Federal Aviation Administration

International Aircraft Materials Fire Test Working Group Meeting

Task Group Session on Revised Cargo Liner Test

Presented to: IAMFTWG, Bremen, Germany

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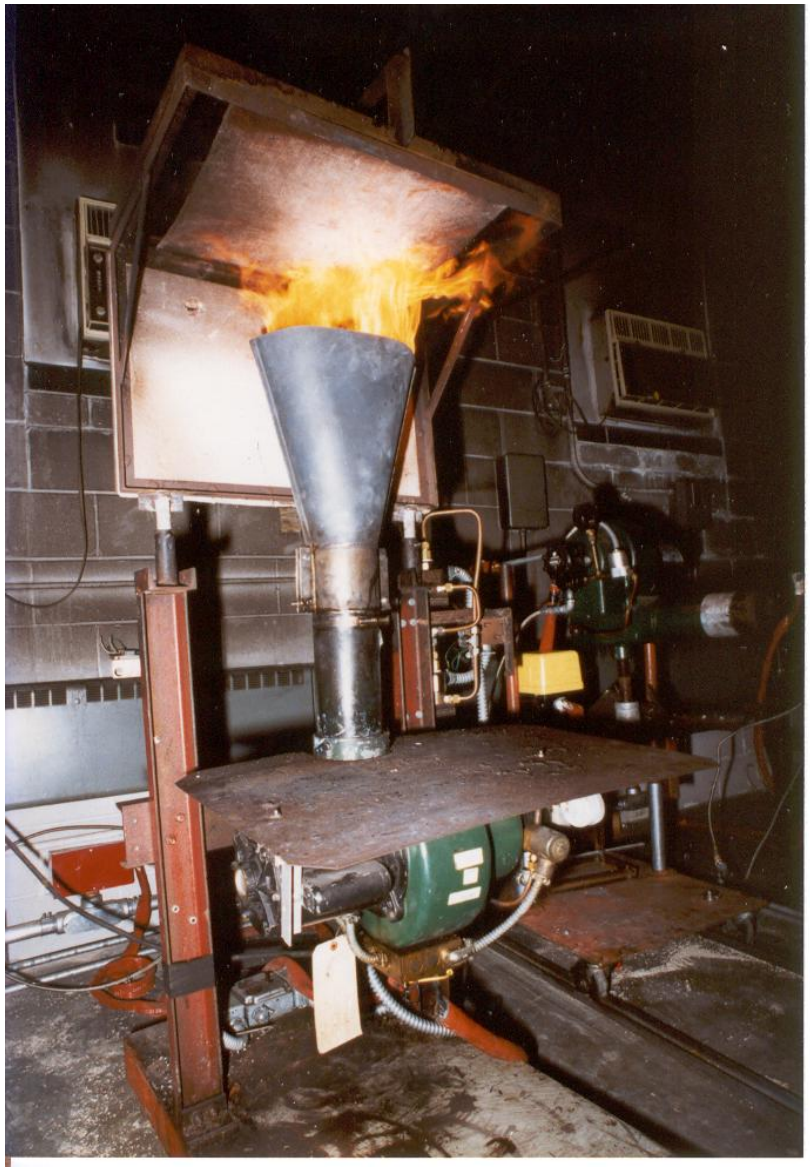
Saudi Arabia Airlines L-1011 Accident, 1980

