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# FEFCO Standards Committee: World standards - Comparison testing methods FEFCO / EN / ISO / TAPPI

*Final version 0204 - Revision October 2018*

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| **General items** |

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| **Test item** | **FEFCO Testing Method** | | **EN Standard** | | **ISO Standard** | | | **TAPPI Test Method** | | **Remarks** |
| Nr. (Year) | Title | Nr. (Year) | Title | Nr. (Year) | | Title | Nr. (Year) | Title |
| Vocabulary (paper and board) |  |  |  |  | 4046 part 1-5  (2016) | | Paper and board - Vocabulary |  |  | Definitions of paper and board terms; terminology |
| Guide lines for using SI-units | R 105 (2002) | Guidelines for the introduction and use of the SI System in the corrugated board industry | 25651 (1993) | Units for expression properties | ~~)~~ | |  | TIP 0800-01  (2012) | SI-units and conversion factors | Identical; preferred SI-units and conversion factors for paper and board properties, reference to testing standards |
| Sampling to determine average quality | TM 1 (1984) | Sampling procedure (corrugated board sheets, corrugated board containers) | 186 (2002) | Sampling to determine average quality | 186 (2002) | | Sampling to determine average quality | T 400 (sp-17) | Sampling | FEFCO/EN/ISO: Terminology different, identical procedure  FEFCO/TAPPI: Terminology identical, number of samples different |
| Compression-testing equipment |  |  |  |  | 13820 (2014) | | Paper, board and corrugated fibreboard – Description and calibration of compression-testing equipment |  |  | Reference standard in many ISO-standards. Description includes both rigid support method and flexible beam method and the preferred testing speed.  No analogue method for tensile tester (details are included in the relevant property testing standards) |
| Standard atmosphere for conditioning and testing of paper and board | Referred to EN 20187 / ISO 187 | | 20187 (1993) | Standard atmosphere for conditioning and testing | 187 (1990) | | Standard atmosphere for conditioning and testing | T 402 (sp-13) | Standard conditioning & testing atmospheres for paper, board, pulp hand sheets and related products | Identical |
| Basis weight (grammage) |  |  | 536 (2013) | Determination of grammage | 536 (2012) | | Determination of grammage | T 410 (om-13) | Grammage of paper and paperboard (weight per unit area) | Identical |
| Thickness |  |  | 534 (2012) | Determination of the thickness of single sheets and apparent bulk density and apparent sheet density | 534 (2011) | | Determination of the thickness of single sheets and apparent bulk density and apparent sheet density | T 411 (om-15) | Thickness (calliper) of paper, paperboard, and combined board | EN/ISO/TAPPI: preferred measuring pressure different; incl. alternate pressure identical |
| **Component papers of the corrugated board** | | | | | | | | | | |
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| **Test item** | **FEFCO Testing Method** | | **EN Standard** | | | **ISO Standard** | | **TAPPI Test Method** | | **Remarks** |
| Nr. (Year) | Title | Nr. (Year) | Title | | Nr. (Year) | Title | Nr. (Year) | Title |
| Bursting strength – corrugated board component papers |  |  | 2759 (2014) | Board – Determination of bursting strength | | 2759 (2014) | Board – Determination of bursting strength | T 807 (om-11) | Bursting strength of paperboard and linerboard | Identical  ISO 2758 can be used as alternative, but gives different (lower) results) |
| Crushing stiffness (SCT) |  |  |  |  | | 9895 (2008) | Compressive strength – Short span test | T 826 (om-13) | Short Span Compressive Strength of Container-board | Identical |
| (RCT) |  |  |  |  | | 12192 (2011) | Compressive strength – Ring crush method | T 818 (cm-07) SARG | Ring crush of paperboard (flexible beam method) | SARG (under review)  Identical procedure; application range (thickness of papers) to high regarding used papers in praxis (≥228µm); testing speed at ISO not clearly stated, but identical |
|  |  |  |  |  | |  |  | T 822 (om-11) | Ring crush of paperboard (rigid support method) |
| Tearing resistance |  |  | 1974 (2012) | Determination of tearing resistance (Elmendorf) | | 1974 (2012) | Determination of tearing resistance (Elmendorf) | T 414 (om-12) | Internal Tearing Resistance of Paper (Elmendorf-Type Method) | Identical; number of plies 4 at ISO, not defined at TAPPI. Use of different number of plies may influence the result |
| Corrugated medium – Flat crush resistance after laboratory fluting (CMT) |  |  | 7263 (2011) | Corrugated medium – Determination of flat crush resistance after laboratory fluting | | 7263 (2011) | Corrugated medium – Determination of flat crush resistance after laboratory fluting | T 809 (om-17) | Flat crush of corrugated medium (CMT test) | Identical procedure; testing time delay (after fluting) different defined; results depend on the time delay |
| Corrugated medium – edge crush resistance (CCT) |  |  |  |  | |  |  | T 843 (om-14) | Fluted edge crush of corrugating medium (rigid support method) |  |
|  |  |  |  |  | |  |  | T 824 (cm-14) | Fluted edge crush of corrugating medium (flexible beam support method) |  |
| Water absorption |  |  | 535 (2014) | Determination of water absorption – Cobb method | | 535 (2014) | Determination of water absorption – Cobb method | T 441 (om-13)  T 835 (om-08) | Water absorptiveness of sized paper, paperboard, and corrugated fibreboard (Cobb test)  Water absorption of corrugating medium: water drop absorption test | Identical procedure except testing-, immersion- and blotting time:  EN/ISO: fixed testing-, immersion- and blotting times  TAPPI: one fixed testing- and blotting time (preferred condition) |

