



The Development of Revised Testing Procedures for Cargo Compartment Design Features

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& Cabin Safety Research Conference**

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Contributors



Contributors

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Abstract and Background

Certifying cargo compartment systems and repairs to the burn resistance requirements of 14 CFR 25.855(c) [cargo oil burner] is non-standardized and complex. With Standardization being a recent recurring theme, Industry and the FAA agreed to collaborate on a series of standard test configurations and substantiation methods of Compliance (MOCs) that could then be released as a FAA Advisory Circular (AC).

This topic had its genesis in the recent ARAC committee, but then was recognized that the guidance had applicability to existing and future FAA rules.

The FAA IAMFTWG then launched a task group in 2012 with a charge to develop AC guidance material and submit to the FAA in 2013.

This proposed AC is intended to standardize, introduce similarities and substantially reduce testing costs.

Task Group Timeline

**February
2012
(Singapore)**

Call to form
AC Cargo
group

**October 2012
(Indianapolis)**

AC format
discussed and
assignments
delegated

**June 2013
(Manchester)**

Further peer
discussion of
draft cargo AC

**June 2012
(Balma)**

Contributors
formally
submit
substantiation
rationales

**March 2013
(Renton)**

Draft cargo
AC
introduced
to the task
group
review

August 2013

Cargo AC
industry
proposal
(Rev NC)
submitted to
FAA

Intro to Cargo Compartments

- How are cargo compartments certified to 14 CFR 25.855(c)?
 - Material tests
 - 16" x 24" cargo liners
 - Joint tests
 - Lap and butt joints
 - Installation tests
 - Shrouds (lighting, smoke detectors, firex, decompression features, ducting interfaces)

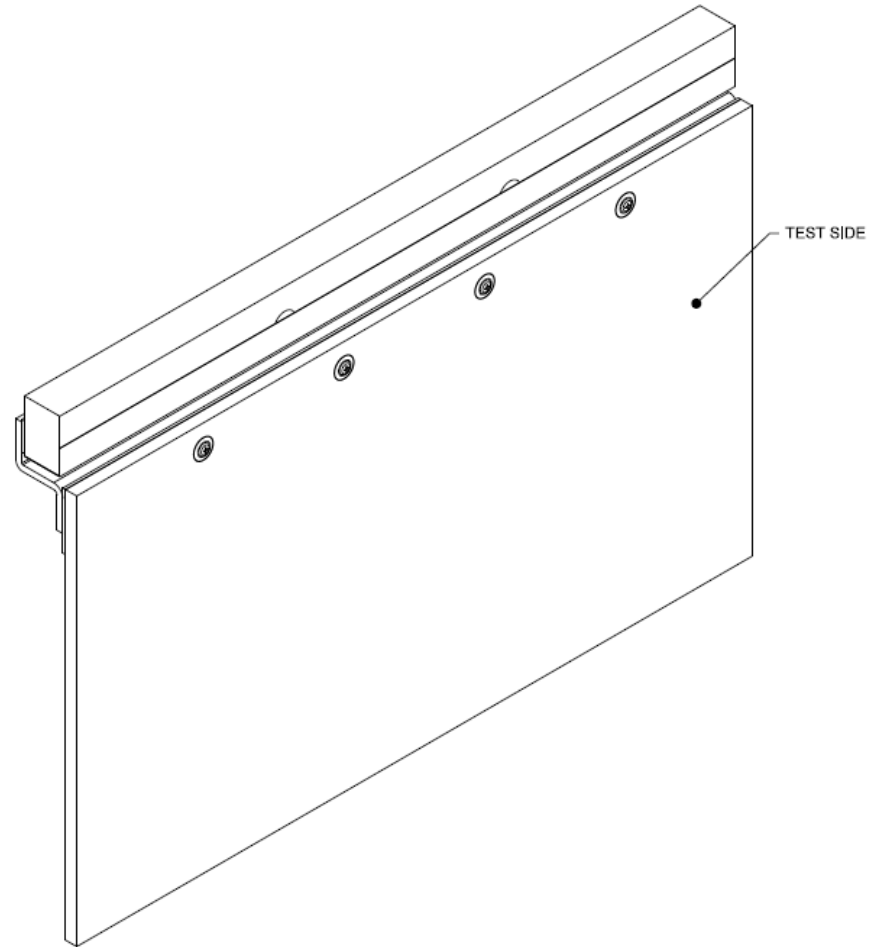
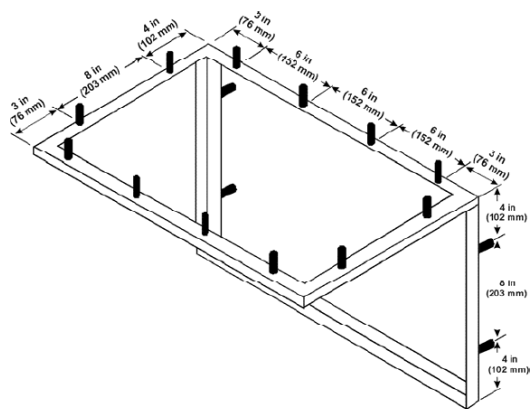


Why is there a need for substantiation and standardization?

