

Proposed Radiant Heat Panel Test

For the Evaluation of Aircraft Duct Material



INTERNATIONAL AIRCRAFT MATERIALS FIRE TEST WORKING GROUP
ATLANTIC CITY, NEW JERSEY MARCH 20-21, 2006 MEETING
WJH FAA Technical Center
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Outline



PRESENTATION OUTLINE:

- Task Group Objective
- October 2005 Meeting Minutes
- Test Results (Past Quarter)
- Status of Proposed Aircraft Ducting Test
- Summary & Final Remarks



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Objectives



OBJECTIVES

- FAA's goal is to raise the standard for the airplane such that fires in inaccessible areas do not spread and create catastrophic conditions.
- The current test for aircraft ducts does not predict the behavior of the part in actual conditions and therefore suggests the need for a new standard.
- For the Task Group, is to develop a new fire test procedure to evaluate the fire-worthiness of aircraft ducting.



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Minutes



OCTOBER 2005 TASK GROUP MEETING MINUTES

- FAA test data available on-line (<ftp://155.178.136.36>)
- Task Group Members comments, concerns & questions:
 - Define ducting system boundaries & exclusions
 - Should insulated covered ducts be regulated under FAR 856 or should it be regulated by the test new protocol?



Minutes



OCTOBER 2005 TASK GROUP MEETING MINUTES

▪ Task Group Members concerns & questions (Cont.):

- Should ducts that transition between the cabin and inaccessible areas be regulated by current cabin federal regulations or the new test protocol?
- Should the repair/replacement of existing parts meet the previous regulation test or the new test protocol?
- When the duct is an integrated part of the structure, should it meet the new test protocol or the old one?
- The task group members were assigned to review the test result data to assess the proposed radiant heat panel test.
- Samples of less fire-worthy materials, with fire retardant coatings, to be provided to the FAA Technical Center for evaluation.



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Results



LAST QUARTER TEST RESULTS

- Tested Taped N (IST and RP)
- Tested Coated Taped N (IST and RP)
- Tested Coated B (RP)
- Received Structural Adhesive
(Scheduled for testing)



Results



LAST QUARTER TEST RESULTS

■ Intermediate-Scale Test Results:

• Taped N

- Peak Temp (degC) = 415
- Heat Flux (kW/m^2) = 61
- Burning Time (min) = 10
- Burned Area (cm^2) = 111



Results



LAST QUARTER TEST RESULTS (CONT.)

■ Intermediate-Scale Test Results (Cont.):

• Coated/Taped N Test 1

- Peak Temp (degC) = 766
- Heat Flux (kW/m²) = 59
- Burning Time (min) = +40
- Burned Area (cm²) = 4985



Results



LAST QUARTER TEST RESULTS (CONT.)

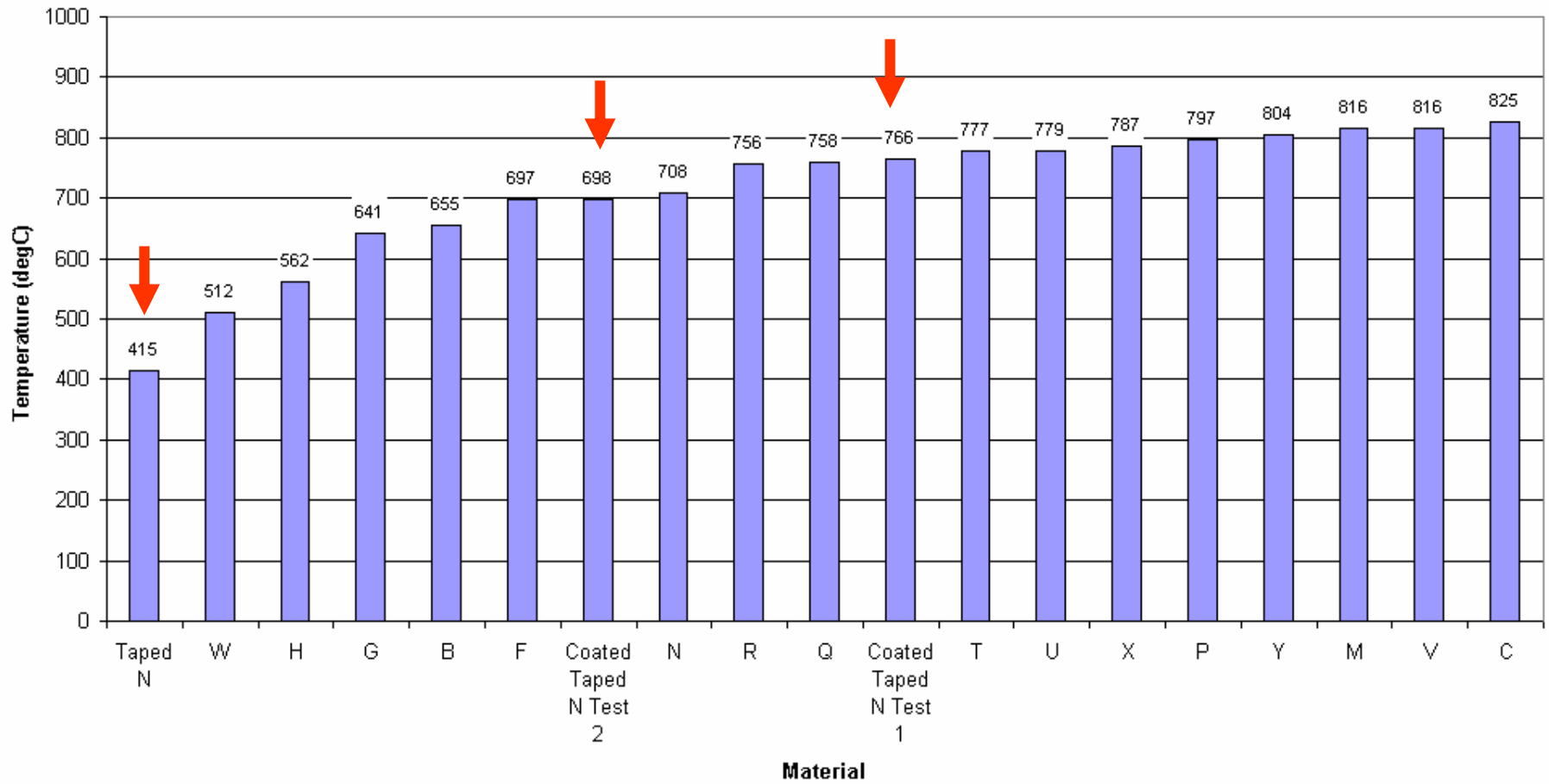
■ Intermediate-Scale Test Results (Cont.):

• Coated/Taped N Test 2

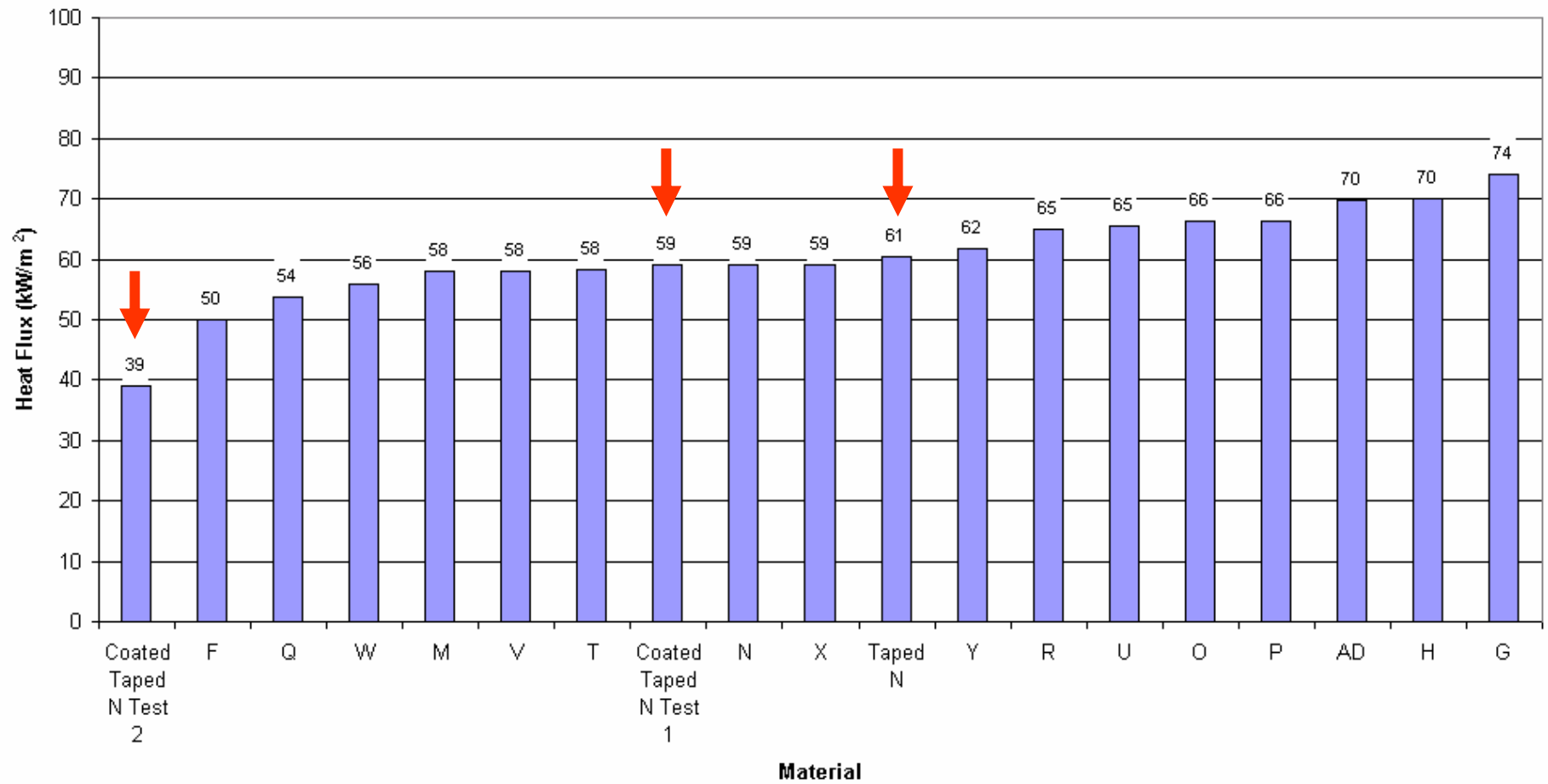
- Peak Temp (degC) = 698
- Heat Flux (kW/m^2) = 39
- Burning Time (min) = 2.18
- Burned Area (cm^2) = 336



