NATIONAL ARCHIVES

Specifications for Corrugated Paperboard

October 2015

I. Scope

This specification covers the requirements for B- and/or E-flute corrugated paperboard.

II. Requirements

Construction

The shipped flat B- or E-flute corrugated single wall (double-faced) paperboard shall consist of two facings (liners) adhered to one fluted medium. Each sheet should be constructed with the flutes running parallel to the long dimension of the sheet.

Dimensions

The dimensions of the boxboard shall be specified in the contract

Paperboard

Composition

All layers of the corrugated paperboard laminate shall be made from cotton or linen pulp, fully bleached chemical wood pulp, or a mixture that meets the following specification:

- Free of groundwood:
  - test negative in ASTM D1030 phloroglucinol test with X5 Spot Stains (ASTM has withdrawn this standard in 2011. NARA is following 2007 version),
  - or Kappa # ≤5 in TAPPI T-236 test.
- Free of alum-rosin sizing (ASTM D 549 or TAPPI T-408)
- Free of optical whitening agent and fire retardant.
- Contain <0.0008% reducible sulfur (TAPPI T-406).
- Free of particles or other impurities such as:
  - metals,
  - waxes,
  - plasticizers (i.e. wet strength additives),
  - plastics,
  - residual bleach,
  - peroxide

NATIONAL ARCHIVES

Sizing

Alkaline sizing shall be used (surface, internal, or both).

Alkaline Reserve

The corrugated paperboard shall contain an alkaline reserve of calcium carbonate, magnesium carbonate, or a combination of both, within a range of 3–6% (calculated as $CaCO_3$) when tested according to TAPPI T-553 or modified by slurrying the sample pulp prior to measurement, and shall be evenly distributed throughout all plies and layers. NARA will provide slurry method procedure upon request

Hydrogen Ion Concentration (pH)

The pH value of the corrugated paperboard shall be between 8.0 and 9.5 when tested according to cold extraction method TAPPI T-509 or modified by slurrying the sample pulp prior to measurement.

Lignin

To demonstrate the adequacy of bleaching or lignin removal, all layers of the corrugated paperboard shall have a negative reading in the phloroglucinol test when tested according to ASTM D1030, or shall have a KAPPA number of ≤5 when tested according to TAPPI T-236.

Basis Weight (TAPPI T-410)

- Liners: ≥35 lb/1000ft^2 (B-flute); ≥33 lb/1000ft^2 (E-flute);
- Corrugated medium: ≥26 lb/1000ft^2

Flute construction

Flute type	**Frequency** (# of flute / ft)	**Flute height** (in.)
B-flute	45-53	0.0787 – 0.1102
E-flute	70-98	0.0445 – 0.550

Abrasion Resistance

The outer surfaces of the liner board stock must show <0.3% total weight-loss (mounting card and sample) when tested according to TAPPI T-476 with a #CS10 wheel and 100 wear cycles.

NATIONAL ARCHIVES

Label Adhesion

The surface of the corrugated paperboard liner shall hold a piece of weighted PS tape securely for ≥10 min. in 6 out of 9 trials, when tested according to ASTM D2860.

Note: Procedure B modified as follows:

- use a 3/4", 3M Scotch® Magic™ 810 pressure sensitive tape to conduct the test
- adhere the tape to the paperboard surface with 2 rolls of a 10kg steel roller
- suspend a 2oz weight from the tape

Surface Smoothness

Smoothness shall be 250-400 Sheffield units as determined by TAPPI T-538.

Bending Resistance

The corrugated paperboard shall be tested for bending resistance in accordance with TAPPI T-836, and shall satisfy the following requirement:

E-Flute: ≥ 1.6 N·m (MD) and ≥ 0.9 N·m (CD).

B-Flute: ≥ 6.2 N·m (MD) and ≥ 2.9 N·m (CD).

Or

The corrugated paperboard shall be tested for bending resistance by adapting TAPPI T-556 to confirm that minimum acceptable stiffness, listed below, is met, except that for each specimen tested the corrugations shall run in the long direction of the specimen. Test conditions shall include 7.5 degrees deflection.

E-Flute: ≥ 4100 mN

B-Flute: ≥ 7000 mN

Delamination

The corrugated paperboard shall have sufficient folding strength, especially along the score lines. It shall show no continuous visual break of the plies when the board is flexed 180°, both parallel and perpendicular to the flutes, or along the score lines, when testing according to ASTM D 4727, section 9.3 (for singlewall corrugated fiberboard).

In addition, in the same test specified above, the liner facings must show no visual surface breaks longer than 1/2" when scored and then folded 180 degrees parallel to the flutes of the board.

