

# American National Standard

*Test Procedure and Acceptance Criteria for —  
Physical Endurance for Steel Doors, Frames,  
Frame Anchors and Hardware Reinforcings*



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**Steel Door Institute**

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American National Standard

Test Procedure and Acceptance Criteria for —  
Physical Endurance for Steel Doors, Frames,  
Frame Anchors and Hardware Reinforcings

Secretariat  
**Steel Door Institute**

Approved Spring, 2001  
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# American National Standard

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**Foreword** (This Foreword is not part of American National Standard A250.4-2001)

The material contained in this document has been developed under the auspices of the Technical Committee of the Steel Door Institute.

The original standard was issued on July 28, 1980 and was revised in 1987 and again in 1994. The current edition is a revision of the 1994 document with the contents being updated to reflect changes that have taken place in the steel door and frame industry since that time.

Suggestions for improvement gained in the use of this standard will be welcome. They should be sent to the Steel Door Institute, 30200 Detroit Road, Cleveland, OH 44145-1967.

The organizations that have approved this standard are part of the ANSI A250 Accredited Standards Committee, formed February 8, 1991, and are as follows:

- American Institute of Architects
- American Insurance Services Group, Inc.
- Architectural Woodwork Institute
- Builders Hardware Manufacturers Association
- Door and Hardware Institute
- Factory Mutual Research Corporation
- General Services Administration
- International Conference of Building Officials
- Intertek Testing Services
- Insulated Steel Door Institute
- Manufactured Housing Institute
- National Association of Architectural Metal Manufacturers
- National Association of Home Builders
- Steel Door Institute
- Underwriters Laboratories Inc.
- Wood Door Manufacturers' Association

The Technical Committee of the Steel Door Institute, which has developed this Standard, had the following personnel at the time of approval:

- Claus Heide, *Chairman*
- Tom Janicak, *Vice Chairman*
- J. Jeffery Wherry, *Manager*

<i>Organization Represented</i>	<i>Name of Representative</i>
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Ceco Door Products .....	Tom R. Janicak
Curries Company .....	Stan L. Horsfall
Deansteel Manufacturing Co. ....	Claus D. Heide
The Kewanee Corporation .....	Jason Lisewski
Mesker Door Company .....	Tim Jarvis
Pioneer Industries .....	Gopal S. Kukke
Republic Builders Products .....	Craig Ordmandy
Security Metal Products .....	Cecil McKinney
Steelcraft .....	Kurt Roeper
Steel Door Institute .....	J. Jeffery Wherry

## American National Standard

# Test Procedure and Acceptance Criteria for – Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcings

## 1 Purpose

The primary purpose of this procedure shall be to establish a standard method of testing the performance of a steel door mounted in a pressed steel or channel iron frame, installed with appropriate anchors, under conditions that might reasonably be considered an accelerated field operating condition.

The user of this performance standard must temper his usage with the knowledge that there are many variables that affect door performance, such as different hardware, anchors, glass and louver cutouts, field modification by parties other than the manufacturer, environmental factors, such as heat, cold, moisture, etc.

### 1.1 Reference documents

ANSI/BHMA A156.1-1997 *Butts and Hinges*

ANSI/BHMA A156.3-1994 *Exit Devices*

ANSI/BHMA A156.4-1992 *Door Controls — Closers*

ANSI/BHMA A156.7-1988 (R1997) *Template Hinge Dimensions*

## 2 Apparatus and equipment

The apparatus and equipment used shall be the same when testing doors, frames or frame anchors. The main testing structure shall be constructed as shown in figures 1 and 2. The structure shall conform to the parts shown, except the opening width and height are permitted to vary to allow the testing of various door sizes. The test frame shall be anchored in such a manner as to insure rigidity.

