Cargo AC Proposal

Revision 4

AC, Objective, Purpose and Background

This ‘Oil Burner- Cargo Liner Testing” AC proposal is being provided in support of 2011- 2012 ARAC Materials Flammability Working Group Work Plan. It’s primary objective is to capture the intent of the cargo liner and features ‘oil burner’ testing in a simplified form that ensures safety validation of the cargo compartments.

The process establishes testing parameters for the common joint types (butt and overlap) in standard test configurations. Once the boundary conditions (fastener spacing, joint overlap, & material system) have been confirmed, analysis can be completed for all common joints within the established boundaries. Unique joints will require further testing.

The methods proposed on this AC are similar in approach concept as in 25.856-2A – “Installation of Thermal/Acoustic Insulation for Burn through Protection” and satisfy the original intent of Cargo NPRM-84-11, 11A and subsequent rule 14 CFR Part 25, Docket Number 24185; Amendment No. 25-60; http://rgl.faa.gov/Regulatory_and_Guidance_Library/rgFinalRule.nsf/a09133bddc7f4fbb852564600060971 2/a31c728d60d0895b862568dd006dcd69!OpenDocument

Test Standards

- Provide guidance for an alternate test method as follows
  - Perform Oil Burner test for 7 minutes (for each test sample)
  - A test sample passes the test when it is tested for at least 5 minutes without burn through
    - If the first 3 test samples pass the test, then the test configuration can be certified
    - If no more than one of the first 3 test samples has burn through during the first 5 minutes of the test, then a fourth sample can be tested
    - If a fourth sample is tested and there is no burn through during the first 5 minutes of the test, and the average time (before burn through of the samples) is 5 minutes or greater, then the test configuration can be certified.
    - If the fourth sample has burn through prior to 5 minutes of testing, up to 2 additional tests (for a total of 6) may be run. If 3 of the 5, or 4 of the 6, tests pass, and the average time (before burn through of the samples) is 5 minutes or greater, then the test configuration can be certified
- Revise backside temperature requirement
  - If primary liner “material only” test passes the oil burner test (400F back side temperature), then the joint test does not require the temperature to be measured above the liner.
  - Note: the intent of this requirement is to ensure the cargo liner material (e.g. expansive materials) are not too ‘open weave’ that would cause general permeability (flame and/or thermal transfer) or have materials prone to ‘backside burning’. Testing of ‘insignificant’ parts is not required; exclusion analysis and rationale is adequate to preclude testing in part or in total.

Test Decision Flow

- The decision flow starts when a cargo compartment configuration is either created or revised. (This includes the use of new materials).
- If a new joint is defined by the new or revised configuration, and there is no joint flammability test data that substantiates this new joint, then a new test must be conducted.
- The new joint can be categorized as one of the following:
  - Overlap joint: A joint can be tested per the test fixture shown in Figure 2 (on page 7) if the production joint configuration can be represented by two overlapping materials that are fastened to a support angle.
  - Butt Joint: A joint can be tested per the test fixture shown in Figure 3 (on page 7) if the production joint configuration can be represented by two materials that butt up to each other and are both fastened to a support angle with fasteners.
  - Unique Joint: A joint that can not be defined as either an overlap or butt joint as defined in Figures 2 and 3.

For all joints, data may substantiate another configuration if all the following are met:

- The materials for composite panels are identical
- Support structure is made of the same material, or an acceptable alternate, and the support has a similar profile and is the same or thinner than tested
- Overlap is the same or larger than tested
- Gap between panels is the same or smaller than tested
- Fastener pitch is the same or smaller than tested

