



BSI Standards Publication

**Sandwich boards for furniture
(SWB-F) — Factory made
products — Definition,
classification and test
methods for determination of
performance characteristics**

National foreword

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English Version

**Sandwich boards for furniture (SWB-F) - Factory made products
- Definition, classification and test methods for determination of
performance characteristics**

Panneaux sandwichés pour meubles (SWB-F) - Produits
manufacturés - Définition, classification et méthodes d'essai
pour la détermination des propriétés fonctionnelles

Sandwichplatten für Möbel (SWB-F) - Werkmäßig
hergestellte Produkte - Definition, Klassifizierung und
Prüfverfahren zur Bestimmung der Leistungseigenschaften

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Foreword

This document (CEN/TS 16526:2013) has been prepared by Technical Committee CEN/TC 112 “Wood-based panels”, the secretariat of which is held by DIN.

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1 Scope

This European Technical Specification defines terms, establishes a classification and specifies test methods for flat, factory made, non-structural, faced and unfaced sandwich boards for use in furniture manufacturing (SWB-F) for dry (service class 1) and humid conditions (service class 2). This European Technical Specification does not specify requirements.

Guidance is provided for the selection of board properties which are relevant for specific board applications.

This European Technical Specification is not applicable to products which are already covered by existing standards.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 311, *Wood-based panels - Surface soundness - Test method*

EN 318, *Wood based panels - Determination of dimensional changes associated with changes in relative humidity*

EN 320, *Particleboards and fibreboards - Determination of resistance to axial withdrawal of screws*

EN 322, *Wood-based panels - Determination of moisture content*

EN 324-1, *Wood-based panels - Determination of dimensions of boards - Part 1: Determination of thickness, width and length*

EN 324-2, *Wood-based panels - Determination of dimensions of boards - Part 2: Determination of squareness and edge straightness*

EN 325, *Wood-based panels - Determination of dimensions of test pieces*

EN 326-1, *Wood-based panels - Sampling, cutting and inspection - Part 1: Sampling and cutting of test pieces and expression of test results*

EN 326-2, *Wood-based panels - Sampling, cutting and inspection - Part 2: Initial type testing and factory production control*

EN 326-3, *Wood-based panels - Sampling, cutting and inspection - Part 3: Inspection of an isolated lot of panels*

EN 438-2, *High-pressure decorative laminates (HPL) - Sheets based on thermosetting resins (usually called Laminates) - Part 2: Determination of properties*

EN 717-1, *Wood-based panels - Determination of formaldehyde release - Part 1: Formaldehyde emission by the chamber method*

EN 717-2, *Wood-based panels - Determination of formaldehyde release - Part 2: Formaldehyde release by the gas analysis method*

EN 789, *Timber structures - Test methods - Determination of mechanical properties of wood based panels*

EN 826, *Thermal insulating products for building applications - Determination of compression behaviour*

EN 950, *Door leaves - Determination of the resistance to hard body impact*

EN 1294, *Door leaves - Determination of the behaviour under humidity variations in successive uniform climates*

EN 1383, *Timber structures - Test methods - Pull through resistance of timber fasteners*

EN 1464, *Adhesives - Determination of peel resistance of adhesive bonds - Floating roller method*

EN 1995-1-1, *Eurocode 5: Design of timber structures - Part 1-1: General - Common rules and rules for buildings*

EN 14323:2004, *Wood-based panels - Melamine faced boards for interior uses - Test methods*

EN 14727:2005, *Laboratory furniture - Storage units for laboratories - Requirements and test methods*

DIN 53293, *Testing of sandwiches - Bending test*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

sandwich board

SWB

laminar composite product consisting of at least two skins positioned on either side of a core, which is firmly connected to the skins (e.g. by bonding, by core-generated adhesion) so that the three (or more) components act compositely when under load

Note 1 to entry: Wood or other lignocellulosic materials constitute at least one of the components.

3.2

skin

flat sheet firmly connected to the core and designed to support in-plane tensile or compressive loads in a sandwich board

Note 1 to entry: Sheets used as skins can consist of composite materials.

Note 2 to entry: Skins in sandwich boards for furniture commonly consist of particleboard (EN 309), fibreboard (EN 316), plywood (EN 636) etc.

Note 3 to entry: If skins consist of or contain veneers (excluding decorative veneer applied to skins in faced SWB-F) or plywood, this SWB can be considered as a core or composite plywood as defined in EN 313–2. The corresponding standards can apply in particular, the requirements and test methods pertaining to the bonding quality.

3.3

core

centrally positioned layer of material, generally low in density, which is bonded between two skins and is designed to support normal compressive and tensile loads and to transfer shear loads in a sandwich board

3.4

core material

homogeneous or inhomogeneous material used in manufacturing the core

Note 1 to entry: Homogeneous and inhomogeneous core materials provide continuous and discontinuous supports of the skins, respectively. Homogeneous (e.g. balsa wood, foams) or inhomogeneous (e.g. honeycomb cores) core materials can be isotropic or anisotropic.

Note 2 to entry: Core materials in sandwich boards for furniture are commonly lightweight materials such as paper, metal or composite honeycomb, open and closed cell foam, corrugated material, bonded composite tubes, or naturally occurring materials such as balsa wood or lightweight (wood) fibre-based boards.

3.5

homogenous material

material in which on a macroscopic scale relevant properties are not a function of the position within the material itself but may be a function of such parameters as time, direction, temperature, etc.

3.6

inhomogeneous material

material, also often referred to as non-homogeneous or structured in which on a macroscopic scale relevant properties are a function of the position within the material itself and relevant properties may be a function of such parameters as time, direction, temperature, etc.

3.7

isotropic

exhibiting the same physical and mechanical properties along different axes

3.8

anisotropic

not isotropic

exhibiting different physical and mechanical properties along different axes

3.9

x-axis

in sandwich boards, an axis in the plane of the skins which is used as the 0 degree reference or major axis

Note 1 to entry: The board dimension in the direction of the x-axis is referred to as the length of the board.

3.10

x-y plane

in sandwich boards, the reference plane parallel to the plane of the skins

3.11

y-axis

in sandwich boards, the axis in the plane of the skins which is perpendicular to the x-axis and which is referred to as the minor axis

Note 1 to entry: The board dimension in the direction of the y-axis is referred to as the width of the board.

3.12

z-axis

in sandwich boards, the reference axis normal to the plane of the skins

Note 1 to entry: The board dimension in the direction of the z-axis is referred to as the thickness of the board.

3.13

structural unit

SU

entity which is repeated periodically in an inhomogeneous core material whose properties vary along the x- or y-axis of the sandwich board

Note 1 to entry: An example of a structural unit is a honeycomb cell in a honeycomb core or a single profile in a corrugated core.

3.14

factory made

mass manufactured commodity product supplied on the open market for the purpose of fabrication of furniture components or furniture

Note 1 to entry: Factory made SWB-F can be subjected by the board manufacturer to additional value-adding processes (e.g. application of decorative surfaces to skins, cutting of boards to customer-specific dimensions, installation of edge-banding).

Note 2 to entry: Purpose built or custom sandwich board manufactured by a furniture producer for a specific furniture product is not considered SWB-F as covered by this European Technical Specification.

3.15

dry conditions

conditions corresponding to service class 1 of EN 1995-1-1 which is characterized by a moisture content in the material corresponding to a temperature of 20 °C and a relative humidity of the surrounding air only exceeding 65 % for a few weeks per year

3.16

humid conditions

conditions corresponding to service class 2 of EN 1995-1-1 which is characterized by a moisture content in the material corresponding to a temperature of 20 °C and a relative humidity of the surrounding air only exceeding 85 % for a few weeks per year

3.17

furniture

moveable or permanently installed articles for lying, sitting, working and storing of goods in areas intended for living, working, dwelling etc.

3.18

non-structural use

all general applications, e.g. furniture and fitments under conditions other than load-bearing conditions as part of a building or other construction or such conditions under which the board constitutes a construction product as defined by the Council Directive 89/106/EEC

3.19

faced sandwich board

sandwich board with overlaid, coated, printed or veneered decorative surfaces applied to skins

3.20

unfaced sandwich board

sandwich board without overlaid, coated, printed or veneered decorative surfaces applied to skins

3.21

overlaid sandwich board

sandwich board surfaced with one or more overlay sheets or films, for example impregnated paper, plastics, resin film, metal

3.22

coated sandwich board

sandwich board surfaced with a coating, normally applied in liquid form, for functional or decorative purposes

3.23

veneered sandwich board

sandwich board overlaid with a (decorative) veneer

3.24

mass per unit area

quotient of mass and area (i.e. length multiplied by width) of a piece of sandwich board expressed in kilograms per square metres [kg/m^2]

3.25

apparent density

mass per unit volume, expressed in kilograms per cubic metre [kg/m^3], and based on the external dimensions of the test piece to calculate the volume which is an average density of material and any hollow spaces (pores, cells, channels etc.)

3.26

peel resistance

average force measured along the bond line, required to separate progressively the two members of a bonded test piece under specified conditions of test

4 Classification

4.1 General

Sandwich boards can be classified according to different criteria. It is not possible to present an exhaustive classification system.

In this European Technical Specification, a combined system of criteria is presented for the classification of sandwich boards for furniture.

4.2 Classification according to board lay-up

- honeycomb sandwich board;
- solid core sandwich board;
- foam core sandwich board.

4.3 Classification according to surface appearance

- unfaced sandwich board;
- faced sandwich board.

4.4 Classification according to conditions of use

- dry conditions;
- humid conditions.

4.5 Classification according to application purposes

- sandwich boards for vertical elements in furniture;
- sandwich boards for horizontal elements in furniture;
- sandwich boards for front elements in furniture;

NOTE Front elements in furniture most commonly act as doors; thus the ability to install hardware in front elements is often of vital importance.

5 Symbols

5.1 General

Different symbols are used for addressing different types of sandwich boards for furniture.

5.2 Symbols related to conditions of use

Table 1 specifies the symbols which shall be used to indicate the conditions of use.

Table 1 — Symbols related to conditions of use

Conditions of use	Symbol
Dry conditions	no symbol
Humid conditions	H

5.3 Symbols related to specific applications

Table 2 specifies the symbols which shall be used to indicate the board application in furniture manufacturing.

