# *Evacuation Slide Materials Test Method: Round Robin 5*

***Tim Marker (for Dung Do)***
***Fire Safety Branch***
***FAA Wm. J. Hughes Technical Center***
***Atlantic City International Airport , NJ 08405***

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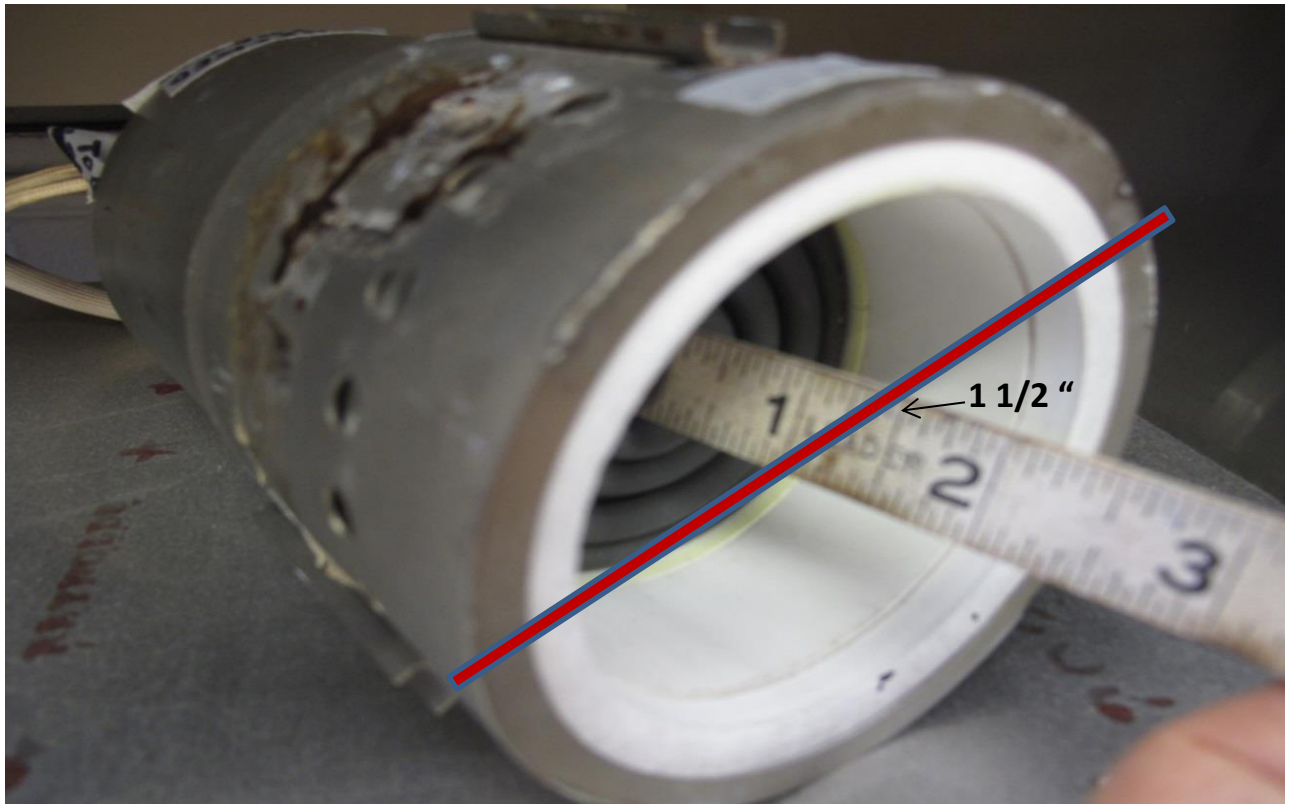
**Federal Aviation Administration**

# *Activities*

***The revised test method controls the power input to the furnace***

- ***Furnace Part # 68086038000 was used for the tests***
- ***Distance from face of the furnace to face of the coil was set at 1 ½ inches***
- ***2 labs participated in this study***
- ***One lab used 2 furnaces to test the materials for their comparison***
- ***2 materials were tested , 3 tests for each material***

