Flammability how and why

Information and Discussion Event 2016

16th September 2016

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Jet Aviation Basel

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Flammability How and why?

Foreword

Regardless of the aircraft component a manufacturer seeks to install on an aircraft, proving compliance to the relevant regulatory requirements is required. Because of the hazards fire poses in the cabin, flammability testing of all materials is mandatory.

At times, understanding what the regulatory requirements are (and ensuring consistent compliance) may be confusing, especially to manufacturers first entering the aviation industry. The best way for a manufacturer to be confident of its compliance is for it to know the applicable regulations, and to seek the counsel of engineers who are experts in this field. Knowing who to ask and what to ask is the challenge.

Foreword

Which Regulations Apply

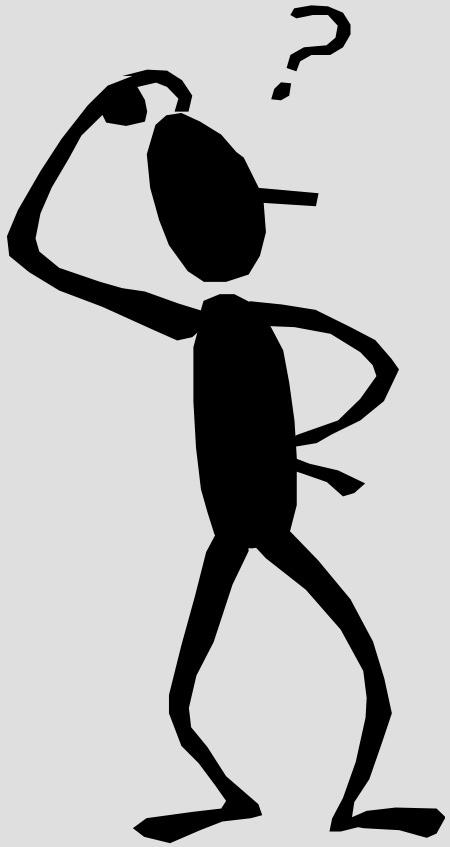
At the very core of flammability compliance for aircraft interiors is regulation Section 25.853 and part 25, appendix F, part I, which details the test criteria.

Section 25.855 is also relevant to interiors manufacturers who make products specifically for the cargo compartments of the aircraft.

Appendix F, part I, provides exact methods for the preparation of test samples, the configuration of the tests by product type, and the test result tolerances by product type.

The FAA Aircraft Materials Fire Test Handbook provides essential information on the various test methods and provides the appropriate test forms to be completed for each of the types of flammability tests.

Flammability regulations



Why are there regulations?

The basic intention of the aviation regulations are to protect

Unconcerned people (on the ground), the passengers,
and the crew from any risks.

- This leads to very stringent requirements especially for the safety aspect – crash loads, evacuation requirements, … and flammability.
- The regulations are designed for transport category aircraft– *Airliners, unlike the aircraft's we work on.*
- Nevertheless our aircraft will be operated different but they will be certified under the same regulations and need to meet the requirements as well.

Flammability regulations

The flammability requirements have developed with the times. Always with the intention to increase cabin safety.

Some of the changes are the results of disasters, for example

Air Canada Flight 797, 1983
Flammability requirements,
Smoke detectors,
Emergency lighting and placards

Flammability issues on Aircrafts: Example 1

A Bombardier CRJ-200, experienced a cockpit fire on the ground shortly after external power was applied to the airplane…

The fire department extinguished the fire, but it had already burned an approximate 18 inch hole through the left upper cockpit crown skin.

Flammability issues on Aircrafts: Example 2

….a **video-entertainment system caught fire aboard** an Air Canada Airbus A330 parked at Vancouver International Airport.
Almost the entire upper fuselage, from just behind the wing box to a point aft of the flight deck, has been burned through to the crown.

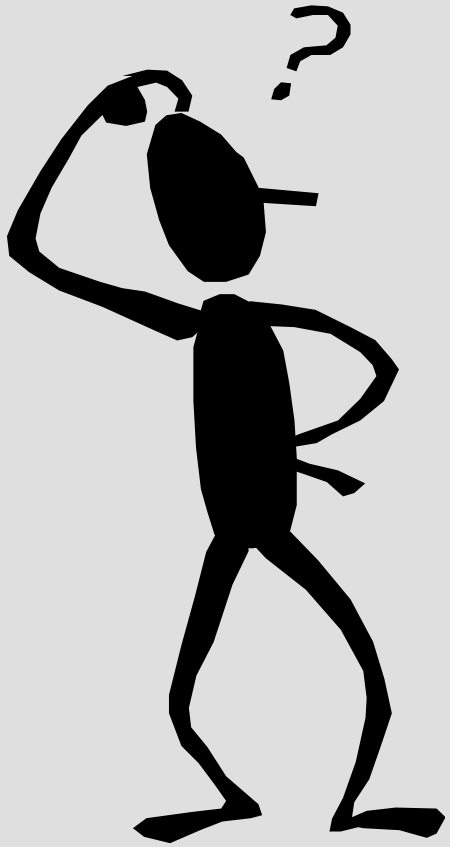
Flammability issues on Aircrafts: Example 3

Swiss Air Flight 111 September 2, 1998

The accident report said that probably a short circuit – caused by the broken insulation of a copper cable behind the upper Headlight fairing - had inflamed the neighboring thermal acoustic insulation. The cable in question supplied the onboard Entertainment system IFEN (In-flight Entertainment Network) with electricity. About the IFEN guests first class and business class could look at their seats videos or playing computer games.

This accident instituted to a flammability improvement for acoustic material and some are just a result of the attempt to improve safety while using new and newest material available.

