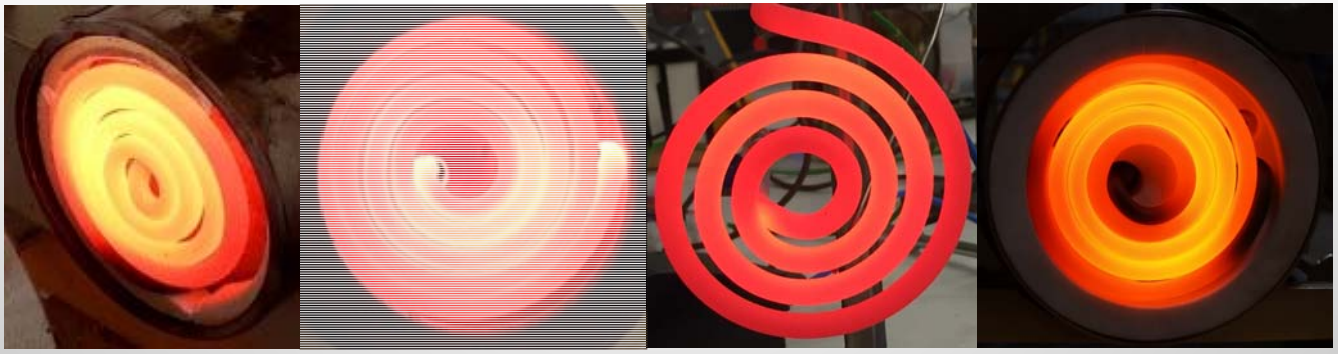
- Positions of cold lengths, allowing connections to be made, may have an effect as well.
- Concerns over drifting outputs when using power control only were also discussed.

FAA VFP3 | MARLIN ENG. | CONCEPT EQUIP. | DEATAK INC.



- Potential overheating of the sheath materials had to be taken into consideration too.
- Movement of the element when at the desired output should also be considered.
- It was suggested that a sub task group was created between the FAA and the manufacturers of the furnaces, to look at potentially generating a common design to avoid these concerns.

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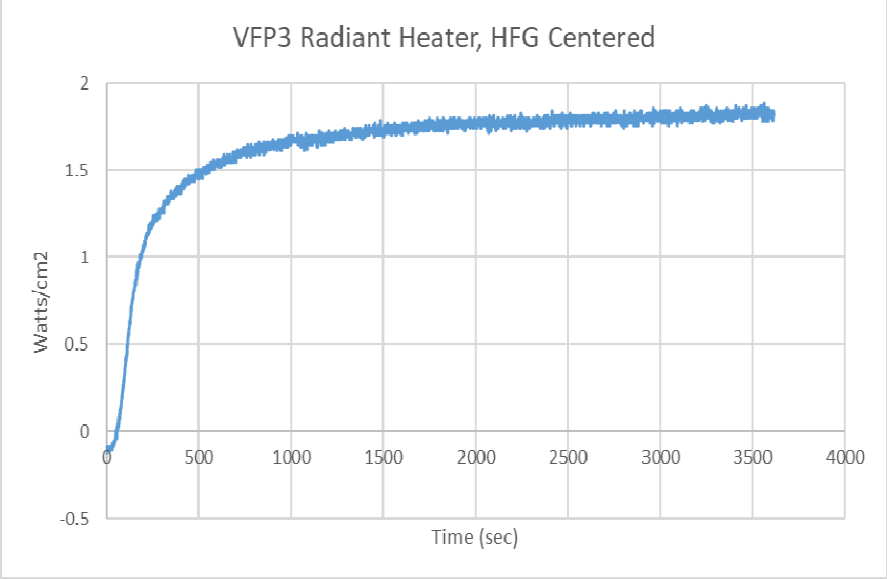
SUB TASK GROUP MEETING

- Manufactures and the FAA met at the Tech Centre at the end of April.
- Prior to meeting, Tina & Rick at the FAA performed a further test on the VFP3 furnace.
- This plot shows the heat flux profile of the FAA VFP3 furnace, inside the VFP chamber, using a heat flux gauge, mounted in a dummy sample board, on the centreline of furnace.
- The results showed a maximum of 1.884 W/cm^2, and an average over last 60 secs of 1.825 W/cm^2.



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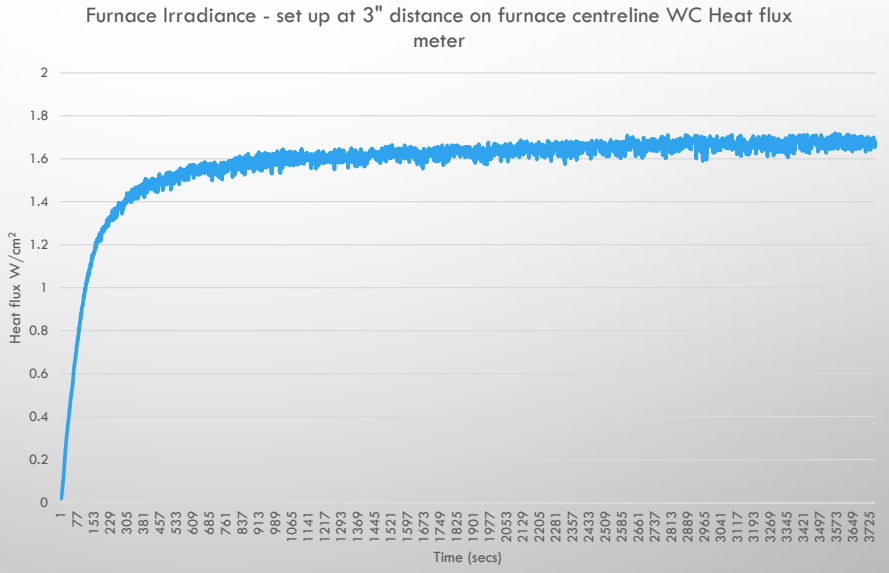
- Concept presented a prototype furnace to the meeting for discussion.
- It was a smoke chamber 600W rated element in a VFP configuration. We ran same test to see how close we could get to the FAA's test with a this furnace.
- We achieved a maximum of 1.718 W/cm^2 heat flux at 571 Watts power.
- The average over the last 60 seconds was 1.678 W/cm^2.
- With 135 Watts less power, we got within 8% of the target average.
- This illustrated further that the design and packaging of the furnace is key.
- We discussed current supplied heaters. The FAA, Concept, Marlin and Deatak elements were all from different suppliers. The FAA furnaces were Newport, who are not involved in this project.



