



Advisory Circular

Subject: Flammability Testing of Aircraft
Cabin Interior Panels After Alterations

Date: June 4, 2012
Initiated by: AIR-120

AC No: 20-178

1. Purpose.

a. This advisory circular (AC) describes acceptable methods to test aircraft cabin interior materials when new finishes are used on existing aircraft cabin interior panels, typically performed on supplemental type certificates (STC) or major alterations. This AC applies to materials for self-extinguishing flammability only. This AC does not apply to materials that must meet heat release or smoke emissions standards established by Title 14 of the Code of Federal Regulations (14 CFR) part 25, Amendment 25-61, and 14 CFR part 121, Amendment 121-289. We, the Federal Aviation Administration (FAA), have written this AC for applicants, offering several methods for demonstrating compliance that may be more cost-effective and less time-consuming than current methods.

b. This AC is not mandatory and does not constitute a regulation. It describes an acceptable means, but not the only means, for you to test your altered cabin interior panel composite buildup. However, if you use the means we describe, you must follow them in their entirety.

2. Definitions. The following definitions apply to this AC only:

a. **Finish.** This term is used to mean the layer or layers of material that are new and for which no approved flammability substantiation for this composite buildup is available. Typically, a finish is a paint, stain, varnish, laminate, appliqué or combination thereof. In the case of appliquéés or laminates, it would also include any adhesive layer.

b. **Panel.** This is the substrate element to which the finish is applied. The panel is the layer(s) of the total material that will be reused in the aircraft. Typical examples of panels include Nomex honeycomb-core construction and wood paneling used in partitions, walls, and ceilings, and veneered plywood and hardwood used in cabinets and furniture.

c. **Composite Buildup.** This term is used to mean the configuration representative of the final material buildup that will be installed in the aircraft. It will typically consist of the original panel from the aircraft and the new finish.

3. Problems with Panel Testing. Refurbishing cabin interiors of existing airplanes often includes replacing the finish on existing panels, creating a new composite buildup that must be tested to determine its flammability characteristics. The new composite buildup (e.g., altered panel) must be tested and pass flammability requirements listed in table 1 of this AC. When spare panels to which the new finish is applied are not available for flammability testing and the panel is no longer in production, the only source for panels is from the aircraft itself. This requires you to cut sections out of the panels from the aircraft to use for testing, which may be a hardship.

4. Current Regulations and What They Cover. Table 1 provides a list of current publications and what each covers.

Table 1. Current Publications

Regulation	What is Covered
14 CFR §§ 23.853(d)(3)(i) Amdt. 23-62, Jan. 31, 2012, & 23.855(b) Amdt. 23-49, Mar. 11, 1996, 25.853(a) Amdt. 25-116, Nov. 26, 2004, 29.853(a)(1), Amdt. 29-23, Nov. 26, 1984	Current regulation on flammability of self-extinguishing materials in aircraft cabin interiors and cabin baggage compartments.
14 CFR part 23, Appendix F, Amdt. 23-62, Jan. 31, 2012	Specific procedures for testing self-extinguishing materials used in cabin interior panels in all small airplanes categories.
14 CFR part 25, Appendix F, part I, (a)(1)(i) Amdt. 25-111, Sept. 2, 2003	Specific flammability requirements and testing procedures for self-extinguishing materials used in cabin interior panels in transport airplanes and transport rotorcraft.
14 CFR part 23, Appendix F (b), Amdt. 23-62, Jan. 31, 2012	Test specimen configuration - "...materials must be tested either as a section cut from a fabricated part as installed in the aircraft or as a specimen simulating a cut section..."
14 CFR part 25, Appendix F, part I (b)(2), Amdt. 25-111, Sept. 2, 2003	Test specimen configuration - "...materials must be tested either as section cut from a fabricated part as installed in the airplane or as a specimen simulating a cut section..."

