U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: THERMAL/ACOUSTIC INSULATION FLAME PROPAGATION TEST METHOD DETAILS	**Date:** DRAFT 12/2/04 **Initiated By:** ANM-115	**AC No:** 25.856-1X **Change:**

1. PURPOSE. This advisory circular (AC) provides guidance concerning the test method to determine the flammability and flame propagation characteristics of thermal/acoustic insulation materials. This guidance applies to airplanes required to comply with § 25.856, and part VI of appendix F to 14 CFR part 25.

2. APPLICABILITY.

a. The guidance provided in this document is directed to airplane manufacturers, modifiers, foreign regulatory authorities, and Federal Aviation Administration (FAA) transport airplane type certification engineers and their designees.

b. This material is neither mandatory nor regulatory in nature and does not constitute a regulation. It describes acceptable means, but not the only means, for demonstrating compliance with the applicable regulations. The FAA will consider other methods of demonstrating compliance that an applicant may elect to present. While these guidelines are not mandatory, they are derived from extensive FAA and industry experience in determining compliance with the relevant regulations. On the other hand, if we become aware of circumstances that convince us that following this AC would not result in compliance with the applicable regulations, we will not be bound by the terms of this AC, and we may require additional substantiation or design changes as a basis for finding compliance.

c. This material does not change, create any additional, authorize changes in, or permit deviations from, regulatory requirements.

3. RELATED REGULATIONS AND DOCUMENTS.

a. 14 CFR 25.856 and part VI of appendix F to 14 CFR part 25; 14 CFR 91.613, 14 CFR 121.312, 14 CFR 125.113,and 14 CFR 135.170.

b. Advisory Circular (AC) 25.856-2, "Installation of Thermal Acoustic Insulation for Burnthrough Protection." An electronic copy of AC 25.856-2 can be downloaded from the Internet at http://www.airweb.faa.gov/rgl. A paper copy may be ordered from the U.S. Department of Transportation, Subsequent Distribution Office, M-30, Ardmore East Business Center, 3341 Q 75th Avenue, Landover, MD 20795:

5. BACKGROUND.

a. General. Amendment 25-111 (68 FR 45046, July 31, 2003) added new fire protection requirements applicable to thermal/acoustic insulation materials. The amendment added test requirements related to flame propagation and burnthrough penetration resistance. Experience has shown the Bunsen burner test that was required prior to the adoption of amendment 25-111 did not provide a sufficient measure of thermal/acoustic insulation's resistance to flame propagation. In addition, since most thermal/acoustic insulation is installed in parts of the airplane that are not accessible for fire fighting, it is critical that the materials themselves will not propagate a fire if ignited.

b. Construction Details. Thermal/acoustic insulation typically consists of a thin film moisture barrier encapsulating a batting material. There are also foam insulation materials that may or may not use a separate moisture barrier. In any case, in addition to the basic materials that make up the insulation, there are frequently construction details that need to be accounted for. These details include thread, tapes and hook and loop fasteners. With the exception of "small parts," covered in part I of appendix F to part 25, details such as these are considered part of the construction of the material and have been shown to have an influence on whether the material will propagate a fire. Since these detailed features of the construction are not uniformly applied and may be used with several different basic materials, fabrication of test samples requires special consideration, in addition to that of the basic materials.

c. Test Method. The test described in part VI of appendix F to part 25 uses a radiant panel with an ignition source to measure the tendency of thermal/acoustic insulation to propagate a fire. The test requires consideration of two parameters as pass/fail criteria: flame propagation and flame time after removal of the ignition source. There is an important distinction between "flame propagation," as assessed by this requirement, and "burn length," as measured in the tests described in part I of appendix F. The radiant panel test is intended to measure the actual propagation of a flame along the test sample and must be observed as it is happening during a test. Burn length, on the other hand, can often be determined by inspecting a test specimen after a test is conducted. Burn length includes charring and consumption of the material, regardless of whether flaming is evident. Flame propagation is strictly an assessment of the propagation of flame from the point of application of the ignition source. The intent of the rule is to limit thermal/acoustic insulation to materials that do not propagate a fire. Since a "zero" propagation requirement is impractical to implement, reasonable pass/fail criteria were established to meet that intent. As with any stringent test method, there will be materials that have slightly greater propagation characteristics but do not meet the requirement.