# *Distance from the Face of the Furnace to the Face of the Coil was set at 1 1/2 inches*



# *Revised Evacuation Slide Test Method*

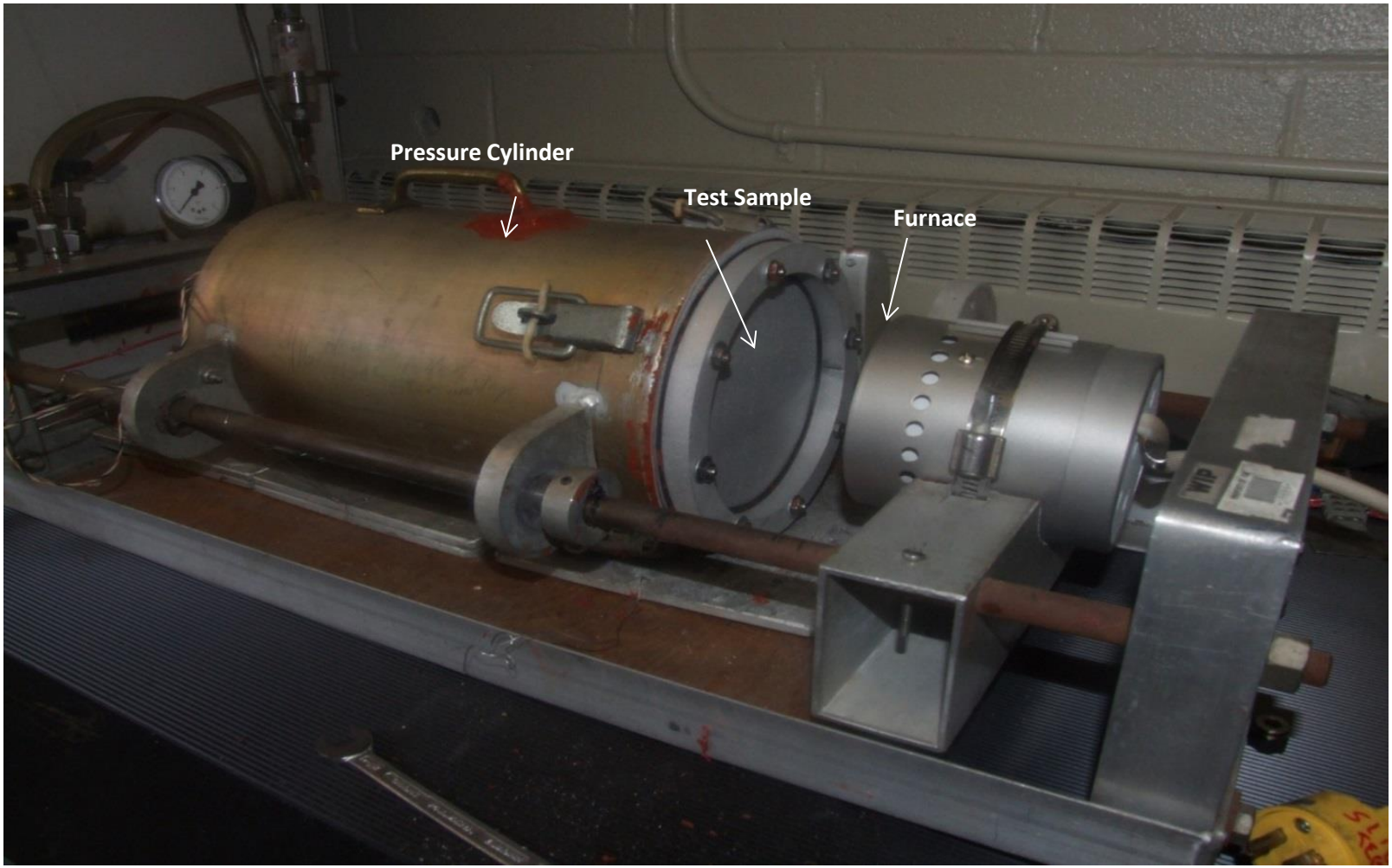
***Calibration:***

1. ***Start the radiant heat furnace and other required instrumentation and allow 30 to 45 minutes for warm up.***
2. ***Adjust the transformer voltage to produce a power input to the furnace between 425 watts and 435 watts. This power input produces a heat flux of 1.5 Btu/ft$^2$sec at a distance of 2 inches in front of the radiant heat furnace.***
3. ***Do not turn off the furnace. Use this radiant heat output for the test.***

