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FIRE REGULATION IN AIRCRAFTS

WORLD OVERVIEW



Beside specifications agreed for operational reasons between manufacturers and purchasers of aircraft, aeroplanes and the materials used in their constructions must comply with national and international regulations.

2 international standards are used at this moment all around the world:

The Federal Airways Regulation part 25 [43](FAR part 25, especially the appendix F which describes all the test methods for materials and components of the pressurised section of fuselage). The European equivalent is the CS part 25 paper [42].

The requirements of these two references are largely similar, and the plane makers has integrated these requirements in their internal standard which are:

- ✓ ABD 0031 describing AIM test methods for Airbus [44],
- ✓ Boeing Safety Standard (BSS) for Boeing.

Table 1: FAR, JAR requirements

JAR/FAR	Description	Parts	Requirement
CS/FAR Part 25, Appendix F - Part I	Flammability, 60s vertical Bunsen burner Figure 1	Interior ceiling panels - Interior wall panels Partitions - Galley structures and panels Large cabinet walls - Structural flooring Dado panels - Passenger service units Door linings incl. slide container - Class dividers Door frame linings - Light panels Linings for stowage compartments Floor beam struts - Floor structure Pressure bulkheads - Fuselage skin - Fuselage frames - Door structure	- After burn length (average) shall not exceed 152 mm - After flame time (average) shall not exceed 15 s. - After flame time of drips (average) shall not exceed 3 s.
CS/FAR Part 25, Appendix F - Part I	Flammability, 12s vertical Bunsen burner Figure 1	Floor Covering - Textiles (incl. draperies and upholstery) Seat cushions - Decorative and non-decorative coated fabrics Padding - Leather Furnishings of trays and galleys - Electrical conduit Thermal and acoustical insulation - Insulation covering Air ducting - Joint and edge covering Insulation blankets - Cargo covers Transparencies - Moulded and thermoformed parts Air ducting joints Linings (incl. floor panels) of all cargo and baggage compartments	- After burn length (average) shall not exceed 203 mm - After flame time (average) shall not exceed 15 s. - After flame time of drips (average) shall not exceed 5 s.
CS/FAR Part 25, Appendix F - Part I	Flammability, horizontal Bunsen burner Figure 2	- Acrylic windows and signs - Seat belts - Structural window panes elastomeric materials - Edge lighted instrument assemblies consisting of two or more instruments in a common housing - Cargo and baggage equipment, including containers, bins pallets, etc.	- Burn rate (average) shall not exceed 64 mm/min.
CS/FAR Part 25, Appendix F - Part I	Flammability, horizontal Bunsen burner,	All other material not included in the first items	- Burn rate (average) shall not exceed 102 mm/min.
CS/FAR Part 25, Appendix F - Part I	Flammability, 45° Bunsen burner	Liners of class B or E cargo and baggage compartments	- The flame shall not penetrate (pass through) the material during application of the flame or subsequent to its removal. - After flame time (average) shall not exceed 15 s. - After glow time (average) shall not exceed 10 s.
CS/FAR Part 25, Appendix F - Part I	Flammability, 60° Bunsen burner Figure 3	Insulation on electrical wire and electrical cable installed in any area of the fuselage	- After burn length (average) shall not exceed 76 mm - After flame time (average) shall not exceed 30 s. - After flame time of drips (average) shall not exceed 3 s.
No requirement	Flammability of heat shrinkable tubings	Heat shrinkable tubings used in any area of the fuselage	- After burn length (average) shall not exceed 76 mm - After flame time (average) shall not exceed 30 s. - After flame time of drips (average) shall not exceed 3 s.