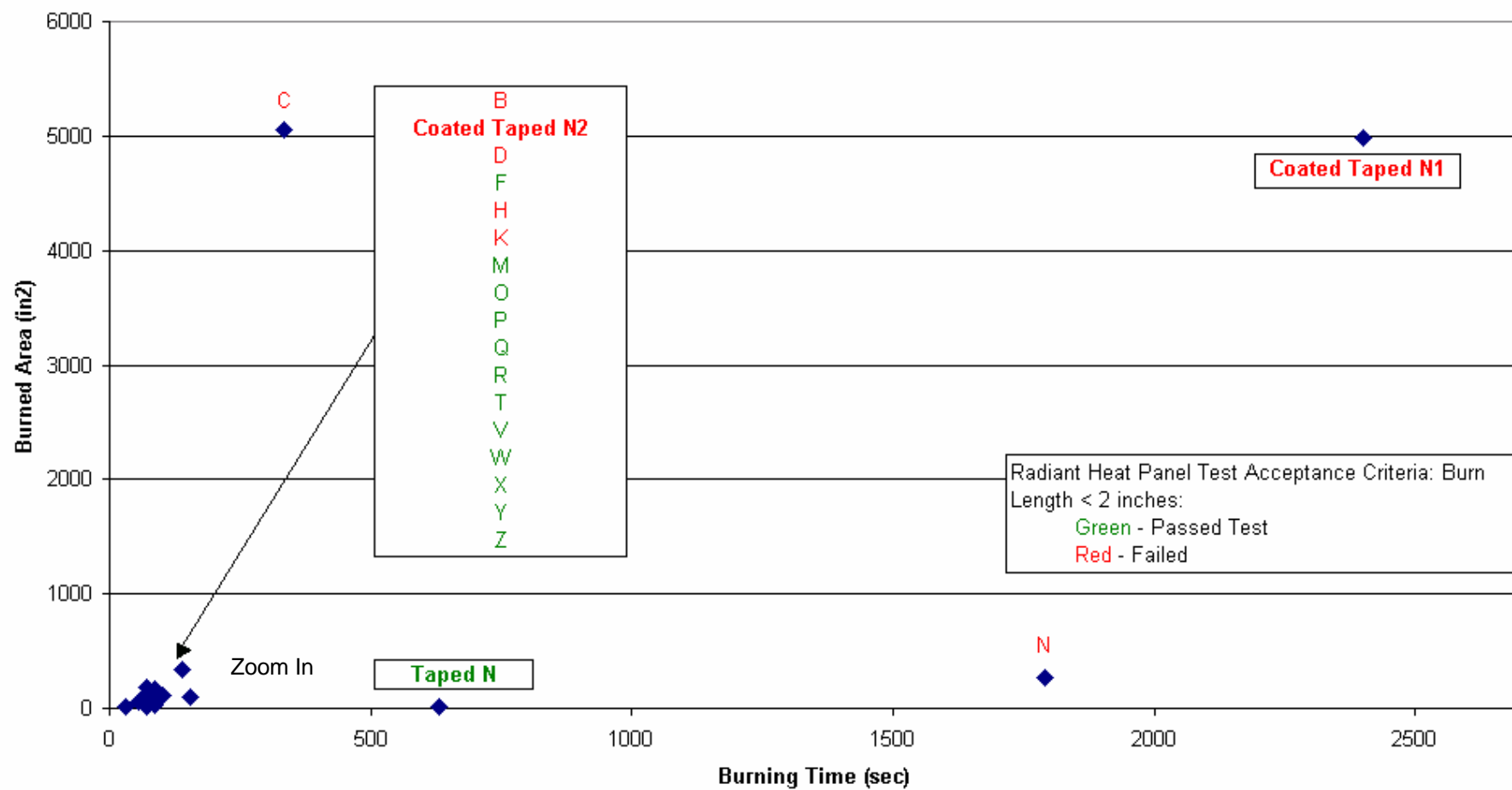
INTERMEDIATE-SCALE FIRE TEST
Aircraft Ducting Materials / Narrow-Body Configuration



INTERMEDIATE-SCALE FIRE TEST
Aircraft Ducting Materials / Narrow-Body Configuration

