

Chapter E3

Test for Electrical Connectors Used in Firewalls

E3.1 Scope

E3.1.1 This test method is intended for use in determining the resistance of high-temperature electrical connectors used in fire zones to damage due to flame and vibration according to requirements of FARs 23.1192, 25.1191, 27.1191, 29.1192, 25.863, 25.865, 25.867, 25.1201, and 25.1203.

E3.1.2 This test is used to evaluate the capability of wired, electrical, firewall connectors to prevent flame from passing to the protected side of the firewall. This test provides a means to evaluate the connectors' ability to sustain a minimum current of 1A for a limited period of time.

E3.1.3 It is suggested that each connector type be tested in three sizes: 22-19, 14-7, and 12-3. Each connector size will be tested separately.

E3.2 Definitions

E3.2.1 Firewall

A firewall is a structure designed to prevent a hazardous quantity of air, fluid, or flame from exiting a designated fire zone in which a fire may erupt and causing additional hazard to the aircraft.

E3.2.2 Firewall Connector

A firewall connector is an electrical connector designed for installation in the firewall.

E3.3 Apparatus

E3.3.1 Simulated Firewall

A piece of steel 10 by 10 by 0.063 inch (254 by 254 by 1.6 mm) thick to simulate a firewall will be provided for each of the three connector sizes. A hole will be drilled in the center of each piece appropriate to the respective connector size. If the simulated steel firewall does not adequately represent the actual application, a test of the proposed configuration may be required.

E3.3.2 Burner/Torch

A burner/torch modified to produce and maintain a minimum flame temperature of 2,000°F (1,093°C) will be provided.

NOTE: An SAE AS401 Propane Burner or equivalent has been found acceptable.

E3.3.2.1 Burner Fuel

Propane gas fuel of 99 percent minimum purity will be used with a gas flow rate equivalent to 33,000 to 37,000 Btu/hr.

E3.3.3 Power Supply (Electrical, AC)

A center-tapped transformer will be provided that is capable of producing between 200V and 260V (AC) at 400 Hz or 60 Hz and delivering a current of at least 2A.

E3.3.4 Power Supply (Electrical, DC)

A power source will be provided that is capable of producing 28V (DC) and a current between 5A and 150A.

E3.3.5 Current Indicator

A multirange ammeter will be provided that is capable of measuring DC currents between 5A and 150A with an accuracy of 1 percent of full scale.

NOTE: Choose the appropriate range of the ammeter to measure the test current. The appropriate range will show the current to be in the middle one-third of the scale.

E3.3.6 Vibration Source

A means will be provided to vibrate the test fixture vertically at 33 Hz with a total excursion of 0.14 inch (3.6 mm).

E3.3.7 Gas Flowmeter

A gas flowmeter will be provided to measure the fuel flow to the burner/torch.

E3.3.8 Temperature Measuring and Recording Equipment

A temperature sensing system will be provided that includes a thermocouple and a stripchart recorder to monitor the flame temperature.

E3.3.8.1 Thermocouple

An ANSI 22-gauge Chromel-Alumel (Type K) thermocouple sheathed to a 1/16-inch (1.6-mm) stainless steel or inconel tube shall be provided.

E3.3.9 High-Temperature Tape

High-temperature tape, 19 to 25 mm wide, will be provided in sufficient length to wrap over the connector and wire bundles (see section E3.4.2.1). NOTE: Untreated fiberglass tape has been found satisfactory.

E3.3.10 Test Fixture

A test fixture and setup such as is shown in figure E3-1, including a cable clamp to stabilize the wire bundle connector interface during the test, will be provided.

E3.3.11 Timer

A stopwatch or other device, calibrated and graduated to the nearest 1 second, will be used to measure the time of application of the burner flame.

E3.4 Test Specimens

E3.4.1 Specimen Number

Prepare at least three specimens for each connector shell size to be tested.

E3.4.2 Specimen Preparation

Clean all oil, grease, dirt, and other foreign material from the specimens.

E3.4.2.1 Wrap the plug and receptacle wire bundle with high-temperature tape over the area to be located under the cable clamp that is used to stabilize the wire bundle connector interface during flame/vibration application. This area is a distance of 7.9 ± 0.2 inches (200 ± 5 mm) from the connector backshell. See figures E3-2 and E3-3 for details.