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CS/FAR Part 25, Appendix F - Part IV	Heat Release and Heat Release Rate Figure 4	Ceiling panels, Wall panels, Partitions, Galley, outer surfaces of, Large cabinet walls, Dado panels, Door linings incl. slide container, Passenger service units, Class dividers, Door frame linings, Storage compartments	- The (average) total positive heat release (HR) over the first two minutes shall not exceed 65 kW min/m ² . - The (average) maximum heat release rate (HRR) during the five minutes test shall not exceed 65 kW/m ² .
CS/FAR Part 25, Appendix F - Part V	Smoke Density / Interior and Equipment parts	Ceiling panels, Wall panels, Partitions, Galley, Large cabinet walls, Dado panels, Door linings incl. slide container, Passenger service units, Class dividers, • Door frame linings, Storage compartments	- The maximum specific optical smoke density (average) shall not exceed. - The Dm = 150 within 4 minutes test duration under flaming conditions.
CS/FAR Part 25, Appendix F - Part V	Smoke Density / Interior and Equipment parts	Floor beam struts, Floor structure, Pressure bulkheads	- See Table 2
CS/FAR Part 25, Appendix F - Part II	Flammability of Seat Cushions Figure 6	Seat cushions, except those on flight crew member seats	- For at least two-thirds of the total number of the specimens sets tested, the burn length shall not reach the side of the cushion opposite the burner. - The burn length shall not exceed 432 mm (17 inches). - The average percentage weight loss shall not exceed 10%. - For at least two-thirds of the total number of the specimens sets tested the weight loss shall not exceed 10%.
CS/FAR Part 25, Appendix F - Part III	Flame Penetration of Cargo Liners Figure 5	Ceiling and sidewall liner panels of Class C and Class D cargo or baggage compartment	-No flame penetration of any specimens within 5 minutes after application of the flame source. - Maximum (peak) temperature measured 102 mm (4 inches) above the upper surface of the horizontal test sample shall not exceed 204°C.
<i>The CS/FAR part 25 regulation does not mention the smoke toxicity assessment. The plane makers has developed internal standards to assess the smoke toxicity. The test method is based on the smoke chamber analysis and analyse during the same round the opacity and the toxicity of smokes.</i> Figure 7			
For AIRBUS: AITM 3.0005 test method For BOEING BSS 7239 test method	Toxicity / Interior and Equipment parts Insulation on. Wire/Cable	Component parts or sub-assemblies, electrical cable/wire insulation materials, and non metallic Structural parts, that are intended for use inside the pressurized section of the fuselage	The average concentration (in parts per million, ppm) of following gas components of smoke shall not exceed the limits, listed table below, within the relevant test duration under the required test conditions. Limiting values as specified in the ABD 00031 Airbus Industrie material test specification: -Hydrogen Fluoride HF -□100 ppm vol -Hydrogen Chloride HCl -□150 ppm vol -Hydrogen Cyanide HCN -□150 ppm vol -Sulfur Dioxide SO ₂ / H ₂ S -□100 ppm vol -Nitrous Gases NO / NO ₂ -□100 ppm vol -Carbon Monoxide CO -□1000 ppm vol

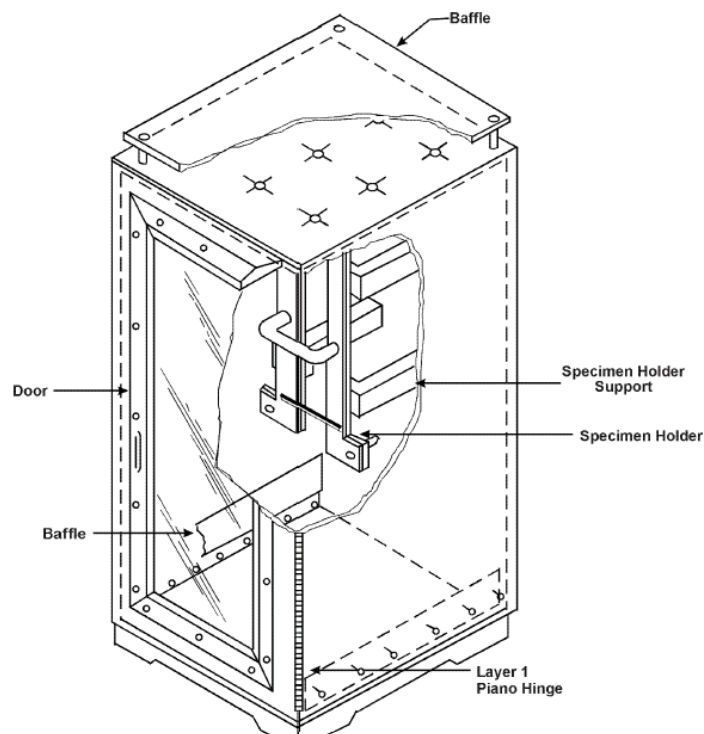
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Table 2: CS/FAR part 25 Smoke requirements