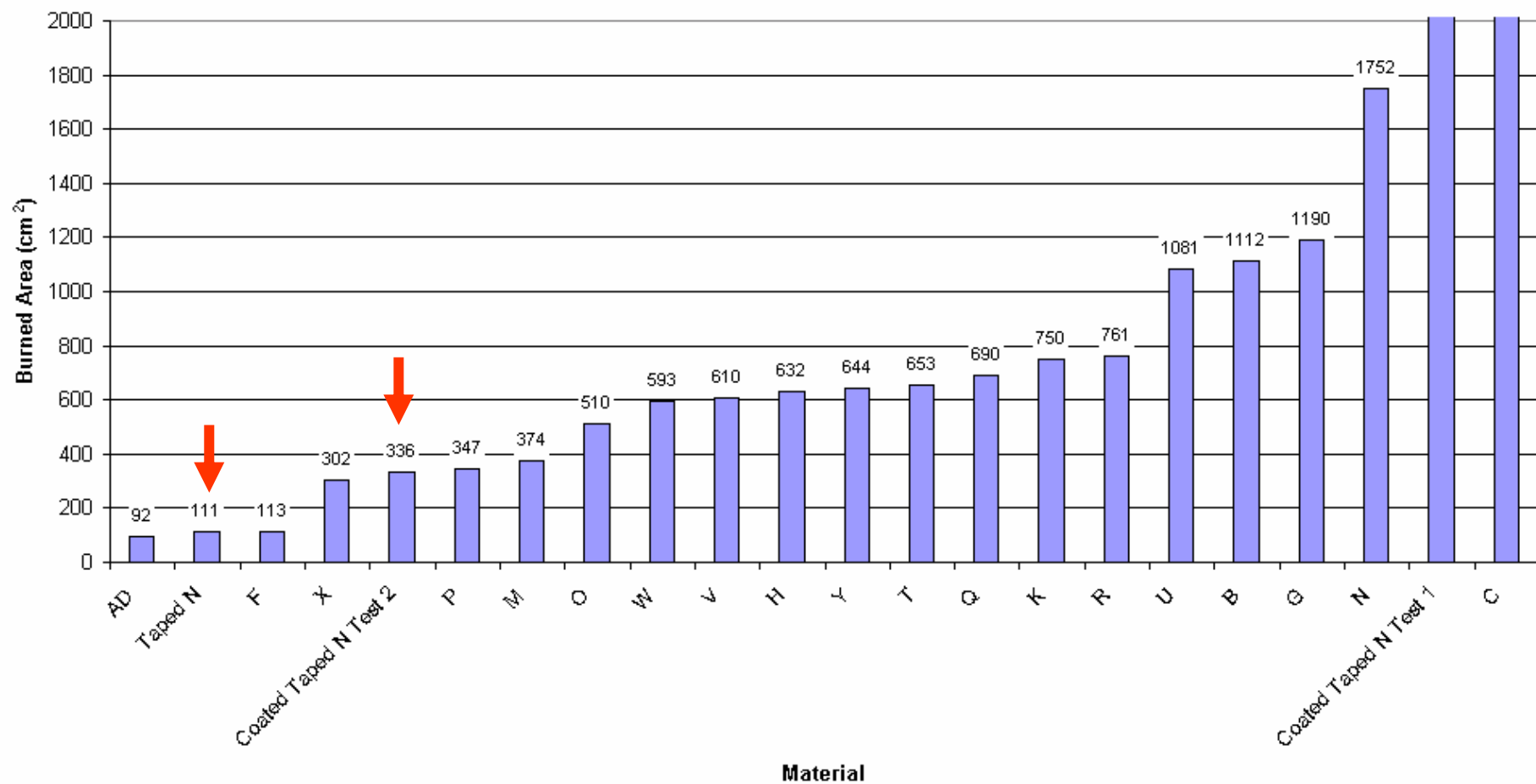


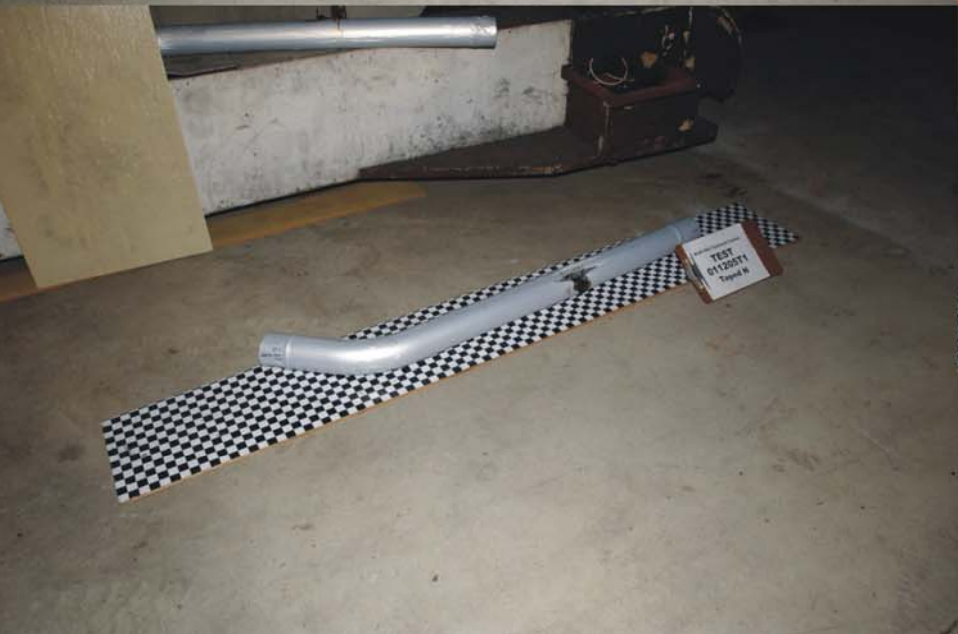
INTERMEDIATE-SCALE TEST Aircraft Ducting Materials



INTERMEDIATE-SCALE FIRE TEST Aircraft Ducting Materials / Narrow-Body Configuration

4985 32583





SAMPLE "TAPED N"

Coated & Taped N: Test 1



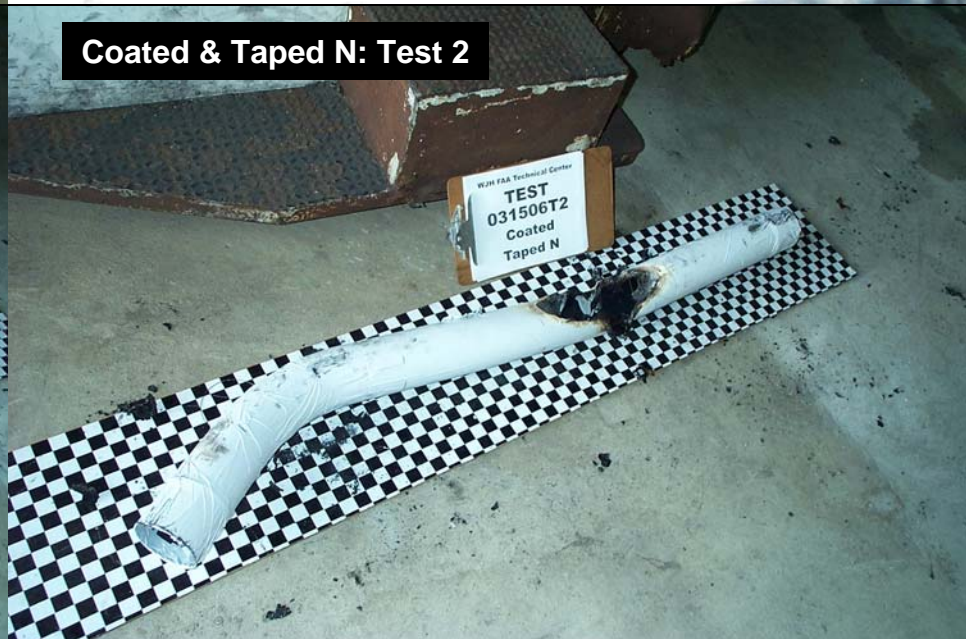
Coated & Taped N: Test 2



Coated & Taped N: Test 1



Coated & Taped N: Test 2



Results



LAST QUARTER TEST RESULTS (CONT.)

■ Radiant Panel Test Results:

• Material Taped N:

– FAA Radiant Panel Test Results

- ❖ Burn Length (cm) = 0.67
- ❖ After Flame Time (sec) = +40

– Proposed Radiant Panel Test Results

- ❖ Burn Length (cm) = 1.5
- ❖ After Flame Time (sec) = 4.4



Results



LAST QUARTER TEST RESULTS (CONT.)

- Radiant Panel Test Results:
 - Material Coated Taped N:
 - FAA Radiant Panel Test Results
 - ❖ Burn Length (cm) = 3.2
 - ❖ After Flame Time (sec) = 7.3
 - Proposed Radiant Panel Test Results
 - ❖ Burn Length (cm) = 9.7
 - ❖ After Flame Time (sec) = +40



Matches Performance of IST Test 1!



Results



LAST QUARTER TEST RESULTS (CONT.)

■ Radiant Panel Test Results:

• Material Coated B:

