



Designation: D1974/D1974M – 22

# Standard Practice for Methods of Closing, Sealing, and Reinforcing Fiberboard Boxes<sup>1</sup>

This standard is issued under the fixed designation D1974/D1974M; 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 reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

*This standard has been approved for use by agencies of the U.S. Department of Defense.*

## 1. Scope

1.1 This practice describes several methods for closing, sealing, and reinforcing fiberboard (solid and corrugated, excluding triple wall) shipping boxes used for shipment. One or several methods listed in this practice may be referenced in regulations, specifications, or contracts. (See Appendix for cross reference).

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

NOTE 1—This practice is intended to be workable in both inch-pound units and SI units. Unit conversions are intended to be functional but are not necessarily exact; this should not significantly affect the performance of the closing, sealing, or reinforcing methods. Descriptions in inch-pound and SI units are considered interchangeable in this practice.

NOTE 2—All references to this standard should be made by closure number.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

<sup>1</sup> This practice is under the jurisdiction of ASTM Committee D10 on Packaging and is the direct responsibility of Subcommittee D10.27 on Fiberboard Shipping Containers, Containerboard and Related Structures and Materials.

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## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

D951 Test Method for Water Resistance of Shipping Containers by Spray Method

D996 Terminology of Packaging and Distribution Environments

D3654/D3654M Test Methods for Shear Adhesion of Pressure-Sensitive Tapes

D3759/D3759M Test Method for Breaking Strength and Elongation of Pressure-Sensitive Tape

D3950 Specification for Strapping, Nonmetallic (and Joining Methods)

D3953 Specification for Strapping, Flat Steel and Seals

D4169 Practice for Performance Testing of Shipping Containers and Systems

D4675 Guide for Selection and Use of Flat Strapping Materials<sup>1</sup>

D5118/D5118M Practice for Fabrication of Fiberboard Shipping Boxes

D5330/D5330M Specification for Pressure-Sensitive Tape for Packaging, Filament-Reinforced

D5486/D5486M Specification for Pressure-Sensitive Tape for Packaging, Box Closure, and Sealing

D5570 Test Method for Water Resistance of Tape and Adhesives Used as Box Closure

D5749 Specification for Reinforced and Plain Gummed Tape for Sealing and Securing

F592 Terminology of Collated and Cohered Fasteners and Their Application Tools (Withdrawn 2017)<sup>3</sup>

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

2.2 *U.S. Government Documents*:<sup>4</sup>

**A-A-59692 Adhesive, Water Resistant (For Closure of Fiberboard Boxes)**

2.3 *Other Standards*:

**International Fiberboard Case Code**<sup>5</sup>

NOTE 3—FEFCO<sup>5</sup> established a code of box styles to facilitate international trade. The box codes consist of four-digit numbers; for example, a regular slotted container was assigned the code 0201.

2.4 *Other Publications*:

**Uniform Freight Classification**<sup>6</sup>

### 3. Terminology

3.1 General definitions for packaging and distribution environments are found in Terminology **D996**.

3.2 *Definitions*:

3.2.1 *crown*—staple end opposite staple point, connecting both staple legs and providing bearing area (**F592**).

3.2.2 *leg*—staple part connecting staple crown with staple point, driven through and into or through materials being fastened (**F592**).

3.2.3 *stitch*—staple cut and formed from wire immediately prior to driving by same machine (**F592**).

3.3 *Definitions of Terms Specific to This Standard*:

3.3.1 *closure*—the means of securing the flaps or covers of a box so that the box will not accidentally open during normal shipment, handling, and storage.

3.3.2 *leg thickness*—dimension of staple-leg cross section measured parallel to staple-crown axis (**F592**).

3.3.3 *leg width*—dimension of staple-leg cross section measured perpendicular to staple-crown axis (**F592**).

3.3.4 *reinforcing*—the means (when required) of improving the stability and integrity of a fiberboard box or closure so as to increase the performance level of the box during normal handling, shipping, or storage.

3.3.5 *sealing*—the means (when required) of making a box reasonably impervious to the entrance of extraneous material (such as dust) or to prevent the leakage of the box contents during distribution.

