



Designation: F 2592 – 08

# Standard Test Method for Measuring the Force-Displacement of a Membrane Switch<sup>1</sup>

This standard is issued under the fixed designation F 2592; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This test method covers the measurement of force displacement characteristics of a membrane switch.

1.1.1 This test method replaces Test Method F 1570 (Tactile Ratio). Tactile Response Slope better represents the characterization of tactile sensation, previously called “Tactile Ratio” in Test Method F 1570.

1.1.2 This test method replaces Test Method F 1682 (Travel).

1.1.3 This test method replaces Test Method F 1597 (Actuation and Contact Force).

1.1.4 This test method replaces Test Method F 1997 (Switch Sensitivity).

1.2 Force displacement hysteresis loop curve can be used in the determination of Actuation Force, Displacement, Contact Force, Return Force, and Tactile Response Slope.

1.3 *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:* <http://www.astm.org/catalog/standards/sis/5c3ab5a9-c080-4800-9000-000000000000>
- F 1570 Test Method for Determining the Tactile Ratio of a Membrane Switch<sup>2</sup>
  - F 1597 Test Method for Determining the Actuation Force and Contact Force of a Membrane Switch
  - F 1682 Test Method for Determining Travel of a Membrane Switch
  - F 1997 Test Method for Determining the Sensitivity (Teasing) of a Tactile Membrane Switch

## 3. Terminology

### 3.1 Definitions:

<sup>1</sup> 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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<sup>2</sup> Withdrawn. The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

3.1.1 *break displacement ( $T_b$ )*—the displacement at contact break.

3.1.2 *break force ( $F_b$ )*—the force at contact break.

3.1.3 *circuit resistance*—electrical resistance as measured between two test points whose internal contacts, when held closed, complete a circuit.

3.1.4 *closure (make)*—the event at which a specified resistance is achieved.

3.1.5 *contact break*—point at which circuit resistance is higher than specified resistance on return.

3.1.6 *contact displacement ( $T_c$ )*—the displacement at contact closure.

3.1.7 *contact force ( $F_c$ )*—the force at contact closure.

3.1.8 *displacement*—displacement is sometimes referred to as “switch travel.”

3.1.9 *F<sub>max</sub>*—an applied force, maximum force measured prior to or including point (*F<sub>min</sub>*) (see Fig. 1).

3.1.9.1 *Discussion*—Sometimes referred to as Actuation Force.

3.1.10 *F<sub>min</sub>*—an applied force, minimum force seen between *F<sub>max</sub>* and point at which probe movement ceases.

3.1.10.1 *Discussion*—*F<sub>max</sub>* can equal *F<sub>min</sub>*.

3.1.11 *force-displacement hysteresis curve*—relationship between force applied and displacement of a membrane switch in terms of the actuation and return (recovery).

3.1.11.1 *Discussion*—Usually expressed as a line graph; sometimes referred to as Force-Travel curve (see Fig. 1).

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

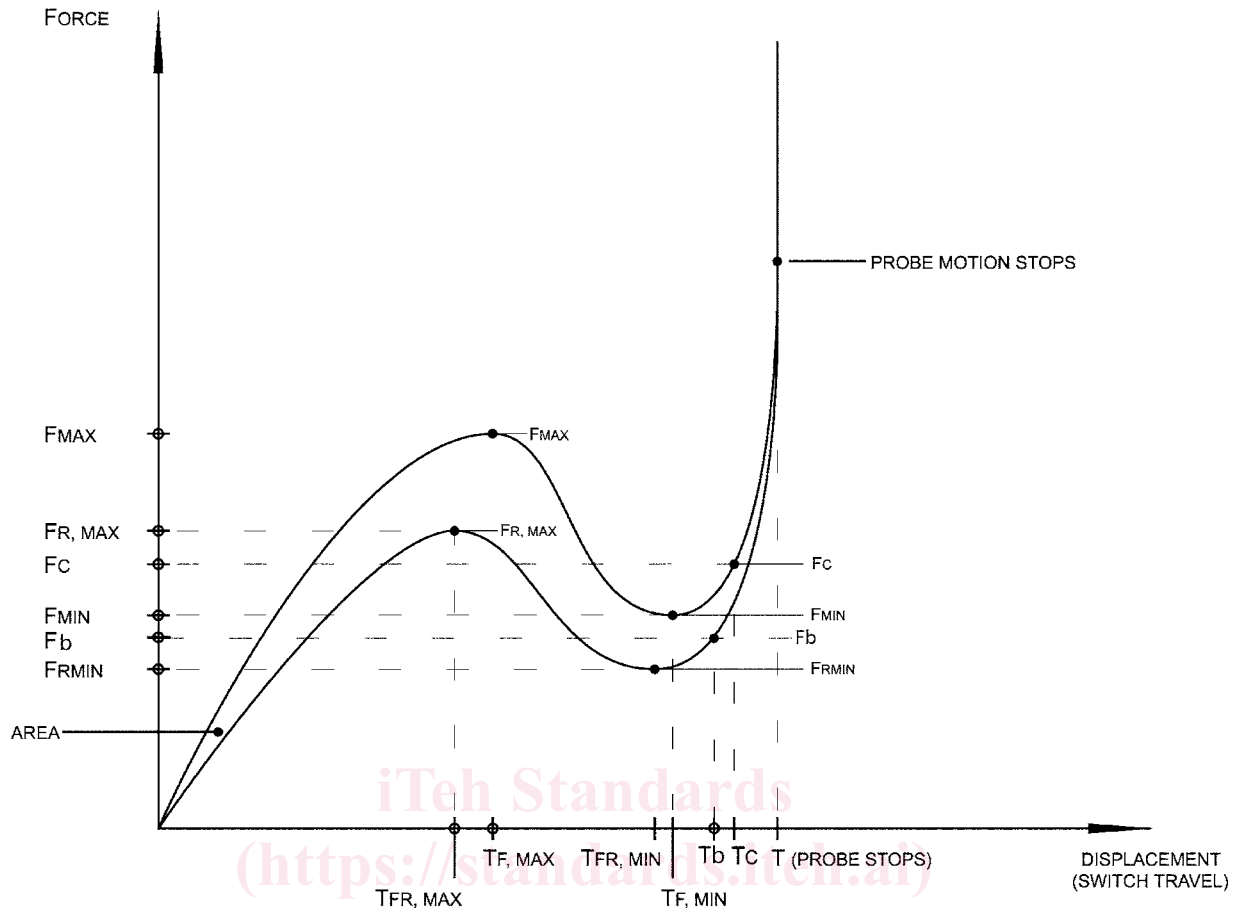
3.1.13 *non-tactile switch*—switch that does not have a tactile response and therefore has a response slope equal to zero because *F<sub>max</sub>* and *F<sub>min</sub>* are the same (see Fig. 2).