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|  |  |  |  |  |  |  | T 819 (wd-17) | Water absorption of corrugating medium: boat method | Different procedure regarding the other tests for the same property. The methods do not give the same numerical results, but, in general, will rank the materials in the same order as this method. |
|  |  |  |  |  |  |  | T 831 (om-14) | Water absorption of corrugating medium: water drop test | Different procedure regarding the other tests for the same property. The methods do not give the same numerical results, but, in general, will rank the materials in the same order as this method. |
|  |  |  |  |  |  |  | T 832 (om-17) | Water absorption of corrugating medium: float curl method | Different procedure regarding the other tests for the same property. The methods do not give the same numerical results, but, in general, will rank the materials in the same order as this method. |
|  |  |  |  |  |  |  | T 835 (om-08) | Water absorption of corrugating medium: water drop absorption | Different procedure regarding the other tests for the same property. The methods do not give the same numerical results, but, in general, will rank the materials in the same order as this method. |
| Friction |  |  |  |  | 15359 (1999) | Determination of the static and kinetic coefficients of friction – Horizontal plane method |  |  | Determination of the static and kinetic coefficient of friction; fully automatic handling  Results: similar to inclined plane method 2) |
|  |  |  |  |  |  |  | T 815 (om-18) | Coefficient of static friction (slide angle) of packaging and packaging materials (inclined plane method) | Determination of the static coefficient of friction  Results: similar to horizontal plane method 2) |
| Bending stiffness |  |  |  |  | 2493 -1 (2010) | Determination of resistance to bending | T 489 (om-15) | Bending resistance (stiffness) of paper and paperboard (Taber-type tester) | Equivalent methods, but the testing apparatus are different. 2-point method; may be applied to component papers of corrugated board, but not recommended for corrugated board.  Result: bending force for defined bending; equivalent results at both methods |
|  |  |  |  |  | 5628 (2012) | Determination of bending stiffness by static methods – General principles |  |  | General method; 2-point, 3-point and 4-point methods described. Guidelines for the limitation of the use of each method given, but not specific testing conditions.  Result: bending stiffness |
| Moisture content |  |  | 287 (2018) | Determination of moisture content – Oven drying method | 287 (2017) | Determination of moisture content – Oven drying method | T 412 (om-11) | Moisture in pulp, paper and paperboard | Identical. Base is the grammage at its time of sampling. |
| Tensile strength |  |  | 1924-2  (2008) | Determination of tensile properties – Part 2: Constant rate of elongation method | 1924-2  (2008) | Determination of tensile properties – Part 2: Constant rate of elongation method | T 494 (om-13) | Tensile properties of paper and paperboard (Using constant rate of elongation apparatus) | EN/ISO – TAPPI: Similar methods with same procedure, but some details different (testing speed (ranges overlapping), sample width). Analogue methods at EN/ISO and TAPPI using pendulum type apparatus)  Results: May be different, but same ranking |