Table 2 — Symbols related to board application in furniture manufacturing

Board application in furniture manufacturing	Symbol
general purpose	no symbol
vertical elements	VE
horizontal elements	HE
front elements	FE

5.4 Combination of symbols for identification of sandwich boards

The symbols indicating conditions of use and application purposes are added to the symbol "SWB-F" for sandwich board for furniture after a full stop, in this sequence:

"SWB-F" condition of use application purpose

EXAMPLE 1 SWB-F.H.FE

sandwich board for furniture to be used in humid conditions as front elements (e.g. for doors in bathroom furniture)

EXAMPLE 2 SWB-F

sandwich board for furniture to be used in dry conditions for general purposes

6 Conditioning and test conditions

Unless otherwise stated in this European Technical Specification the test pieces shall be conditioned to constant mass in an atmosphere with a relative humidity of (65 ± 5) % and a temperature of (20 ± 2) °C. Constant mass is considered to be reached when the results of two successive weighing operations, carried out at an interval of 24 h, do not differ by more than 0,1 % of the mass of the test piece.

Unless otherwise stated in this European Technical Specification tests should be carried out at ambient room temperature and no requirements pertaining to the relative humidity during testing apply. However, if the ambient conditions of testing are not the same as those in the conditioning chamber, tests shall be undertaken immediately after the test pieces have been removed from the conditioning chamber.

7 Sampling, preparation and handling of test pieces and expression of test results

7.1 General requirements

Sampling, cutting of test pieces (also referred to as test pieces) and expression of test results shall be carried out according to EN 326-1.

Unless otherwise stated in this European Technical Specification the minimum number of test pieces *m* to be tested for determination of the respective property shall be taken from Table 3.

Table 3 — Minimum number of test pieces *m* which have to be tested to determine properties of sandwich boards

Property	Reference to test method	Minimum number of test pieces <i>m</i>
Moisture content	8.2.2	4
Apparent density and mass per unit area	8.2.3	6
Linear expansion due to changes in relative humidity	8.2.4	4
Behaviour under humidity variations in successive uniform climates	8.2.5	2
Moisture resistance	8.2.6	see respective test method
Bending test	8.3.1.2	6
Bending properties of sandwich board for shelving and similar applications	8.3.1.3	5
Surface soundness	8.3.2	8
Flatwise compressive behaviour	8.3.3.1	10
Resistance to a concentrated static point load	8.3.3.2	10
Resistance to a concentrated static load applied in close proximity to the board edge	8.3.3.3	10
Impact resistance	8.3.4	see respective test method
Shear strength	8.3.5	6
Resistance of the board edge with edgebanding against a static concentrated load	8.4.3.2	6
Peel resistance of edge-banding	8.4.3.3	6
Determination of axial withdrawal resistance of fastener	8.4.4.2	10
Pull through resistance of fasteners	8.4.4.3	10
Load bearing capacity of shelf supports	8.4.4.4	10
Shear resistance of a grooved board	8.4.5	10

In order to determine properties, which differ with respect to the x-axis and the y-axis of the board, two groups of m test pieces shall be tested. For the purpose of ensuring and demonstrating compliance with specific requirements in factory production control, testing can be limited to test pieces with the known weakest orientation in the plane of the board.

7.2 Testing of SWB-F in combination with auxiliary material(s) or after execution of additional processing steps

For certain purposes (e.g. evaluation of properties of SWB-F for a very specific application or furniture design) it may be desirable to evaluate properties of SWB-F in combination with auxiliary materials or after the execution of further processing steps which are to be applied to the respective SWB-F in the manufacturing of furniture or furniture components.

Examples of such auxiliary materials and/or processing steps are the installation of edge reinforcements and/or edge banding, the application of decorative surface finishes etc. The respective auxiliary materials and/or processing steps etc. have to be specified and described in the test report. Test results are only applicable to the tested SWB-F in combination with the specified auxiliary material and/or processing steps.

7.3 Test piece size

Unless other specifications are provided in this European Technical Specification for the respective test method the test piece size shall be as follows:

The test piece shall be square. The side length of the test piece shall measure 100 mm. The thickness of the test pieces shall be equal to the thickness of the sandwich board. For a sandwich board with an inhomogeneous core the side length may have to be increased in order to meet the following criteria:

For inhomogeneous core materials with a longitudinal orientation of the structural units (e.g. channels in a corrugated core) a minimum of three structural units shall be contained in the test piece cross section. For inhomogeneous core materials with cellular structural units at least nine structural units shall be contained in the test piece cross section.

Generally the person or entity applying this European Technical Specification is responsible for ensuring that representative and reproducible test results can be obtained by considering characteristics of and local variations within the respective sandwich board and its core material when choosing a sampling strategy, a test piece cutting plan and a test piece size.

Test piece dimensions shall be stated in the test report.

If larger test pieces have to be employed to determine certain properties suitable modifications of the test equipment may have to be implemented and described in the test report (e.g. larger loading plates for determination of the flatwise compressive behaviour as described in 8.3.3.1).

7.4 Determination of dimensions of test pieces

Unless otherwise stated in this European Technical Specification dimension of test pieces shall be determined following conditioning of test pieces according to the provisions stated in Clause 6. Dimensions of test pieces with a maximum nominal length and/or width of 300 mm shall be determined according to EN 325. Dimensions of test pieces which are larger in size shall be determined according to the provision of the respective test method or in case that no provisions are given in the respective test method by applying the procedures specified in 8.2.1.

The thickness of a test piece shall be measured at four points located 25 mm from the nearest edges. The average thickness is recorded.

The length and width of a square test piece with a nominal size of 10 000 mm² shall be measured at two points located 2 mm from the nearest edge, respectively. The average length and width shall be recorded.

The length and width of a rectangular test piece or of a square test piece with a nominal size of $\geq 40\,000\text{ mm}^2$ shall be measured at two points located 25 mm from the nearest edge and at the point midway along the edge(s) measuring $\geq 200\text{ mm}$ in length. The average length and width shall be recorded.

7.5 Expression of test results

Unless otherwise stated in this European Technical Specification test results shall be expressed as 5 percentile values (95 percentile values in case of properties for which an upper limit is imposed) based on the mean values for individual boards and calculated in accordance with EN 326-1. Mean values and standard deviations shall also be reported.

Evaluation and statistical analysis procedures of results shall be carried out in accordance with EN 326-2 if test procedures provided in this European Technical Specification are employed by a manufacturer as part of initial type testing or of factory production control.

Evaluation and statistical analysis procedures of results shall be carried out in accordance with EN 326-3 for the inspection of an isolated lot of boards.

8 Test methods

8.1 General guideline on the description and use of test methods

Methods provided for determination of various properties are either described in full in this European Technical Specification or they are based partially or fully on existing standards. Whenever test methods are based on existing standards it shall be observed that unless otherwise stated in this European Technical Specification the provisions of Clause 6 ("Conditioning and test conditions") and Clause 7 ("Sampling, preparation and handling of test pieces and expression of test results") of this European Technical Specification replace the respective provision of the referenced standards. Other modifications which apply to specific, referenced test methods are provided in the description of the test method within this European Technical Specification.

8.2 Physical properties

8.2.1 Determination of board dimensions

Thickness, width and length of a sandwich board shall be determined in accordance with EN 324-1. Squareness and edge straightness of a sandwich board shall be determined in accordance with EN 324-2.

Warping of a sandwich board shall be determined and expressed according to EN 14323:2004, 5.2.

The edges of a sandwich board have to be trimmed in a precise manner such that any deviations in size of the two skins are negligible. Width, length, squareness and edge straightness of a sandwich board are equal to the width, length, squareness and edge straightness of its skins.

8.2.2 Moisture content

The moisture content of a sandwich board shall be determined according to EN 322 using 4 test pieces with a minimum weight of at least 100 g each.

The method for determination of moisture content according to EN 322 is based on differential weighing of board material prior to and after drying of material at a temperature of $(103 \pm 2)\text{ }^\circ\text{C}$. If the sandwich board to be tested contains particularly temperature sensitive (i.e. volatile) substances the method according to EN 322 may lead to an incorrect and non-reproducible result. In order to obtain accurate results SWB-F containing volatile, heat-sensitive or readily flammable materials shall be dried over a desiccant under vacuum conditions (pressure: $< 100\text{ Pa}$) at low temperatures (temperature: max. $50\text{ }^\circ\text{C}$) in a desiccator.

8.2.3 Apparent density and mass per unit area

Apparent density of a sandwich board shall be determined according to the principle of EN 322 using external test piece dimensions in calculating the volume.

The mass per unit area [kg/m^2] shall be calculated as the product of the apparent density [kg/m^3] multiplied by the board thickness [m].

8.2.4 Linear expansion due to changes in relative humidity

The linear expansion due to changes in relative humidity shall be determined in accordance with EN 318. Test pieces shall measure (300 ± 2) mm in length and (100 ± 2) mm in width. The thickness of the test pieces shall be equal to the board thickness. Larger test pieces may also be used.

For SWB-F with inhomogeneous core material the test piece size may have to be increased to meet the following criteria:

- for inhomogeneous core materials with a longitudinal orientation of the structural units (e.g. channels in a corrugated core) a minimum of three structural units shall be contained in the test piece cross section;
- for inhomogeneous core materials with cellular structural units at least nine structural units shall be contained in the test piece cross section.

8.2.5 Behaviour under humidity variations in successive uniform climates

The resistance of SWB-F against moisture induced warping shall be determined and expressed following the principles of EN 1294. Two SWB-F test pieces measuring $(2\,000 \pm 5)$ mm in length and (850 ± 5) mm in width shall be tested. Unfaced SWB-F and faced SWB-F test pieces shall be stored in the different climates for at least 7 days and 21 days, respectively or until constant mass is reached. Constant mass is considered to be reached when the results of two successive weighing operations, carried out at an interval of 24 h, do not differ by more than 0,1 % of the mass of the test piece.

Local deflections shall be determined and stated only upon special request. Any alterations in visual appearance and in particular any damage shall be documented and reported.

8.2.6 Moisture resistance

8.2.6.1 Principle

Moisture resistance of SWB-F shall be assessed by evaluating the effect of elevated temperature and moisture conditions on a specified property (or specified properties) of SWB-F. For this purpose prior to testing two groups of test pieces are conditioned at reference conditions and at elevated temperature and moisture conditions, respectively. The property to be assessed shall be specified by the user of this European Technical Specification. The relative effect of the elevated moisture and temperature conditions is expressed as the property retention index on the basis of the reference level determined subsequent to conditioning at reference conditions.

For certain applications or products the moisture resistance may be evaluated on the basis of two or more property retention indices.