Test Process Flow

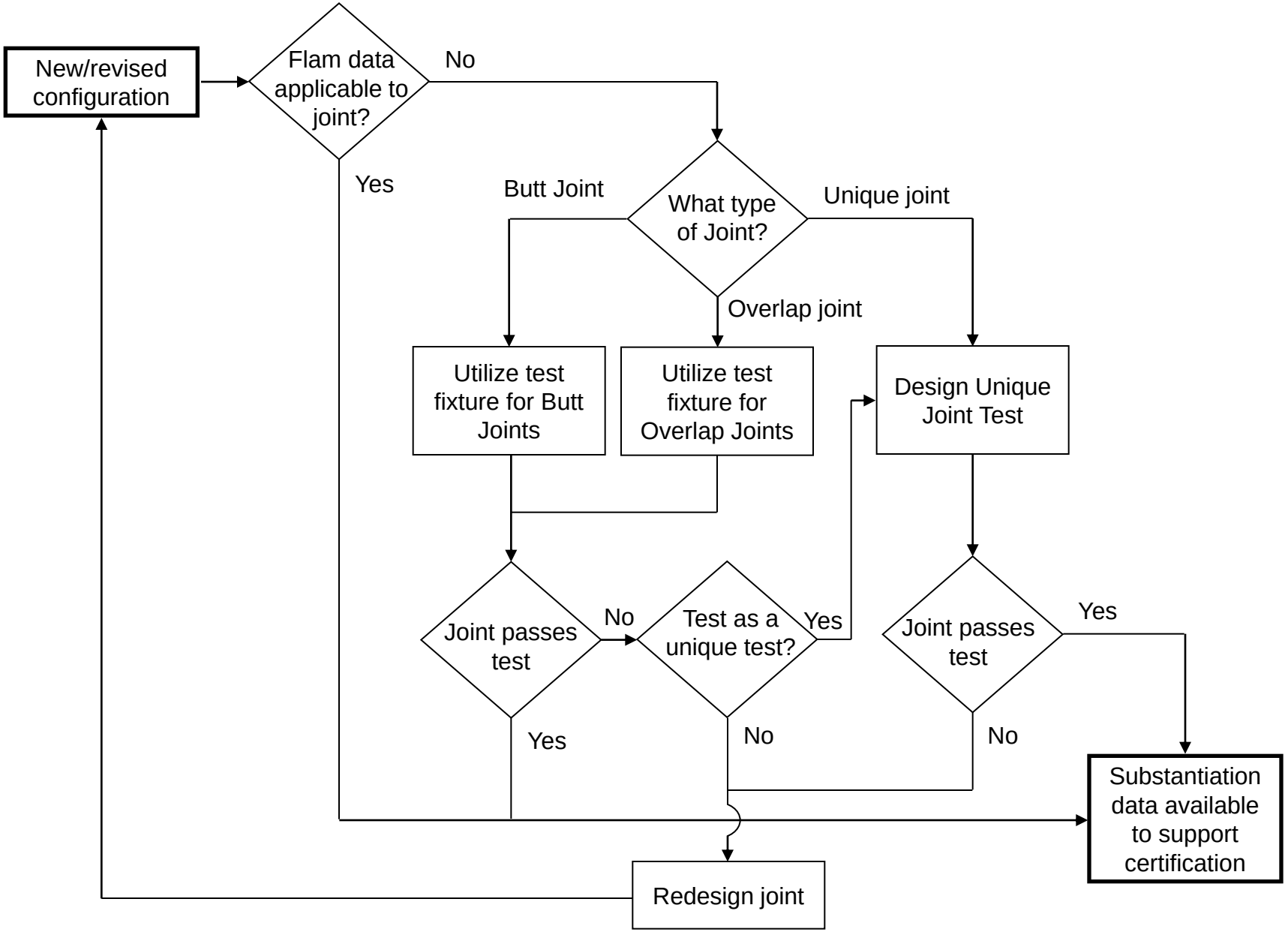


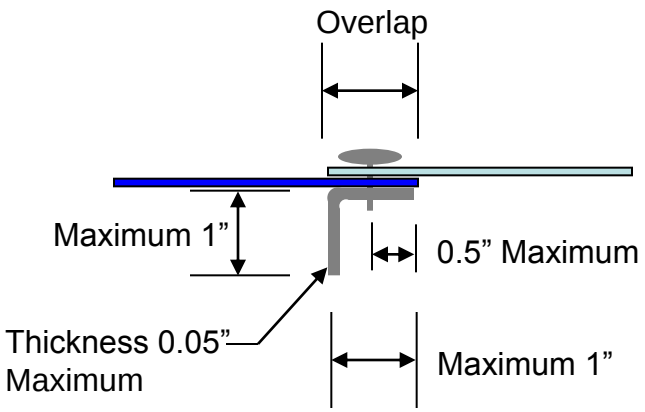
Figure 1

Overlap and Butt Joint Fixtures

Proposal: Use the overlap and butt joint test fixtures for most of the cargo compartment liner joints to reduce the number of tests.