6. TEST SAMPLE CONSTRUCTION.

a. Except as noted below, test samples are constructed as described in part VI of appendix F. A small (on the order of an inch) slit should be cut into film coverings to permit ventilation of gases. The slit should be cut toward the end of the sample away from the pilot burner. The slit is for test purposes only and is not a requirement for the installed insulation.

b. Tape. Tapes are used both during initial production, as well as to make repairs or facilitate material replacements on airplanes in service. It is not practical to test each possible configuration of tape and film/batting material. To simplify this process, the following procedure has been developed to show compliance for the use of tape.

(1) Each type of tape requires qualification on each material on which it is used. It is acceptable, however, to use a standard batting material for all tape/film combinations.

(2) Tapes should be arranged in 2-inch wide strips, as supplied by the manufacturer, both front to back along the test sample, as well as right to left along the length of the sample, so that each strip of tape overlaps the preceding strip by 1/2 +/- 1/8 inch. Figure 1 shows the general arrangement of the sample to the inner edges of the frame. The pilot burner nozzle is also shown in figure 1 as a point of reference.

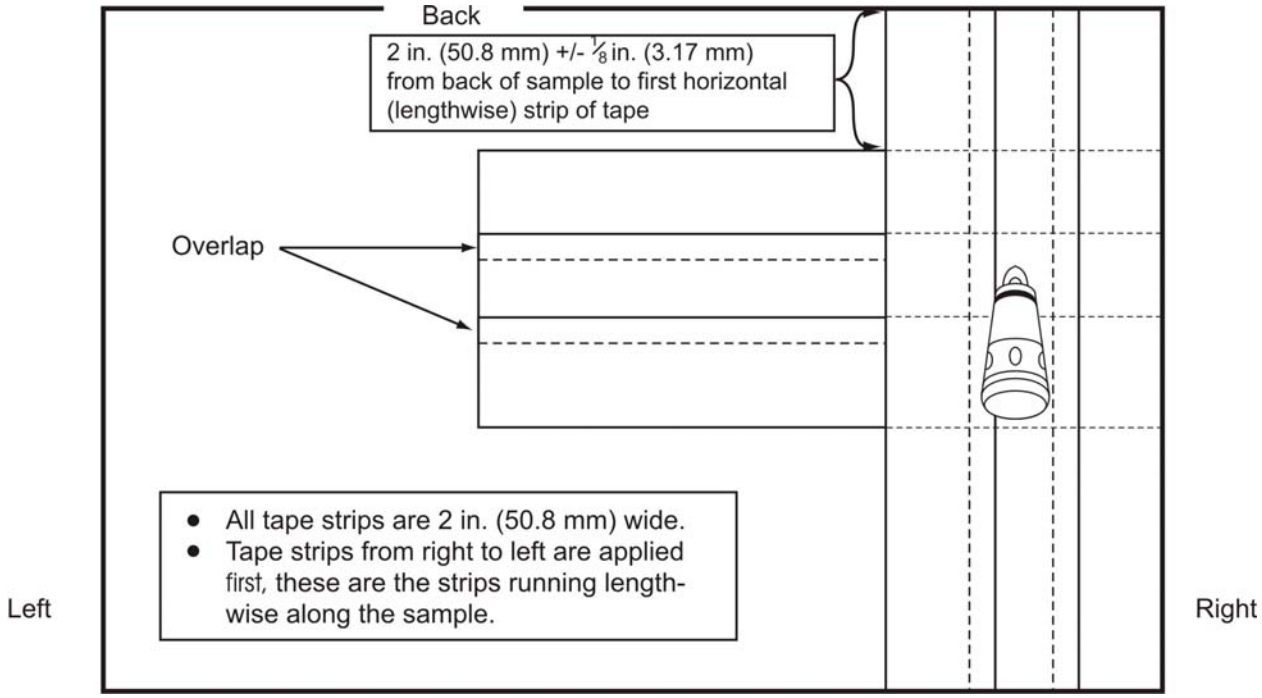

Figure 1

(3) The tape running right to left along the length of the sample should be applied first, with the strip furthest from the front of the test chamber (back) applied first.