– FAA Radiant Panel Test Results

- ❖ Burn Length (cm) = 3.6
- ❖ After Flame Time (sec) = 3.6

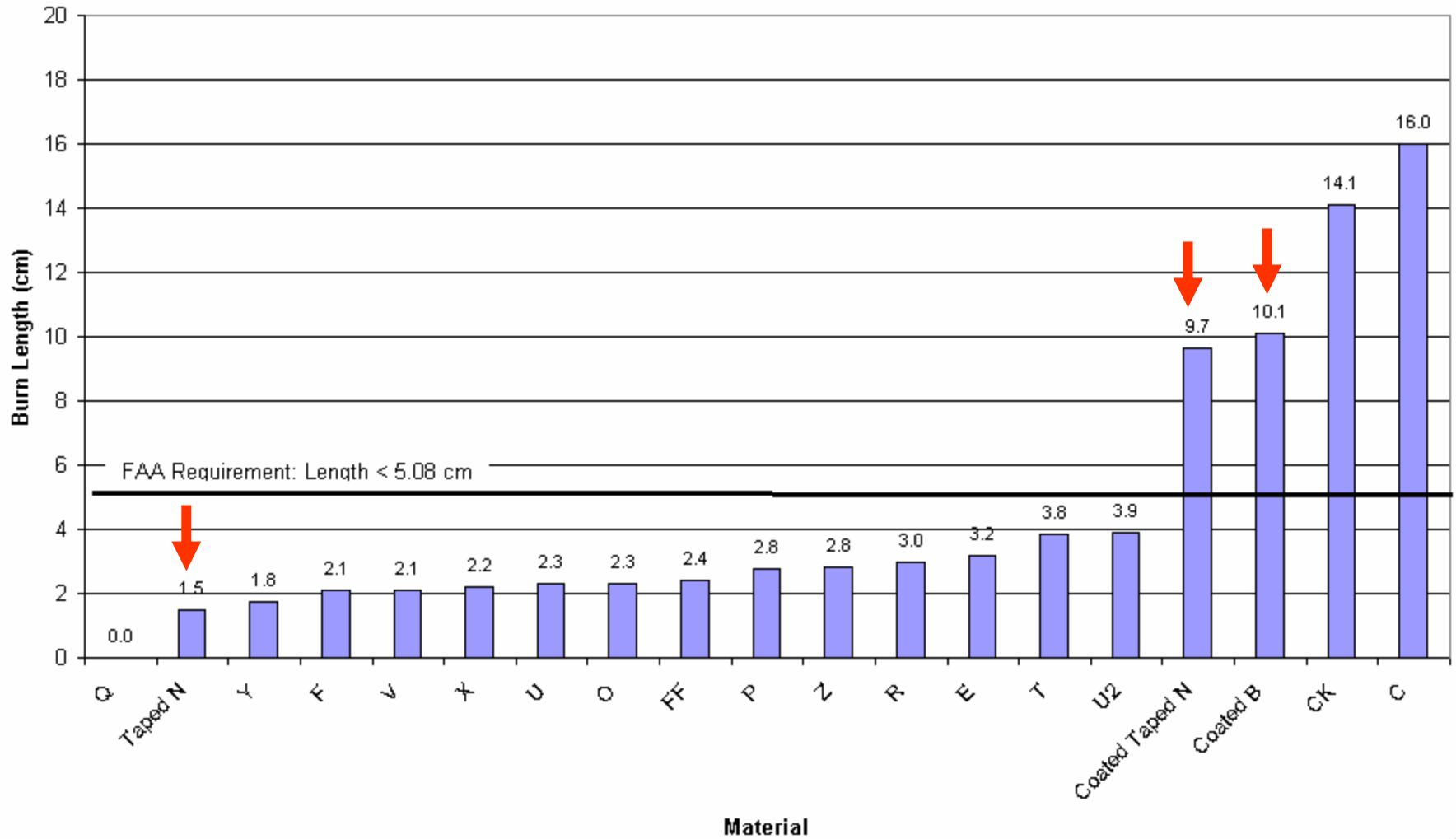
– Proposed Radiant Panel Test Results

- ❖ Burn Length (cm) = 10.1
- ❖ After Flame Time (sec) = +40

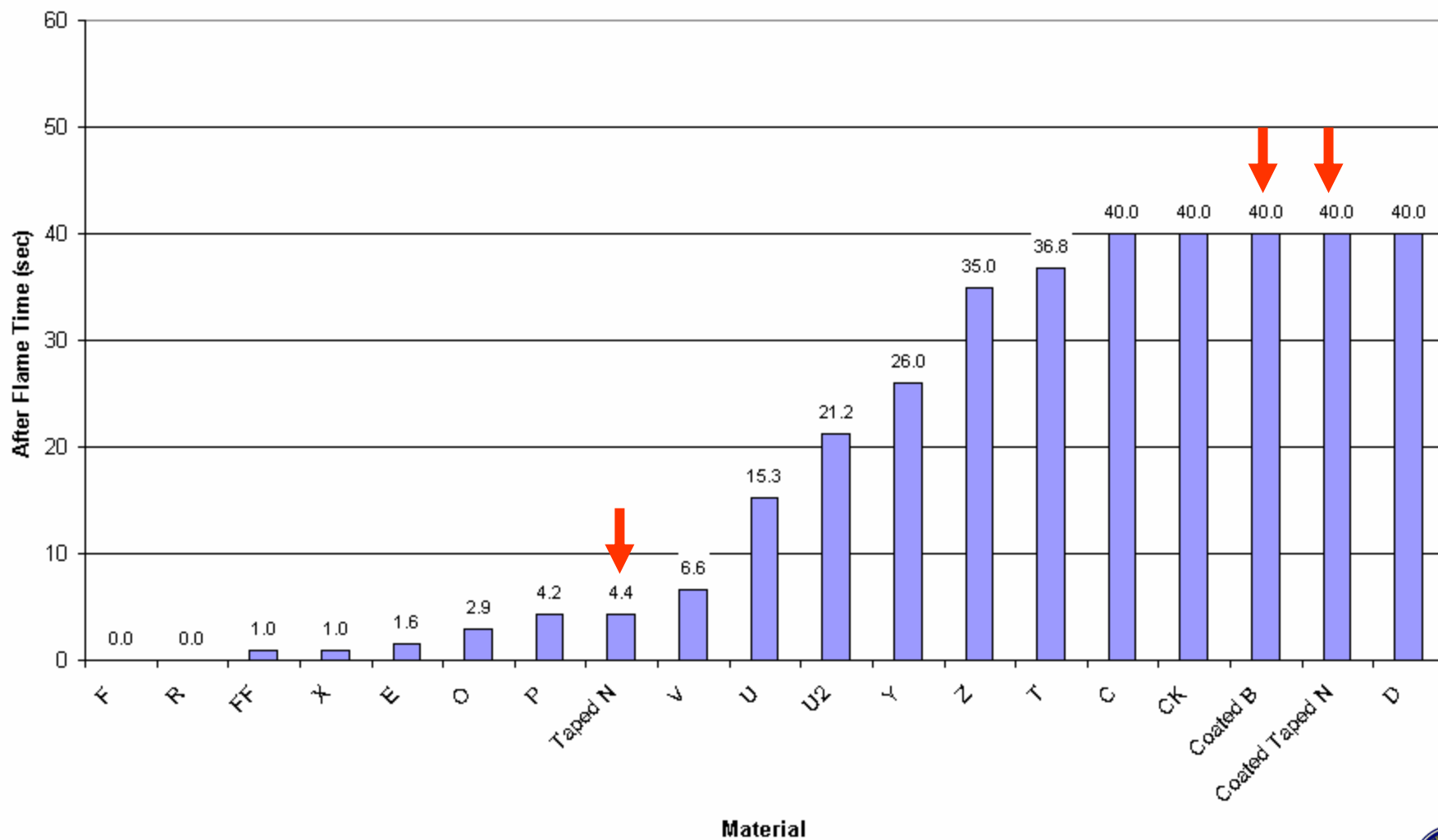


EXPERIMENTAL RADIANT PANEL TEST RESULTS

Aircraft Ducting Materials



EXPERIMENTAL RADIANT PANEL TEST RESULTS Aircraft Ducting Materials



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Status of Test



PROPOSED RADIANT PANEL TEST:

Test Protocol: Based on Appendix F to Part 25 (Part IV) – Test Method To Determine the Flammability and Flame Propagation Characteristics of Thermal/Acoustic Insulation Materials

Sample Size: 215.9mm x 279.4mm

Heat Source: Propane Flame & Radiant Heating Coils (147 kW/m² pilot , 17 kW/m² panel).

Heat Source Exposure: One minute exposure to radiant heat, then 10 seconds pilot impingement.