- Eliminate redundancy.
- Reduce certification costs.
- Shorten certification lead times.
- Establish proper approach in representing features and interfaces in the cargo oil burner test.
- Number of cargo oil burner sets required to certify TC aircraft:
 - 20-150 sets (official)
- Lab costs for 1 set
 - \$600+
- Typical cargo certification task time
 - 6-24 months

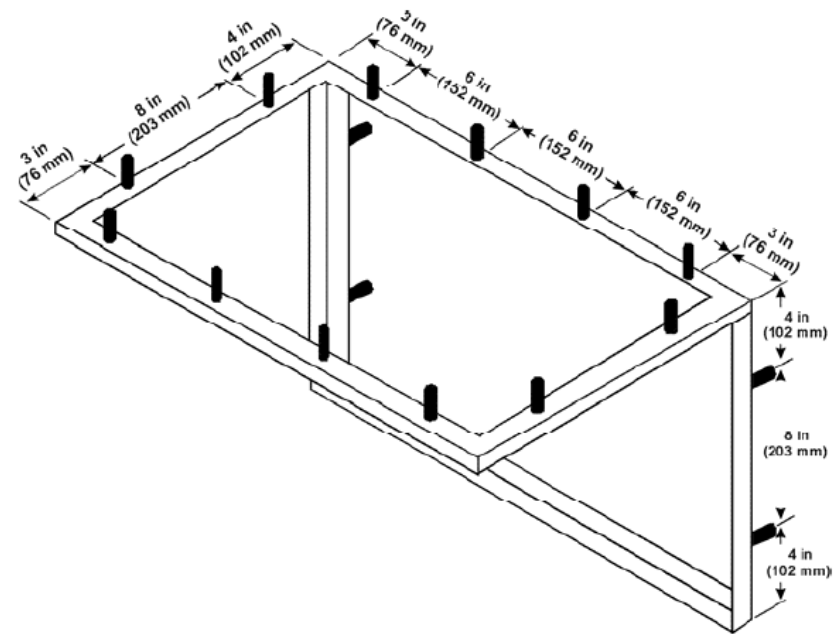
Test procedure highlights

- Clamping vs. pegging
- Shimming test specimens
- Clarifying thermal couple placement



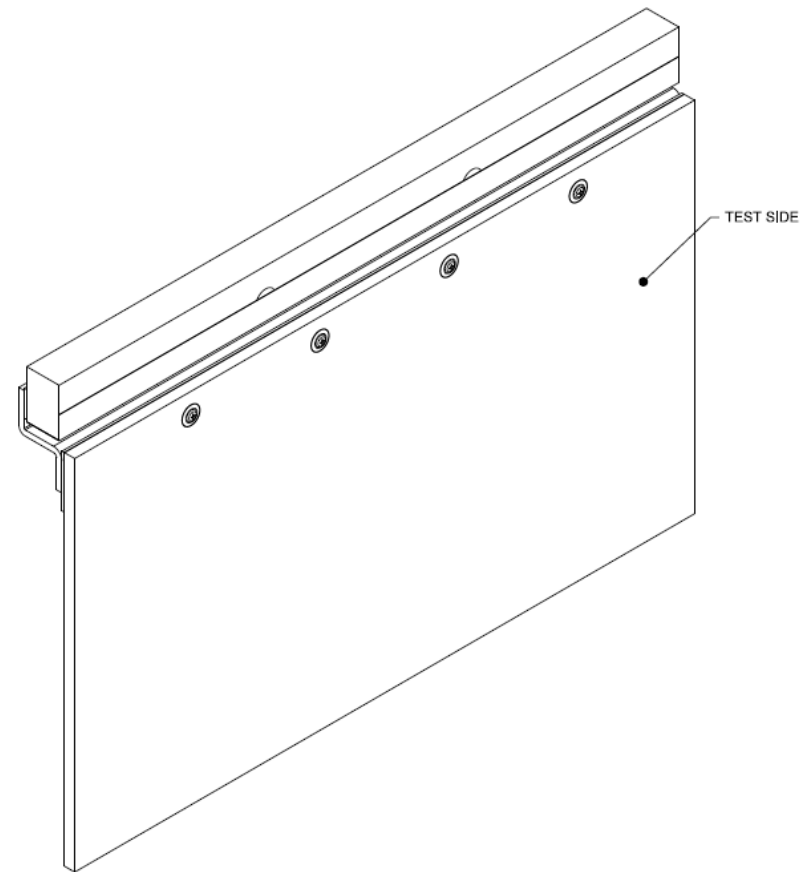
Test procedure highlights

- Clamping vs. pegging
 - Clamping samples into the test rig is acceptable provided the samples are prevented from shrinking or pulling out of the test rig for the duration of the test. If the sample pulls out from the test fixture the test is invalidated and should be retested with an alternate fixturing method (pegs, additional clamps, etc.).



Test procedure highlights

- Shimming test specimens
 - Simulating joints often creates stepped gaps between the test fixture frames. It is acceptable to close out these gaps using suitable materials to prevent the cargo oil burner flame from penetrating these gaps (e.g., metal/composite rigid shims or suitable non-flammable pastes).

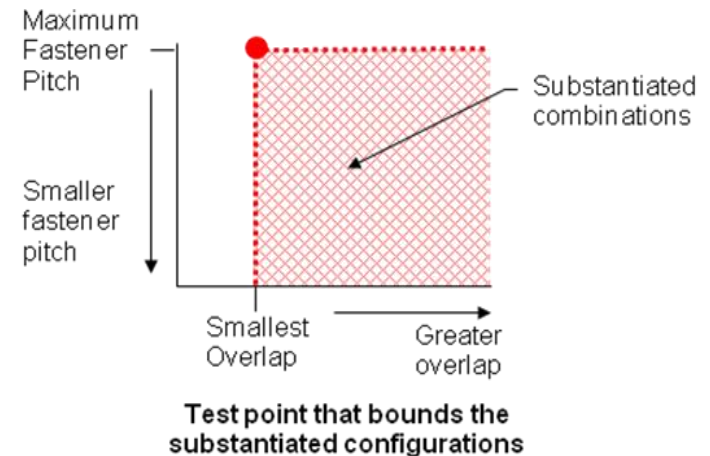


Test procedure highlights

- Clarifying thermal couple placement
 - Horizontal test specimens will have backside temperature measured.
 - Vertical and corner specimens do not require backside temperature measurement.
 - The thermocouple shall be positioned 4" above the cool side of a flat panel/liner test surface for panels ≤ 1.25 " thick.
 - Non-flattened features will be evaluated to ensure equivalent intent.

