Designation: F2866 – 11

Standard Test Method for Flammability of a Membrane Switch in Defined Assembly[1]

This standard is issued under the fixed designation F2866; 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 covers the determination of the flammability characteristics of a membrane switch.

1.2 This test method defines the MSB rating of a membrane switch. Each character of the MSB rating represents a discrete characteristic of a membrane switch performance under destructive thermal loading.

1.3 This test procedure will be destructive, but should provide an insight into the relative performance flame-resistance characteristics of differing designs or assemblies, or both.

1.4 This test method will focus on the use of convective contact (burner flame) method for ignition, though other methods of ignition are available.

1.5 This test method is designed to determine if the membrane switch assembly will add (or detract) from the flame propagation from an exterior flame/fire source.

1.6 If this test is intended to be used for an internal flammability source then set up the unit under test (UUT) appropriately and note it in the test scope and results.

1.7 *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. Referenced Documents

2.1 *ASTM Standards:*[2]

E906 Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using a Thermopile Method

3. Terminology

3.1 *Definitions:*

3.1.1 *burn damage*—percentage of the UUT that is damaged due to burn test. This is a visiual observation.

3.1.2 *flame propagation*—refers to patterns in the flame front that are examined (for example, uniform rate of advance, spotty ignition or charring, etc.). These observations are qualitative and should be noted in the data field.

3.1.3 *flame spread rate (FSR)*—the rate at which a flame front travels along the surfaces of tested materials/assemblies, typically measured in mm/s or in./min.

3.1.4 *flame target area*—refers to the normalized target area of a UUT that will be used for ignition location. Any variations should be noted.

3.1.5 *flame time (F_{time}) or flame endurance*—amount of time, usually in seconds, that a self-sustaining flame will endure after removal of initial ignition source before flame on UUT is extinguished.

3.1.6 *flame time of drippings ($F_{time,drip}$)*—amount of time that burning drippings, if any, remain burning. Typically measured in seconds.

3.1.7 *gauze ignition*—this is a verification that UUT ignites the gauze.

3.1.8 *ignition source*—the source that provides the heat-flux to begin the flammability test. This test method will recommend a convective flame for the ignition source, however, care should be taken that any comparative tests should use the same method of ignition.

3.1.9 *mass-loss (m_{loss})*—the mass from a test specimen it lost to smoke, vaporization and char debris carried away or fallen away, or both, during the flammability test cycle. Typically measured in grams (average).

3.1.10 *membrane switch assembly*—the membrane switch should not be tested in its unmounted state. The switch sample should be mounted onto the final end-use enclosure, panel, bezel, or agreed upon material.

3.1.10.1 *Discussion—Assembly Specimen*: This test method is trying to provide a practical world analog for the results herein obtained. As a result, the unit under test (UUT) must in the final mounted condition. The test is able to show flame-resistance in the final assembly as it interacts with the membrane switch's construction.

[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.

3.1.11 *MSB*—rating to quantify the burn characteristics of a membrane switch. Each character of the MSB rating represents a discrete characteristic of a membrane switch performance under destructive thermal loading. (see Table 1.)

3.1.12 *time-to-ignition* (t_{ign}) —the time to ignite UUT under thermal loading (by any ignition source selected) with a self-standing flame front on the UUT (flame on the test specimen moving away from the thermal load source). The method for ignition (source) can be conductive contact (heated filament), radiant energy (electrical or gas) or convective (free flame). Typically measured in seconds.

3.1.12.1 *Discussion*—A "perfect" incombustible material will have infinite time to ignition; similarly a UUT with no sustained flame within the length of the ignition exposure would be reported as "no ignition time observed".

3.1.12.2 *Discussion*—Using a convective (free flame) ignition source the time to ignition may be difficult to determine (due to the fact that there is interference between the ignition source and the ignition of the UUT).

4. Significance and Use

4.1 There are numerous flammability ratings and tests. Almost without fail, these standards and tests are focused on very specific industries or results, many of which are not applicable to the membrane switch/human machine interface assembly. This test is designed to provide relative results between membrane switches that have been assembled to the unit's final enclosure, housing, etc.