The property/properties to be evaluated shall be selected on the basis of the application of the respective SWB-F. For example the bending test according to 8.3.1.3 shall be selected for SWB-F.H.HE intended for shelving. For other applications testing of the axial withdrawal resistance of fasteners (see 8.4.4.2) may be regarded as crucial.

The property/properties to be evaluated may also be selected on the basis of the estimated impact of high moisture conditions on the different components of SWB-F (e.g. by testing of the compressive strength

according to 8.3.3.1 for moisture sensitive core materials) or on the interface between the respective components of SWB-F (e.g. by evaluating the shear strength according to 8.3.5).

8.2.6.2 Conditioning

Two equal sets of test pieces shall be prepared and randomly assigned to the following two conditioning groups:

- reference group (index: ρ): storage at reference conditions as stated in Clause 6;
- elevated moisture group (index: w): storage at a temperature of (30 ± 2) °C and a humidity of (90 ± 5) %.

Unfaced SWB-F and faced SWB-F test pieces shall be stored in the different climates for at least 7 days and 21 days, respectively or until constant mass is reached. Constant mass is considered to be reached when the results of two successive weighing operations, carried out at an interval of 24 h, do not differ by more than 0,1 % of the mass of the test piece.

Subsequent to the respective conditioning steps tests shall be conducted according to the method selected.

8.2.6.3 Calculation of the property retention index

From the test results based on m test pieces the property retention index is calculated using the formulas given below.

The mean of the results obtained for the reference group constitutes the level of the reference property and is calculated as follows:

$$\bar{p}_o = \frac{\sum_{i=0}^m p_{o,i}}{m} \quad (1)$$

where

$p_{o,i}$ is measured initial property of each test piece of the reference group.

The property retention index (%) for each test piece from the elevated moisture group ($z_{w,i}$) is calculated according to the formula:

$$z_{w,i} = \frac{p_{w,i}}{p_o} \quad (2)$$

where

$p_{w,i}$ is measured initial property of each test piece of the elevated moisture group.

The mean property retention index (%) for the elevated moisture group is calculated according to the formula:

$$\bar{Z}_w = \sqrt{\frac{\sum_{i=0}^m z_{w,i}}{m}} \quad (3)$$

The standard deviation of the property retention index is calculated using the following formula:

$$s_{w,z} = \sqrt{\frac{\sum_{i=0}^m (z_{w,i} - \bar{Z}_w)^2}{m - 1}} \quad (4)$$

The mean property retention index and the standard deviation are to be reported together with all observations regarding changes in the boards or the failure modes observed during testing.

If applicable information on the moisture resistance of components and materials (e.g. adhesives) used in manufacturing SWB-F for use in humid conditions shall be reported. If standardized wood-based panels are used as components in the manufacturing of SWB-F for use in humid conditions (e.g. particleboard according to EN 312, MDF according to EN 622-5, plywood according to EN 636) then these wood-based panels have to meet the moisture resistance requirements specified in the respective product standards.

NOTE If standardized wood-based panels complying with applicable moisture resistance requirements (e.g. application of P3 particleboard in the skins) are employed in the skins then the determination of the property retention index of the surface soundness according to 8.3.2 can be omitted.

8.3 Mechanical properties

8.3.1 Flexural properties

8.3.1.1 General

Research results and experience have shown that bending stiffness of SWB-F varies with the span employed during testing due to large deformation in the sandwich core. The test method given in 8.3.1.2 is regarded as unsuitable to reliably measure the bending properties of sandwich boards with core materials of relatively low shear strength. The test method according to 8.3.1.3 shall be employed to determine the bending properties in such a case.

8.3.1.2 Bending test

DIN 53293 shall be employed for testing SWB-F in bending under 4-point loading. Test piece sizes shall be based on the provisions of DIN 53293.

8.3.1.3 Bending properties of sandwich board for shelving and similar applications

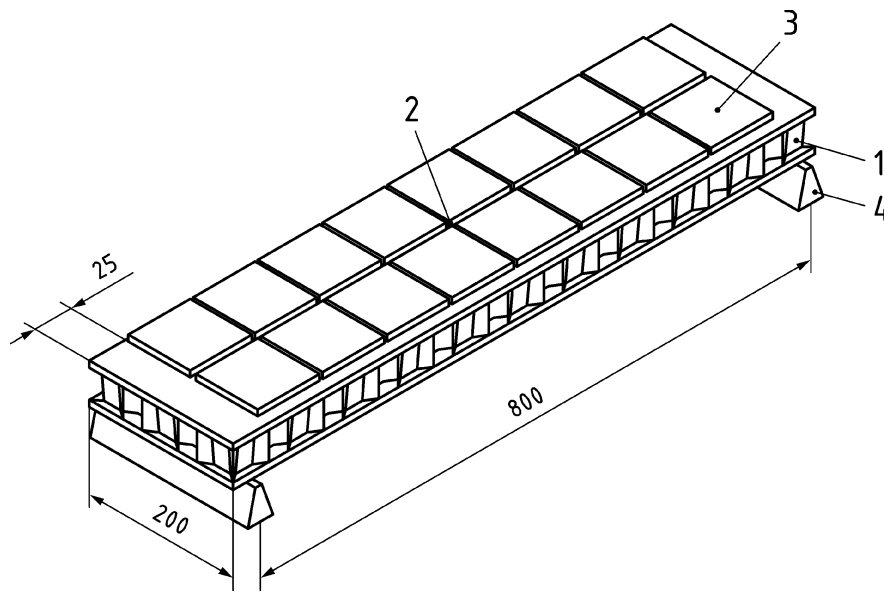
Bending properties of SWB-F for shelving and similar applications shall be assessed following the principle of EN 14727:2005, 7.1.2.

NOTE DIN 68874-1:1985, 5.3.1 describes a similar test set-up in more detail.

Testing is to be conducted in a purpose-built and rigid test frame not in an actual furniture carcass. Testing shall be conducted under stable climatic conditions preferably in a room maintained at a constant temperature of (22 ± 2) °C and relative humidity of (57 ± 10) %. Test pieces shall measure (850 ± 5) mm in length and (200 ± 5) mm in width. Test pieces shall not show any signs of warping or other out-of-plane deflection.

Test pieces shall be placed on two cylindrical or rounded supports which are positioned at a distance of (800 ± 2) mm measured on centre (i.e. span). The radius of supports shall be large enough to avoid local deformations of the boards as a result of compressive forces (e.g. indentations). The test piece and loading configuration is depicted in Figure 1. The measuring points "A" and "D" located at midspan are more clearly shown on the underside of a test piece in Figure 2.

Dimensions in millimetres



Key

- 1 test piece
- 2 central measurement point A for deflection
- 3 weights for application of uniform load
- 4 support

Figure 1 — Test method for determination of bending properties of SWB-F for horizontal elements such as shelving

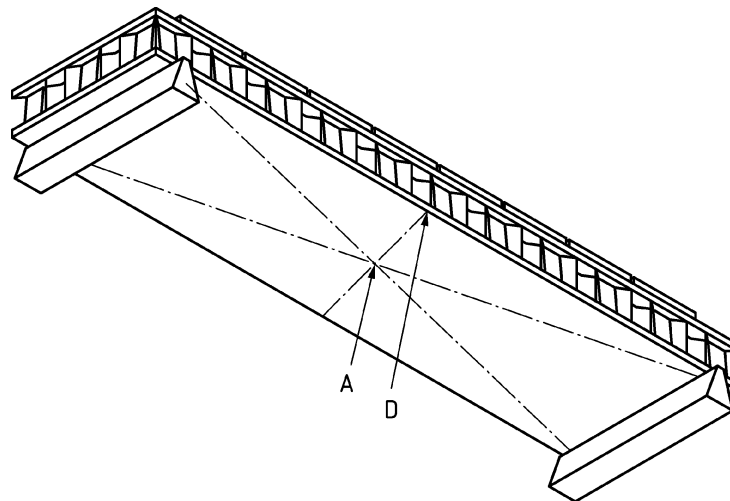


Figure 2 — Locations of measuring points “A” and “D” for the test method for determination of bending properties of SWB-F for horizontal elements such as shelving

A uniformly distributed load shall be applied to the test piece using individual weights with a mass of $(1\ 000 \pm 10)$ g each.

NOTE It is common practice to employ weights consisting of steel plates measuring 85 mm in length, 50 mm in width and 30 mm in thickness.

Unless otherwise specified an evenly distributed load amounting in total to a weight of 100 kg/m^2 is applied. The weights shall be removed after 28 days and the unloaded test piece shall be allowed to recover in the test frame for 24 h. In accordance with the provisions of EN 14727:2005 the deflection at midspan shall be measured at the points A and D of Figure 2 to an accuracy of 0,1 mm at the points in time stated below and reported in the test report:

- just before applying the load;
- 5 min (± 30 s) after applying the load;
- 14 days (± 3 h) after applying the load;
- 28 (± 3 h) days after applying the load;
- 24 h (± 30 min) after removal of the load which had been in place for 28 days.

Values for the sag f_A and f_D shall be calculated by dividing the deflections determined at the points A and D at the aforementioned points in time by the span, respectively. Values for the sag f_A and f_D shall be rounded to the nearest 0,01 mm.

A test may be concluded after 14 days if it has been demonstrated that at least 90 % of the total deflection over a period of 28 days occurs within the first 14 days after application of the load.

8.3.2 Surface soundness

For wood-based panels for furniture applications surface soundness tests are routinely conducted in order to determine the strength or bond quality between the surface layer and the subjacent layer. Due to the design and composition of sandwich boards and due to the nature of the test method surface soundness tests will not yield representative and reproducible results for all types of sandwich boards. In order to determine the surface soundness of sandwich boards one of the following options shall be chosen:

- The surface soundness of skin materials of sandwich boards shall be determined in accordance with EN 311. It shall be clearly stated in the test report that the test results represent the surface soundness of the sandwich board skin material.
- The surface soundness of sandwich boards with homogeneous core materials shall be conducted according to EN 311. When bonding the steel pad to the test piece the use of cold-setting epoxy adhesives and the use of minimum pressure ($0,1 \text{ N/mm}^2$) is recommended in order to minimize negative effects on the integrity of the sandwich board. It shall be clearly stated in the test report that the test results represent the surface soundness of the sandwich board.