Cargo Liner Flame Penetration Test Using Oil Burner



Possible New Appendix F Structure

Appendix F Part I: Requirements for In-Flight Fire Threats

A. Radiant Panel (insulation, ducting, wiring, composite fuselage)

B. Oil Burner – cargo liner

C. Fire Containment

D. Bunsen burner

Appendix F Part II: Requirements for Postcrash Fire Threats

A. OSU

B. Oil Burner – seats

C. Oil Burner - insulation

D. Escape Slide radiant heat

E. Oil Burner – seat structure

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

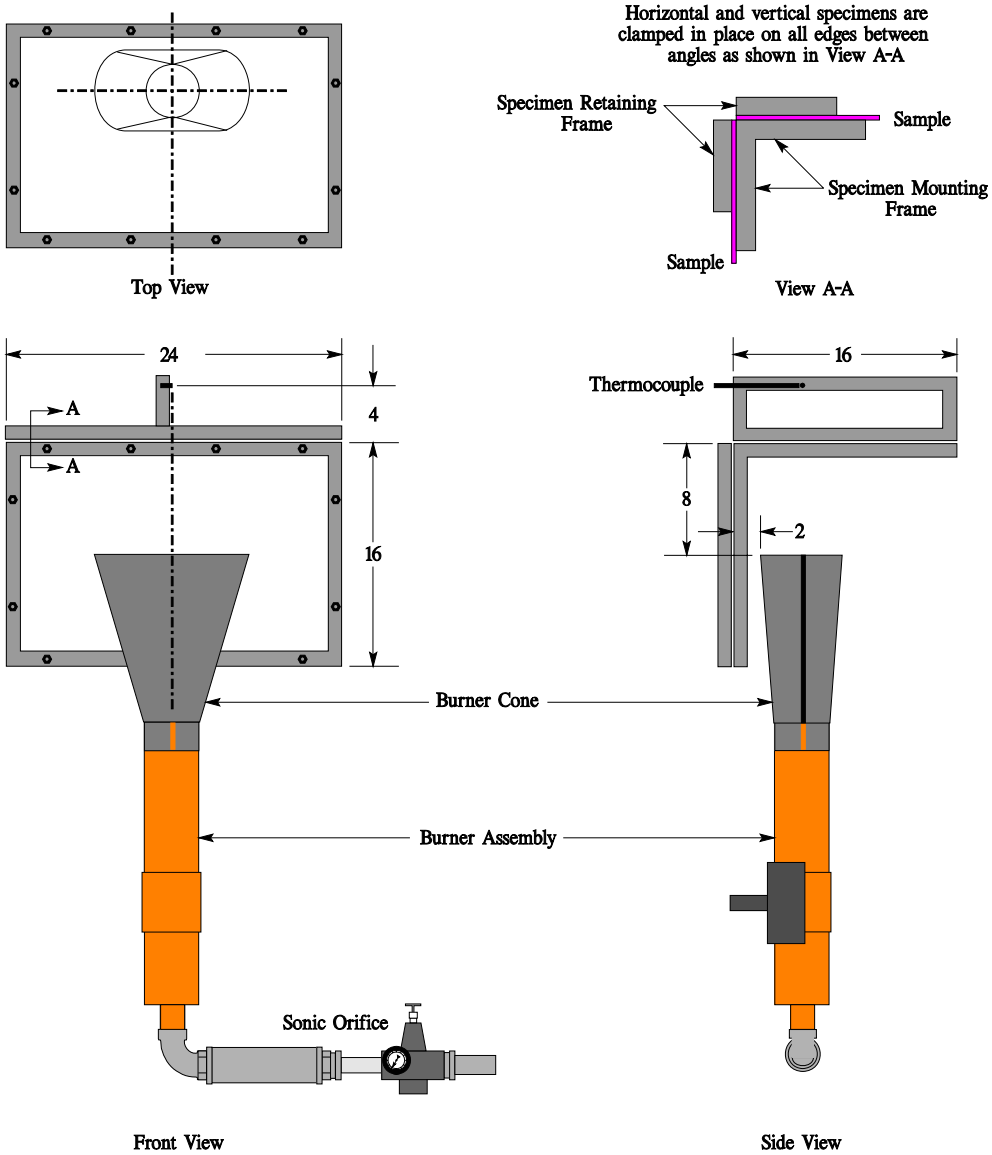


Figure X-1. Test Apparatus for Horizontal and Vertical Mounting for Cargo Liner Oil Burner Testing

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.

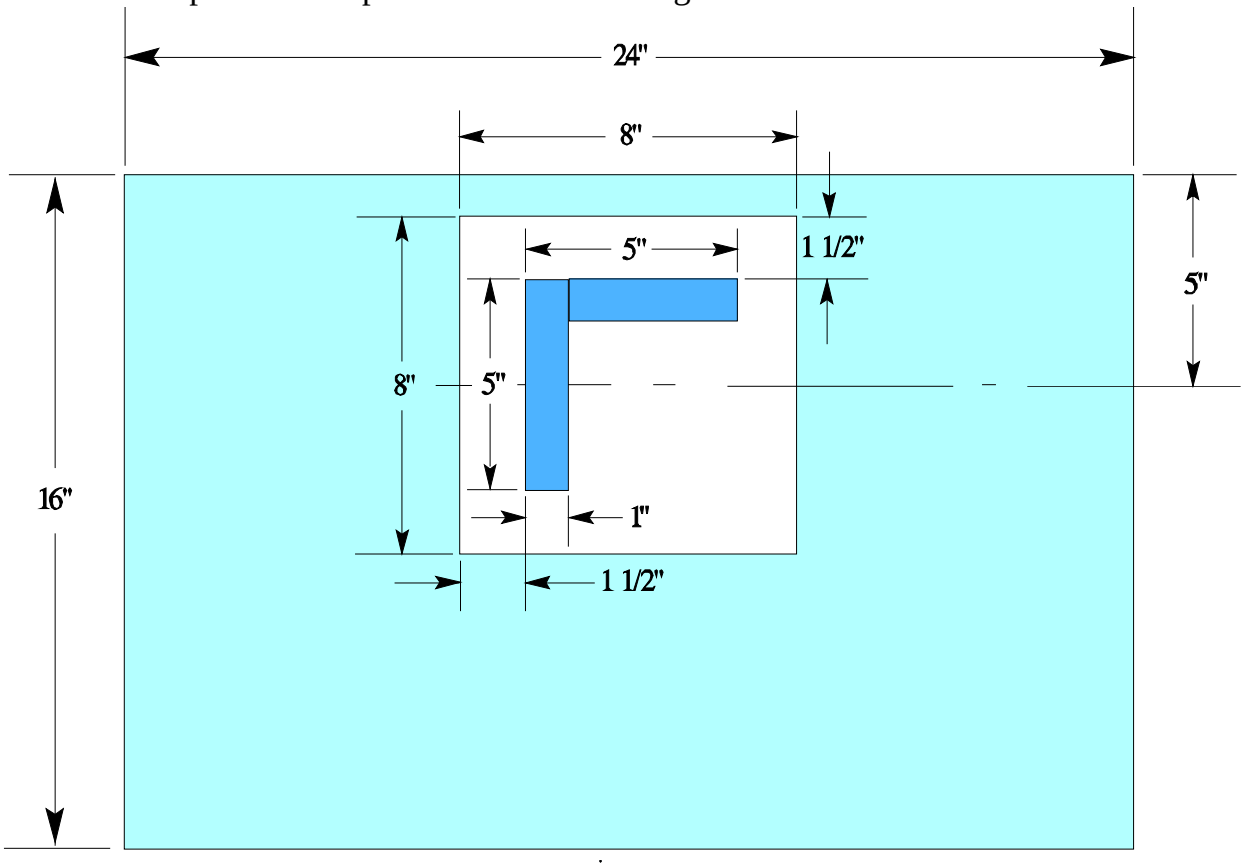


Figure X-5. Patch Location Over Standard Damage Area in Liner Sample

X.9.1.3 Liner Repair Shingling Specimen

Two 4- by 4-inch patches must be overlapped by 1 inch and placed over the standard damage area in the sample liner. The damage area must measure 1 by 5 inches and be positioned as shown in figure X-6. Follow test procedures specified in X.8.1 through X.8.9.