3.3.6 *setup*—the forming of a knocked-down box (or box section) into a box (section) ready for filling, including the end, cover, and section closures made before the box is filled.

3.3.7 *staple*—preformed U-shaped wire fastener usually with two same-size pointed or pointless legs connected by crown located opposite staple-point ends; designed to be driven by strike, pneumatic, electric, manual, or spring tools through or through and into layers of penetrable material and to hold two or more pieces together.

3.3.8 *wide crown staple*—a staple whose nominal width is 1¼ in. [approximately 32 mm] or greater.

<sup>4</sup> Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, <http://dodssp.daps.dla.mil>.

<sup>5</sup> International Fiberboard Case Code, European Federation of Manufacturers of Corrugated Board (FEFCO), 37 rue d'Amsterdam, 75008, Paris, France, 874-63-76.

3.3.9 *wide crown stitch*—a stitch whose nominal width is 1¼ in. [approximately 32 mm] or greater.

### 4. Significance and Use

4.1 The means of closing the flaps of corrugated shipping containers is one of the important decisions for a shipper. It may affect the overall material cost, the labor costs, the packaging equipment costs, and the performance of the box during distribution.

4.2 This practice provides a list of many available procedures for closing, sealing, and reinforcing boxes. Most of these describe a particular packaging material and a particular use of it on a box. Some methods involve package performance testing; any closure or reinforcement which passes prescribed tests (usually on the proposed box and contents) is considered to comply with that section of this practice. Performance-based methods are encouraged because they allow for considerable flexibility in the choice of packaging materials and methods yet provide assurance of a given level of performance.

4.3 A diverse range of methods are described in this practice but relative performance levels are not given. Laboratory package testing such as Practice **D4169** and field experience are recommended to rate alternative methods on performance for the intended use.

4.4 The descriptions of materials and methods in this practice provide direction for the procurement of materials and for their common uses on boxes. These descriptions may be sufficient for some specification purposes, but others will require more thorough material and application requirements than those given here.

4.5 The list of methods in this practice is not exhaustive; deviation or variation from the listed methods is possible with the approval of the appropriate parties referencing this practice. Depending on the characteristics of the contents, the specific shipping container, the acceptable package costs, the distribution hazards, and the desired degree of assurance of successful shipment, more stringent methods than those listed may be needed or less stringent methods than those listed may be adequate. The methods described are typical uses of the closure, reinforcing, or sealing materials; many of these materials can be used for other box styles or other methods on boxes but all of these are not included in this practice. Materials for box closure, reinforcement, or sealing are commercially available which have higher or lower performance characteristics than those listed in this practice; these may often be used in a lesser or greater quantity than the described applications of the listed materials.

4.6 This practice assumes the following:

4.6.1 The shipping container and inner packing are properly designed for the contents and the distribution hazards (see Practices **D4169** and **D5118/D5118M**),

4.6.2 Normal, reasonable care is taken in shipment, including storage, handling, loading, and bracing, and

4.6.3 Normal, reasonable care is taken in the application of the closure, reinforcing, or sealing materials to the shipping container.

## 5. Materials and Equipment

### 5.1 Adhesives:

5.1.1 *Hot Melt Adhesives*—Hot melt adhesives are solid at room temperature, liquified by heat, applied molten, and solid upon cooling to bond two surfaces. They are based on thermoplastic polymers modified with resins or waxes, or both, and are usually applied in the range of approximately 300 to 400 °F [approximately 150 to 200 °C]. The adhesive should maintain its functionality in environmental conditions expected in distribution and storage.

5.1.2 *Water-Borne Adhesives*—Several types of adhesives are available in which water is the vehicle or solvent. These are typically applied at room temperature and the surfaces are compressed together until the adhesive develops sufficient strength to maintain substrate contact. The adhesive should maintain its functionality in environmental conditions expected in distribution and storage.

5.1.3 Semi-automatic and fully automatic box closure equipment is available for the application of adhesives. Hot melt adhesives are also applied by hand held “guns.” Adhesives work best on clean, dry surfaces. It is important to have the box flaps held in place until the hot melt adhesive solidifies or the water borne adhesive develops sufficient bond.