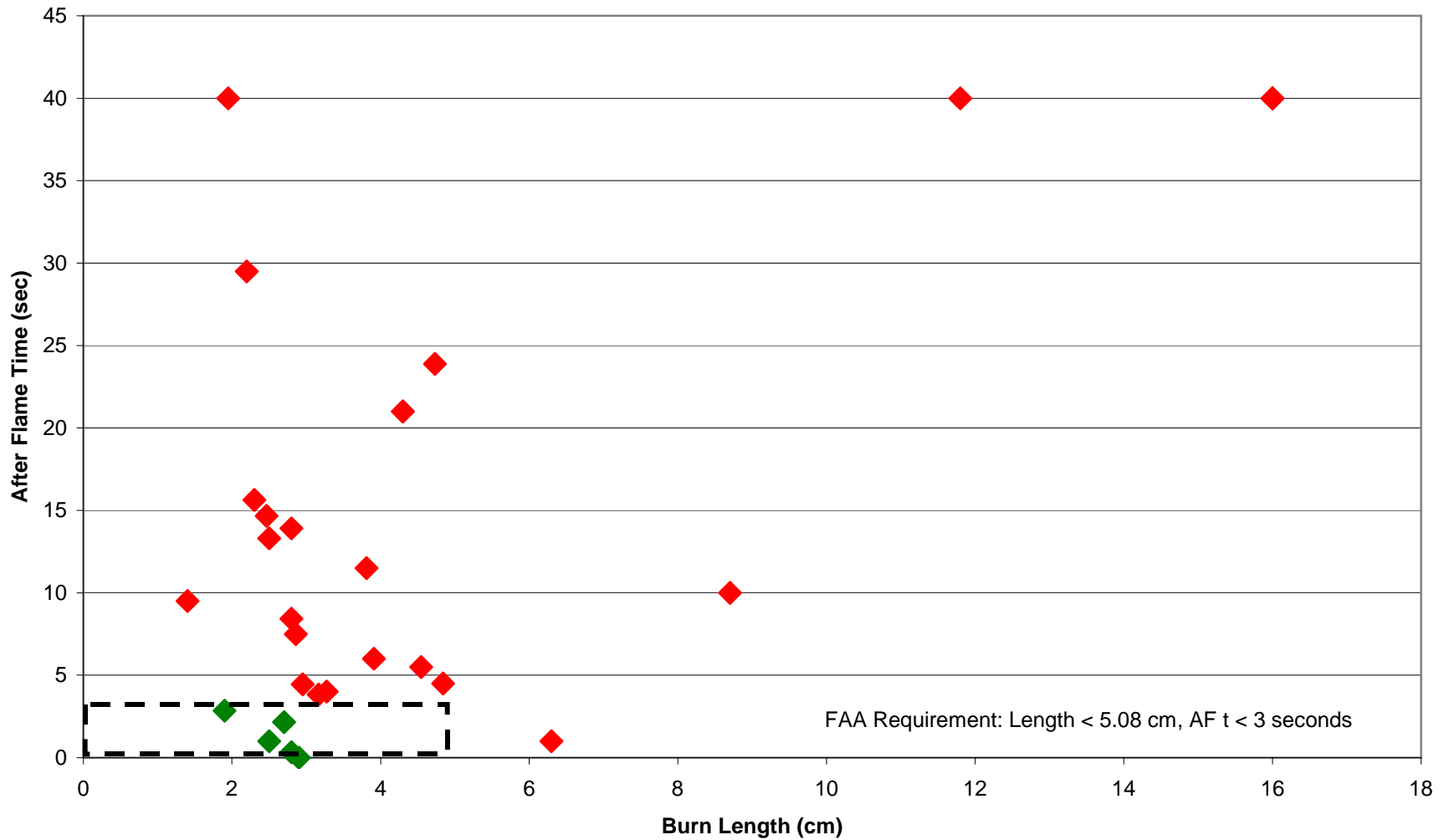
Max Flame Propagation: < 5.08 cm

Max Flame Time: TBD



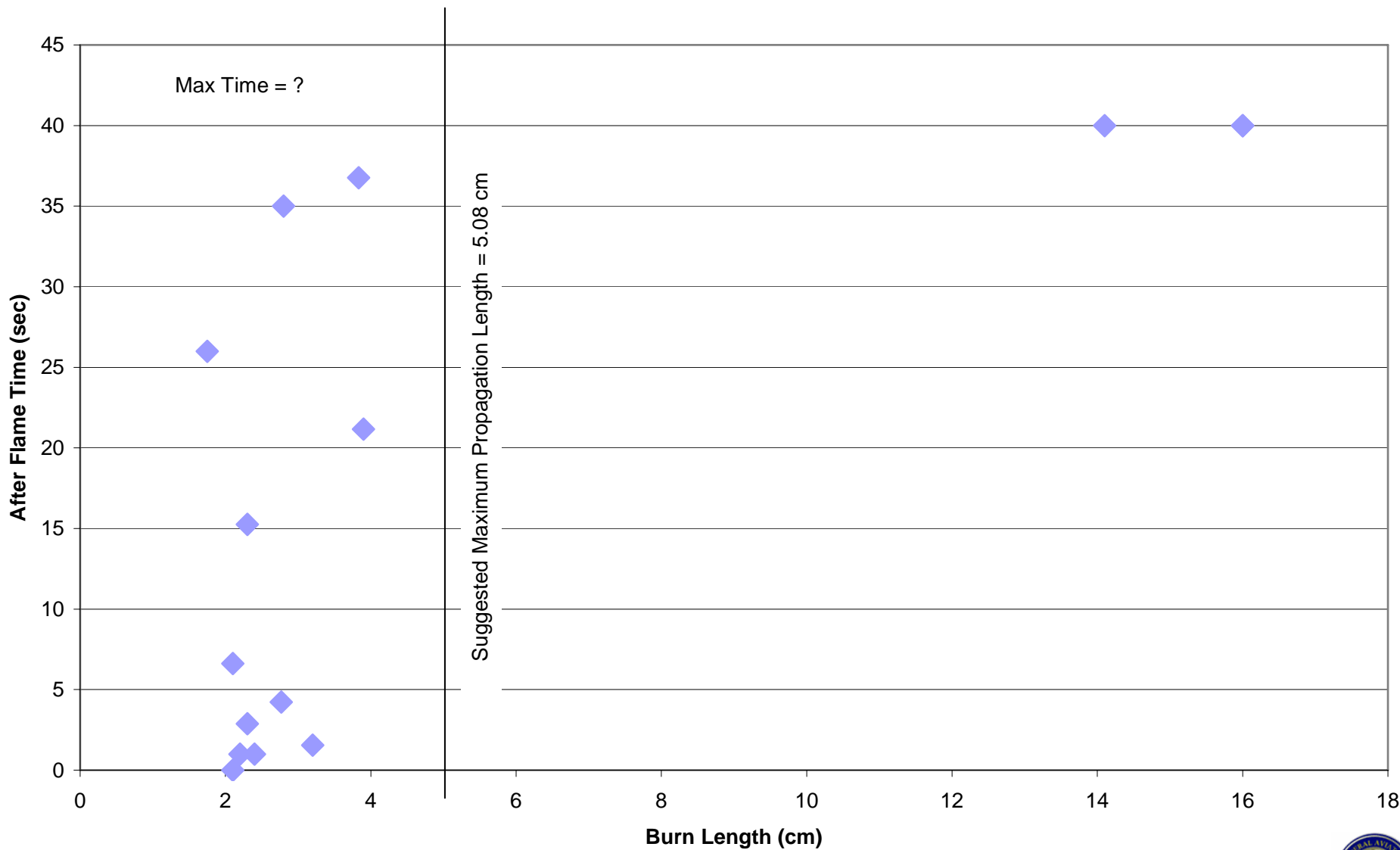
RADIANT PANEL TEST RESULTS

Aircraft Ducting Materials



EXPERIMENTAL RADIANT PANEL TEST RESULTS

Aircraft Ducting Materials



Status of Test

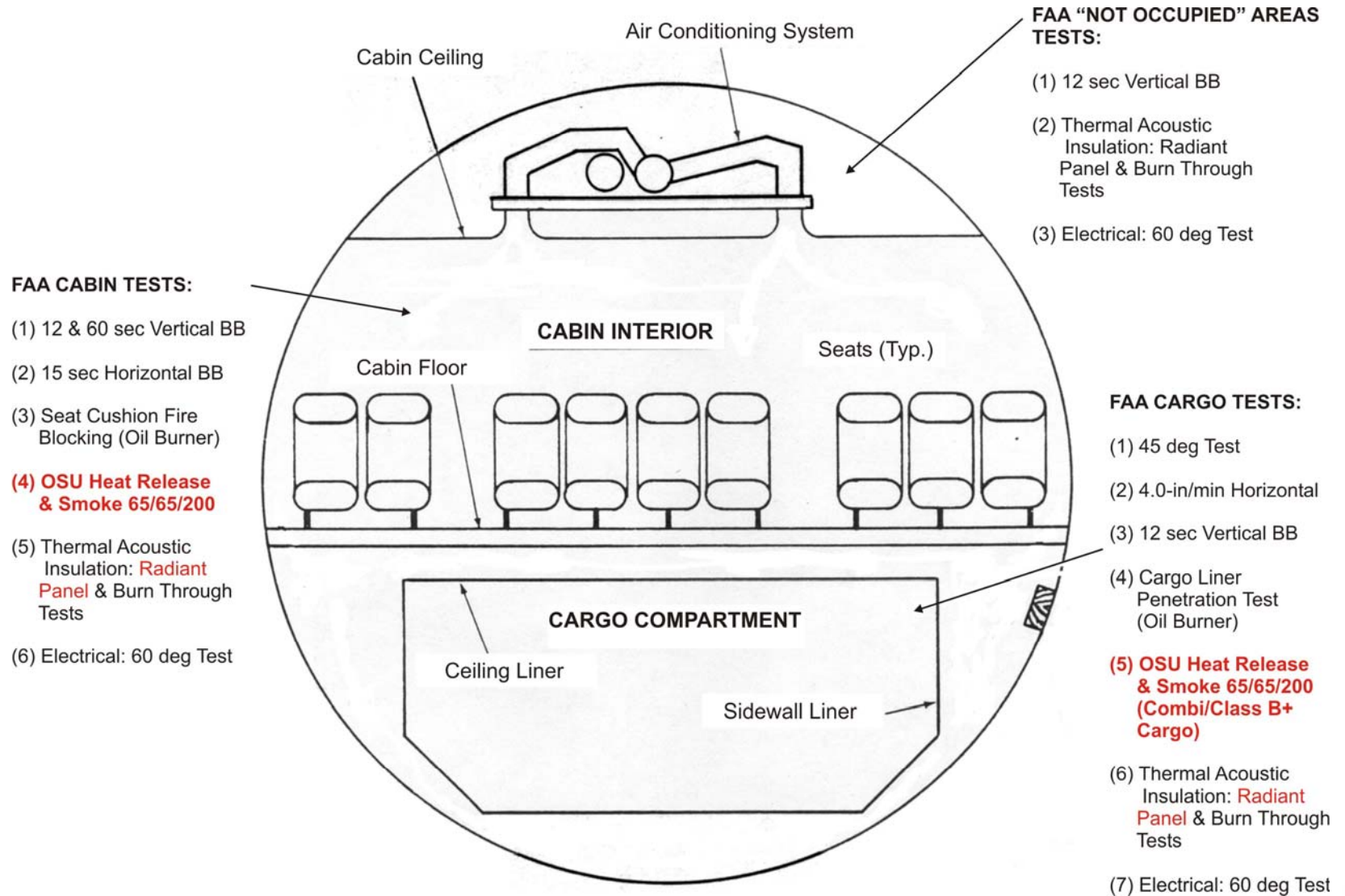


PROPOSED AIRCRAFT DUCTING TEST (CONT.):