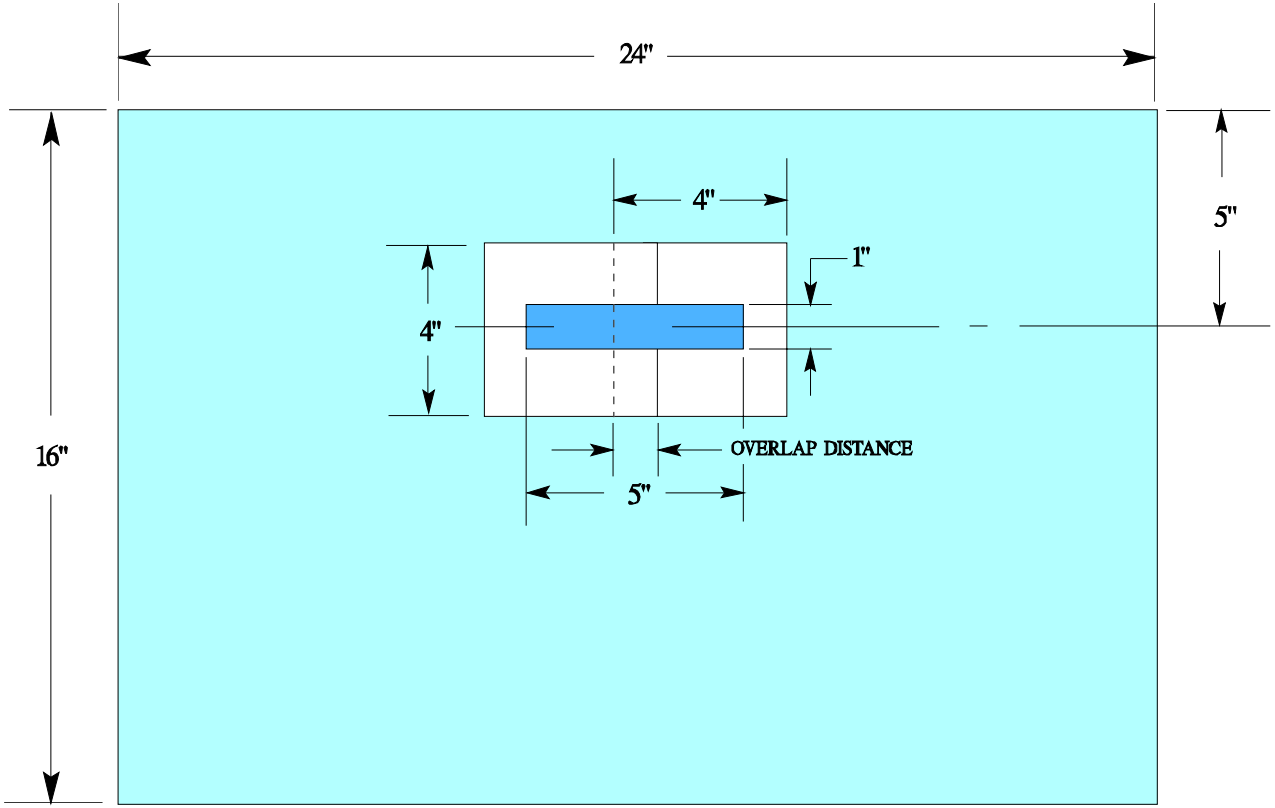


Figure X-6. Overlapped Patches for Shingling Test

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.

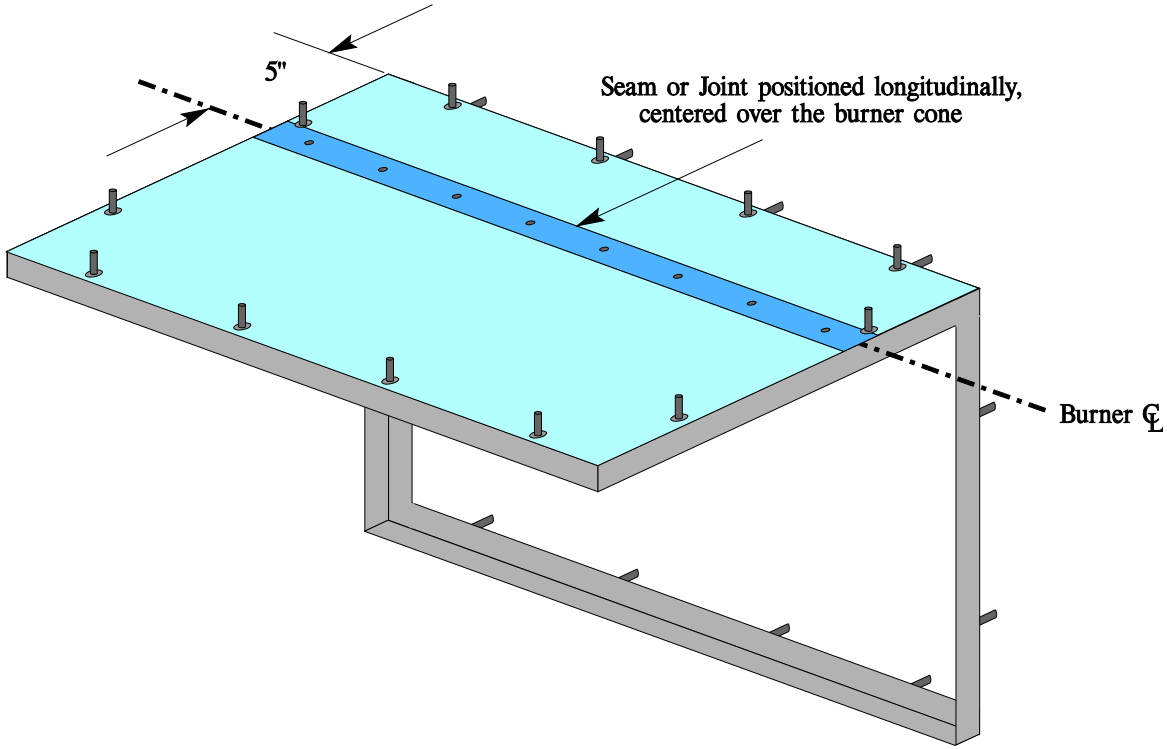


Figure X-7. Arrangement for the Testing of Seams and Joints in the Compartment Ceiling

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.

