Designation: E405 – 04 (Reapproved 2012)

Standard Test Methods for Wear Testing Rotary Operators for Windows[1]

This standard is issued under the fixed designation E405; 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 These test methods describe the wear testing of gear-type rotary operating devices used for opening and closing windows (Note 1).

1.2 These test methods do not directly determine the effects of varying environmental conditions but may be employed after environmental exposure to evaluate the effect of such exposure.

1.3 These test methods are not intended to evaluate the structural adequacy of the operator in resisting the maximum force to which it may be subjected.

NOTE 1—Certain types of rotary window operators, such as torque-bar operators and telescopic operators cannot be tested by these test methods.

1.4 The values stated in inch-pound units are to be regarded as the standard. The metric equivalents of inch-pound units may be approximate.

1.5 *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 a specific hazard statement, see 9.1.2.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E631 Terminology of Building Constructions

3. Terminology

3.1 *Definitions*—Definitions are in accordance with Terminology E631 unless otherwise indicated.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *closing torque, n*—a constant torque applied to the input shaft when the operator is in the fully closed position, simulating the forces applied by a person tightly closing the window and shall be expressed in pound-force-inches (or newton metres).

3.2.2 *fully closed position of the operator, n*—the position of the operator with the window in a fully closed position.

3.2.3 *fully opened position of the operator, n*—the position of the arm from 2 to 5° short of locking the mechanism with the window in an open position.

3.2.4 *gear-type rotary operator, n*—a mechanical operating device for opening and closing windows. It consists basically of an operating handle turning an input shaft which drives a gear mechanism that causes an arm or arms to pivot, operating the window.

3.2.5 *operating moment, n*—the product of the applied force and the length of the output lever arm from the point of load application to the pivot axis. It shall be expressed in pound-force-inches (or newton metres). During a test cycle, the operating moment varies from a maximum value with the arm in a centered position (peak operating moment) to some lesser value as the arm is moved away from the centered position.

3.2.6 *operator test specimen, n*—an entire, assembled gear-type rotary operator, including the operating handle.

3.2.7 *test cycle, n:*

3.2.7.1 *Test Method A*—fully opening and fully closing the operator.

3.2.7.2 *Test Method B*—the number of rotations of the handle to open and close the operator fully.

3.2.8 *test force, n, for Test Method A*—the force applied to the operator arm at the point of attachment. The required test force in pounds-force (or newtons) is equal to the specified peak operating moment in pound-force-inches (or newton metres) divided by the distance in inches (or metres) measured perpendicular to the line of action of the force from the pivot axis to the point of attachment.

4. Summary of Test Methods

4.1 These test methods consist of subjecting the rotary operator to an operating moment against which the operator shall work in a cyclic function of opening and closing. Test Method A evaluates the operator for its ability to resist wear through a given number of cycles against the test moment with a specified torque applied to the input shaft. Test Method B

[1] These test methods are under the jurisdiction of ASTM Committee E06 on Performance of Buildings and are the direct responsibility of Subcommittee E06.51 on Performance of Windows, Doors, Skylights and Curtain Walls.

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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.

evaluates only the rotating fingergrip portion of handle assemblies having rotating fingergrips.

5. Significance and Use

5.1 These tests provide standard methods for evaluating the mechanical performance of the rotary-type window operators, while the operators are subjected to cyclic wear in opening and closing against the operating moment.

6. Apparatus

6.1 The apparatus described is general in nature and any arrangement of equipment capable of performing the test procedure within the allowable tolerances is permitted.

6.2 *Test Method A:*

6.2.1 The test apparatus for Test Method A shall consist of a frame for mounting the rotary operator with the operator arm(s) centered (approximately the center of travel); test weights up to 5 lbs (2280 g) accurate to within ±1.0 % or test weights above 5 lbs (2280 g) accurate to within ±0.5 %, attached by flexible cable to the arm(s) to provide the required test forces; an attachment bolt fastening the cable to the arm; a torque-limiting clutch, whose output is within ±15 % of the specified closing torque, attached to the handle drive mechanism in line with the operator input shaft and driven by a reversible motor; and limit switching devices to effect reversal of rotation at the fully open and fully closed operator positions (see Fig. 1).

6.2.2 The arm or the test attachment bolt through the arm shall bear against the test frame, if necessary, to prevent the arm from closing beyond the nominal fully closed position. The cables shall be adjustable to provide an equal tension force in both the cables when the test attachment point and pivot are centered.