Flammability Requirements



Flammability requirements

Annex to ED Decision 2016/010/R

European Aviation Safety Agency

Certification Specifications

and

Acceptable Means of Compliance

for

Large Aeroplanes

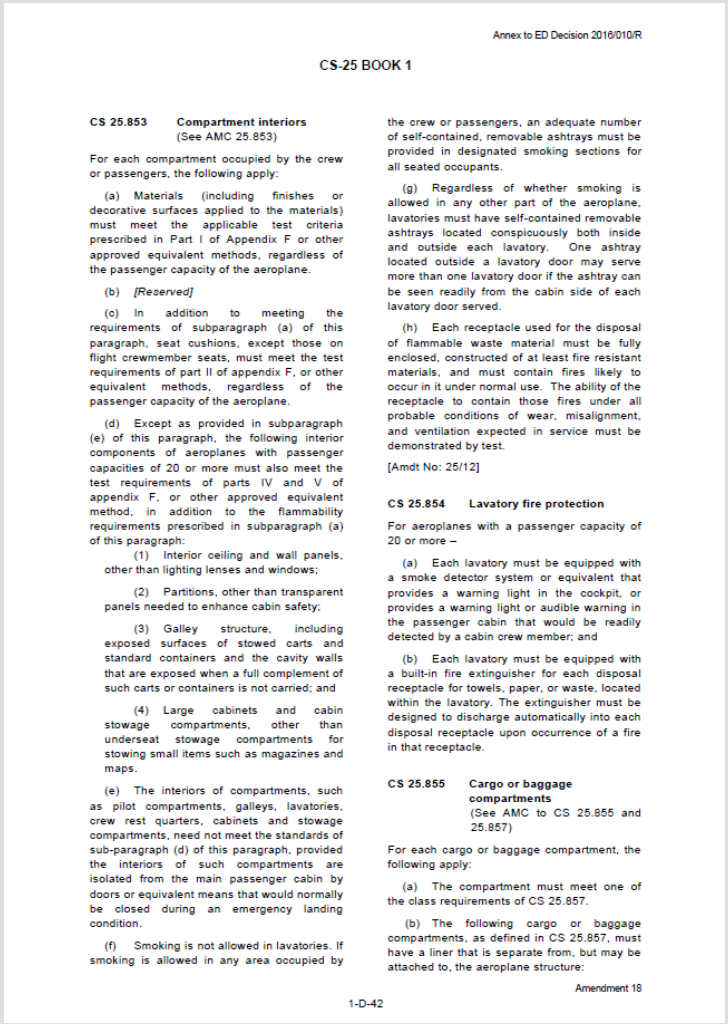
CS-25

Amendment 18

22 June 2016[1]

[1] For the date of entry into force of Amendment 18, please refer to Decision 2016/010/R in the Official Publication of the Agency.

Amendment 18



Annex to ED Decision 2016/010/R

CS-25 BOOK 1

CS 25.853 Compartment interiors
(See AMC 25.853)

For each compartment occupied by the crew or passengers, the following apply:

(a) Materials (including finishes or decorative surfaces applied to the materials) must meet the applicable test criteria prescribed in Part I of Appendix F or other approved equivalent methods, regardless of the passenger capacity of the aeroplane.

(b) *[Reserved]*

(c) In addition to meeting the requirements of subparagraph (a) of this paragraph, seat cushions, except those on flight crewmember seats, must meet the test requirements of part II of appendix F, or other equivalent methods, regardless of the passenger capacity of the aeroplane.

(d) Except as provided in subparagraph (e) of this paragraph, the following interior components of aeroplanes with passenger capacities of 20 or more must also meet the test requirements of parts IV and V of appendix F, or other approved equivalent method, in addition to the flammability requirements prescribed in subparagraph (a) of this paragraph:

(1) Interior ceiling and wall panels, other than lighting lenses and windows;

(2) Partitions, other than transparent panels needed to enhance cabin safety;

(3) Galley structure, including exposed surfaces of stowed carts and standard containers and the cavity walls that are exposed when a full complement of such carts or containers is not carried; and

(4) Large cabinets and cabin stowage compartments, other than underseat stowage compartments for stowing small items such as magazines and maps.

(e) The interiors of compartments, such as pilot compartments, galleys, lavatories, crew rest quarters, cabinets and stowage compartments, need not meet the standards of sub-paragraph (d) of this paragraph, provided the interiors of such compartments are isolated from the main passenger cabin by doors or equivalent means that would normally be closed during an emergency landing condition.

(f) Smoking is not allowed in lavatories. If smoking is allowed in any area occupied by the crew or passengers, an adequate number of self-contained, removable ashtrays must be provided in designated smoking sections for all seated occupants.

(g) Regardless of whether smoking is allowed in any other part of the aeroplane, lavatories must have self-contained removable ashtrays located conspicuously both inside and outside each lavatory. One ashtray located outside a lavatory door may serve more than one lavatory door if the ashtray can be seen readily from the cabin side of each lavatory door served.

(h) Each receptacle used for the disposal of flammable waste material must be fully enclosed, constructed of at least fire resistant materials, and must contain fires likely to occur in it under normal use. The ability of the receptacle to contain those fires under all probable conditions of wear, misalignment, and ventilation expected in service must be demonstrated by test.

[Amdt No: 25/12]

CS 25.854 Lavatory fire protection

For aeroplanes with a passenger capacity of 20 or more –

(a) Each lavatory must be equipped with a smoke detector system or equivalent that provides a warning light in the cockpit, or provides a warning light or audible warning in the passenger cabin that would be readily detected by a cabin crew member; and

(b) Each lavatory must be equipped with a built-in fire extinguisher for each disposal receptacle for towels, paper, or waste, located within the lavatory. The extinguisher must be designed to discharge automatically into each disposal receptacle upon occurrence of a fire in that receptacle.

CS 25.855 Cargo or baggage compartments
(See AMC to CS 25.855 and 25.857)

For each cargo or baggage compartment, the following apply:

(a) The compartment must meet one of the class requirements of CS 25.857.

(b) The following cargo or baggage compartments, as defined in CS 25.857, must have a liner that is separate from, but may be attached to, the aeroplane structure:

Amendment 18

1-D-42

Flammability requirements

The today's testing is based on the FAR/CS 25, the FAA Fire Testing Handbook and several Advisory Circulars

- **25.853 Part I** Test Criteria and Procedures for Showing Compliance with Sec. 25.853, or 25.855.
- **25.853 Part II** Flammability of Seat Cushions
- **25.855 Part III** Test Method to Determine Flame Penetration Resistance of Cargo Compartment Liners.
- **25.853 Part IV** Test Method to Determine the Heat Release Rate From Cabin Materials Exposed to Radiant Heat.
- **25.853 Part V** Test Method to Determine the Smoke Emission Characteristics of Cabin Materials
- **25.856 Part VI** Test Method To Determine the Flammability and Flame Propagation Characteristics of Thermal/Acoustic Insulation Materials
- **25.856 Part VII** Test Method To Determine the Burnthrough Resistance of Thermal/Acoustic Insulation Materials

Horizontal-Vertical Flame Chamber

Burn test chamber Model HVFAA, S/N HVF-1022; at the JBSC burn test lab

- Used for performing FAR/CS 25.853 tests

Vertical Bunsen Burner Test

FAR/CS 25.853

APPENDIX F PART I (a)(1)(i)