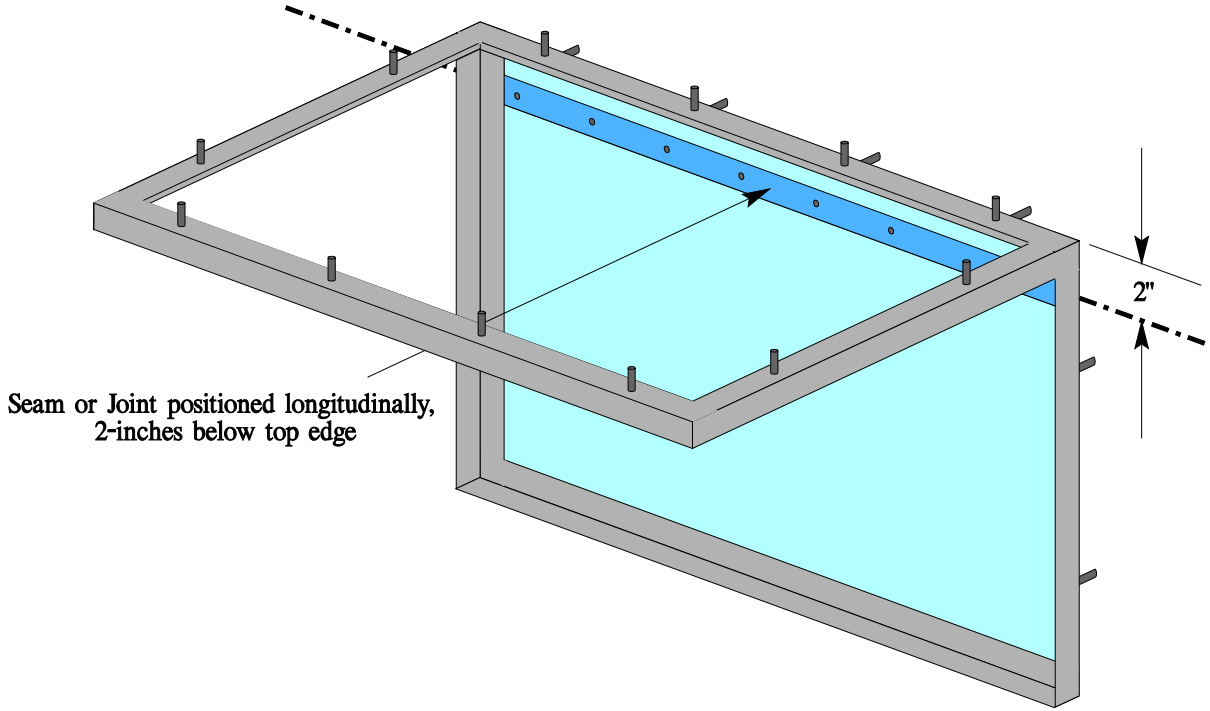


Figure X-8. Arrangement for the Testing of Seams and Joints in the Compartment Sidewall

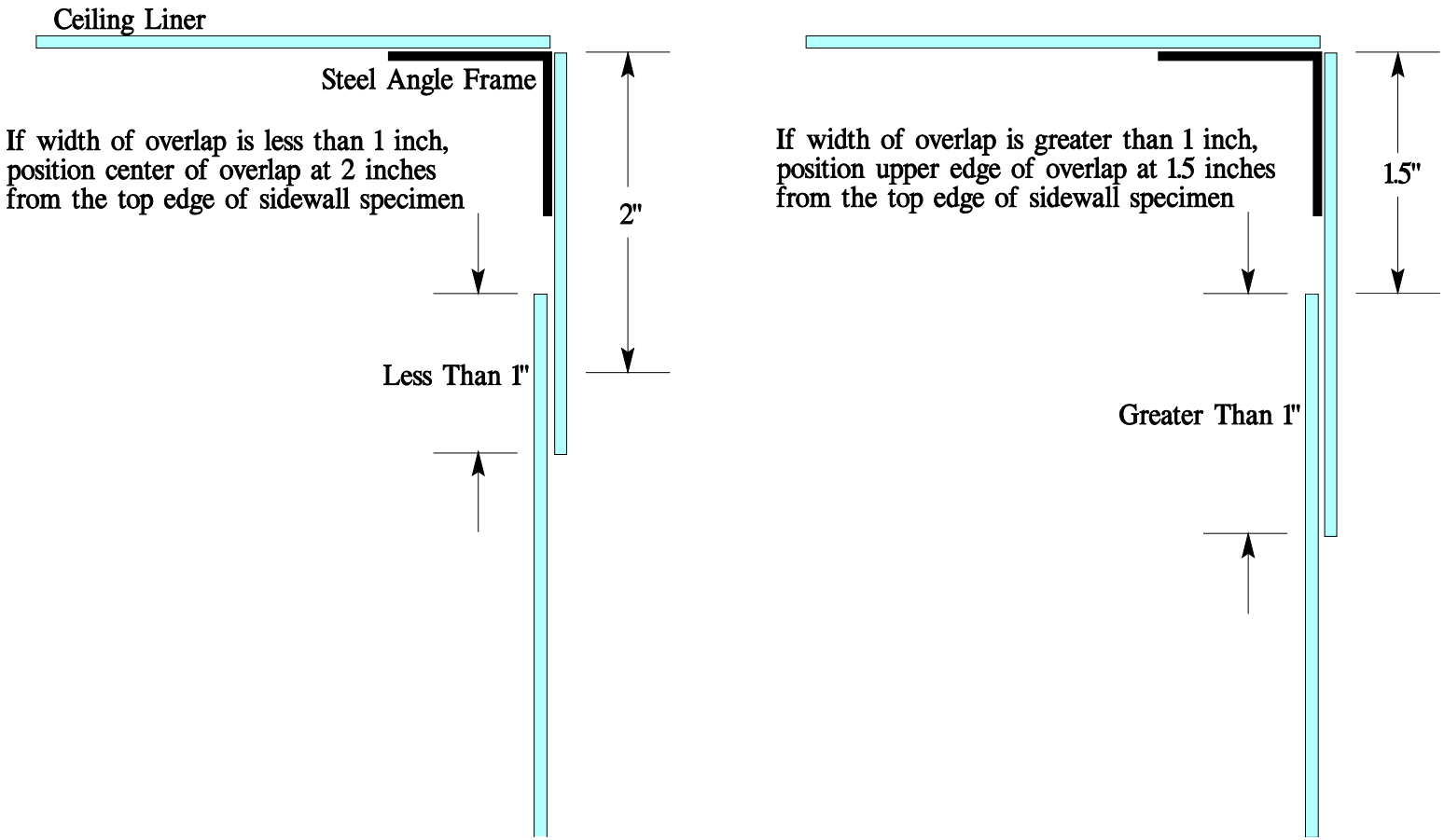


Figure X-9. Methodology for the Testing of Seams and Joints in the Compartment Sidewall

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.

