



## Standard Test Method for Determining Interior Dimensions of Fiberboard Boxes (Box Gage Method)<sup>1</sup>

This standard is issued under the fixed designation D 2658; 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 interior dimensions of regular slotted or special slotted styles of single-wall corrugated, double-wall corrugated, and solid fiberboard boxes.

1.2 *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:

D 685 Practice for Conditioning Paper and Paper Products for Testing<sup>2</sup>

D 996 Terminology of Packaging and Distribution Environments<sup>2</sup>

D 4332 Practice for Conditioning Containers, Packages, or Packaging Components for Testing<sup>2</sup>

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method<sup>3</sup>

#### 2.2 ANSI Standard:

B46.1 Surface Texture Surface Roughness, Waviness and Lay<sup>4</sup>

### 3. Terminology

3.1 **Definitions**—General terms in this test method are defined in Terminology D 996.

#### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 **depth**—the distance between the innermost surfaces of the box measured perpendicular to the length and width.

3.2.2 **interior dimensions**—the shortest distances between opposite walls.

3.2.3 **length**—the larger of the two dimensions of the open face.

3.2.4 **regular slotted**—one-piece box with all flaps the same length and outer flaps meeting. Inner flaps may or may not meet, but do not overlap.

3.2.5 **special slotted**—one-piece box with all flaps meeting or not meeting but not overlapping.

3.2.6 **width**—the lesser of the two dimensions of the open face.

### 4. Significance and Use

4.1 The interior dimensions are important properties in the general construction of a box, and accurate methods of measurement are required for research work, routine control, and acceptance testing for conformance to specifications. For containers to carry and protect their contents effectively and efficiently, the containers must be of proper and uniform size. This method involves a degree of human judgment and assumes careful and accurate placement and reading of specified apparatus.

### 5. Apparatus

5.1 **Measuring Equipment**, consisting of two flat metal plates mounted on each end and at right angles to a telescoping spacing bar (Fig. 1).

5.1.1 **Metal Plates**—The metal plates shall be not less than  $\frac{3}{16}$  in. (4.76 mm) thick and shall have length and width dimensions of 4 by 3 in. (102 by 76 mm) with a maximum surface roughness height of 64  $\mu$ in. (1.63  $\mu$ m), in accordance with ANSI B46.1. All sharp edges shall be relieved and corners shall be rounded with approximately  $\frac{1}{4}$ -in. (6.35-mm) radius. The plates shall be mounted firmly at each end of the telescoping bar and must be parallel to each other within 0.02 in. (0.5 mm).

5.1.2 **Spacing Bar**—Provision shall be made for adjusting and locking the spacing bar at the linear distance between the two plane surfaces. If the spacing bar incorporates a built-in scale for convenience in reading measurements, it shall be accurate to one half of the minimum measurement unit; that is, if the minimum measurement unit is  $\frac{1}{16}$  in. (1.6 mm), the instrument must be accurate to  $\frac{1}{32}$  in. (0.8 mm), etc.

5.2 **Size and Weight Ranges**—Correct weight of the measuring instrument is important. Weights of instruments for

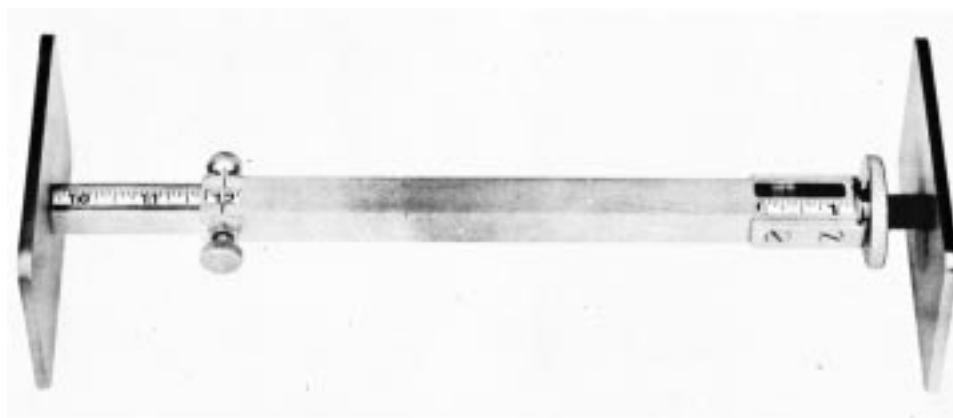
<sup>1</sup> This test method is under the jurisdiction of ASTM Committee D-10 on Packaging and is the direct responsibility of Subcommittee D10.27 on Paper and Paperboard.

Current edition approved May 15, 1994. Published July 1994. Originally published as D 2658 – 67 T. Last previous edition D 2658 – 91.

<sup>2</sup> *Annual Book of ASTM Standards*, Vol 15.09.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 14.02.

<sup>4</sup> Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.



NOTE 1—The unit shown covers the middle range from 10 to 18 in. (254 to 457 mm). Rounded knurled knob at upper left is lifted to set gage to the nearest full unit measurement below box dimension. Knurled knob at lower left is used to lock extension rod in place. Adjusting nut at right end moves right end plate to proper tension against side of box. Fractions of unit measurement over initial adjustment are read at right end scale. Reading shown is  $12\frac{5}{16}$  in.