Ignition Time 60 sec

Extinguishing time max. 15 sec

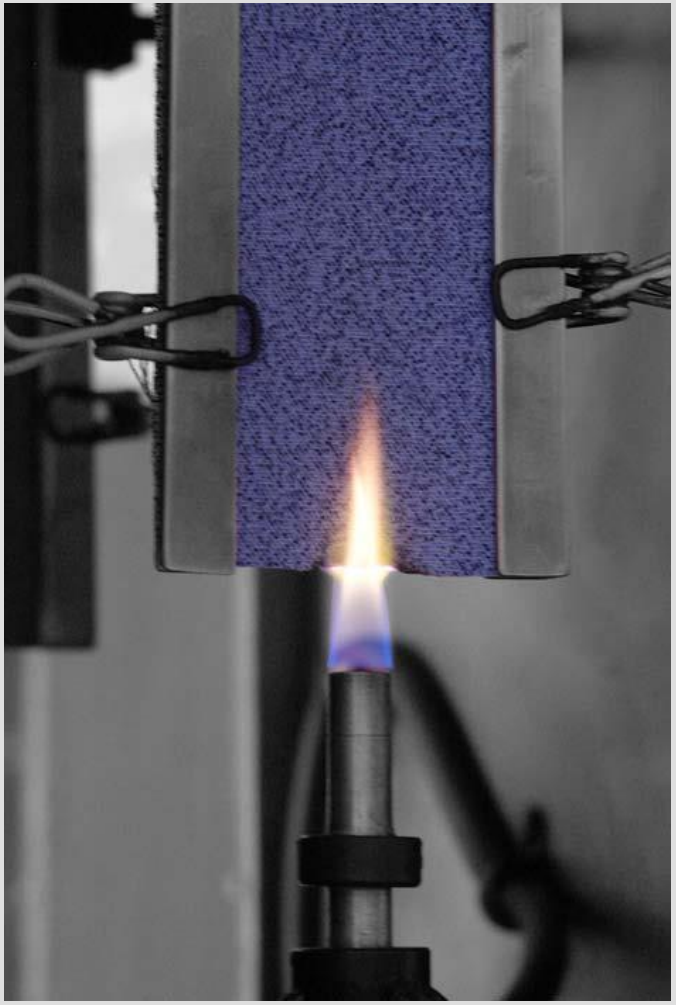
Burn length max 15 cm (6 inch)

Drip extinguishing time Max 3 sec

Minimum Flame temperature 843°C

Coupon size: 3”X12”

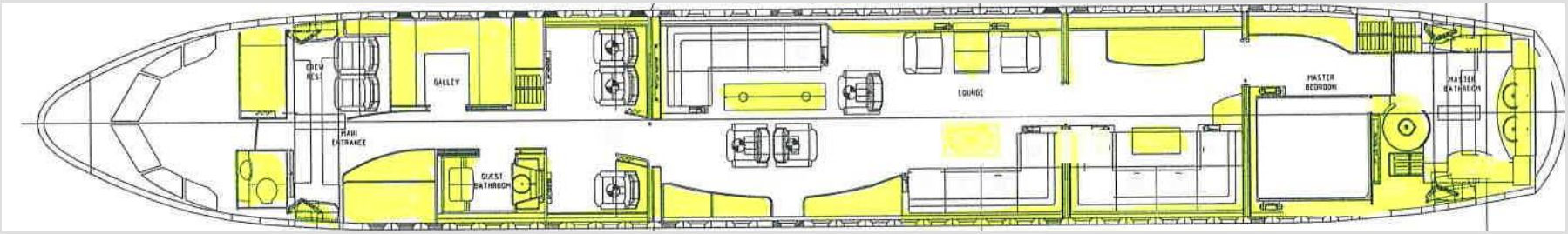
Coupon Qty: 3 each (if fabric 6 each)

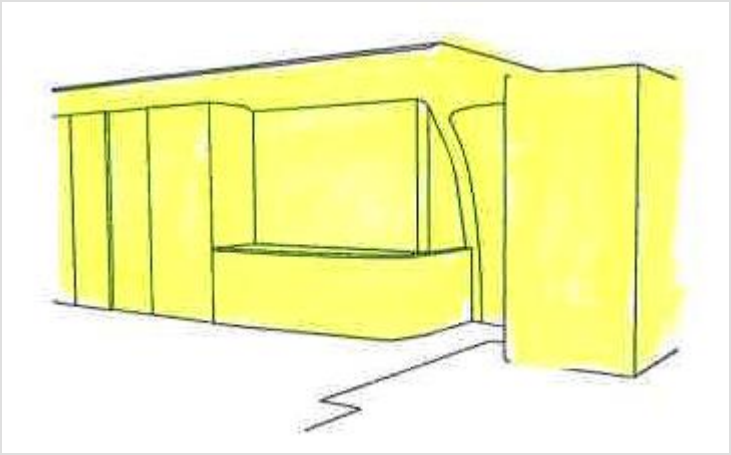


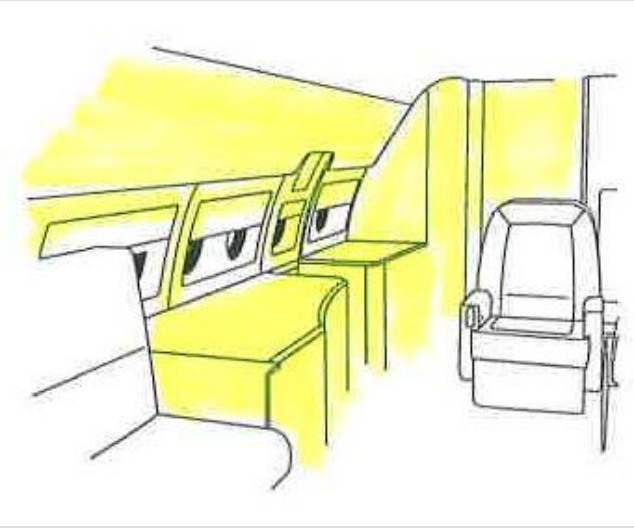
Vertical Bunsen Burner Test

FAR/CS 25.853

APPENDIX F PART I (60 second vertical test)







Vertical Bunsen Burner Test

FAR/CS 25.853

APPENDIX F PART I (a)(1)(ii)