Component parts to be tested	Dm (flaming) <i>Dm is the maximum specific optical smoke density (calculated by averaging the Ds - figures obtained from each test run).</i>
<i>Major Interior Panels</i> - Ceiling and side wall panels - Dado panels (without textile covering) - Door and door frame linings - Partitions - Cabin walls, eg: lavatories - Overhead passenger service units - Stowage compartments (other than under seat)	150
Cargo liners	100
<i>Textile components</i> - Textile covered panels - Cabin floor panel	200
Upholstery	200
Drapery	200
Carpets	250
<i>Other components</i> - Air ducting - Thermal and acoustic insulation - Insulation Coverings	100
Seat cushion - Components, eg: Transparencies, elastomeric (used within the passenger cabin and for air conducting) and thermoplastic parts, non-textile floor covering Interior equipment parts	200

Figure 1: vertical Bunsen burner test set up [43]



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Figure 2: horizontal bunsen burner test Set up [43]

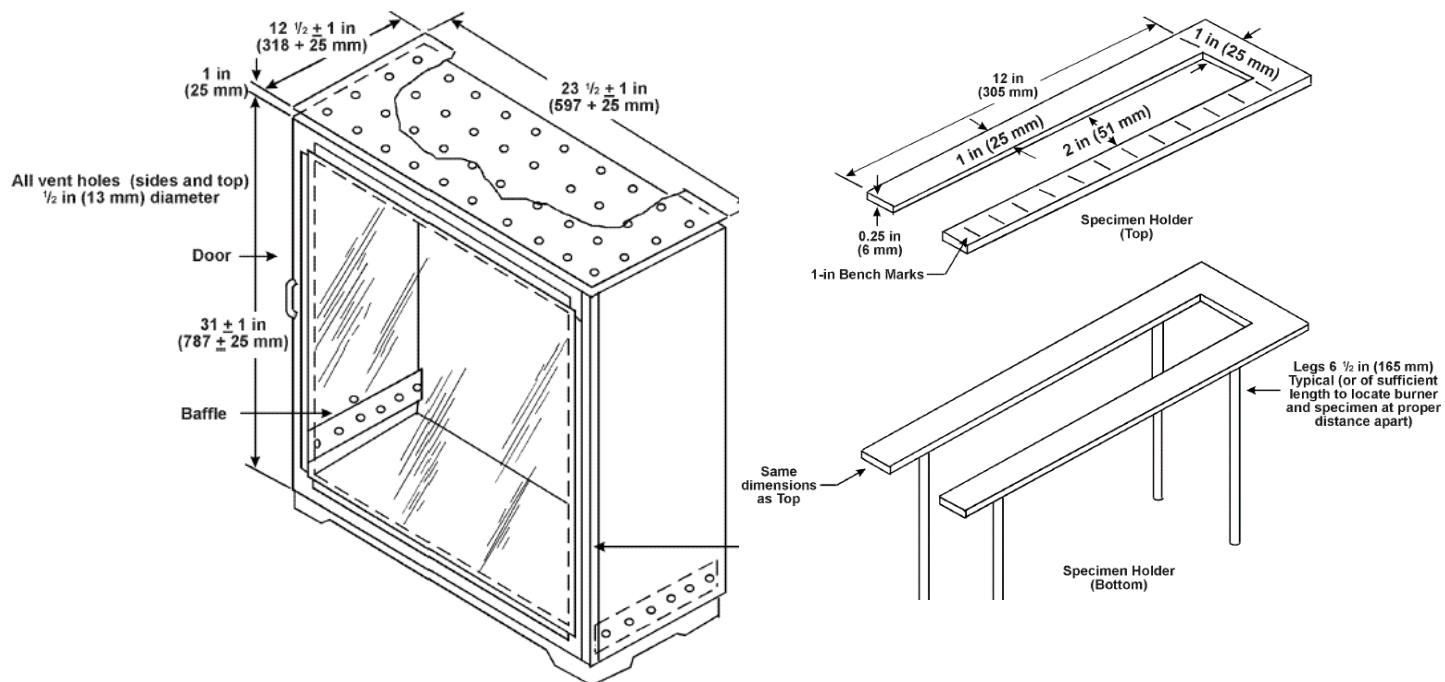
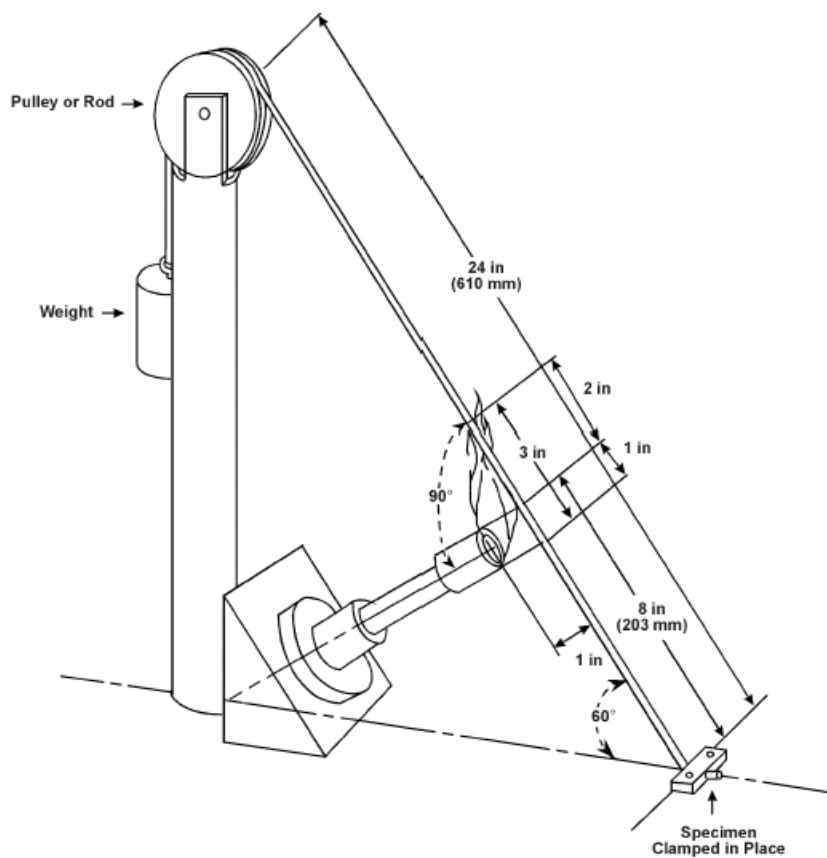


Figure 3: 60 degree bunsen burner test set up [43]



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Figure 4: Rate of Heat Release Apparatus [6]