***Test Procedure (after power input is established):***

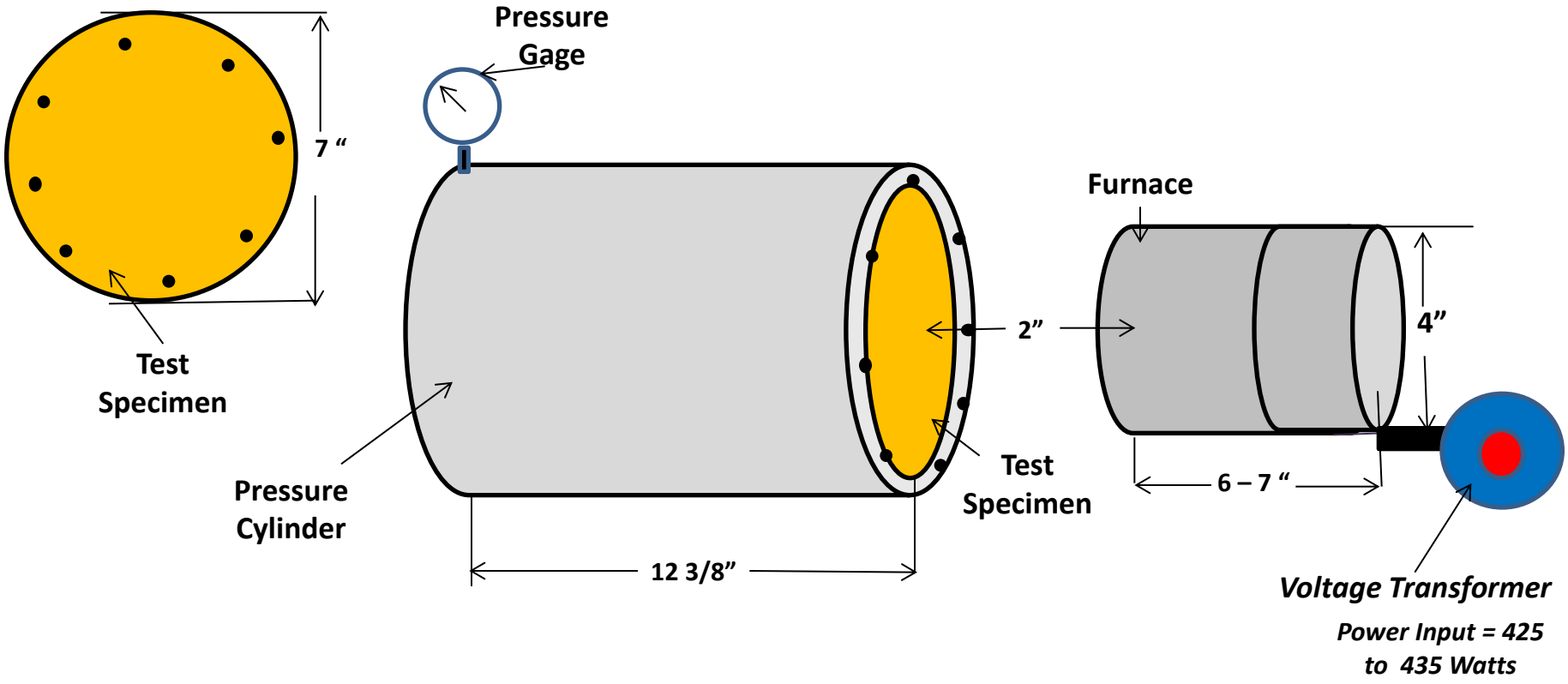
1. ***Pressurize the cylinder with test specimen to the normal operating pressure and check the distance of the center of the expanded surface of the test specimen, which must be 2 inches in front of the radiant heat furnace. Ensure that the test specimen holds pressure for at least 3 minutes before the test.***
2. ***Check and make sure the power input is set to 425 to 435 watts.***
3. ***Rotate the pressure cylinder with the test specimen in front of the radiant heat furnace. Simultaneously start the timer.***
4. ***Record time (in seconds)of the first observed pressure loss.***
5. ***Each specimen must maintain correct pressure for a minimum of 180 seconds to pass the test.***
6. ***Repeat the complete Calibration and Test Procedure for each test specimen.***