4.2 In addition to the test's measurement of the rate of burn, a laboratory can also observe the effects of burning material falling from the test specimen onto other materials (typically a gauze test area) not directly part of the test specimen. The indirect burning is an issue of interest to see if the test specimen will be able to act as an initiator for a far greater and more damaging flame event (fire). Observations should be noted, as qualitative descriptions, as appropriate.

4.3 This test can measure the flammability via the use of high-speed photographic or video equipment.

4.4 Temperature of the ignition source can be measured via a calibrated thermocouple pyrometer, calorimeter or IR thermometer with an appropriate range.

4.5 This test is not designed to provide a PASS or NO PASS status for a switch, rather, it is designed to provide a "grade" for the level of flammability of a membrane switch assembly (as defined in 3.1.10). The end user should make the final determination if the level of flammability is acceptable for the particular application.

5. Interferences

5.1 *Method of Ignition*—Results compared between different methods of ignition (radiant versus convective) may provide different results for t_{ign}. Therefore any comparative samples should use the same calibrated method of ignition.

5.2 *Mounted in Final Assembly*—Mounting the membrane switch to the end use substrate or enclosure will account for the thermal heat sink effect provided by the mounting substrate or enclosure.

5.3 *Rigid Fixture Support*—The membrane switch assembly should have rigid fixture support in order to allow remote testing during the burn cycle. UUT should be mounted to insure that the parts to do not fall while under test.

5.4 *Venting of the FPA Test Booth*—The type and placement of venting and exhausting for airflow in test booth should be noted or documented by photos or drawings, or both. Duplication of test results may be achieved only with the same amount of air-flow and air-to-fuel mixture in the test booth.

5.5 *Oxygen Concentration*—The concentration of the oxygen in the FPA chamber atmosphere (normal air, concentrated O_2, pressurized, etc.) during the test or oxidizers, or both, found in the test material(s) will affect the results.

5.6 *Duration of Ignition*—The longer the ignition burn test the greater the chance the part will ignite and begin to exhibit flame propagation.

5.7 *Relative Humidity in FPA*—It is thought this will have some effect on the results, however the extent of which is to be determined.

6. Apparatus

6.1 *Fire Propagation Apparatus (FPA)*—Draft-free booth made of non-flammable material (high-temp Pyrex, ceramic or steel) rectangular or cylindrical space with proper: *(1)* ventilation for exhaust fumes, smoke, etc., *(2)* free empty area for mounting rigs and UUT and *(3)* appropriate fixings and mounts, as needed for ignition source and *(4)* vent holes or ventilation, or both, for inflow of fresh air.

6.1.1 *FPA*—may also provide oxygen in standard sea-level normal air concentration, 40 % oxygen, air with pure nitrogen

TABLE 1 MSB Rating

Model	$t_{(ign)}$ Time to ignition	*FSR* Flame Spread Rate	$F_{(time)}$ Continuation of burn	$m_{(loss)}$ Mass loss	Burn Damage %	Gauze Ignition
The following >>	0 = no ignition	0 = no burn	0 = self extinguishing	0 = no loss	0 = 0 % damage	0 = no
should be	1 = 10 s>	1 = 1 mm/s	1 = 1 s	1 = 10 % loss	1 = 10 % damage	
considered	2 = 9 s	2 = 2 mm/s	2 = 2 s	2 = 20 % loss	2 = 20 % damage	
when deciding	3 = 8 s	3 = 3 mm/s	3 = 3 s	3 = 30 % loss	3 = 30 % damage	
on a switch	4 = 7 s	4 = 4 mm/s	4 = 4 s	4 = 40 % loss	4 = 40 % damage	
MSB rating	5 = 6 s	5 = 5 mm/s	5 = 5 s	5 = 50 % loss	5 = 50 % damage	
	6 = 5 s	6 = 6 mm/s	6 = 6 s	6 = 60 % loss	6 = 60 % damage	
	7 = 4 s	7 = 7 mm/s	7 = 7 s	7 = 70 % loss	7 = 70 % damage	
	8 = 3 s	8 = 8 mm/s	8 = 8 s	8 = 80 % loss	8 = 80 % damage	
	9 = 2 s or less	9 = very very fast burn	9 = 9 s>	9 = 90 %>	9 = 90 % or more	9 = yes