



**Federal Aviation  
Administration**

# International Aircraft Materials Fire Test Working Group Meeting

## Task Group Session on Revised Cargo Liner Test

Presented to: IAMFTWG, Atlantic City, NJ

By: Tim Marker, FAA Technical Center

Date: October 19-20, 2011



## Part IB. Oil Burner Test for Cargo Liners (proposed)

X.1 Scope

X.2 Definitions

X.3 Apparatus

X.4 Test Specimens

X.5 Specimen Conditioning

X.6 Preparation of Apparatus

X.7 Flame Calibration

X.8 Procedure

X.9 Alternate Methodology for Testing Cargo Liner Design Details

X.10 Report

X.11 Requirements



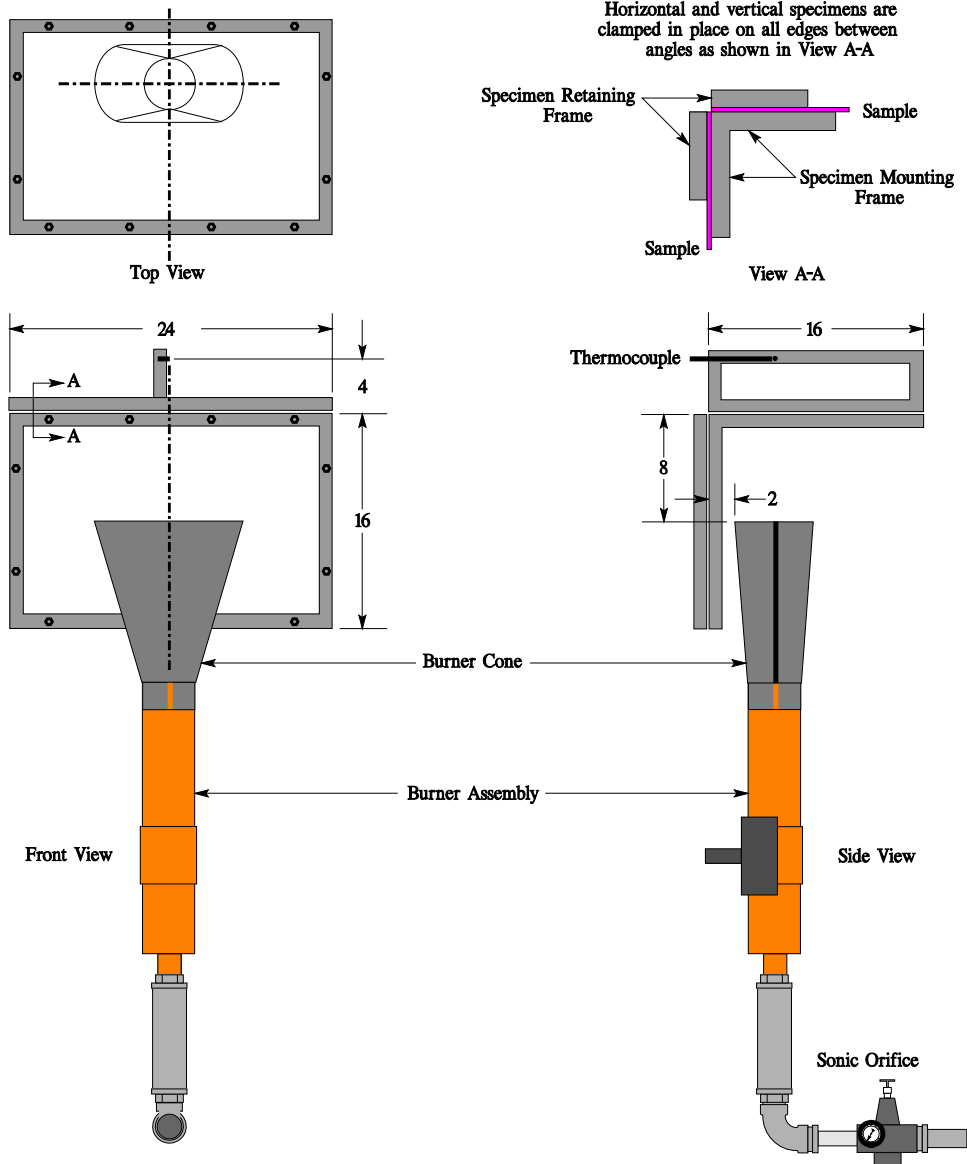


Figure X-1. Test Apparatus for Horizontal and Vertical Mounting for Cargo Liner Oil Burner Testing

# Summary of Activities: Apparatus

1. Generate calibration temperature results with FAATC Park burner apparatus
  - Results will be used to calibrate Sonic burner apparatus

Status: **completed**. Significant base of calibration data compiled using Park burner



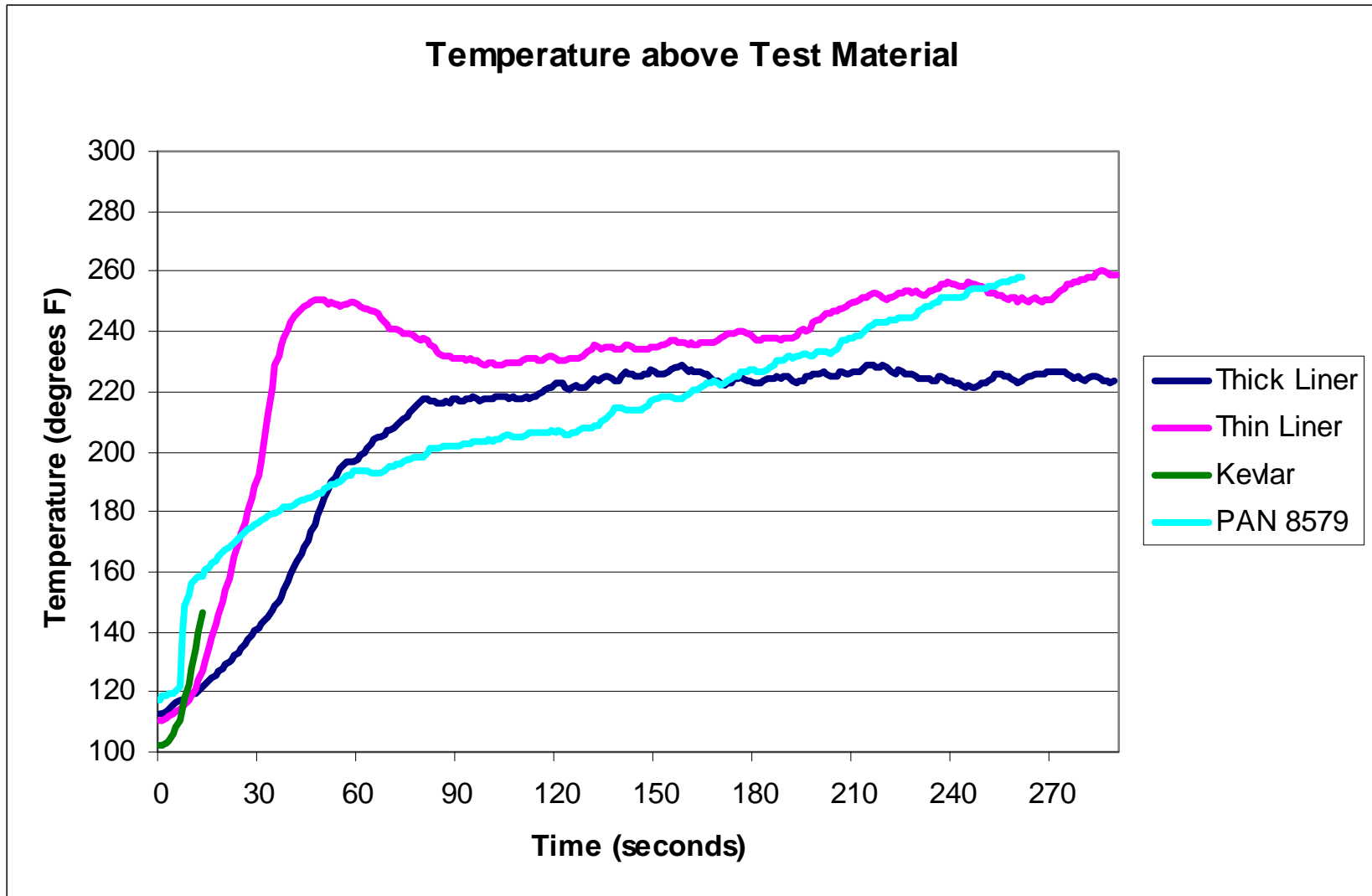
# Summary of Activities: Apparatus

## 2. Generate test results with FAATC Park burner apparatus

- Results will be used to correlate sonic burner (B/T times and temp vs. time plots)
- 3 styles of liner and 1 PAN felt have been tested
- 2 additional materials also tested

