

Designation: F 1996 – 01

Standard Test Method for Silver Migration for Membrane Switch Circuitry¹

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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
- F 1596 Practice for Exposure of Membrane Switches to Temperature and Relative Humidity
- F 1689 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).
- $^{\rm 1}$ 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.

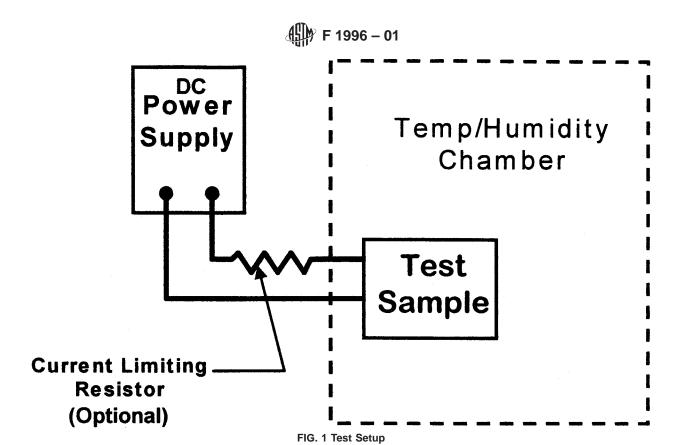
- 5.1.4 Test surface.
- 5.1.5 Connector area may be susceptible to silver migration.
- 5.1.6 Post test handling may damage or destroy silver dendrites.
- 5.1.7 Dendrites normally grow from the cathode conductor to the anode. To test both electrodes of a switch design connect replicate specimens so that 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.

6. Apparatus

- 6.1 *Closed Environmental System*, with temperature and humidity control (see Practice F 1596).
- 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 F 1689).
 - 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)*:
- 7.2.1 Secure switch on test surface and measure initial insulation resistance between test points and record results.
- 7.2.2 Place switch at a 90 \pm 15° to horizontal (unless otherwise specified) in the test chamber to prevent condensate accumulation.
 - 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).
- 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, and
- 8.1.7 Report initial insulation resistance, final insulation resistance, pass/fail.
 - 8.1.8 Report results of visual inspection.

9. Keywords

9.1 membrane switch; silver dendrite; silver migration

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