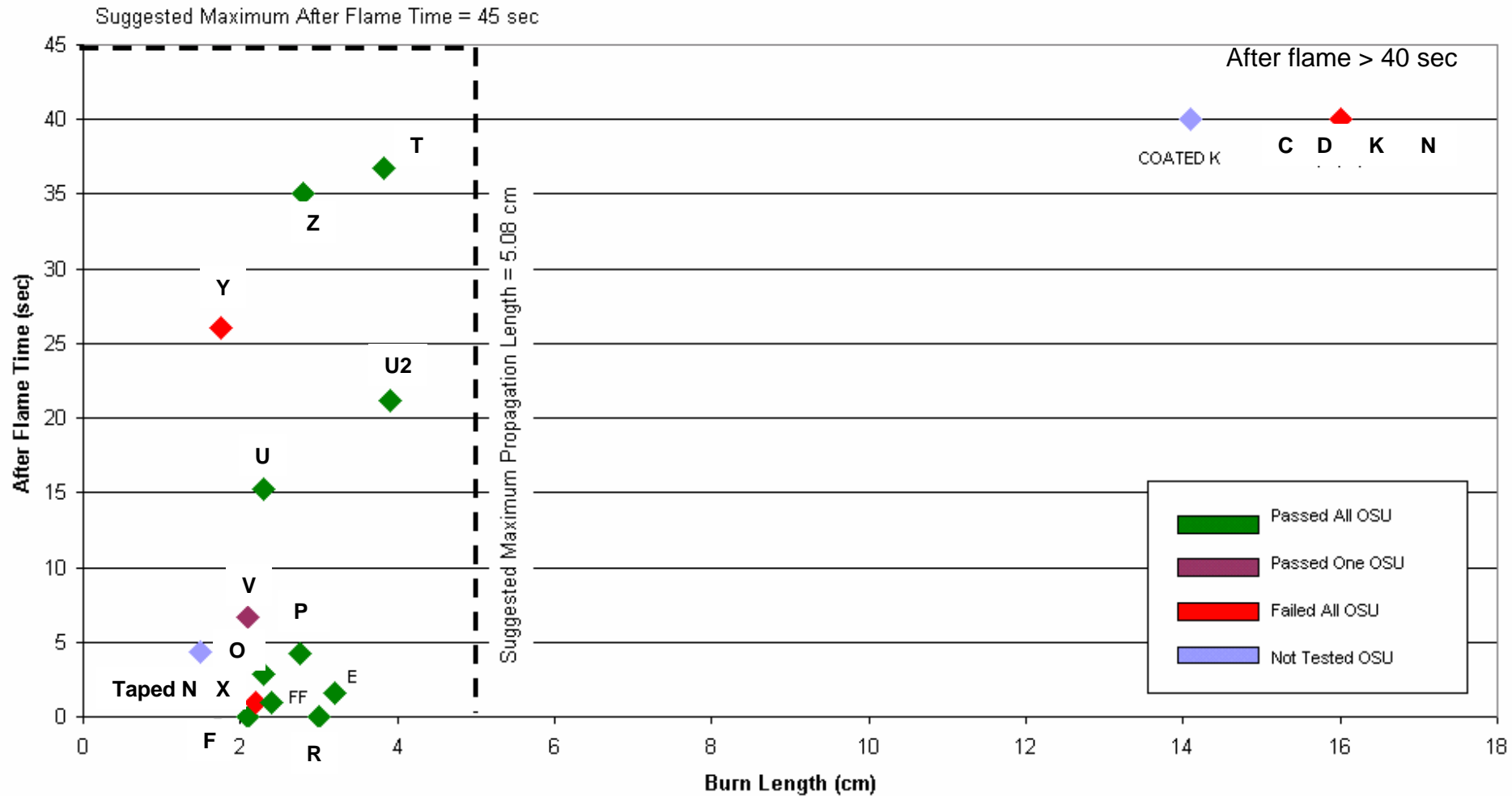
- Some components or parts of the ducting system are installed between the hidden areas (such as the attic and cargo compartment) and the cabin area.
- Suggestion: Use the performance of materials that passed the OSU to determine the maximum “After Flame Time”.



FAA FIRE TESTS



EXPERIMENTAL RADIANT PANEL TEST RESULTS Aircraft Ducting Materials



Status of Test



PROPOSED AIRCRAFT DUCTING TEST:

Topics for Discussion with Task Group Members

- (1) “After Flame Time” recommended to be 45 seconds
- (2) Should we change the pilot flame impingement time back to 15 seconds?

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Summary

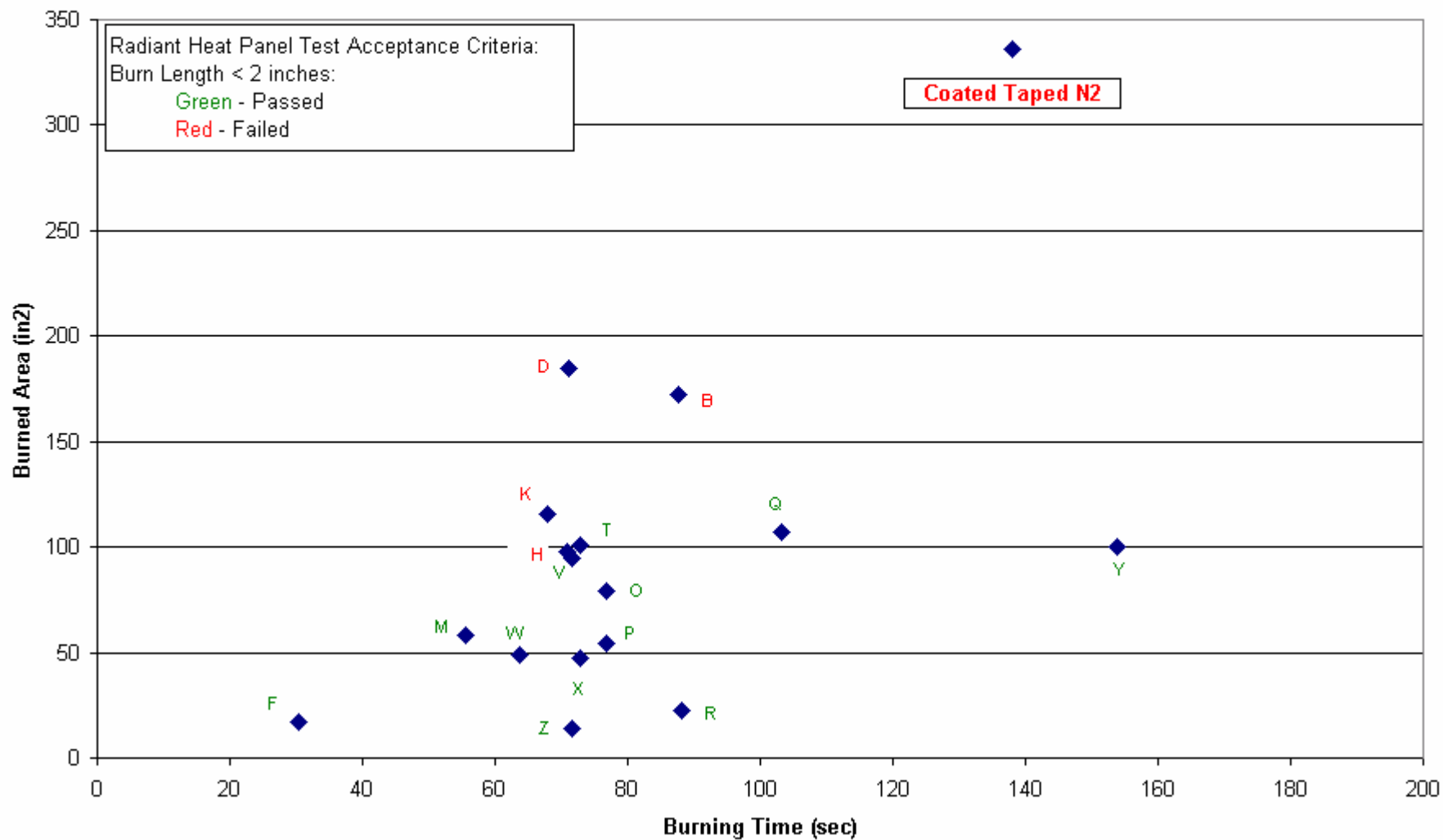


SUMMARY & FINAL REMARKS

- OCTOBER MINUTES: Task Group member's policy questions cannot be answered at this time, but they will be included in the report for future reference.
- LAST QUARTER TESTING: There was a significant improvement (+10x) on the performance of material N during IST and RP tests when a fire retardant tape was applied to it. The same could not be said about the FR coating (Taped N or B).
- PROPOSED TEST: **Obtain Task Group members' feedback**
 - "After Flame Time" recommended: 45 seconds (based on test data)
 - Extend pilot impingement time (from 10 sec to 15 sec)
 - Continue testing materials (as needed)
 - Initiate test protocol draft report



INTERMEDIATE-SCALE TEST Aircraft Ducting Materials



←GO BACK



$T_i = 239\text{ }^{\circ}\text{C}$
IST Burning Time = 5.58 minutes
IST Burned Area = $32,583\text{ cm}^2$
IST Peak Temperature = $825\text{ }^{\circ}\text{C}$
RP Burned Length = 16 cm
RP After Flame = >40 sec
OSU Peak Heat Released = 82.8 kW/m^2
OSU Total Heat Released = 111.8 kW/m^2
Smoke Density = 130.7

SAMPLE "C"



$T_i = 486\text{ }^{\circ}\text{C}$
IST Burning Time = 1.18 minutes
IST Burned Area = 1190 cm^2
IST Peak Temperature = $641\text{ }^{\circ}\text{C}$
RP Burned Length = 16 cm
RP After Flame = >40 sec
OSU Peak Heat Released = 66.3 kW/m^2
OSU Total Heat Released = 29.6 kW/m^2
Smoke Density = 4.5