The swinging mechanism shall be in two parts:

### 2.1 Door opener

The door opener shall be an air motor positioned at 65° to the plane of the door in its closed position. This will apply pressures on the crossbar of an exit device mounted on the test door. The actual contact point shall be set to push the door far enough to open it 60° ±5°, and retract to allow the door closer to bring the door back into its original closed position and then begin the cycle again. See the specifications in figures 1 and 1A.

### 2.2 Hardware

The exit device, door closer and hinges used in testing shall be selected based on the manufacturer's recommendations for the testing level described in Swing Test Form 1. The manufacturer's hardware part number shall be a part of the report. All hardware shall be applied to the door and frame with fasteners normally provided by the hardware manufacturer (for example, machine screws or sex bolts) in the location recommended by the door manufacturer. The hardware shall conform to the latest editions of American National Standards ANSI/BHMA A156.1, 3, and 4. The device shall be set to close the door at an approximate rate of 15 cycles per minute.

Note: Where the applicable BHMA Test Standards has been followed, this information shall be recorded as part of the test report.

## 3 Preparation for test

The door shall be hung in the frame on the hinges. Hinges used shall conform to American National Standard ANSI/BHMA A156.7-1988

(R1997), or latest edition. Care shall be taken to insure the hinges are properly applied to the door and frame as recommended by the hinge manufacturers, and any hinge fillers, if any, are in place. The clearance between the door and the frame shall be made part of the performance test report.

The door frame shall be securely fastened to the test frame opening structure in accordance with the manufacturer's instructions. The manufacturer is permitted to select anchors for specific wall applications (i.e., wood stud anchors or steel stud anchors, loose or welded in or existing masonry wall anchors).

Mutes shall be installed on the frame and the stop face of the door shall contact the mutes. The frame shall be checked for plumbness, squareness, rigidity, and general appearance.

When applicable, wall surface materials (e.g., drywall) shall be applied to the test frame opening at the frame throat to simulate actual construction conditions.

## **4 Test specimen**

### **4.1 Doors**

Unless specified otherwise, the test shall be performed on a 3070 nominal size door. Other sizes shall be specified for testing if the user deems it necessary. Any door of the same construction but of lesser size than the successfully tested specimen shall be deemed to have passed. Production doors shall be used except when this procedure is used in experimental work.

A detailed description of the construction of the door and the applicable process such as welding, bonding, etc. used for attaching components, shall be recorded as part of the performance report, Swing Test Form 1, under the "remarks" section.

### **4.2 Frames**

Unless specified otherwise, the test shall be performed on a 3070 nominal size frame having a 5 3/4" jamb depth. Other sizes are permitted to be specified if the user deems it necessary. Production frames and anchors shall be

used, except when this procedure is used in experimental work.

A detailed description of the door frame which shall cover all components used in the frame's construction, as well as applicable processes (such as welding, etc.) used for attaching and connecting components, shall be recorded as part of the performance report, Swing Test Form 2, under the "remarks" section.

### **4.3 Frame anchors**

Unless specified otherwise, anchors tested shall be those designed for a 5 3/4" jamb depth frame. This will allow the test frame vertical support channels to remain at a reasonable size. The test is intended to evaluate the performance of, but not limited to, welded-in wood stud, loose snap-in wood stud, welded-in steel stud, loose snap-in steel stud, compression anchor, welded-in existing masonry wall and loose snap-in existing masonry wall anchors. Anchors taken from production shall be used, except when this procedure is used in experimental work.

A detailed description of the frame and anchoring system which shall cover all details of the anchors, as well as the means of attachment in the frame and the weight of the door used for the test shall be recorded as part of the performance report, Swing Test Form 2.

## **5 Swing test**

### **5.1 Doors**

Duration of the test shall be 250,000 cycles with latching for Level C doors; 500,000 cycles with latching for Level B doors; and 1,000,000 cycles with latching for Level A doors. A general inspection of the door shall be made at 25,000 cycle intervals for the first 100,000 cycles and at 50,000 cycles thereafter. A mechanical counter or equivalent shall be used to record the cycles.