Ignition Time12 sec

Extinguishing time max. 15 sec

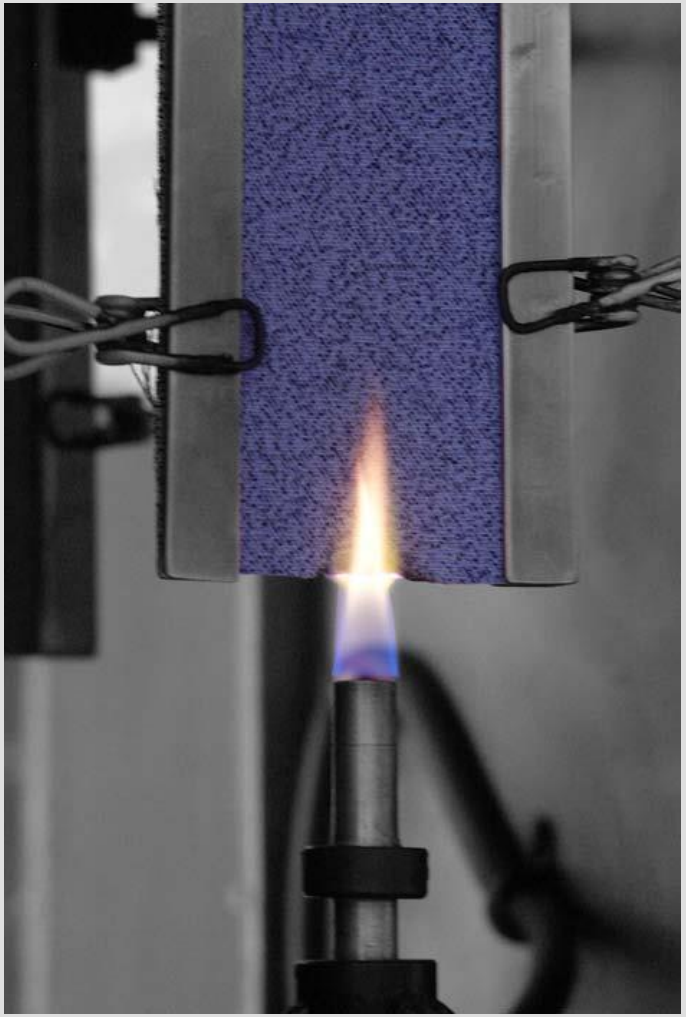
Burn length max 20 cm (8 inch)

Drip extinguishing time Max 5 sec

Minimum Flame temperature 843°C

Coupon size: 3”X12”

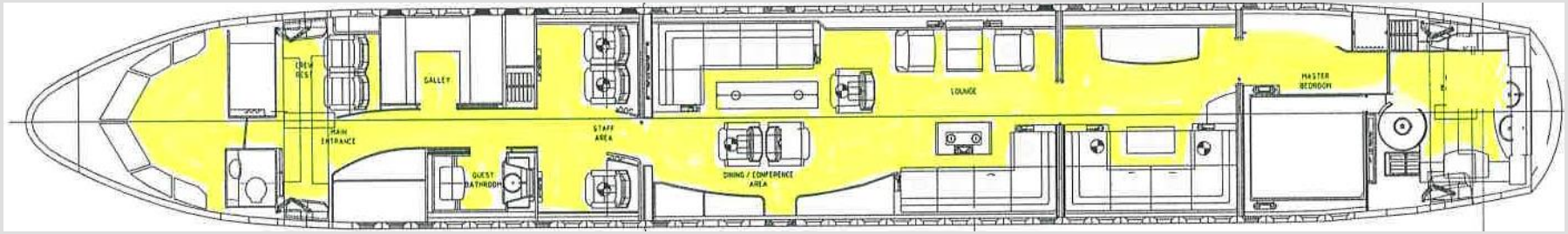
Coupon Qty: 3 each (if fabric 6 each)

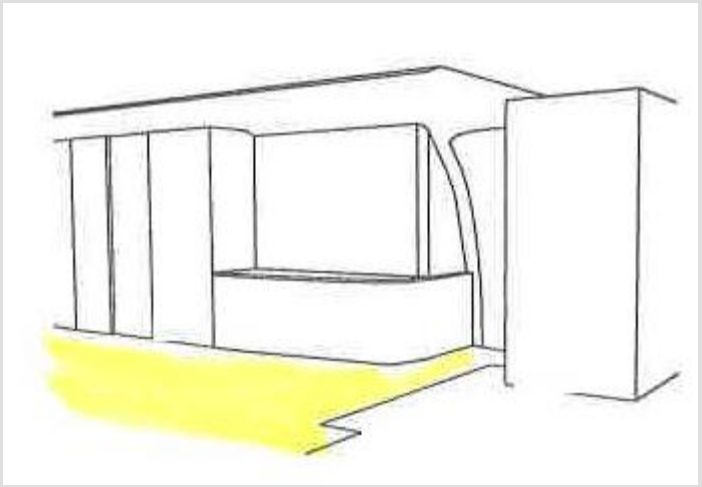


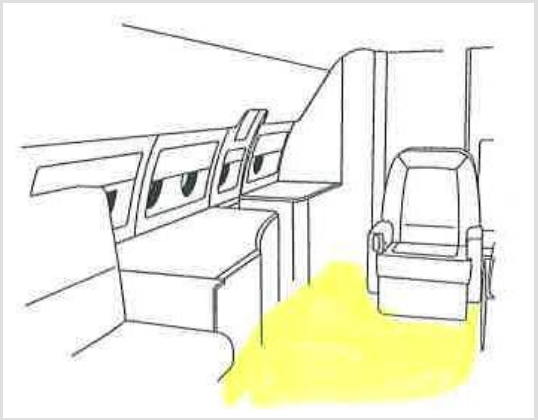
Vertical Bunsen Burner Test

FAR/CS 25.853

APPENDIX F PART I (12 second vertical test)







Vertical Bunsen Burner Test

FAR 25.853 Small part Definition

14 CFR §25.853(b-3), Amendment 25-32 Materials that are Exempt from Flammability Testing

Small parts that do not require flammability testing are defined by FAA regulations as knobs, handles, rollers, fasteners, clips, grommets, rub strips, pulleys and small electrical parts. In addition other components having sizes of 3.0" H X 3.0" W X 0.50" T or less or a group of components that can fit inside a 2.0" H X 2.0" W X 2.0" T cube are classified herein as small parts that would not contribute significantly to the propagation of a fire and therefore also do not require flammability testing.

Fire Containment Test

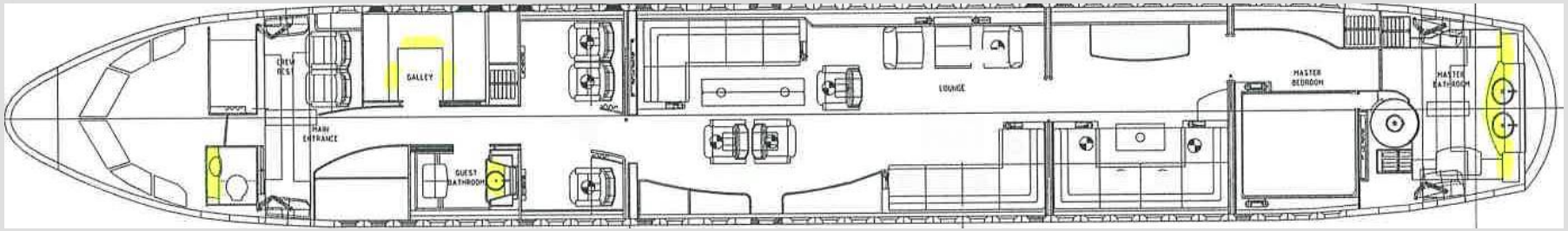
FAR 25.853 (e)