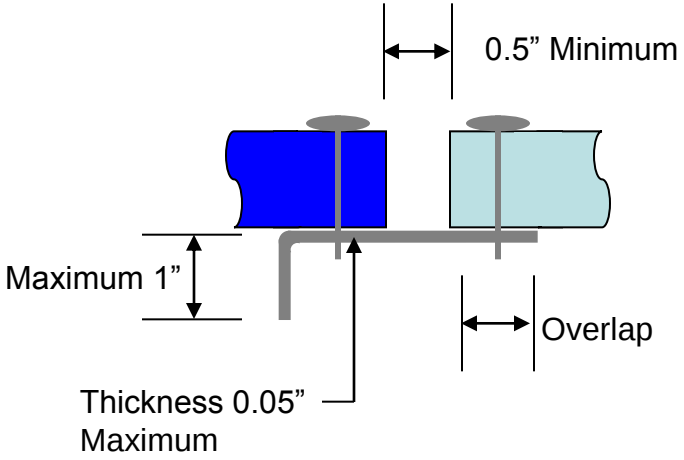
- Method may be used for honeycomb core panels, rigid cargo liner, and laminates made from a single material
- Joints can be tested using the thinnest and thickest materials to substantiate all thicknesses in between if they are made from a single material (rigid cargo liner, laminates, etc.)
  - This would apply to different thicknesses of single materials, or to laminates made from a single material
- The joint test fixtures would be designed to test the following three configurations (see figure 4) as design boundary conditions:
  - Test #1 - Smallest overlap and the smallest fastener spacing
  - Test #2 - Overlap that is within 0.5” of smallest & largest overlap dimensions, fastener spacing that is within 3” of smallest & largest fastener spacing.
  - Test #3 - Largest overlap and largest fastener spacing
- A fastener representative of design
  - It is acceptable to use washers in test constructions as long as the washer used has the same or smaller diameter as that used in the type design
- The largest hole representative of design
- Supports used in test fixtures
  - Fixture support angles (as described in Figures 2 and 3) may only be used if there is a support in the production configuration and it is not a flat sheet
  - Overlap: Fixture support has dimensions of 1” x 1” 90 degreed formed or extruded section, 0.05” thick, made from either 2024 or 7075 series aluminum (see Figure 2)
  - Butt: Fixture support with a 1” Leg, 90 degreed formed or extruded section, 0.05” thick, made from either 2024 or 7075 series aluminum (see Figure 3)

Overlap and Butt Joint Fixtures



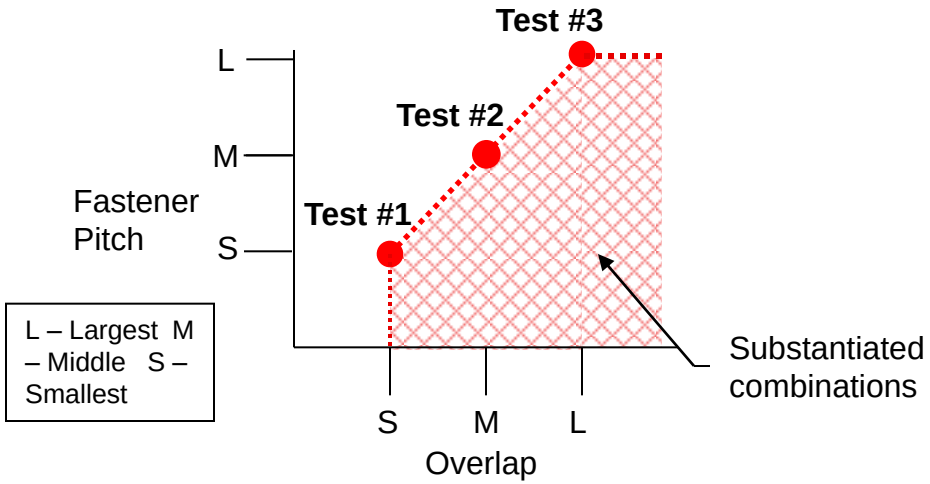
Overlap Joint Test Fixture

Figure 2



Butt Joint Test Fixture

Figure 3



Test points that bound substantiated configurations

Figure 4

- Connect the test configuration points with a line
- Region is bound by the line, the max fastener pitch, and minimum overlap
- Once the three test configurations pass the oil burner test, the area below and right of the line are considered substantiated combinations for production configurations using the same material/joint system

