Designation: D5168 – 12 (Reapproved 2017)

Standard Practice for Fabrication and Closure of Triple-Wall Corrugated Fiberboard Containers[1]

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 and health 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

D3950 Specification for Strapping, Nonmetallic (and Joining Methods)

D3951 Practice for Commercial Packaging

D3953 Specification for Strapping, Flat Steel and Seals

D4675 Guide for Selection and Use of Flat Strapping Materials[1]

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

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 Classification[5]

Uniform Freight Classification[6]

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.

[1] This practice is under the jurisdiction of ASTM Committee D10 on Packagingand 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.

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

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. Style

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

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

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

6. Requirements

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

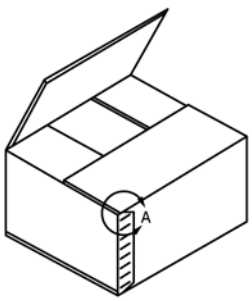
6.1.1 *CF*—Non-weather-resistant containers are for domestic shipments and storage in known, favorable conditions.

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

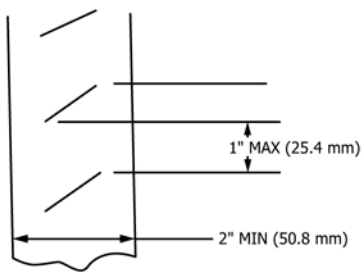
6.1.3 *CFWR*—Weather-resistant containers are for export shipments and storage where high humidities or extreme climatic conditions may be encountered.

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.

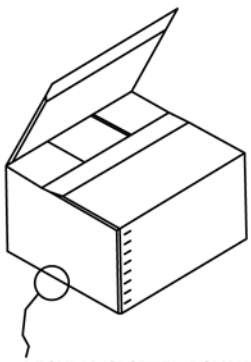


REGULAR SLOTTED BOX

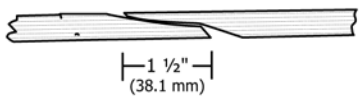


DETAIL "A"

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

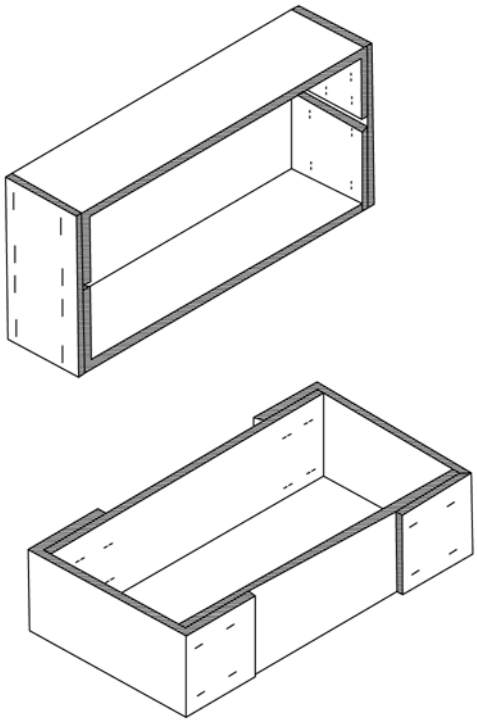


FIG. 2 Style B Box

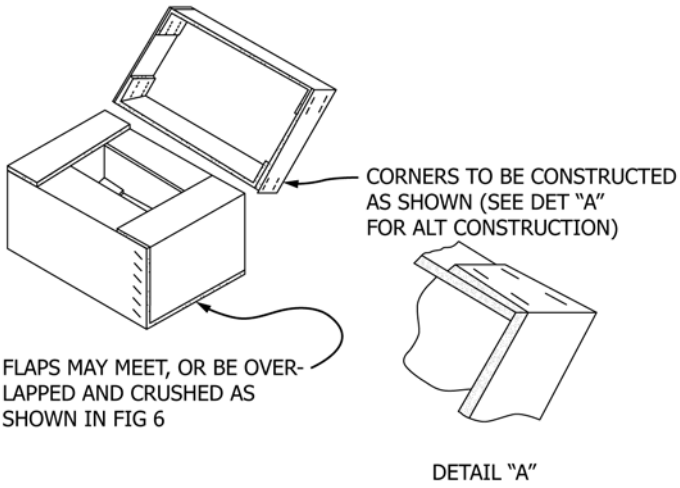


FIG. 3 Style C Box

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 ft^2 (127 g/m^2), 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 ft^2 (1289 g/m^2), 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 strength requirement. (Note an exception for grades 1100 CG, 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.