# *Small Scale Test Apparatus*



# Revised Test Method Controls Power Input

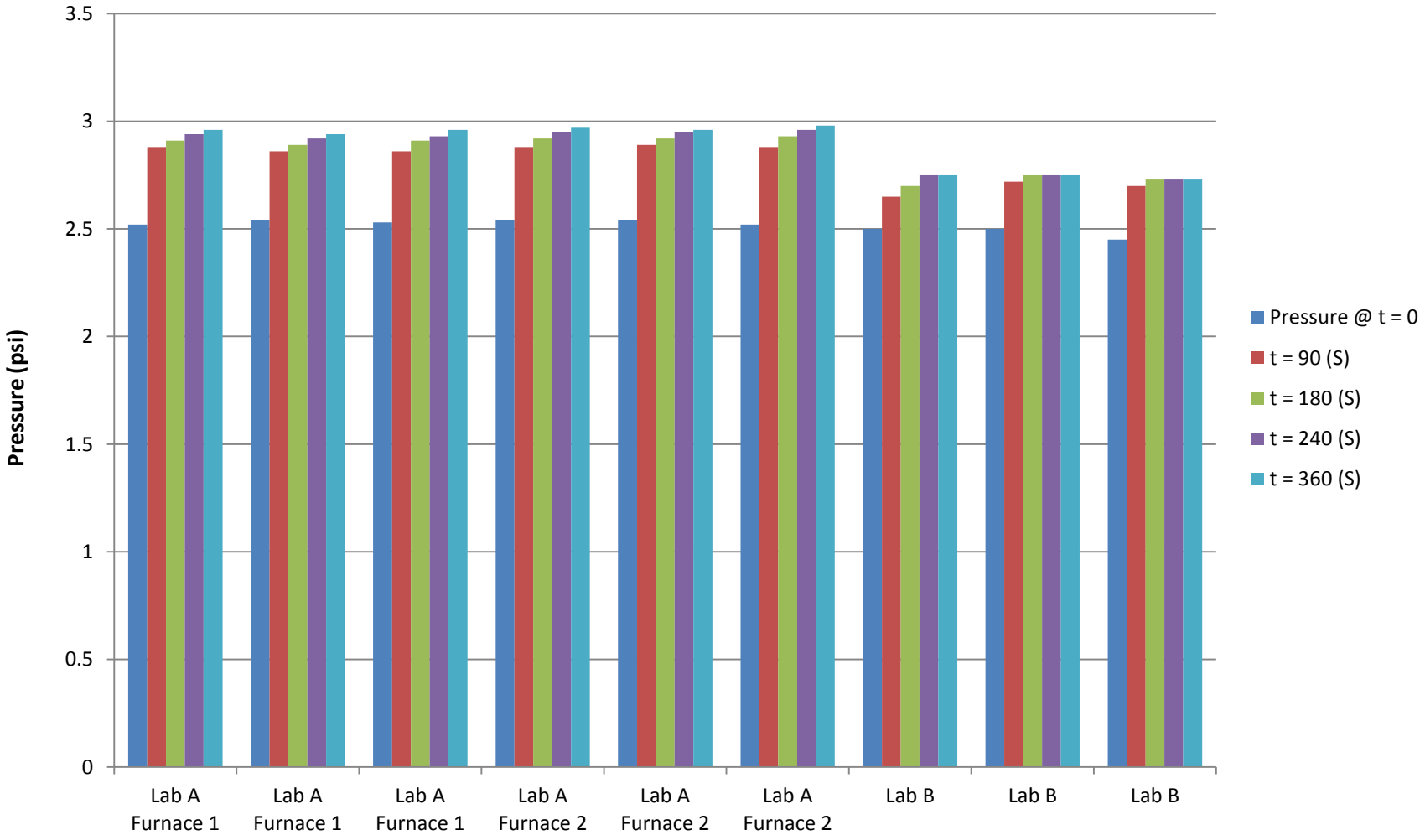
- *Test Specimens: 7 inches diameter, with eight 0.250-inch holes*
- *Test vessel pressurized to normal operating pressure*
- *Power Input of the furnace: 425 to 435 Watts*
- *Record time to first observed pressure loss*
- **Each specimen must hold pressure for a minimum of 180 seconds.**



# *Materials Used in RR5*

| | |
|---|---|
| ***Yellow/Gray Material*** | ***A single ply , polyurethane coated, not quite square woven, nylon fabric. Gray side is fine aluminum flake mixed into the polyurethane raw material.*** |
| ***Mustard/ Mustard Material*** | ***Two ply neoprene coated with nylon fabric*** |

