

Chapter A2

Radiant Heat Test for Evacuation Slides, Ramps, and Rafts

A2.1 Scope

A2.1.1 Test Method

This test method evaluates the ability of an evacuation slide material to resist heat and maintain pressure when subjected to a radiant heat source that simulates a large jet fuel fire. This test method is also used to show compliance with Technical Standard Order (TSO) C69A.

A2.2 Definitions

A2.2.1 Time to Failure

The time to failure is the time between first application of heat to the sample and the first decrease in pressure below the maximum pressure attained in the test cylinder during the test.

A2.2.2 Test Sample

A test sample must replicate the material used in the pressurized portion of an evacuation slide vessel.

A2.3 Test Apparatus

A2.3.1 Pressure Cylinder Sample Holder

The pressure cylinder consists of a 12-inch long (314 mm) aluminum cylinder with a 7-inch (178 mm) outside diameter (OD) and a 6.5-inch (165 mm) inside diameter (ID), and is used to hold the test sample in place and under pressure in front of the radiant heat source. Figure A2-1 shows an overview diagram of the test apparatus. Refer to Appendix J for more details on the pressure cylinder and supporting parts.

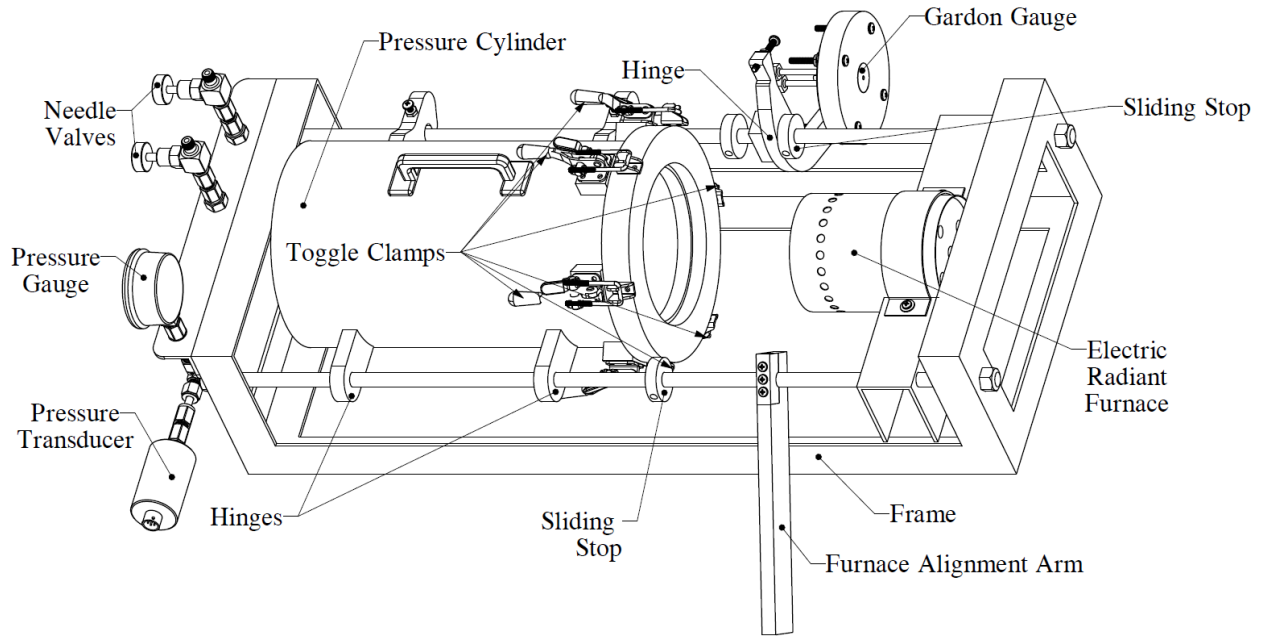


Figure A2-1. Overview of evacuation slide material test apparatus

A2.3.2 Electric Furnace

An electric radiant furnace with a 3-inch (76-mm) diameter opening, as shown in figure A2-4, must be used to supply a constant irradiance on the sample surface. The diameter of the spiral element is nominally 3 inches. It is an 875-Watt, 120-Volt alternating current (AC) element with an internal resistance of approximately 17 ohms. It is shown to the right of the pressure cylinder in figure A2-1. Refer to Appendix J for more details on the electric furnace.