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

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/m2]	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]

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]

specimen may fall below the allowable minimum and that reading shall not be more that 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. There shall be no surface breaks in the board when folded 180° along the score line parallel to the flute direction and 90° along the score line perpendicular to the flute direction.

6.5.2 *Alternate Construction:*

6.5.2.1 When specified, Style A containers shall be furnished with a 1½-in. (36-mm) overlap on the outside top and bottom flaps. The overlapped areas of the flaps shall be crushed (see Fig. 1).

6.5.2.2 When specified, the score lines of the inner flaps, die-cut only, of Style A containers shall be offset a distance of the thickness of the board from the score lines of the outer flaps.

6.5.2.3 When specified, all flaps shall be crushed or scored adjacent to the score line approximately 2½ in. (65 mm) wide along the entire length of the flap to facilitate closure of the container flap.

6.6 *Style B Containers:*

6.6.1 *Construction*—Construction shall be in accordance with Fig. 2 (full telescope container). The container shall consist of a body and a cover, each being one piece of slotted and scored triple-wall corrugated fiberboard. The inside depth of the cover shall be the overall depth of the body. When set up, the flaps shall not overlap and shall be fastened to the side walls of the container with staples, or, when specified, by gluing. The arrangement of the staples shall be as shown in Fig. 2, and each flap shall have not less than four staples. The staples shall be not more than 1½ in. (36 mm) nor less than 1 in. (25 mm) from the free edges of the flaps. The spacing of the staples around the edge of each flap shall be not more than 5 in. (127 mm) from the center of one staple to the center of the next staple. When flaps are glued, there shall be a minimum of 75 % fiber tear of the overlap area when pulled apart. There shall be no surface breaks in the board when folded 90° along the score line.

6.7 *Style C Container:*

6.7.1 *Construction*—Construction shall be in accordance with Fig. 3. This is a two-piece triple-wall corrugated fiberboard container consisting of a half slotted container body with top flaps 4 in. (102 mm) long and a separate flanged cover.

Stapling or gluing for the body shall meet the requirements of 6.5.1, and for the cover shall meet the requirements of 6.6.1. The cover shall be at least 6 in. (152 mm) deep. The direction of the flutes shall be vertical in the sides and ends of the container. There shall be no surface breaks in the board when folded 180° along the score line parallel to the flute direction, and 90° along the score line perpendicular to the flute direction.

6.7.2 *Alternate Construction:*

6.7.2.1 When specified, Style C containers shall be furnished with a 1½-in. (38-mm) overlap on the bottom flaps. The overlapped areas of the flaps shall be crushed as shown for a Style A container (see Fig. 1).

6.7.2.2 When specified, offset scoring shall be in accordance with 6.5.2.2.

6.7.2.3 When specified, crushing of flaps shall be in accordance with 6.5.2.3.

6.7.2.4 When specified, double-wall fiberboard covered by Specification D4727/D4727M shall be used in construction of covers for Class 1, Style C containers.

6.7.3 Unless otherwise specified, Style C containers shall be furnished without pallet bases. When pallet bases are required, the size and style, including material requirements, placement, and size of skids, and so forth, shall be specified in the contract or order. When specified, the cover shall have double thickness of end flaps or possess interlocking features. When specified, sleeves and interior pads made of triple-wall fiberboard shall be furnished with each container.