NATIONAL ARCHIVES

Burst Strength

The corrugated paperboard shall be tested for burst strength using TAPPI T-810 and meet the following specification:

B-Flute: ≥170 psi

E-Flute: ≥150 psi.

Note: Need to pass ≥5 tests out of 6 total tests. If failed, retest 12 times with ≥8 passes

Flat Crush

When tested according to TAPPI T-825 (rigid support method), the corrugated paperboard should have a flat crush reading of

≥48psi for B-flute and ≥85psi for E-flute.

Adhesion Strength of Flutes (Pin Adhesion)

The adhesion strength between the flutes and liners shall reach ≥48 lbs per foot of glue line, when tested according to TAPPI T 821 (only applies to B-flute corrugated board).

Color

The color of the corrugated paperboard shall be blue or grey.

Color & Dye Bleed/Transfer

Dyes used to color the corrugated paperboard shall show no bleeding or transferring when soaked in distilled or deionized water for 48 hrs. under ambient temperature while held in direct contact with white bond paper.

Adhesive

A stable adhesive shall be used when adhering the two paperboard facings to each side of the fluted inner paperboard sheet. More specifically:

- Water resistant adhesive shall be used.
- When aging in a humidity chamber of 50°C and 87% RH for 4 hrs., the adhesive shall hold the components of the corrugated paperboard firmly together, not soften or run.
- The addition of adhesive shall not negatively impact the specification of the paperboard, such as reduce the pH or alkaline reserve, increase the sulfur content, or decrease the stiffness.

- If it is necessary to buffer the adhesive, the same buffer shall be used as those in the paperboard (calcium or magnesium carbonate, or a combination of both).
- The adhesive shall be invisible through and not alter the color of the paperboard.
- The adhesive shall not contain sulfur, iron, copper or other ingredients that may be detrimental to archival records.
- The adhesive shall not contain or generate oxidants.
- When used, the adhesive must not extend beyond the joined area.

Workmanship

The corrugated paperboard shall be assembled in accordance with good commercial practice, and shall be free of visible imperfections that may affect its utility or aesthetic appearance. The board must be compatible with all functionality of the conservation boxmaking instrument [KASEMAKE KM626A cutting system].

- Each sheet should be constructed with the flutes running parallel to the long dimension of the sheet.
- The smoothest side (felt side) of the liners should be the outer surfaces of the board.
- The wire side of the liners should be next to the corrugated medium, to promote maximum adhesion.
- The flutes must be adhered to each liner all along their tips.
- The corrugated paperboard should show no continuous visual surface break (checking) of the outer component ply, nor any facing completely split through at the score line (fracture).
- The surfaces shall be free of knots, shives, tears, punctures, wrinkles, blisters, washboarding, splices, abrasive particles and surface dirt of any kind, such as smudges, fingerprints, or scuff, marks. The surfaces shall not be marred (dents, bumps, etc.) or show any other types of physical defects.
- All edges shall be cut straight and shall be smooth and even, free of fraying, cracks, and breaks.
- Edges should be properly aligned so that the distance between the edges of any two components is ≤6 mm [1⁄4 in.].
- The edges or ends of the fiberboard sheet should not be delaminated for a distance of more than 6 mm [1⁄4 in.].
- The corners of the paperboard shall be square.
- When scored, the paperboard shall score evenly.
- The board must be acceptable for the creation of boxes of all sizes, including the extremes of both very large and very small boxes.

NATIONAL ARCHIVES

III. Preparation for Delivery

Packaging

The corrugated paperboard shall be shipped flat following standard commercial shipping practices that meet the following requirements: full enclosure (i.e. a box) sealed with tape to provide rigid support and protection from the elements that is non-damaging to the contents (does not bend, crimp, or fold edges or corners) so that the product arrives dry and undamaged.

The following amounts per box must be met:

B-Flute: 15 units/box

E-Flute: 25 units/box

The amount of warp upon delivery should not exceed 20 mm/m [1⁄4 in./ft].

Marking (package level)

The outside of each packing container shall be legibly marked with the following information: the purchase order number, the type, size and number of corrugated paperboard packed in the container.

IV. Quality Assurance Provisions

Tests

Test procedures and controls specified in this document shall be used to determine the quality of the product. Other procedures and controls must be approved by the National Archives before test results will be accepted.

Unless otherwise indicated, the tests shall be performed at, and the samples be conditioned to, a standard conditions of 73±3.5 °F and 50±2% RH (TAPPI T-402).

Sampling for Tests

Sampling Method

The sampling of corrugated paperboards in each shipment for examination shall be carried out according to methods specified in ANSI/ASQ Z1.4, inspection level S-2.