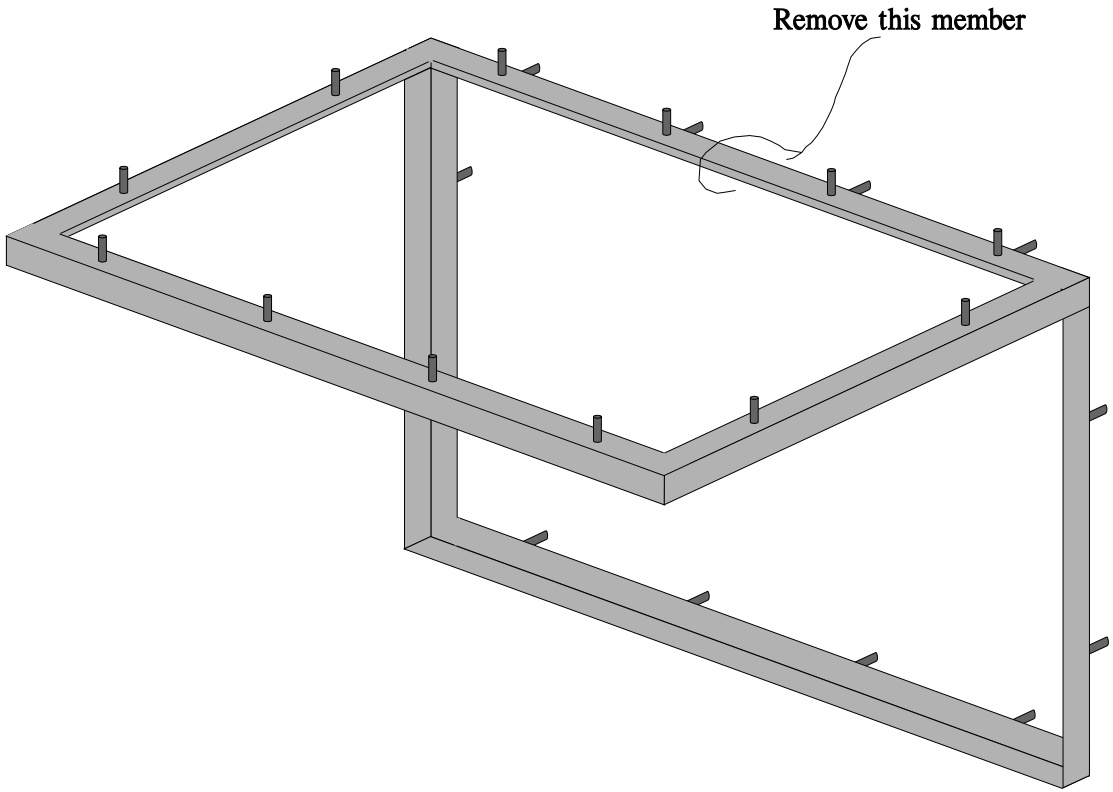


Figure X-10. Modified Test Specimen Mounting Frame for Corner Testing

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.

Summary of Activities

Generate calibration temperature results with FAATC Park burner apparatus **(completed)**

- Results will be used to calibrate Sonic burner apparatus
- Additional calibration trials using 1/8-inch thermocouples will be conducted

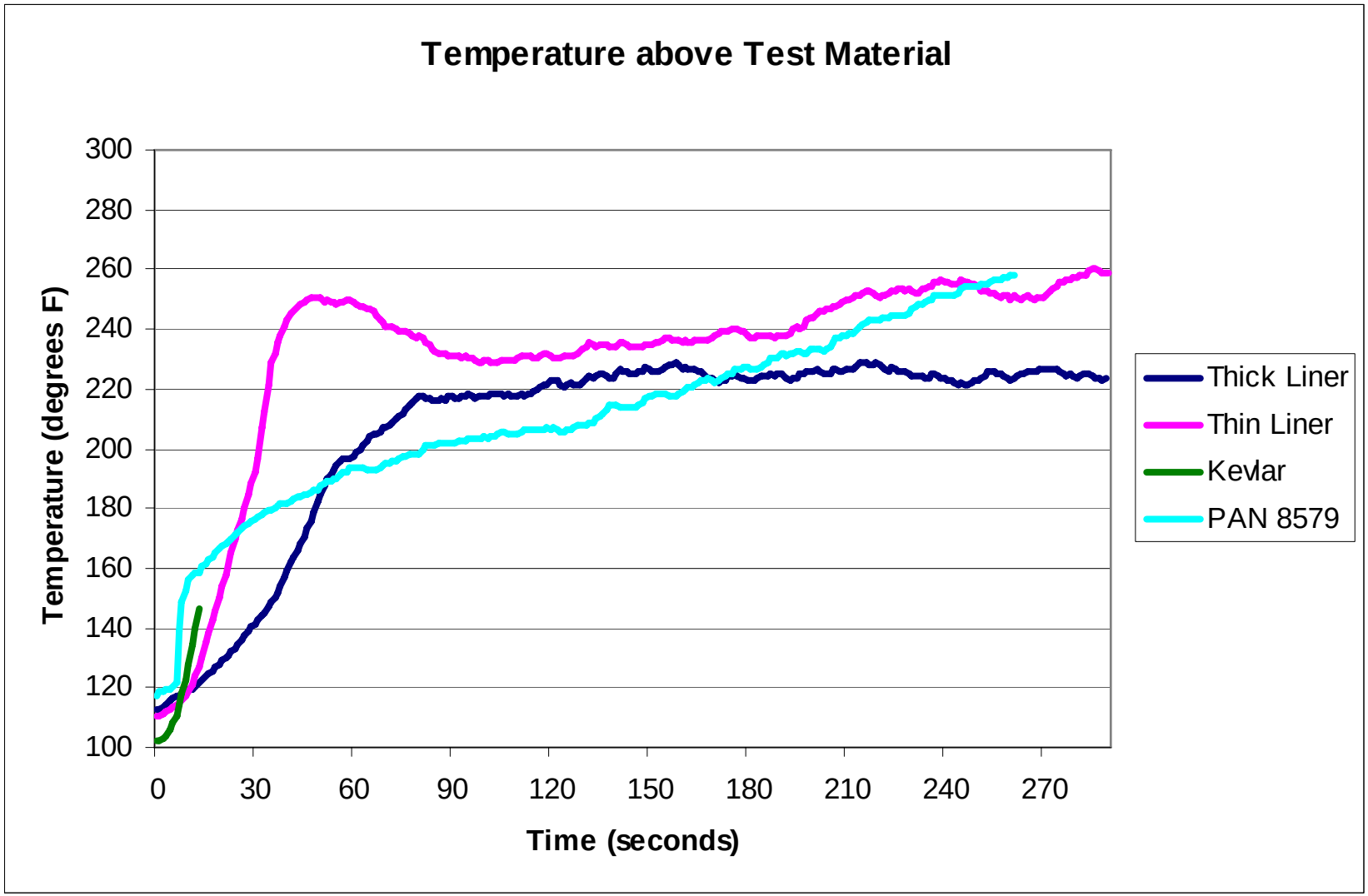
Generate test results with FAATC Park burner apparatus **(completed)**