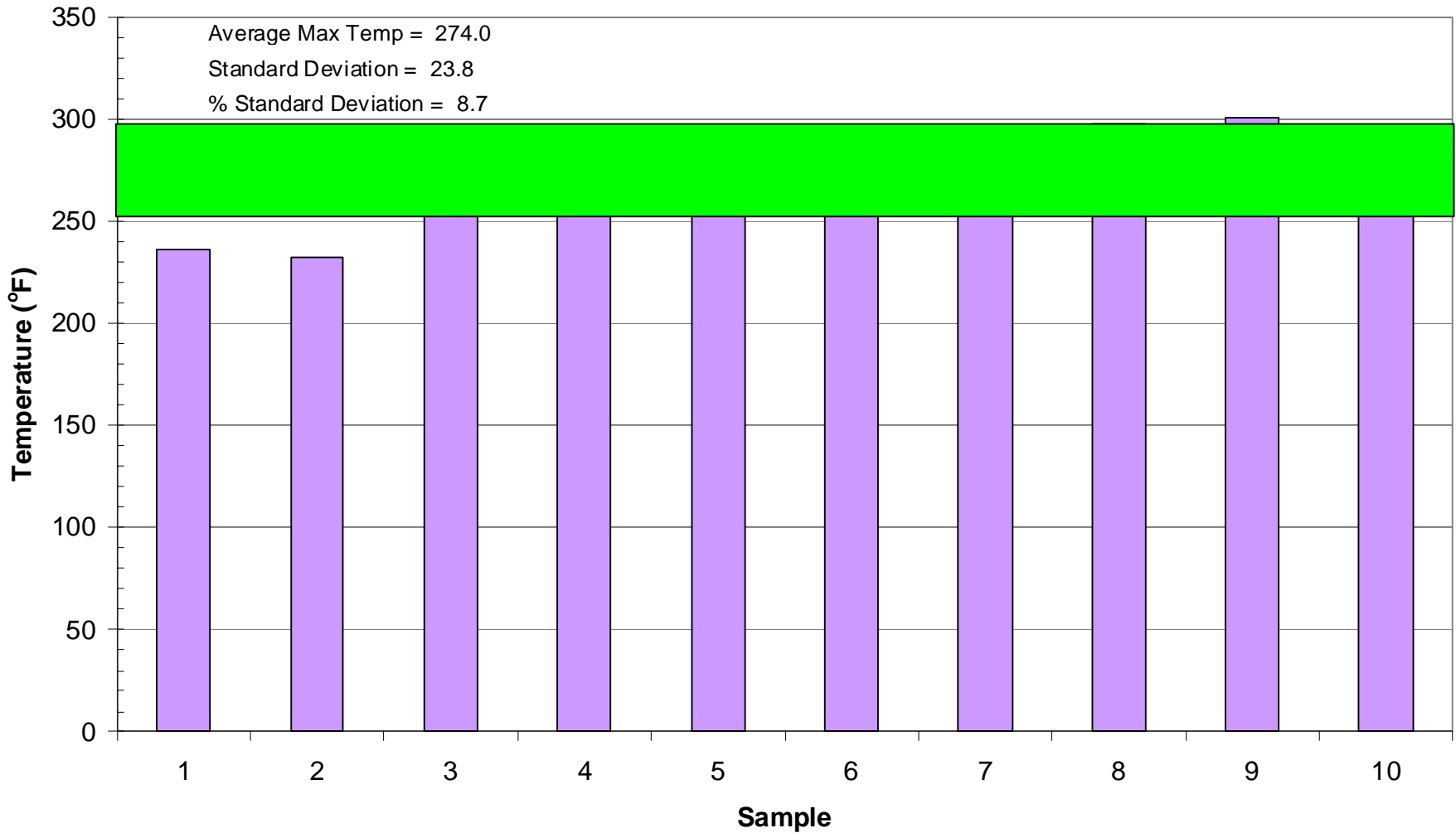
Status: **completed**. Significant base of data compiled on various samples using Park burner