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| Nr. (Year) | Title | Nr. (Year) | Title | Nr. (Year) | Title | Nr. (Year) | Title |
| Wet tensile strength |  |  |  |  | 3781 (2011) | Determination of tensile strength after immersion in water | T 456 (om-15) | Tensile breaking strength of water-saturated paper and paperboard (“wet tensile strength”) | Procedure for wetting the paper before doing the tensile test. Wet strength may be compared with “dry” tensile strength  TAPPI T 456 is not recommended for paper/board only but not for corrugated board |
| Optical properties |  |  |  |  | 11664 -1 to- 5 (2007 through 2013)  9416 (2009) | CIE standard colorimetric illuminants and observers     Paper-determination of light scattering and absorption coefficients (using Kubelka-Munk theory) |  |  |  |
| Brightness |  |  |  |  | 2470 -1 (2009)   2470 -2 (2008) | Measurement of diffuse reflectance factor (ISO brightness)   Measurement of diffuse reflectance factor (D65 brightness) | T 571 (wd-06) | Diffuse brightness of paper and paperboard (d/0) | Remark: Measurements under D65/10° illumination/ observer conditions may not be called “ISO brightness” (→ D65 brightness)  Remark TAPPI-method: Results not identical to those determined with TAPPI T 452. |
|  |  |  |  |  |  |  | T 452 (om-18) | Brightness of pulp, paper and paperboard (directional reflectance at 457 nm) | Method for determination of the “directional reflectance brightness at 457 nm”; 45° illumination and 0° viewing geometry; blue light. This method is suitable for paers containing optical brightener, but not suitable for paper or paperboard containing added coloring matter.  Remark: The results determined according to this method are not identical to those determined according TAPPI  T 571 or ISO 2470. |
| Colour |  |  |  |  | 5631 -1 (2015)  5631 -2 (2015)  5631 -3 (2015) | Determination of Colour (C/2°) – Diffuse reflectance method  Determination of Colour (D65/10°) – Diffuse reflectance method  Determination of Colour (D50/2°) – Diffuse reflectance method | ~~T 527 (om-13)~~ |  | Identical methods for determining of L\*, a\*, b\* under CIE C/2° illumination/observer conditions  Remark: Measurements under D65/10° illumination/ observer conditions can be carried out in an analogous manner (not in accordance with the standard).  Results: ISO: CIELAB colour values  TAPPI: CIELAB colour values; Hunter colour   values; CIE L\*, C\*, h values |
|  |  |  |  |  |  |  | T 524 (om-13) | Colour of paper and paperboard (45/0, C/2) | Identical methods for determining of L\*, a\*, b\* under CIE C/2° illumination/observer conditions  Results: TAPPI: CIELAB colour values; Hunter colour   values; CIE L\*, C\*, h values |
| Whiteness |  |  |  |  | 11475 (2017) | Determination of CIE whiteness, D65/10° (outdoor daylight) |  |  | Identical methods for white or near-white papers without or with optical brightener under D65/10° illumination/ observer condition  Results: CIE Whiteness, Tint  Fluorescence |
|  |  |  |  |  | 11476 (2016) | Determination of CIE whiteness, C/2° (indoor illumination) | T 560 (om-10) | CIE Whiteness and Tint of paper and paper-board (Using d/0°, diffuse illumination and normal viewing) | Identical methods for white or near-white papers without or with optical brightener under C/2° illumination/observer condition  Results: CIE Whiteness, Tint  Fluorescence |
|  |  |  |  |  |  |  | T 562 (om-10) | CIE Whiteness and Tint of paper and paper-board (Using 45°/0°, directional illumination and normal viewing) | Method for white or near-white papers without or with optical brightener under C/2° illumination/observer condition  Results: CIE Whiteness, Tint  Fluorescence |
| Opacity |  |  |  |  | 2471 (2008) | Determination of opacity (paper backing) – diffuse reflectance method | T 519 (om-17) | Diffuse opacity of paper (d/0 paper backing) | Identical methods for white or near-white papers without or with optical brightener and colored papers with reflectance > 20% and opacity > 45% under C/2° illumination/ observer condition. Paper backing.  Result: diffuse opacity |
|  |  |  |  |  |  |  | T 425 (om-16) | Opacity of paper (15/d geometry, illuminant A/2°, 89% reflectance backing and paper backing | Methods for paper, paperboard, containerboard etc.; A/2° illumination/observer condition, 15/d geometry and using 89% reflectance backing or paper backing.  Results: 89% reflectance opacity C0.89 (“contrast ratio”)   paper backing opacity (“printing opacity”)  Scattering power sW / -coefficient s  Absorption power kW / -coefficient k |

