



Designation: D5168 – 22

Standard Practice for Fabrication and Closure of Triple-Wall Corrugated Fiberboard Containers¹

This standard is issued under the fixed designation D5168; 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.

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

1. Scope*

1.1 This practice covers the fabrication and closure of new triple-wall corrugated fiberboard containers.

1.2 This practice indicates the factors and components that must be controlled in the manufacture of triple-wall fiberboard containers.

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

1.5 *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.*

2. Referenced Documents

2.1 ASTM Standards:²

[D996 Terminology of Packaging and Distribution Environments](#)

[D1968 Terminology Relating to Paper and Paper Products](#)

[D3950 Specification for Strapping, Nonmetallic \(and Joining Methods\)](#)

[D3951 Practice for Commercial Packaging](#)

[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 Materials¹](#)

[D4727/D4727M Specification for Corrugated and Solid Fiberboard Sheet Stock \(Container Grade\) and Cut Shapes](#)

[D5330/D5330M Specification for Pressure-Sensitive Tape for Packaging, Filament-Reinforced](#)

[D5486/D5486M Specification for Pressure-Sensitive Tape for Packaging, Box Closure, and Sealing](#)

[D5639 Practice for Selection of Corrugated Fiberboard Materials and Box Construction Based on Performance Requirements](#)

[D6198 Guide for Transport Packaging Design](#)

[SI 10 American National Standard for Use of the International System of Units \(SI\): The Modern Metric System](#)

2.2 TAPPI Standards:³

[T 411 Test Method for Thickness of Paper and Paperboard](#)

[T 803 Puncture and Stiffness Test of Container Board](#)

[T 810 Bursting Strength of Corrugated and Solid Fiberboard](#)

[T 811 Edgewise Compression Strength of Corrugated Fiberboard \(Short Column Test\)](#)

[T 812 Ply Separation of Solid and Corrugated Fiberboard \(Wet\)](#)

2.3 Code of Federal Regulations:⁴

[CFR Parts 107-180 Title 49, Hazardous Materials Regulations](#)

2.4 Other Standards:

[National Motor Freight Classification⁵](#)

[Uniform Freight Classification⁶](#)

¹ 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 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.

³ Available from Technical Association of the Pulp and Paper Industry (TAPPI), 15 Technology Parkway South, Norcross, GA 30092, <http://www.tappi.org>.

⁴ Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401, <http://www.access.gpo.gov>.

⁵ Available from National Motor Freight Traffic Association (NMFTA), 1001 N. Fairfax St., Alexandria, VA 22314, <http://www.nmfta.org>.

⁶ Available from Short Line and Regional Railroad Association, 50 F Street, N.W., Suite 7020, Washington, DC 20001-1536.

*A Summary of Changes section appears at the end of this standard

ISTA Distribution Simulation⁷

2.5 Use of Other Specifications:

2.5.1 Nothing in this practice shall be construed to prohibit the use of containers of special design or of fiberboard containers identified by package number in the current Uniform Freight Classification and National Motor Freight Classification when in the experience and judgment of the purchaser, the nature of the articles or material to be shipped justifies such containers.

2.5.2 Exceptional commodities may require better containers than are specified herein. Containers for explosives and dangerous articles shall comply with the specifications prescribed in the Department of Transportation's (DOT) Office of Hazardous Materials Code of Federal Regulations, Title 49 CFR Parts 107-180. In addition, for the particular articles to which these regulations apply, if the requirements contained in this practice are more stringent, then they must also meet the requirements specified herein. (The DOT regulations apply to such articles as explosives, flammable liquids and solids, compressed gases, oxidizing materials, poisons, and so forth).

3. Terminology

3.1 Definitions:

3.1.1 General definitions for packaging are found in Terminology **D996**.

3.1.2 Definitions specific to paper and related structures is found in **D1968**.

4. Significance and Use

4.1 Triple-wall corrugated fiberboard containers are used to unitize products into containers of size and shape suitable for manual or mechanical handling and to protect the contents against environmental, handling, shipping, and storage conditions.

4.2 This practice is intended to cover some of the basic constructions and styles of commercially available triple-wall fiberboard packaging used to unitize and protect contents.

5. Design and Style

5.1 *Design and Strength Considerations*—Selection of materials and box design are highly dependent on a number of factors which are describe in standards references in **5.1.1** and **5.1.2**.