# Park Burner Baseline Test Results

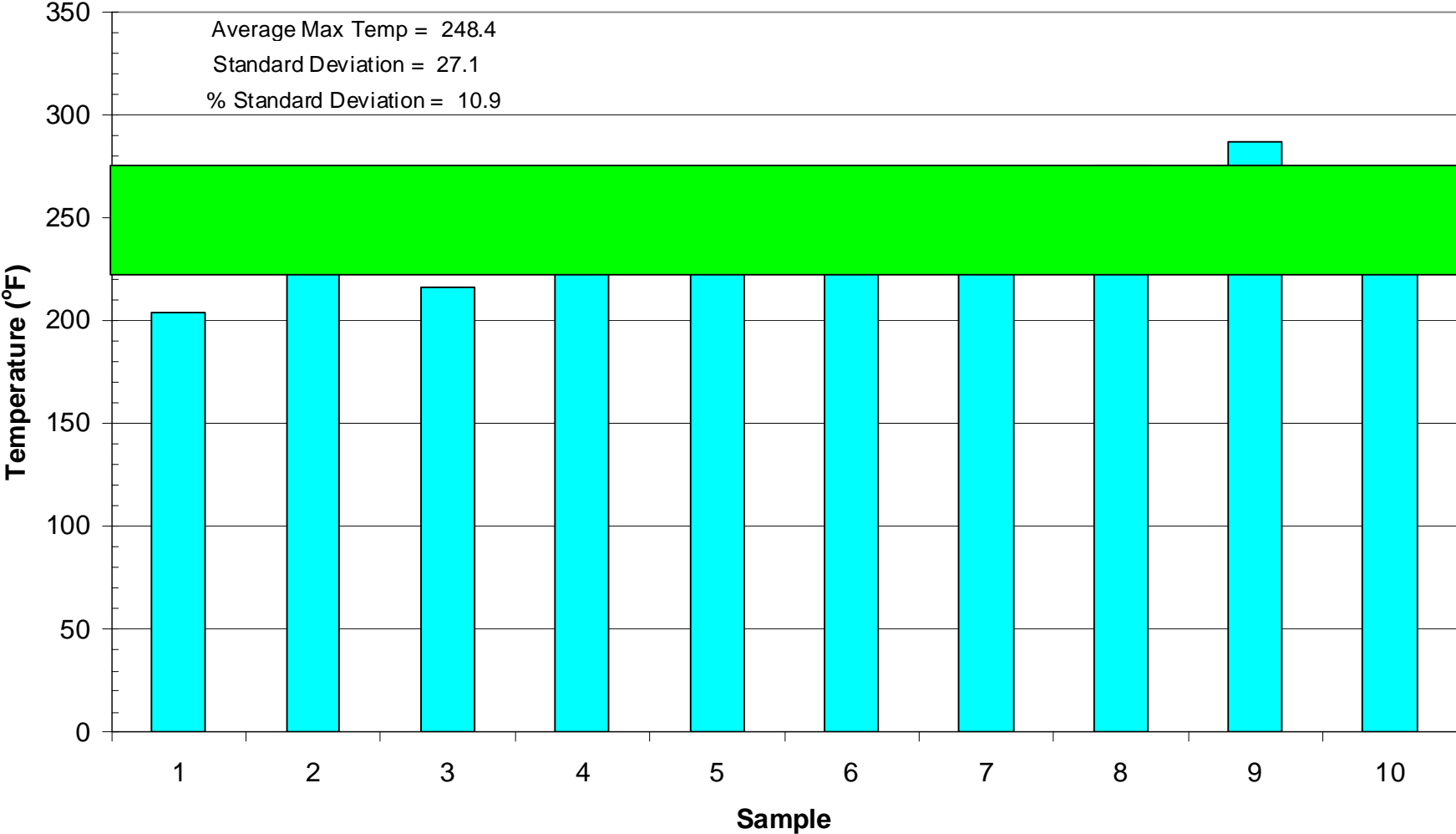




## Thin F/G Liner Maximum Temperatures (.0224-.0241 inch thickness)

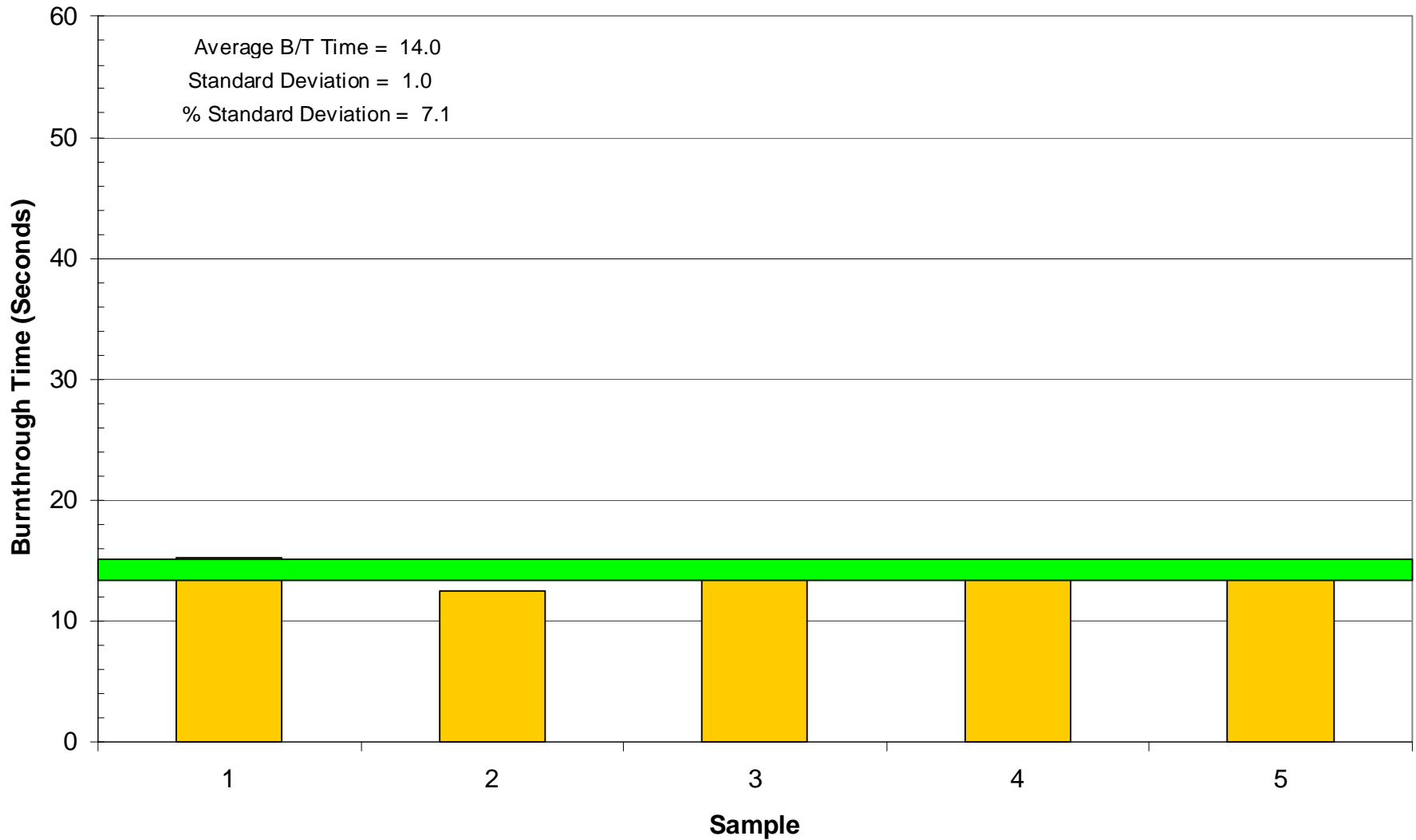


# Thick F/G Liner Maximum Temperatures (.0351-.0372 inch thickness)

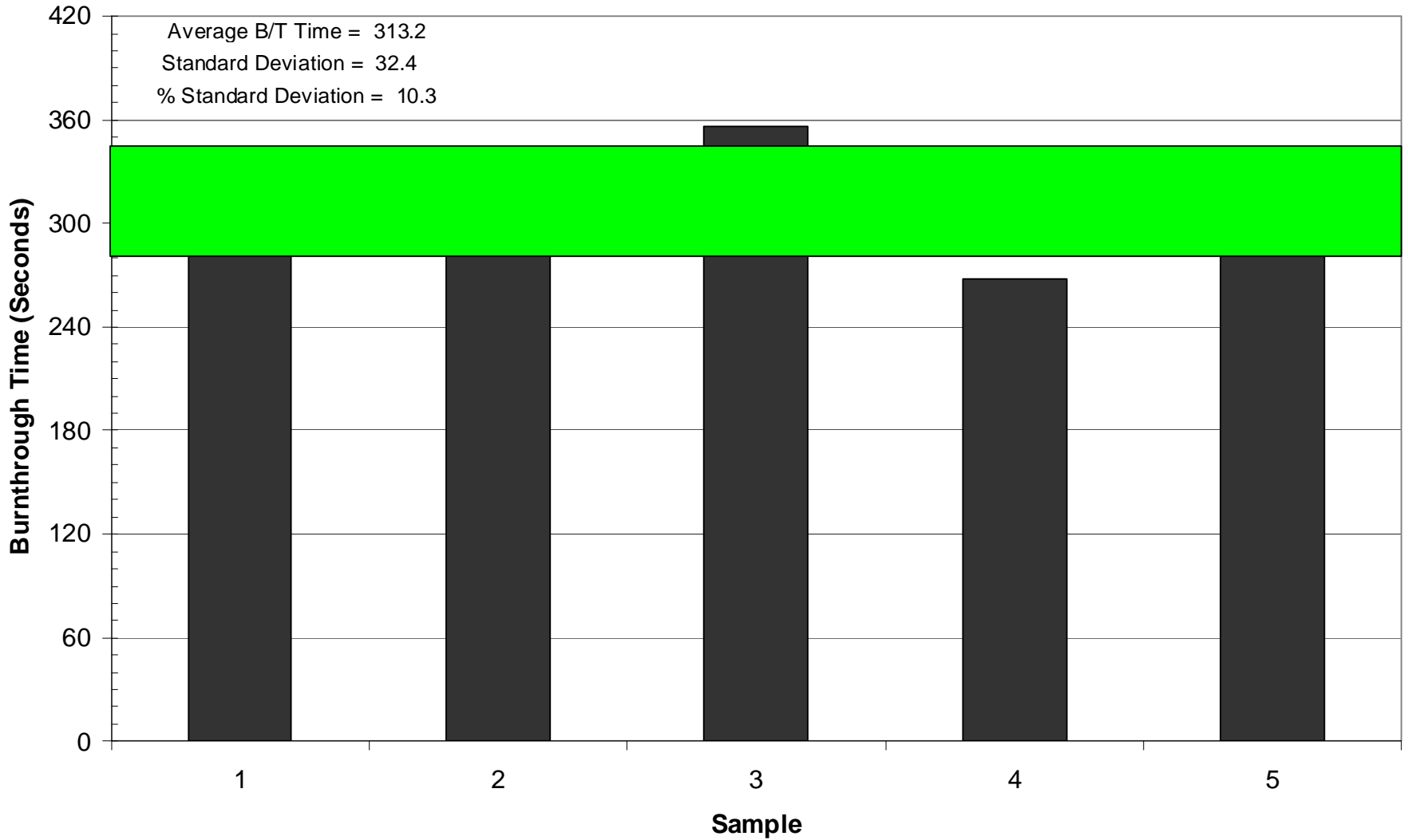




## Kevlar Liner Burnthrough Time (.0178-.0186 inch thickness)



# 8579 PAN Burnthrough Time



# Summary of Activities: Apparatus

*Wire grid used to restrain thin PAN material*



## Summary of Activities: Apparatus

*Wire grid used to restrain thin PAN material*



# Summary of Activities: Apparatus

3. Construct new sonic burner apparatus using parts from Marlin Engineering

Status: *completed.*

Determine impact of 90° elbow position (repositioning will make apparatus much higher, but should calibrate easier)