Acceptable quality levels

- For construction and workmanship at product level, the acceptable quality level shall be ≤4.0% defective from each lot of material delivered.

- For QC testing at product level, the acceptable quality level shall be ≤2.5% defective from each lot of material delivered.
- For compliance with packaging and marking requirements at package level, the acceptable quality level shall be ≤4.0% defective from each lot of material delivered.

Test Methods

The requirements for quality and characteristics shall be tested in accordance with specified test methods of the American Society for Testing and Materials (*ASTM*), the Technical association of the Pulp and Paper Industry (*TAPPI*), and the American National Standards Institute (ANSI). Publications describing these tests may be ordered directly from the technical associations.

Responsibility for Tests

The Contractor is responsible for quality control to ensure the specifications of this contract are met. The Contractor shall provide test results to the Contract Specialist (CS) and/or Contracting Officer (CO), **for each production lot** used to provide supplies under this contract. The test results shall display, at a minimum, the characteristics listed below and shall be provided at least 30 days prior to shipping any items from the production lot under this contract. The Contractor may use his or her own facilities or any commercial laboratory certified to run quality assurance test methods listed below. The National Archives and Records Administration (NARA) reserves the right to perform quality assurance at any time during the contract where such tests are deemed necessary to assure that supplies and services conform to the specifications. Therefore, the test results [pH, alkaline reserve, lignin, sizing, sulfur, basis weight, abrasion and bending resistances, label adhesion capability, burst strength, flat crush, surface smoothness, pin adhesion, score and fold strength, bleed and adhesive], two samples of each item purchased, and a sample of at least 12” x 12” of the material used to make the item (for example boxboard), shall be sent together to the CS within 14 days after award of the contract. Additionally, the Contractor shall provide a sample of at least 12” x 12” of the material from a new production lot at any time, upon request of the Government.

NATIONAL ARCHIVES

List of Tests for Corrugated Paperboard Quality

Test Items	Spec. Targets	Notes (test methods, test conditions, etc.)
Lignin	Negative or Kappa number ≤5	Phloroglucinol test, ASTM D1030 (X5 Spot Stains) TAPPI T-236
Alum-rosin sizing	Negative	TAPPI T-408 or ASTM D 549
Reducible Sulfur	<0.0008%	TAPPI T-406
Alkaline reserve	3 – 6% (calculated as $CaCO_3$)	TAPPI T-553 (or slurry method)
pH	8.0 – 9.5	TAPPI T-509 (or slurry method)
Basis Weight	Corrugated medium: ≥26 lb/1000ft^2 B-Flute liner: ≥35 lb/1000ft^2 E-Flute liner: : ≥33 lb/1000ft^2	TAPPI T-410
Abrasion Resistance	<0.3% (total weight-loss)	TAPPI T-476 (#CS10 wheel, 100 wear cycles, on outer surface)
Label Adhesion	Suspend a 2oz weight from the tape for ≥10 min. (≥6 passes out of 9 trials)	ASTM D2860, Method B, modified by: • Use a 3/4" wide, 3M Scotch® Magic™ 810 pressure sensitive tape • Adhere the tape to the sample surface with 2 rolls of a 10kg steel roller
Surface Smoothness	250-400 Sheffield units	TAPPI T 538
Bending Resistance	E-Flute: ≥1.6 N·m (MD) & ≥0.9 N·m (CD). B-Flute: ≥6.2 N·m (MD) & ≥2.9 N·m (CD).	TAPPI T-836
Bending Resistance (continued)	E-Flute: ≥4100 mN B-Flute: ≥7000 mN	TAPPI T-556
Delamination	No fraying, cracking, splitting, or continuous surface break of plies (see details in page 3)	ASTM D 4727, section 9.3. Flex the sample 180° both parallel and perpendicular to the flutes, or along the score lines.
Burst Strength	B-Flute: ≥170 psi E-Flute: : ≥150 psi	TAPPI T-810. Need to pass ≥5 tests out of 6 total tests. If failed, re-test 12 times with a total of ≥8 passes.
Flat Crush	B-Flute: ≥48 psi E-Flute: ≥85 psi	TAPPI T-825
Adhesion Strength of Flutes (Pin Adhesion)	≥48 lbs per foot of glue line	TAPPI T 821 (only applies to B-flute corrugated board)
Color & Dye Bleed / Transfer	No visible transferring	See above text for detailed test method and conditions
Strength of Water Resistance Adhesive	The adhesive can hold the components together, not soften / run	When aging for 4 hrs. under 50°C and 87% RH.

NATIONAL ARCHIVES

Revision note: Revision from Jan. 2015 version.