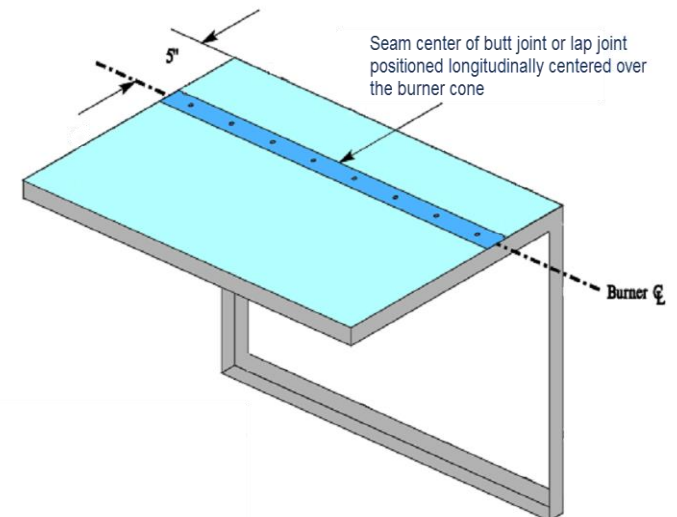
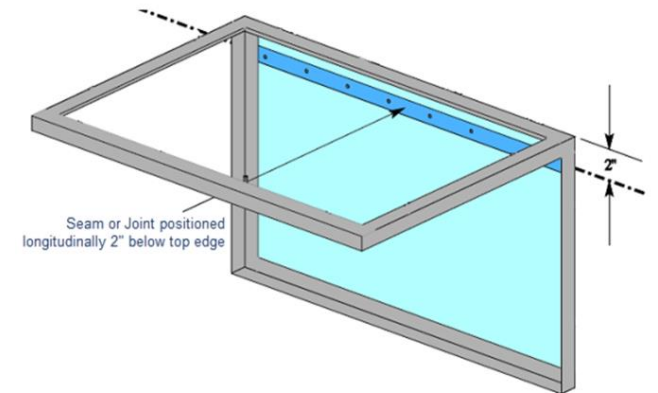
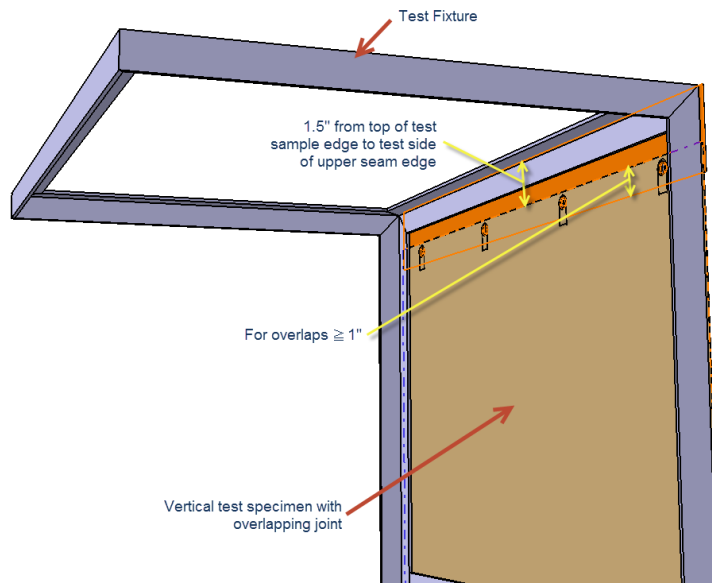
Feature substantiation highlights

- The Basics
 - Locating interfaces on test fixtures
 - Establishing worst overlap and pitch
 - Fireproof vs. non-fireproof materials
 - Material tests
 - Testing with insulation
 - Testing thin for thick for materials
 - Identifying fastener pitch
 - Fastener substitution
 - Metal substitution



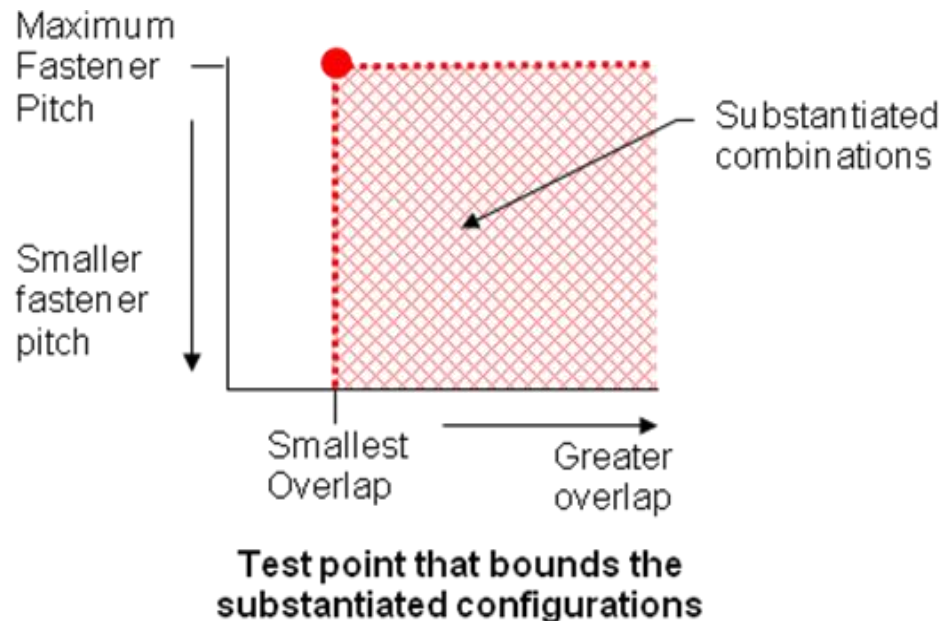
Feature substantiation highlights

- The Basics
 - Locating interfaces on test fixtures



Feature substantiation highlights

- The Basics
 - Establishing worst overlap and pitch



Feature substantiation highlights

- The Basics - Fireproof vs. non-fireproof materials

- Reference 14 CFR 25.1.1.1.