5.1.4 The federal specification applicable to adhesives is A-A-59692.

### 5.2 Pressure-Sensitive Tape:

5.2.1 *Pressure-Sensitive, Film-Backed Tape*—This tape consists of a film backing, usually a biaxially oriented polypropylene or polyester (some polyvinyl chloride films are also used), with a high tack pressure-sensitive adhesive. No solvents, heat, or moistening are needed. The tape should maintain its functionality in the environmental conditions expected in distribution and storage. The applicable reference is Specification **D5486/D5486M**.

5.2.2 *Pressure-Sensitive Filament Tape*—This type of tape typically consists of fiberglass filaments embedded in a pressure-sensitive adhesive with a protective film backing. Several grades of tape are available. The tape should maintain its functionality in environmental conditions expected in distribution and storage. The applicable reference is Specification D5530.

5.2.3 *Pressure-Sensitive Paper Tape*—This type of tape has a backing of kraft paper and a pressure-sensitive adhesive. The tape should maintain its functionality in environmental conditions expected in distribution and storage. The applicable reference is Specification **D5486/D5486M**.

5.2.4 A wide variety of tape dispensing and applying equipment is available. Hand-held dispensers are common. Pressure-sensitive tapes also capable of being applied by equipment at high speeds. Tapes work best on clean, dry surfaces. It is important to give an adequate rubdown to pressure-sensitive tapes to develop sufficient bond to hold the flaps closed.

5.2.5 Uses of pressure-sensitive tape in the closure, sealing, and reinforcing methods call for their commonly available commercial widths. The widths common in the U.S. Customary system are not identical to the available metric replacement widths. The most frequent width conversions are as follows:

U.S. Customary	Metric
in.	mm
0.5	12
0.75	18
1	24
2	48
3	72

NOTE 4—The effect of this width difference on package performance is not considered significant.<sup>7</sup>

### 5.3 Gummed (Remoistenable) Tape:

5.3.1 *Reinforced Gummed Tapes*—This type of tape has a water activated adhesive and contains glass/synthetic reinforcing fibers embedded between two sheets of paper, using nonasphaltic binders. Many constructions are available. The tape should maintain its functionality in environmental conditions expected in distribution and storage. The applicable reference is Specification **D5749**.

5.3.2 *Gummed Paper Tape*—This type of tape has a backing of kraft paper and a water activated adhesive. The tape should maintain its functionality in environmental conditions expected in distribution and storage. The applicable reference is Specification **D5749**.

5.3.3 A wide variety of tape dispensing and applying equipment is available. Table top dispensers are common. Gummed tapes are capable of being applied by equipment at high speeds. Tapes work best on clean, dry surfaces. It is important to hold water activated tapes in place until they develop sufficient bond to hold the flaps closed.

### 5.4 Staples and Stitches:

#### 5.4.1 Staples:

5.4.1.1 Staples shall be of good commercial quality steel and have a minimum tensile strength of 80 000 psi [550 mPa]. They shall have a rust-resistant coating of copper, zinc, or other material. Staples and stitches listed in the closure methods of this practice shall meet or exceed the following minimums:

Nominal Size	Crown Width	Leg Width	Leg Thickness
0.5 in.	0.37 in. [9.5 mm]	0.100 in. [2.5 mm]	0.017 in. [0.43 mm]
1.25 in.	1.125 in. [28.5 mm]	0.072 in. [1.9 mm]	0.033 in. [0.84 mm]

5.4.1.2 Staples are collated and cohered into strips or rolls. The strips are designed for loading into straight magazines. The roll, also called a coil, allows the loading of a large number of staples into a tool.

5.4.1.3 Staples are driven by staplers. Two types of staplers are in common use.

(a) One type of stapler uses moving anvils to clinch the staple legs around the fiberboard. These tools drive the staple legs through the flaps, simultaneously inserting anvils through the flap surface to meet and clinch the staple legs so they grab the inner flaps and secure them to the outer flaps. The anvils then retract from the flaps.

<sup>7</sup> Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D10-1004. Contact ASTM Customer Service at service@astm.org.