5. Testing – Importance and Problems. FAA fire tests have shown that the flammability characteristics of large surface area panels have a significant effect on cabin fire safety.

a. Flammability certification rules specify that you test the panel and finish together as a unit specimen to account for any synergistic effects among the panel components when exposed to fire. Most non-original equipment manufacturer (OEM) applicants find that test specimens of original panel composite buildups are difficult to obtain. They are either unable to get the specifications needed to produce the panel composite buildup from the airplane manufacturer, or the materials are no longer produced. As a result, applicants sacrifice serviceable panels for specimens, or use alternate composite buildups to demonstrate equivalent levels of safety.

b. There can be significant problems with using alternate composite buildups because of the unknown flammability behavior of untested combinations of materials.

c. Some applicants have advocated the position that flammability testing, using new burn-resistant overlay replacement material on old panels, is counter-productive because the flammability characteristics of the new materials are superior to those of the old or original material. They believe new composite buildups have a higher probability of meeting the burn test requirements than the old composite buildups. This may be valid, but until the specimen availability problem is solved, the primary means of ensuring safety for all applications is by either testing an approved spare panel and new finish or by testing a used panel from the plane with a new finish.

6. Using Surrogate Panels for Flammability Testing.

a. The International Aircraft Materials Fire Test Working Group and the FAA Technical Center investigated whether a similar but nonidentical panel, known as a surrogate panel, may be used in place of original base panel composite buildup for flammability testing of renovated aircraft interiors. The investigation report, DOT/FAA/AR-TN01/112, *Heat Release and Flammability Testing of Surrogate Panels*, dated December 2001, documented the measured heat release rates and 60-second vertical burn lengths generated by panels constructed to the same standard by three different manufacturers. The report also documented the complex behavior of theoretically identical panels when burned. (Go to www.fire.tc.faa.gov/reports/reports.asp to view the report.) Based in part on the results of this testing, this AC offers an alternative approach for flammability testing of altered interior panels.

b. Although the FAA Technical Center staff demonstrated the difficulty of producing surrogate material identical to the original materials for flammability testing, they did develop a method to account for the variability in producing identical materials. This method will allow applicants to test new finishes on old panels and make a compliance determination to the applicable airworthiness standard after testing the new finish on a suitable surrogate panel. The old panels are the panels that were previously tested with the old finish and approved under the aircraft's type design. The applicant is responsible for determining the applicable regulations under which the current configuration was certificated.

c. Before testing the surrogate panel with the new finish, test the surrogate panel without the new finish to show that it provides a conservative test basis when compared to the old panel. As an example, when the aircraft interior panels are required to be self-extinguishing, a surrogate panel without the new finish is tested that must show a longer, or worse, 60-second vertical burn length than the old panel. You can then test the surrogate panel with the new finish to determine the 60-second vertical burn length. This ensures that uncertainties and variability in the burn characteristics between the old panel and the surrogate panel are compensated for in the test to certify the new composite buildup (old panel with its new finish).

d. All surrogate panels shall represent the configuration of the old panel, including:

- (1) Core type;
- (2) Resin and adhesive type;
- (3) Thickness, number and type of pre-preg or non pre-peg plies; and
- (4) All old finishes that will not be removed prior to applying the new finish.

e. We expect you to determine the basic construction of the original panel (for example, honeycomb versus closed-cell foam core, number of panel layers, number of plies, thickness of each layer, and wood veneer versus appliqué). This will help you to fabricate a surrogate panel of similar construction. We know that it will not be possible in every case to determine the exact identity of each material used in the original panel (such as core brand, resin brand, veneer or appliqué brand). For this reason, using the same material “type” that approximates the original material is acceptable. In this context, type is defined by the materials used in the construction of the panels. For example, if the original panel is constructed with a cherry wood veneer that will be used again (after sanding and refinishing), it is reasonable and acceptable to construct a surrogate panel with a cherry wood veneer of the same thickness. Use of a surrogate veneer will require the surrogate material to be validated in a manner similar to that of the panels themselves. Similarly, if the original panel is a simple honeycomb “sandwich” type construction, it would typically use Nomex honeycomb core sandwiched between face plies on the front and back. The face plies would generally be constructed of either glass fiber or carbon fiber, with the face plies impregnated with an epoxy or phenolic-based resin. In this case, it would be necessary to replicate the thickness and pattern of the honeycomb, the thickness and type of the face plies, and the proper type of impregnating resin.

f. When spare original panels are available (without destructive testing of installed components), then you cannot use a surrogate panel to demonstrate compliance to the flammability requirements. Reasonable effort should be made to acquire original panels before using surrogate panels per options 3, 4, and 5 in table 2 below. A reasonable effort should be judged by if the panels can be purchased for a fair price.