(4) The tape running front to back across the sample should have the strip nearest the end the sample (the end toward the pilot burner) applied first.

(5) The tape strips nearest the pilot burner should be located so that the tape is as close as practical to the edge of the test sample.

c. Hook and Loop. Separate insulation blankets are often connected using hook and loop fastening systems. Depending on the installation, hook and loop fasteners could also be used to attach the insulation to the airplane structure. As with tape, there are many possible combinations and orientations of fastener and film/batting, such that testing each one could be impractical. Nonetheless, the influence of the hook and loop on fire safety is potentially significant and must be addressed in testing. A test procedure has been developed to simplify the certification process. This procedure uses test samples that differ from that specified in part VI of appendix F. Because the regulation does specify a sample size, it would be acceptable to construct samples of that size where the entire surface is covered with hook and loop material as applicable. This is considered excessive, however, and the alternative procedure outlined below is recommended.

(1) In order to address the different uses of hook and loop materials, samples are tested as mated components. While hook and loop material is not always mated when installed (e.g., there may be small segments of unmated material), testing indicates that materials that pass when mated are satisfactory.

(2) Mated samples may be stapled together along the non-mated edges. Figure 2 shows the configuration for the mated samples. Note that in this case the sample size and orientation relative to the pilot burner are different than for a typical test sample. The 1-inch hook and loop strips should be attached within 0.25-inch of the sample edge.