6.8 *Compliance and Certification Markings:*

6.8.1 *Weather-Resistant Containers*—Weather-resistant containers made to comply with this specification shall be imprinted with the following data that will legibly occupy a total area of not more than 36 in.^{2} (23 225 cm^2) nor less than 16 in.^{2} (10 320 cm^2):

6.8.1.1 Boxmaker's name or boxmaker's certificate,

6.8.1.2 Month and year of manufacture (for example, "6-08"),

6.8.1.3 Individual grade or identification symbols, and

6.8.1.4 Specification compliance data and specification number.

7. Ordering Information

7.1 Purchasers should select the preferred options offered herein and include the following data in procurement documents:

7.1.1 Title, number, and date of this specification,

7.1.2 Class and style of container (see 6.1).

7.1.3 Inside dimensions (see 6.3),

7.1.4 Special features for Style A, B, and C containers,

7.1.5 Unless otherwise specified, packing and marking shall be in accordance with Practice D3951,

7.1.6 Whether containers are to be shipped partly assembled or knocked down and in bundles,

7.1.7 When pallet bases are required (see 6.7.3), and

7.1.8 When gluing is permitted (see 6.6.1).

7.2 *Size and Weight Limitations*—When size and weight limitations of the carrier's classification (see National Motor Freight Classification and Uniform Freight Classification) are exceeded, a special package permit should be obtained, when applicable.

8. Packaging and Package Marking

8.1 Unless otherwise specified in the purchase order or contract, packing and marking shall be in accordance with Practice D3951.

9. Keywords

9.1 corrugated; fiberboard; performance; short column crush test; triple wall

APPENDIX

(Nonmandatory Information)

X1. CLOSURE OF CONTAINERS

X1.1 Scope

X1.1.1 This appendix covers recommendations for the closure and sealing of containers fabricated in accordance with the requirements of this specification.

X1.2 Additional Referenced Documents

X1.2.1 *Specifications*—The following additional specifications of the issues in effect on date of invitations for bids, form a part of this appendix to the extent specified herein:

X1.2.2 *ASTM Standards:*[2]

D3950 Specification for Strapping, Nonmetallic (and Connectors)

D3953 Specification for Strapping, Flat Steel Strap and Connectors

D4675 Guide for Selection and Use of Flat Strapping Materials

X1.3 Requirements

X1.3.1 *Materials:*

X1.3.1.1 *Staples*—When used for closure of Styles A, B and C containers, staples shall be as specified in X1.3.4.1.

X1.3.1.2 *Strapping*—When strapping is used, see Guide D4675.

X1.3.1.3 *Strapping, Plastic*—Plastic strapping shall be in accordance with Specification D3950, Type I, II, or III. When Type I is used, it shall be Grade B and have a nominal width of ⅝ in. (16 mm) or greater. When Type II is used, it shall have a nominal width of ½ in. (12 mm) or more, and a minimum breaking strength of not less than 660 lb (300 kg). When Type

III is used, it shall have a nominal width of 7/16 in. (11 mm) or more, and a minimum breaking strength of not less than 700 lb (318 kg).

X1.3.1.4 *Closure Tape*—When used for closure, tape shall be pressure-sensitive filament-reinforced tape meeting the requirements of Specification D5330/D5330M, Type III, and shall be nominal ½ in. (12 mm) wide. (For Style A and B containers, tapes shall be nominal 1 in. (24 mm) wide.) On weather-resistant containers, Specification D5330/D5330M, Type IV tape shall be nominal ¾ in. (18 mm) wide. (For Styles E and F containers, tape shall be nominal 1 in. (24 mm) wide.)

X1.3.1.5 *Sealing Tape*— When used for sealing containers, tape shall be pressure-sensitive, water-resistant, and shall meet the requirements of Specification D5486/D5486M. The tape shall be nominal 2 in. (48 mm) wide.

X1.3.2 *Sealing*—Where sealing against entry of water or dust is desired, all seams and joints shall be covered with tape (see X1.3.1.5).

