International Aircraft Materials Fire Test Working Group Meeting

Evacuation Slide Test Method: Comparison of HFG and Power Controller Calibration Methods

Presented to: International Aircraft Materials Fire Test Working Group, Atlantic City, NJ

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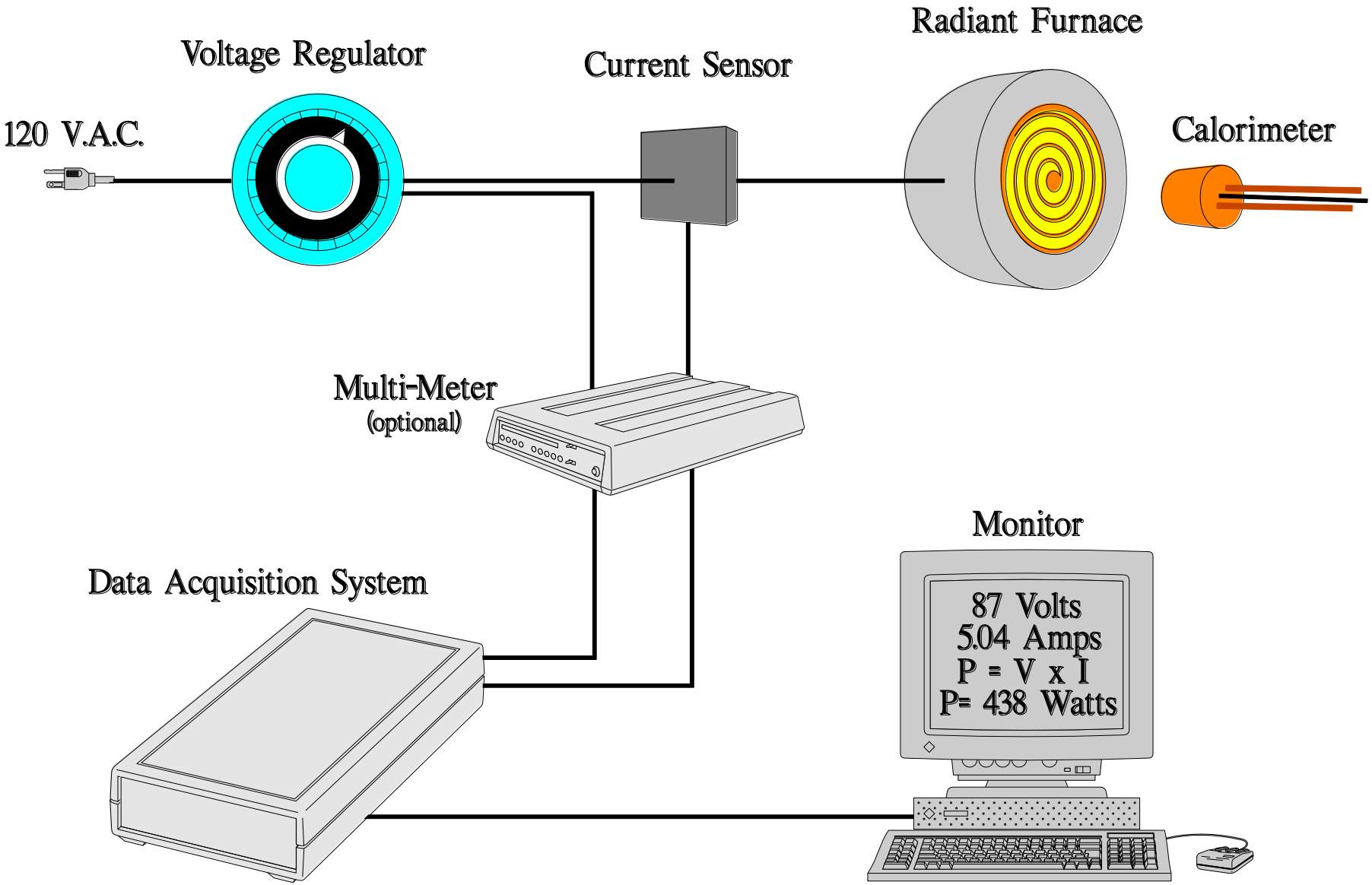
Federal Aviation Administration

Activities

- **Determination of radiant furnace input voltage required to produce appropriate 1.5 Btu/ft^2 sec heat flux**

- **Comparison of test using 2 furnace calibration methods**
  - The first method used a calorimeter to calibrate the furnace
  - The second method used power output to calibrate the furnace

