

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

16 September 2004

### General items

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 (2002)	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	5651 (1989)	Units for expression properties	TIS 0800-01 (2000)	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-02)	Sampling	FEFCO/EN/ISO: Terminology different, identical procedure FEFCO/TAPPI: Terminology identical, number of samples different
Compression-testing equipment					13820 (1996)	Paper, board and corrugated fibreboard – Description and calibra- tion 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-98)	Standard Conditioning and Testing Atmosphere for Paper, Board, Pulp and related products	Identical
							T402 (sp-03)	Standard conditioning & testing atmospheres for paper, board, pulp handsheets and related products	

## Component papers of the corrugated board

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	
Basis weight (grammage)			536 (1996)	Determination of grammage	536 (1995)	Determination of grammage	T 410 (om-02)	Grammage of paper and paperboard (weight per unit area)	Identical
Thickness			20534 (1993)	Determination of the thickness of single sheets and apparent bulk density and apparent sheet density	534 (1988)	Determination of the thickness of single sheets and apparent bulk density and apparent sheet density	T 411 (om-97)	Thickness (caliper) of paper, paperboard, and combined board	EN/ISO/TAPPI: preferred measuring pressure different; incl. alternate pressure identical
Bursting strength – corrugated board component papers					2759 (2001)	Board – Determination of bursting strength	T 807 (om-99)	Bursting strength of paperboard and linerboard	Identical ISO 2758 can be used as alternative, but gives different (lower) results)
Crushing stiffness (SCT)  (RCT)					9895 (1989)	Compressive strength – Short span test	T 826 (wd-01)	Short Span Compressive Strength of Paperboard	Identical
					12192 (2002)	Compressive strength – Ring crush method	T 818 (om97)	Ring crush of paperboard (flexible beam method)	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-02)	Ring crush of paperboard (rigid support method)	
Tearing resistance			21974 (1994)	Determination of tearing resistance (Elmendorf)	1974 (1990)	Determination of tearing resistance (Elmendorf)	T 414 (om-98)	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 (1995)	Corrugated medium – Determination of flat crush resistance after laboratory fluting	7263 (1994)	Corrugated medium – Determination of flat crush resistance after laboratory fluting	T 809 (om-99)	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-02)	Fluted edge crush of corrugating medium (rigid support method)	
							T 824 (om-02)	Fluted edge crush of corrugating medium (flexible beam support method)	
Water absorption			20535 (1994)	Determination of water absorption – Cobb method	535 (1991)	Determination of water absorption – Cobb method	T 441 (om-98)	Water absorptiveness of sized paper, paperboard, and corrugated fiberboard (Cobb test)	Identical procedure except testing-, immersion- and blotting time: EN/ISO: fixed testing-, immersion- and blotting times

Water absorption (continued)							T 819 (cm-95)	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-99)	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-03)	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-03)	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. One fixed testing and blotting time (preferred condition)
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 <sup>2)</sup>
							T 815 (om-01)	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 <sup>2)</sup>
Bending stiffness					2493 (1992)	Determination of resistance to bending	T 489 (om-99)	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 (1990)	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			20287 (1994)	Determination of moisture content – Oven drying method	287 (1985)	Determination of moisture content – Oven drying method	T 412 (om-02)	Moisture in pulp, paper and paperboard	Identical. Base is the grammage at its time of sampling.
Tensile strength			1924-2 (1995)	Determination of tensile properties – Part 2: Constant rate of elongation method	1924-2 (1994)	Determination of tensile properties – Part 2: Constant rate of elongation method	T 494 (om-01)	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

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	
Wet tensile strength					3781 (1983)	Determination of tensile strength after immersion in water	T 456 (0m-03)	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					10526  10527  9416	CIE standard colorimetric illuminants  CIE standard colorimetric observers  Paper-determination of light scattering and absorption coefficients (using Kubelka-Munk theory)			
Brightness					2470 (1999)	Measurement of diffuse reflectance factor (ISO brightness)	T 571 (0m-03)	Diffuse brightness of paper and paperboard (d/0)	Identical methods for determination of the "diffuse blue reflectance brightness (ISO brightness)" under CIE C/2° illumination/observer conditions.  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 (0m-02)	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 papers 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 (2000)	Determination of Colour (C/2°) – Diffuse reflectance method	T 527 (0m-02)	Color of paper and paperboard (d/0, C/2)	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 color values TAPPI: CIELAB color values; Hunter color values; CIE L*, C*, h values
							T 524 (0m-02)	Color 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 color values; Hunter color values; CIE L*, C*, h values