## Summary of Activities: Apparatus

4. Construct new calibration rake using 1/8-inch thermocouples (**completed**)



## Summary of Activities: Apparatus

5. Construct test sample rig to fit sonic burner equipment.

Status: *complete.*





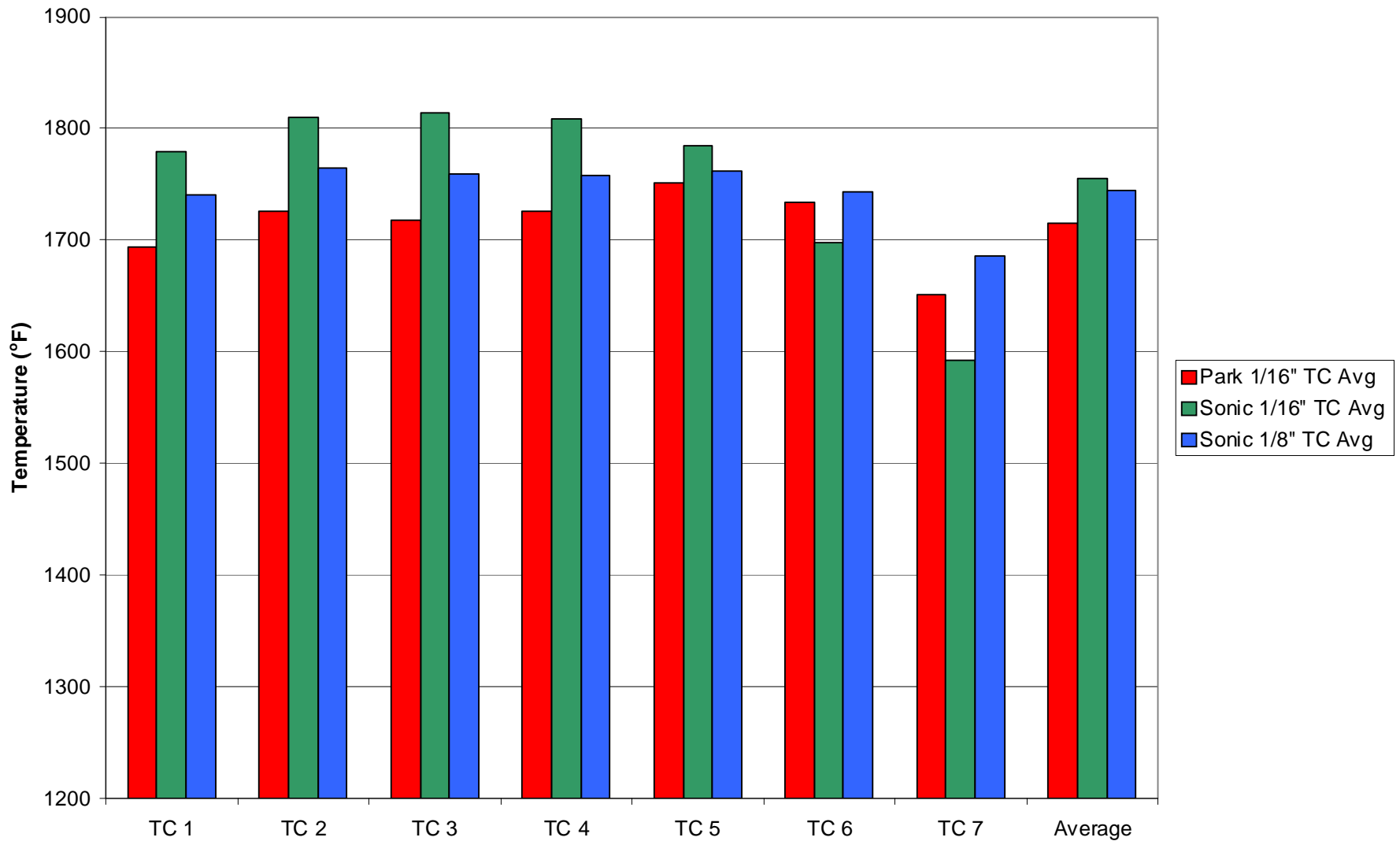
## Summary of Activities: Apparatus

6. Calibrate NexGen burner to match Park burner temperature results.

Status: *in progress*.

This will be accomplished by using 1/16-inch thermocouples identical to those used in the Park base-lining exercise. The burner was initially set-up using parameters obtained from the seat burner trials (stator angle, stator depth, nozzle depth, etc). Slight adjustments to the sonic burner were made to ensure the temperatures are equivalent to the Park temperature Profiles. Following this, 1/8-inch thermocouples will be substituted, without changing the burner. This is how the original temperature profile will be transferred.

## Thermocouple Average Temperatures During Burner Calibration



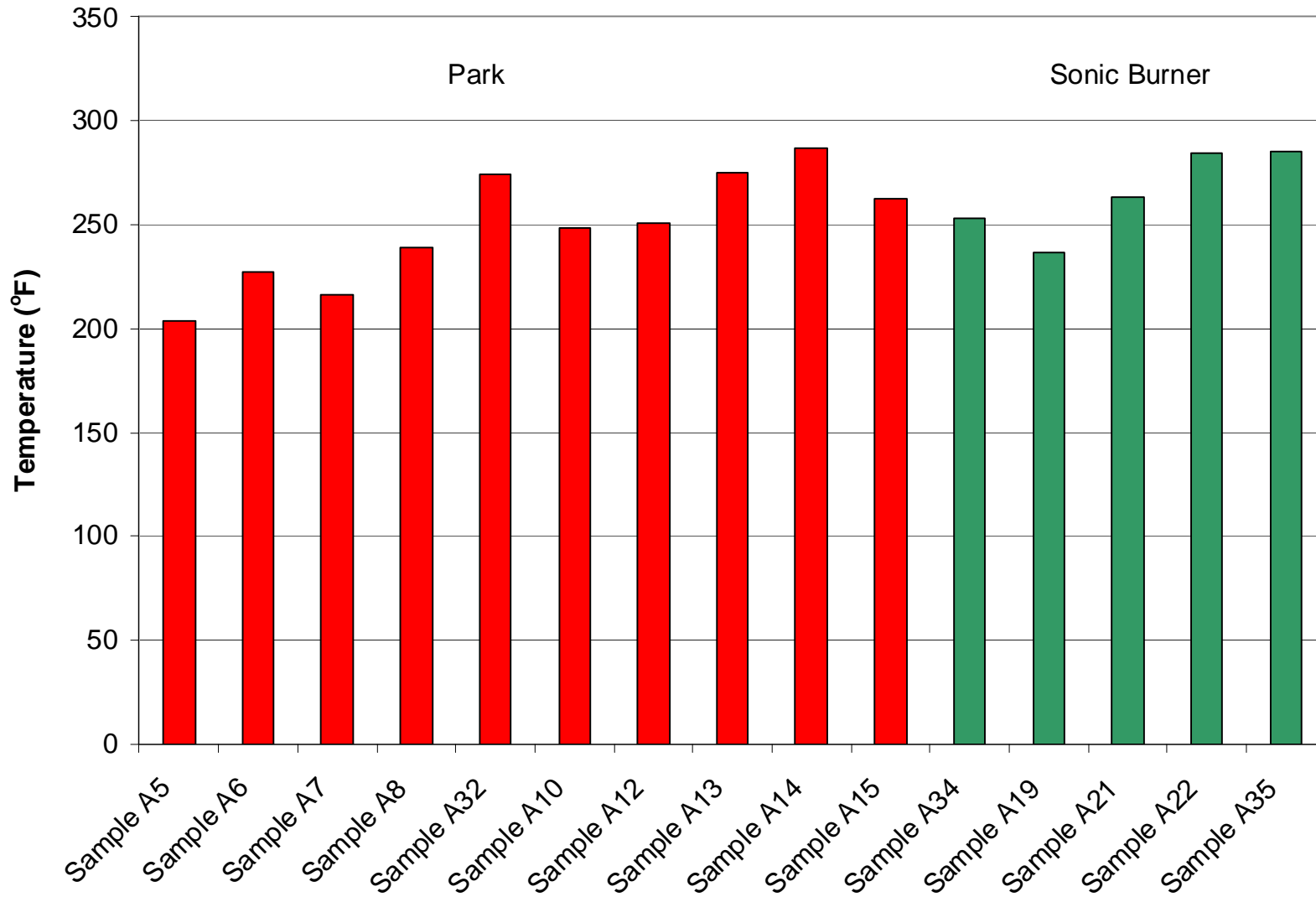
## Summary of Activities: Apparatus

7. Conduct test trials using identical cargo liner samples used in Park burner tests.

Status: *in progress*.

This will be an iterative process to make sure that all materials previously tested using the Park burner will react similarly when using the NexGen burner (i.e., conduct only several tests with each material type to ensure desired results first before moving on).

# Maximum Temperature above Test Specimen, Thick Liner



# Planned Activities

Finalize burner settings by conducting temperature calibrations

Complete testing of samples to ensure sonic equivalency to Park

Average of NexGen test results must be within 5-10% of Park burner results??

Check comments from KSN site and incorporate changes to test procedure

Development of advisory material for cargo design features? Possible ARAC recommendation

Conduct Round Robin?