The general inspection shall cover all components readily accessible, such as face skins, exposed hinge and/or lock stiles, flush closing channels, end closures, hinge reinforcements, and lock body/face plate reinforcements. Additionally, the inspection shall cover the integrity and reliability of processes, such as weld-

ing, bonding, mechanical interlocking, etc., used to connect the various door components.

Doors which have passed the cycling criteria at one level shall be deemed to have passed all lower levels. The results shall be recorded on a standard performance report, Swing Test Form 1.

### **5.2 Frame**

Duration of the test shall be 250,000 cycles for Level C frames; 500,000 cycles for Level B frames; and 1,000,000 cycles for Level A frames. A general inspection of the frame shall be made at 25,000 cycle intervals for the first 100,000 cycles and at 50,000 cycle intervals thereafter.

The general inspection shall cover all frame components (excluding anchors under this section) readily accessible, such as corner clips and screws, corner tabs and slots, head and jamb tabs/slots hinge reinforcements, and strike reinforcements.

Additionally, the inspection shall cover the integrity and reliability of processes, such as welding, bonding, mechanical interlocking, etc., used to connect the various frame components.

Door frames which have passed the cycling criteria at one level shall be deemed to have passed all lower levels. The results shall be recorded as part of the test report, Swing Test Form 2. The condition of the hardware and mutes shall be noted at the same time and their replacement made when deemed necessary. Hinge lubrication shall be mandatory every 100,000 cycles.

### **5.3 Frame anchors**

Duration of the test shall be 250,000 cycles for Level C anchors; 500,000 cycles for Level B anchors; and 1,000,000 cycles for Level A anchors. A general inspection of the anchors shall be made at 25,000 cycle intervals for the first 100,000 cycles and at 50,000 cycles thereafter.

The general inspection shall cover the integrity of the anchor attachment to the door frame, attachment to the test frame vertical support channels, metal fatigue and integrity of attachment processes, such as welding, bond-

ing, friction fitting (snapping-in), and attachment by means of hardware, such as sheet metal screws, etc.

## **6 Twist test**

The twist test is applicable in evaluating door construction only.

The deterioration of the door strength during the test, if any, shall be checked through a series of twist tests. These twist tests shall be performed before the cycle test begins and then at 25,000 cycle intervals for the first 100,000 cycles and at 50,000 cycle intervals for the balance of the test.

During the twist test, the hinge pins and silencers (mutes) shall be removed from the door and frame assembly and the exit device shall be unlatched. The door is then clamped in place as noted in figure 2. If necessary to facilitate twist testing, the door is permitted to be taken from the test fixture and installed in a separate twist fixture. Loads in 30lb. increments shall be applied at the upper lock edge corner through the screw jack and force gage in the area illustrated in figure 2. The deflection noted on the dial indicator shall be plotted against the load applied to the corner on Twist Test Form 3. A maximum 300 lb. load shall be applied. The load shall then be reduced in 30 lb. increments and corresponding deflections recorded and plotted on Twist Test Form 3. A smooth curve drawn through the points shall graphically demonstrate the reaction of the door to increasing and decreasing pressures at different cycle intervals.

At the completion of each twist test, the hinges shall be reassembled by means of inserting the hinge pins, silencers (mutes) shall be reinstalled, the exit device shall be latched, and the assembly shall be subjected to another 25,000 or 50,000 cycles. The condition of the silencers (mutes) shall be noted and replacements made where deemed necessary.

A thorough lubrication of the hinges and exit devices at 100,000 cycle intervals is mandatory. Hinges and exit devices shall be replaced when deemed necessary.

## 7 Acceptance criteria

### 7.1 Doors

**7.1.1** Doors shall not show any visual indication of metal fatigue, cracking or deformation at hardware provision cutouts or along form contours.