- (1) With respect to materials and parts used to confine fire in a designated fire zone, means the capacity to withstand at least as well as steel in dimensions appropriate for the purpose for which they are used, the heat produced when there is a severe fire of extended duration in that zone; and
- (2) With respect to other materials and parts, means the capacity to withstand the heat associated with fire at least as well as steel in dimensions appropriate for the purpose for which they are used.

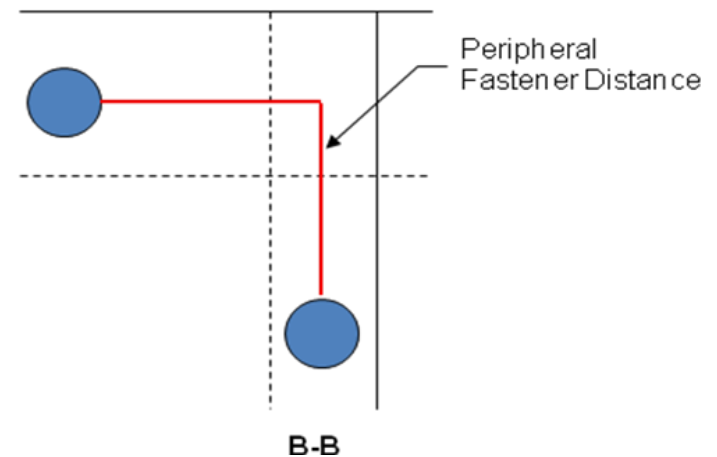
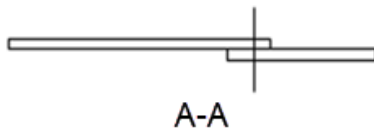
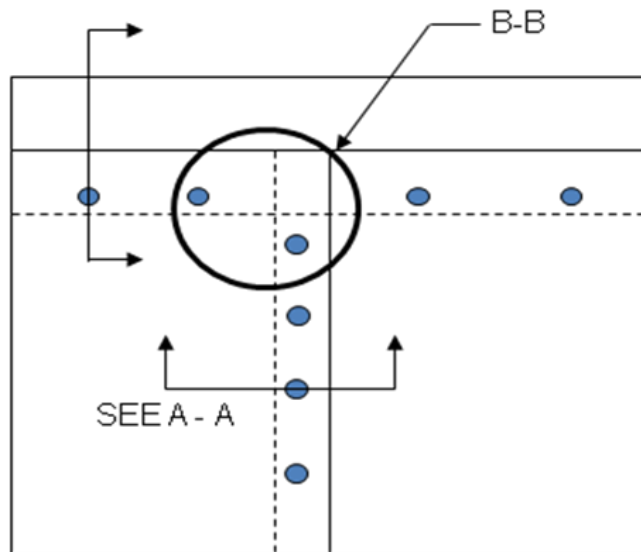
- Steel
- Titanium

Feature substantiation highlights

- The Basics
 - Testing with insulation
 - Bonded layers covering the majority of the liner on the outside to be tested to the material test (not for joints).
 - Testing thin for thick for materials
 - Thinner liners substantiate thick panels in the material test.
 - Sandwich panels can be substantiated by testing the same face sheet material of the same or less plies.

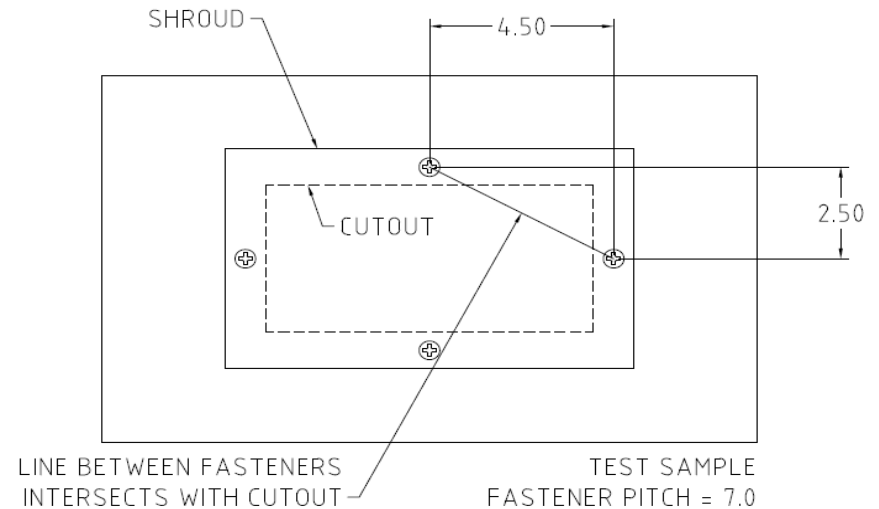
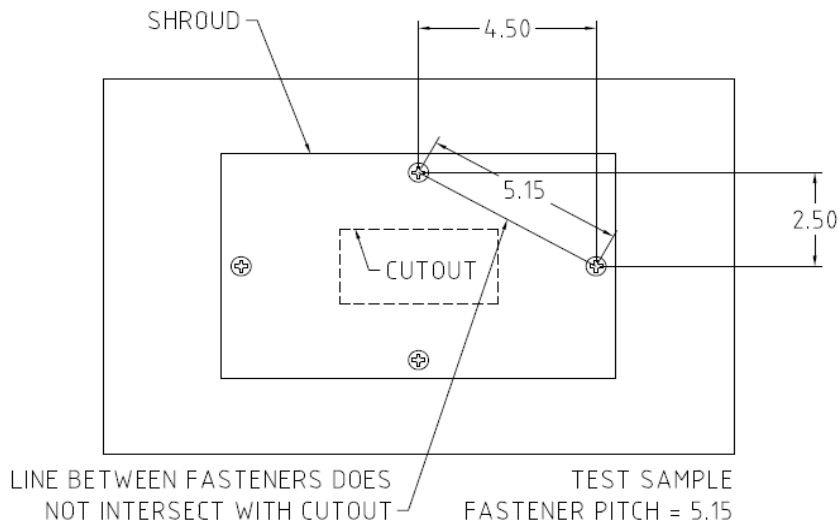
Feature substantiation highlights