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| Nr. (Year) | Title | Nr. (Year) | Title | Nr. (Year) | Title | Nr. (Year) | Title |
| Gloss |  |  | 14086 (2003)  8254-1 (2009) | Paper & board-measurement of specular gloss-45° gloss with a parallel beam, DIN method  Measurement of specular gloss Part 1: 75° gloss with a converging beam. TAPPI method | 8254-1 (2009) | Measurement of specular gloss Part 1: 75° gloss with a converging beam. TAPPI method | T 480 (om-15) | Specular gloss of paper and paperboard at 75 degrees | Identical methods |
|  |  |  | 8254-2 (2016) | Measurement of specular gloss Part 2: 75° gloss with a parallel beam. DIN method | 8254-2 (2016) | Measurement of specular gloss Part 2: 75° gloss with a parallel beam. DIN method |  |  | Results may be different to those of 75° TAPPI method |
|  |  |  |  |  | 8254-3 (2016) | Measurement of specular gloss Part 3: 20° gloss with a converging beam. TAPPI method | T 653 (om-07) | Specular gloss of paper and paperboard at 20- degrees | Identical methods |
| Terminology related to the appearance of paper |  |  |  |  |  |  | T 1500 (gl-12) SARG | Optical measurements terminology (related to appearance evaluation of paper) | Definition of terms related to the appearance (e.g. brightness, whiteness, colour, gloss etc)  SARG (under review) |

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| **Corrugated board** | | | | | | | | | |
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| Nr. (Year) | Title | Nr. (Year) | Title | Nr. (Year) | Title | Nr. (Year) | Title |
| Sampling to determine average quality | TM 1 (1984) | Sampling procedure (corrugated board sheets, corrugated board containers) | 186 (2002) | Sampling to determine average quality | 186 (2002) | Sampling to determine average quality | T 400 (sp-17) | Sampling | FEFCO/ ISO: Terminology different, identical procedure  FEFCO/TAPPI: Terminology identical, number of samples different |
| Basis weight of the corrugated board (grammage) | TM 2 (1985) | Determination of basis weight of corrugated fibreboard | 536 (2013) | Determination of grammage | 536 (2012) | Determination of grammage | T 410 (om-13) | Grammage of paper and paperboard (weight per unit area) | Identical |
| Basis weight of the component papers of the corrugated board | TM 10 (1985) | Determination of the basis weight of the component papers of corrugated fibreboard after separation |  |  | 3039 (2010) | Determination of the grammage of the component papers after separation |  |  | Identical procedure; max. drying temperature lower at ISO |
| Thickness of the corrugated board | TM 3 (1985) | Determination of thickness (calliper) of corrugated fibreboard |  |  | 3034 (2011) | Determination of thickness | T 411 (om-15) | Thickness (calliper) of paper, paperboard, and combined board | FEFCO/ISO: identical  FEFCO/TAPPI: Plunger size and measuring pressure different |
| Bursting strength – corrugated board (BST) | TM 4 (1997) | Determination of bursting strength of corrugated fibreboard | 2759 (2014) | Board – Determination of bursting strength | 2759 (2014) | Board – Determination of bursting strength | T 810 (om-17) | Bursting strength of corrugated and solid fibreboard | Identical procedure, normally identical results;  TAPPI: stiffness of diaphragm only at 9.5mm defined, definition of clamping pressure different |
| Bursting strength after immersion in water |  |  |  |  | 3689 (1983) | Board – Determination of bursting strength after immersion in water |  |  | Base is “dry” bursting strength test. Prior to testing the sample is immersed in water |
| Puncture resistance (PET) | TM 5 (1985) | Determination of puncture resistance of corrugated fibreboard |  |  | 3036 (1975) | Determination of puncture resistance | T 803 (cm-10) | Puncture test of container board | Identical procedure. Minor differences regarding:  - Range of puncture head edges radius - clamping pressure range.  Results similar, but not always 100% identical |
| Flat crush resistance (FCT) | TM 6 (1986) | Determination of flat crush resistance of corrugated fibreboard | 3035 (2011) | Determination of flat crush resistance (single-faced or single wall corrugated board) | 3035 (2011) | Determination of flat crush resistance (single-faced or single wall corrugated board) | T 825 (om-14) | Flat crush test of corrugated board (rigid support method) | Identical procedure; sample size (preferred) different. Results similar. |
|  |  |  |  |  |  |  | T 808 (cm-15) | Flat crush test of corrugated board (flexible beam method) | Identical procedure; sample size (preferred) different. Large sample size may lead to “leaning flute” problems |
| Water absorption | TM 7 (1997) | Determination of water absorptiveness of corrugated fibreboard (Cobb test) | 535 (2014) | Determination of water absorption – Cobb method | 535 (2014) | Determination of water absorption – Cobb method | T 441 (om-13) | Water absorptiveness of sized paper, paperboard, and corrugated fibreboard (Cobb test) | Identical procedure except testing-, immersion- and blotting time:  FEFCO: only Cobb1800 (30min)  ISO: fixed testing-, immersion- and blotting times  TAPPI: one fixed testing- and blotting time (preferred condition) |