# Questions?

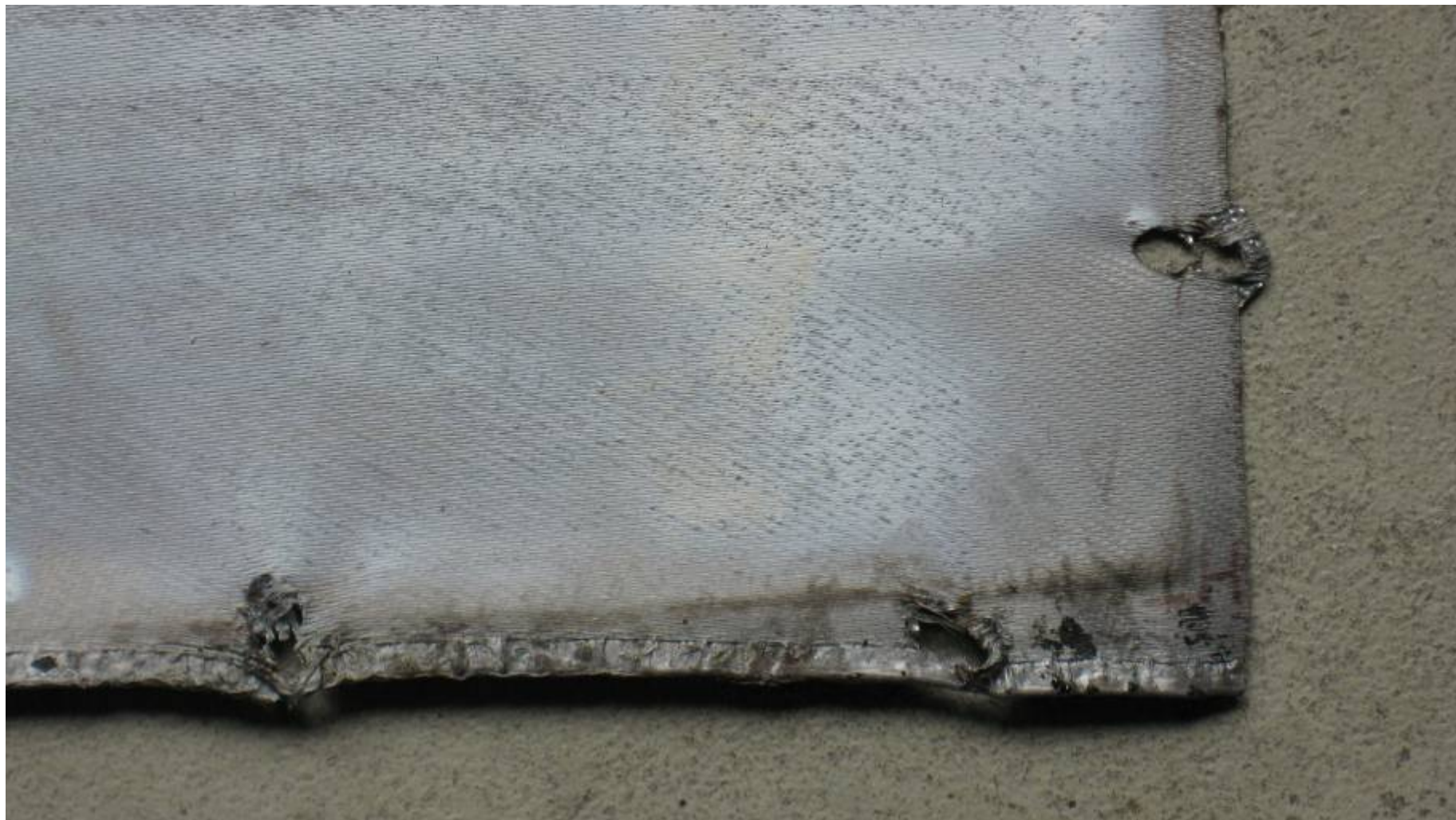


# Determine Influence of Sample Holder Studs on Shrinking Materials





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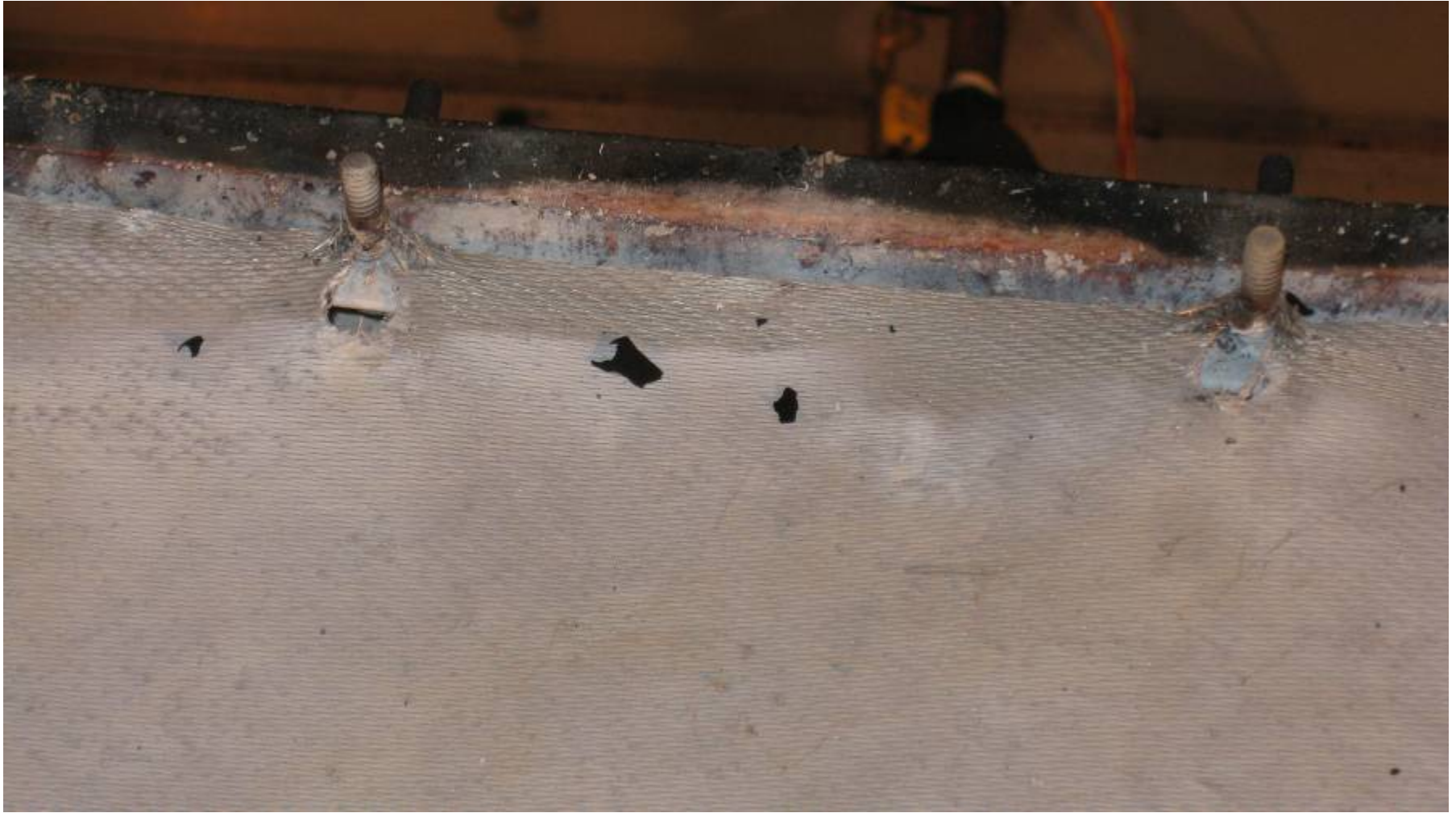




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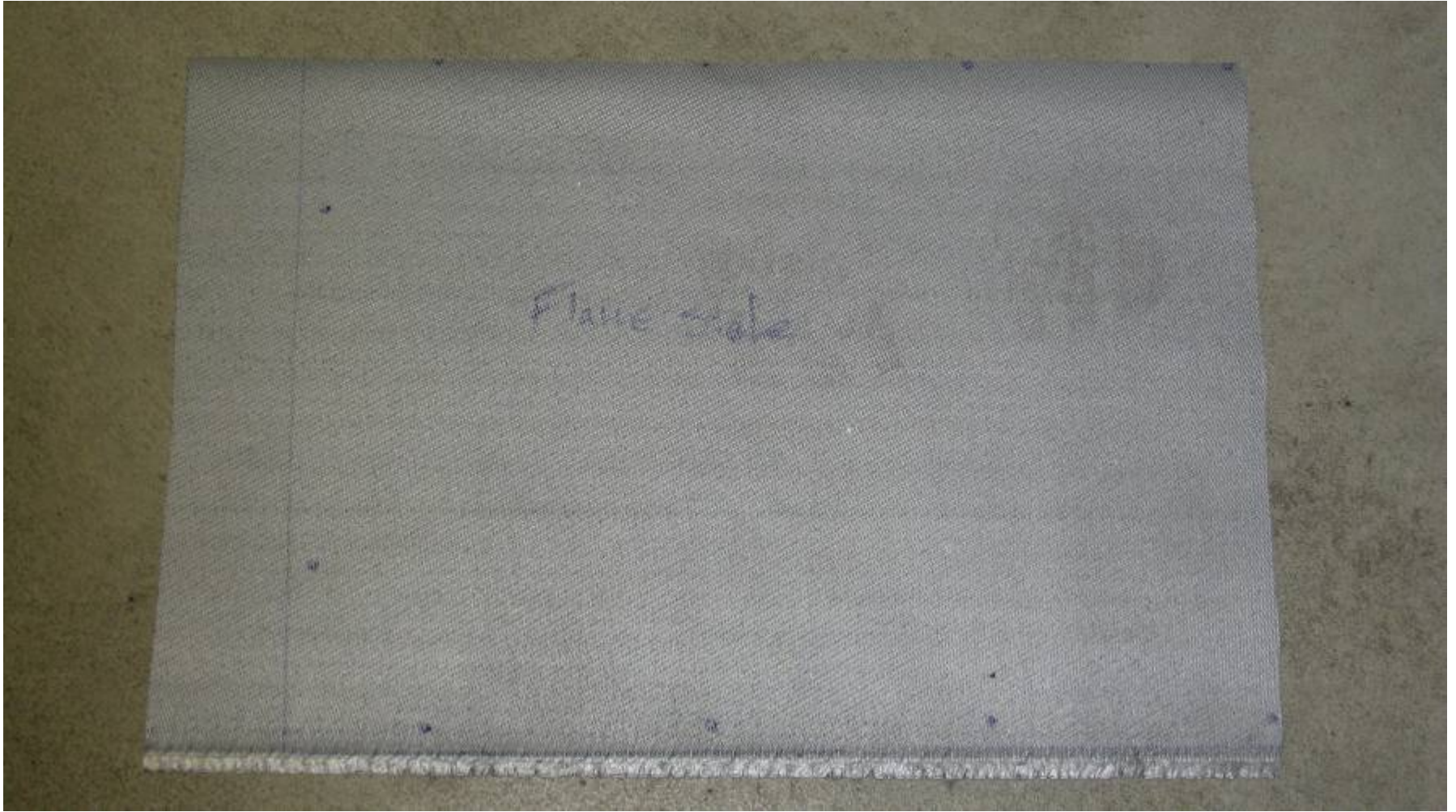