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	Nr. (Year)	Title	Nr. (Year)	Title	Nr. (Year)	Title	Nr. (Year)	Title	
Whiteness					11475 (1999)	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 (2000)	Determination of CIE whiteness, C/2° (indoor illumination)	T 560 (pm-96)	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 (pm-96)	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 (1999)	Determination of opacity (paper backing) – diffuse reflectance method	T 519 (om-02)	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-01)	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 $C_{0,89}$ ("contrast ratio") paper backing opacity ("printing opacity") Scattering power $s_W$ / -coefficient $s$ Absorption power $k_W$ / -coefficient $k$
Gloss			EN 14086	Paper & board-measurement of specular gloss-45° gloss with a parallel beam, DIN method			T 480 (om-99)	Specular gloss of paper and paperboard at 75 degrees	Identical methods
					8254-1 (2003)	Measurement of specular gloss Part 1: 75° gloss with a converging beam. TAPPI method			

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	
Gloss (continued)			8254-2 (2003)	Measurement of specular gloss Part 2: 75° gloss with a parallel beam. DIN method	8254-3 (2003)	Measurement of specular gloss Part 2: 75° gloss with a parallel beam. DIN method			Results may be different to those of 75° TAPPI method
					8254-2 (2003)	Measurement of specular gloss Part 3: 20° gloss with a converging beam. TAPPI method	T 653 (01-98)	Specular gloss of paper and paperboard at 20-degrees	Identical methods
Terminology related to the appearance of paper							T 1213 (sp-03)	Optical measurements terminology (related to appearance evaluation of paper)	Definition of terms related to the appearance (e.g. brightness, whiteness, color, gloss etc)

## Corrugated board

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	
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-02r)	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 (1996)	Determination of grammage	536 (1995)	Determination of grammage	T 410 (om-02)	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 (1975)	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 (1975)	Determination of thickness	T 411 (om-97)	Thickness (caliper) 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 (2001)	Board – Determination of bursting strength	T 810 (om-98)	Bursting strength of corrugated and solid fiberboard	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 (om-99)	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	23035 (1994)	Determination of flat crush resistance (single-faced or single wall corrugated board)	3035 (1982)	Determination of flat crush resistance (single-faced or single wall corrugated board)	T 825 (om-96)	Flat crush test of corrugated board (rigid support method)	Identical procedure; sample size (preferred) different. Results similar.
							T 825 (om-03)	Flat crush test of corrugated board (rigid support method)	
							T 808 (om-01)	Flat crush test of corrugated board (flexible beam method)	Identical procedure; sample size (preferred) different. Large sample size may lead to "leaning flute" problems

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	
Water absorption	TM 7 (1997)	Determination of water absorptiveness of corrugated fibreboard (Cobb test)	20535 (1994)	Determination of water absorption – Cobb method	535 (1991)	Determination of water absorption – Cobb method	T 441 (om-98)	Water absorptiveness of sized paper, paperboard, and corrugated fiberboard (Cobb test)	Identical procedure except testing-, immersion- and blotting time: FEFCO: only Cobb <sub>1800</sub> (30min) ISO: fixed testing-, immersion- and blotting times TAPPI: one fixed testing- and blotting time (preferred condition)
Edge crush resistance (ECT)	TM 8 (1997)	Edgewise crush resistance of corrugated fibreboard	3037 (1996)	Determination of edgewise crush resistance (Unwaxed method) (FEFCO)	3037 (1994)	Determination of edgewise crush resistance (Unwaxed method) (FEFCO)			Identical. Result very sensitive to cutting precision of the sample (using double bevelled knives, worn out knives or bad cutting (geometry) lead to lower results) <sup>1)</sup> No TAPPI method for FEFCO sample
					13821 (2002)	Determination of edgewise crush resistance (Waxed edge method)	T 811 (om-02)	Edgewise compression strength of corrugated fiberboard using the clamp method (short column test)	Identical. "Heavy" procedure due to waxing and reconditioning Similar results as FEFCO-method (careful cutting of the FEFCO sample is necessary) <sup>1)</sup>
							T 841 (om-03)	Edgewise compressive strength of corrugated fibre board using the Morris method	
							T838 (pm-03)	Edge crush using neckdown	Similar results as FEFCO-method, no advantage regarding cutting, precision etc. <sup>1)</sup>
							T 839 (om-02)	Edgewise compression strength of corrugated fiberboard (short column test)	Similar results as FEFCO-method (careful cutting of the FEFCO sample is necessary); no advantage regarding cutting, precision etc. <sup>1)</sup> special specimen clamping device needing at least 60mm space between pressure plates
							T 841 (wd-02)	Edgewise compression strength of corrugated fiberboard using the Morris Method (short column test)	50 x 50mm test piece, special specimen holder needed. Some % lower results than with TAPPI T 811
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)