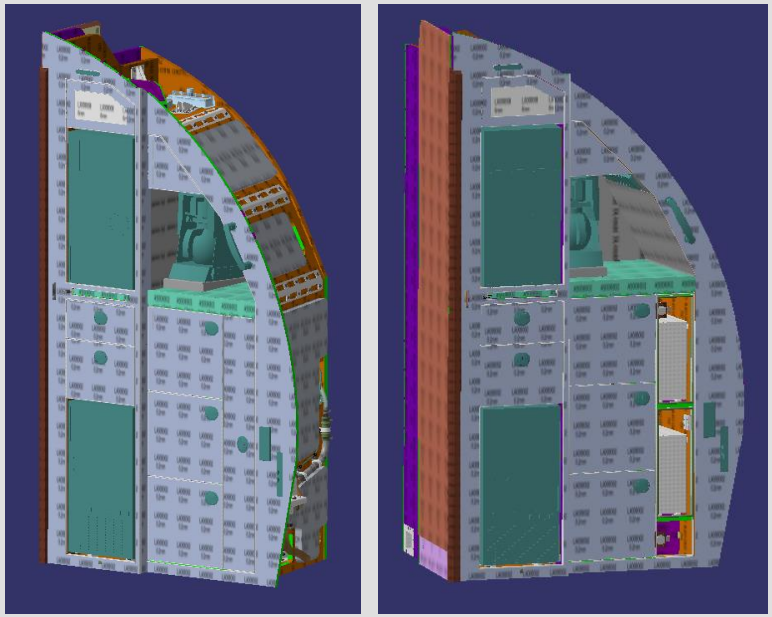
Aircraft Materials Fire testing Handbook Chapter 10
Fire Containment Test of Waste Stowage Compartments

These methods are intended for use in determining the fire containment capability of containers, carts, and compartments used to store combustible waste materials according to the requirements of FAR 25.853(e)

Fire Containment Test

FAR 25.853 (e)





Fire Containment Test

FAR 25.853 (e)

The Trash Container will be tested with paint, the fire extinguisher will be removed and all holes sealed with aluminum tape.

Procedure and Materials
The lid will be hinged opened so that typical refuse can be placed in the container.
The following mixture of combustibles shall be utilized:

Eight (8) Paper Towels, 11x14 inches-40% by number

Five (5) Paper Napkins, 12.5x13 inches-25% by number

Four (4) Paper Drink Cups, 0.2 lt.-20% by number

Two (2) Paper Drink Cups, 0.1 lt.-10% by number

One (1) empty cigarette package

Fire Containment Test

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Oil burner test for seat cushions

FAR/CS 25.853 F PART II

14CFR 25.853 Compartment Interiors

(a) Materials (including finishes or decorative surfaces applied to the materials) must meet the applicable test criteria prescribed in part I of Appendix F of this Part, or other approved equivalent methods, regardless of passenger capacity of the airplane.

(c) In addition to meeting the requirements of paragraph (a) of this section, seat cushions, except those on the flight crewmember seats, must meet the test requirements of Part II of appendix F of this Part, or other equivalent methods, regardless of the passenger capacity of the airplane.

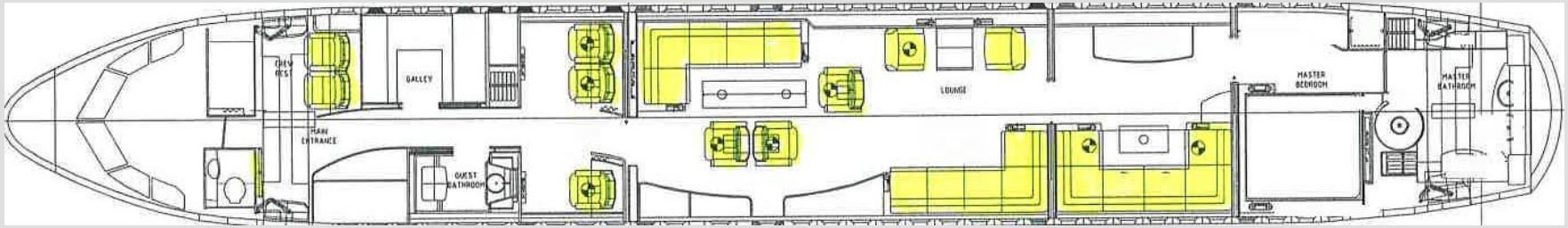
Oil burner test for seat cushions

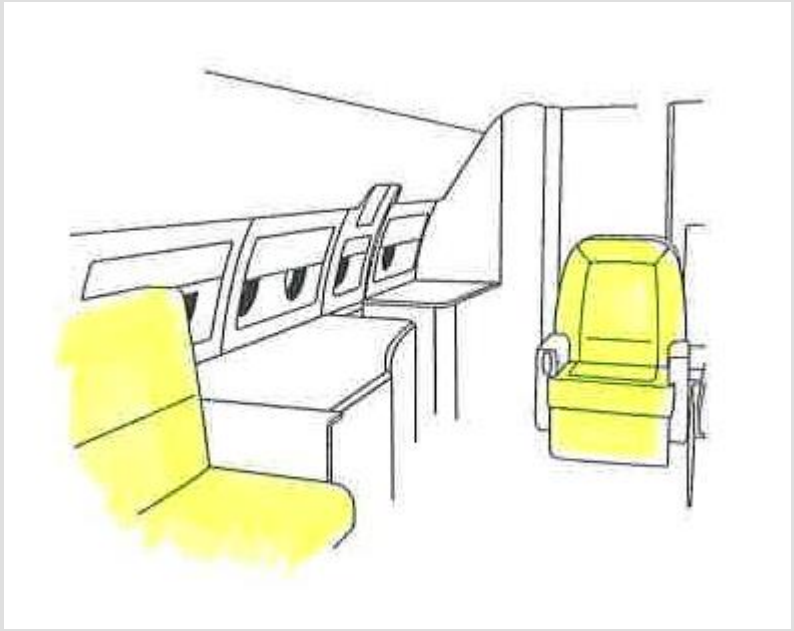
FAR/CS 25.853 APPENDIX F PART II

- Average weight loss max. 10 %
- Burn length max. 43 cm (17 inches)
- Apply time 2 minutes
- Flame temperature Approx. 1000 °C
- Flame length Approx. 30 cm
- Coupon Qty (3each seat and 3 each back cushion)
- Coupon sizes for seat cushion: 20”X18”
- Coupon sizes for back cushion: 25”X18”

Oil burner test for seat cushions

FAR/CS 25.853 F PART II (Oil burner test for seat cushions)





Oil burner test for cargo liners

FAR/CS 25.855 Appendix F Part III

Sec. 25.855 cargo or baggage compartments

For each cargo and baggage compartment, the following apply:

(c) Ceiling and sidewall liner panels of Class C compartments must meet the test requirements of Part III of Appendix F of this part or other approved equivalent methods.

(d) All other materials used in the construction of the cargo or baggage compartment must meet the applicable test criteria prescribed in Part I of Appendix F of this part or other approved equivalent methods.