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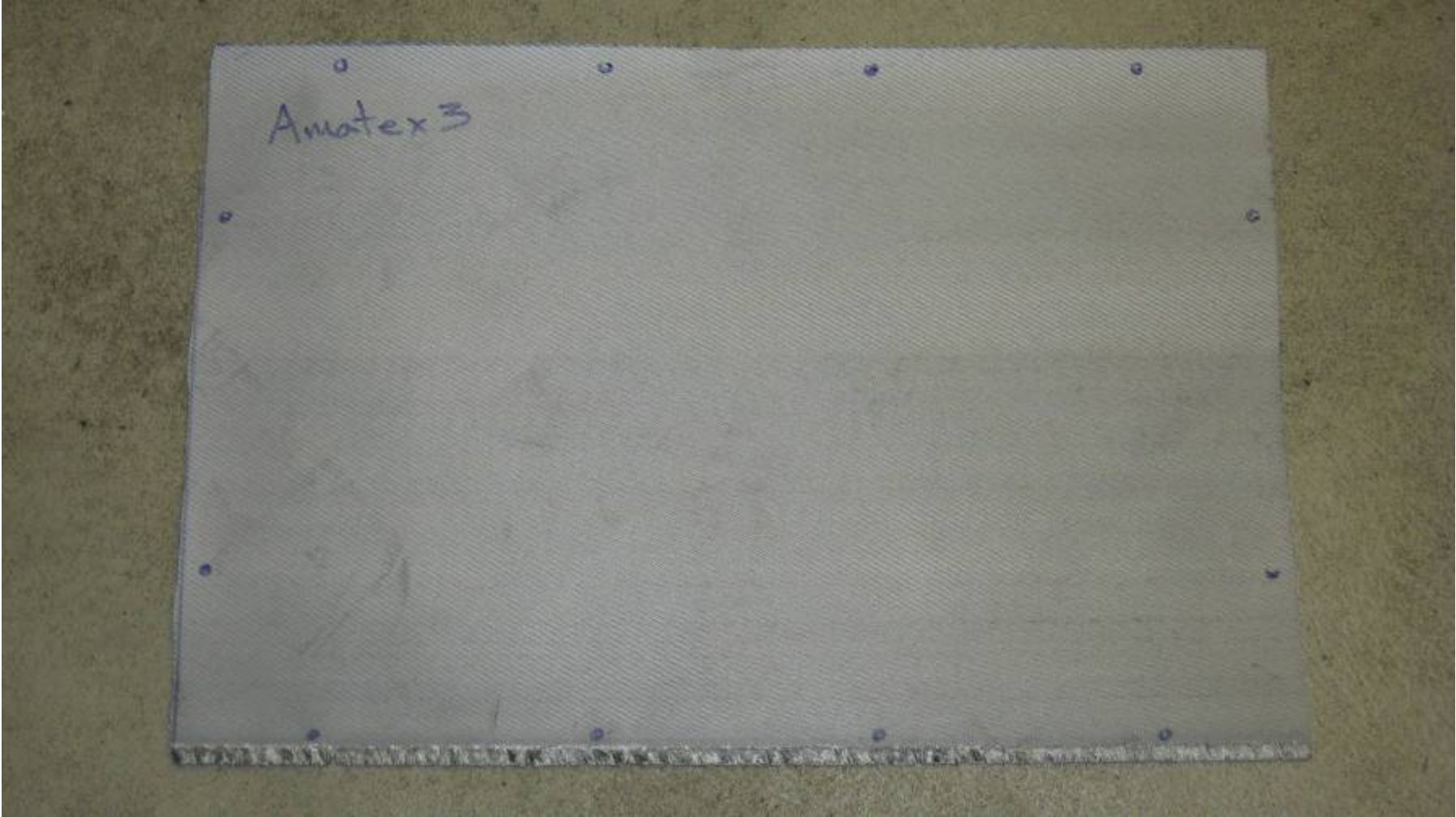




# Determine Influence of Sample Holder Studs on Shrinking Materials



# Determine Influence of Sample Holder Studs on Shrinking Materials









## X.9 Alternate Methodology for Testing Cargo Liner Design Details

### X.9.1 Testing of patch repairs

The cargo liner used in the construction of test specimens for evaluating patch repairs must be identical to the in-service liner in both material type and thickness, since certain thicknesses of liner may react quite differently than others. Thicker liners release significantly more amounts of heat than do thinner liners. Thinner (conventional type) liners contain less reinforcement, thereby providing less structural support to which the repair unit can adhere. If a patch is intended for use on a variety of liner thicknesses, tests should be run for each thickness. As an alternative, tests may be run on the minimum and maximum thicknesses of liners that the repair patch will be used on in service to alleviate the testing of all thicknesses within this range. Similarly, if there are several variants of a particular liner resin structure (i.e., fiberglass reinforcement with several slightly different epoxy resins), it is only necessary to test the generic construction (fiberglass/epoxy) and not every single resin type. See Handbook Chapter 15 for more specific instructions. (should Handbook Chapter 15 be referenced?)

#### X.9.1.1 Liner Repair Burnthrough Resistance Specimen

A flat sheet of material, identical to that used in the construction of the repair unit (patch), must be tested for resistance to burnthrough in the ceiling position of the cargo liner test apparatus. Follow test procedures specified in X.8.1 through X.8.9

### X.9.1.2 Liner Repair Adhesion Specimen

The repair patch must be placed over the standard simulated damage area in the sample liner. The damage area must measure 5 by 5 inches with a width of 1 inch, in the form of an L-shape, and positioned according to figure X-5. The placement of the repair patch in this location has been shown to be the most severe. Follow test procedures specified in X.8.1 through X.8.9.

