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

This test method is used to evaluate the flammability and flame propagation characteristics of thermal/acoustic insulation when exposed to both a radiant heat source and a flame.

(a) Definitions.

(1) Thermal/Acoustic Insulation. Thermal/acoustic insulation is defined as a material or system of materials used to provide thermal and/or acoustic protection. Examples include a film-covering material encapsulating a core material such as fiberglass or other batting material and foams.

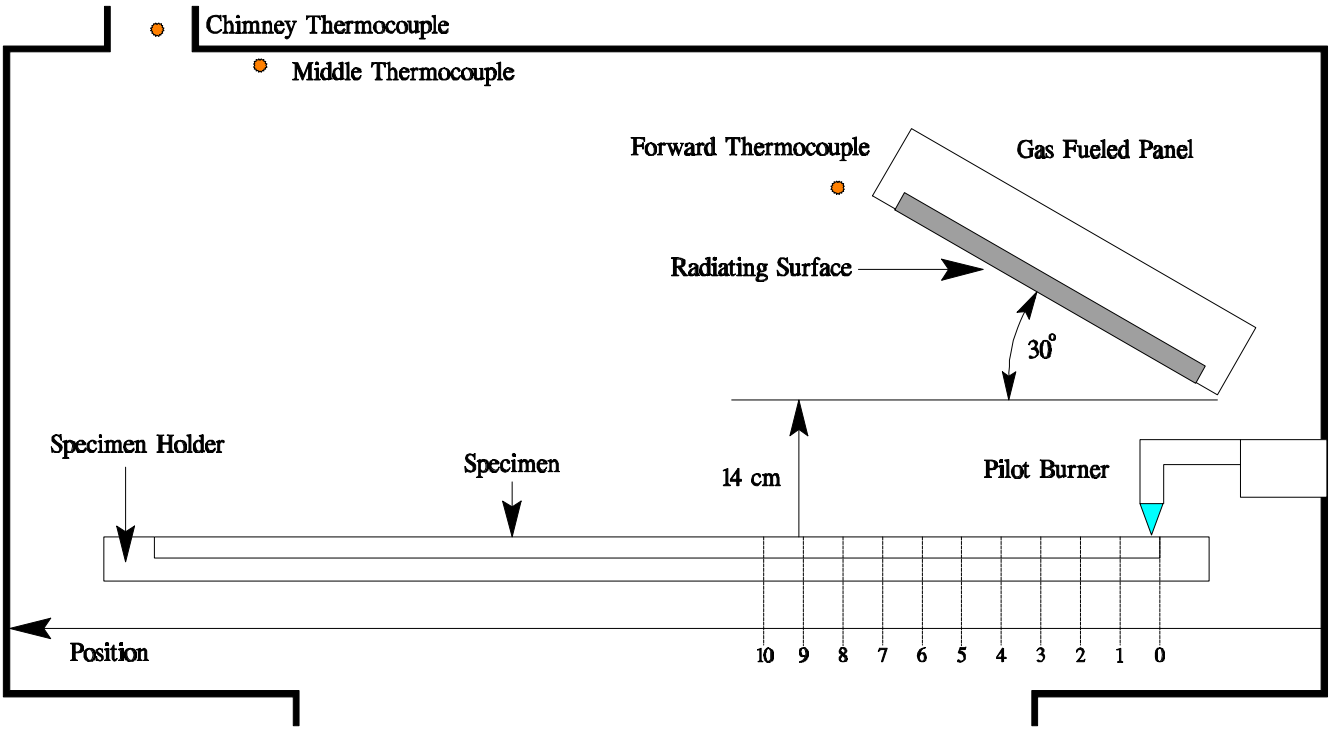
(2) Radiant Heat Source. The radiant heat source is an air gas fueled radiant heat energy panel.

(b) Test Apparatus (as schematically shown in figure 1).

(1) Radiant Panel Test Chamber. Tests will be conducted in the radiant panel test chamber as used in ASTM–Designation: E 648. It is suggested that the test chamber be located under an exhaust hood to facilitate clearing the chamber of smoke after each test. The radiant panel test chamber shall consist of an enclosure 55 inches (1400 mm) long by 19 1/2 inches (500 mm) deep by 28 inches (710 mm) above the test specimen. The sides, ends, and top shall be insulated with a fibrous ceramic insulation such as Kaowool™ board. One side shall be provided with an approximately 48 by 6 inch (1219 by 152mm) draft tight, high temperature, heat resistant glass observation window, to facilitate viewing the sample during testing. On the same side and below the window is a door which, when open, allows the specimen platform to be moved out for mounting or removal of test specimens. The bottom of the test chamber shall consist of a sliding steel platform, which has provisions for securing the test specimen holder in a fixed and level position. The top of the chamber shall have an exhaust stack with interior dimensions of 4 inches (102mm)

wide by 15 inches (380 mm) deep by 12.5 inches (318mm) high at the opposite end of the chamber from the radiant energy source.