- 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
- Additional liners available for testing if needed

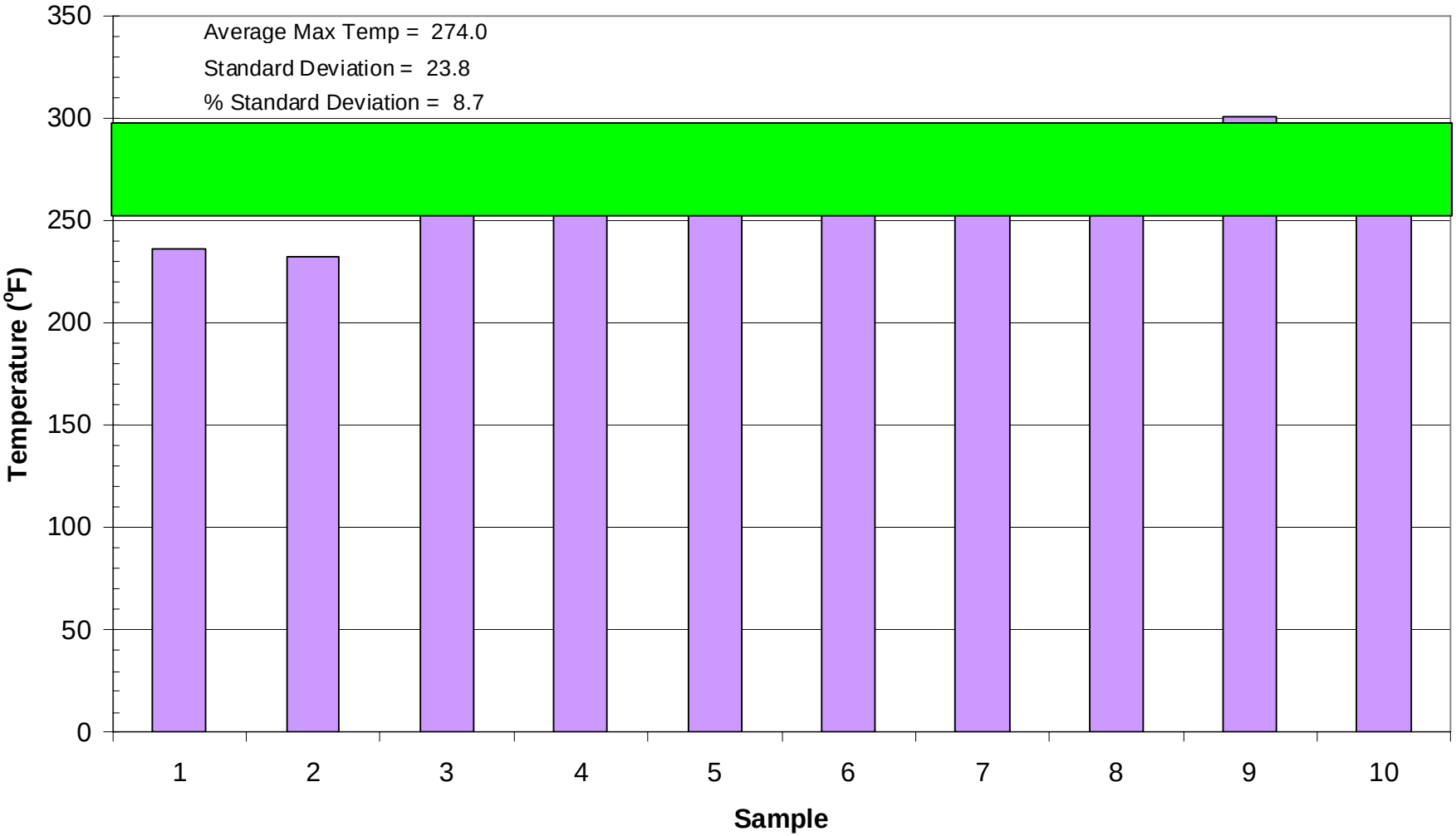
Park Burner Baseline Test Results

- **When testing is completed, the Park burner will be removed, and the Nexgen burner will replace it. Testing will then begin with the Nexgen so that test results match those of the Park burner.**