Oil burner test for cargo liners

FAR/CS 25.855
APPENDIX F PART III

(TEST METODE TO DETERMINE FLAME PENETRATION RESISTANCE OF CARGO COMPARTMENT LINERS)

- Flame penetration: There will be no flame penetration of any specimen within 5 minutes after application of the flame source.
- Peak temperature: The peak temperature measured at 4 inches above the upper surface of the horizontal test sample must not exceed 400°F
- Apply time 5 minutes
- Flame temperature Approx. 1700 °F
- Flame length Approx. 30 cm
- Coupon Qty: 3 sets (sidewall or ceiling panel)
- Coupon size: 16” x 24”

Oil burner test for cargo liners

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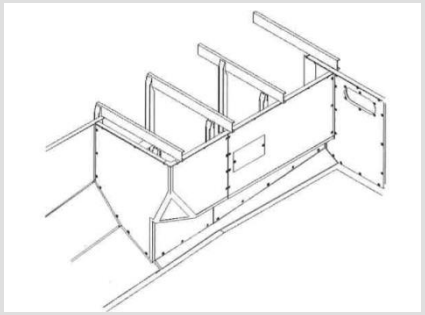
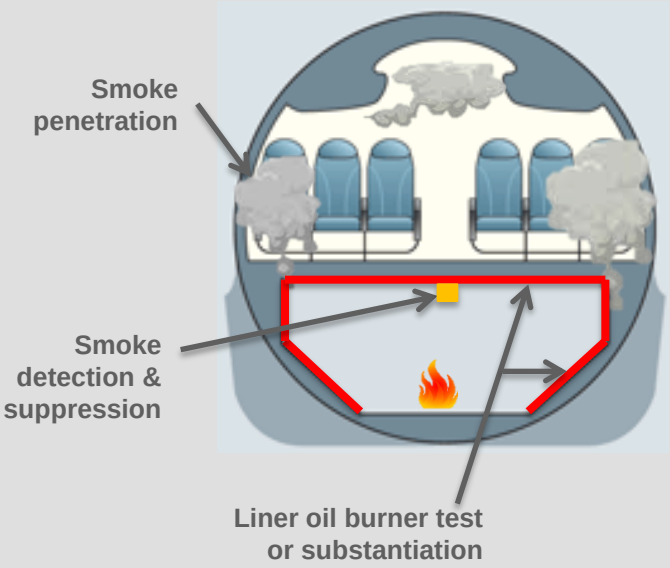
FAR/CS 25.855 Appendix F Part III

Sec. 25.855 cargo or baggage compartments





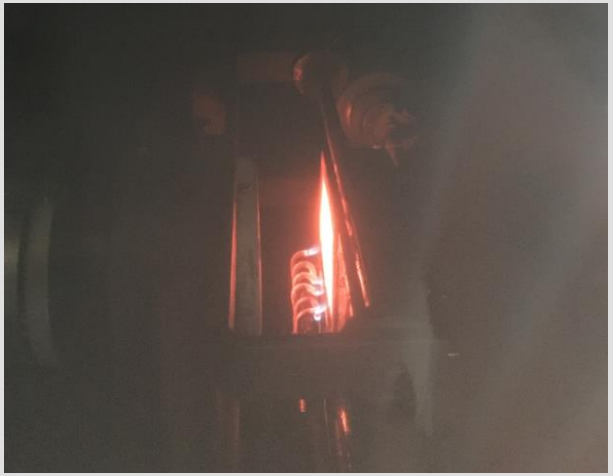
Large stowage compartments on the main passenger deck may be classified as Class B cargo compartments and therefore subject to further requirement (e.g 45 degree burn through test)

Heat release rate: Smoke density

Sec. 25.853 (d) - Compartment interiors.

Interior ceiling and wall panels, partitions, galley structure, including carts and containers, cabinets and cabin stowage compartment for airplanes with passenger capacities of 20 or more must meet the requirements for **Heat Release Rate and Smoke Emission**. The interiors of cabinets and stowage compartments, cockpit, galleys, lavatories, crew rest quarters or other not occupied areas need not meet the requirements, provided they are isolated from the main passenger cabin by doors that would be closed during *taxi takeoff and landing (TT & L)*

Heat release rate / Smoke density (quantity of heat transmitted through the panel)