A2.3.3 Furnace Voltage Control

A variable voltage control unit, 115-volt, 600-watt minimum, will be connected to the electric furnace power supply to adequately control the heat flux from the furnace. The furnace control system will be capable of maintaining the irradiance level under steady-state conditions for a minimum of 20 minutes.

A2.3.4 Voltmeter

The voltmeter is used to measure the input AC voltage going to the furnace and must have a range capable of measuring the maximum AC voltage produced by the input circuitry (typically 0–120 volts or 0–240 volts).

A2.3.5 Ammeter

The ammeter is used to measure the input AC current going to the furnace, and must have a minimum range of 0–7.5 amperes.

A2.3.6 Apparatus Framework

A2.3.6.1 Pressure Supply and Equipment

Compressed air is supplied to the pressure cylinder through a needle valve attached to the end of the framework. A tee-manifold on the outlet side of the valve provides for a 0–5 psig pressure gauge, a transducer, a flexible tube to supply air to the rear plate of the pressure cylinder, and a bleed valve, as shown in figure A2-2.

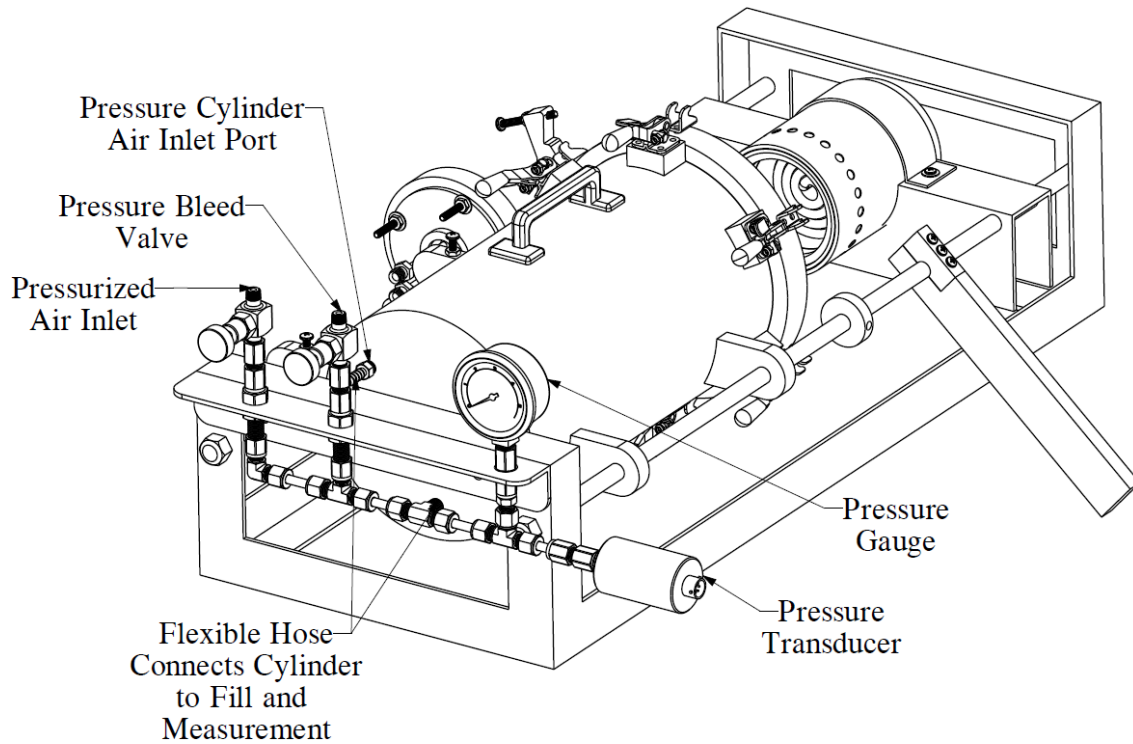


Figure A2-2. Evacuation slide test apparatus in test position

A2.3.6.2 Heat Flux Gauge