8.3.3 Compressive properties perpendicular to the plane of the board

8.3.3.1 Flatwise compressive behaviour

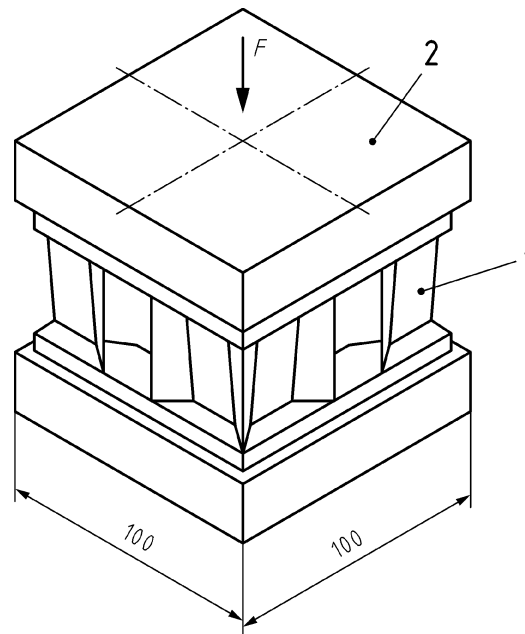
To determine the properties of sandwich board when loaded flatwise in compression perpendicular to the plane of the board (i.e. parallel to the z-axis) the following parameters shall be determined and expressed in accordance with EN 826:

- compressive strength and corresponding strain;
- compressive stress at 10 % strain.

A schematic of the test set-up is provided in Figure 3.

The test may be terminated once a stress level of 4 N/mm^2 has been reached. In this case the result shall be expressed as compressive strength $\geq 4 \text{ N/mm}^2$ and as the compressive stress at 10 % strain if this strain level was reached.

Dimensions in millimetres



Key

- 1 test piece
- 2 top loading platen
- F* compressive force

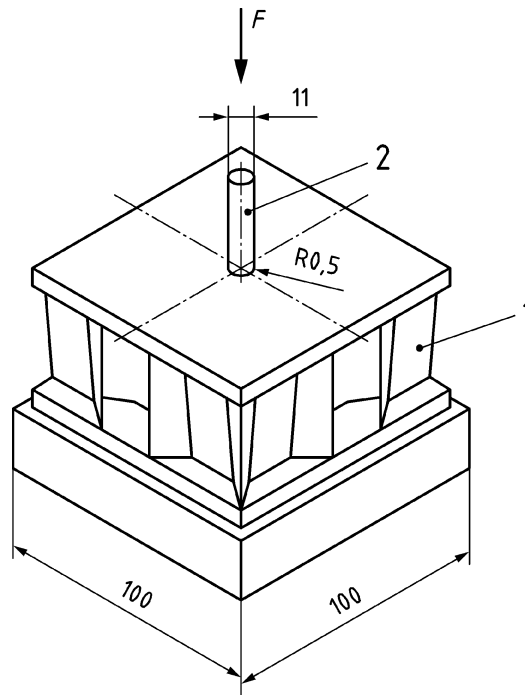
Figure 3 — Test method for determination of flatwise compressive behaviour of SWB-F

8.3.3.2 Resistance to a concentrated static point load

The resistance to a concentrated static load is determined by modifying the test method for flatwise compressive behaviour of 8.3.3.1 in the following way:

The top flat platen is replaced by a fixture with a steel pin measuring $(11 \pm 0,2)$ mm diameter. The tip of the pin shall have a round chamfer with a radius of $(0,5 \pm 0,1)$ mm. A schematic of the test set-up is provided in Figure 4 The area to be loaded via the pin shall be selected according to the following criteria:

- a) for SWB-F with inhomogeneous core material the load shall be applied to the estimated weakest point close to the centre of the test piece;
- b) for SWB-F with homogeneous core material the load shall be applied to the centre of test piece.



Key

- 1 test piece
- 2 steel pin
- F compressive force

Figure 4 — Test method for determination of resistance of SWB-F to a concentrated static point load

The results shall be expressed as minimum value, mean value and standard deviation of the following parameters:

- compressive force and corresponding strain;
- compressive force at 10 % strain.

Furthermore, the failure mode shall be stated as part of the test results.

8.3.3.3 Resistance to a concentrated static load applied in close proximity to the board edge

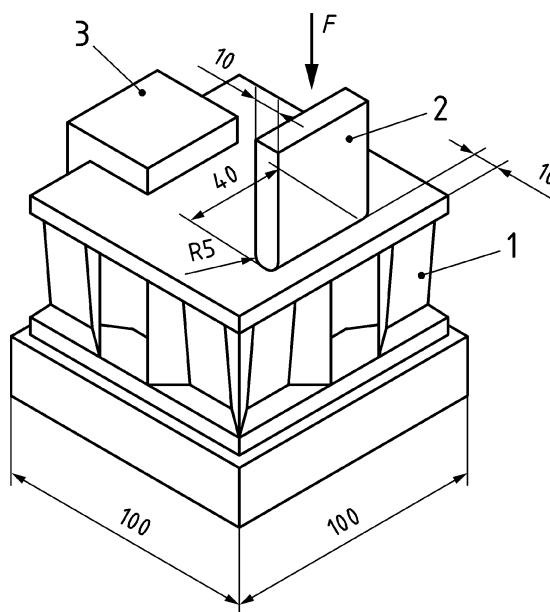
The resistance to a concentrated static load applied in close proximity to the board edge is determined as shown in Figure 5 by modifying the test method for flatwise compressive behaviour of 8.3.3.1 in the following manner:

- The top flat platen is replaced by a cylindrical loading head measuring $(10 \pm 0,2)$ mm in diameter and $(40 \pm 0,2)$ mm in length. A hold-down bracket shall be employed in order to prevent lifting-off of the unloaded edge of the test piece from the bottom platen. The hold-down bracket shall be adjustable and positioned in close contact with the upper skin of the test piece before application of a testing force in such a way that no pressure is exerted on the test piece.
- The test piece shall comply with the specifications provided in 7.3. Larger test pieces shall be employed when testing SWB-F with very thick and/or very stiff skins. Test pieces can also be tested with reinforced

edges. In such a case the edge reinforcement shall be specified and reported in the test report. Test results only apply to boards in combination with the specified edge reinforcement (see also 7.2).

- The load shall be applied at a distance of 10 mm from a randomly selected edge and at equal distances from the closest corners. When testing SWB-F with inhomogeneous core materials it may be necessary to vary test piece cutting patterns and/or alter the position of the loading head slightly (i.e. closer to one of the corners; the distance of 10 mm from the edge is to be maintained) in order to assess the compressive resistance at the weakest or one of the weakest areas along the edge of a test piece.

Dimensions in millimetres



Key

- 1 test piece
- 2 loading head
- 3 hold-down
- F compressive force

Figure 5 — Test method for determination of resistance of SWB-F to a concentrated static point load

The results shall be expressed as minimum value, mean value and standard deviation of the following parameters:

- compressive force and corresponding strain;
- compressive stress at 10 % strain.

Furthermore, the failure mode shall be stated as part of the test results.

8.3.4 Impact resistance

Depending on the application of the SWB-F to be tested or other requirements one of the following methods shall be selected in order to determine the impact resistance of SWB-F.

The impact resistance of faced sandwich boards can be determined in accordance with EN 438-2 (large ball).

Impact resistance of faced and unfaced SWB-F can be determined according to EN 950. Two SWB-F test pieces measuring $(2\ 000 \pm 5)$ mm in length and (850 ± 5) mm in width shall be tested. Alternative test piece sizes may be applied.

Test results shall be reported as stated in EN 438-2 and EN 950, respectively. Minimum values, mean values and standard deviations shall be reported.

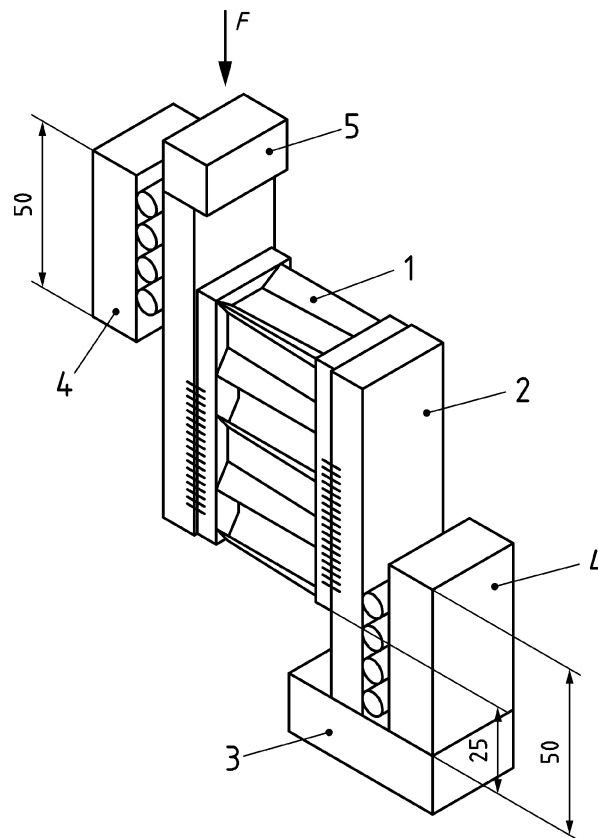
A suitable sampling procedure shall be applied when selecting test pieces from SWB-F with non-homogeneous core material to ensure that the impact resistance in the weakest region of the board is determined.

8.3.5 Shear strength

8.3.5.1 General shear strength test method

Shear strength of SWB-F shall be determined according to the principle of EN 789. The steel loading plates described in EN 789 shall be replaced with loading plates manufactured from plywood with sufficient thickness. Steel loading plates shall be used when testing SWB-F with high shear strength in order to avoid significant deformations of the loading plates. A schematic of the test set-up is provided in Figure 6.

Dimensions in millimetres



Key

- 1 test piece
- 2 glued-on loading plate
- 3 bottom platen
- 4 slide bearings
- 5 loading platen
- F compressive force

Figure 6 — Loading configuration for determination of the shear strength of SWB-F according to EN 789

8.3.5.2 Simplified shear resistance test method

A simplified test method for determination of the shear strength of SWB-F with core material with low shear strength is presented in A.1.3.

8.4 Properties relevant to processing and to performance in use

8.4.1 General

This subclause specifies test methods for properties which are relevant to the processing and to the performance of SWB-F in use. This subclause does not necessarily provide test methods for all relevant properties and not all relevant properties are addressed. For specific applications the suitability of SWB-F may have to be verified with suitable methods, e.g. resistance of SWB-F to elevated temperatures.