3.1.14 *return min force ( $F_{rmin}$ )*—minimum force seen during return cycle before reaching *F<sub>rmax</sub>*.

3.1.15 *return max force ( $F_{rmax}$ )*—maximum force measured during return cycle after achieving *F<sub>rmin</sub>*.

3.1.16 *specified resistance*—maximum allowable resistance as measured between two terminations whose internal switch contacts are held closed to complete a circuit.

3.1.17 *switch teasing (break)*—the displacement measurement on the force-displacement curve between contact break (*F<sub>b</sub>*) and return force (*F<sub>rmin</sub>*).



NOTE—Area between forward and return curves is the difference in work by the tactile mechanism showing hysteresis in the tactile system.

FIG. 1 Force Displacement Hysteresis Loop

3.1.18 *switch teasing (make)*—the displacement measurement on the force-displacement curve between contact force ( $F_c$ ) and minimum force ( $F_{min}$ ).

3.1.19 *tactile recovery slope*—rate of change of return force with respect to displacement, as measured between  $T_{fmin}$  and  $T_{fmax}$  (see Fig. 3).

3.1.20 *tactile response*—a physical sensation, caused by a sudden collapse or snapback, or both, of a membrane switch.

3.1.21 *tactile response slope*—rate of change of applied force with respect to displacement, as measured between  $T_{fmax}$  and  $T_{fmin}$  (see Figs. 3 and 4).

3.1.22 *tactile switch*—a switch that has a tactile response and therefore has a response slope less than zero (negative slope).

3.1.23  $T_{fmax}$ —Displacement at  $F_{max}$ .

3.1.24  $T_{fmin}$ —Displacement at  $F_{min}$ .

3.1.25  $T_{frmax}$ —displacement at  $F_{rmax}$ .

3.1.26  $T_{frmin}$ —displacement at  $F_{rmin}$ .

#### 4. Significance and Use

4.1 The force and displacement values when converted to a slope are useful in quantifying the differences in tactile response among membrane switches.

4.2 Specified resistance is useful to manufacturers and users when designing membrane switch interface circuitry.

4.3 Actuation force and contact force are useful to manufacturers and users in determining the suitability, reference and aesthetics of a membrane switch in a given application.

4.4 The tendency of a switch to make or break electrical contact at unexpected moments during closure or release can be a sign of a poor design. The degree of teasing can range from a simple annoyance to a failure of critical control process.

4.5 The amount of switch sensitivity or teasing can also be a result of poor surface conductivity that will prevent an electrical event even when switch poles are in partial contact.

#### 5. Interferences

5.1 Results compared between a manual measurement system and automated measurement system can be significant based on the response time of operator and the equipment.

5.2 The switch sample should be mounted on a rigid support in order to get a more accurate representation of the force and displacement (travel).

#### 6. Apparatus

6.1 *Test Probe*, made of non-elastic material with a circular flat tip with a diameter approximately 50 % of the minimum spacer opening for a non-tactile switch or 50 % of the tactile element diameter for a tactile switch.