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| Nr. (Year) | Title | Nr. (Year) | Title | Nr. (Year) | Title | Nr. (Year) | Title |
| Edge crush resistance (ECT) | TM 8 (1997) | Edgewise crush resistance of corrugated fibreboard | 3037 (2013) | Determination of edgewise crush resistance (Unwaxed method) (FEFCO) | 3037 (2013) | Determination of edgewise crush resistance (Unwaxed method) (FEFCO) |  |  | Identical. Result very sensitive to cutting precision of the sample (using double bevelled knifes, worn out knifes or bad cutting (geometry) lead to lower results)1)  No TAPPI method for FEFCO sample |
|  |  |  |  |  | 13821 (2002) | Determination of edgewise crush resistance (Waxed edge method) | T 811 (om-17)  T 841  (wd-13) | Edgewise compression strength of corrugated fibreboard using the clamp method (short column test)  Edgewise compressive strength of corrugated fibre board using the Morris method | Identical.”Heavy” procedure due to waxing and reconditioning  Similar results as FEFCO-method (careful cutting of the FEFCO sample is necessary)1)  50 x 50mm test piece, special specimen holder needed. Some % lower results than with TAPPI T 811 |
|  |  |  |  |  |  |  | T838 (om-12) | Edge crush using neckdown | Similar results as FEFCO-method, no advantage regarding cutting, precision etc.1) |
|  |  |  |  |  |  |  | T 839 (om-18) | Edgewise compression strength of corrugated fibreboard (short column test) | Similar results as FEFCO-method (careful cutting of the FEFCO sample is necessary); no advantage regarding cutting, precision etc.1) special specimen clamping device needing at least 60mm space between pressure plates |
| Water resistance of the gluing | TM 9 (1985) | Determination of water resistance of the glue bond of corrugated fibreboard by immersion |  |  | 3038 (1975) | Determination of the water resistance of the glue bond by immersion |  |  | Identical.  FEFCO: special remark regarding testing of manufacturer’s joint of a box  ISO: Contains unnecessary drawings regarding preparation of the samples (cutting) |
|  |  |  |  |  |  |  | TIP 0304-69 (2017) | Understanding wet strength: what are MRA, WRA and WPA? | Information paper regarding definition and interpretation of “wet strength”: 3 wet strength levels defined: MRA, WRA and WPA |
|  |  |  |  |  |  |  | T 842 (wd-03) | Corrugated board glue bond wet shear test | Similar principle as FEFCO/ISO, but the failing force is measured after a defined immersion time; increased water temperature for immersion (40°C) |
|  |  |  |  |  |  |  | T 812 (om-13) | Ply separation of solid and corrugated fibreboard (wet) | Method: Intension is to distinguish between boards fabricated with water-resistant adhesive and with non- water-resistant adhesive (visual laboratory method). Normal soaking time 24h |
|  |  |  |  |  |  |  | T 821 (om-17) | Pin adhesion of corrugated board by selective separation | Similar method to FEFCO 11, but after immersion in water or after conditioning in a high-humidity atmosphere. The force required to separate the corrugated board between the flutes and the liners is measured |