8.4.2 Integrity of board edges

8.4.2.1 General

The integrity of edges of full-size sandwich boards and of cut-to-order board sections can be tainted by damage sustained during cutting (i.e. so-called edge chipping), handling and transport operations. Edge integrity shall be assessed according to procedure described below which is based on the test method provided in EN 14323:2004, 5.3.

NOTE This test method does not apply to sandwich boards or board sections with edge-banding.

8.4.2.2 Principle

Edge chipping is assessed by placing a graduated mask or tape measure on the full-size board or cut-to-order board-section under test and measuring the size of chips removed from the board edge.

8.4.2.3 Apparatus

A metal tape measure or mask graduated in divisions of 1 mm.

8.4.2.4 Test piece

A full-size board or cut-to-order board-section which is ready to be dispatched.

8.4.2.5 Procedure

The test piece is placed flat on a protective surface. Loose surface contamination is to be removed using a brush. Using the metal tape or the mask the size of the chips is measured at right angles to the board edge across the chips towards the centre of the test piece.

8.4.2.6 Expression of test results

Record the largest chip removed to the neared millimetre.

8.4.3 Quality of edge banding

8.4.3.1 General

The application of edge-banding to SWB-F is regarded as a crucial processing step in the manufacturing of furniture and/or furniture components from SWB-F.

The methods described hereafter are designed to allow the assessment of certain characteristics of edge-banding in combination with a specific SWB-F product and specified processing parameters (i.e. adhesive employed, edge-banding equipment, auxiliary materials). Results obtained using these methods thus depend on a number of parameters and are not to be regarded as a material characteristic describing the tested SWB-F product only. The significance of processing parameters has to be observed in test piece preparation and in interpretation of test results.

8.4.3.2 Resistance of the board edge with edge-banding against a static concentrated load

8.4.3.2.1 Principle

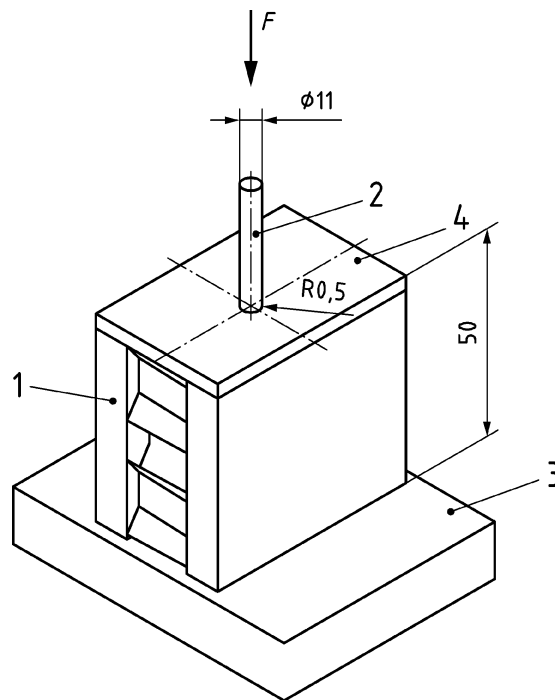
The resistance of the board edge with edge-banding against a static concentrated load is determined by applying a static point load at a fixed rate of loading and by stating the resulting deformation at different levels of loading and by stating the load at failure.

8.4.3.2.2 Apparatus and loading device

The apparatus and test set-up according to in 8.3.3.2 shall be applied. The test set-up is also depicted in Figure 7.

SWB-F with a core thickness of ≥ 10 mm may be tested using the steel pin depicted in Figure 7. A thinner steel pin shall be selected and described in the test report when testing SWB-F with a core thickness < 10 mm.

Dimensions in millimetres



Key

- 1 test piece
- 2 steel pin
- 3 bottom support platen
- 4 edge-banding
- F compressive force

Figure 7 — Test method for determination of the resistance of the board edge with edge-banding against a static concentrated load F

8.4.3.2.3 Test pieces

Test pieces shall be prepared individually or cut from sections of SWB-F panels with edge-banding already applied. Edge-banding shall be applied using suitable methods and materials (e.g. adhesives).

Test pieces shall be rectangular measuring 100 mm in length and 45 mm to 50 mm in width. The thickness of the test pieces shall be equal to the thickness of the sandwich board.

As a general guideline for a sandwich board with an inhomogeneous core the length of the rectangular test pieces shall be increased to 200 mm and the width shall be between 95 mm and 100 mm. For some sandwich

boards with an inhomogeneous core the length and width may have to be increased further (while maintaining a length to width ratio of approximately 2 to 1) to meet the following criteria.

For inhomogeneous core materials with a longitudinal orientation of the structural units (e.g. channels in a corrugated core) a minimum of three structural units shall be contained in the test piece cross section. For inhomogeneous core materials with cellular structural units at least nine structural units shall be contained in the test piece cross section.

8.4.3.2.4 Procedure

After installation of the loading pin in the testing machine the force measurement system shall be reset to zero.

Position the test piece centrally and upright on the bottom flat platen such that the test piece edge with the edge-banding faces upward towards the steel pin depicted in Figure 7. The point to which the concentrated load is to be applied shall be located at equal distances from both board surfaces (i.e. at half the board thickness) and midway along the length of the test piece (i.e. at half the test piece length).

The loading pin shall be slowly brought into contact with the test piece and a preload of 5 N shall be applied to the test piece by moving the crosshead of the testing machine at a very small loading rate. Thereupon the displacement measuring device is reset to zero, recording of the load-displacement data is initiated and a load is applied via the steel pin by moving the crosshead of the testing machine at a constant loading rate of 2,5 mm/min until a force of 200 N is reached or until the test piece fails.

8.4.3.2.5 Expression of test results

By means of the recorded load displacement data report the displacements measured at the following force levels: 20 N, 50 N, 100 N and 200 N. If the test piece failed prior to reaching a level of 200 N report the force which lead to the failure. The mode of failure shall be described briefly.

8.4.3.3 Peel resistance of edge-banding

8.4.3.3.1 Principle

The test method described hereafter is based on the test procedure of EN 1464. It allows the determination of the peel resistance of adhesives bonds between edge-banding as the flexible adherent and a SWB-F as the rigid adherent.

In order to reduce or eliminate the effect of the stiffness of the flexible adherent the apparent peel resistance of a test piece without bonding between the rigid and the flexible adherent is determined and considered in the expression of the test results as the corrected average peel resistance.

The effect of the stiffness of the flexible adherent can be disregarded if it has been demonstrated that the stiffness of the flexible adherent accounts for less than 10 % of the average peel resistance of the adhesive bond.

Auxiliary materials (e.g. edge reinforcement) may be employed in the application of edge-banding to SWB-F. Such auxiliary materials may be part of the rigid adherend or of the flexible adherend in the peel test. The utilization and specifications of such auxiliary materials shall be described in the test report and their effects shall be considered when evaluating peel resistance test results.

8.4.3.3.2 Apparatus

A tensile testing machine capable of maintaining a pre-determined constant crosshead rate of 100 mm/min shall be employed. The tensile testing machine shall be equipped with a suitable instrument capable of measuring the crosshead position with an accuracy of 0,1 mm. Furthermore a suitable load measurement system capable of measuring the load applied to the test piece with an accuracy of ± 1 % of the measured

value shall be part of the tensing testing machine. The tensile testing machine shall be connected to a recording device for simultaneously recording the force and the corresponding displacement.

The tensile testing machine shall be provided with a suitable self-aligning grip to hold the test piece. The jaws of this grip shall firmly engage the outer 25 mm of the end of the flexible adherend. The grip and attachments shall be so constructed in such a manner that they will move into alignment with the test piece as soon as the force is applied and that the flexible member of the test piece will coincide with the direction of the applied pull through the centre line of the grip.

The self-aligning grip shall be light in weight or otherwise the test set-up shall be such that the weight of the self-aligning grips is eliminated in the set-up.

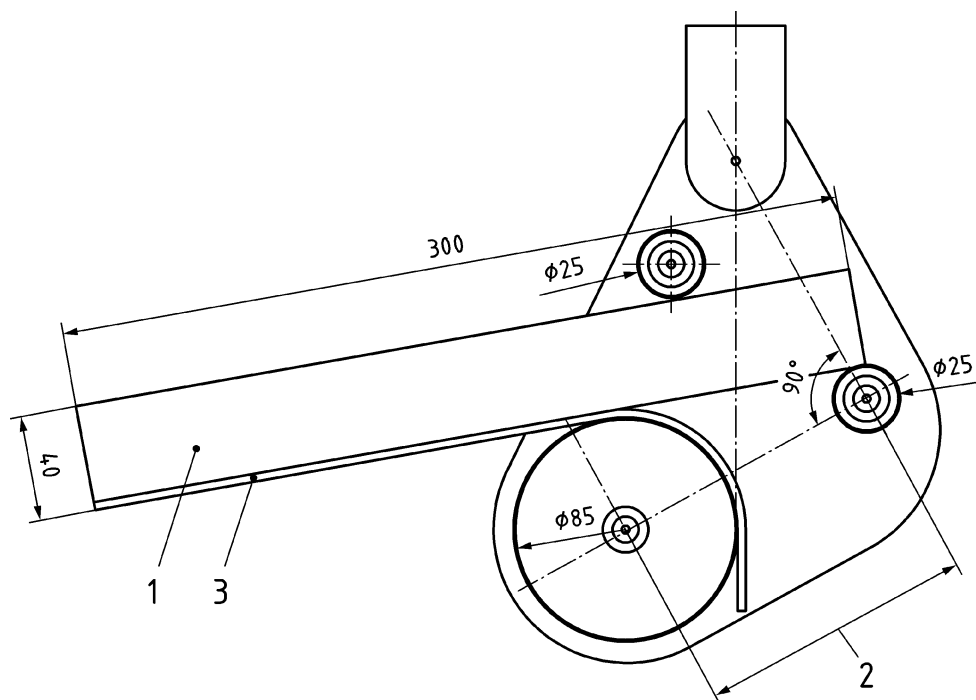
8.4.3.3.3 Peel test fixture

8.4.3.3.3.1 General

The peel test fixture as shown in Figure 8 is attached to one of the cross-arms (traverse) and supports the test piece. The $(25 \pm 0,5)$ mm diameter rollers and the (85 ± 1) mm diameter roller on the test fixture shall roll freely (see Figure 9). The angle determined by the rollers (see Figure 8) and the use of dual roller bearings are critical and the rollers shall therefore be carefully maintained.

The width of the peel test fixture (i.e. 50 mm as stated in Figure 9) has to be increased if the peel resistance of edge-banding applied to SWB-F with a thickness ≥ 50 mm is to be determined.

