INTERNATIONAL

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Standard Test Method for Determination of Operating Force of Sliding Windows and Doors[1]

This standard is issued under the fixed designation E2068; 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 determines the operating forces for opening and closing horizontal and vertical sliding windows and horizontal sliding door systems. It does not address the forces required for opening pivoting, projecting, or other fenestration systems. This test method does not address the use or performance of add-on devices or mechanical operators that might be installed to reduce operating forces of sliding windows or doors. It deals only with the forces necessary to open and close a sash or panel through the direct application of force to the operable sash or panel.

1.2 This test method is suitable for laboratory product comparisons or for qualifying products, or both, as meeting window or door operating force specifications. This test method is also suitable for use in the field to determine the operating forces required to open and close installed sliding windows and doors.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 *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.* For specific precautionary statements, see Section 7.

2. Referenced Documents

2.1 *ASTM Standards:*[2]
E631 Terminology of Building Constructions

3. Terminology

3.1 Definitions are in accordance with Terminology E631 unless otherwise specified.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *breakaway force*—the force required to start a sash (panel) in motion from a fully closed or fully open position.

~~3.2.2 *fully open position*—the point at the limits of the operating hardware (if applicable) or the point at which the sash or panel contacts a limiting device.~~

3.2.2 *fully closed position*—the position of the sash or panel after being closed, latched, and unlatched, or where the sash or panel is closed to its maximum engagement within a frame or pocket if no latching mechanism is provided.

3.2.3 *fully open position*—the point at the limits of the operating hardware (if applicable) or the point at which the sash or panel contacts a limiting device.

3.2.4 *in-motion operating force*—the force required to maintain a sash or panel in motion while moving the sash or panel between 1 in. from fully open to 1 in. from fully closed positions, or 1 in. from fully closed to 1 in. from fully open position.

4. Summary of Test Method

4.1 Two equivalent test methods for determining operating force are described. Test Method A uses dead weights and a cable and pulley system to apply force to operate a sash or panel. Test Method B uses a force gage and hand-applied pressure to operate

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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.

a sash or panel. The test specimen is mounted in a rigid support frame. After attaching the loading system to the operating sash or panel, the weight or force is applied and increased until the sash or panel is put into motion. This determines breakaway force. Starting from ~~one inch~~1 in. (25 mm) from a closed or open position the minimum amount of weight or force required to keep a sash in motion, once it is started moving, is measured. This determines the in-motion operating force. Forces required to operate a sliding window or patio door in both opening and closing directions are determined by this test method.

5. Significance and Use

5.1 This test method determines the operational forces of sliding windows and doors by simulating force applied by hand directly to movable sash or panels. Breakaway and in-motion operating forces are measures of the ease of operation of fenestration products. Product specifications, building codes, and building specifications establish operating force limits as measures of product performance or limits for handicapped accessibility, or both.

5.2 Window and door performance standards for air infiltration and water penetration in some cases require operating force measurements to be made and reported as an indication of the operability of the test specimen.

5.3 Operating forces can vary significantly from unit to unit due to factors such as installation parameters, wearing of sliding or rolling parts, lubrication, stiffening or softening of weather-strip, and environmental factors (for example, humidity, temperature, accumulation of dirt, and so forth). Therefore, when applied to new product designs, this test method requires that units be tested in a laboratory under controlled conditions including accurate mounting (plumb, square, and level) following the manufacturer's instructions. Use of this test method in the field does not necessarily indicate the operating forces that are inherent in the particular window design, but rather, provides a measurement of the forces required for operation of the particular unit at the particular time. The user is cautioned that installation defects such as bowed jambs, racked frames, or inadequate anchoring can result in binding or sticking of movable components and increased operating forces.

5.4 This test method requires measurement of both breakaway and in-motion operating forces. Generally, breakaway force is higher than in-motion operating force due to the difference between static and dynamic friction coefficients or the presence of weather-stripping and sash pockets, or both. Traditional fenestration product standards have required determination of in-motion operating force in the opening direction only and referred to this simply as operating force.

5.5 This test method is intended to determine the forces required to operate a window or sliding door which is properly installed and which is operated by hand application of force to a handle, pull bar, or sash member. Application of force through jerking or impact motion is not measured or evaluated by this test method. Operating forces can be significantly different between the opening and closing directions of movement; therefore, this test method involves measurements in both directions of movement.

5.6 This test method provides for two procedures which include a dead weight test method (Test Method A) and a force gage test method (Test Method B) of applying and measuring forces required to operate a sliding window or sliding door. When properly applied, both test methods are deemed to produce equivalent results. The dead weight test method is considered to be less likely to be affected by the operator's skill in applying loads in a steady and properly timed manner. The force gage test method is considered simpler to apply and more applicable to field testing where the installation of pulleys and cabling is often impractical. Both test methods are subject to a similar uncertainty.

6. Apparatus

6.1 This description of apparatus is general in nature and any arrangement of equipment capable of performing the test method, within allowable tolerances, is permitted.

6.2 *Test Method A*—The primary equipment used in Test Method A consists of a set of weights capable of being suspended and applied in 1-lb (0.5-kg) increments, a platen, lightweight flexible cable or cord, ball-bearing sheave(s), and a framework capable of supporting the sheaves and cable system in the appropriate location. Sheaves used to transmit the deadweight load to the specimen under test shall be a minimum of 3 in. (75 mm) in diameter. Weights used are to be Class F or better. In addition, a force gage in accordance with ~~7.3.1shall~~ 7.3.1 shall be used to verify that the load applied is transmitted to the unit under test when two or more sheaves are used to direct the load. (See Fig. 1.)

6.3 *Test Method B*—For Test Method B, a calibrated force gage with an accuracy of ±0.5 lbf (2.0 N) and with a peak hold and continuous reading capability is required.

6.4 Hardware such as hooks, cable, cord, small pulleys, and screw-eyes are to be used as necessary to provide for attachment of the loading system to the sash or panel.

7. Safety Precautions

7.1 When using Test Method A, be prepared for sudden movement of the sash or panel and potentially rapid dropping of the weights. The weights are to be suspended in such a manner that their fall will be stopped before the sash moves to the full limit of its travel to reduce impact between components. When using Test Method B, be prepared for sudden movement of the sash or panel.