Allowable Substitutions

- A test run with a flat support or with no support may be used to substantiate a configuration with a formed support
- A test run with a thinner support may substantiate a configuration with a thicker support
- Test constructions tested without finish can substantiate constructions with standard finishes:

  Standard Finish Definition: Standard paint/finishes are defined as aircraft OEM inorganic finishes (e.g., anodize, alodine), epoxy primers and topcoats, urethane topcoats, and corrosion inhibiting dry films (reference; "Flammability Standardization Working Group proposal for #16 Metal Parts, Rev B, submitted to the FAA on April 13, 2011“)
- Test constructions tested without decorative/Tedlar can be used to substantiate constructions with decorative/Tedlar
- Any color may substantiate any other color (as any difference in flammability properties has no appreciable effect on the ability of a construction to pass)
- Data from a test using one size of fastener may substantiate a production configuration with a different size fastener as long as the fastener in the tested configuration is no greater than 1/16” larger than the production configuration, and the fastener is made from a similar material (i.e. if you have data for a 3/16” fastener you could use it to substantiate a production design with a 1/4” fastener, or any smaller fastener)
- Fasteners may be interchanged as long as the head diameter is no more than 1/16” larger in diameter and it is made from Steel or Ti alloys
- Data from a test using one size hole may substantiate a configuration with a different size hole as long as the hole in the production design is no greater than 1/16” diameter larger than the tested configuration
- Titanium and Steel alloys are two way interchangeable
- Any temper of aluminum may substantiate any other temper
- Aluminum alloys may be substituted as follows
  - **2000 and 7000 series aluminums are two way interchangeable**
  - **2000 and 7000 series aluminums are one way interchangeable for 6000 series aluminum**
  - **Substitutions may be made within a series (i.e. 2000, 6000, 7000 series)**
- Bare and Clad aluminum are two way interchangeable

Intersection of Joints

- Intersections between multiple joints are exempt from testing as long as the following criteria are met:
  - Each of the constituent joints that make up the intersection has passing data
  - If there is no fastener at the intersection, the peripheral distance between fasteners is no greater than that of the constituent joints