- The Basics
 - Identifying fastener pitch



Feature substantiation highlights

- The Basics
 - Identifying fastener pitch



Feature substantiation highlights

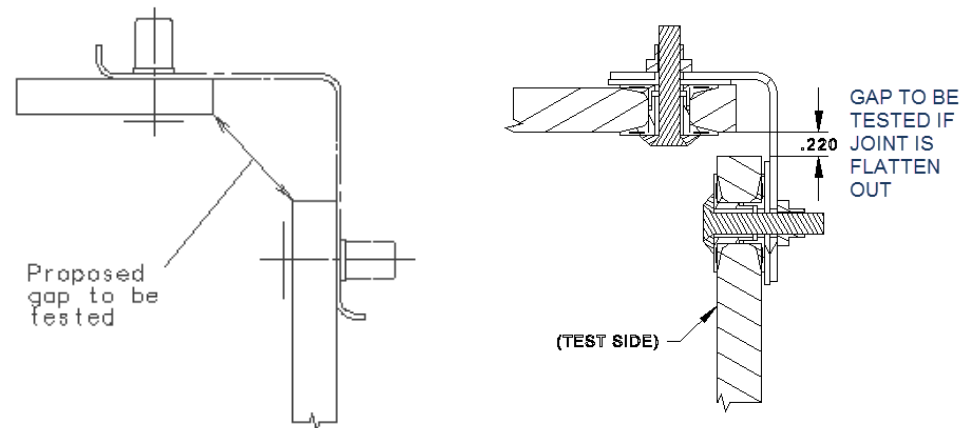
- The Basics
 - Fastener substitution
 - Plastic can substantiate steel and titanium.
 - Conventional screws can be used in lieu of $\frac{1}{4}$ turns.
 - $\frac{1}{16}$ " differences in diameter are considered similar as long as the washer and faster head provide the same protection.
 - Smaller fastener heads and washers are worst case.

Feature substantiation highlights

- The Basics
 - Metal substitution
 - Metals with melting temperatures above 2000 °F, such as titanium and steel alloys, are two way interchangeable.
 - Any temper of metal may substantiate any other temper.
 - Metals with melting temperatures below 2000 °F are substitutable for metals with higher melting temperatures. For example, 6061 (1080 - 1205 °F) aluminum may be replaced by 7075 (890 - 1175 °F).
 - Bare, clad, or plated metals are two way interchangeable.

Feature Substantiation Highlights

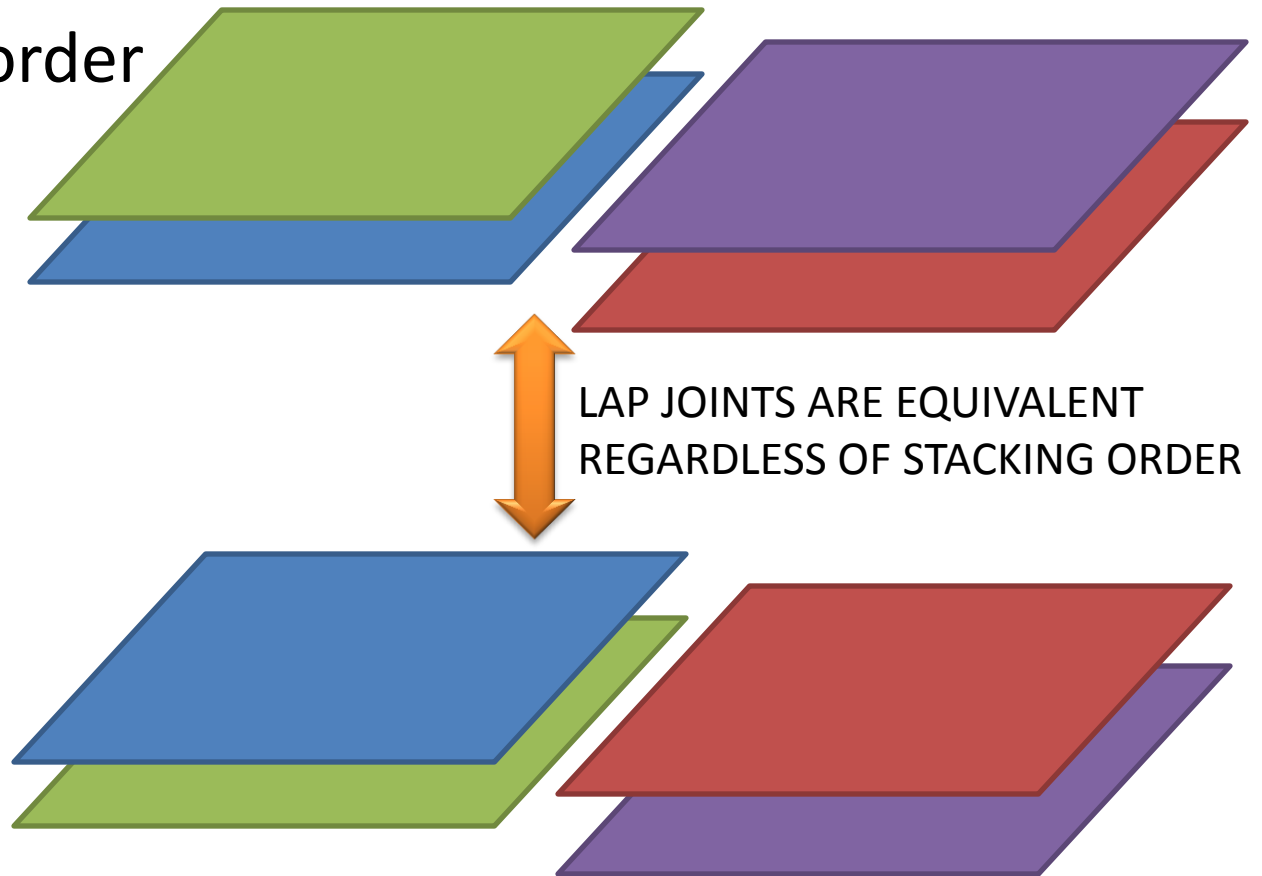
- Joints
 - Stacking order
 - Seals
 - Simulating structure or testing without it
 - Gap measurements