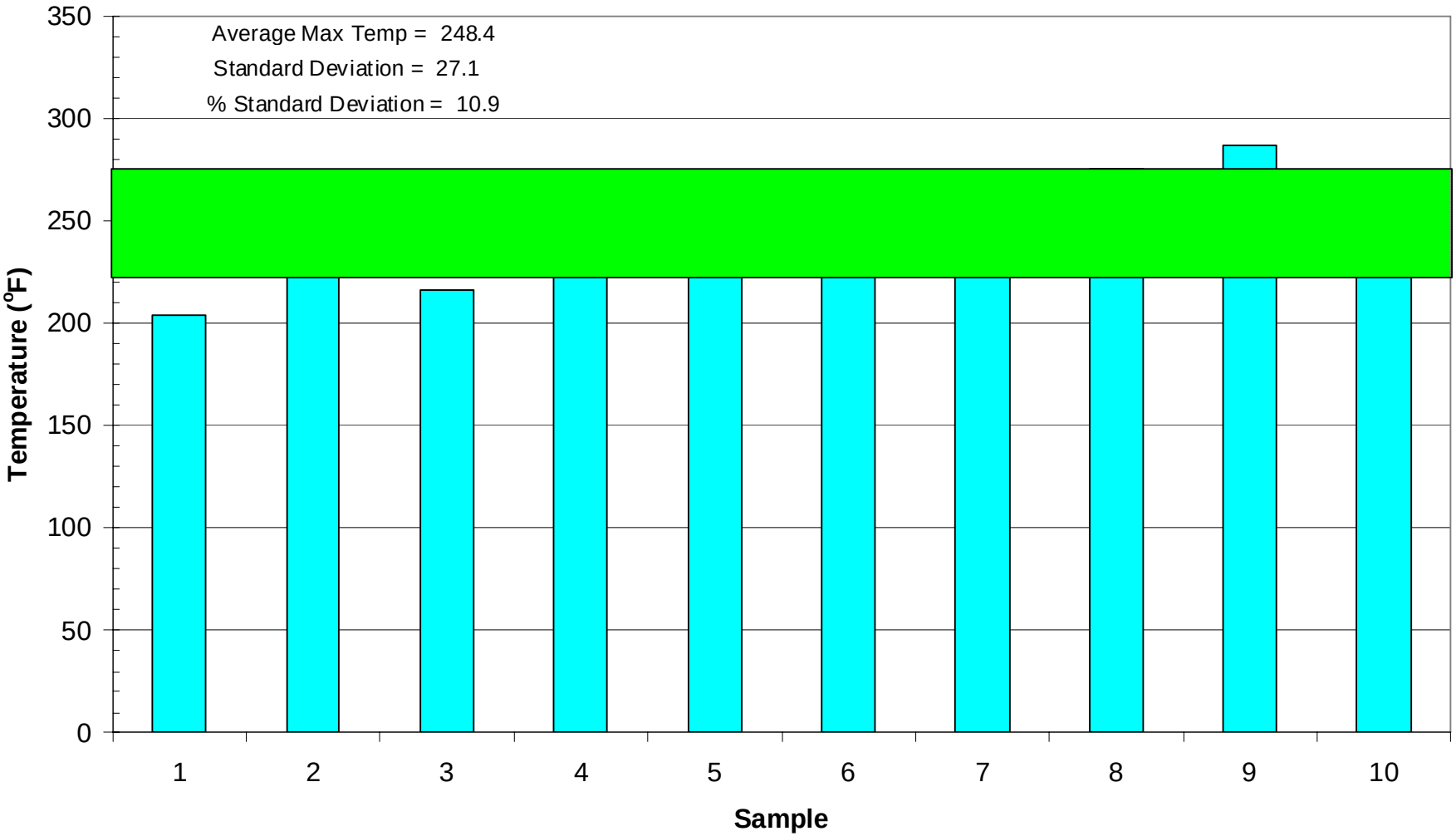
Park Burner Baseline Test Results



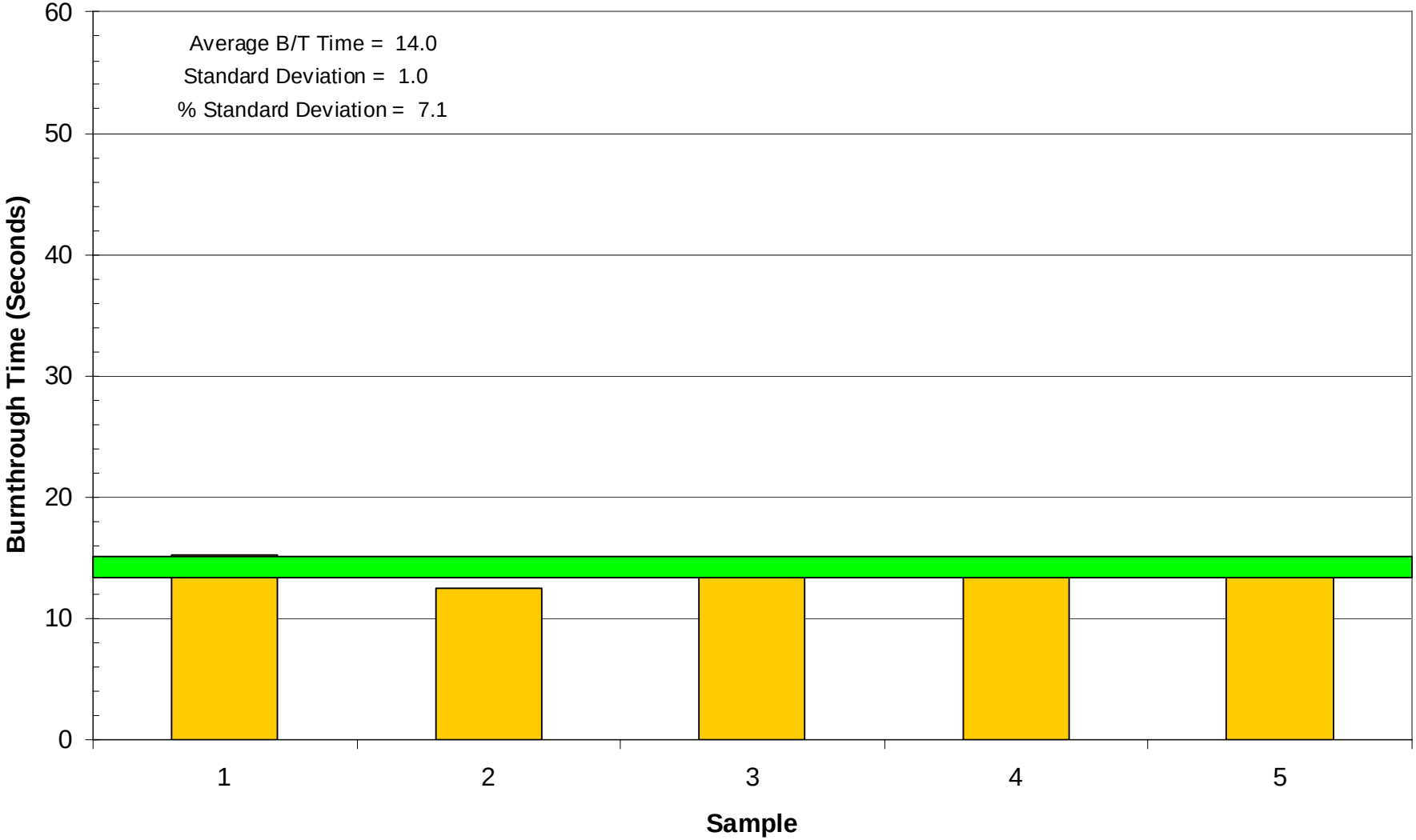
Thin F/G Liner Maximum Temperatures
(.0224-.0241 inch thickness)