Dimensions in millimetres

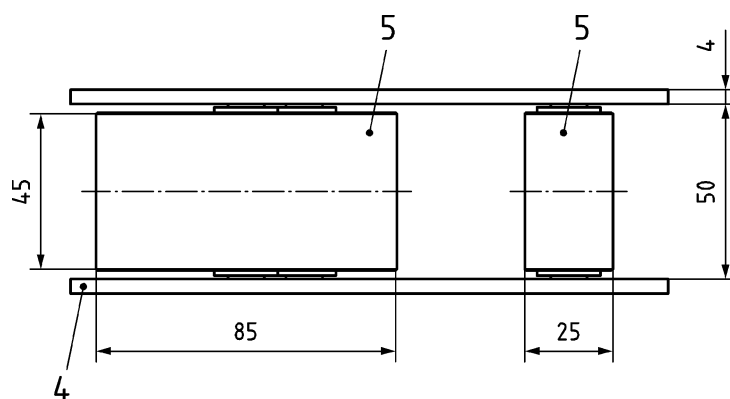


Key

- 1 SWB.F section (rigid adherend)
- 2 peeling zone
- 3 edge-banding (flexible adherend)

Figure 8 — Peel test fixture

Dimensions in millimetres



Key

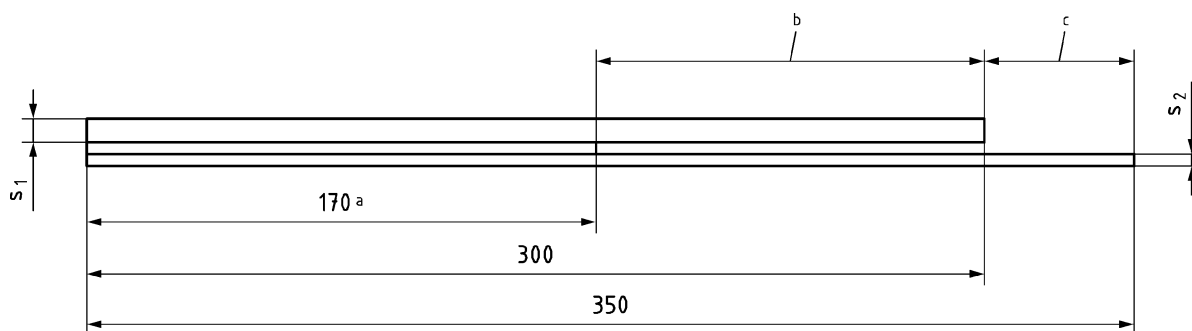
- 4 mild steel
- 5 dual roller bearing assembly

Figure 9 — Dual roller bearing assembly in the peel test fixture

8.4.3.3.3.2 Bonded test piece

A test piece of the dimensions depicted in Figure 10 shall be prepared individually or cut from bonded panels. The test piece's width shall be equal to the thickness of the tested SWB-F and shall be smaller than the width of the peel test fixture. The test piece's overall thickness (i.e. S1 combined with S2 as given in Figure 10) shall be 40 mm. Edge-banding shall be applied using suitable methods and materials (e.g. adhesives).

Dimensions in millimetres



Key

- S 1 thickness the rigid adherend
- S 2 thickness of the flexible adherend
- a zone with bonding
- b zone with no bonding
- c gripping zone

Figure 10 — Dimensions of a bonded test piece with the rigid adherend (top), the bond-line (middle) and the flexible adherend (bottom)

Employing the measurement equipment and procedure of EN 325 the width of each test piece shall be measured at two points located at a distance of 50 mm from each end and at equal distances from each longitudinal edge of the test piece, respectively. The average width is recorded.

If test pieces are prepared from bonded panels a suitable method shall be employed to separate the edge-banding from the board in the initial zone with no bonding (see Figure 10).

In order to determine the peel resistance of the adhesive bond between a SWB-F and specific edge-banding, which due to its nature and/or material properties cannot be peeled off (i.e. due to its brittleness or low tensile strength) (e.g. melamine edge banding), it may be necessary to firmly bond a flexible, suitable auxiliary material with low thickness and high tensile strength to the edge banding and thus manufacture a suitable composite flexible adherend for testing. The bond within the composite flexible adherend has to be significantly stronger than the bond between the flexible and the rigid adherend in order for the test to yield representative results. All details on test piece preparation shall be reported in the test report.

8.4.3.3.3 Blank test piece without bonding

Prepare a set of three blank test pieces of the dimensions depicted in Figure 10 but without adhesive bonding between the rigid and the flexible adherend. These test pieces are to be utilized for measuring the apparent peel resistance resulting from the bending stiffness of the flexible adherend.

Applying the measurement equipment and procedure of EN 325 the width of each test piece shall be measured at two points located at a distance of 50 mm from each end and at equal distances from each longitudinal edge of the test piece, respectively. The average width is recorded.

In order to stabilize a blank test piece or to avoid excessive slip between the edge-banding and the board the two adherends can be joined loosely by suitable means (e.g. double sided adhesive tape) preferably in the region of the test piece which will not be considered when analysing the autographic curve (see 8.4.3.3.5) (i.e. the first 25 mm and the last 25 mm).

8.4.3.3.4 Procedure

Insert the test piece (see 8.4.3.3.3.2) into the peel test fixture (see 8.4.3.3.3.1) as shown in Figure 8, with the unbounded end of the flexible adherend gripped in the jaw of the testing machine (see "gripping zone" in Figure 10). Peel the test piece at a constant crosshead rate of (100 ± 5) mm/min.

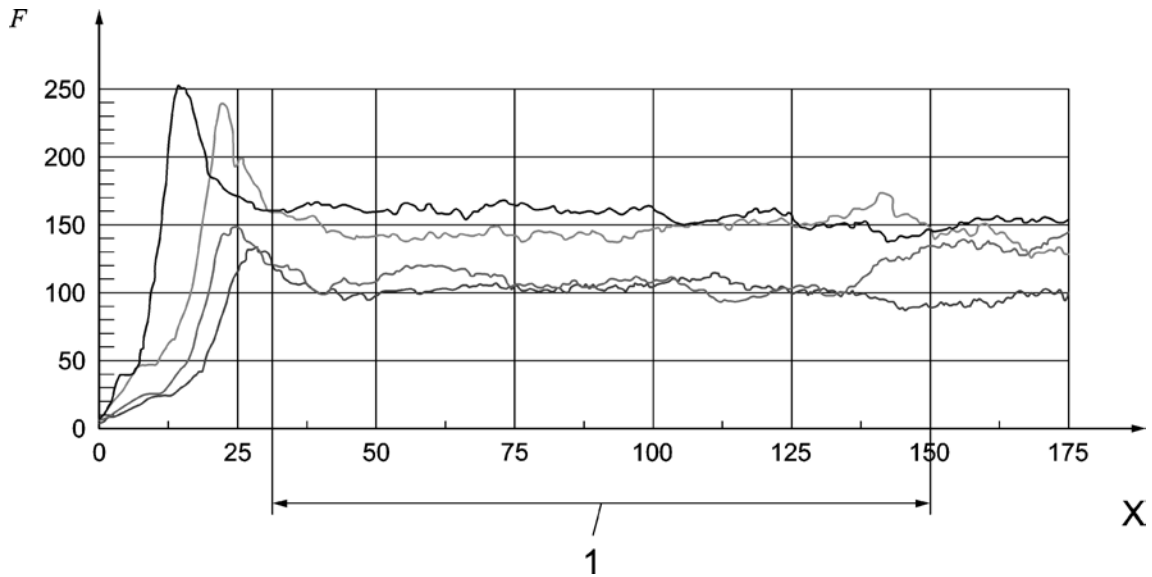
During the peel test, make an autographic recording of force versus crosshead movement (i.e. force versus distance peeled) of the peeling action. An example of autographic recordings for four test pieces is shown in Figure 11. Disregard the results if failure occurs outside the peeling zone as defined in Figure 8.

Test the blank test pieces (see 8.4.3.3.3.3) using the same procedure as described above.

8.4.3.3.5 Expression of test results

8.4.3.3.5.1 Measured peel resistance of each bonded test piece

Determine the peel resistance of each bonded test piece in Newtons (N) by calculating the average peel resistance from the autographic curve, for at 100 mm of peeling (disregarding the first 50 mm and the last 25 mm, see Figure 11).



Key

- 1 autographic curve evaluated for expression of test results
- F force in Newtons
- X crosshead movement in millimetres

Figure 11 — Example of the recordings for four test pieces of force [N] (depicted on the y-axis) versus crosshead movement [mm] (depicted on the x-axis) (the region of the autographic curves to be averaged for calculation of the peel resistance is highlighted)

8.4.3.3.5.2 Mean apparent peel resistance for test pieces without bonding

In the same manner determine the apparent peel resistance from the autographic curve for each blank test piece without bonding. Calculate the mean apparent peel resistance for all three blank test pieces without bonding. If the average peel resistance of any of the three blank test pieces without bonding differs by more than 20 % from the mean apparent peel resistance another set of three blank test pieces shall be tested and the mean of all six blank test pieces shall be calculated and considered as the mean apparent peel resistance for test pieces without bonding.

8.4.3.3.5.3 Corrected peel resistance

The corrected peel resistance of each bonded test piece shall be determined by subtracting the mean apparent peel resistance for test pieces without bonding from the measured peel resistance of each bonded test piece. The peel resistance of edge-banding is expressed as the average corrected peel resistance calculated from all individual corrected average peel resistance values. The standard deviation and the failure mode shall also be stated.

NOTE For certain purposes it may be useful to divide the aforementioned corrected average peel resistance [N] by the test piece width [mm] to obtain the average peeling resistance required to separate the adherends in Newtons per millimetre (N/mm).

8.4.4 Load bearing capacity of fasteners

8.4.4.1 General

Fasteners in SWB-F may be subjected to different loading scenarios depending on the direction under which the load is applied to the fasteners. This European Technical Specification provides test methods for the following loading scenarios:

- axial loading of the fastener with the force acting in the direction of the fastener's head (or crown) which is counteracted by an axial withdrawal resistance (see 8.4.4.2);
- axial loading of the fastener with the force acting in the direction opposite to the fastener's head (or crown) which is counteracted by a pull through resistance (see 8.4.4.3);
- lateral loading of the fastener in a direction perpendicular to the axis of the fastener (see 8.4.4.4).

