Designation: F1996 – 14

Standard Test Method for Silver Migration for Membrane Switch Circuitry[1]

This standard is issued under the fixed designation F1996; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method is used to determine the susceptibility of a membrane switch to the migration of the silver between circuit traces under dc voltage potential.

1.2 Silver migration will occur when special conditions of moisture and electrical energy are present.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

F1596 Test Method for Exposure of Membrane Switches to Temperature and Relative Humidity

F1689 Test Method for Determining the Insulation Resistance of a Membrane Switch

3. Terminology

3.1 *Definitions:*

3.1.1 *silver migration*—A process by which silver, when in contact with insulating materials under electrical potential, is removed ionically from its original location, and is redeposit as a metal (silver dendrite) at some other location.

4. Significance and Use

4.1 The effects of silver migration are short circuiting or reduction in insulation resistance. It is evidenced by staining or dicoloration between the cathode and anode conductive traces.

4.2 Accelerated testing may be accomplished by increasing the voltage over the specified voltages. (A typical starting point would be 5Vdc 50mA).

5. Interferences

5.1 The following parameters may affect the results of this test:

5.1.1 Temperature.

5.1.2 Relative Humidity.

5.1.3 Electrical Load (that is, current and voltage).

5.1.4 Test surface.

5.1.5 Flex tail connector area may be susceptible to silver migration which may or may not be a part of the scope of this test. If the flex tail is to be excluded from the test it should be sealed with an inert compound that has no influence on the test or switch materials.

5.1.6 Post test handling may damage or destroy silver dendrites.

5.1.7 Dendrites normally grow from the cathode conductor to the anode. To test both electrodes of a switch design connect replicate specimens so that current flows through them in opposite directions.

5.1.8 Without limited current, the migration could occur, causing a short and a dramatic current surge, which then destroys the short and returns the circuit to a nonstandard, but functional condition. If an observer was not present (or the details were not continuously recorded) this most dramatic failure might go unnoticed.

5.1.9 Surfactants and other contaminants from the environment can be transferred to membrane switch components during handling. These contaminants can adversely affect the results of this test.

6. Apparatus

6.1 *Closed Environmental System* , with temperature and humidity control (see Practice F1596).

6.2 *Current-Limiting DC Power Source.* (Series current limiting resistor may be used with dc power supply).

6.3 *Milliamp Meter* (see Test Method F1689).

6.4 *Megohm Meter.*

6.5 *Test Surface,* flat, smooth, unyielding, nonporous, and larger than switch under test.

7. Procedure

7.1 *Pretest Setup:*

7.1.1 Test specimen(s) shall be permitted to stabilize at 20 to 25°C and 40 to 60 % relative humidity (RH) for a minimum of 24 h.

7.2 *Test Setup (*Fig. 1*):*

[1] This test method is under the jurisdiction of ASTM Committee F01 on Electronics, and is the direct responsibility of Subcommittee F01.18 on Membrane Switches.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