(2) Radiant Heat Source. The radiant heat energy source will be a panel of porous refractory material mounted in a cast iron frame, with a radiation surface of 12 by 18 inches (305 by 457mm). It shall be capable of operating at temperatures up to 1500°F (816°C) (Figure 1).



(i) Radiant Panel Fuel System. The radiant panel fuel will be propane (liquid petroleum gas – 2.1 UN 1075). The panel fuel system shall consist of a venturi-type aspirator for mixing gas and air at approximately atmospheric pressure. Suitable instrumentation will be necessary for monitoring and controlling the flow of fuel and air to the panel. Instrumentation will include an air flow gauge, an air flow regulator, a gas pressure gauge, and a rotameter for measuring gas flow.

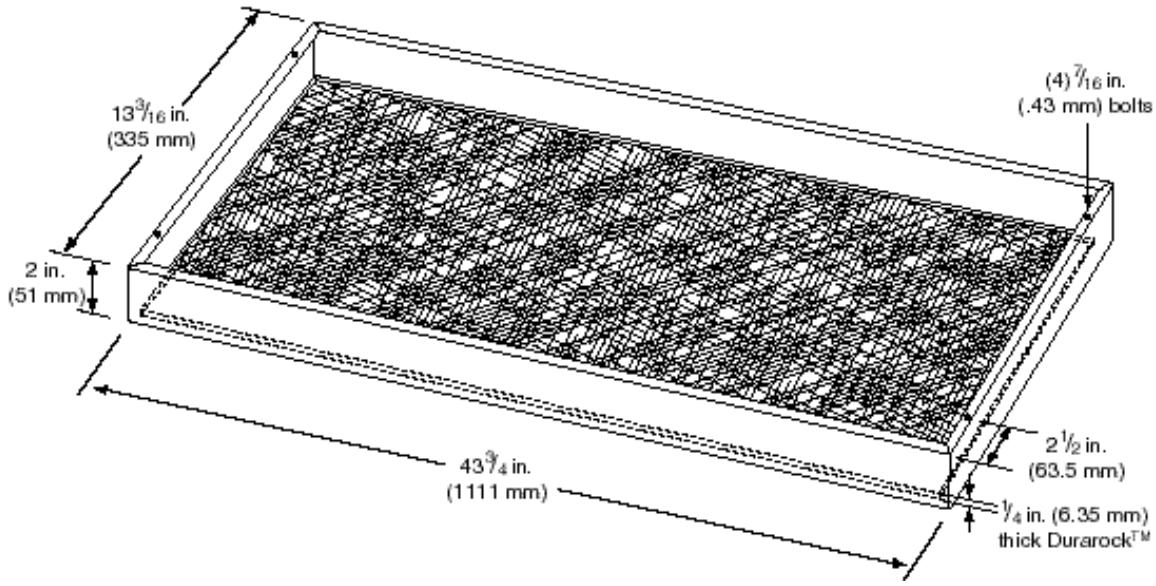
(ii) Radiant Panel Placement. The panel will be mounted in the chamber at 30 degrees to the horizontal specimen plane.

(3) Specimen Holding System.

(i) The sliding platform serves as the housing for test specimen placement. A ¼ inch (6.35mm) sheet of Durarock™, or other non-combustible base, measuring 43 ¼ inches by 12 1/2 inches (1098 by 317.5mm) will be placed in the open bottom (base) of the sliding platform. It is necessary to cut the non-combustible base into two pieces for placement in the bottom of the platform, since it will be supported by a ¾-inch (19.1mm) lip that extends around the bottom of the platform base. It is suggested that the shortest piece be placed at the end furthest from the radiant panel (figure 1). A ½ inch (13mm) piece of Kaowool™ board or other high temperature material measuring 41 ½ by 8 ¼ inches (1054 by 210mm) will be attached to the back side of the platform. This board will serve as a heat retainer and will protect the test specimen from excessive preheating. The height of this board must not be too high such that it will impede the sliding platform movement (in and out) of the test chamber.