SAMPLE "D"





$T_i = 561\text{ }^{\circ}\text{C}$

IST Burning Time = 0.51 minutes

IST Burned Area = 113 cm^2

IST Peak Temperature = $697\text{ }^{\circ}\text{C}$

RP Burned Length = 2.1 cm

RP After Flame = 0 sec

OSU Peak Heat Released = 30.2 kW/m^2

OSU Total Heat Released = 25.9 kW/m^2

Smoke Density = 19.4

SAMPLE "F"



WJH FAA Tech Center
Test 012705T02
Kevlar/Epoxy



$T_i = 322\text{ }^{\circ}\text{C}$

IST Burning Time = 1.13 minutes

IST Burned Area = 750 cm^2

IST Peak Temperature = $896\text{ }^{\circ}\text{C}$

RP Burned Length = 16 cm

RP After Flame = >40 sec

OSU Peak Heat Released = 70.5 kW/m^2

OSU Total Heat Released = 72.9 kW/m^2

Smoke Density = 189

SAMPLE "K"





$T_i = 554\text{ }^{\circ}\text{C}$

IST Burning Time = 0.93 minutes

IST Burned Area = 374 cm^2

IST Peak Temperature = $816\text{ }^{\circ}\text{C}$

RP Burned Length = N/A (3.9 cm)

RP After Flame = N/A (6 sec)

OSU Peak Heat Released = 53.4 kW/m^2

OSU Total Heat Released = 66.6 kW/m^2

Smoke Density = 0.5

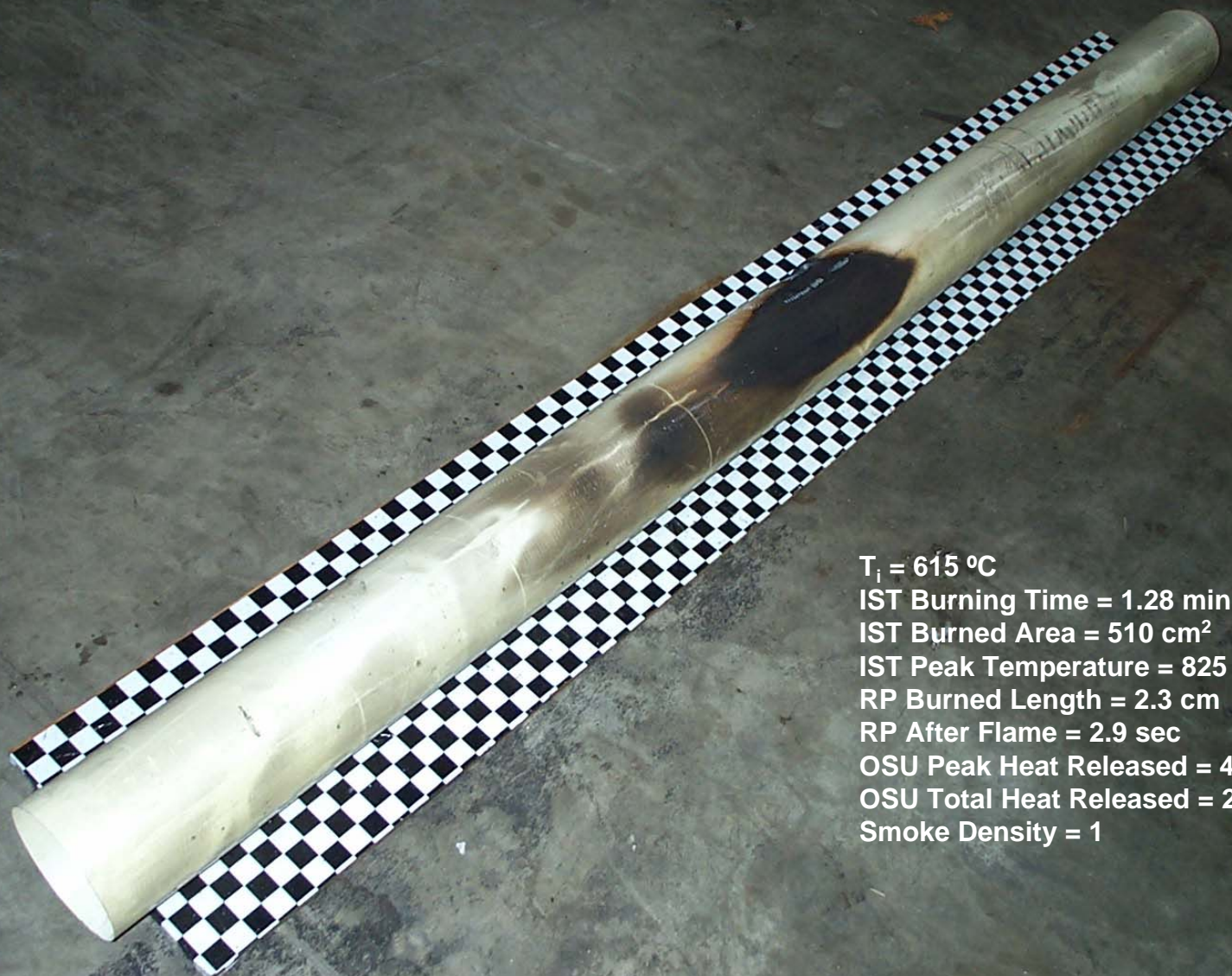
SAMPLE "M"



$T_i = 358\text{ }^{\circ}\text{C}$
IST Burning Time = 30 minutes
IST Burned Area = 1752 cm^2
IST Peak Temperature = $708\text{ }^{\circ}\text{C}$
RP Burned Length = 16 cm
RP After Flame = > 40 sec
OSU Peak Heat Released = 179.3 kW/m^2
OSU Total Heat Released = 114.2 kW/m^2
Smoke Density = 175.8

SAMPLE "N"





$T_i = 615\text{ }^{\circ}\text{C}$
IST Burning Time = 1.28 minutes
IST Burned Area = 510 cm^2
IST Peak Temperature = $825\text{ }^{\circ}\text{C}$
RP Burned Length = 2.3 cm
RP After Flame = 2.9 sec
OSU Peak Heat Released = 40.7 kW/m^2
OSU Total Heat Released = 25.7 kW/m^2
Smoke Density = 1



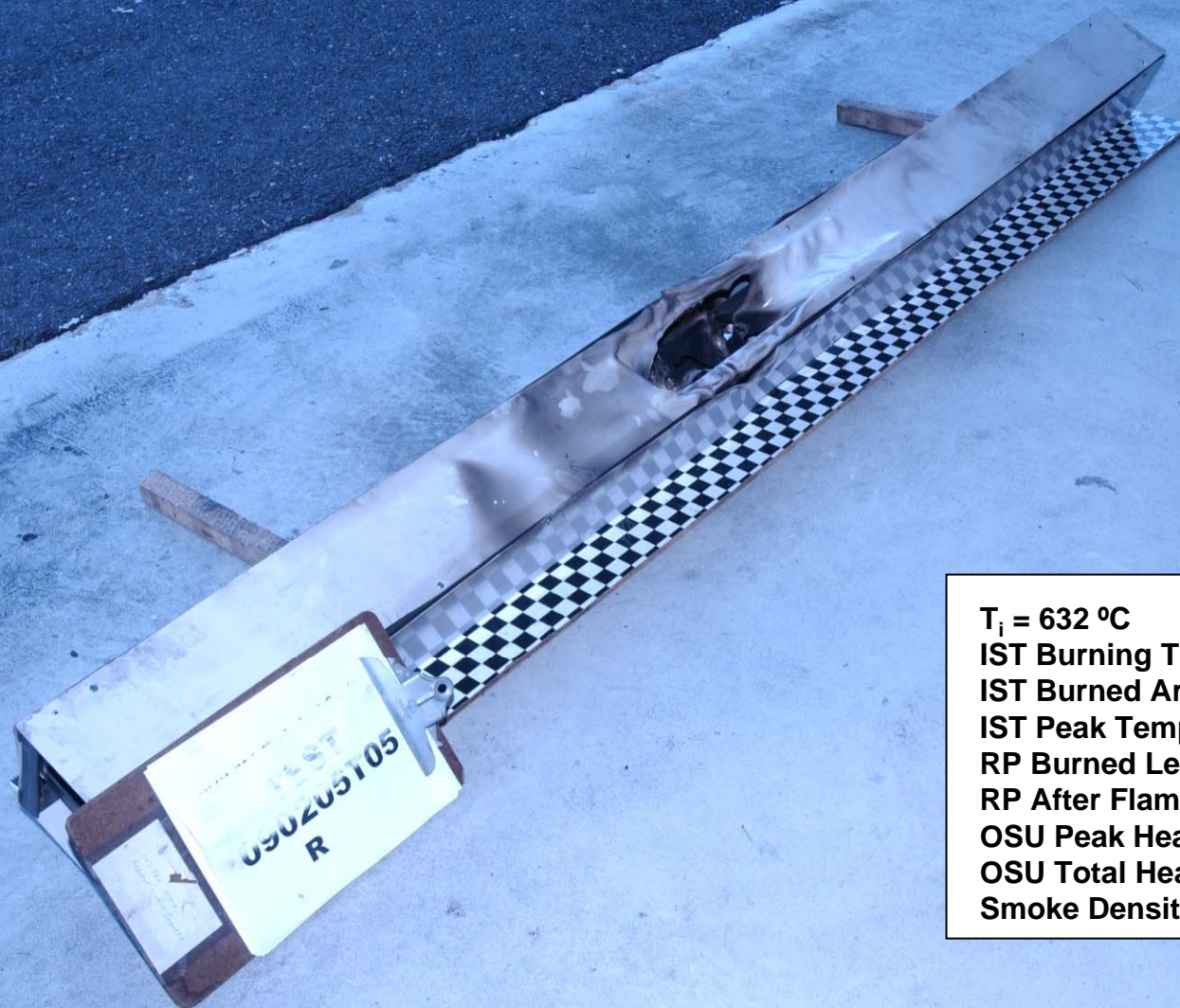
SAMPLE "O"