A 0 to 4.4 Btu/ft²s (0 to 5 W/cm²) water-cooled, Gardon-type heat flux gauge (HFG) must be used to measure the heat flux from the furnace. The HFG will be mounted in a 4.5 inch (114 mm)-diameter by 0.75 inch (19 mm)-thick insulating block, such as calcium-silicate millboard, with the surface of the HFG flush with the surface of the insulating block. The HFG will be hinged to one of the sliding bars of the framework and centered with the furnace, as shown in figure A2-1. The surface of the HFG must be 2 inches from the front edge of the radiant heater, as shown in figure A2-3. The HFG cooling water temperature, pressure, and flow shall be maintained within the manufacturer's recommendations. Ensure no condensation occurs on the gauge surface at any time (often caused by cooling water being too cold).

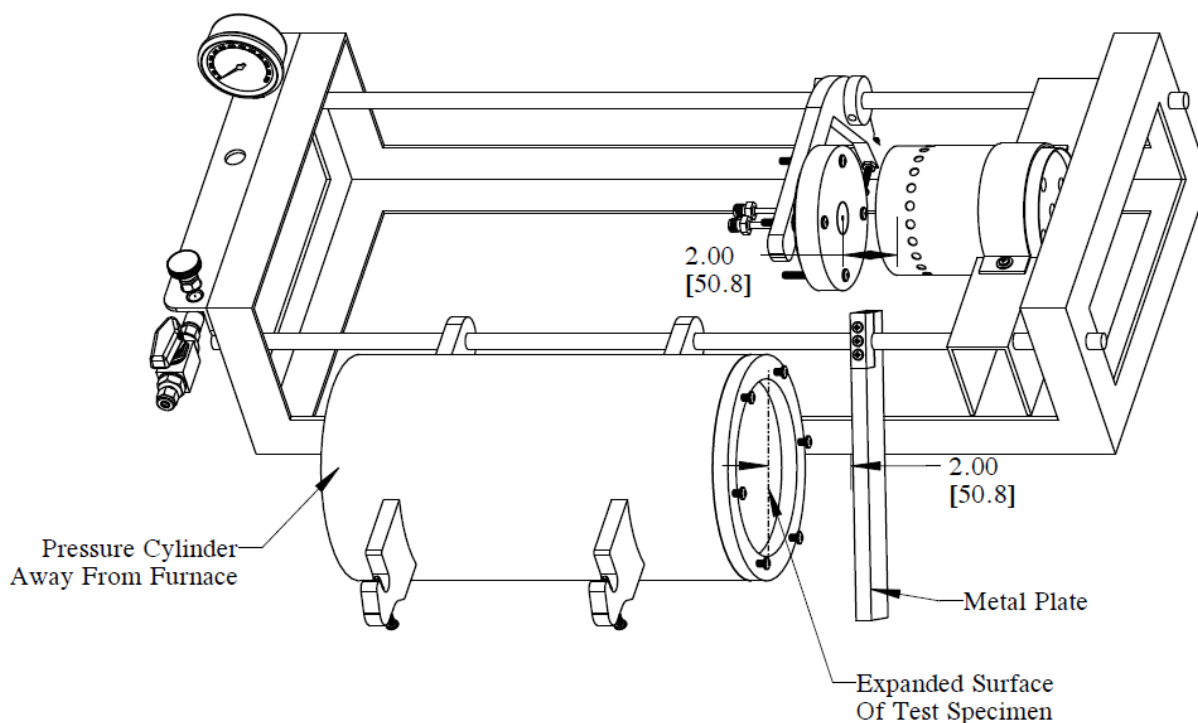


Figure A2-3. Sample and heat flux gauge to furnace distance measurements

A2.3.7 Instrumentation

A2.3.7.1 Data Acquisition

A calibrated recording device or a computerized data-acquisition system with an appropriate range must be used to measure and record the heat flux, the power input of the furnace, and pressure transducer reading. If a voltmeter is used, it requires a resolution of 0.01 V and an accuracy of 0.3%.