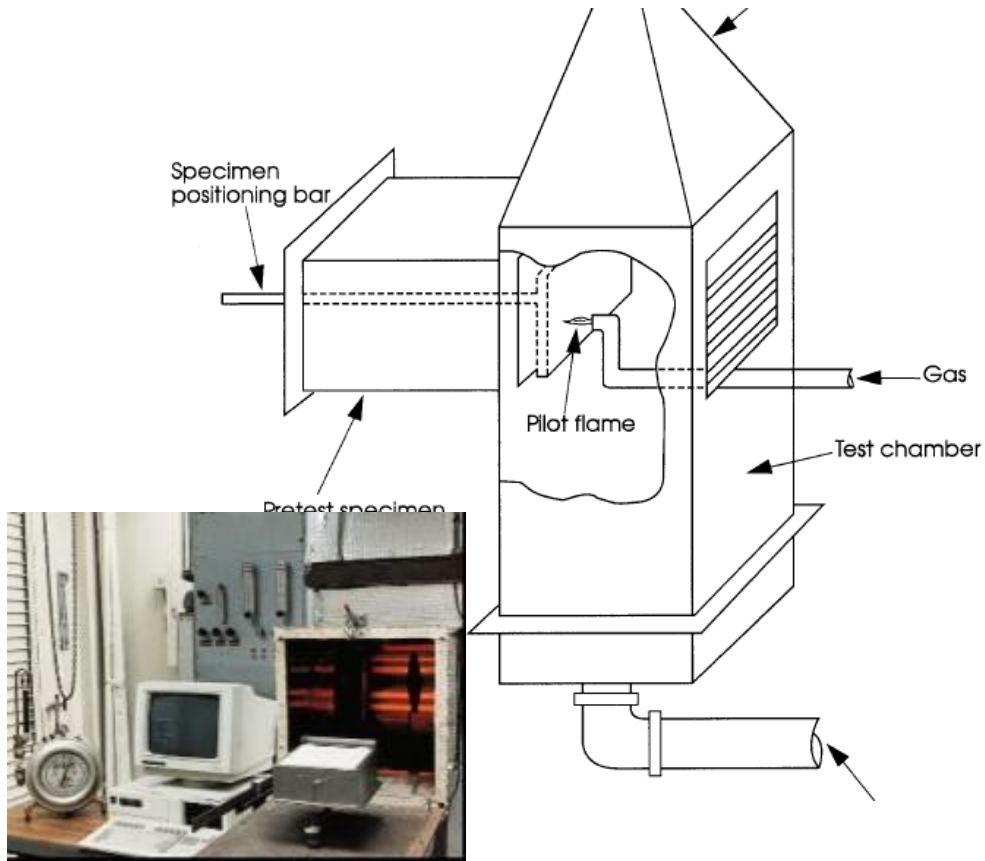


Figure 5: test apparatus for horizontal and vertical mounting for Cargo Liner Oil Burner Testing [6]

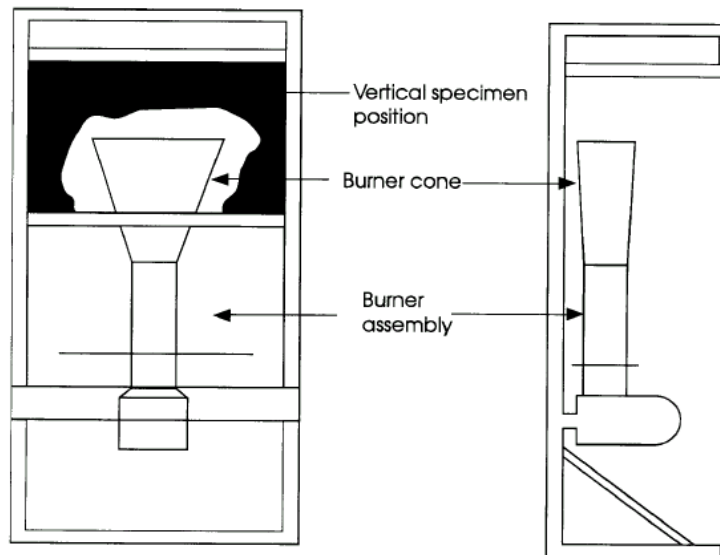


Figure 6: top and side view of specimen set up in test frame [43]