X1.3.3 *Closure and Reinforcement*—The kinds of closure used will depend on the style and may be made by means of staples, steel strapping, plastic strapping, or filament reinforced tape, or combination of those materials. Reinforcement may be made by steel strapping, plastic strapping, or filament reinforced tape, as applicable. Edge protectors as shown in Fig. X1.1 should be used with steel strapping. Special requirements may be stipulated in the contract or order.

X1.3.4 *Style A Container:*

X1.3.4.1 *Closure*—Unless otherwise specified, Style A containers may be closed by the use of staple, steel, or plastic strapping or with tape at a supplier's option.

(1) Staple (Preformed or Machine-Stitched) Closure—Staple closure for Style A containers shall be in accordance with the requirements of the Uniform Freight Classification and the National Motor Freight Classification for closing conventional slotted containers.

(2) Steel or Nominal Strapping Closure—When steel or plastic strapping is used for closure, two such straps shall be applied girthwise encircling the top, sides, and bottom and shall be located no more than 3 in. (76 mm) from the ends of the container.

(3) Tape Closure—When tape is used for closure, a 12-in. (300-mm) strip shall be applied to each end of the two top and two bottom flaps so that 6 in. (152 mm) of each strip is attached to the flap and 6 in. of tape extends onto the end panel of the container. The strips shall be located adjacent to the inner length edge of the flaps and approximately 2 in. (50 mm) from this edge. When the length of the container is 24 in. (610 mm) or more, one strip of tape shall be applied across the top of the container and one across the bottom of the container so that they are perpendicular to the length of the container. They shall be of sufficient length so that the ends of the strips extend onto the side panels a minimum of 3 in. (76 mm).

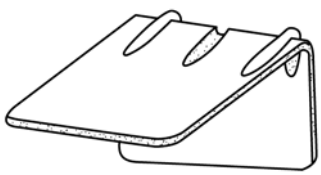


FIG. X1.1 Edge Protector

X1.3.4.2 *Reinforcement*—In reinforcing the closure of a Style A container, steel straps, plastic straps, or tape may be used. One such reinforcement (strapping or tape) shall be added for containers of a length greater than 24 in. (610 mm). For each additional 18-in. (457-mm) increment of length, an additional reinforcement shall be added. These shall be evenly spaced along the length of the container..

X1.3.5 For Style A containers (alternate) with crushed overlapping flaps, the closure and reinforcement shall be accomplished as specified for the regular Style A container (see X1.3.4).

X1.3.6 *Style B Container:*

X1.3.6.1 *Closure*—Style B containers may be closed with steel straps, plastic straps, or tape. When steel or plastic strapping is used, closure shall be accomplished as outlined for this method under Style A containers (see X1.3.4.1). Where tape is used for closure, a strip shall be used on each side and each end. The strips shall be not less than 12 in. (300 mm) long and shall be applied at the center of both side and end panels. The strip shall extend from the side or end panel onto the bottom surface of the lower half of the container.

X1.3.6.2 *Reinforcement*—Reinforcement shall be as that for a Style A container as outlined in X1.3.4.2, but in addition, similar reinforcements shall be added for width as those required for length. When tape is used, additional strips shall be added longitudinally so that the sum total longitudinal tensile strength of all strips is not less than twelve times the gross weight of the container.

X1.3.7 *Style C Container:*

X1.3.7.1 *Closure*—When a Style C container is used in conjunction with a pallet, closure and sealing shall be as specified by the procuring activity. When the container is used without a pallet, it shall be closed with steel or plastic straps. One strap shall be centrally located around the top, ends, and bottom. Two straps shall be applied around top, sides, and bottom and placed 3 in. (76 mm) from the end of the container.

X1.3.7.2 *Reinforcement*—If the distance between straps as applied in X1.3.7.1 exceeds 24 in. (610 mm), additional reinforcement straps shall be spaced not more than 24 in. (610 mm) apart.

X1.4 Carriers Freight Classification

X1.4.1 Containers closed and reinforced as specified by this appendix should meet or exceed the requirements of Rule 41 of the Uniform Freight Classification and Item 222 of the National Motor Freight Classification. Additional reinforcement shall be used, when necessary, to ensure compliance with these requirements.