A2.3.7.2 Timing Device

A stopwatch or other device, accurate to within ± 1 second per 8 hours (± 3 sec/day), must be used to measure the time of application of the burner flame and the test sample ignition and extinguishment times.

A2.4 Apparatus Configuration

A2.4.1 Power Measurement Hardware

The source voltage (typically from a wall outlet) must first go to the voltage regulator to control the voltage input to the furnace. The output of the voltage regulator connects to the ammeter, which then connects to the furnace. The voltmeter is connected between the positive and negative leads going to the furnace. The voltage and current readings must be recorded during testing by a computerized data-acquisition system or other calibrated recording device. The data-acquisition system is connected to the voltmeter and ammeter to record the data and calculate the power input. Figure A2-4 shows a schematic of this configuration.

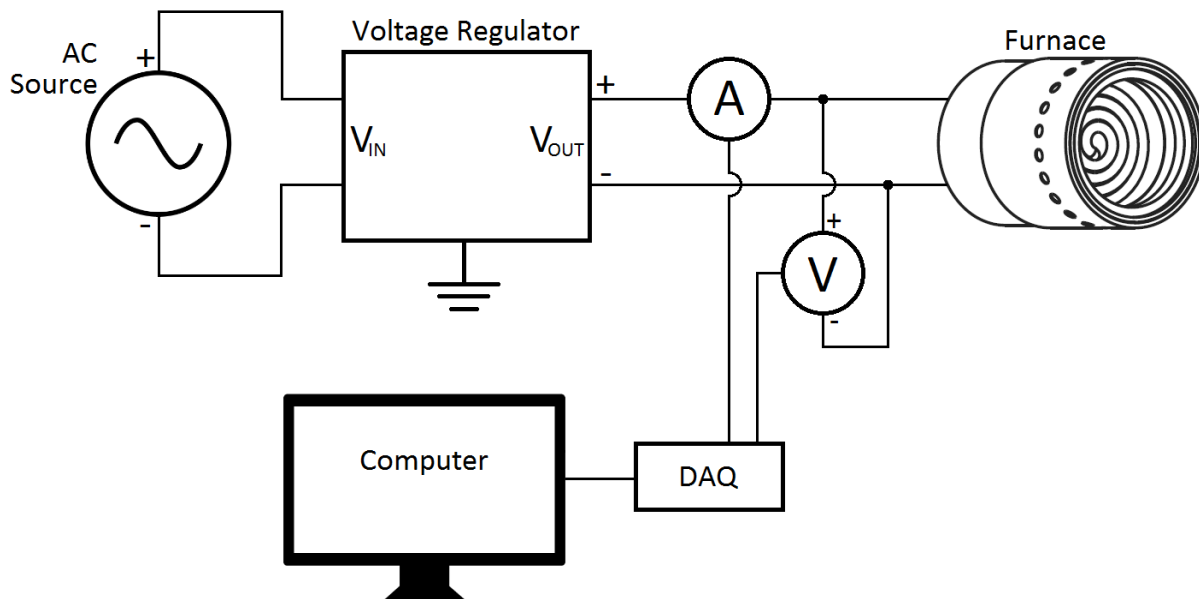


Figure A2-4. Schematic of power measurement hardware

A2.5 Test Samples

A2.5.1 Sample Selection

Samples tested must be either cut from a fabricated slide as installed in the aircraft or cut from a section simulating a fabricated slide (e.g., cut from a flat sheet of material that simulates the fabricated slide). The sample may be cut from any location in the fabricated slide; however, the surface exposed to the burner must not consist of the finished or protected edge of the sample.