Feature Substantiation Highlights

- Joints

- Stacking order

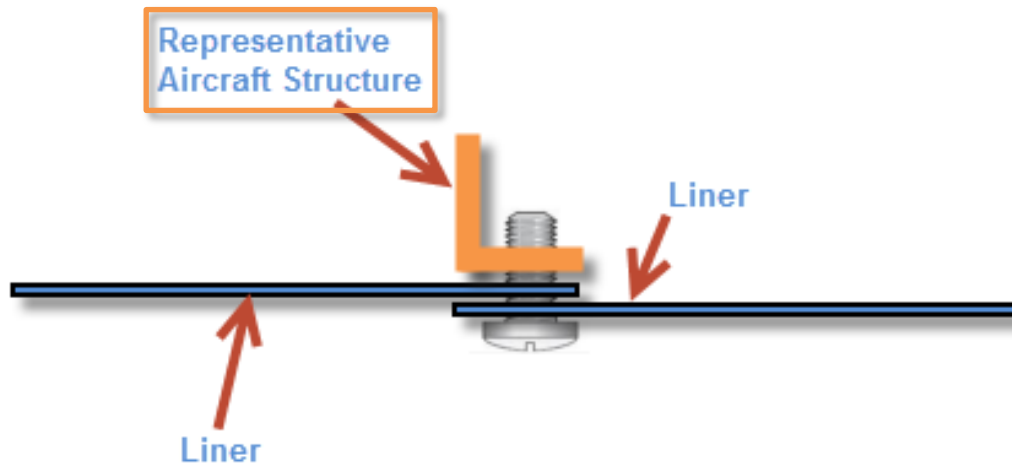


Feature Substantiation Highlights

- Joints
 - Seals
 - Sandwiched seals (e.g., silicone foam) no more than .125” thick may be omitted from joint tests provided they are undercut .125” from overlapped edge exposed to the backside (non-test side) and have been shown to not exhibit backside ignition.

Feature Substantiation Highlights

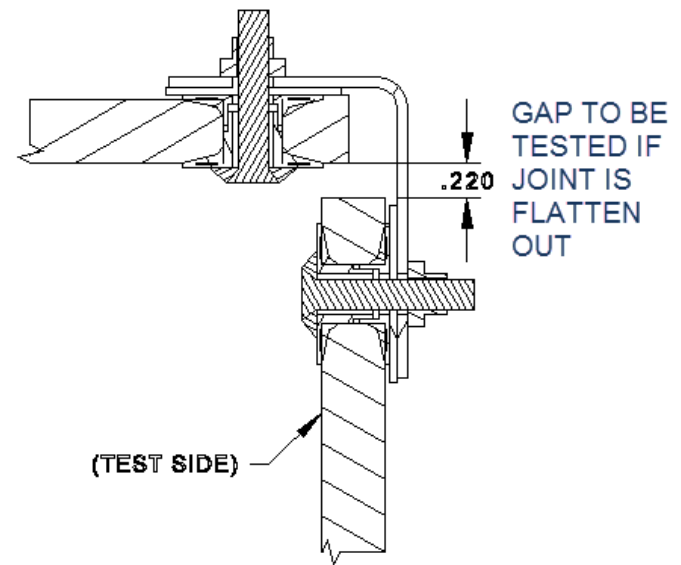
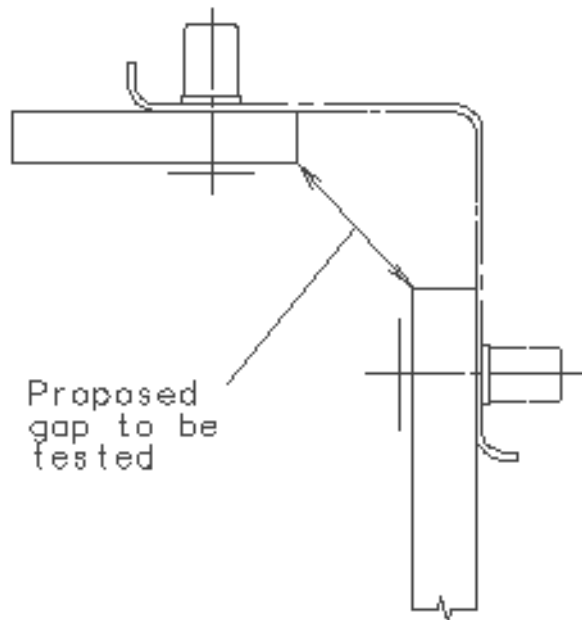
- Joints
 - Simulating structure or testing without it



- A test run with no joint support strap or with a flat joint support strap of same material, representative width or less, and equal or less thickness may be used to substantiate a configuration with a formed support. A less rigid, less reinforcing representation of a liner support is worse case.