5.1.1 Practice **D5639** assists users in selecting appropriate performance characteristics of corrugated fiberboard or box construction, or both, commensurate with their user's needs for packing and distribution of goods. This practice describes several attributes of fiberboard and boxes which relate to various hazards encountered in distribution and describes test parameters which may be specified by the user to ensure sufficient strength in the box for containment, storage, handling, transport and protection of contents.

5.1.2 Guide **D6198** assists users in design and development of packaging intended for the protection of goods while they are in transit from point of origin to final destination.

5.2 Common Triplewall Styles:

5.2.1 *Style A*—Regular slotted container or alternate construction, regular slotted container with crushed flaps (see **Fig. 1**).

5.2.2 *Style B*—Full telescope container (see **Fig. 2**).

5.2.3 *Style C*—Half regular slotted container with short top flaps and cover or alternate construction (see **Fig. 3**).

5.3 Box Testing and Transit Simulation:

5.3.1 *Corrugated Fiberboard Tests and Requirements*—Triplewall corrugated fiberboard requirements are shown in **6.2.2** to **6.2.3.2**.

5.3.2 *Transit Simulation*—Information needed to assist in the design of optimum package or to confirm that the selected package will perform well in storage and transit can be obtained by utilizing sequential testing processes. Common transit testing sequences and selection criteria can be found in **D4169** and in ISTA Series 2 and 3 testing.

6. Requirements

6.1 *Classes*—Triple-wall corrugated fiberboard containers may be furnished in the following classes, styles, and types of ends, as specified:

6.1.1 *CF*—Non-weather-resistant containers are for domestic shipments and storage in known, favorable conditions.

6.1.2 *CG*—Non-weather resistant containers for government shipments and storage in known, favorable conditions.

6.1.3 *CFWR*—Weather-resistant containers are for export shipments and storage where high humidities or extreme climatic conditions may be encountered.

6.1.4 *CGWR*—Weather-resistant containers are for government export shipments and storage where high humidities or extreme climatic conditions may be encountered.

6.1.5 *CFFR—Fire-Retardant Containers*—When specified, triple-wall containers shall use materials as specified in Specification **D4727/D4727M**, Variety TW, class WR/FR.

6.1.6 *CGFR—Fire-Retardant Containers*—When specified, triple-wall containers shall use materials as specified in Specification **D4727/D4727M**, Variety TW, class WR/FR.

6.2 Materials:

6.2.1 *Fiberboard*—The fiberboard shall consist of three corrugated mediums and four facings fabricated into a triple-wall structural material.

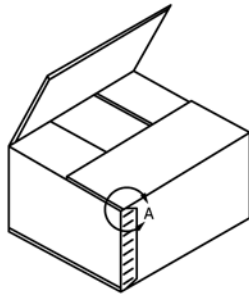
6.2.1.1 Corrugating Mediums:

(1) *Weight of Mediums*—The weight of material used to fabricate the corrugated medium shall be no less than 26 lb/1000 ft² (127 g/m²), or as otherwise specified.

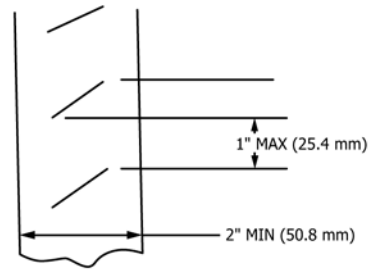
(2) *Flute Arrangement*—There shall be two A Flutes, with the remaining flute being either A or C Flute. Flute arrangement shall be agreed upon between the purchaser and the supplier. In accordance with Department of Defense requirements, the flute combination shall be C-A-A (or meet equivalent performance levels).

6.2.1.2 *Facings*—The combined weight of facings for Class CG, CGWR and CGFR shall be not less than 264 lb/1000 ft² (1289 g/m²), with the heaviest facings on the outside. For boxes made to the puncture strength requirement the minimum combined weight of facings shall be as shown in **Table 1**. There is no facing weight requirement for boxes made to the ECT

⁷ Available from International Safe Transit Association (ISTA), 1400 Abbot Rd, Suite 380, East Lansing, MI 48823, <http://www.ista.org>.