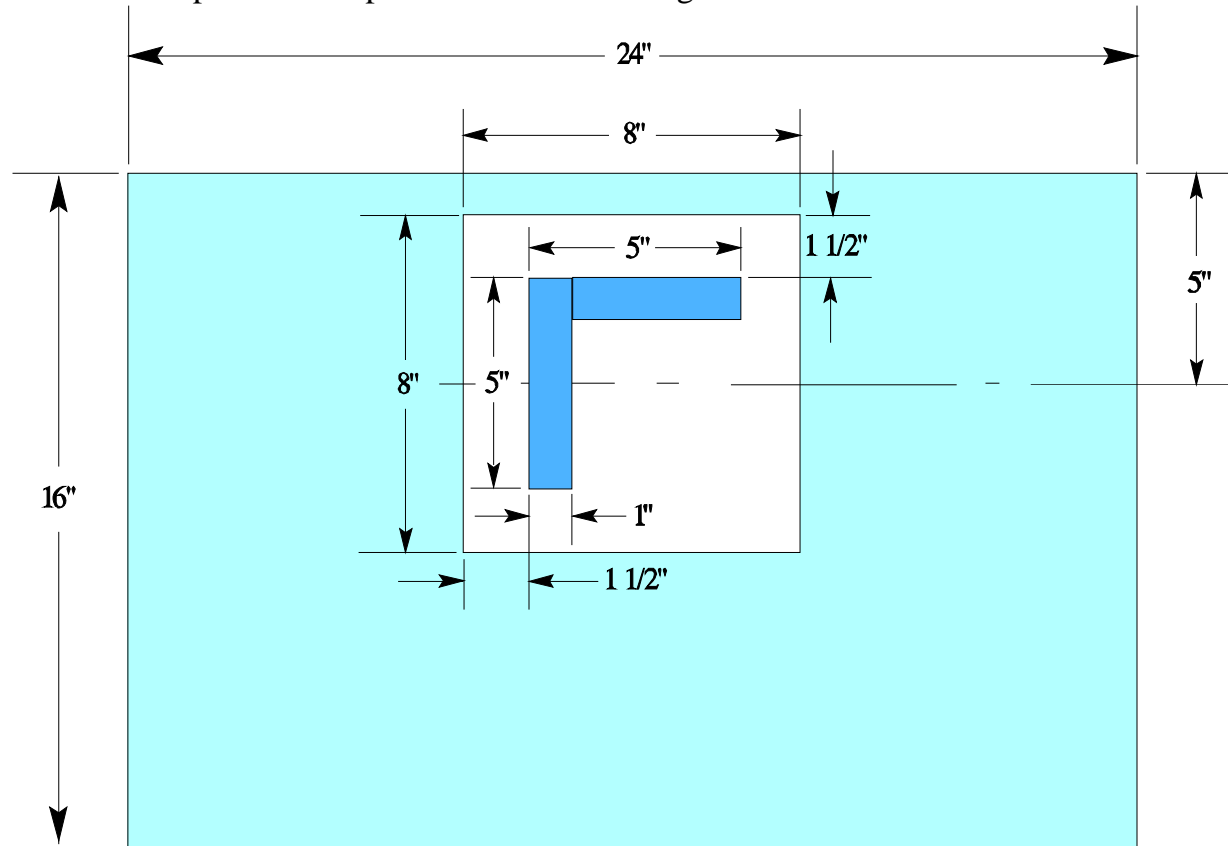


Figure X-5. Patch Location Over Standard Damage Area in Liner Sample



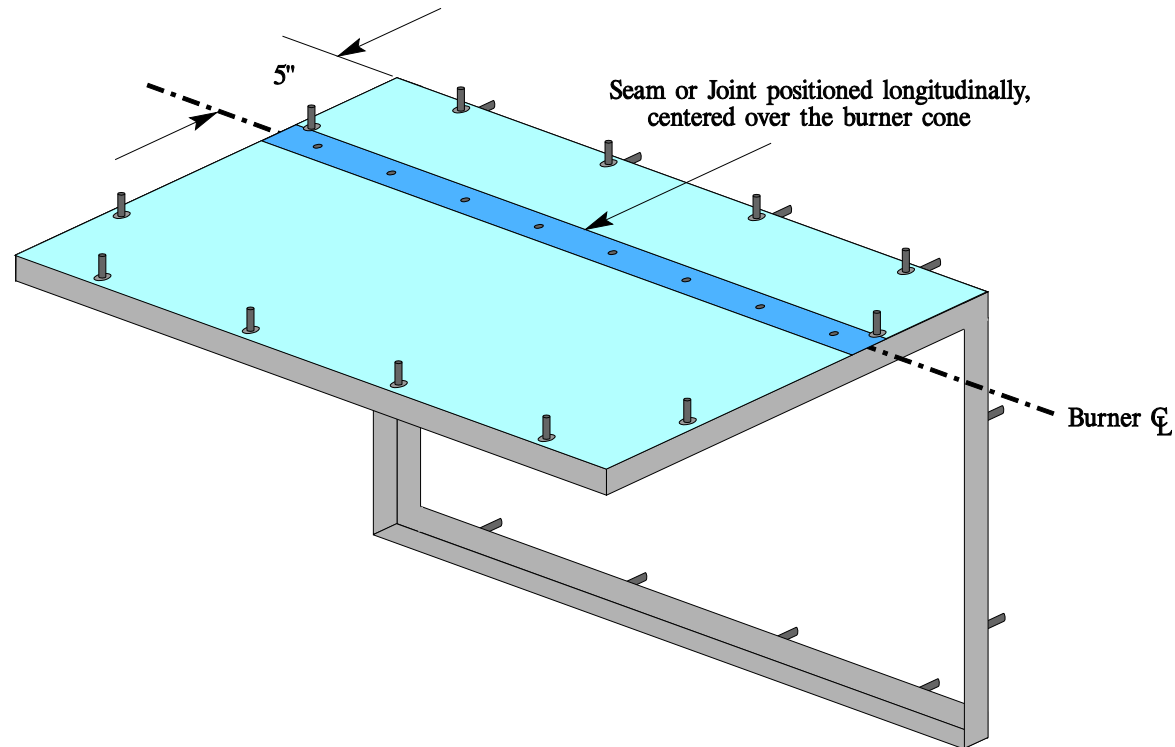
## X.9.2 Testing of Seams, Joints, and Corners

Cargo compartment design typically involves the mounting of protective liner sheet or panel materials over the aircraft structure that comprise the compartment floors, ceiling, and sidewalls. Seams and joints formed at the junction of two or more liner panels are common. It is important that the entire lining system, including the means of attachment at seams and joints, maintain the burnthrough resistant capabilities of the compartment in the event of a fire. For this reason, all seams, joints, corners, and associated attachment mechanisms must be tested.

The cargo liner used in the construction of test specimens for evaluating seams and joints must be identical to the in-service liner in both material type and thickness, since certain thicknesses of liner may react quite differently than others. Thicker liners release significantly more amounts of heat than do thinner liners, while thinner (conventional type) liners contain less reinforcement, thereby providing less structural support to which the seam or joint attachment mechanism can adhere. If an attachment mechanism is intended for use on a variety of liner thicknesses, tests should be run for each thickness. As an alternative, tests may be run on the minimum and maximum thicknesses of liners that the attachment mechanism will be used on in service to alleviate the testing of all thicknesses within this range. Similarly, if there are several variants of a particular liner resin structure (i.e., fiberglass reinforcement with several slightly different epoxy resins), it is only necessary to test the generic construction (fiberglass/epoxy) and not every single resin type.

### X.9.2.1 Seams, Joints, Fastening Systems Located in Compartment Ceiling

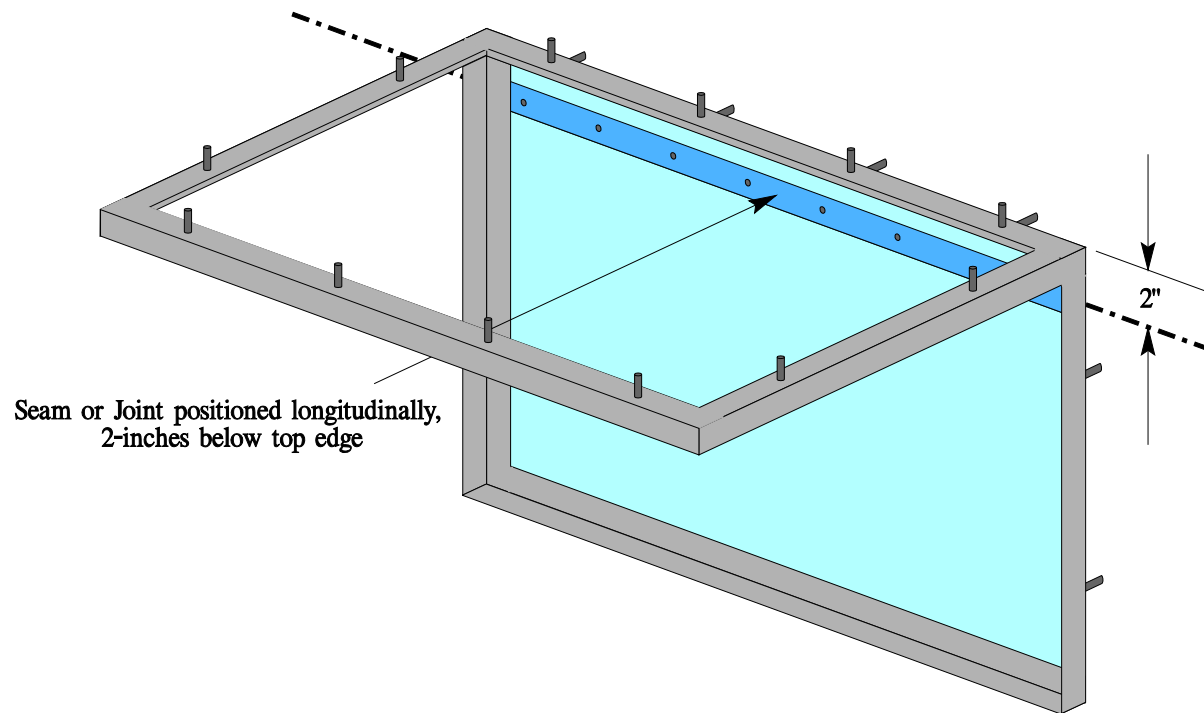
Seams and joints formed by butting or overlapping liner materials, including all associated fasteners located in the ceiling position of the cargo compartment shall be tested in the horizontal test specimen mounting frame. The seam detail shall be positioned longitudinally, extending the length of the liner and centered over the burner cone (figure X-7). Follow test procedures specified in X.8.1 through X.8.9.