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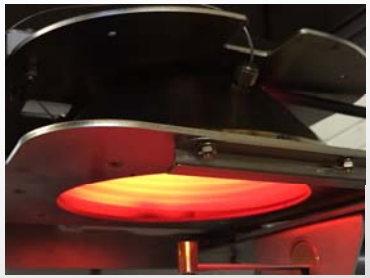
- Alternatives to the tubular elements were discussed, wire coil and Thermocoax type but the FAA wanted to retain the tubular element at this stage of development.
- Manufacturers were in agreement that it would be difficult to achieve a consistent radiant exposure to the sample, based on a fixed power setpoint only, even if we all attempted to manufacture the same ‘standard furnace’, as we would have no other parameter to adjust.
- We used the comparison of the standardised Nexgen burner. Standard parts and assembly where we can tweak the fuel or air flow and have the thermocouple validation procedure. We would not have anything to adjust with the furnace or a means to validate it was giving the correct irradiance.
- Therefore, we felt we needed to have an additional validation criteria other than a fixed power of 706 watts in this stage of the furnace development.
- The FAA were not keen on heat flux or temperature measurement to do this.
- The manufactures’ however, were united in wanting to use heat flux as the validation criteria.
- It has worked well in controlled environment applications such as the NBS ASTM chamber, ISO5659-2 chamber, Cone calorimeter and Radiant Flooring Panel apparatus.
- Previous experience with OSU and Nexgen were argued not to be ideal applications for stable heat flux measurements, due to the high turbulence environments.
- The general tolerance for heater calibration used in fire testing was +/- 0.1 W/cm^2 . However, the NBS ASTM chamber was +/- 0.05 W/cm^2.
- Concept, Marlin and Deatak all achieve this specification on their NBS and ISO chambers.



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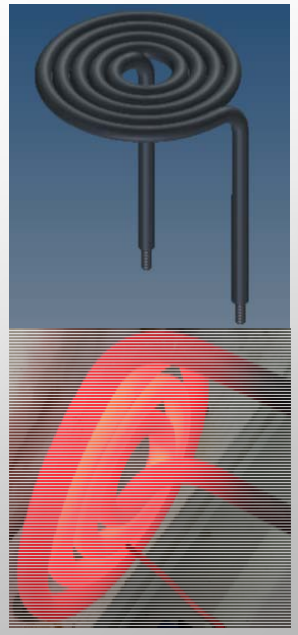
FURNACE II SPECIFICATION

- It was agreed to use a 1” (25.4mm) diameter heat flux gauge to provide validation of furnace designs by all manufacturers and the FAA.
- The heat flux target threshold should be 1.75 – 1.85 W/cm^2 at 3” from sample.
- An Inconel tubular element, 0.265” Dia. +/- 0.015” will be used.
- The nominal diameter of the spiral geometry shall be 3” +/- 0.13”
- Cold zones must not be visible on the radiant surface of the element.
- Outside housing shall be made from Stainless steel.
- Outer diameter of furnace remains at 4” with a fixed aperture at the front of the furnace of 3” +/- 0.1”, exposing the radiating element surface.
- The radiant plane of the element will be 0.0625” +/- 0.0313 from the front face of furnace housing.
- Ceramic rings or discs will fill void behind the element in the furnace.
- An optional stainless steel reflector may be added behind the element.
- An optional thermocouple may be added to potentially improve the output power control of the furnace much like the NBS Chambers.



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FUTURE WORK

- FAA will modify their furnaces to comply with the agreed Furnace II specification.
- FAA will then repeat previous heat flux test in the VFP chamber.
- Concept, Marlin and Deatak will update their furnace designs to comply with Furnace II specification and build prototypes ready for further comparison tests.
- FAA to run further tests to ascertain the required heat flux in the additional upper vertical positions and advise requirements to manufacturers.
- The manufacturers will produce a dummy calibration board to hold the heat flux meter on the centreline of the furnace as well as three other vertical positions.
- FAA and manufacturers to run comparison tests on updated furnaces using heat flux measurements in the VFP Chamber.
- Sub task group to meet regularly via WebEx, at normal meetings and in between meetings if necessary.
- Review and update furnace specification as required.
- Update Vertical Flame Propagation Test Construction Document as necessary.

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QUESTIONS ?

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