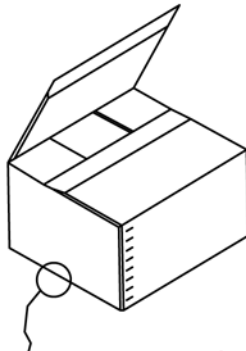


REGULAR SLOTTED BOX

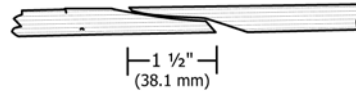


DETAIL "A"

NOTE:
LAP MAY BE INTEGRAL WITH END OR SIDE PANEL AND MAY BE ON INSIDE OR OUTSIDE OF ADJACENT PANEL



REGULAR SLOTTED BOX WITH CRUSHED ROLLED OVERLAPPING FLAPS



DETAIL "B"

ALTERNATE CONSTRUCTION

FIG. 1 Style A Box

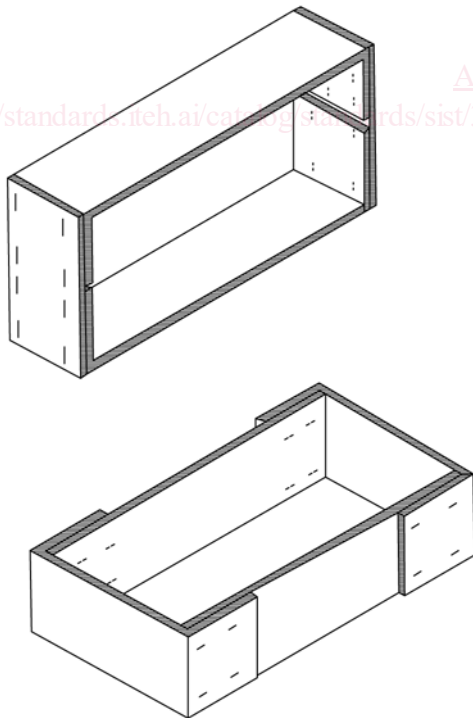
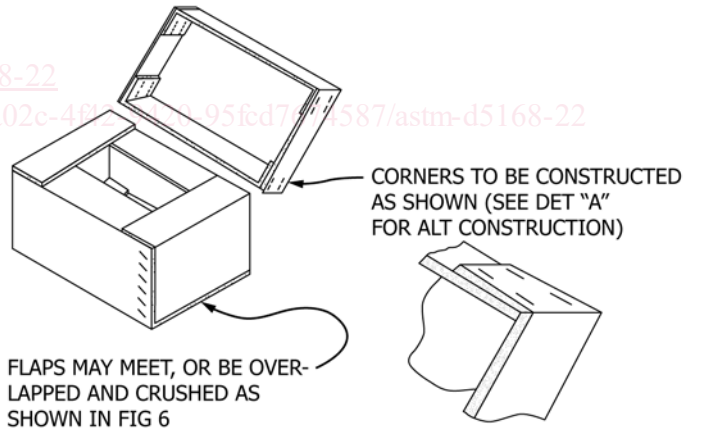


FIG. 2 Style B Box



DETAIL "A"

FIG. 3 Style C Box

1100 CGWR and 1100 CGFR, which have basis weight, puncture, and ECT requirements.) For weather-resistant boxes, Classes CFWR and CGWR, the outer facings shall be highly water-resistant paperboard which has been treated with a suitable high-grade, wet strength resin. For Class CGWR, the water-resistant paperboard shall have a 35 % minimum wet mullen retention versus dry mullen when tested in accordance with TAPPI T 810 and T 812.

strength requirement. (Note an exception for grades 1100 CG,

TABLE 1 Size and Weight Limitations for CF, CFWR/FR, CG, and CGWR/FR Classes of Fiberboard Boxes

Type TW		Combined Weight Facings Only, min. (SF is total weight of plies)		Max Weight of Boxes and Contents		Max Outside Dimensions Length + Width + Depth	
Classes CF and CFWR/FR	Classes CG CGWR/FR	lb/1000 ft.2	[g/m ²]	lbs	[kg]	in.	[mm]
700		168	[820]	240	[109]	110	[2794]
900		222	[1083]	260	[118]	115	[2921]
1100		264	[1289]	280	[127]	120	[3048]
	1100	264	[1289]	280	[127]	120	[3048]
1300		360	[1758]	300	[136]	125	[3175]

6.2.2 *Caliper*—The thickness of the finished Class CG, CGWR and CGFR fiberboard shall be no less than 0.525 in. (13.3 mm), when tested in accordance with TAPPI T 411.