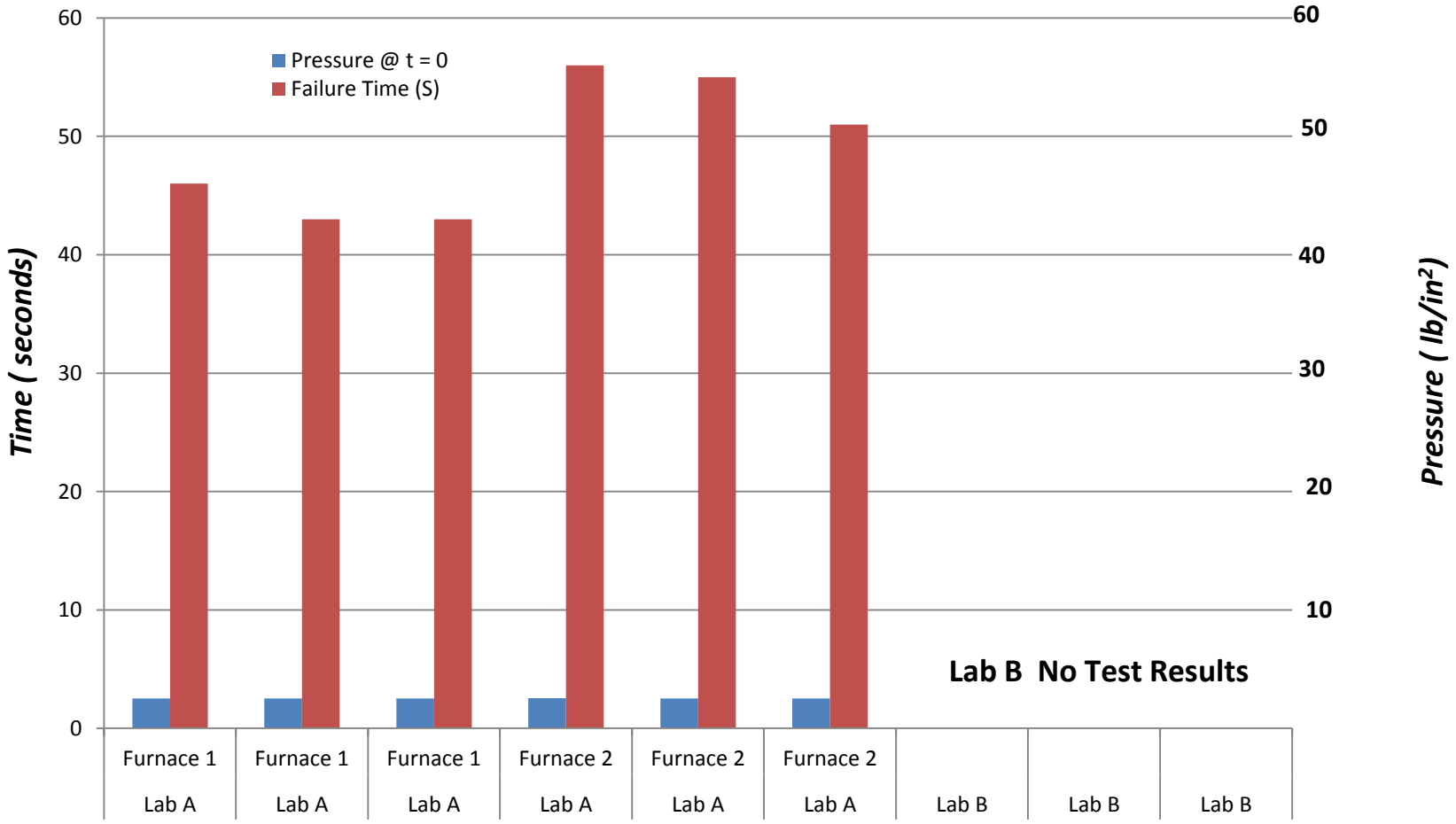
# Yellow/Gray Material Results



# The Test Results of the Yellow/ Gray Material for Two Labs

| Test # | Lab # | Furnace type | Material | Power input (Watts) | Pressure at 0 sec | Pressure at 90 sec | Pressure at 180 sec | Pressure at 240 sec | Pressure at 300 sec | Pass/fail |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | A Furnace 1 | Solid Coil Furnace (part # = 68086038000) | Yellow/Gray | 430 | 2.52 | 2.88 | 2.91 | 2.94 | 2.96 | Pass |
| 2 | A Furnace 1 | Solid Coil Furnace (part # = 68086038000) | Yellow/Gray | 424 | 2.54 | 2.86 | 2.89 | 2.92 | 2.94 | Pass |
| 3 | A Furnace 1 | 2.94Solid Coil Furnace (part # = 68086038000) | Yellow/Gray | 430 | 2.53 | 2.86 | 2.91 | 2.93 | 2.96 | Pass |
| 4 | A Furnace 2 | Solid Coil Furnace (part # = 68086038000) | Yellow/Gray | 433 | 2.54 | 2.88 | 2.92 | 2.95 | 2.97 | Pass |
| 5 | A Furnace 2 | Solid Coil Furnace (part # = 68086038000) | Yellow/Gray | 434 | 2.54 | 2.89 | 2.92 | 2.95 | 2.96 | Pass |
| 6 | A Furnace 2 | Solid Coil Furnace (part # = 68086038000) | Yellow/Gray | 433 | 2.52 | 2.88 | 2.93 | 2.96 | 2.98 | Pass |
| 7 | B | Solid Coil Furnace (part # = 68086038000) | Yellow/Gray | 431 | 2.5 | 2.65 | 2.7 | 2.75 | 2.75 | Pass |
| 8 | B | Solid Coil Furnace (part # = 68086038000) | Yellow/Gray | 431 | 2.5 | 2.72 | 2.75 | 2.75 | 2.75 | Pass |
| 9 | B | Solid Coil Furnace (part # = 68086038000) | Yellow/Gray | 431 | 2.45 | 2.7 | 2.73 | 2.73 | 2.73 | Pass |