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| Nr. (Year) | Title | Nr. (Year) | Title | Nr. (Year) | Title | Nr. (Year) | Title |
| Pin adhesion test (dry) | TM 11 (1985) | Determination the adhesion strength of the glue bonds of corrugated fibreboard (pin method) |  |  |  |  | T 821 (om-17) | Pin adhesion of corrugated board by selective separation | Similar methods at standard atmosphere. The force required to separate the corrugated board between the flutes and the liners is measured.  Differences: Sample size, testing speed for flexible beam tester |
| Coefficient of static and kinetic friction | R 104 (2002) | Procedure for the determination of the angle of slip for corrugated board |  |  |  |  | T 815 (om-18) | Coefficient of static friction (slide angle) of packaging and packaging materials (inclined plane method) | Similar testing principles; sample dimensions and loading weight different. Equivalent results at both methods and equivalent to horizontal plane methods 2) |
|  |  |  |  |  | 15359 (1999) | Determination of the static and kinetic coefficients of friction – Horizontal plane method | T 816 (wd-00) | Coefficient of static friction of corrugated and solid fibreboard (horizontal plane method); withdrawn | Similar testing principles, but technical requirements on the friction tester different.  ISO: determination of the static and kinetic coefficient of friction, fully automatic handling  TAPPI: only static coefficient of friction (manual loading possible).  Results static coefficient of friction: equivalent at both methods and equivalent to inclined plane methods 2) |
| Bending stiffness |  |  |  |  | 5628 (2012) | Determination of bending stiffness by static methods – General principles | T 820 (cm-09) | Flexural stiffness of corrugated board | ISO: General method; 2-point, 3-point and 4-point methods described. Guidelines for the limitation of the use of each method given, but not specific testing conditions. Recommended for corrugated board: 3-point and 4-point methods. Result: bending stiffness  TAPPI T 820: 4-point method, general description as ISO  Results: Equivalent at both methods |
|  |  |  |  |  |  |  | T 836 (om-13) | Bending stiffness, four point method | Similar method for testing corrugated board as TAPPI T820, but the application of the bending load is different. Specific recommendations for testing settings for the diverse corrugated board types given.  Results: Equivalent to the above methods |
| Take-up factor of fluting paper | R 102 (2002) | Determination of the take-up factor of the fluting paper |  |  |  |  |  |  | Principle: Measuring of the difference in the length of the corrugated board papers after separation (according TM 10/ISO 3039) and the corrugated board sample before the separation process. |
| Moisture content |  |  | 287 (2018) | Determination of moisture content – Oven drying method | 287 (2018) | Determination of moisture content – Oven drying method | T 412 (om-11) | Moisture in pulp, paper and paperboard | Identical. Base is the grammage at its time of sampling. Aim is to determine the moisture “as received” |
|  |  |  |  |  |  |  | T 550 (om-13) | Determination of equilibrium moisture in pulp, paper and paperboard for chemical analysis | Similar method as TAPPI T 412, but reference is conditioned sample. Aim is to determine the moisture “after conditioning in the standard atmosphere” |

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| Printing |  |  |  |  |  |  | T 830 (om-18) | Ink rub test of container board | Evaluation of scuffing- or rubbing resistance of an ink film or fibre surface on container board |
| Brightness Colour Whiteness |  |  |  |  |  |  |  |  | See item at “Component papers of the corrugated board” |
| Gloss |  |  |  |  |  |  |  |  | See item at ”Component papers of the corrugated board” |