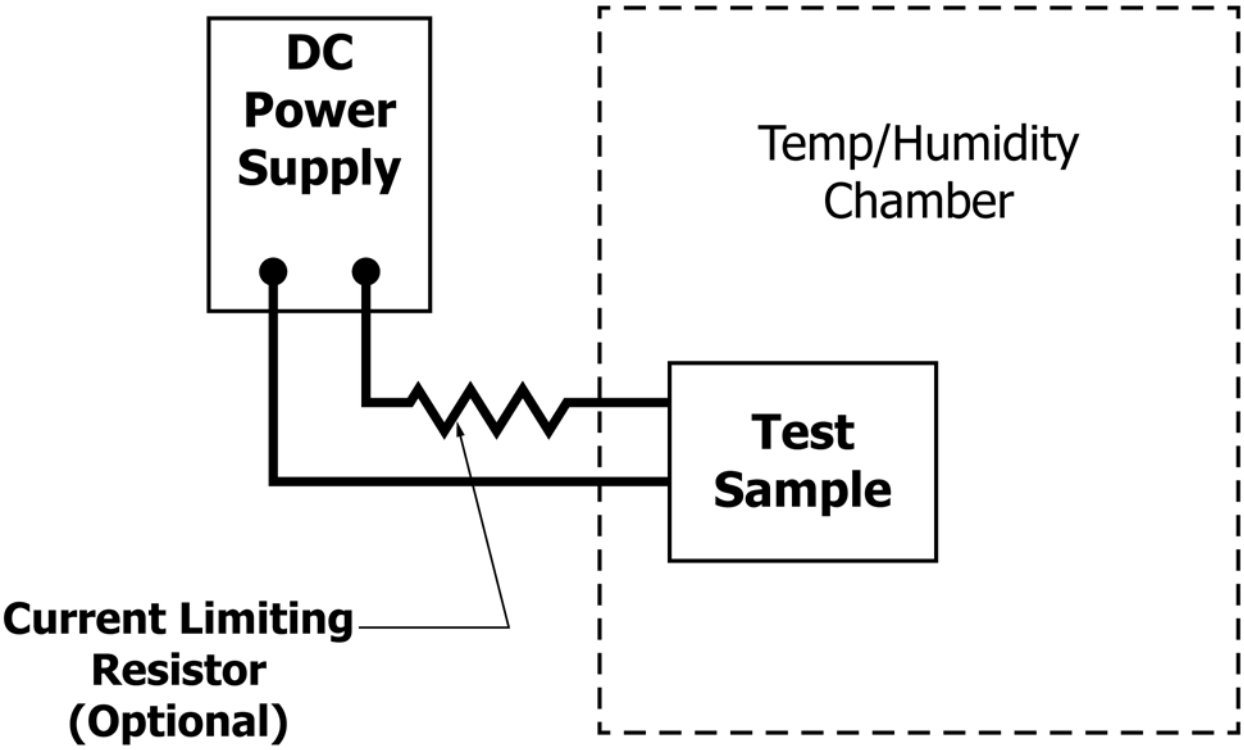

FIG. 1 Test Setup

7.2.1 Secure switch on test surface and measure initial insulation resistance between test points and record results. Protect connector as necessary (see 5.1.5).

7.2.2 Orient switch and flex tail in positions that simulate the end use application positions unless otherwise specified. The flex tail orientation (bent down, up or back) may differ from the orientation of the switch (horizontal, vertical or angled).

7.2.3 Connect power supply leads to test points.

7.3 *In Process Test:*

7.3.1 Apply voltage to the test points. Limit the current to prevent high current from disintegrating the dendrites caused by silver migration. Use a current limiting resistor to limit the current to 2 milliamps or less. (See Fig. 1)

7.3.2 Expose test specimen(s) to specified temperature and humidity while under electrical load for a specified duration, (for example, 10 days at 55°C/85 % RH). The ramp rate to the specified test set points (temperature and humidity) should be chosen to maintain a non-condensing environment.

7.3.3 After specified duration disconnect power supply and remove from chamber. Allow to stabilize following 7.1.1.

7.4 *Post Test:*

7.4.1 Measure final insulation resistance between test points and record results.

7.4.2 An insulation resistance measurement below specified value constitutes a failure of this test.

7.4.3 If a failure, inspect visually (without magnification) for staining or discoloration.

8. Report

8.1 Report the following information:

8.1.1 Humidity,

8.1.2 Temperature,

8.1.3 Voltage,

8.1.4 Current limit value,

8.1.5 Specified duration,

8.1.6 Schematic of unit under test indicating circuit connections and polarity,

8.1.7 Initial insulation resistance, final insulation resistance, pass/fail,

8.1.8 Results of visual inspection,

8.1.9 Mounting substrate and orientation of switch and flex during test, and

8.1.10 Note if flex tail connector is sealed and with what potting material.

9. Keywords

9.1 membrane switch; silver dendrite; silver migration