For the purposes of this European Technical Specification any item that joins SWB-F with other structural items and transfers loads from one to the other across a localized joint (i.e. not spread over a larger surface area as for example in an adhesive joint between two board surfaces) shall be considered as a fastener. While the test methods provided hereafter are primarily designed for mechanical fasteners (e.g. nails, staples, pins, corrugated fasteners, screws dowels) specific fastener systems for SWB-F may also rely partially or entirely on other joining forces (e.g. adhesion) to form a localized joint. Testing of such fasteners may only be performed and interpreted as systems (i.e. fastener in combination with auxiliary materials, special installation methods or tools etc.).

8.4.4.2 Determination of axial withdrawal resistance of fasteners

For SWB-F with a thickness ≥ 15 mm face and edge withdrawal resistance of a fastener is determined according to the principles of EN 320 and following the options specified below by measuring the force required to withdraw a defined or specified fastener from the test piece. Edge withdrawal is only determined on SWB-F of 15 mm thickness and more.

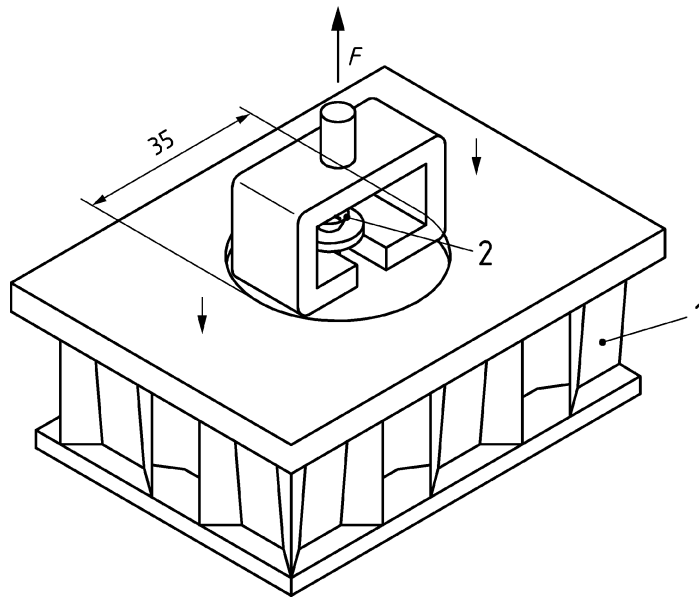
If comparison testing is undertaken the fastener specified in EN 320 shall be used and inserted according to the respective requirements of EN 320. For specific design purposes it may be necessary to conduct testing with a specific screw or fastener. The design of the fastener and the method of its insertion (e.g. diameter and depth of the pilot hole) shall be documented and report in the test report.

Withdrawal capacity from faces shall be determined according to the following two options for mounting and holding the test pieces:

- Option 1: a test piece shall be mounted in accordance with EN 320 and Figure 12 in such a way that the surface under test (i.e. the surface into which the screw was inserted) is held perpendicular to the direction of the force applied to the screw. A special jig with a central opening/hole measuring (10 ± 1) mm in diameter as described in EN 320 shall be used for SWB-F ≤ 15 mm in thickness.

For fasteners measuring more than 15 mm in diameter the diameter of the central boring in the holding plate has to be increased from 35 mm to 45 mm.

- Option 2: a test piece shall be mounted rigidly perpendicular to the direction of the force applied to the screw by attaching the surface which is not under test firmly to a flat platen (e.g. by bonding) (see Figure 13) Test pieces can also be tested with reinforced edges. In such a case the edge reinforcement shall be specified and reported in the test report. Test results only apply to boards in combination with the specified edge reinforcement (see also 7.1). Depending on the insertion point of the fastener tests according to Option 2 can be carried out using the following three configurations:



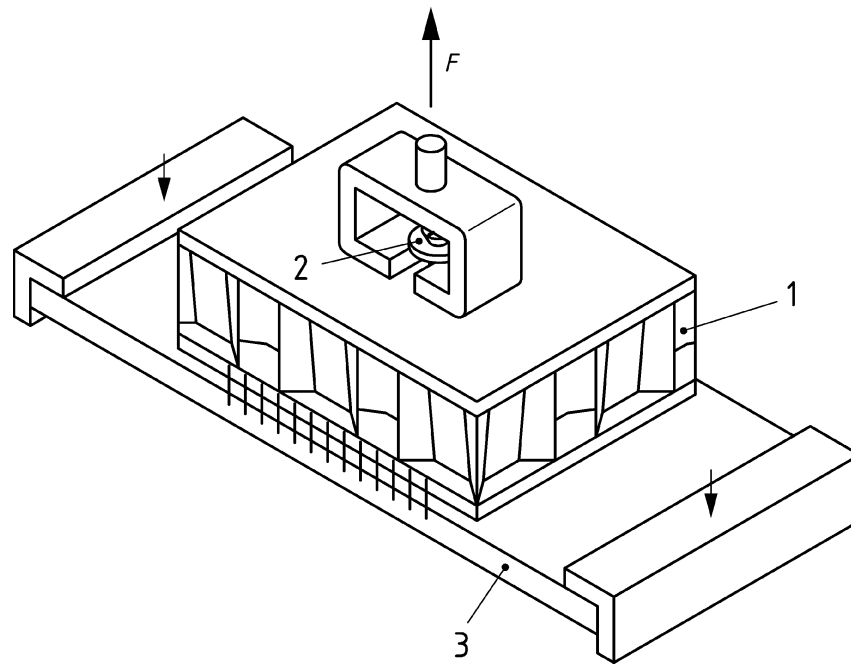
Key

- 1 test piece
- 2 fastener
- F tensile force

Figure 12 — Test set-up according to Option 1 for determination of the load bearing capacity of fasteners in SWB-F with a thickness > 15 mm; downward holding forces act on the holding plate

- a) Centre-point insertion: the fastener is inserted at the centre-point (i.e. at equal distances from all four edges) (as depicted in Figure 13).
- b) Insertion in close proximity to a board edge: the fastener is inserted at a distance of 10 mm from a randomly selected edge and at equal distances from the closest corners. When testing SWB-F with inhomogeneous core materials it may be necessary to vary test piece cutting patterns in order to assess the fastener withdrawal resistance at the weakest or one of the weakest points along the edge of a test piece.
- c) Insertion in close proximity to a corner of the board: the fastener is inserted at a distance of 10 mm from two randomly selected, adjacent edges (i.e. the fastener is inserted at a distance of approximately 14,1 mm from the corner enclosed by the two aforementioned edges). When testing SWB-F with inhomogeneous core materials it may be necessary to vary test piece cutting patterns in order to assess the fastener withdrawal resistance at the or one of the weakest areas along the edge of a test piece.

When assessing the axial withdrawal resistance of fasteners according to Option 2, testing according configuration 2 a) shall always be performed while configuration 2 b) and c) shall be regarded as optional.



Key

- 1 test piece
- 2 fastener
- 3 bottom plate
- F tensile force

Figure 13 — Test set-up according to Option 2 a) (i.e. centre point insertion of the fastener) for determination of the load bearing capacity of fasteners in SWB-F

Test results shall be expressed in accordance with EN 320. In addition for testing of withdrawal capacity from faces the mounting option(s) employed shall be stated together with the test result. Furthermore, a description of the failure modes shall be provided.

8.4.4.3 Pull through resistance of fasteners

This test shall be conducted in order to determine the resistance of a SWB-F test piece to the pulling through of the head of a fastener.

The pull through resistance of a specified fastener shall be tested according to EN 1383. The test result shall be expressed in terms of the head pull through parameter as described in EN 1383.

For the purpose of board characterization and for comparative evaluation of SWB-F products independently of a specific fastener the test method provided in A.1.5 shall be applied.

8.4.4.4 Load bearing capacity of shelf supports

Load bearing capacity of shelf supports shall be determined using the test method provided in A.1.4.

8.4.5 Shear resistance of a grooved board

In order to assess the possibility of using SWB-F in combination with certain standard designs and assembly methods in furniture manufacturing the shear resistance of a grooved board shall be determined according to the method specified in A.1.

8.5 Formaldehyde emission

If no formaldehyde emitting adhesives or materials are used in the manufacturing of the SWB-F then the formaldehyde emission of SWB-F shall be stated on the basis of the materials (i.e. skins, core materials) used in manufacturing the respective board.

If adhesives containing formaldehyde are employed in manufacturing of the respective SWB-F the formaldehyde emission of this product shall be determined according to EN 717-1. For testing according to EN 717-1 of SWB-F with a non-homogeneous core all board edges are to be sealed carefully.

Other derived methods (e.g. EN 717-2) may be employed for quality assurance purposes or comparative testing. For these purposes it may be necessary to establish a correlation between the respective derived test method and EN 717-1.

Material for formaldehyde testing from SWB-F with non-homogeneous core material has to be selected carefully as formaldehyde emission behaviour may vary depending on the position in the board.

NOTE National or other requirements may apply to the emission of formaldehyde from SWB-F and the applicable test methods.

9 Marking

For boards tested in conformity with this European Technical Specification, each board or package shall be clearly marked by the manufacturer by indelible direct printing with at least the following information in this sequence:

- a) manufacturer's name, trade mark, or identification mark;
- b) board type e.g. SWB-F.X.XX;
- c) nominal thickness;
- d) formaldehyde class;
- e) batch number, or the production week and year.

10 Test report

The test report shall contain the following information:

- a) name and address of the test laboratory;
- b) sampling report according to EN 326-1;
- c) date of the test report;
- d) reference to this European Technical Specification;
- e) type and thickness of the board;
- f) relevant product specification;
- g) information on sampling and test piece preparation, information on auxiliary materials and/or processing steps applied to the testes material (if applicable);
- h) description of test procedure and size of test pieces;

- i) specific equipment used, in case of different possibilities allowed in this European Technical Specification;
- j) test results, expressed in accordance with the requirements given for the respective property;
- k) all deviations from this European Technical Specification.

Annex A (normative)

Test methods

A.1 Shear resistance of grooved board

A.1.1 Principle

A shear force is applied at a given rate of displacement parallel to the skins of two squarely cut test piece via loading brackets which rest in grooves machined into the two test pieces. The resulting maximum shear force is measured, divided by a factor of two ("2"), related to the area loaded in shear of each test piece and reported as the shear resistance.