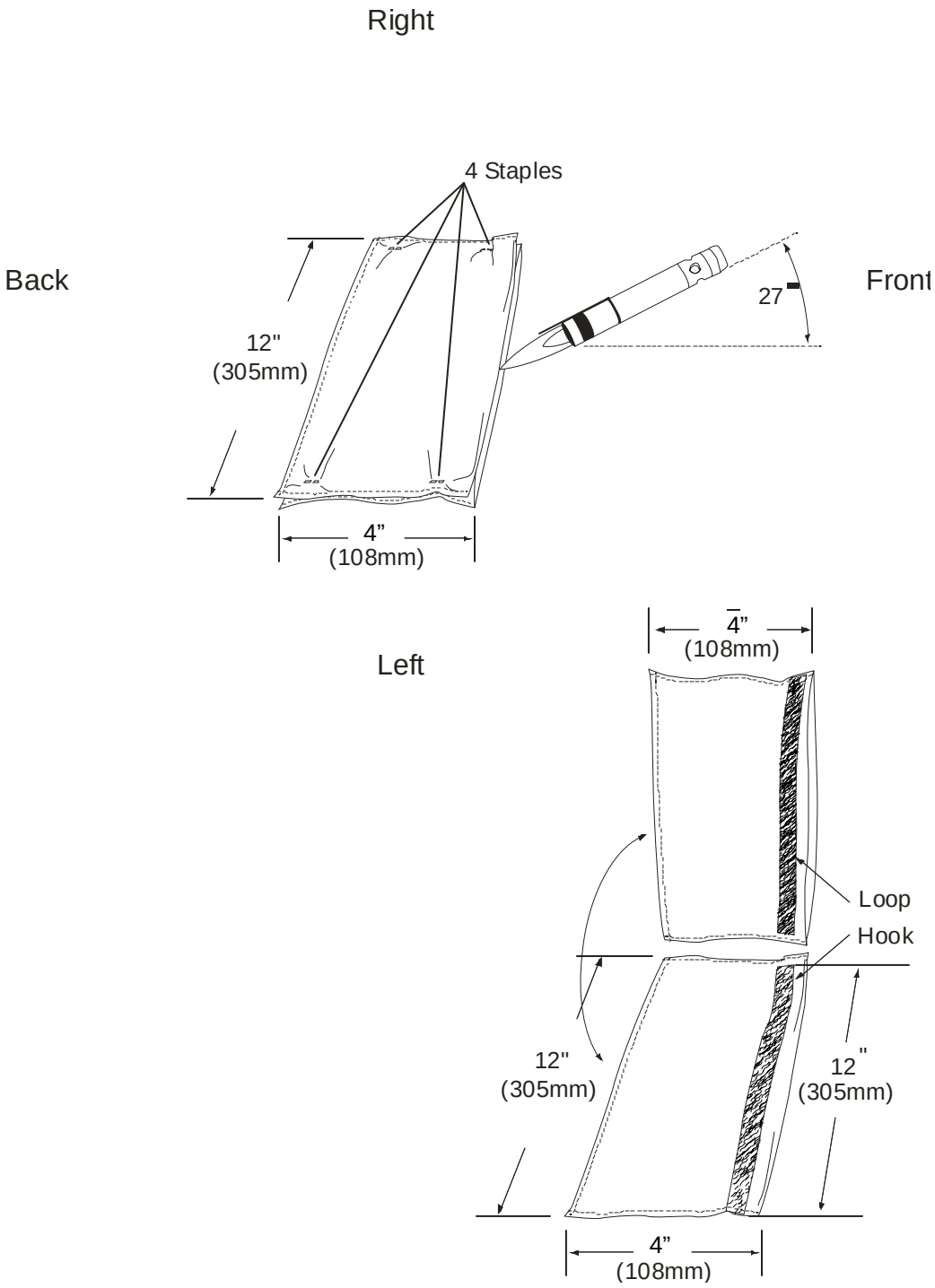

Figure 2

(3) A small retaining frame must be constructed in order to keep the sample in place. The frame is fabricated of mild steel, having a thickness of 1/8 inch (3.2 mm). The sample retaining frame is shown in figure 3. It may also be necessary to adjust the height of the sample to ensure that the relationship to the pilot burner is maintained such that the junction of the hook

and loop is exposed to the tip of the burner flame. Figure 4 shows the sample with the retaining frame in place.