**7.1.2** Doors of laminated construction (cores laminated to face sheets, channels or stiffeners laminated to face sheets, etc.) shall not delaminate in excess of 10% of the total surface area. (Strike the door surface softly with a mallet to identify delaminated areas, if any).

**7.1.3** In doors of welded construction (stiffeners or channels welded to face sheets, etc.) breakage of welds shall not exceed 10% of the total weld of those face stiffeners.

**7.1.4** Top, bottom or edge channels shall remain securely in place, without any weld breakage.

**7.1.5** Doors of stile and panel, stile and rail or tubular construction shall not be misaligned.

**7.1.6** Where seams occur on doors, there shall be no opening or spreading of the seam.

**7.1.7** All hardware reinforcements shall remain securely in place and show no visual signs of metal fatigue, cracking or deformation.

**7.1.8** As a result of the twist test, the maximum deflection permitted shall not exceed 2 1/2" when loaded to 300 lb. for Level C. For Level B and Level A doors the maximum deflection shall not exceed 1 1/4" when loaded to 300 lb.

**7.1.9** Permanent deflection for doors shall not exceed 1/8" when load is removed.

**7.1.10** Tapped holes shall not strip.

**7.1.11** At the completion of the swing and twist tests, the door shall be fully operable.

**7.1.12** Upon completion of the foregoing checks and measurements, remove door from test structure and cut door into four equal sections with a horizontal and a vertical cut at the center of the door height and door width. Internal construction of door shall be inspected

visually for delamination, metal fatigue, cracking and weld failure. The results of this inspection shall be noted.

### 7.2 Frames

**7.2.1** Frames shall remain plumb, square, rigid, and show no visual signs of metal fatigue, cracking, or deformation at hardware provision cutouts or along form contours.

**7.2.2** Corners shall stay aligned with seams in a closed position.

**7.2.3** Perimeter clearances between door and frame shall not be greater than 1/16" from those listed at onset of test.

**7.2.4** Hardware reinforcements shall remain securely attached to the frame, with all welds intact.

**7.2.5** Tapped holes shall not strip.

**7.2.6** At the completion of the test, the frame shall not limit door operation. If during the test the door becomes inoperable, it shall be determined whether a defective door frame, hardware reinforcement, hinge wear, etc., caused the failure and shall be so noted in the test report.

### 7.3 Frame anchors

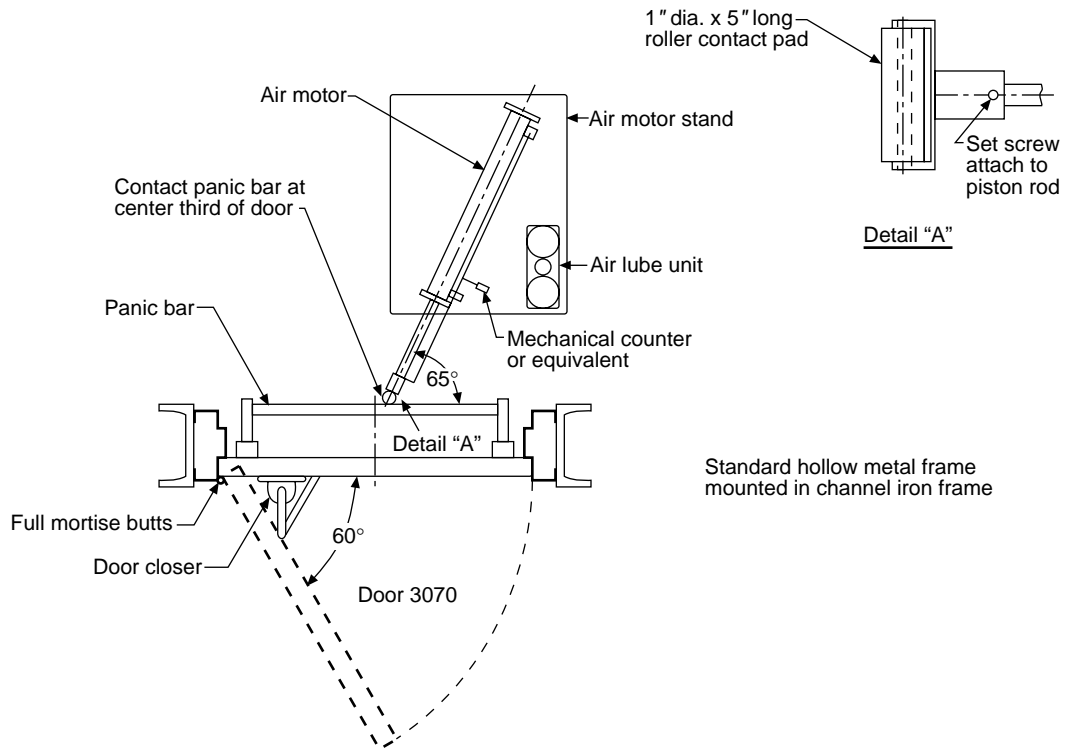
**7.3.1** Anchors shall show no visual indication of metal fatigue, cracking, or deformation at cutouts or along form contours.

