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Standard Guide for Classifying the Degrees of Ingress of Dust and Water into a Membrane Switch[1]

This standard is issued under the fixed designation F2865; 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 guide establishes a classification system and references test methods for verifying the degrees of:

1.1.1 The ingress of dust into the internal layers of a membrane switch.

1.1.2 Ingress of water into the internal layers of a membrane switch.

1.1.3 Where external test methods are referenced, this guide specifies the special conditions that shall be considered in applying these tests to membrane switches and how the results are interpreted.

1.2 This guide references test methods that can be used to establish the ingress classification of a membrane switch.

1.3 This guide utilizes the test methods and reporting structure of IEC 60529 – (Degrees of Protection Provided by Enclosures) modified for membrane switches.

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

F1578 Test Method for Contact Closure Cycling of a Membrane Switch

F1595 Practice for Viewing Conditions for Visual Inspection of Membrane Switches

F1680 Test Method for Determining Circuit Resistance of a Membrane Switch

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

F2592 Test Method for Measuring the Force-Displacement of a Membrane Switch

2.2 *IEC Standard:*[3]

60529 Degrees of Protection Provided by Enclosures

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *membrane switch, n*—a momentary switching device in which at least one contact is on, or made of, a flexible substrate.

4. Classification System

4.1 The ingress classification of a membrane switch is designated by the MSIP code:

4.1.1 **MSIP 6 5 A**

4.1.1.1 **MSIP** = Membrane Switch Ingress classification.

4.1.1.2 1st Numeral = Dust Protection Code (see Table 1).

4.1.1.3 2nd Numeral = Water (Liquid) Protection Code (see Table 2).

4.1.1.4 **A** = If "A" is present then method or media deviates from this guide and is reported.

4.1.2 The MSIP code comprises a series of numerals. Each numeral represents the level of ingress offered by the membrane switch to each contaminant. In this guide when addressing only the 1st or 2nd numeral the other numeral is replaced with an "X" for clarity. For example, MSIP X5 refers only to testing for water ingression. The "X" notation is not used as a final designation. If testing is not completed a " 0" is used for that numeral (see Table 1 and Table 2).

4.1.3 The numeric designations for dust and water are based on those classified under IEC 60529.

5. Significance and Use

5.1 Ingression protection classifications are widely used by manufacturers for specifying the level of protection offered by enclosures.

5.2 An example of such a classification scheme is IEC 60529. Membrane switch manufacturers are often asked to

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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.

[3] Available from International Electrotechnical Commission (IEC), 3, rue de Varembé, P.O. Box 131, CH-1211 Geneva 20, Switzerland, http://www.iec.ch.

TABLE 1 1st Numeral = Dust Protection Code

Numerals or Letters	Degree of Ingress	Requirement Summary	Test Equipment
0	Not tested or no ingress prevention demonstrated	none	N/A
1,2,3,4[A]	Not applicable to membrane switches	none	N/A
5	Dust protected	Ingress of dust is not totally prevented. The switch operates as declared and the post-test circuit resistance change is less than +30 % of pre-test, and below the maximum circuit resistance as specified by the manufacturer.	IEC 60529 – Dust Chamber Category 2 – No pressure difference created in the chamber
6	Dust tight	No Ingress of Dust in the internal switch cavities. The switch operates as declared and the post-test circuit resistance change is less than +30 % of pre-test, and below the maximum circuit resistance as specified by the manufacturer.	IEC 60529 – Dust Chamber Category 2 – No pressure difference created in the test chamber

[A]IP codes 1,2,3 and 4 are not applicable to membrane switches because they indicate a level of protection for objects of 50 mm, 12 mm, 2.5 mm and 1.0 mm diameter respectively.

TABLE 2 2nd Numeral = Water (Liquid) Protection Code

Numerals or Letters	Degree of Ingress	Test Equipment
0	Not tested or no ingress prevention demonstrated	N/A
1	Vertically dripping	IEC 60529 – Drip Box
2	Dripping (15 deg tilted)	IEC 60529 – Drip Box
3	Spraying	IEC 60529 – Oscillating Tube or Spray Nozzle
4	Splashing	IEC 60529 – Oscillating Tube or Spray Nozzle
5	Jetting	IEC 60529 – Test Nozzle with 6.3 mm nozzle
6	Powerful Jetting	IEC 60529 – Test Nozzle with 12.5 mm nozzle
7	Temporary immersion	IEC 60529 – Complete immersion in water
8	Continuous immersion	IEC 60529 – Complete immersion in water

meet these standards, however the test methods specified within these standards do not address considerations specific to membrane switches.

5.3 The MSIP classification system considers the membrane switch separately from the testing and IP codes used for classifying the enclosure when subject to similar test conditions.

5.4 Ingression testing can be useful to identify design deficiencies.

6. Interferences

6.1 The membrane switch shall be tested in a mounted state specified in this guide because this is a classification of the membrane switch only without consideration of the enclosure.

6.2 The length of time between the manufacture of the membrane switch and the performance of the test.

6.3 The temperature at which the test is being conducted.

7. Conditioning

7.1 Unless otherwise specified in a relevant product standard, the test samples for each test shall be in a clean and new condition, and mounted to the testing backer for 24 h.

7.2 The testing backer must be a rigid transparent backer to better observe the ingression of dust or water into the switch. Testing backer with geometries other than flat shall be reported.