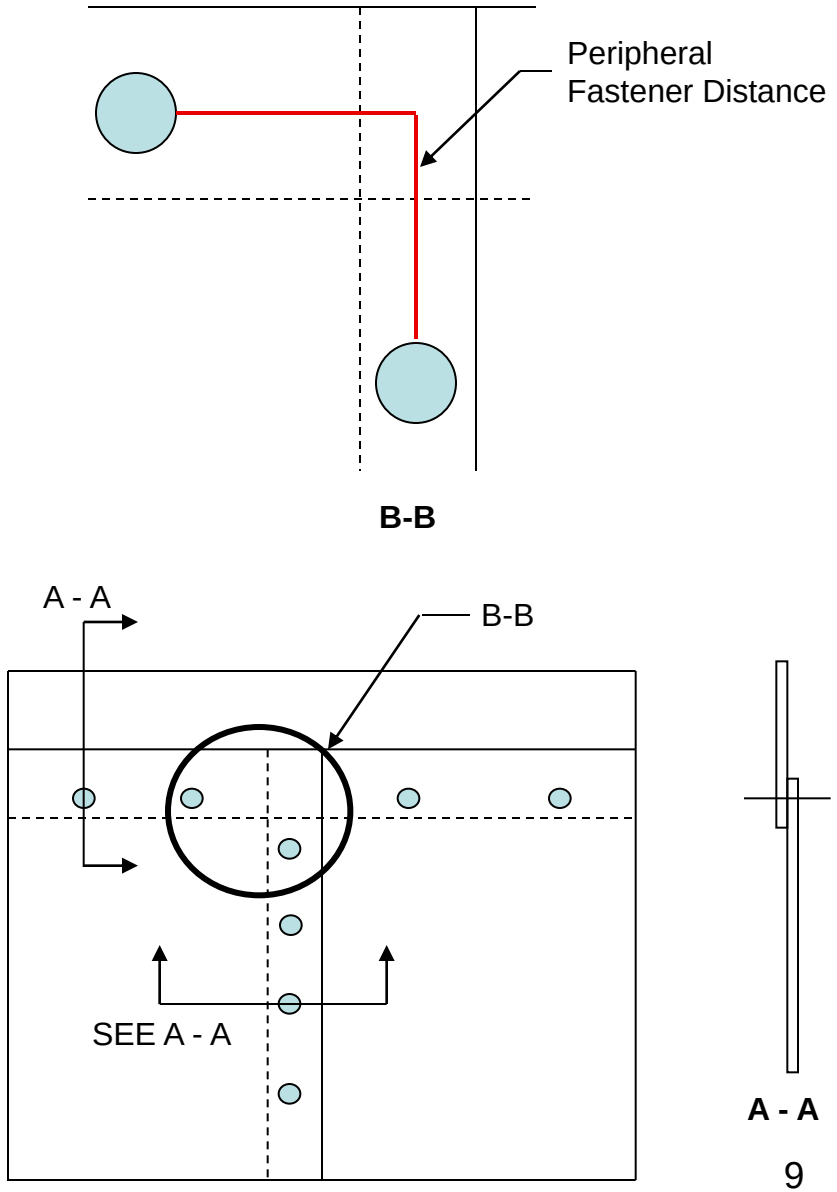


Figure 5

Wire Penetrations through Liner

- Joint between cargo liner and shroud must meet requirements of Appendix F Part III
- All penetrations through the ceiling liner are defined to be part of the liner and must be tested per Appendix F Part III
- Wire penetrations through the cargo liner are exempt from testing if they meet all the following requirements
  - They are required for the functionality of the equipment
  - Equipment is enclosed in a shroud made of a material that meets Appendix F Part III requirements
  - They are located in the vertical or lower surface of the equipment shroud