(1) The test methodology in table 2 lets an applicant use certain surrogate panels for determining compliance of repairs and alterations of aircraft interiors. Table 2, option 3, specifies the 60-second vertical burn lengths that the surrogate panels (without the new finish) must show based on the values of the originally-approved panels. Table 2 also provides alternative options if the data for the originally-approved panel is not available.

(2) The surrogate panel with the new finish must comply with at least the original type certification basis or its properly altered subsequent certification basis for flammability requirements.

Table 2. Methods for Testing 60-Second Vertical Burn Length of New Finishes on Old Panels

Option 1	Use identical flat panel spares (i.e., same part number as those installed in aircraft and evidence of flammability approval), or	
Option 2	Use a panel cut from the aircraft to be modified, or	
Option 3	If original approved data for the component to be modified (without new finish) demonstrates the 60-second vertical Bunsen burner test burn length is	Fabricate and use a surrogate panel with a burn length no less than
	Less than or equal to 1 inch	1.5 inches
	More than 1 inch and less than or equal to 2 inches	2.5 inches
	More than 2 inches and less than or equal to 3 inches	3.5 inches
	More than 3 inches and less than or equal to 4 inches	4.5 inches
	More than 4 inches and less than or equal to 6 inches	5.5 inches
Option 4	If original data does not exist for the 60-second vertical Bunsen burner test, use a surrogate panel with a burn length no less than 5.5 inches, or	
Option 5	If original data does not exist for the 60-second vertical Bunsen burner test, develop new data from panel cut from the aircraft. Use a surrogate panel with a burn length as specified in Option 3. (The intent is to use the surrogate method for testing but retain as many original panels as possible installed in the aircraft.)	

g. For STC projects, questions regarding whether or not the surrogate panel is representative of the actual panel will be determined by the geographic aircraft certification office (ACO) for domestic projects, and the standards staff of the directorate responsible for the 14 CFR part to which the applicant seeks approval of foreign projects. For major repairs and major alterations, an appropriately qualified ACO engineer, or designated engineering representative (DER), or organization delegation authorization (ODA) may approve the flammability testing data associated with the STC project.

h. There are several factors that can have a significant effect on the flammability testing results. In an effort to prevent this, the alteration process needs to be controlled with these and other possible factors in mind:

- (1) Variations in the application process (e.g., adhesive or paint thickness).

Note: Variations in the application process that can affect flammability should be tested to determine the critical case.

- (2) Any residue left over from the cleaning process.
- (3) Repairs of the panel that may have introduced new materials or additional mass.

(4) Cutout selection of test specimens should be based on available areas where curvature is at a minimum.

i. There are different methods used in the approval of flammability test data. Data for major repairs and alterations must receive approval by one of the following:

(1) DERs use FAA Form 8110-3, *Statement of Compliance with Airworthiness Standards*, only to approve flammability test data associated with specific certification projects (design approvals), major repairs, and major alterations. This form is not for quality assurance or material certification.

(2) Appropriately-authorized ODA units use FAA Form 8100-9, *Statement of Compliance with Airworthiness Standards*, to approve flammability test data for major repairs or major alterations only for a specified product (by make, model, and serial number), or an STC ODA unit may issue an STC if it finds that the requirements of 14 CFR 21.20, 21.113, & 21.115 for issuance of an STC have been met.

Note: The ACO engineer that approves flammability testing data must have the appropriate background to do so.

7. **Frequently Asked Questions.** Table 3 provides answers to frequently asked questions.

Table 3. Frequently Asked Questions and Answers

Question	Answer
Q1. If I have approved data for my existing panel that shows a 60-second vertical burn length of less than 1.0 inch, why do I use a surrogate panel with a burn length of <i>not less</i> than 1.5 inches?	A1. Using a surrogate panel with a minimum burn length establishes a conservative basis for qualifying the new finish. The difference between the approved data burn length of the original panel and the burn length of the surrogate panel – in this case at least 1.5 inches – establishes an acceptable margin to account for the uncertainties in using a surrogate panel.
Q2. Can the surrogate panel have a 60-second vertical burn length that exceeds the criteria in Table 2 of this AC?	A2. Yes, but whether it exceeds or not, when it is burned, the surrogate panel with the new finish must meet all of the minimum requirements established by the appropriate test method prescribed in the CFR.
Q3. If I have approved data that shows the burn length of the original panel and finish was 2.3 inches, what's the 60-second vertical burn length that must be demonstrated with the surrogate panel and new finish?	A3. The maximum allowable 60-second vertical burn length is dictated by the applicable flammability requirements for the aircraft type regardless of the burn length of the approved original panel. For self-extinguishing requirements in part 23 airplanes, transport category airplanes, and rotorcraft, the maximum allowable 60-second vertical burn length is not to exceed 6 inches.