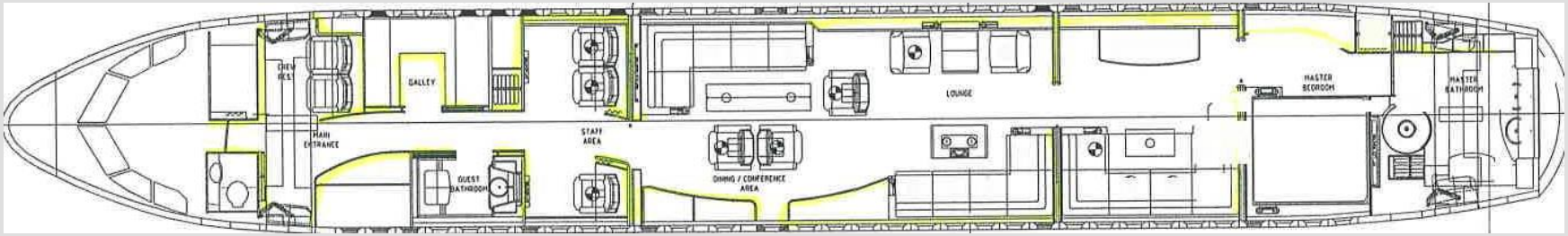
FAR/CS 25.853

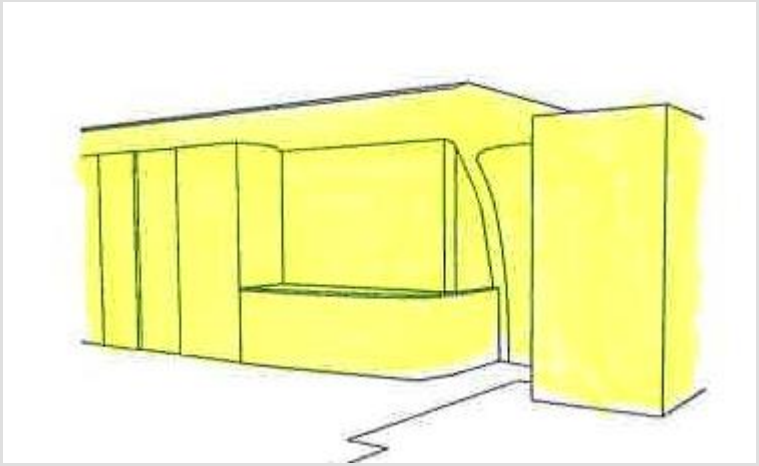
APPENDIX F, PART IV/V

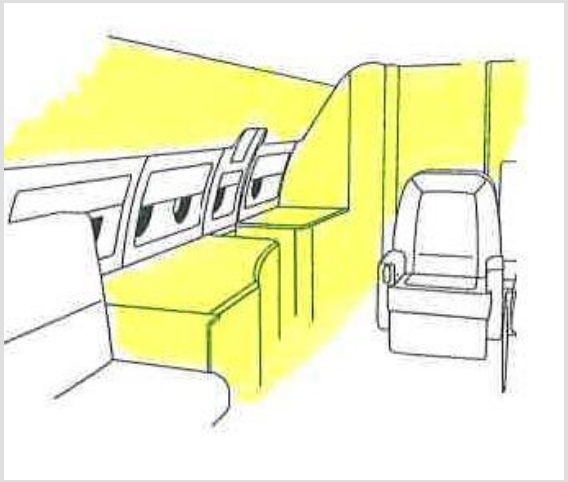
- Total heat release max. 65 KW min/m2 at 2 min.
- Peak heat release max. 65 KW/m2
- Smoke density max. 200 Ds/4 min.
- Apply time 5 minutes
- Heating elements 3.5 W / cm2
- 1 lower pilot burner
- 1 upper pilot burner
- Air inlet 40 l / s
- Coupon size:
  for Heat release test 151 x 151 mm
- Coupon Qty: 3 each
- Coupon Size:
  for Smoke density test 75mm x 75mm
- Coupon Qty: 3 each

Heat release rate: Smoke density

Sec. 25.853 (d) - Compartment interiors.







Heat and Smoke Release Exemption

comply with 25.853(d) in the following cases:

- Commercially operated and with a passenger capacity of 20 or more

When an exemption to HR/SE is requested, the design must comply with the following:

- Limited to Private use only or if commercially operated limited to **max 19 passengers**
- Evacuation of all occupants must be shown **within 45 seconds**

Test Method To Determine the Flammability and Flame Propagation Characteristics of Thermal/Acoustic Insulation Materials

Amendment 25-111 (68 FR 45046, July 31, 2003)

added new fire protection requirements applicable to thermal/acoustic insulation materials. The term ‘thermal/acoustic’ means either thermal or acoustic, or both. The amendment added test requirements in parts VI and VII of Appendix F related to flame propagation and burn through penetration resistance, respectively.

Test Method To Determine the Flammability and Flame Propagation Characteristics of Thermal/Acoustic Insulation Materials

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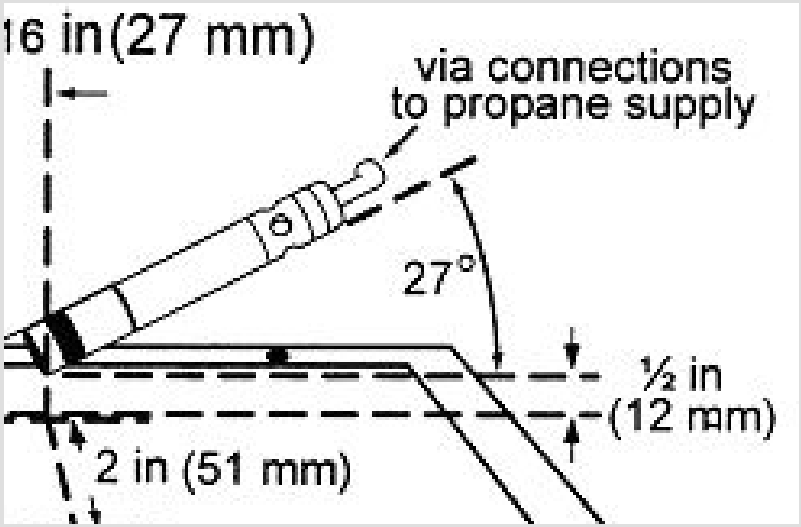


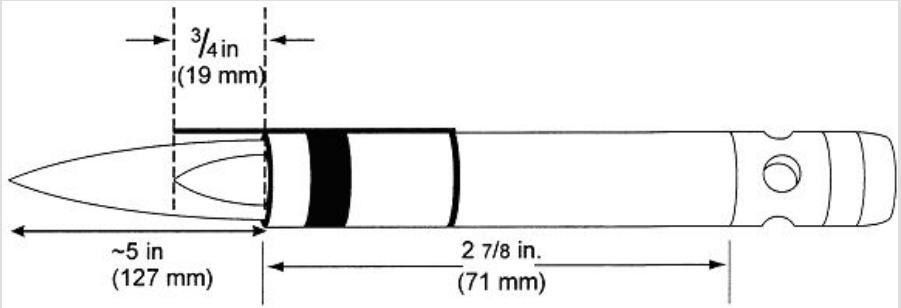
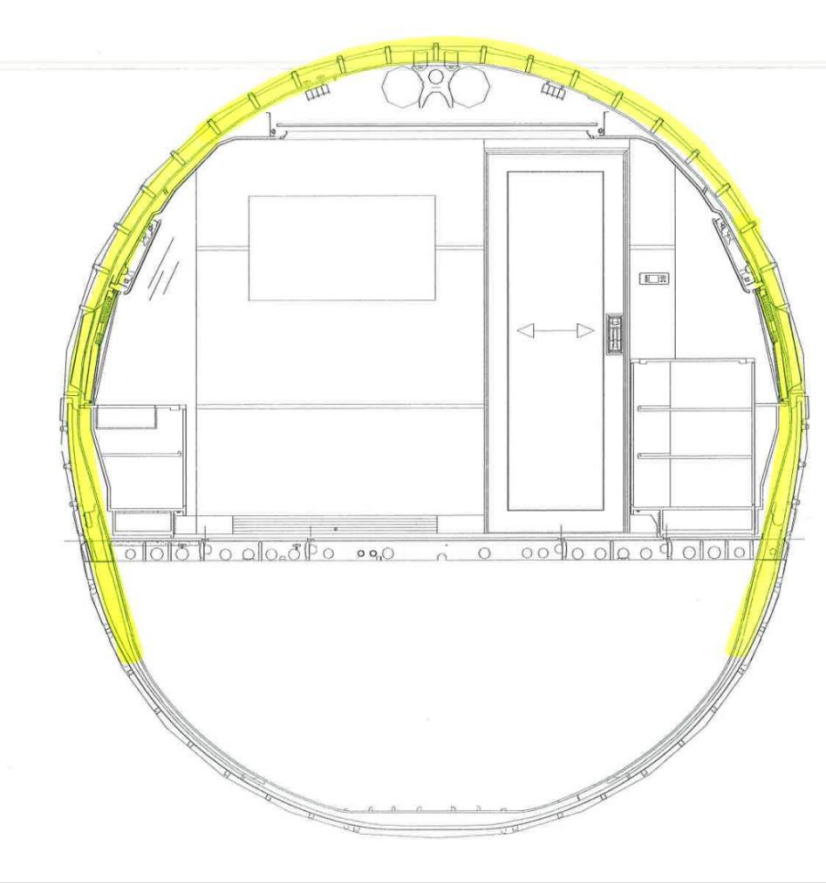