**7.3.2** Mechanically fastened or lock-in (snap-in, non-welded) anchors shall remain securely attached to the frame member.

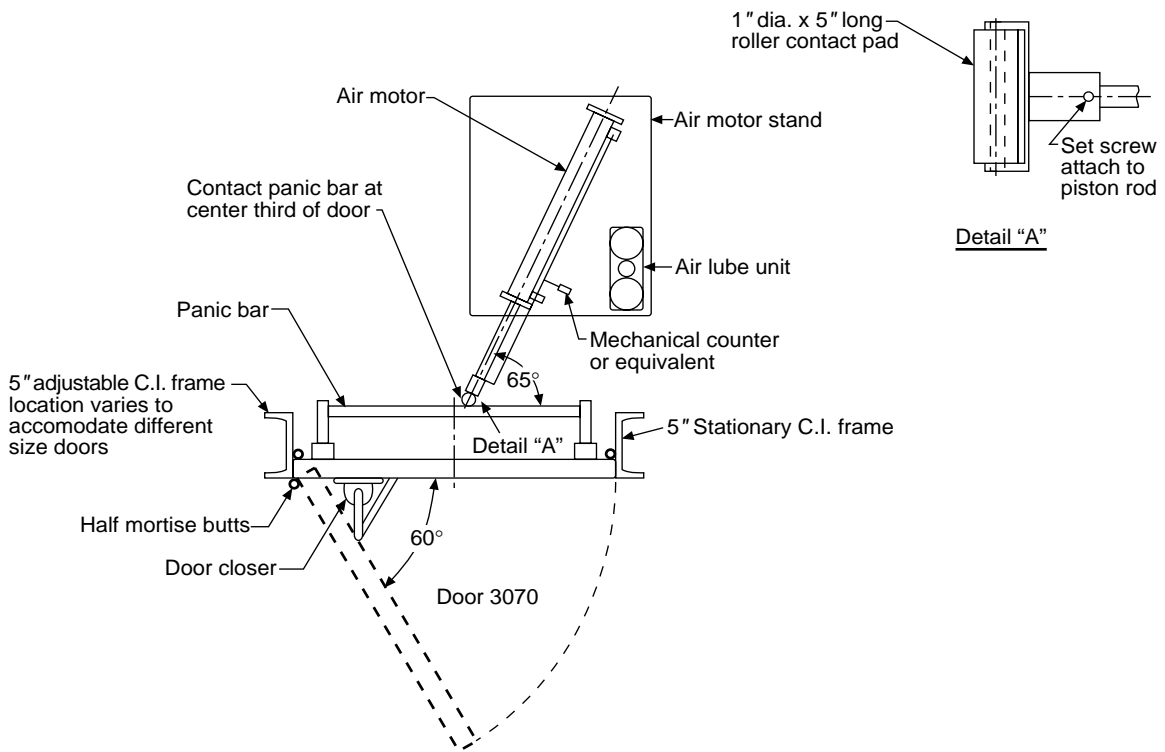
**7.3.3** Welded-in anchors shall remain secure with all welds intact.