Table 3. Frequently Asked Questions and Answers (continued)

<p>Q4. What can I do if I can't obtain the original burn data and can't get spare panels?</p>	<p>A4. You can do one of three things:</p> <ol style="list-style-type: none"> 1. Cut coupons from the original panels in the aircraft for each burn test, per table 2, option 2, or 2. Avoid cutting panels from the aircraft by using a surrogate panel with a burn length of at least 5.5 inches, per table 2, option 4, or 3. Generate the data from a panel cut from the aircraft per table 2, option 5. After the new data is generated, you can use Option 3 to determine the requirements for the surrogate panel. (The intent is to use the surrogate method for testing but retain as many original panels as possible installed in the aircraft.) The benefit of Option 5 is that only a single 60-second vertical burn test is necessary with panel material cut from the aircraft to establish the burn length. You can then use the surrogate panel to validate multiple finishes for the same aircraft or for other aircraft having the same original panels. This will reduce the number of test specimens that will have to be cut from the aircraft. It may also be easier to develop or find a surrogate panel with a minimum burn length above the newly generated data (per Option 3) than to default to the surrogate panel burn length of 5.5" specified in Option 4.
<p>Q5. Since it takes only a single burn test to determine the burn length from the panel material cut from the aircraft, how many test specimens do I have to burn: one or three?</p>	<p>A5. Three. When generating new data from panels in the aircraft, from spare panels, and for surrogate panels, the tests must be done per the applicable regulations. 14 CFR part 25 Appendix F requires you to burn a minimum of three specimens and average the results to establish the 60-second vertical burn rate for the tested material. But once you generate the data from specimens cut from the aircraft, you can use the approved data to certify other finishes as explained in A4.3. above.</p>
<p>Q6. If the applicant or the ACO or DER reviewing the applicant's test plan have questions whether or not the surrogate panel is representative of the panel needing approval, who will ultimately answer those questions?</p>	<p>A6. Answers regarding whether or not the surrogate panel is representative of the actual panel will be determined by the geographic ACO for domestic projects and the standards staff of the directorate responsible for the 14 CFR part to which the applicant seeks approval of foreign projects.</p>
<p>Q7. The AC does not explain how to address the scenario if the spare panels (Option 1) or panel cut from the aircraft to be modified (Option 2 and Option 5) fail the burn test.</p>	<p>A7. If spare panels or specimens cut from in-service panels fail the burn test they could only be used if subsequent testing with a new finish demonstrated that they do not exceed the maximum allowable 60-second vertical burn length, not to exceed six inches. Burn test failures of in-service panels may indicate that further investigation of the status of these panels is warranted.</p>

8. Deviations. We do not regard this guidance as compulsory, but it does show a means of demonstrating compliance with the applicable regulations.

a. If you deviate from this guidance, the deviance has to be resolved through issue papers. The responsible ACO will coordinate all issue papers with the accountable directorate and Aircraft Engineering Division, AIR-100, to ensure that our policy application is standard.

b. You should expect certificating officials to consider these issue papers when making findings of compliance in new certificate actions.

9. Related Publications.

a. Title 14 of the Code of Federal Regulations.

b. Order 8900.1, *Flight Standards Information Management System*, volume 4, *Aircraft Equipment & Authorization*, chapter 14, *General Operating and Flight Rules—Maintenance Issues*, section 14, *Flammability Testing of Interior Materials Used in Repairs and Alterations* (CHG 187 – 12/6/11).

c. Order 8110.113, *Approval of Flammability Test Data in Support of Major Repairs or Major Alterations*, dated November 22, 2010.



Susan J. M. Cabler
Assistant Manager, Aircraft Engineering Division
Aircraft Certification Service