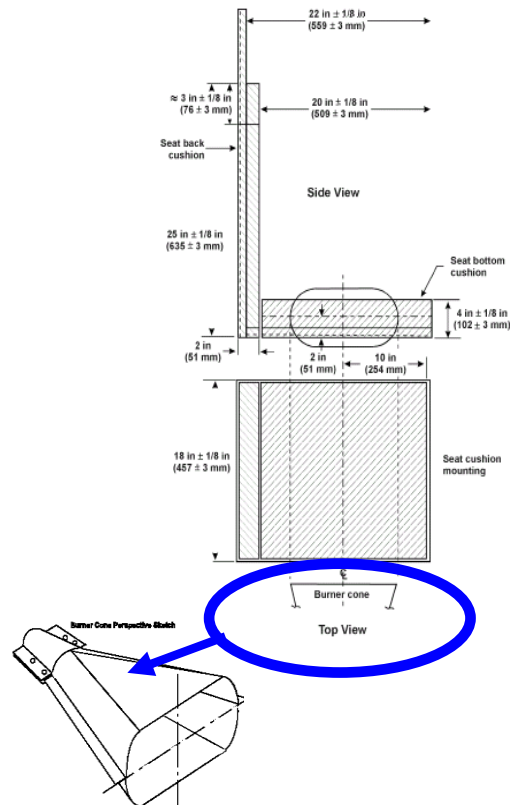
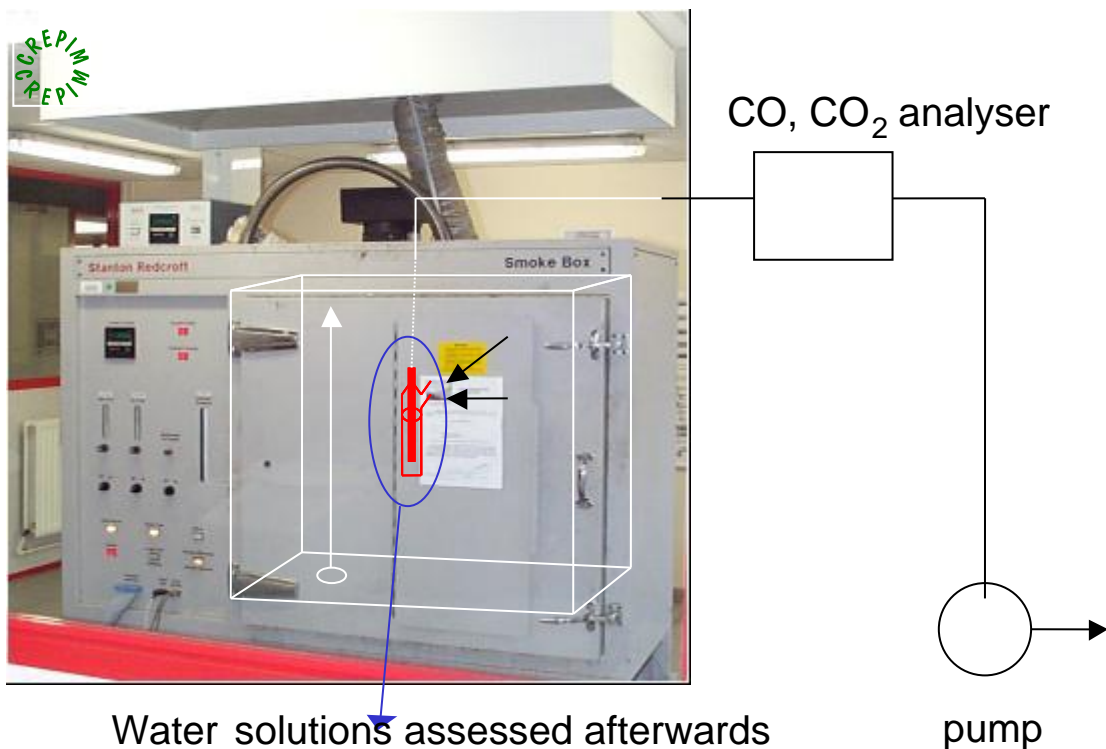


Figure 7: Airbus Industrie AITM 3.0005 test specification



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We have devoted lots of energy to set up this document and probably all the updates are not in – hope however it will help you to catch the big picture of the complex fire standards and regulation