# Mustard/Mustard Material Results



# *The Test Results of Mustard/Mustard Material*

| *Test #* | *Lab #* | *Furnace type* | *Material* | *Power input (Watts)* | *Pressure at 0 sec* | *Pressure at 90 sec* | *Pass / Fail* |
|---|---|---|---|---|---|---|---|
| *1* | *A Furnace 1* | *Solid Coil Furnace (part # = 68086038000)* | *Mustard/Mustard* | *430* | *2.52* | | *Failed at 46 sec* |
| *2* | *A Furnace 1* | *Solid Coil Furnace (part # = 68086038000)* | *Mustard/Mustard* | *430* | *2.53* | | *Failed at 43 sec* |
| *3* | *A Furnace 1* | *2.94Solid Coil Furnace (part # = 68086038000)* | *Mustard/Mustard* | *433* | *2.52* | | *Failed a 43 sec* |
| *4* | *A Furnace 2* | *Solid Coil Furnace (part # = 68086038000)* | *Mustard/Mustard* | *433* | *2.54* | | *Failed at 56 sec* |
| *5* | *A Furnace 2* | *Solid Coil Furnace (part # = 68086038000)* | *Mustard/Mustard* | *434* | *2.53* | | *Fail at 55 sec* |
| *6* | *A Furnace 2* | *Solid Coil Furnace (part # = 68086038000)* | *Mustard/Mustard* | *433* | *2.52* | | *Failed at 51 sec* |

# Conclusion

- ***The Yellow/ Gray material passed the tests for both labs.***

- ***The Mustard/Mustard material failed the test at Lab A (Lab B did not return data). This Mustard/Mustard material had a time-to-failure of about 15 to 20 seconds longer than those previously tested. This indicates the material has changed since previous round robin testing.***

# *Additional Activities*

## *Furnace Angle vs. Heat Flux*

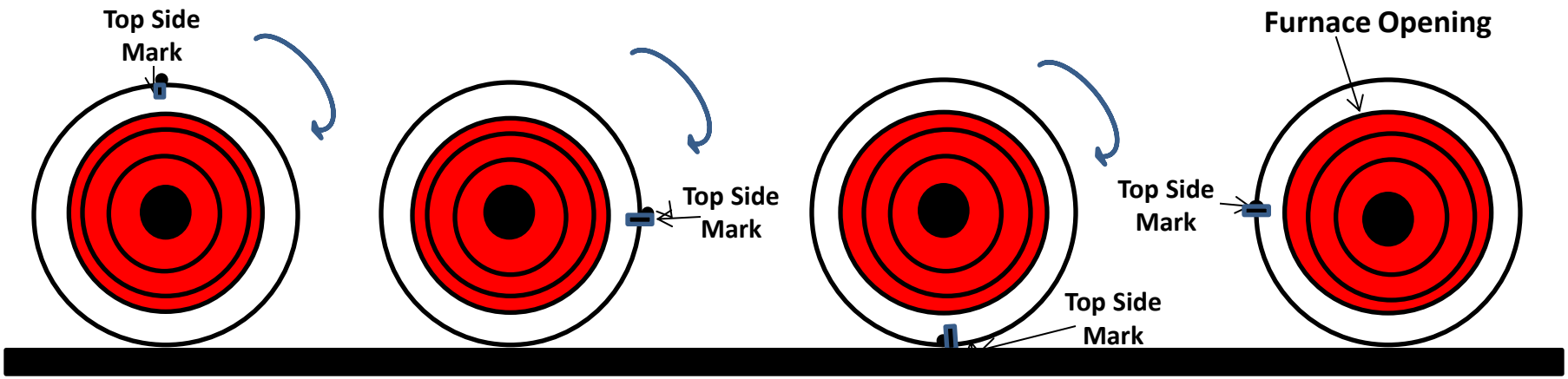
***A top side mark is printed on the furnace by the manufacturer to indicate how to place the furnace in the apparatus.***