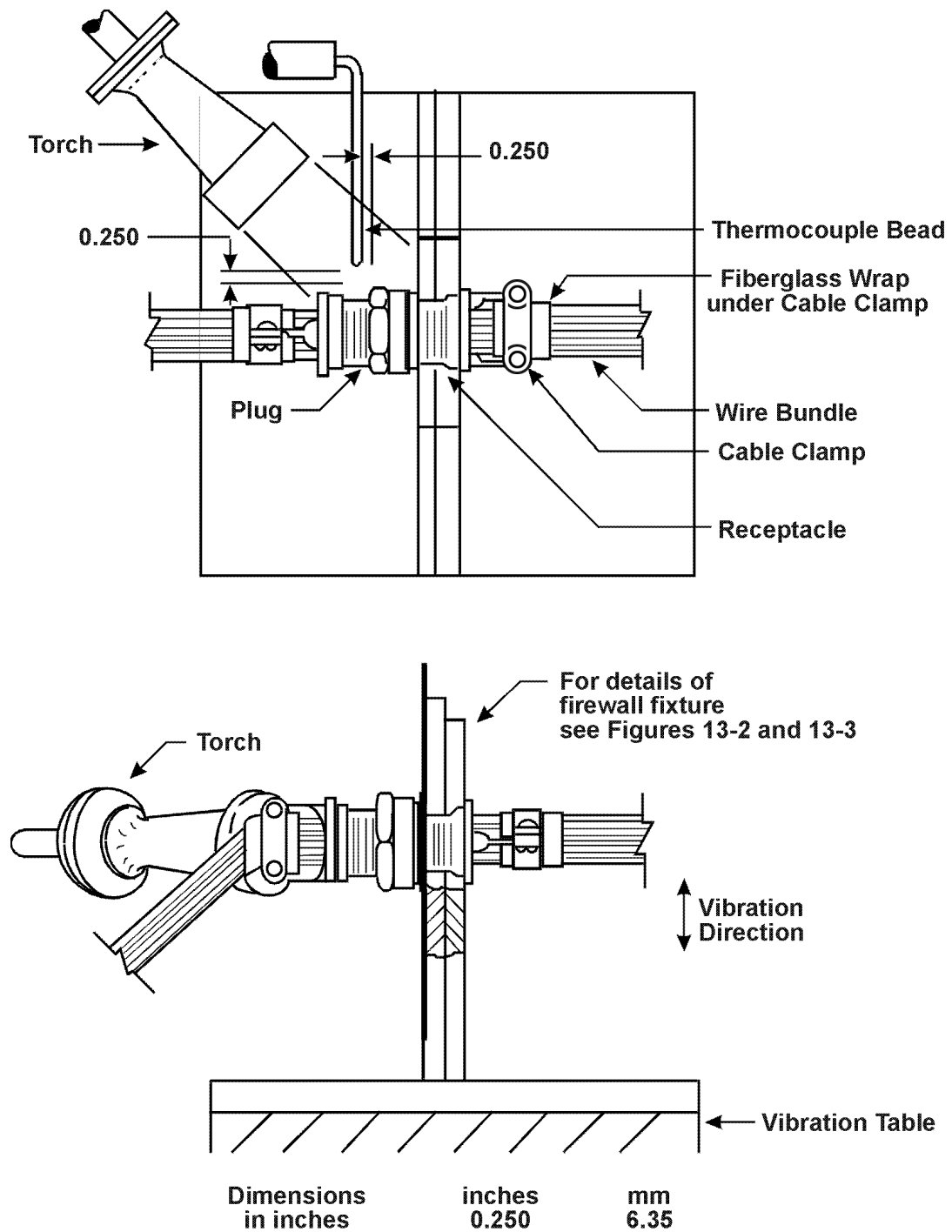


Figure E3-1. Firewall Connector Test Setup

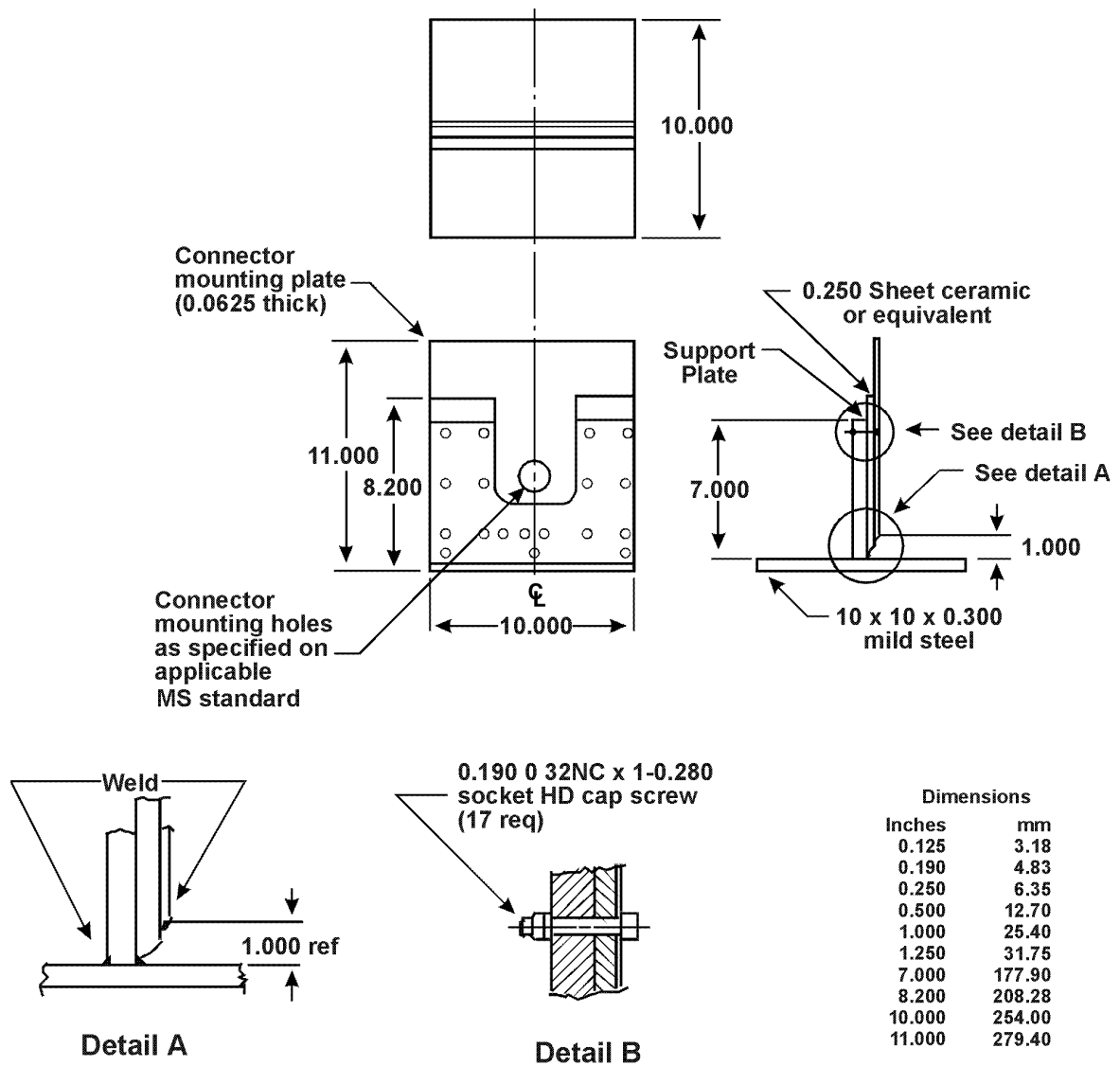


Figure E3-2. Firewall Connector Fixture Assembly

E3.5.1.2 Ensure that the connector shell is well grounded prior to starting the test.

E3.5.1.3 Use a circuit for the test designed so that by closing one switch or relay (designated as Switch 2), the connector contacts are connected in series and the direct current potential is applied and, by closing another switch or relay (designated Switch 1), the alternating current potential is applied between even and odd numbered contacts, as shown in figure E3-4.