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	
Water resistance of the gluing (continued)							TIP 0304-69 (1997)	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 (pm-99)	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-03)	Ply separation of solid and corrugated fibreboard (wet)	Method: Intension is to distinguish between boards fabricated with water-resistant adhesive and with nonwater-resistant adhesive (visual laboratory method). Normal soaking time 24h
Pin adhesion test (dry)	TM 11 (1985)	Determination the adhesion strength of the glue bonds of corrugated fibreboard (pin method)					T 821 (om-96)	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-01)	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 <sup>2)</sup>
					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 fiberboard (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 <sup>2)</sup>
Bending stiffness					5628 (1990)	Determination of bending stiffness by static methods – General principles	T 820 (cm-00)	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-02)	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

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	
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			20287 (1994)	Determination of moisture content – Oven drying method	287 (1985)	Determination of moisture content – Oven drying method	T 412 (om-02)	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-03)	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"
Printing							T 830 (sp-99)	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"

## Boxes, packages

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	
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 ( $\pm 3\%$ compared with $\pm 2\%$ ) ? 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-02)	Compression test of fiberboard 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 <sup>3)</sup>  EN / ISO 12048: only complete, filled packages covered  General: Results may vary due to different testing speed <sup>3),4)</sup>
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; Center of gravity			13054 (1992)	Complete, filled transport packages – Center of gravity					Method for determining the center 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-99)	Drop test for fiberboard shipping containers	Identical

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	
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 (0m-02)	Impact resistance of fiberboard 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)
Handling resistance of filled boxes							T 800 (0m-96)	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 (0m-89; wd-96)	Vibration test of fiberboard 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 (2003)	Complete, filled transport packages and unit loads – Vertical random vibration test	13355 (2001)	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 300Hz..

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	
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.
			24180-1 (1992)	Complete, filled transport packages – General rules for the compilation of performance test schedules – Part 1: General principles	4180-1 (1980)	Complete, filled transport packages – General rules for the compilation of performance test schedules – Part 1: General principles			General rules and principles for the compilation of performance test schedules for road-, rail-, ship- and air transport of complete, filled transport packages.
			24180-2 (1992)	Complete, filled transport packages – General rules for the compilation of performance test schedules – Part 2: Quantitative data	4180-2 (1980)	Complete, filled transport packages – General rules for the compilation of performance test schedules – Part 2: Quantitative data			General rules and principles for the compilation of performance test schedules for road-, rail-, ship- and air transport of complete, filled transport packages; quantitative data and test levels.
Strength of manufacturers joint	TM 55 (1999)	Determination of the strength of the manufacturers' joint of corrugated fibreboard containers (compression method)					T 813 (om-99)	Tensile test for the manufacturer's joint of fiberboard shipping containers	Different procedures with different results. The methods are applicable to all types of manufacturer's joint.
							T 840 (om-03)	Testing adhesives used in glued lap joints of corrugated fiberboard 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-03)	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	(2001)	FEFCO-ASSCO Code		Work item at CEN TC 261					EN-standard refers to FEFCO-ASSCO code
Box dimensions	R 101 (2002)	Procedure for determining the internal dimensions of the flap type of one piece corrugated board cases					T 827 (sp-01)	Box blank dimensioning	Identical. The score-to-score distances of a box blank are determined.

Strength at high humidity	<b>Standard testing conditions:</b> see EN ISO 2233:2001 (ISO 2233:2000) Complete, filled transport packages and unit loads – Conditioning for testing: Conditions 4 / 6 / 8 / 9 / 11
	<b>Water spray pre-treatment of the Package:</b> see EN ISO 2875:2002 (ISO 2875:2000) Packaging – Complete, filled transport packages and unit loads – Water spray test
	<b>Transport of dangerous goods Water spray test:</b> see RID / ADR 6.3.2.5 / 6.4.15.1 Water spray test
	<b>Water immersion:</b> see ISO 8474:1986 Packaging – Complete, filled transport packages – Water immersion test
	<b>Water resistance of the board:</b> see Corrugated board: Water resistance of the gluing
	<b>Water resistance of the gluing of the manufacturers joint:</b> see Corrugated board: Water resistance of the gluing FEFCO Testing method No. 9
	<b>Wet strength of the component papers of the corrugated board:</b> 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  
 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