- **Two different materials were tested (**3 tests on each material)


Radiant Furnace
Voltage Regulator
Current Sensor
120 V.A.C.
Calorimeter
Multi-Meter
(optional)
Monitor
Data Acquisition System
87 Volts
5.04 Amps
P = V x I
P= 438 Watts

Testing to Determine Power Requirement to Yield Correct Heat Flux Output:

Power Output: Current and Voltage of the furnace are measured, recorded and converted to Power Output using a computerized data acquisition system

Power output of between 438 to 448 Watts of the furnace produces a heat flux of 1.5 Btu/ft^{2}sec at the location 2 inches in front of the radiant heat furnace

Test #	Voltage (AC Volts) of the furnace	Current (Ampere) of the furnace	Power (Watts) of the furnace	Heat Flux (Btu/ft^{2}sec) of HFG at 2 inches in front of the radiant heat furnace
1	86-87	5.04	438 to 440	1.49 to 1.51
2	87	5.04 to 5.10	438 to 448	1.50 to 1.53
3	86-87	5.04 to 5.10	438 to 448	1.51 to 1.52

Evacuation Slide Test Method
Method 1: Using HFG to Calibrate the Furnace

- **Calibration**:
  1. Start the radiant heat furnace and other required instrumentation and allow ½ to ¾ hours (30 to 45 minutes) for warm up
  2. Position HFG at 2 inches in front of furnace and adjust transformer voltage to produce heat flux of 1.5 Btu/ft^2 sec (1.7 Watts/cm^2)
  3. Do not turn off the furnace. Use this radiant heat output for the test

- **Test Procedure**:
  1. After the heat flux is achieved in step 2 specified under calibration, rotate the HFG assembly away from the furnace
  2. Pressurize the cylinder with the test specimen to the slide material normal operating pressure and check the distance of the center of expanded surface of test specimen that is 2 inches in front of the furnace. Ensure that the test specimen holds the pressure for at least 3 minutes before the test
  3. Position the HFG in front of the radiant heat furnace to verify that heat flux is 1.5 Btu/ft^{2}sec (1.7 W/cm^2)
  4. Rotate the pressure cylinder with the test specimen in front of the radiant heat furnace. Simultaneously start the timer
  5. Record time (in seconds) to the first observed pressure loss
  6. Requirement for each test specimen is to maintain the correct pressure for a minimum of 180 seconds
  7. Repeat calibration and test procedure for each test specimen

Evacuation Slide Test Method:
Method 2: Using Power Output to Calibrate the Furnace

- Calibration:

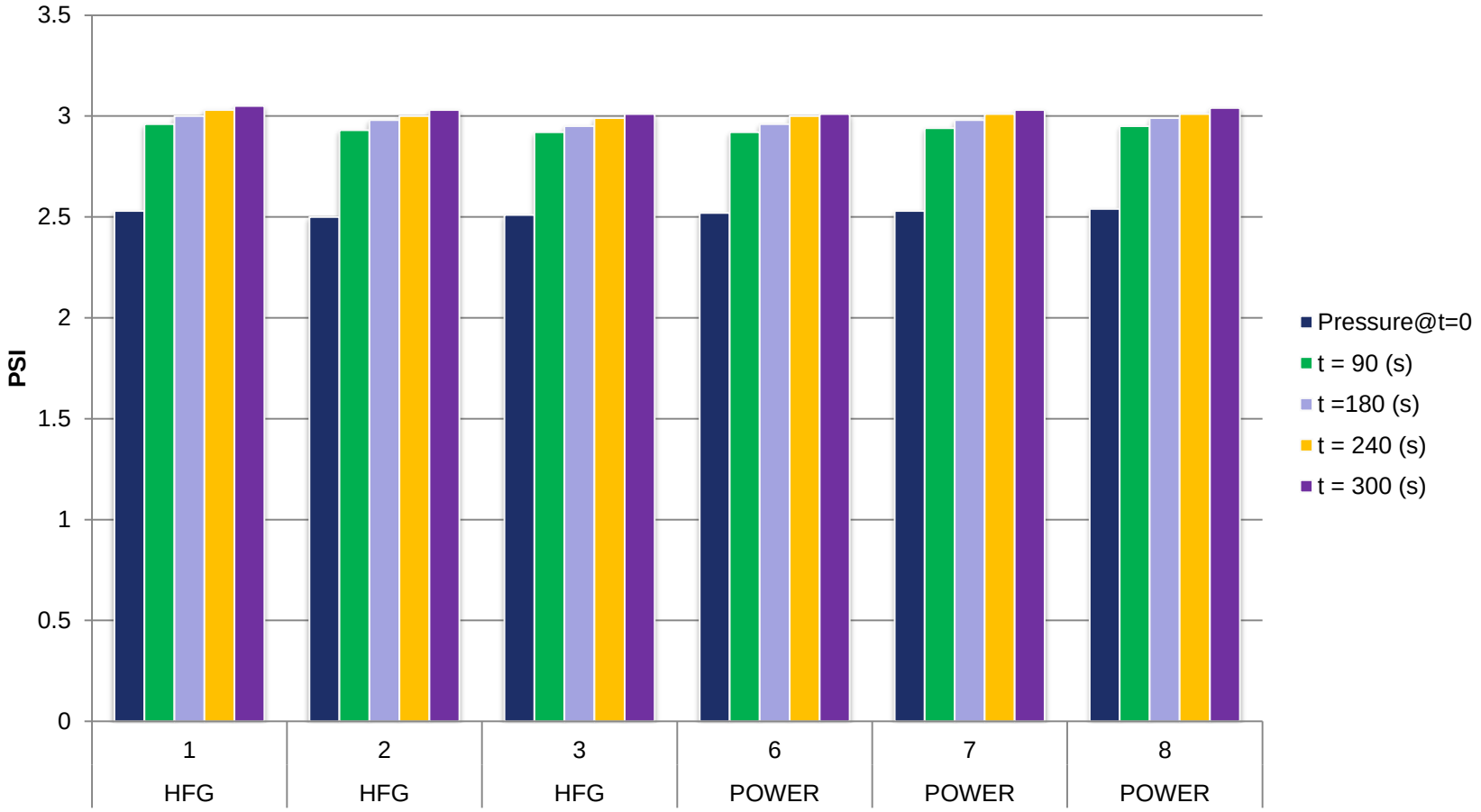
1. Start the radiant heat furnace and other required instrumentation and allow ½ to ¾ hours (30 to 45 minutes) for warm up.
2. Adjust the transformer voltage to produce a power output of the furnace between 438 watts and 448 watts. This power output produces a heat flux of 1.5 Btu/ft^{2}sec at the distance 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:

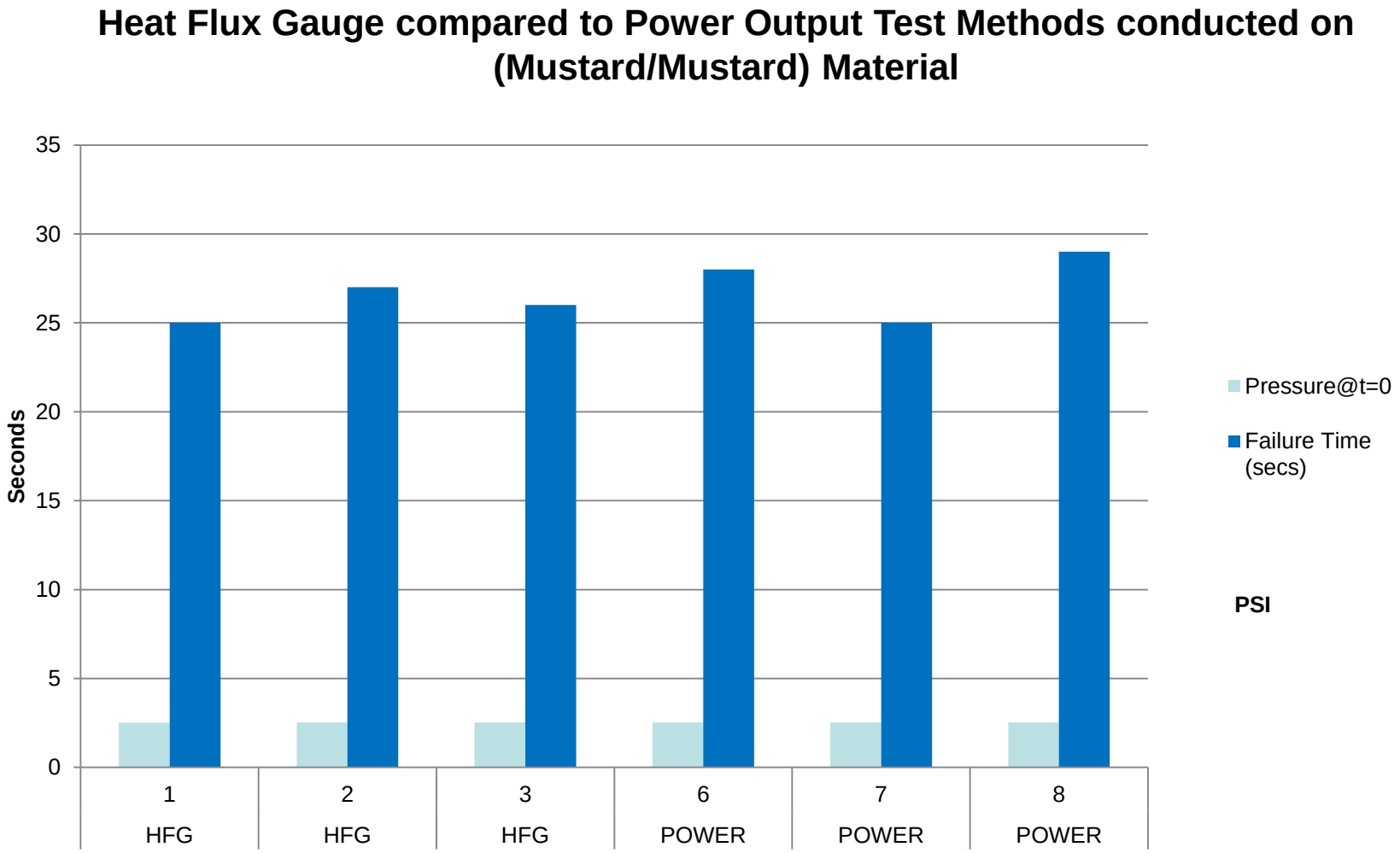
1. After the power output is achieved in the calibration,
2. Pressurize the cylinder with test specimen to the normal operating pressure and check the distance of the center of the expanded surface of the test specimen, which is 2 inches in front of the radiant heat furnace. Ensure that the test specimen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