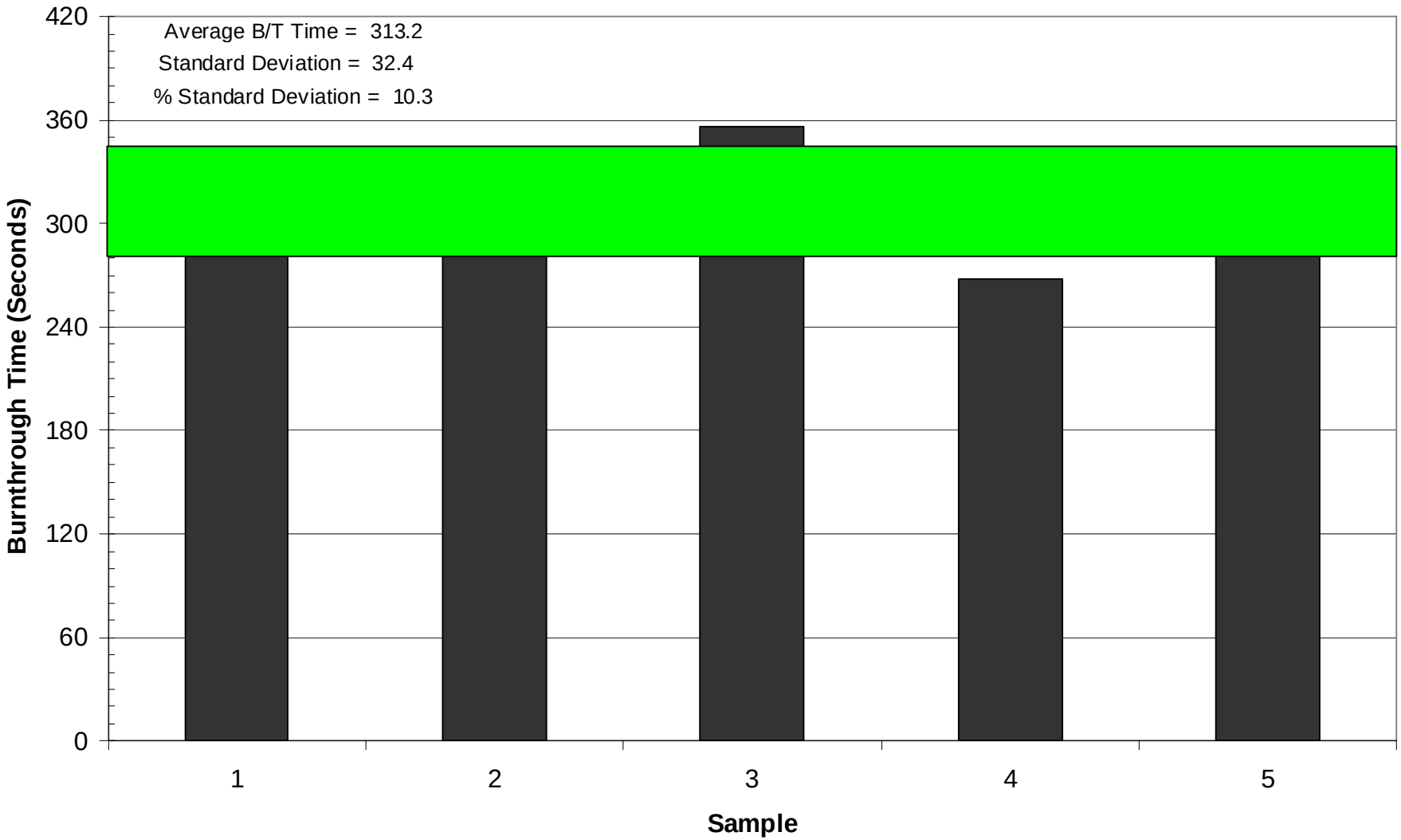
Thick F/G Liner Maximum Temperatures
(.0351-.0372 inch thickness)



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



8579 PAN Burnthrough Time



Summary of Activities (cont')

Construction of apparatus using sonic burner parts from Marlin Engineering **(completed)**

Construction of new calibration rake using 1/8-inch thermocouples **(completed)**

Conduct temperature calibrations with set-up parameters obtained from seat burner trials (TBC)

Conduct test trials using identical cargo liner samples used in Park burner tests (TBC)

New NexGen Cargo Liner Rig Constructed

New Temperature Calibration Rig Constructed

Planned Activities

Wrap up liner testing using Park burner by compiling significant base of data on various samples

Install NexGen burner in testing chamber, along with new calibration rig

Calibrate NexGen burner to match Park burner temperature results (use 1/8-inch thermocouples)

Determine impact of 90^{o} elbow position (repositioning will make apparatus much higher)

Conduct tests using NexGen burner with materials previously used

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

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

Conduct Round Robin?