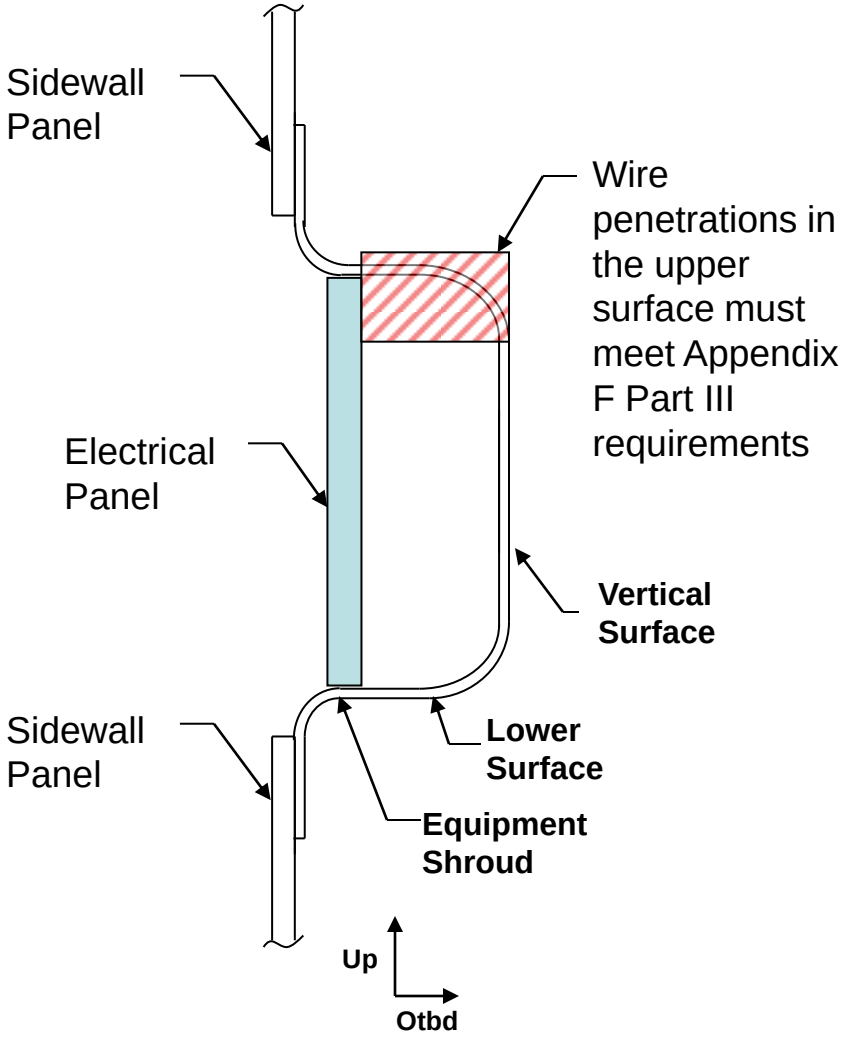


Figure 6

Testing of Features

- Features, such as lights, smoke detectors, etc. that are installed in the cargo liners may be tested in one of the following ways:
  - If the feature will fit within the test fixture, so that the feature can be centered to the requirements of Appendix F Part III, it may be tested as a complete unit (see Figure 7) The data can only be used to substantiate the feature tested and may not be used to qualify other joints
  - The individual joints of the feature can be tested separately. For example, the joint between the liner and the shroud, and the shroud and the wire penetration may be tested individually or can be substantiated by existing data (see Figure 8)
- Sacrificial components (light bulbs, lenses, etc.) are not required to be included in testing