A2.5.1.1 Sample Directionality

For slides that may have different flammability characteristics in different directions (e.g., textiles), separate sets of samples cut from each direction showing the greatest difference (e.g., warp and fill) must also be tested.

A2.5.1.2 Sample Representation

If the evacuation slide (pressure holding material) has any exposed surfaces that are marked, overlay material, seams, or altered in any other manner that affects radiant heat resistance, each different surface must be tested as a separate sample set.

A2.5.2 Sample Number

Each separate set of samples prepared for testing must consist of at least three test samples.

A2.5.3 Sample Size

The test sample must be 7 inches (178 mm) in diameter with eight 0.25-inch (6-mm) holes punched in the material to match the studs in the pressure cylinder.

A2.5.4 Test Sample Operating Pressure

Nominal operating pressure is the pressure that the slide will generally achieve when deployed under normal operating conditions. Each evacuation slide material has its own nominal operating pressure for the test. The nominal test pressure is the midpoint pressure between the highest and lowest normal deployment range pressures.

A2.5.5 Test Sample Conditioning

Condition test samples at $70^{\circ} \pm 5^{\circ}\text{F}$ ($21^{\circ} \pm 3^{\circ}\text{C}$) and 55% +/- 10% relative humidity for a minimum of 24 hours prior to testing.

A2.6 Furnace Calibration

A2.6.1 Conduct the calibration in a draft-free room or enclosed space.

A2.6.2 Level the pressure cylinder and the furnace. Make certain that the center line of the pressure cylinder will line up with the center of the furnace when positioned in front of it.

A2.6.3 Position the heat flux gauge in front of the furnace. Make certain that the center line of the heat flux gauge lines up with the center of the furnace and is positioned 2 inches from the front face of the furnace.

A2.6.3 Turn on the heat flux gauge cooling water pump, radiant heat furnace, and other required instrumentation, and allow 30 to 45 minutes to stabilize the heat output and instrumentation.

A2.6.4 Adjust the transformer voltage such that the heat flux is 1.50 Btu/ft²s at steady-state. Record the power input to the furnace. This power level must be maintained throughout testing.

NOTE: To prolong the life of the furnace, increase the voltage slowly.

A2.6.5 Do not turn off the furnace. Use this radiant heat output for the test. Rotate the heat flux gauge out of position

A2.7 Procedure

A2.7.1 Conduct the test in a draft-free room or enclosed space. It is recommended that tests be conducted under a hood or other means to remove potentially hazardous gases from the test area.

A2.7.2 Mount the test sample with the reflective surface of the material facing the furnace on the open end of the cylinder. A neoprene gasket or comparable gaskets, such as silicone, must be positioned on each side of the test sample. Place the aluminum ring on the studs and tighten the nuts to 30 inch-pounds so that an airtight seal is achieved.

NOTE: It is acceptable to use Toggle clamps instead of nuts and bolts (see figure A2-1) as a method to secure the test sample in place between the aluminum ring holder and the pressure cylinder.

A2.7.3 Pressurize the cylinder to the correct operating pressure for the test sample material and check for leakage. The nuts must be torqued before and after the cylinder is pressurized to prevent air leakage from the cylinder. Ensure that the test sample holds the pressure for at least 3 minutes before testing. During this time, place a sheet of insulation board in front of the sample, without making contact with the sample, to block any radiant heat from the furnace before the test starts (see figure A2-5).