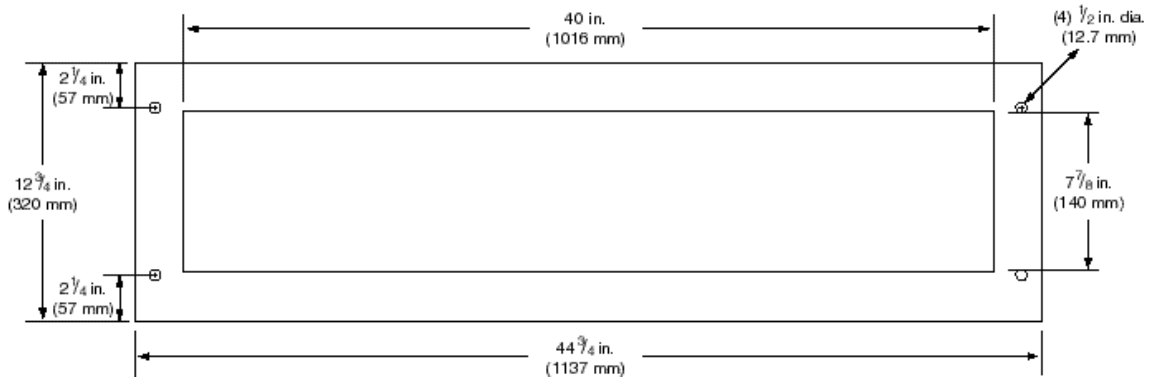
(ii) The test specimen will be placed horizontally on the non-combustible base. A stainless steel retaining frame (AISI Type 300 UNA-NO8330), or equivalent, having a thickness of 0.078 inches (1.98mm) and overall dimensions of 44 3/4 by 12 3/4 inches (1137 by 320mm) with a specimen opening of 40 by 7 7/8 (1016 by 140mm) will be placed on top of the test specimen. The retaining frame will have two ½ inch (12.7mm) holes drilled at each end for positioning the frame to the two stud bolts at each end of the sliding platform (figure 2).

Figure 3: Sliding Platform



(iii) A securing frame (acting as a clamping mechanism) constructed of mild steel will be placed over the test specimen. The securing frame overall dimensions are 42 ½ by 10 ½ inches (1080 by 267mm) with a specimen opening of 39 ½ by 7 ½ inches (1003 by190mm). Hence, the exposed area of test specimen exposed to the radiant panel is 39 ¼ by 7 ¼ inches (996 by 184mm). See figure 3. It is not necessary to physically fasten the securing frame over the test specimen due to the weight of the frame itself.

Figure 4: Stainless Steel Retaing Frame



(4) Pilot Burner. The pilot burner used to ignite the specimen is a commercial propane venturi torch with an axially symmetric burner tip having a propane supply tube with an orifice diameter of 0.003 inches (0.076mm). The propane flow is adjusted to produce a pencil flame blue inner cone length of ½ inch (13mm). There will be a means

provided to move the burner out of the ignition position so that the flame is horizontal and at least 2 inches (50mm) above the specimen plane.

(5) Thermocouples. Three 24 American Wire Gauge (AWG) Type K (Chromel-Alumel) thermocouples will be installed in the test chamber for temperature monitoring. All three are inserted into the chamber through three small holes drilled through the top of the chamber. One thermocouple is placed 2 inches (51mm) from the end of the radiant panel and approximately 16 inches (406mm) above the test specimen. The second thermocouple is placed 5 inches (127mm) from the first thermocouple and approximately 16 inches (406mm) from the sample. The third thermocouple is located in the chimney approximately 38 inches (965mm) above the specimen.

(6) Calorimeter. The calorimeter will be a one inch cylindrical water-cooled, total heat flux density, foil type Gardon Gage that has a range of 0 to 5 BTU/ft^2- second (0 to 5.6 Watts/cm^2).

(7) Calorimeter Calibration Specification and Procedure.

(i) Calorimeter Specification.

(A) Foil diameter will be 0.25 +/-0.005 inches (6.35+/-0.13mm).

(B) Foil thickness will be 0.0005 +/-0.0001 inches (0.013+/-0.0025mm).

(C) Foil material will be thermocouple grade Constantan.

(D) Temperature measurement will be a Copper Constantan thermocouple.

(E) The copper center wire diameter will be 0.0005 inches (0.013mm).

(F) The entire face of the calorimeter will be lightly coated with “Black Velvet” paint having an emissivity of 96 or greater.

(ii) Calorimeter Calibration.

(A) The calibration method will be by comparison to a like standardized transducer.