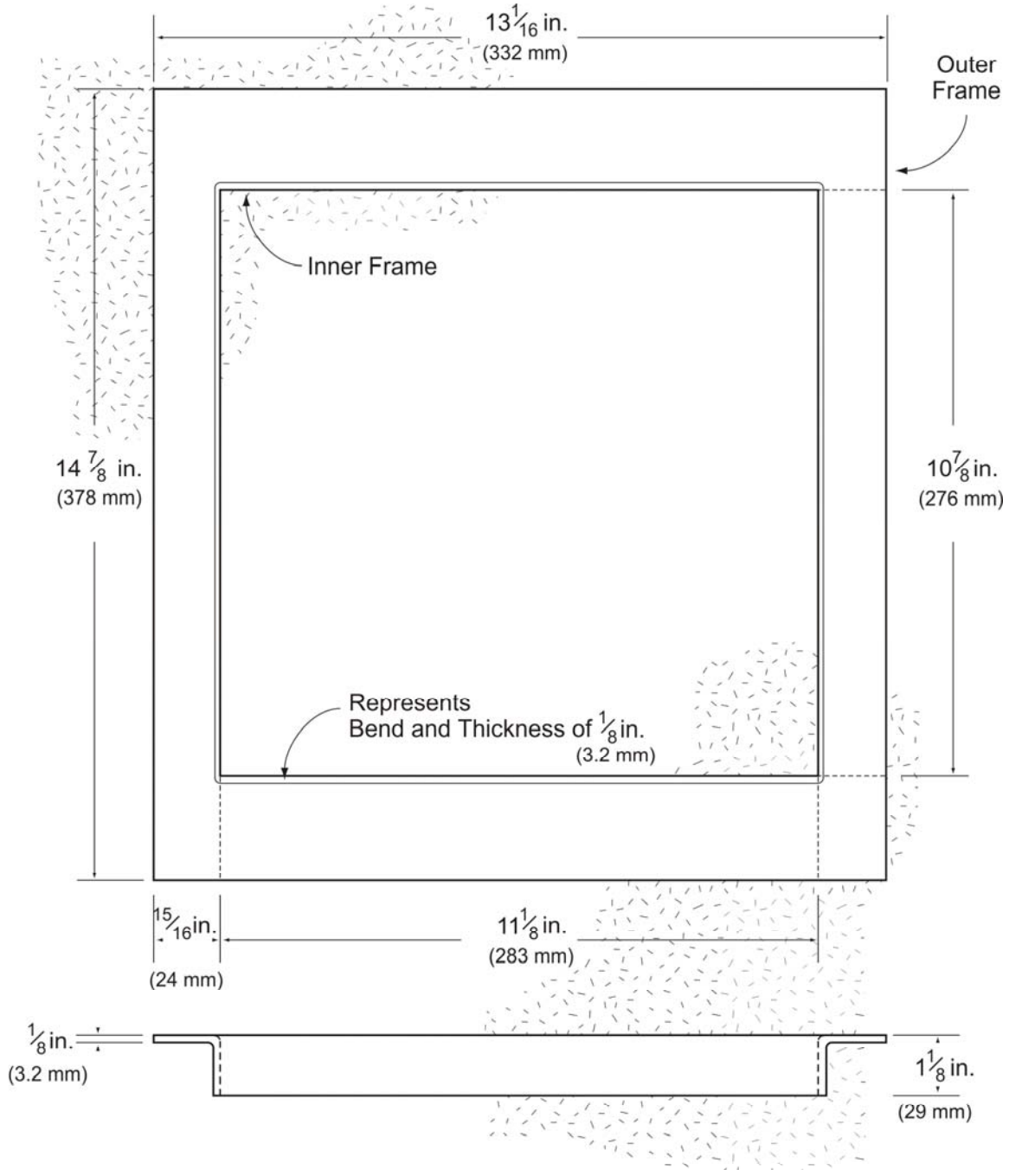

Figure 3

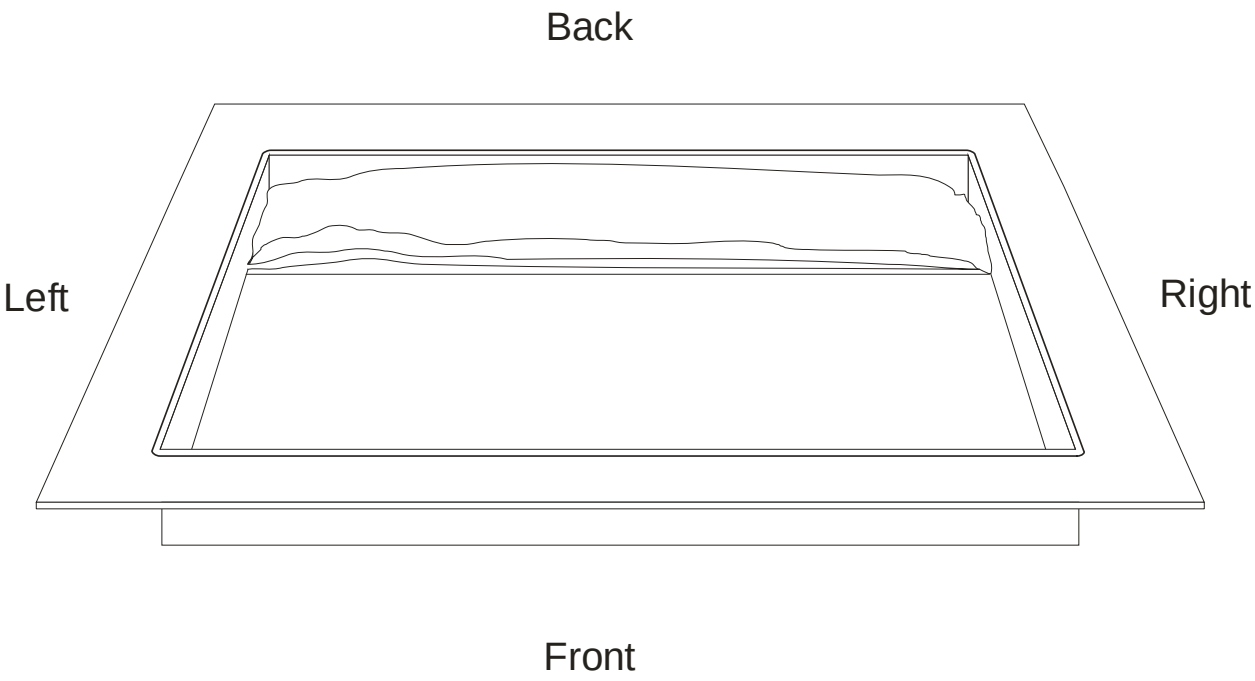

Figure 4

(4) Three tests are conducted with each type of sample (all hook, all loop, and mated) using the same pass/fail criteria as specified in part VI of appendix F.

(5) Tests on a 1-inch thick batting material may be used to substantiate the hook and loop on all other thickness and densities of that material.

d. Quilted blanket configurations need to be validated and may require separate testing depending on the thread and stitch pattern used.

7. TEST CONDUCT CONSIDERATIONS.

a. The actual heat flux generated by the radiant panel has a direct influence on test results. Experiments suggest that variations in heat flux from the standard can influence both flame time (after removal of the pilot burner flame) and propagation length, although not necessarily in the same way. A slightly higher heat flux might be critical for one parameter, whereas a slightly lower heat flux might be critical for the other parameter. It is essential that heat flux be maintained as specified in the regulation.

b. In addition to the procedural details described in part VI of appendix F, the test results can be significantly influenced by the condition of the chimney in the test chamber. The chimney should always be open and clear of obstruction for valid results.

c. Materials that melt can alter the flame profile of the pilot burner if the material melts to the point that the pilot burner impinges directly on the backing board. Tests of such materials need to be observed closely to determine whether the material is burning or simply melting. Burning material beyond the 2-inch limit is considered flame propagation, regardless of whether the influence of the flame profile on the backing board is involved.

8. APPLICABILITY TO CERTAIN MATERIALS AND INSTALLATIONS.

a. The regulation applies to thermal/acoustic insulation installed within the fuselage. There are three reasons that materials associated with thermal/acoustic insulation would not require testing under part VI of appendix F:

(1) The material is not in the fuselage.

(2) The material is not thermal/acoustic insulation.

(3) The material is not so extensive a part of the insulation system that it could have an effect on flame propagation.