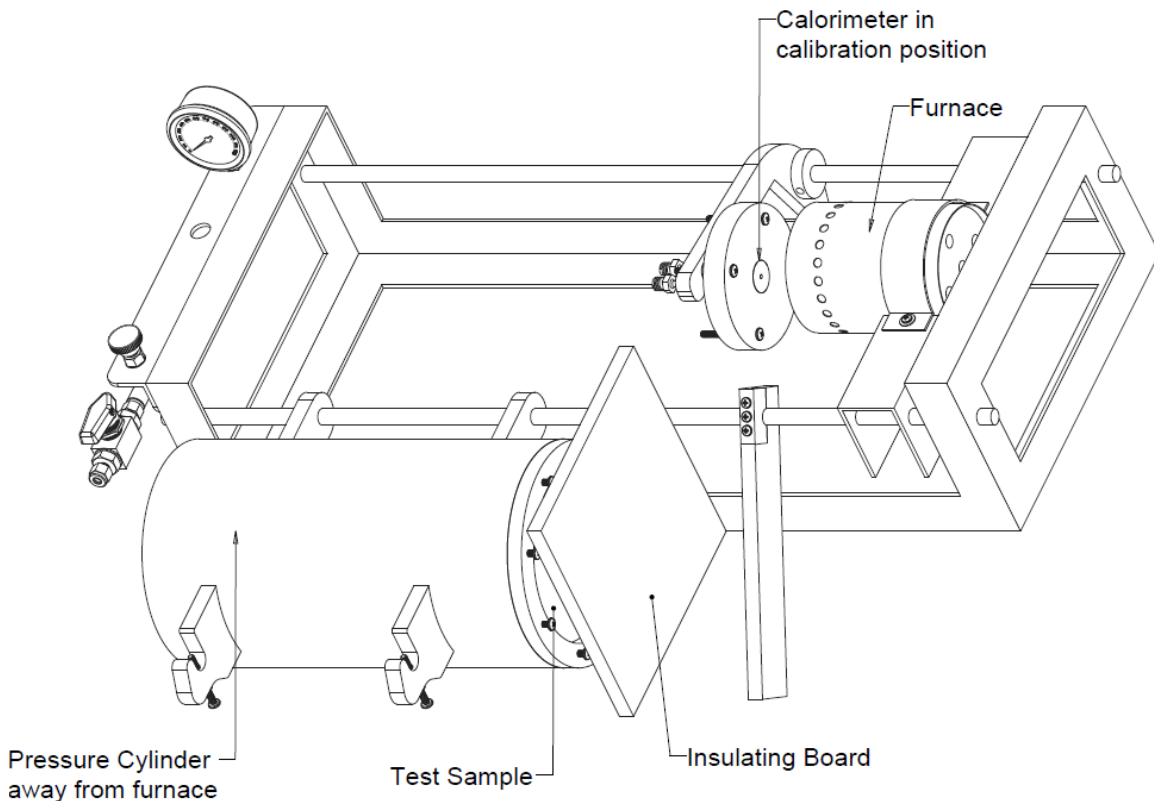


Figure A2-5. Insulating board placed in front of sample during 3-minute waiting period

A2.7.4 Using the sample distance measuring tool, check the distance from the center of the expanded surface of the test sample to the furnace. Ensure that this distance will be 2 inches once the pressure cylinder with test sample is rotated into test position (see figure A2-3).

A2.7.5 Check and make sure the power input is the same as measured during calibration.

A2.7.6 Rotate the pressurized cylinder with the test sample in front of the radiant heat furnace. Simultaneously start the timer.

A2.7.7 Monitor the pressurized cylinder from the time the test sample is placed in front of the furnace until the first observed pressure loss.

A2.7.8 Record time to failure in seconds.

A2.7.9 The duration of the test is 180 seconds.

A2.8 Report

A2.8.1 Report material description and full identification of the sample. This may include type of fabric and coating, manufacturer, manufacturer style number, weight, thickness, color, and any alterations, if applicable.

A2.8.2 Report the starting pressure for each of the three samples.

A2.8.3 Report any observations of the material's behavior during the test and times of the occurrence.

A2.8.4 Report the time to failure for each of the test samples.

A2.9 Requirement

A2.9.1. A minimum of three samples must be tested. At least 80% of the test samples must maintain the correct pressure for a minimum of 180 seconds