(B) The standardized transducer will meet the specification given in paragraph (6).

(C) It will be calibrated against a primary standard by the National Institute of Standards and Technology (NIST).

(D) The method of transfer will be a heated graphite plate.

(E) The graphite plate will be electrically heated, have a clear surface area on each side of the plate of at least 2 by 2 inches (51 by 51mm), and be 1/8 inch +/- 1/16 inch thick (3.2 +/- 1.6mm).

(F) The 2 transducers will be centered on opposite sides of the plates at equal distances from the plate.

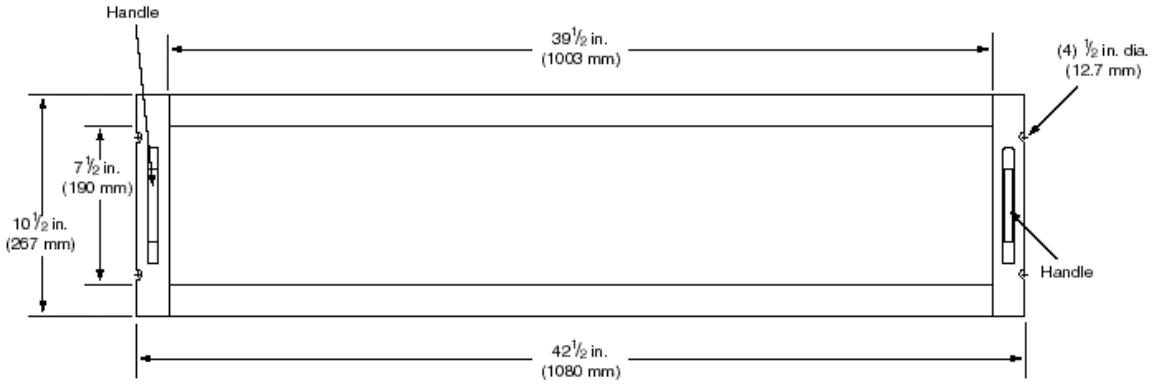
(G) The distance of the calorimeter to the plate will be no less than 0.0625 inches (1.6mm), nor greater than 0.375 inches (9.5mm).

(H) The range used in calibration will be at least 0-3.5 BTUs/ft^2 second (0-3.9Watts/cm^2) and no greater than 0-5.6 BTUs/ft^2 second (0-5 Watts/cm^2.

(I) The recording device used must record the 2 transducers simultaneously or at least within 1/10 of each other.

(8) Calorimeter Fixture. With the sliding platform pulled out of the chamber, install a 2-rail fixture that has a travel range of 40 ¼ inches (1022mm) over the sliding platform. The dimension between the 2 rails is 2 11/16 inches (68mm). The rail fixture is screwed into the sliding panel, such that it is always directly under the geometric center of the radiant panel (figure 4). Push the platform into the chamber and insert the calorimeter. The calorimeter, which is mounted in an insulated housing, fits in the rail opening but has enough clearance such that it may be moved along the rail for heat flux readings. The top surface of the calorimeter must be level with the rails.

Figure 5: Angle Iron (1.5x1.5) Securing Frame
*NOTE: All Seams Welded



(9) Instrumentation. A calibrated recording device with an appropriate range or a computerized data acquisition system will be provided to measure and record the outputs of the calorimeter and the thermocouples. The data acquisition system must be capable of recording the calorimeter output every second.

(10) Timing Device. A stopwatch or other device, accurate to +/- 1second/hour, will be provided to measure the time of application of the pilot burner flame.

(c) Test Specimens.

(1) Specimen Preparation. A minimum of three test specimens will be prepared and tested.

(2) Construction. Cut a piece of core material such as foam or fiberglass, 43 inches long (1092mm) by 11 inches (279mm) wide. Cut a piece of film cover material (if used) large enough to cover the core material. It is permissible to staple the film cover at the ends, as they are not exposed to the radiant heat source. The specimen thickness must be of the same thickness as installed in the airplane.