$T_i = 615\text{ }^{\circ}\text{C}$
IST Burning Time = 1.28 minutes
IST Burned Area = 347 cm^2
IST Peak Temperature = $797\text{ }^{\circ}\text{C}$
RP Burned Length = 4.2 cm
RP After Flame = 2.8 sec
OSU Peak Heat Released = 44.2 kW/m^2
OSU Total Heat Released = 39.8 kW/m^2
Smoke Density = 0.7



SAMPLE "P"



$T_i = 632\text{ }^{\circ}\text{C}$
IST Burning Time = 1.47 minutes
IST Burned Area = 761 cm^2
IST Peak Temperature = $756\text{ }^{\circ}\text{C}$
RP Burned Length = 3.0 cm
RP After Flame = 0.0 sec
OSU Peak Heat Released = 30.5 kW/m^2
OSU Total Heat Released = 8.9 kW/m^2
Smoke Density = 0.1

SAMPLE "M"



$T_i = 581\text{ }^{\circ}\text{C}$
IST Burning Time = 1.21 minutes
IST Burned Area = 653 cm^2
IST Peak Temperature = $777\text{ }^{\circ}\text{C}$
RP Burned Length = 3.8 cm
RP After Flame = 36.8 sec
OSU Peak Heat Released = 33.5 kW/m^2
OSU Total Heat Released = 24.4 kW/m^2
Smoke Density = 8.6

SAMPLE "T"

$T_i = \text{N/A}$

IST Burning Time = ~10 minutes

IST Burned Area = 111 cm²

IST Peak Temperature = 415 °C

RP Burned Length = 1.5 cm

RP After Flame = 4.4 sec

OSU Peak Heat Released = N/A

OSU Total Heat Released = N/A

Smoke Density = N/A

WJH FAA Technical Center

TEST
011205T2
Taped N

SAMPLE "TAPED N"



$T_i = 578\text{ }^{\circ}\text{C}$
IST Burning Time = N/C minutes
IST Burned Area = 1081 cm^2
IST Peak Temperature = $779\text{ }^{\circ}\text{C}$
RP Burned Length = 2.3 – 3.9 cm
RP After Flame = 15.3 – 21.2 sec
OSU Peak Heat Released = 42.0 kW/m^2
OSU Total Heat Released = 34.6 kW/m^2
Smoke Density = 17.6

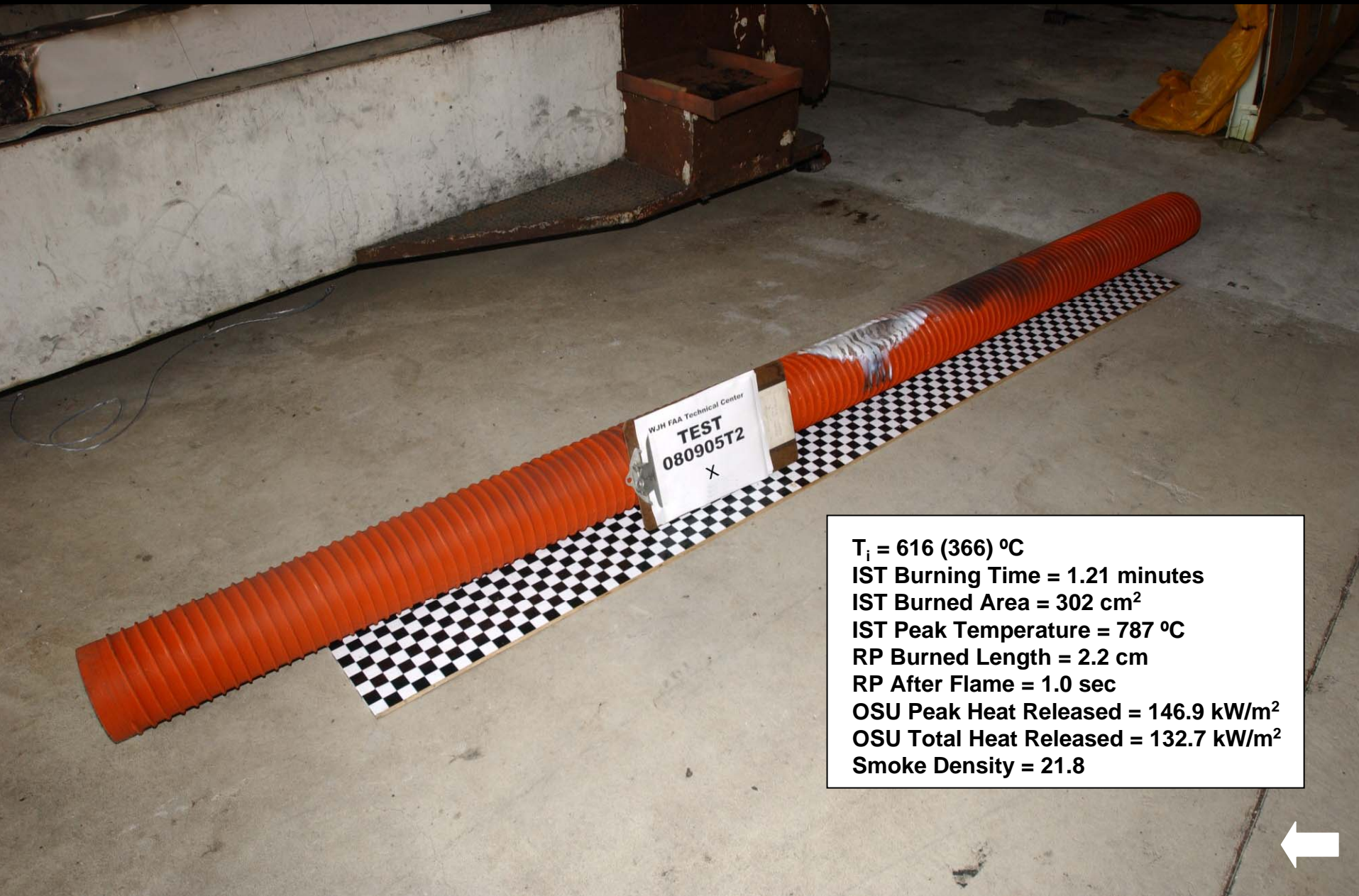
SAMPLE “U & U2”





$T_i = 594\text{ }^{\circ}\text{C}$
IST Burning Time = 1.19 minutes
IST Burned Area = 610 cm^2
IST Peak Temperature = $816\text{ }^{\circ}\text{C}$
RP Burned Length = 2.1 cm
RP After Flame = 6.6 sec
OSU Peak Heat Released = 81 kW/m^2
OSU Total Heat Released = 48 kW/m^2
Smoke Density = 12

SAMPLE "V"



$T_i = 616 (366) ^\circ\text{C}$
IST Burning Time = 1.21 minutes
IST Burned Area = 302 cm^2
IST Peak Temperature = $787 ^\circ\text{C}$
RP Burned Length = 2.2 cm
RP After Flame = 1.0 sec
OSU Peak Heat Released = 146.9 kW/m^2
OSU Total Heat Released = 132.7 kW/m^2
Smoke Density = 21.8

SAMPLE "X"



$T_i = 359 (616) ^\circ\text{C}$
IST Burning Time = 2.56 minutes
IST Burned Area = 644 cm^2
IST Peak Temperature = $804 ^\circ\text{C}$
RP Burned Length = 1.8 cm
RP After Flame = 26 sec
OSU Peak Heat Released = 115.3 kW/m^2
OSU Total Heat Released = 120.4 kW/m^2
Smoke Density = 42.7

SAMPLE "Y"



$T_i = 623\text{ }^{\circ}\text{C}$
IST Burning Time = 1.19 minutes
IST Burned Area = Film shrunk, Min to Duct
IST Peak Temperature = $834\text{ }^{\circ}\text{C}$
RP Burned Length = 2.8 cm
RP After Flame = 35 sec
OSU Peak Heat Released = 34.6 kW/m^2
OSU Total Heat Released = 43.6 kW/m^2
Smoke Density = 17.7

SAMPLE "Z"