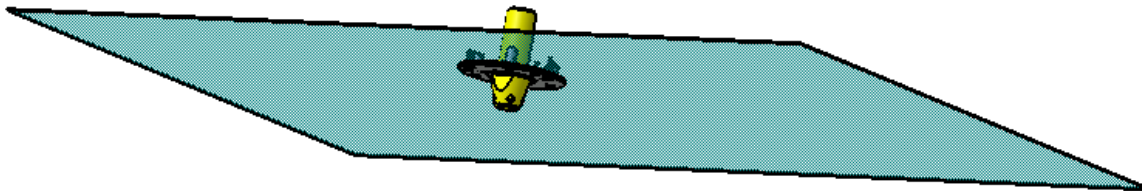
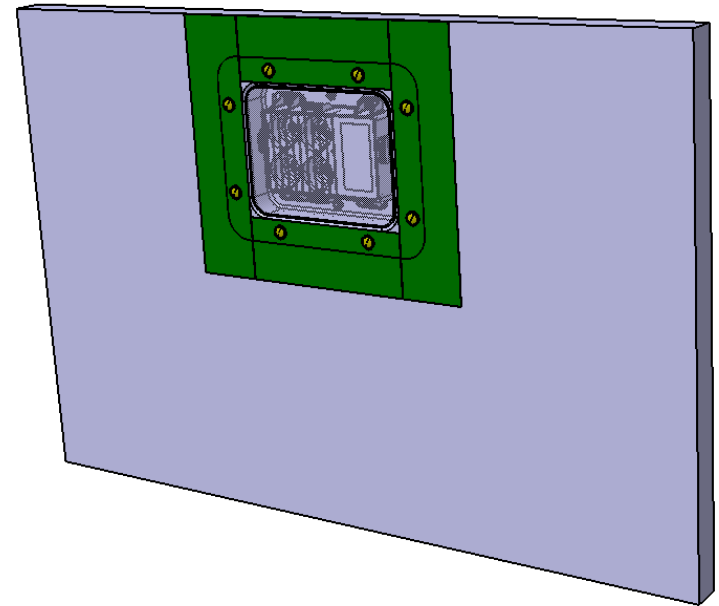
Feature Substantiation Highlights

- Joints
 - Gap measurements



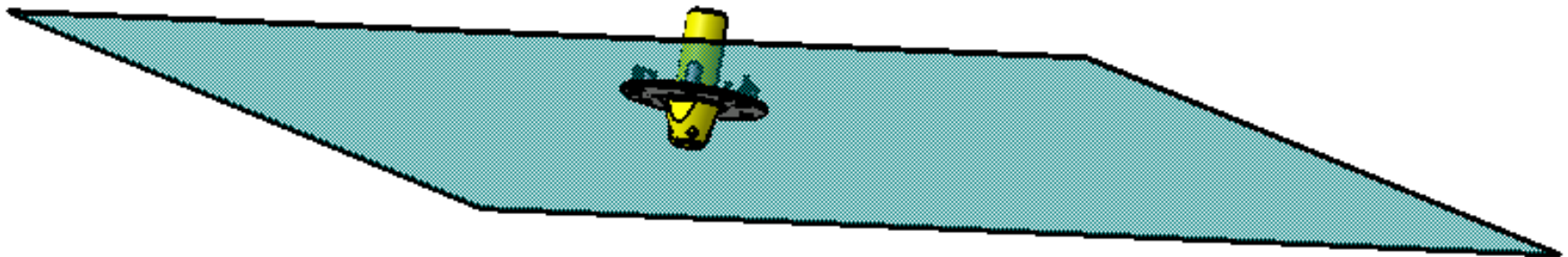
Feature Substantiation Highlights

- Features
 - Light shrouds
 - Smoke detectors
 - Air ducts and ducting
 - Fire extinguishing nozzles



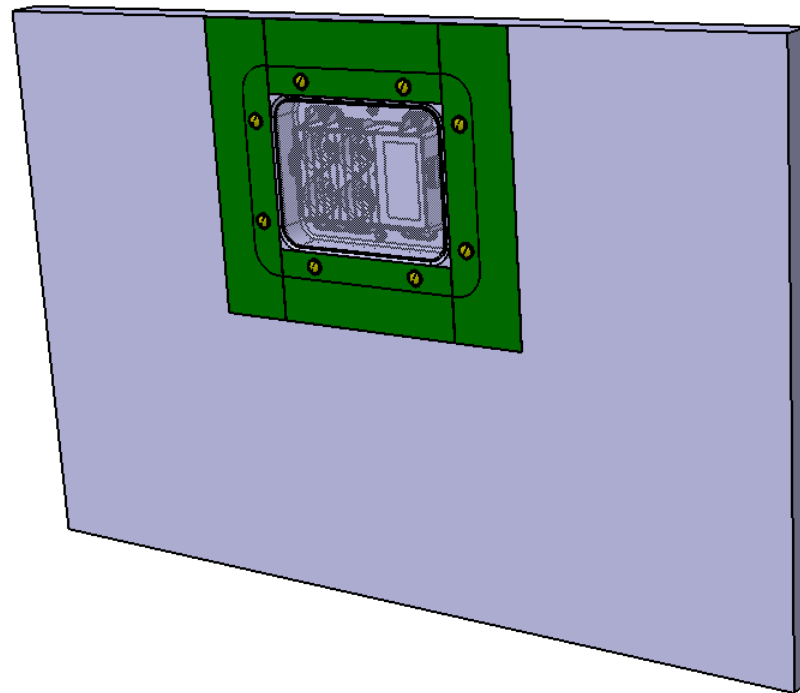
Feature Substantiation Highlights

- Features
 - Adding support to features on the test specimen that are normally secured to aircraft structure.



Feature Substantiation Highlights

- Features
 - Non-essential components that do not offer any fire protection on the test side can be removed prior to test.