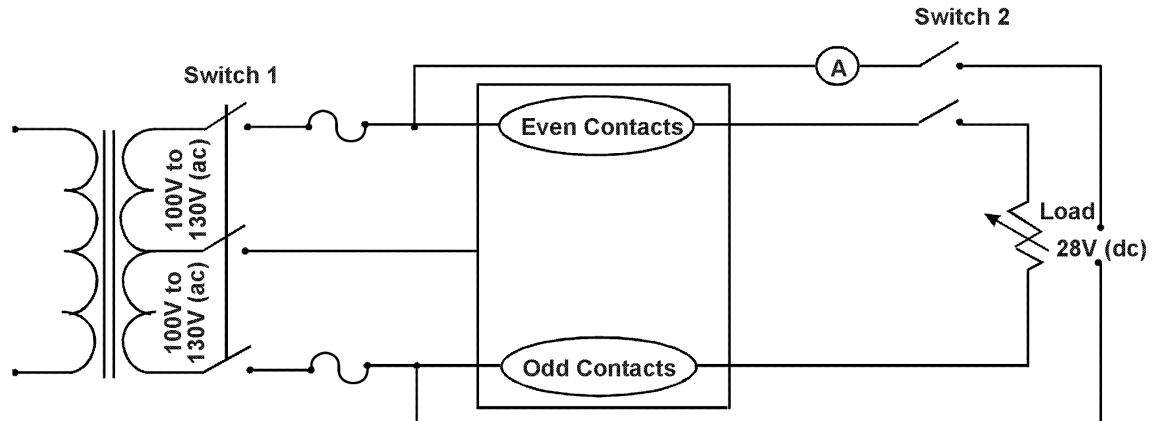


Figure E3-4. Connector Electrical Integrity Connection Diagram

E3.5.2 Burner Adjustment

Ignite the burner/torch and adjust the flow of gas and air to obtain a nonoxidizing and nonreducing flame with a flame temperature of $2,000^{\circ} \pm 50^{\circ}\text{F}$ ($1,093^{\circ} \pm 28^{\circ}\text{C}$).

E3.5.3 Test Procedure

E3.5.3.1 Light the burner and stabilize the flame at a minimum temperature of $2,000^{\circ}\text{F}$ ($1,093^{\circ}\text{C}$) for 5 minutes prior to starting the test.

E3.5.3.2 Turn on the vibration source and connect the circuit, as described in section E3.5.1.3.

E3.5.3.3 Simultaneously start the timer and direct the flame at the plug side of the connector test specimen, as shown in figure E3-2, at a distance such that the thermocouple monitoring the temperature is within 0.26 inch (6.5 mm) of the connector. Monitor the temperature of the flame continuously.

E3.5.3.3.1 For the first 5 minutes of the test, connect the contacts in series and load with their rated DC current for the appropriate size contact as determined by table E3-1. Start the current flow by closing Switch 2. Monitor the current continuously using the ammeter to determine whether or not the connector circuit retains its conductance.

Table E3-1. Firewall Connector Test Current

Contact Size	Test Current (DC)
22	5
20	7.5
16	13

12	23
8	46
4	80
0	150

E3.5.3.4 At the end of 5 minutes, the difference in potential of the even and odd numbered contacts will be 200V to 260V (AC) and the difference in potential between the shell and any contact will be 100V to 130V (AC). Remove the DC source and break the series connection by closing Switch 1. Immediately after Switch 1 is closed, apply the AC potential by opening Switch 2. Do not allow the circuit to draw a current greater than 2A. At the end of 1 minute, shut off the current. Observe and record any indication of an increase in current that would show a contact-contact or a contact-shell short circuit.

E3.5.3.5 Continue the flame exposure of the connector until a total time of 20 minutes has elapsed and monitor whether any flame appears on the protected side of the firewall.

E3.6 Report

E3.6.1 Material Identification

Identify the material being tested.

E3.6.2 Flame Penetration

Report whether any flame was detected on the protected side of the firewall during the test.

E3.6.3 Conductivity

Report the minimum current that occurred during the application of electrical power.

E3.6.4 Circuit Integrity

Report any evidence of a contact-contact or a contact-shell short circuit.

E3.7 Requirements

E3.7.1 Flame Penetration

There will be no flame detected on the protected side of the firewall barrier at any time during the 20-minute test.

E3.7.2 Conductivity

The current through the connector during the application of electrical power will not be less than 1A.

E3.7.3 Circuit Integrity

There shall be no evidence of any contact-contact or contact-shell short circuit.

E3.7.4 Backside Ignition

There shall be no ignition on the backside of the wire bundle.