Evacuation Slide Test Results:

Heat Flux Gauge compared to Power Output Test Methods conducted on (Yellow/Gray) Material



Evacuation Slide Test Results:



(Yellow/Gray)Test Results: Comparing HFG and Power Output

Test #	Method	Material	Pressure (PSI) at 0 sec	Pressure (PSI) at 90 sec	Pressure (PSI) at 180 sec	Pressure (PSI) at 240 sec	Pressure (PSI) at 300 sec	Pass/ Fail
1	HFG	Yellow/Gray	2.53	2.96	3	3.03	3.05	Pass
2	HFG	Yellow/Gray	2.50	2.93	2.98	3	3.03	Pass
3	HFG	Yellow/Gray	2.51	2.92	2.96	2.99	3.01	Pass
5	Power Output	Yellow/Gray	2.52	2.92	2.96	3	3.01	Pass
6	Power Output	Yellow/Gray	2.53	2.94	2.98	3.01	3.03	Pass
7	Power Output	Yellow/Gray	2.54	2.95	2.99	3.01	3.04	Pass

(Mustard/Mustard) Test Results: Comparing HFG and Power Output

Test #	Method	Material	Pressure (PSI) at o sec	Pressure (PSI) at 90 sec	Pressure (PSI) at 180 sec	Pressure (PSI) at 240 sec	Pressure (PSI) at 300 sec	Pass/Fail
1	HFG	Mustard/Mustard	2.51					Failed at 25 sec
2	HFG	Mustard/Mustard	2.52					Failed at 27 sec
3	HFG	Mustard/Mustard	2.52					Failed at 26 sec
5	Power Output	Mustard/Mustard	2.53					Failed at 28 sec
7	Power Output	Mustard/Mustard	2.52					Failed at 25 sec
8	Power Output	Mustard/mustard	2.52					Failed at 29 sec

Conclusions

- **(Yellow/Gray) slide materials passed the tests with both test methods**
- **(Mustard/Mustard) slide materials failed the tests with both test methods**
- **Data/Results of both test methods were similar**
- **Power Output method has advantage:**

  -Time for furnace calibration is quick

  -Additional time saved by not having to recheck heat flux before each test

Future Work

- **FAA will conduct Test Calibrations of several furnaces to compare their power outputs for the slide test**

- **FAA will run the Slide Test to evaluate the performance of several furnaces, using power output to calibrate the furnace**

- **Round Robin 4 will be conducted when the Participants are ready to use Power Output to calibrate the furnace**