Designation: F2188 – 02 (Reapproved 2011)

Standard Test Method for Determining the Effect of Variable Frequency Vibration on a Membrane Switch or Membrane Switch Assembly[1]

This standard is issued under the fixed designation F2188; 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 establishes procedures for determining the effect of sinusoidal vibration, within the specified frequency range, on switch contacts, mounting hardware, adhered component parts, solder or heat stakes, tactile devices, and cable or ribbon interconnects associated with a membrane switch or membrane switch assembly.

1.2 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Terminology

2.1 *Definitions:*

2.1.1 *contact closure*—the event at which a specified resistance is achieved on a membrane switch.

2.1.2 *critical resonance frequency*—any point on the specimen that is observed to have maximum amplitude or more than twice that of the base input amplitude or support points.

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

2.1.4 *specified resistance*—maximum allowable circuit resistance as measured between two test points whose internal contacts, when held closed, complete a circuit.

2.1.5 *test points*—two pre-selected conductive points in a circuit loop, possibly including a switch.

3. Significance and Use

3.1 Vibration encountered in the field is not usually simple harmonic.

3.2 This test can be used to determine relative motion between parts, critical frequencies, adhesion strengths, loosening of parts or other physical effects that can cause fatigue or failure.

3.3 Experience has shown that this test will expose potential failures associated with the electronic components of a membrane switch, where tests of lower levels will not.

3.4 This practice can be used to qualify a membrane switch for aerospace, medical and other applications.

3.5 This test is potentially destructive, intended for device qualification.

3.6 Either Test Condition A or B can be chosen, based upon the intent of the test determined by the qualified engineer.

4. Apparatus

4.1 *Vibration Fixture,* capable of holding the unit under test and subjecting it to the specified random frequency and duration as described in the In-Process Test.

4.2 *Contact Closure Detection Device,* (if test is performed under load conditions), instrumentation capable of resolving a switch opening time of greater than or equal to 1.0 ms.

4.3 *Resonant Detecting Instrumentation,* (if determination of critical resonance frequency is desired), capable of determining the critical resonance frequency.

5. Procedure—Test Condition A, 10 g

5.1 *Pre-Test Setup:*

5.1.1 Secure membrane switch on vibration test surface with appropriate fixturing.

5.1.2 Connect switch detection leads to test points on the membrane switch (if contact closure is being monitored during the test).

5.1.3 Function testing to be specified and performed again after test completion for comparison.

5.2 *In-Process Test:*

5.2.1 Subject test unit to sinusoidal vibration varied in frequency from 10 to 500 Hz at a logarithmic rate of 0.5 octave per minute for a duration of 18 cycles per each orthogonal axis (total of 56 times). The amplitude of the vibration shall be

[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.

Current edition approved Feb. 1, 2011. Published March 2011. Originally approved in 2002. Last previous edition approved in 2002 as D2188 - 02. DOI: 10.1520/F2188-02R11.

either 0.06-in. double inch amplitude or 10 gravities (g-peak), whichever is less. The tolerance for the vibration profile is ±3dB.

5.2.2 Visual inspection shall be conducted after each axis of vibration.

5.2.3 Electrical and functional testing shall be specified by the qualified engineer and performed at either test completion or between each axis of vibration.

5.2.4 A failure shall occur if parts show signs of mechanical fatigue, cracking, excessive rubbing or loosening of the supporting hardware. A failure should also be designated if contact closure occurs during vibration and or electrical or other functional testing provides unsatisfactory results.

6. Procedure—Test Condition B, 20 g

6.1 *Pre-Test Setup:*

6.1.1 Secure membrane switch on vibration test surface with appropriate fixturing.

6.1.2 Connect switch detection leads to test points on the membrane switch (if contact closure is being monitored during test).

6.1.3 Function testing to be specified and performed again after test completion for comparison.

6.2 *In-Process Test:*

6.2.1 Subject test unit to sinusoidal vibration varied in frequency from 10 to 500 Hz at a logarithmic rate of 0.5 octave per minute for a duration of 18 cycles per each orthogonal axis (total of 56 times). The amplitude of the vibration shall be either 0.06-in. double inch amplitude or 20 gravities (g-peak), whichever is less. The tolerance for the vibration profile is ±3dB.

6.2.2 Visual inspection shall be conducted after each axis of vibration.

6.2.3 Electrical and functional testing shall be specified by the qualified engineer and performed at either test completion or between each axis of vibration.

6.2.4 A failure shall occur if parts show signs of mechanical fatigue, cracking, excessive rubbing or loosening of the supporting hardware. A failure should also be designated if contact closure occurs during vibration and or electrical or other functional testing provides unsatisfactory results.

7. Report

7.1 Report the following information:

7.1.1 Description of vibration equipment used,

7.1.2 Description of mounting fixture including drawing, diagrams, and photos as necessary,

7.1.3 Functional testing results before and after test,

7.1.4 Describe Test Condition used, either A or B,

7.1.5 Description of the visual fatigue of any components or hardware,

7.1.6 Contact closure event (if monitored), when occurred and axis being tested,

7.1.7 Temperature,

7.1.8 Relative humidity,

7.1.9 Barometric pressure,

7.1.10 Part number or description of switch, or both, and

7.1.11 Date of test.

8. Keywords

8.1 contact closure; frequency; membrane switch; vibration