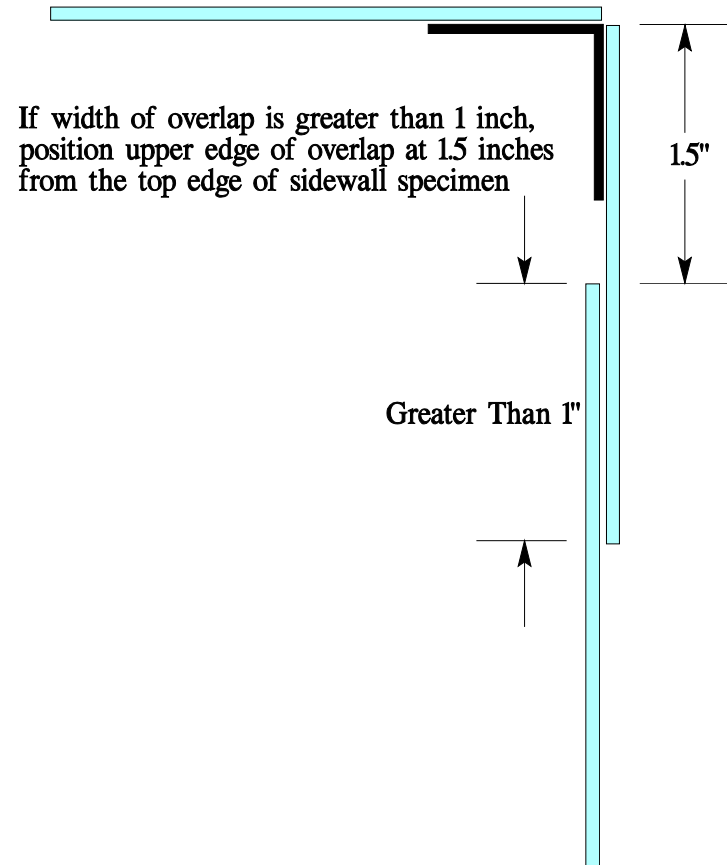
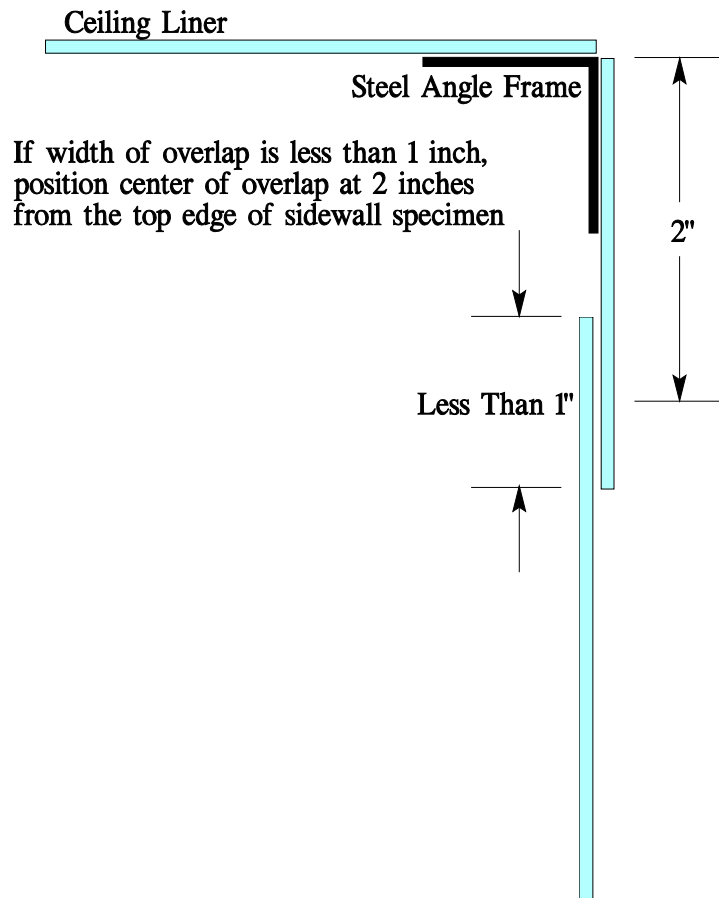
*Figure X-7. Arrangement for the Testing of Seams and Joints in the Compartment Ceiling*

### X.9.2.2 Seams, Joints, Fastening Systems Located in Compartment Sidewall

Seams or joints formed by butting or overlapping liner materials (including all associated fasteners) located in the sidewall position of the cargo compartment shall be tested in the vertical test specimen mounting frame. The seam detail shall be positioned longitudinally, 2 inches from the top of the vertical test specimen liner edge (Figure X-8). Some sidewall seam or joint details may be too wide to fit into the vertical specimen area without clearance issues. This can be rectified by moving the seam detail lower, provided the upper edge of the detail is situated 1.5 inches from the top edge (Figure X-9). Follow test procedures specified in X.8.1 through X.8.9.



*Figure X-8. Arrangement for the Testing of Seams and Joints in the Compartment Sidewall*

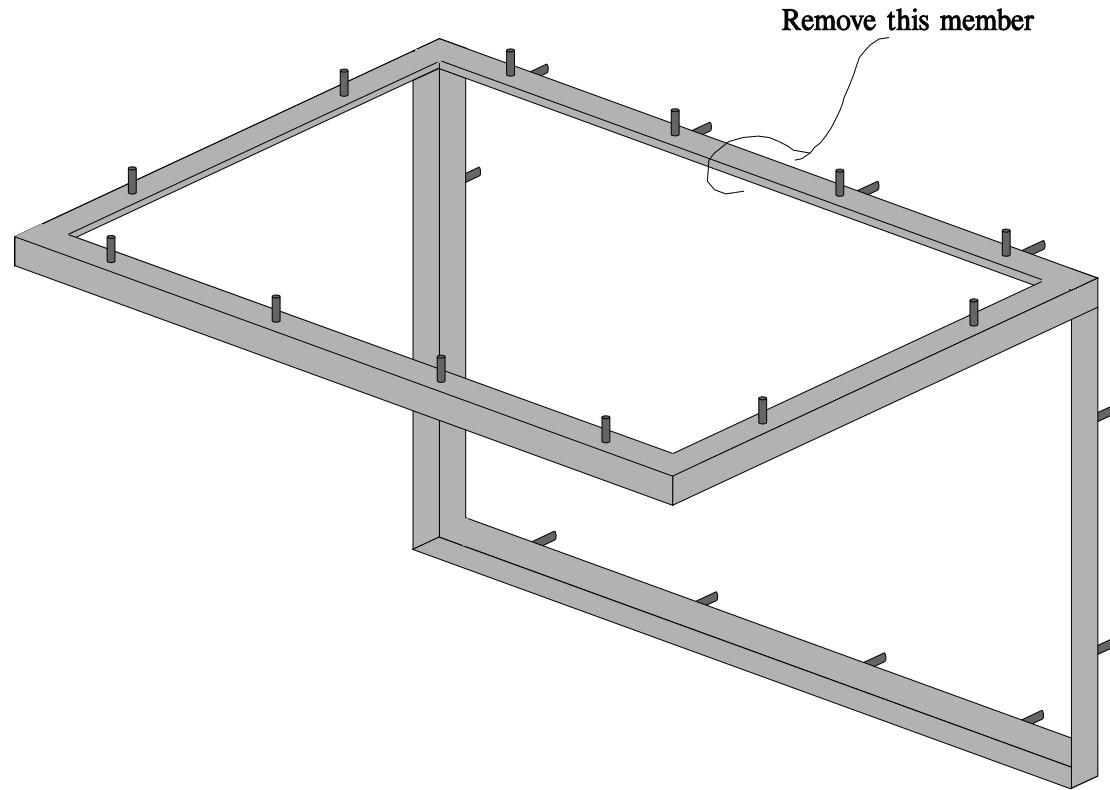


*Figure X-9. Methodology for the Testing of Seams and Joints in the Compartment Sidewall*



### X.9.2.3 Corner Joints

The testing of corner joints formed at the intersection of ceiling and sidewall liners will require the test specimen mounting frame to be modified. The corner member of the test specimen mounting frame shall first be removed (figure X-10). Follow test procedures specified in X.8.1 through X.8.9.



*Figure X-10. Modified Test Specimen Mounting Frame for Corner Testing*

### X.9.3 Testing of Lighting Fixtures and Lamp Assemblies

The material that comprises the fire barrier used in design features such as recessed lighting fixtures and pressure relief valves will be tested as a flat sheet, 16 inches by 24 inches, in the same manner as a typical cargo liner specimen. If the design feature will be used only in a sidewall location in service, the flat sheet of representative material may be tested in the sidewall location of the test apparatus. Similarly, if the design feature will be used in the ceiling location of the cargo compartment in service, the representative material must be tested in the ceiling location of the apparatus.