***The top side mark was rotated from $0^o$ to $90^o$, $180^o$, and $270^o$ in order to determine the heat flux output at the various orientations. Power inputs at each position were compared when adjusted to provide a Heat Flux 1.5 Btu/$ft^2$sec at 2 inches from the furnace:***

- ***Position 1: Top side mark on the top of furnace, $0^o$***
- ***Position 2: Top side mark was rotated about $90^o$ clockwise***
- ***Position 3: Top side mark was rotated about $180^o$ clockwise***
- ***Position 4: Top side mark was rotated about $270^o$ clockwise***

***Two Calibration Tests of the furnace were conducted at each position of the Top side Mark***

# *Four Different Furnace Positions Tested*



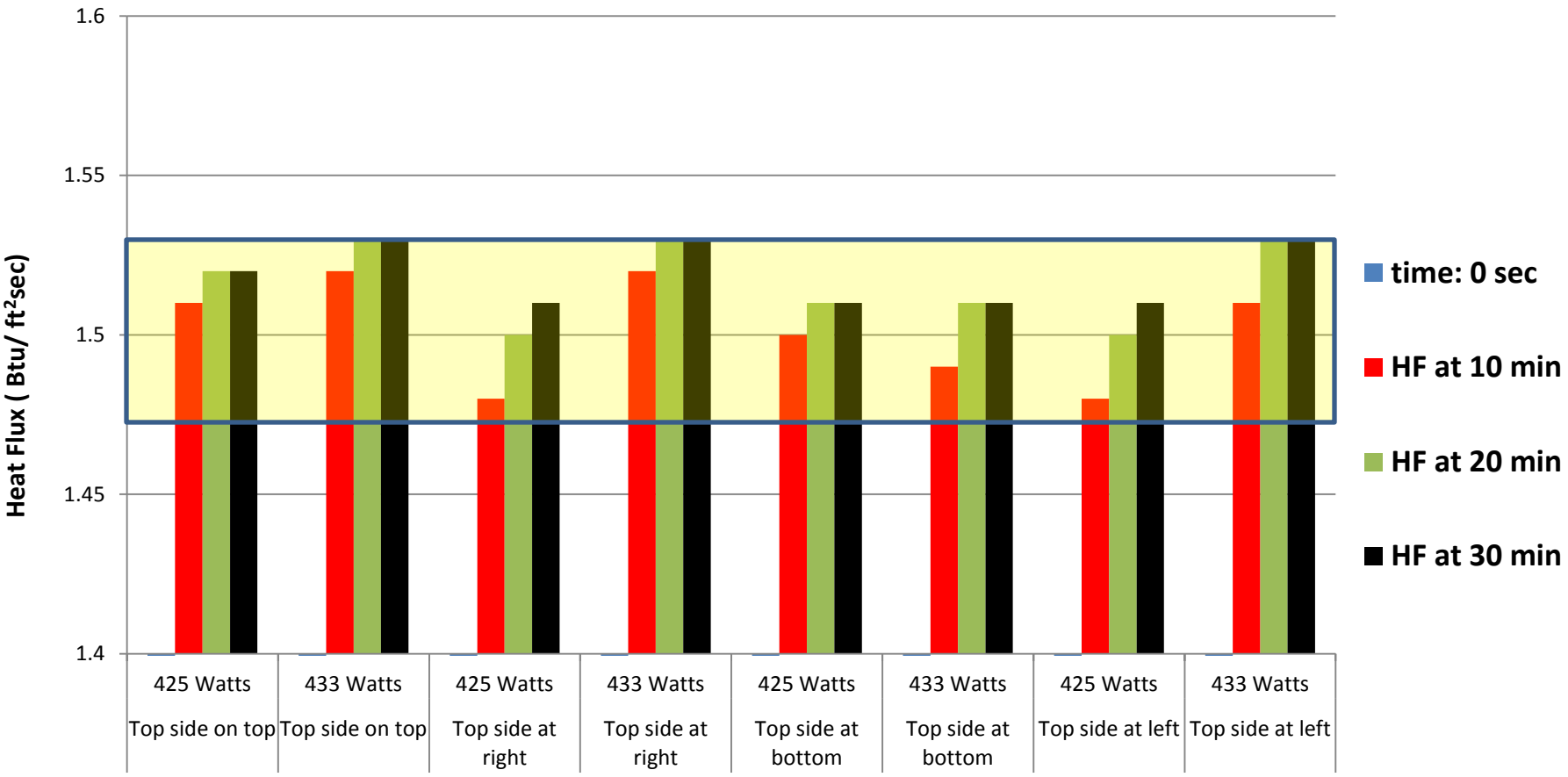

**Test 1**
**Top Side Mark placed on top side of the Furnace**

**Test 2**
**Top Side Mark placed on right side of the Furnace**

**Test 3**
**Top Side Mark placed at bottom side of the Furnace**

**Test 3**
**Top Side Mark placed at left side of the Furnace**

# Power Input Test Results of Four Furnace Positions for the Calibration Tests



# The Test results of the Power Input at four different position of the furnace

| Test # | Time (minutes) recorded after 30 minutes Warmup the furnace | Power Input (Watts) | Heat Flux (Btu/ft$^2$sec ) | Orientation of the furnace |
|---|---|---|---|---|
| 1 | 10 minutes | 426 | 1.51 | Top Side mark at the top of the furnace |
| | 20 minutes | 424 | 1.52 | Top Side mark at top side of the furnace |
| | 30 minutes | 425 | 1.52 | Top Side mark at top side of the furnace |
| 2 | 10 minutes | 433 | 1.52 | Top Side mark at top side of the furnace |
| | 20 minutes | 431 | 1.53 | Top Side mark at the top side of the furnace |
| | 30 minutes | 433 | 1.53 | Top Side mark at the top side of the furnace |
| 3 | 10 minutes | 424 | 1.48 | Top Side mark at the right side of the furnace |
| | 20 minutes | 424 | 1.50 | Top Side mark at the right side of the furnace |
| | 30 minutes | 425 | 1.51 | Top Side mark at the right side of the furnace |
| 4 | 10 minutes | 433 | 1.52 | Top Side mark at the right side of the furnace |
| | 20 minutes | 432 | 1.53 | Top Side mark at the right side of the furnace |