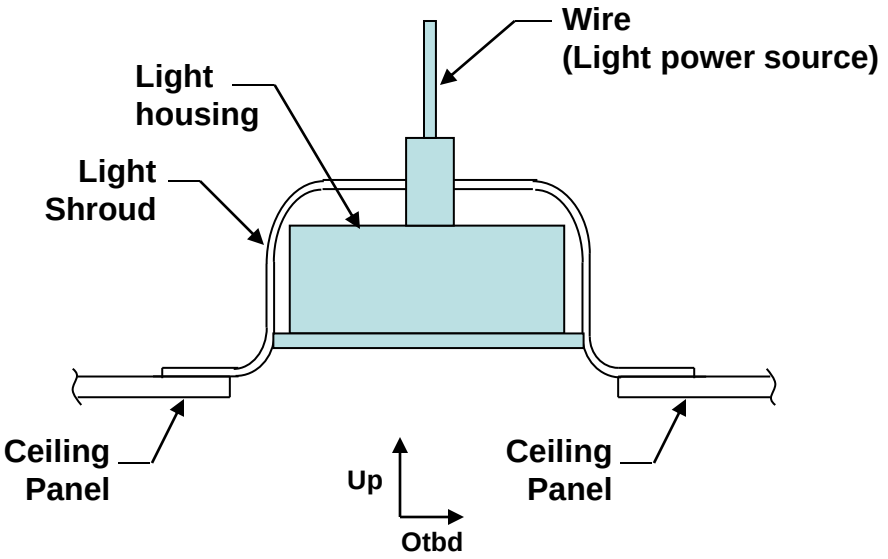


Figure 7

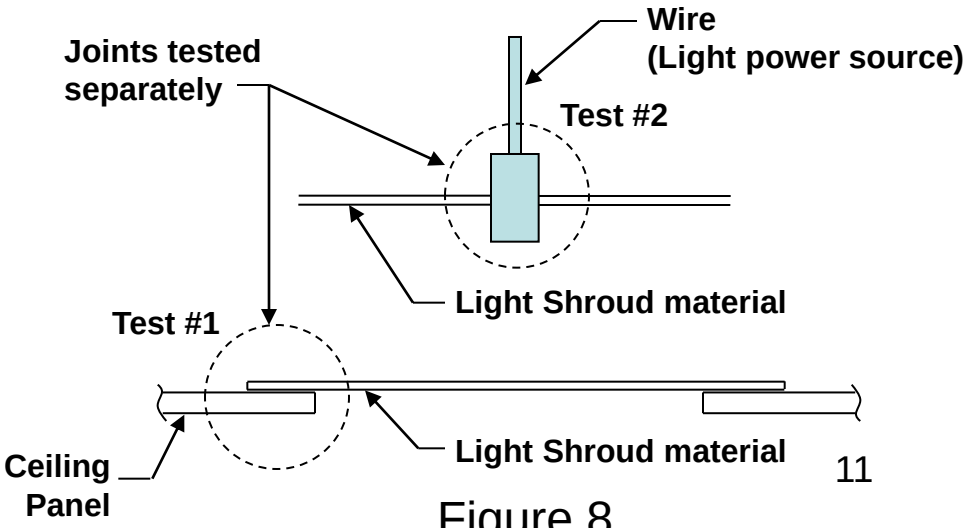


Figure 8

Small Unique Joints

- There are situations in which small joints exist that make up a small fraction of the cargo compartment. These joints may be excluded from testing if they meet the following requirements (see Figure 9)
  - The area of the joint is lined as practicable
  - The joint does not extend more than 4” and has a minimum overlap of 0.15”
  - The joint consists of materials that meet the requirements of Appendix F Part III

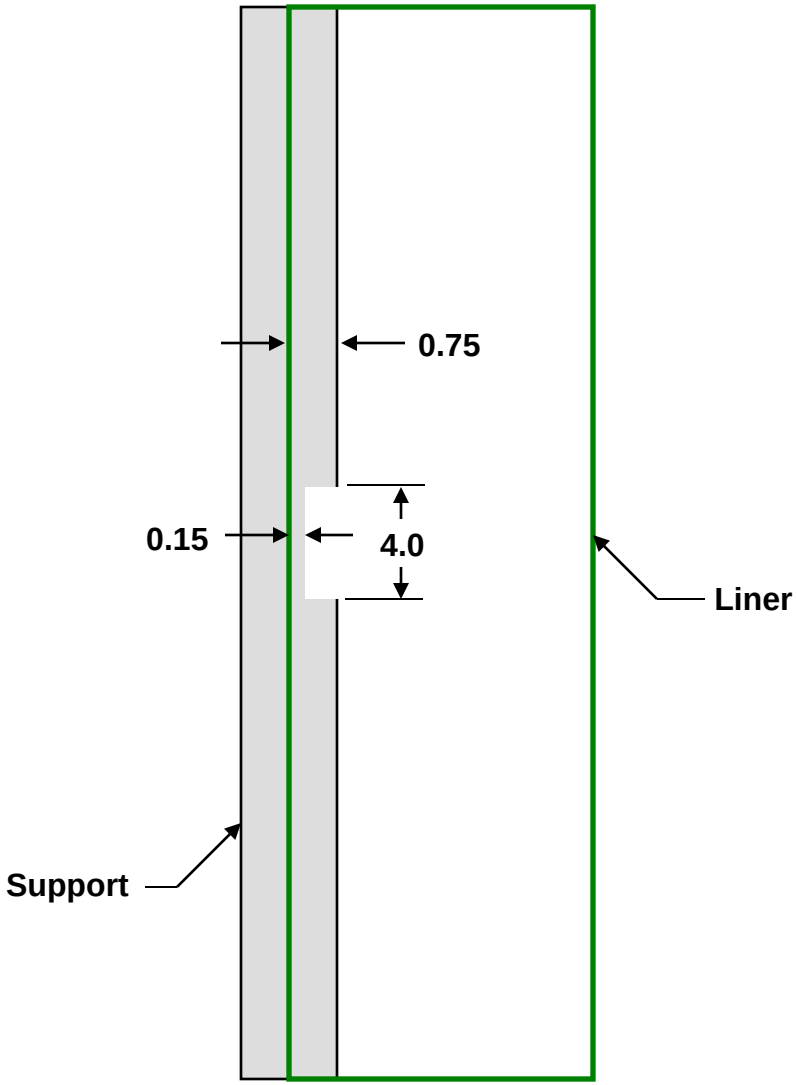


Figure 9

Excluded Areas

- The following exclusions apply to joint tests only. These areas must be lined as practicable with materials that meet Appendix F Part III requirements[1]
  - Joints on cargo doors are excluded from Appendix F Part III as any flame penetration does not pose a risk to critical systems
  - Any joint that attaches to or is below the cargo floor or cargo conveyance system is considered outside the cargo compartment and does not need to be oil burner tested (45 degree test is still required)

1 - The following exclusions may not apply to aircraft with composite structure as they may not adequately address the impact of excess heat on structure. Additional system analysis is required.