6.2.3 Fig. 2 shows how, if a vertical arrangement were used, to test a single-arm operator, a system of two test weights, an upper weight equal to the test force, and a lower weight of twice the test force would act to provide the required downward force when the arm is above the center position of its travel and the same force upward when the arm is below the center of its travel. For operators with two arms, sum of the test weight on each arm should equal the total test weight with neither arm seeing less than 25 % of the total test weight. The test weight is to be divided proportionally to simulate the loading seen in actual use. Fig. 3 shows a typical handle drive fork used to operate the rotary operator. If it is impractical to drive certain operating handles through their grip portion, they may be modified so that portion making the connection to the operator input shaft is used as part of the test operator.

6.3 *Test Method B:*

6.3.1 The test apparatus for Test Method B shall consist of a motor, shaft, timer, test weight, and attaching collar. The reversible motor drives a horizontal shaft to which the test handle is attached. The shaft shall be obtained by removing the input shaft from an operator or as an additionally supplied part. The handle end of the shaft shall be identical to the input shafts of the test operators. The timing device effects a reversal of the motor at required intervals. The split collar carries the test weight and attaches to the rotating fingergrip of the handle causing one revolution of the fingergrip with respect to the handle for each revolution of the handle (see Fig. 4).

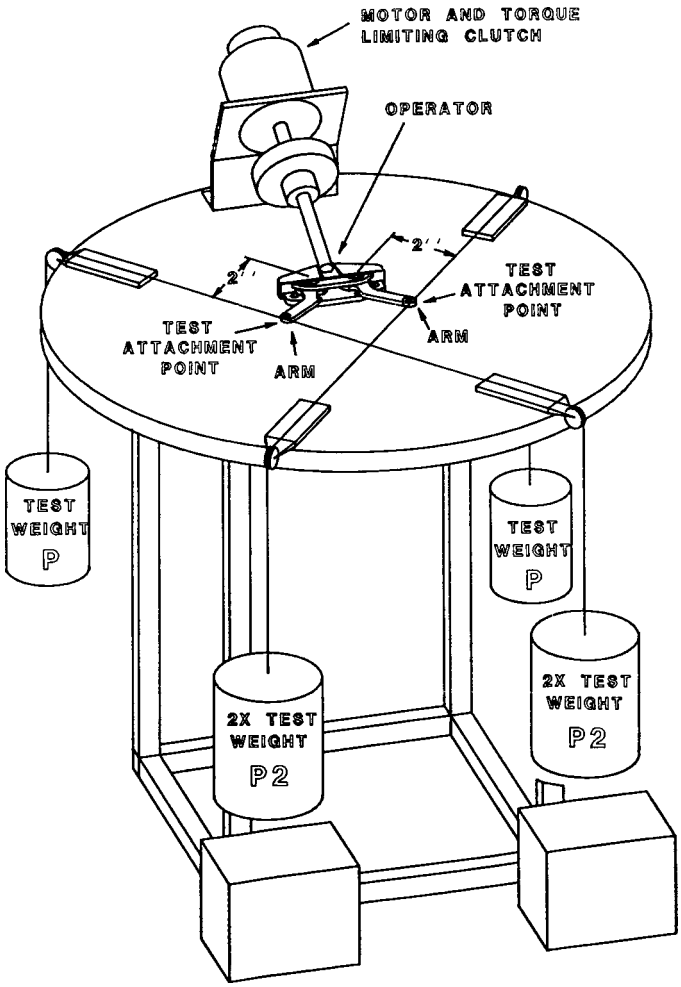

FIG. 1 Typical Operator Test Apparatus

7. Test Specimens

7.1 The operator test specimens shall be representative in all respects of the operators to be qualified under these test methods. Unless otherwise specified, the specimens shall consist of six identical production samples of the complete rotary operator, four of which shall be selected at random for testing. The remaining two samples shall be identified and filed with the four tested specimens as part of the retained sample.

7.2 Handles shall be included in all test specimens. Where several styles of handles are furnished to fit different models of operators having identical input shaft ends, handles tested on one model of operator shall be considered tested at that test operating moment and closing torque on all models of operators with identical shaft ends.

8. Required Information From Specifying Authority

8.1 The specifying authority shall provide the following information:

8.1.1 Identification of the test samples,

8.1.2 The required peak operating moment, in some full multiple of 10 lbf·in. (1.1 N·m),