FIG. 1 Detail of Measuring Equipment

three basic size ranges shall conform to the specifications given in Table 1.

## 6. Sampling

6.1 Select specimens at random in accordance with good practice or sampling procedures.

## 7. Test Specimens

7.1 In no instance shall fewer than five specimens be measured and taken as representative of the lot.

## 8. Conditioning

8.1 Condition the boxes for measuring in accordance with Practice D 685 and Practice D 4332.

## 9. Procedure

9.1 Set up and square the box to be measured in the normal manner and place it on a smooth, flat surface with the bottom flaps folded into position but not secured by any type of sealing device or preparation.

9.2 *Measuring Length*— Measure the length dimension between the two end panels, holding the instrument as close as possible to the side panel opposite the manufacturer's joint. Place one end of the instrument firmly against one end of the box and adjust the other end until it is just tight enough that, when released with the box inclined so that the side panel closest to the instrument is at an angle of approximately  $65^\circ$  to the horizontal, the instrument will slide slowly down the side of the box and come to rest at the bottom. When the correct extension of the instrument has been obtained, lock it, and if equipped with a self-contained scale, read the distance between

the faces directly. If the instrument does not incorporate a scale, remove the instrument from the box and measure the distance between the outer surfaces of the plates by means of a separate scale accurate to  $\frac{1}{32}$  in. (0.8 mm).

9.3 *Measuring Width*— Measure the width dimension of the box between the two side panels, holding the instrument as close as possible to the end panel opposite the manufacturer's joint. Correct extension and measurement reading is obtained in the same manner as previously described for length.

### 9.4 Measuring Depth:

9.4.1 Measure the depth dimension between the end flaps when these have been folded into position and at the end opposite the manufacturer's joint. Place the instrument, with the spacing bar extended to a point less than the actual depth of the box, in an upright position approximately in the center of the bottom end flap and close the corresponding top end flap over it. Extend the instrument while in this position until the top end flap is brought into a horizontal position. This may be checked by closing the top outer flaps over the inner flap with the instrument locked in position and placing a straightedge across the outer flaps at right angles to the length dimension and overlying the instrument. The proper extension has been reached when the outer flaps exhibit a slight crown as indicated by light showing between the straightedge and the outer flaps for a distance of about 1 in. (25.4 mm) from the flap score. Then, remove the instrument from the box and measure as previously described.

9.4.2 A second method for measuring depth consists of marking a line on the long flap inner scoreline center. The long flap is bent to about a  $45^\circ$  angle to the side of the box, while marking the scoreline center with a ballpoint pen or sharp pencil. Place the box gage under the folded-down inside flap and against the container side wall. The edge of the 4 by 3-in. (102 by 76-mm) plate shall be just visible where the cut edge of the inner flap contacts the line previously drawn on the scoreline center. Extend the instrument until the top of the inner flap coincides with the line. Then remove the instrument from the box and measure as previously described.

TABLE 1 Instrument Weight for Three Basic Size Ranges

| Size Range of Boxes,<br>in. (mm) | Instrument Weight,<br>oz (g) |
|----------------------------------|------------------------------|
| Up to 10 <sup>A</sup> (254)      | 2 lb 0 ± 2 (907 ± 57)        |
| 10 to 18 (254 to 457)            | 2 lb 8 ± 2 (1134 ± 57)       |
| 18 to 34 (457 to 864)            | 3 lb 6 ± 3 (1530 ± 85)       |

<sup>A</sup> A purchased instrument may have a minimum usable size of 6 in. (152 mm).

## 10. Report

10.1 Report the following:

10.1.1 Size of the box (length by width by depth, inside dimensions) in inches and sixteenths of an inch, or millimetres,

10.1.2 The number of specimens measured, and

10.1.3 A detailed description of the boxes measured including style, grade, and construction.

## 11. Precision and Bias

11.1 The precision statement<sup>5</sup> (see Practice E 691) is based

on data developed from a round robin box measurement test using regular slotted containers (RSC). The test was conducted by ten laboratories or individuals familiar with the use of the box gage. The test specimens consisted of four different size boxes ranging in size to use all three box gages. The repeatability concerns the variability between single independent test results obtained within a single laboratory. The reproducibility concerns the variability between average test results obtained in different laboratories. The precision of the method for regular or special slotted containers is shown in Table 2.

11.2 There is no bias because the value of the interior dimensions is defined only in terms of this test method.

## 12. Keywords

12.1 box gage method; fiberboard boxes; interior dimensions

<sup>5</sup> Supporting data are available from ASTM Headquarters. Request RR:D10-1007.

**TABLE 2 Precision Summary**

NOTE 1—1 in. = 25.4 mm.

|        | Within Laboratory  |                     | Between Laboratory |                       |
|--------|--------------------|---------------------|--------------------|-----------------------|
|        | Standard Deviation | Repeatability Limit | Standard Deviation | Reproducibility Limit |
| Length | 0.05               | 0.14                | 0.04               | 0.12                  |
| Width  | 0.05               | 0.14                | 0.04               | 0.12                  |
| Depth  | 0.05               | 0.14                | 0.09               | 0.25                  |

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