| | 30 minutes | 431 | 1.53 | Top Side mark at the right side of the furnace |
| 5 | 10 minutes | 423 | 1.50 | Top Side mark at the bottom side of the furnace |
| | 20 minutes | 425 | 1.51 | Top Side mark at the bottom side of the furnace |
| | 30 minutes | 425 | 1.51 | Top Side mark at the bottom side of the furnace |
| 6 | 10 minutes | 433 | 1.49 | Top Side mark at the bottom side of the furnace |
| | 20 minutes | 433 | 1.51 | Top Side mark at the bottom side of the furnace |
| | 30 minutes | 431 | 1.51 | Top Side mark at the bottom side of the furnace |
| 7 | 10 minutes | 427 | 1.48 | Top Side mark at the left side of the furnace |
| | 20 minutes | 424 | 1.50 | Top Side mark at the left side of the furnace |
| | 30 minutes | 425 | 1.51 | Top Side mark at the left side of the furnace |
| 8 | 10 minutes | 433 | 1.51 | Top Side mark at the left side of the furnace |
| | 20 minutes | 433 | 1.53 | Top Side mark at the left side of the furnace |
| | 30 minutes | 433 | 1.53 | Top Side mark at the left side of the furnace |

# *Conclusion*

- ***All four furnace positions provided heat flux output in the desired range of 1.5 Btu/ft$^2$ sec +/- 0.03 at a distance of 2 inches from the material when the power input was adjusted between 425 and 435 watts.***

- ***Rotational orientation had no impact on heat flux output.***

# *Future Work*

***2 solid coil furnaces (part # 68086038000 and part # 68086040400 ) were manufactured for the radiant heat test. The revised evacuation slide test method currently uses furnace part # 68086038000.***

***Some labs only have furnace part # 68086040400 and could not participate in Round Robin 5. This Furnace will be calibrated by FAATC to achieve the same power output of 1.5 +/- 0.03 Btu/ft² sec when the input power is adjusted to 425 to 435 watts.***

***Furnace part # 68086040400 will be adjusted and calibrated to help more labs be capable of conducting tests according to the revised test method. This configuration will also provide an alternate capability if furnace part # 68086038000 becomes obsolete or is no longer manufactured in the future.***