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| **Boxes, packages** | | | | | | | | | |
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| Nr. (Year) | Title | Nr. (Year) | Title | Nr. (Year) | Title | Nr. (Year) | Title |
| **Standard atmosphere for conditioning and testing of packages** | referred in Test Method Nr. 51, 52, 53, 55 to EN / ISO 2233 | | 2233 (2001) | Complete, filled transport packages and unit loads – Conditioning for testing | 2233 (2000) | Complete, filled transport packages and unit loads – Conditioning for testing |  |  | FEFCO: only 23°C 50% rh mentioned; range for rel. humidity bigger than EN / ISO (± 3% compared with ± 2%) → test results not different |
| **Packages – Identification of parts when testing** | See TM 51 or EN 22206 | | 22206 (1992) | Complete, filled transport packages – Identification of parts when testing | 2206 (1987) | Complete, filled transport packages – Identification of parts when testing | See T 801 and T802 | | identical |
| **Compression resistance of the box (BCT)** | TM 50 (1997) | Determination of the Compression Resistance of corrugated fibreboard containers | 12048 (2000) | Complete, filled transport packages – Compression and stacking tests using a compression tester | 12048 (1994) | Complete, filled transport packages – Compression and stacking tests using a compression tester | T 804 (om-12) | Compression test of fibreboard shipping containers | Similar procedure. Differences in testing speed (ranges overlapping)  FEFCO 50: no fixing of the flaps; box simply erected  TAPPI T 804: When testing empty boxes, the flaps must be fixed → BCT result different (lower by approx. 5%) compared to FEFCO 50 3)  EN / ISO 12048: only complete, filled packages covered  General: Results may vary due to different testing speed 3) 4) |
| Stacking resistance of the box |  |  | 12048 (2000) | Complete, filled transport packages – Compression and stacking tests using a compression tester | 12048 (1994) | Complete, filled transport packages – Compression and stacking tests using a compression tester |  |  | A predetermined load is applied for a predetermined time or until failure occurs. |
|  |  |  | 2234 (2002) | Complete, filled transport packages and unit loads – Stacking tests using a static load | 2234 (2000) | Complete, filled transport packages and unit loads – Stacking tests using a static load |  |  | A predetermined load is applied for a predetermined time or until failure occurs. |
| Transport packages; Centre of gravity |  |  | 13054 (2001) | Complete, filled transport packages – Center of gravity |  |  |  |  | Method for determining the centre of gravity of a complete, filled package |
| Vertical impact resistance (drop test by free fall) of empty and/or filled boxes | TM 51 (1999) | Filled corrugated fibreboard containers – Vertical impact test by dropping | 22248 (1992) | Complete, filled transport packages – Vertical impact by dropping | 2248 (1985) | Complete, filled transport packages – Vertical impact by dropping | T 802 (om-17) | Drop test for fibreboard shipping containers | Identical |
| Horizontal impact resistance of filled boxes | TM 53 (1999) | Filled corrugated fibreboard containers – Horizontal impact test (inclined plane test) | 2244 (2002) | Complete, filled transport packages – Horizontal impact tests | 2244 (2000) | Complete, filled transport packages – Horizontal impact tests | T 801 (wd-11) | Impact resistance of fibreboard shipping containers | Identical.  ISO: alternate procedure: pendulum test |
|  |  |  |  |  |  |  |  |  | ASTM D 4003-92: Standard test method for programmable horizontal impact test for shipping container. Test methods to determine the ability of a package to withstand laboratory simulated horizontal impact forces (programmed shock inputs) |

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| **Test item** | **FEFCO Testing Method** | | **EN Standard** | | **ISO Standard** | | **TAPPI Test Method** | | **Remarks** |
| Nr. (Year) | Title | Nr. (Year) | Title | Nr. (Year) | Title | Nr. (Year) | Title |
| Handling resistance of filled boxes |  |  |  |  |  |  | T 800 (cm-06) | Drum test for fibreboard shipping containers (revolving hexagonal drum) | Test method to determine the ability of a shipping container to withstand rough handling.  Identical method: ASTM D 782-82: Standard test for shipping containers in revolving hexagonal drum. |
| Rolling test of filled boxes |  |  | 22876 (1992) | Complete, filled transport packages – Rolling test | 2876 (1985) | Complete, filled transport packages – Rolling test |  |  | Method of testing to assess the performance of the package for damages when the package is rolled; similar test see ISO 8768 Toppling test |
| Toppling test of filled boxes |  |  | 28768 (1992) | Complete, filled transport packages – Toppling test | 8768 (1986) | Complete, filled transport packages – Toppling test |  |  | Method of testing to assess the performance of the package for damages when the package is toppled |
| Rotational drop of filled boxes |  |  | 14149 (2003) | Complete, filled transport packages and unit loads – Impact test by rotational drop |  |  |  |  | Method of testing to assess the performance of the package for damages when the package is charged by a rotational drop; similar test see ISO 8768 Toppling test and ISO 2876 Rolling test |
| Vibration resistance of packages | TM 52 (1999) | Filled corrugated fibreboard containers – Vibration test at fixed low frequency | 2247 (2002) | Complete, filled transport packages – Vibration test at fixed, low frequency | 2247 (2000) | Complete, filled transport packages – Vibration test at fixed, low frequency | T 817 (om-89; wd-96) | Vibration test of fibreboard shipping containers (withdrawn) | FEFCO/EN/ISO: identical procedure. Both accelerations  ≤ 1G (test specimen is not separating from the table) and  > 1G ((test specimen is separating from the table) are described. Fixed sinusoidal frequency between 2 and 7Hz.  TAPPI: Several test options. Method A is similar to FEFCO/EN/ISO: low frequency, but acceleration > 1G |
|  |  |  | 8318 (2002) | Complete, filled transport packages and unit loads – Sinusoidal vibration tests using a variable frequency | 8318 (2000) | Complete, filled transport packages and unit loads – Sinusoidal vibration tests using a variable frequency |  |  | Vibration test on a complete, filled package or unit load using a variable sinusoidal frequency. |
|  |  |  | 13355 (2016) | Complete, filled transport packages and unit loads – Vertical random vibration test | 13355 (2016) | Complete, filled transport packages and unit loads – Vertical random vibration test |  |  | Vibration test on a complete, filled package or unit load using a vertical random excitation with frequency between 3Hz and 300 Hz. |
| Stability of unit loads |  |  |  |  | 10531 (1992) | Complete, filled transport packages – Stability of unit loads |  |  | Methods of testing for the stability of unit loads; to assess the performance of completely formed unit loads |
| Distribution trials |  |  | 24178 (1992) | Complete, filled transport packages – Distribution trials – Information to be recorded | 4178 (1980) | Complete, filled transport packages – Distribution trials – Information to be recorded |  |  | Standard to specify the information to be recorded when carrying out distribution trials involving complete, filled transport packages. |
|  |  |  | 4180 (2010) | Complete, filled transport packages – General rules for the compilation of performance test schedules | 4180 (2009) | Complete, filled transport packages – General rules for the compilation of performance test schedules |  |  | General rules and principles for the compilation of performance test schedules for road-, rail-, ship- and air transport of complete, filled transport packages. |