Complex Feature Installations

As Is

Separate
Features

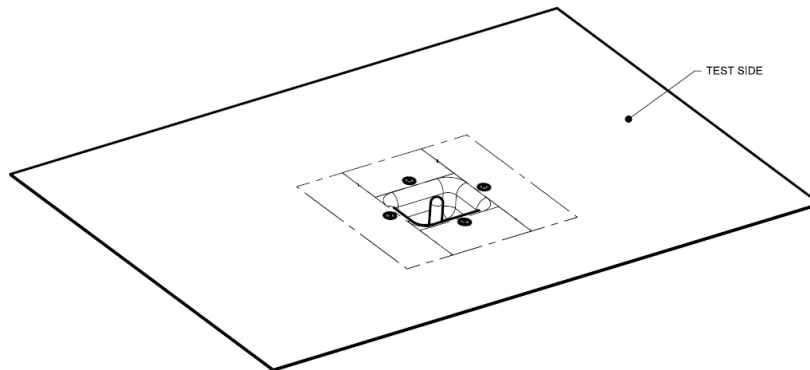
Test as
installed
configuration

Breaking
down the
design to
basic features

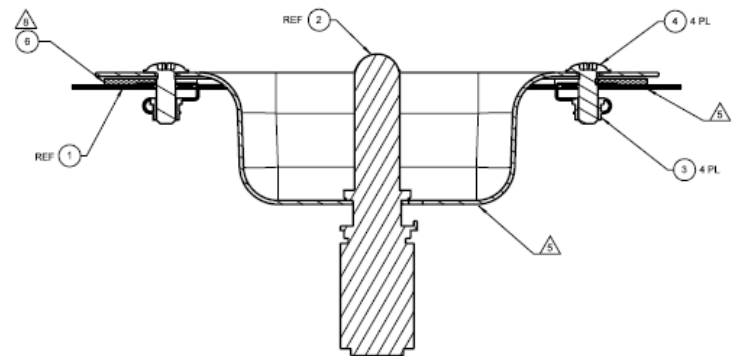
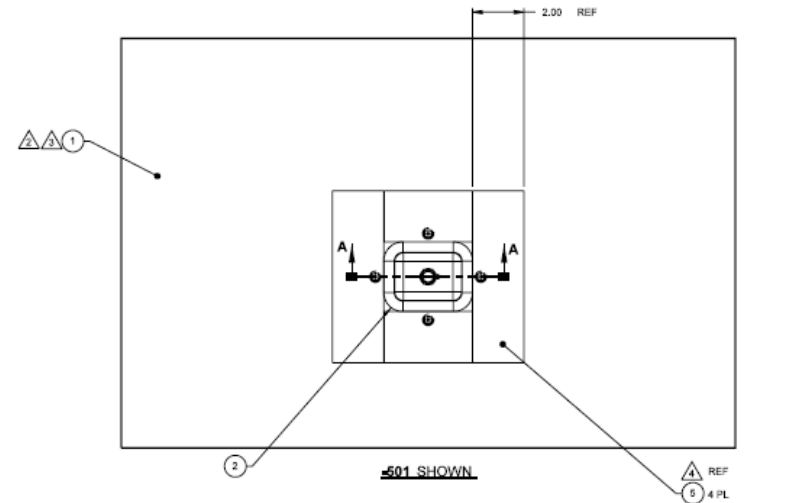
Test each
feature
individually

Complex Feature Installations

- **Test as Installed**
 - Improved rigidity representative of the actual part.
 - Shroud or housing may not be available as a flat sheet.



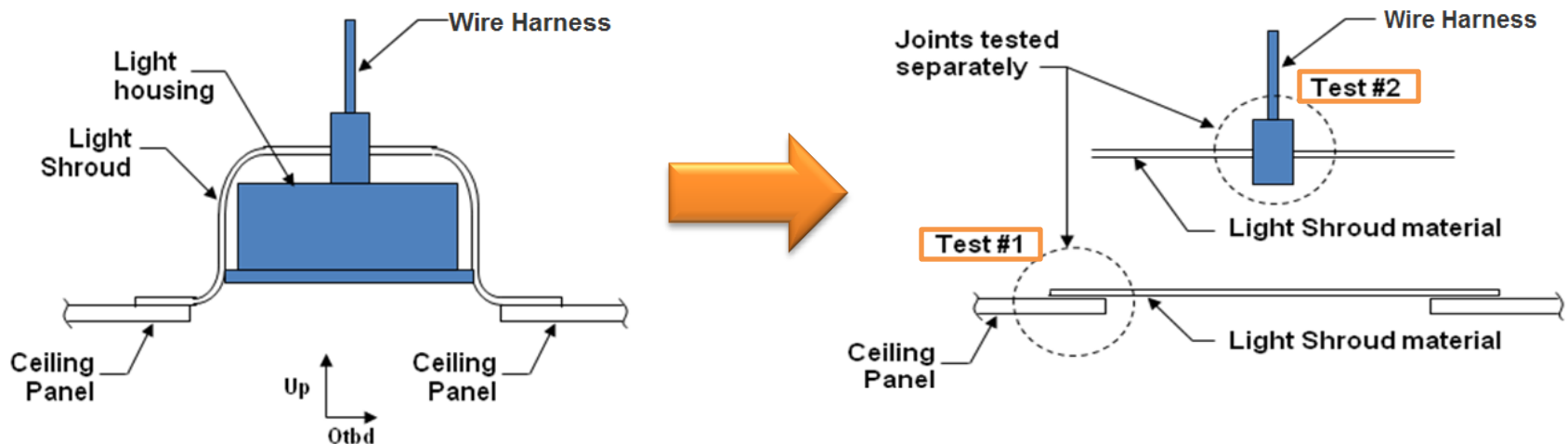
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Complex Feature Installations

- **Test as Separate Features**

- Breaking down multiple joints and overlaps in one area into multiple tests.
- Flattening raised contour features for lap joint tests.



Proposed Test Exclusions

- Cargo door areas
- Door mechanism penetrations
- Joints on cargo door and door surround
- Joints to the floor or cargo conveyance systems
- Small unique joints
- Holes in ceiling panels used as sampling ports for smoke detectors
- Ceiling liner gaps $< .125''$ diameter
- Sidewall liner gaps $< 0.25''$ around penetrations (e.g., pipe, wire)

Where are we now?

- Draft proposal AC submitted to the FAA (Jeff Gardlin) for official review and comments.



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Possible Next Revision Updates

Guidelines

- Improved consolidation of guidelines.
- Create coding reference system.

Examples

- Provide multiple examples for various scenarios.
- Reference applicable guidelines.

Questions?