**7.3.4** Compression-type anchors shall remain securely attached to the frame and shall not move out of adjustment causing loss of compression between the anchor and rough opening studs.

**7.3.5** Snap-in or screw-in type sill anchors shall remain securely attached to the frame via the screw or friction fitting (snapping-in). No loosening of the anchor due to the screw or loss of friction-holding force (for snap-in anchors) shall be permitted.



**Figure 1 – Swing test detail**



**Figure 1A – Swing test detail**

Door can be tested in channel iron frame with half mortise hinges (no pressed steel frame).

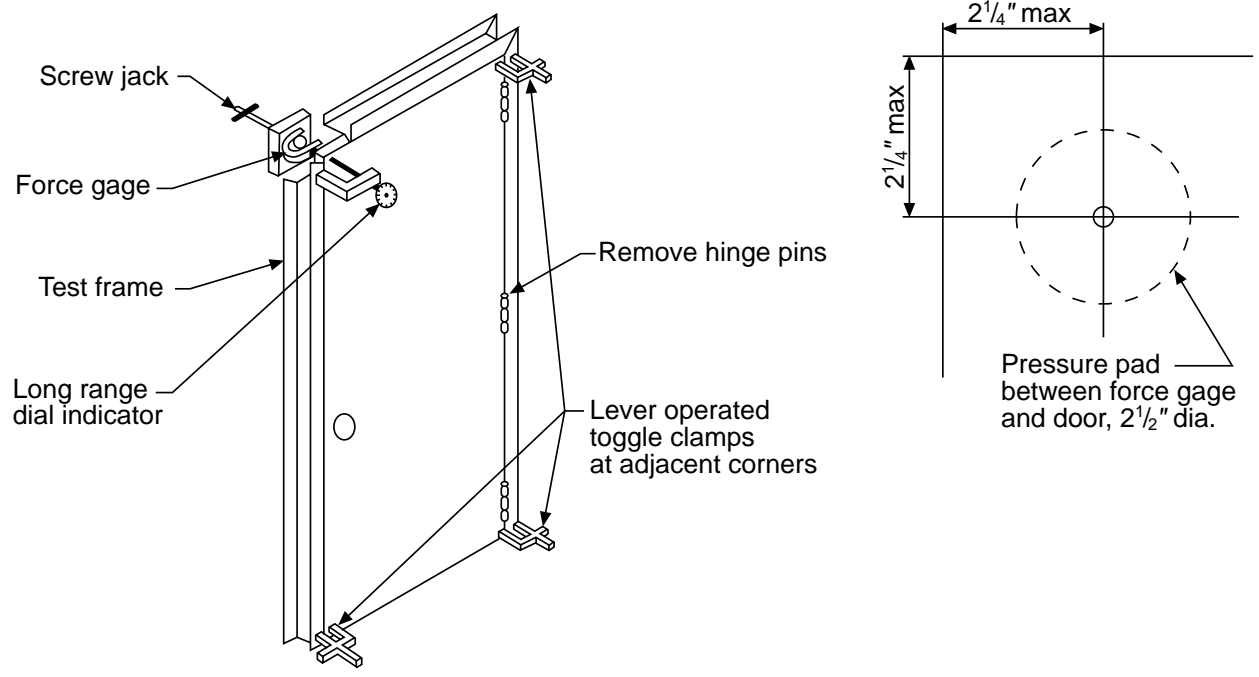


Figure 2 – Twist test





# Performance Report — Twist Test Form 3

Test No. \_\_\_\_\_ Date \_\_\_\_\_

Product Description \_\_\_\_\_