b. Areas not considered to be in the fuselage include the wing, wing-to-body fairings, empennage and wheel wells. Other areas, including unpressurized portions of the fuselage are covered by the rule. However, for an area within the fuselage that is a designated fire zone under § 25.1181, compliance with § 25.856 is considered to be satisfied by equivalent level of safety under § 21.21(b)(1), because the standards for those areas already provide protection against fire propagation. Insulation installed in that area does not require testing under part VI of appendix F.

c. Certain items are installed in conjunction with thermal/acoustic insulation, but are not themselves part of the thermal/acoustic insulation. These include small grommets to permit fastening of wire bundles or other systems, clamps, small moisture diverters, and small moisture traps on structural components.

d. Other materials may be bonded to the insulation but, unlike hook and loop and tapes, are not so extensive that they could affect the flame propagation properties of the insulation system. These are materials that are installed at limited locations in the airplane, are not contiguous with respect to each other, and are generally only a few square inches in area. Examples of this are moisture seals on structural penetrations, small foam standoffs, and ventilation hole reinforcement grommets. Additional testing under part VI of appendix F using those materials is not needed to demonstrate acceptable flame propagation characteristics.

e. Structural damping materials may be considered thermal/acoustic insulation, depending on their specific configuration and use. These materials are often a soft aluminum sheet bonded to airplane structure. The aluminum sheet itself is not susceptible to flame propagation, and is not itself, “insulation.” Small aluminum sheets bonded directly to the skin with a layer of adhesive would not be considered thermal/acoustic insulation. Damping materials that include a

layer of additional foam or other material would be treated as thermal/acoustic insulation and tested similar to mated hook and loop samples, such that the interface of the insulating material and substrate is exposed to the burner flame.