Figure 6 – Propane Pilot Burner

Test Method To Determine the Flammability and Flame Propagation Characteristics of Thermal/Acoustic Insulation Materials

FAR/CS 25.856(a)

APPENDIX F PART VI



Test Method To Determine the Burn through Resistance of Thermal/Acoustic Insulation Materials

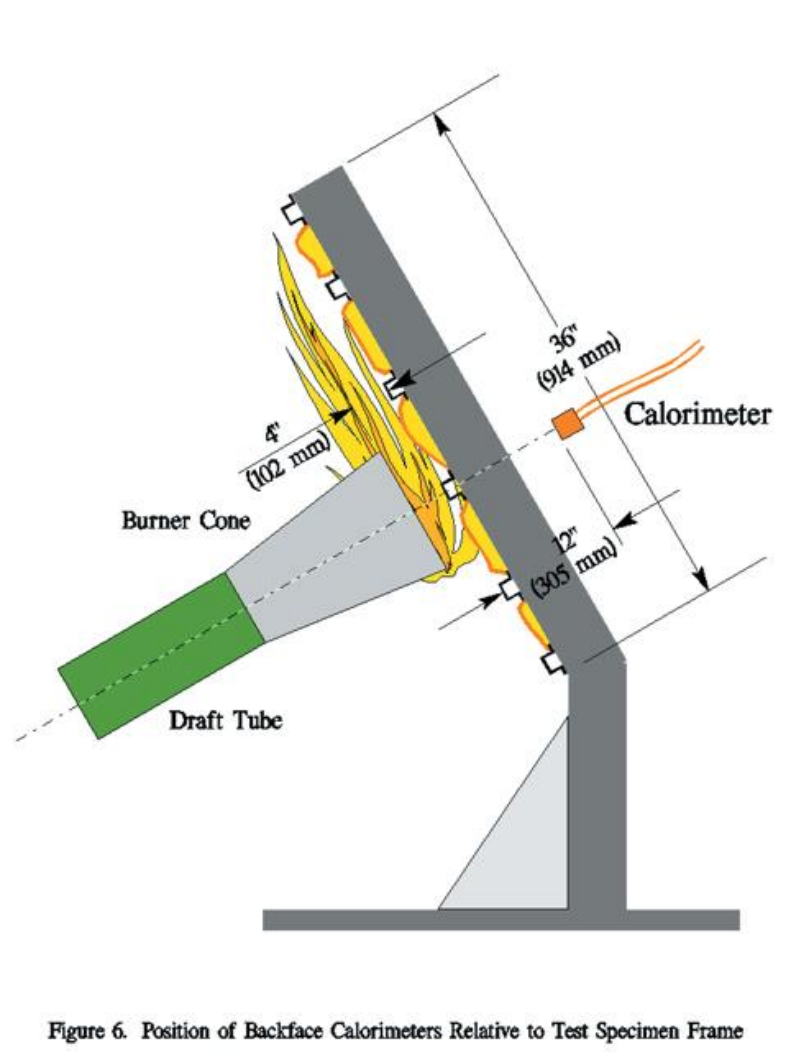
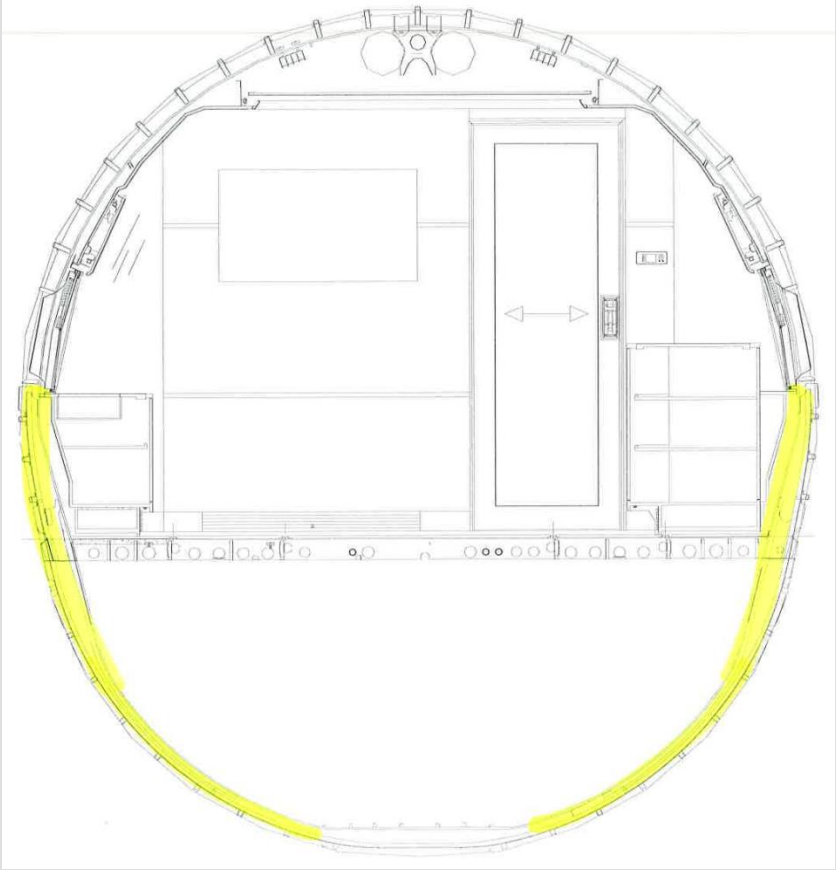


Figure 6. Position of Backface Calorimeters Relative to Test Specimen Frame

Test Method To Determine the Burn through Resistance of Thermal/Acoustic Insulation Materials

FAR/CS 25.856(b)

APPENDIX F PART VII



Outlook

- FAA and EASA working on a complete update of §25.853
- Result of update will be discussed at the Bi-yearly FAA Flammability Conference
- Implementation (rulemaking) not before 2018

- Jet Aviation has been part of a working group comprised of industry and authority members tasked with creating a set of requirements for executive interior aeroplanes. A new CS 25 appendix and AMC has been created for the certification specifications for Executive Interior aeroplanes.

Where to find more info

EASA Web site:

http://www.easa.eu.int/ws_prod/index.html

FAA:

http://www.fire.tc.faa.gov/handbook.stm

Transport Canada:

http://www.tc.gc.ca/civilaviation

EASA Certification Standard 25:

http://www.easa.europa.eu/ws_prod/g/doc/Agency_Mesures/Certification_Spec/decision_ED_2003_02_RM.pdf

Many thanks for your attention

Questions & Answer