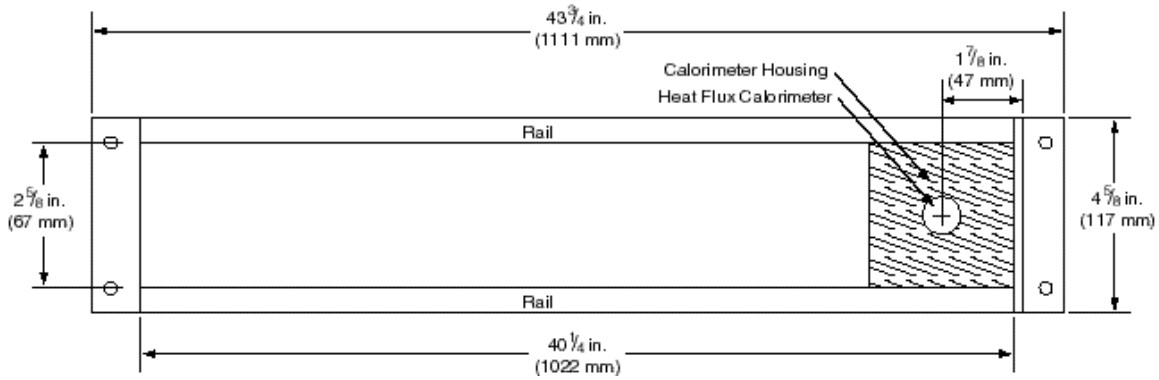
(d) Specimen Conditioning. The specimens will be conditioned at 70 +/- 5°F (21 +/-2°C) and 55%+/- 10% relative humidity for a minimum of 24 hours prior to testing.

(e) Calibration.

(1) With the sliding platform out of the chamber, install the rail fixture. Push the platform back into the chamber, install the calorimeter (in its housing), and move the

calorimeter to the “zero” position (figure 5). Close the bottom door located below the sliding platform. The centerline of the calorimeter is 1 7/8 inches (46mm) from the end of the sliding platform. This will be the “zero” position. The distance from the center of the calorimeter to the radiant panel surface at this point is 7.5 inches +/- 1/8 (191 mm +/- 3).

Figure 6: Calorimeter Rail



(i) Prior to igniting the radiant panel, ensure that the calorimeter face is clean and that there is water running through the calorimeter.

(2) Ignite the panel. Adjust the fuel/air mixture to achieve 1.5 BTUs/ft^2-second +/-0.025 BTUs/ft^2-second (1.9 Watts/cm^2 +/-0.025 Watts/cm^{2}at the “zero” position. Allow the unit to reach steady state (this may take up to 1 hour). The pilot burner is off during this time. The temperature as measured by the thermocouple closest to the panel (forward) is approximately 1100°F (600°C). The temperatures recorded by thermocouples 2 and 3 (thermocouple 3 located in chimney) are approximately 430°F (230°C) and 300°F (135°C), respectively.

(3) After steady-state conditions have been reached, move the calorimeter 2 inches (51mm) from the “zero” position and record the heat flux. Allow a minimum of 30 seconds at each position for the calorimeter to stabilize. Record at least 10 positions. (figure 6 depicts a calibration profile.)

(4) It is not necessary to run a full heat flux calibration (minimum of 10 positions) each time the chamber is powered on. It is required that a heat flux measurement be taken at the "zero" position at the start of the test period (i.e., each morning) to ensure that the 1.5 BTU/ft^2-second (1.9 Watts/cm^2) requirement be met. A full calibration should be run periodically.

(5) Open the bottom door, pull out the sliding platform, and remove the calorimeter and rail fixture.

(f) Test Procedure.

(1) Ignite the pilot burner. Ensure that it is at least 2 inches (51mm) above the top of the platform. The burner must not contact the specimen until the test begins.

(2) Place the test specimen in the sliding platform holder. Ensure that the test sample surface is level with the top of the platform. At "zero" point, the specimen surface is 7 ½ inches +/-1/8 (191mm +/-3) below the radiant panel.

(3) With film/fiberglass assemblies, it may be necessary to puncture small holes in the film cover to purge any air inside. This allows the operator to maintain the proper test specimen position (level with the top of the platform). The holes should be made in the sides and/or the corners of the test specimen using a needle-like tool.

(4) Place the retaining frame and the securing frame over the test specimen.

(5) A small mark should be placed on the "zero" point.

(6) Immediately push the sliding platform into the chamber and close the bottom door.

(7) Bring the pilot burner flame into contact with the center of the specimen at the "zero" point and simultaneously start the timer.

(8) Leave the burner in position for 15 seconds and then remove to a position at least 2 inches (51mm) above the specimen.

(g) Report.

(1) Identify and describe the specimen being tested.

(2) Report any shrinkage or melting of the test specimen.

(h) Requirements.

(1) There shall be no flaming of the test sample beyond a 2-inch (51mm) radius from the center of the point of flame application.

(2) There shall be no flaming of the test sample after pilot burner removal.