8. Test Method for Ingress of Dust into a Membrane Switch

8.1 *Apparatus:*

8.1.1 Dust Chamber: Reference IEC 60529 Section 13.4.

8.1.2 *Dust Media:*

8.1.2.1 For MSIP5X and MSIP6X : Reference IEC 60529 Section 13.4.

8.1.2.2 *MSIP5XA and MSIP6XA:* Media to be specified.

8.1.2.3 *Mounting Surface*—The testing backer must be rigid and transparent and compatible with the mounting adhesive. Testing backer with geometries other than flat shall be reported.

8.2 *Pre-Test Setup:*

8.2.1 Measurements and Process Testing should be conducted on switches nearest the weakest point for ingress of dust, such as the first switch cavity adjacent to an external vent channel.

8.2.2 Measure the circuit resistance per Test Method F1680.

8.2.3 Measure the insulation resistance per Test Method F1680.

8.2.4 For additional setup requirement see IEC 60529 Section 13.4.

8.2.5 Perform visual inspection per Practice F1595 and establish visual baseline to establish pre-test condition.

8.3 *In Process Test:*

8.3.1 For ingress of dust, numerals 5 and 6, the test is carried out according to Category 2 (testing at atmospheric pressure) per IEC 60529 Section 13.4.

8.3.2 Cycle switch per Test Method F1578 contact closure cycling. The cycling rate shall not be greater than 5 cycles per second. The cycling may be completed without electrical load. The probe, number of cycles, cycling rate and duty cycle will be reported.

8.4 *Post Test:*

8.4.1 Remove dust from the outside of the membrane switch.

8.4.2 Visually inspect from the outside of the membrane switch per Test Method F1595 and record any evidence of dust or cosmetic blemishes.

8.4.3 Measurements are made at the same locations used for Pre-Test Setup.

8.4.4 Measure the circuit resistance per Test Method F1680.

8.4.5 Measure insulation resistance per Test Method F1689.

8.4.6 Visually inspect the inside of the membrane switch. Separate the layers of the switch for internal inspection such as cavities, vent tracks, contact surfaces, etc.

8.4.7 See Table 1 for applicable MSIP rating and result requirement summary.

9. Test Method for Ingress of Water into a Membrane Switch

9.1 *Apparatus:*

9.1.1 *Water Equipment:* Reference IEC 60529 Section 14.0.

9.1.2 *Water Media:*

9.1.2.1 For MSIPX1 to 8: Reference IEC 60529 Section 14.0.

9.1.2.2 For all MSIPX1A to 8A and media to be specified.

9.1.2.3 *Mounting Surface*—The switch shall be fitted to not allow water into the enclosure except through the membrane switch. It is preferred that the switch be mounted on the manufacturers end product enclosure, however if none is provided, use a rigid transparent backer to better observe the ingression of water into the switch.

9.2 *Pre-Test Setup:*

9.2.1 Measurements and Process Testing are completed on switches nearest the weakest point for ingress of water, such as the first switch cavity adjacent to an external vent channel.

9.2.2 Measure *F*max and *Fc* and any other desired characteristic per Test Method F2592 and record.

9.2.3 Insulation Resistance per Test Method F1680.

9.2.4 Reference IEC 60529 Section 14.0.

9.3 *In-Process Test:*

9.3.1 Reference IEC 60529 Section 14.0.

9.3.2 A switch affecting the venting to all switches in the pre-test setup group shall be cycled according to Test Method F1578 contact closure, Paragraph 6, Procedure. The probe, number of cycles and duty cycle are declared. The cycling rate shall be 3 to 5 cycles per second. The cycling may be completed with no electrical load.

9.4 *Post Test:*

9.4.1 Measurements are made at the same locations used for pre-test setup.

9.4.2 Measure the circuit resistance per Test Method F1680.

9.4.3 Measure insulation resistance per Test Method F1689.

9.4.4 Reference IEC 60529 Sections 14.2.1 thru 14.2.8 for MSIPX1 to 8 or MSIPX1A to 8A. The presence of any water inside the membrane switch is determined in part by the measurements indicated above. Visual inspections shall be made where practical; the results are recorded as qualitative observations.

9.4.5 The presence of any water inside the membrane switch is determined by opening the switch for internal inspection of the complete switch such as cavities, vent tracks, contact surfaces, etc. No water is permitted.

9.4.6 See Table 2 for applicable MSIP rating.

9.5 Report the following information if applicable:

9.5.1 Visual cosmetic change per Practice F1595.

9.5.2 Specified maximum circuit resistance.

9.5.3 *Mechanical Changes:*

9.5.3.1 *F*max, *F*min, *Fc* mandatory per Test Method F2592 – other force displacement supporting data and curves optional.

9.5.4 *Electrical Characteristic Changes:*

9.5.4.1 Circuit resistance per Test Method F1680, pre-test and post-test values.

9.5.4.2 Insulation resistance per Test Method F1689, pre-test and post-test values.

9.5.5 *Test Conditions:*

9.5.5.1 Temperature.

9.5.5.2 Humidity.

9.5.6 *Test Probe:*

9.5.6.1 Shape and material (durometer if elastic probe is used).

9.5.6.2 Test probe orientation if other than 90 degrees to sample.

9.5.6.3 Location of contact point if other than center of switch.

9.5.6.4 Duty cycle.

9.5.6.5 Test rate.

9.5.6.6 Number of cycles.

9.5.6.7 Applied force.

9.5.7 Environmental test conditions other than standard control laboratory atmosphere.

9.5.8 Mounting surface description (such as material type, radius, texture, area of contact, etc.).

9.5.9 *Dust*—if tested with a different dust material than specified in IEC 60529.

9.5.10 *Water*—if tested with a different liquid material than specified in IEC 60529.