6.2.3 *Board Strength*:

6.2.3.1 *Puncture Resistance*—The fiberboard shall have a minimum puncture test value as is shown in Table 2 when tested in accordance with TAPPI T 803. Only one puncture reading on each specimen may fall below the allowable minimum and that reading shall be not more than 10 % below the allowable minimum reading.

6.2.3.2 *Short Column Crush*—The short column crush strength (ECT) of the class 1100 CG, 1100 CGWR and 1100 CGFR fiberboard shall not have a minimum average that is less than is shown in Table 2 when tested in accordance with TAPPI T 811. For all other types and classes, the ECT values shown in Table 2 are minimum values. Only one ECT reading in a specimen may fall below the allowable minimum and that reading shall not be more than 10% below the allowable minimum reading.

6.2.4 *Adhesive*:

6.2.4.1 For non-weather-resistant containers, the facings and corrugated medium shall be securely bonded with adhesive over the entire area of contact.

6.2.4.2 For weather-resistant containers, in addition to the requirements specified in 6.2.4.1, the adhesive shall be of the water-resistant type and the fiberboard shall show no ply separation greater than ¼ in. (6 mm) when tested in accordance with TAPPI T 812.

6.2.5 *Metal Fasteners (3x)*—Metal fasteners shall be commercially pre-formed staples or staples formed from commercial steel stitching wire. All metal fasteners shall have commercially-applied coating of zinc or copper wash.

6.3 *Dimensions*—Dimensions of the containers furnished shall be as specified (see 7.1.3). Unless otherwise specified, the container dimensions shall be inside measurements with a

tolerance of ±¼ in. (6 mm). Maximum dimensions are shown in Table 1, see also 7.2.

6.4 *Certification*—The manufacturer shall furnish the procuring activity with certification that containers furnished under this specification meet the requirements specified herein.

6.5 *Style A Containers*:

6.5.1 *Construction*—Construction shall be in accordance with Fig. 1 (regular-slotted container). This container shall be one piece of triple-wall corrugated fiberboard scored and slotted (slots shall have a minimum width of ⅜ in. (10 mm)) to form a body piece having four flaps for closing each of two opposite faces. The flaps along the longer edge are the outer flaps, and those along the shorter edge are the inner flaps. Flaps shall not project beyond the edge of the container. All length flaps shall be equal in length, and all width flaps shall be equal in length. The outer flaps shall not overlap when closed nor have a gap to exceed ½ in. (12.7 mm). The body joint (manufacturers joint) overlap shall be not less than 2 in. (50 mm) wide, and both the overlap and the overlapped portion of the body shall be crushed prior to stapling or gluing. The container may be constructed from two sheets of triple-wall corrugated fiberboard only when the board manufacturer's machinery is incapable of producing sheets of a size suitable for single-sheet construction. When two-piece construction is utilized, the two body joints shall be on diagonally opposite edges. When metal staples are used they shall be placed approximately on a 45° angle across the overlap and shall be placed not more than 1 in. (25 mm) apart. The 1-in. measurement shall be from the lower tip on one staple to the top tip of the staple directly below. The first and last staple shall be placed ¾ ± ¼ in. (20 ± 7 mm) from the end of the overlap. When the joint is glued, there shall be a minimum of 75 % fiber tear of the overlap area when pulled apart. The direction of the flutes shall be vertical in the sides and ends of the container.

TABLE 2 Strength Limitations for CF, CFWR/FR, CG, and CGWR/FR Classes of Fiberboard Boxes

NOTE 1—(1) Boxes can be made to either the Puncture or the ECT strength requirement, see 6.2.1.2.
(2) 1100 CG ECT value is minimum average value, all other ECT values shown for other classes are minimum values, see 6.2.3.2.

Type TW		Puncture		ECT	
Classes CF and CFWR/FR	Classes CG and CGWR/FR	in oz/in tear	[J/m]	lb/in	[kN/m]
700		700	[2518]	67	[11.7]
900		900	[3237]	80	[14.0]
1100		1100	[3957]	90	[15.8]
	1100	1100	[3957]	155	[27.1]
1300		1300	[4676]	112	[19.6]