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| **Test item** | **FEFCO Testing Method** | | **EN Standard** | | **ISO Standard** | | **TAPPI Test Method** | | **Remarks** |
| Nr. (Year) | Title | Nr. (Year) | Title | Nr. (Year) | Title | Nr. (Year) | Title |
| Strength of manufacturers joint | TM 55 (1999) | Determination of the strength of the manufacturers’ joint of corrugated fibreboard containers (compression method) |  |  |  |  | T 813 (wd-12) | Tensile test for the manufacturer’s joint of fibreboard shipping containers | Different procedures with different results. The methods are applicable to all types of manufacturer’s joint. |
|  |  |  |  |  |  |  | T 840 (om-10) | Testing adhesives used in glued lap joints of corrugated fibreboard containers | Method for evaluating the adhesive used in glued lap joints (heat-, water- and cold resistance of the adhesive).  Remark: Testing the joint of a finished container see TAPPI T 813 |
| Score quality |  |  |  |  |  |  | T 829 (om-15) | Score quality test | The ultimate bending resistance (3-point method with a short bending length) of a scored section is compared with an unscored section. |
| Design of boxes | (2007) | FEFCO-ESBO Code |  | Work item at CEN TC 261 |  |  |  |  | EN-standard refers to FEFCO-ESBO code |
| Box dimensions | R 101 (2002) | Procedure for determining the internal dimensions of the flap type of one-piece corrugated board cases |  |  |  |  | T 827 (om-17) | Box blank dimensioning | Identical. The score-to-score distances of a box blank are determined. |
| Strength at high humidity | **Standard testing conditions:** see EN ISO 2233:2001 (ISO 2233:2000) Complete, filled transport packages and unit loads – Conditioning for testing: Conditions 4 / 6 / 8 / 9 / 11 | | | | | | | | |
|  | **Water spray pre-treatment of the Package:** see EN ISO 2875:2002 (ISO 2875:2000) Packaging – Complete, filled transport packages and unit loads – Water spray test | | | | | | | | |
|  | **Transport of dangerous goods Water spray test:** see RID / ADR 6.3.2.5 / 6.4.15.1 Water spray test | | | | | | | | |
|  | **Water immersion:** see ISO 8474:1986 Packaging – Complete, filled transport packages – Water immersion test | | | | | | | | |
|  | **Water resistance of the board:** see Corrugated board: Water resistance of the gluing | | | | | | | | |
|  | **Water resistance of the gluing of the manufacturers joint:** see Corrugated board: Water resistance of the gluing FEFCO Testing Method No. 9 | | | | | | | | |
|  | **Wet strength of the component papers of the corrugated board:** see Component papers of the corrugated board: Wet tensile strength | | | | | | | | |

Legend:

TM: FEFCO Testing Method

R: FEFCO Recommendation

T: TAPPI Standard: - om: Official test method; pm: Provisional test method; cm: Classical method; sp: Standard praxis: wd: Withdrawn method gl: Glossary

TIP: Technical Information Papers

EN: EN Standard

ISO: ISO Standard

(Year): year of the actual edition

Note 1: FEFCO Round Robin Tests; special projects

Note 2: FEFCO Round Robin Tests: Determination of the static coefficient of friction; Remarks at TAPPI test methods

Note 3: FEFCO Round Robin Test: BCT

Note 4: Note at ISO 12048

Urs Ernst 2003-08-25

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