A.1.2 Apparatus and test set-up

A.1.2.1 Compression testing machine

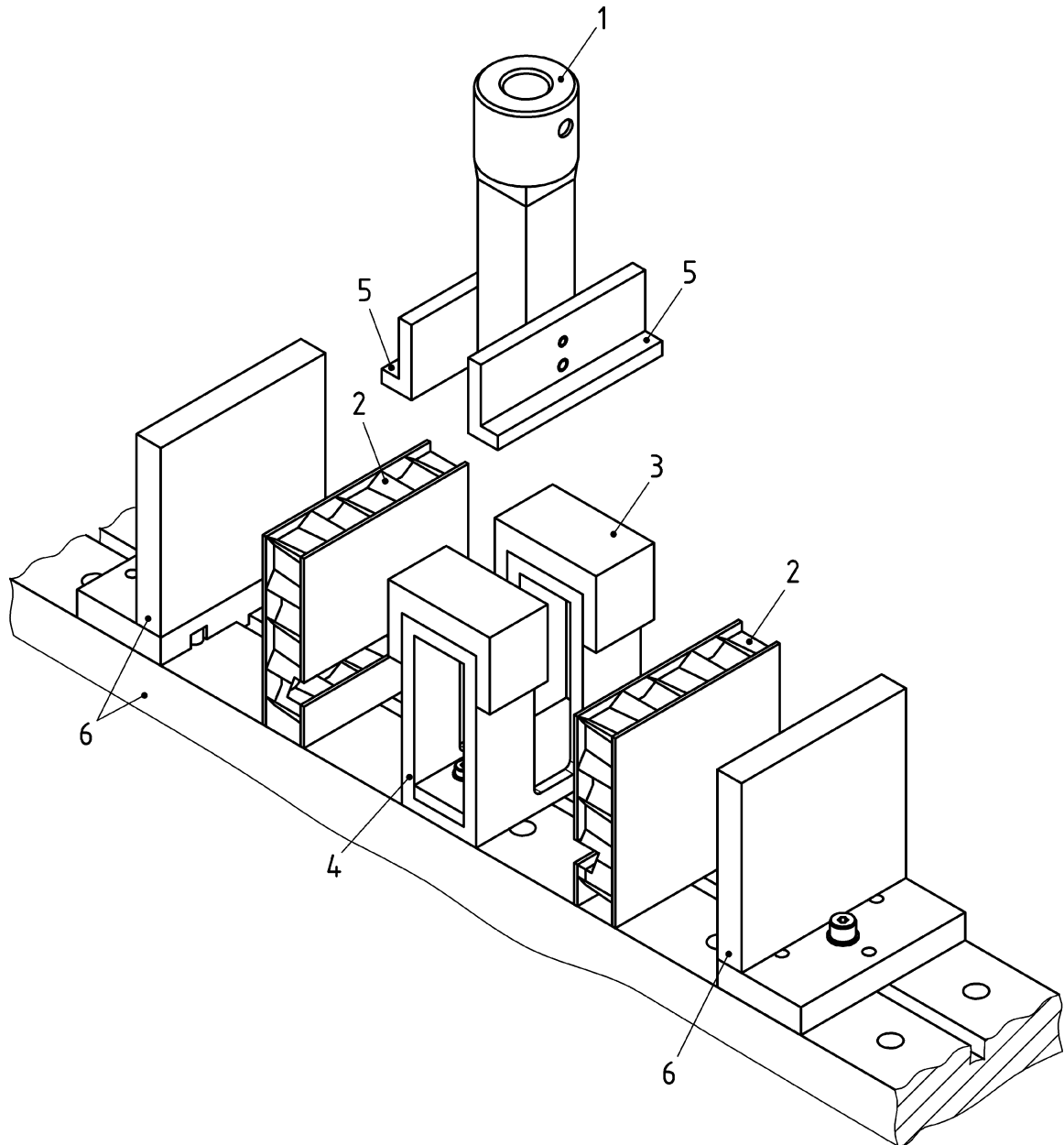
Compression testing machine, designed to suit the range of force involved, having one fixture to which the loading brackets can be firmly attached and having one very rigid, square bottom platen with a minimum side length equal to the side length of the test piece. It shall be possible to move and firmly position the bottom platen. Furthermore a rigid, vertically oriented supporting element, to which the test piece can be attached (e.g. by clamping), shall be attachable to the bottom platen.

A.1.2.2 Measurement of force

A Sensor fitted to the compression testing machine is used to measure the force produced by the reaction of the test piece upon the bottom platen and the loading bracket. This sensor shall be such that its own deformation during the measuring operation is negligible compared with that being measured or if not it shall be taken into account by calculation. In addition, it shall allow the continuous measurement of the force to an accuracy of 1 %.

A.1.2.3 Loading assembly

The test set-up is depicted in Figure A.1 in its unassembled, i.e. open state and in Figure A.2 in the assembled state, i.e. prior to the start of a test. The loading assembly encompasses a fixture firmly attached to the compression testing machine and designed to carry the loading brackets, a guiding device for the fixture designed to guide and stabilize the loading fixture without restricting its vertical movement and two loading brackets. Each loading bracket shall be manufactured of steel and be designed to fit the groove to be tested and (e.g. material thickness of 4,5 mm) suit the range of force involved, with sufficient stiffness such that deformations of the loading brackets remain negligible.



Key

- 1 loading block
- 2 SWB-F test pieces
- 3 removable shims
- 4 guiding device for loading block
- 5 loading brackets
- 6 adjustable horizontal supports and base plate

Figure A.1 — Unassembled test set-up for determining the shear resistance of a grooved board

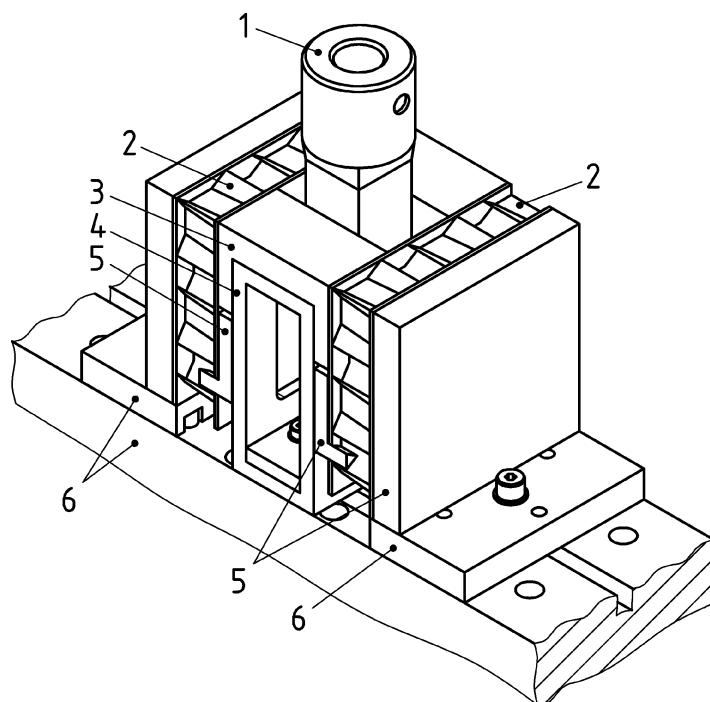
A.1.2.4 Test piece preparation

A groove measuring $(10 \pm 0,5)$ mm in depth and $(5 \pm 0,3)$ mm in width shall be machined into test pieces at a distance of 12 mm from an edge selected at random or selected on the basis of the designated application, when surface and/or core material are anisotropic. Test pieces can also be tested with reinforced edges (see

7.2). In such a case the edge reinforcement shall be specified and reported in the test report. Consequently test results only apply to boards in combination with the specified edge reinforcement.

A.1.2.5 Procedure

For each test piece the length and width of the area to be loaded in shear shall be determined with an accuracy of 0,1 mm using a sliding calliper. The test pieces shall be placed in the testing machine in an upright position with the groove positioned horizontally and in the lower half of the test piece as shown in Figure A.1 and Figure A.2. The bottom platen and the vertical supporting element shall be positioned and fixed such that the test piece is not supported in the area beneath the machined groove. The test piece shall be attached to the supporting element using sufficient means to counteract any moment forces. The lower section of the loading bracket shall be inserted in the groove and a compressive force shall be applied at a rate of 5 mm/min in the centre to the top section of the loading bracket. Continue compression until the test piece yields.



Key

- 1 loading block
- 2 SWB-F test pieces
- 3 removable shims
- 4 guiding device for loading block
- 5 loading brackets
- 6 adjustable horizontal supports and base plate

Figure A.2 — Assembled test set-up for determining the shear resistance of a grooved board prior to the start of test

A.1.2.6 Calculation and expression of results

The shear resistance [N/mm^2] of a grooved board shall be calculated by dividing the maximum compressive force [N] by a factor of two ("2") to account for the two test pieces tested in parallel and by the area [mm^2] of each SWB-F test piece which was loaded in shear.

A.1.3 Simplified test method for determination of the shear strength of SWB-F

A.1.3.1 Principle

A simplified method can be used to determine the shear strength of SWB-F with core material with low density and low shear resistance. The shear strength of such SWB-F is determined by simultaneously measuring the resistance of a set of two symmetrically positioned SWB-F test pieces to a compressive force acting parallel to the skins and displacing one skin relative to the other for each SWB-F test piece. The resulting maximum force is measured, divided by a factor of two and related to the area of the test piece to report the shear strength.

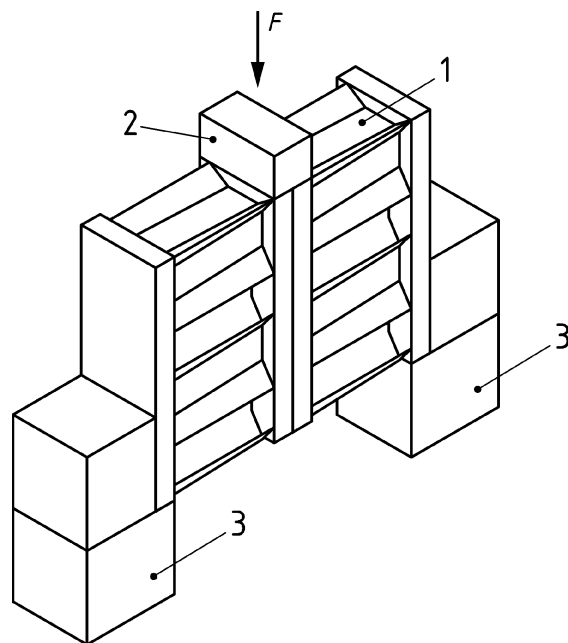
A.1.3.2 Apparatus and test set-up

Compression testing machine, with force and displacement measuring and recording devices as described in EN 826 where the top platen is replaced with a fixture firmly holding a loading block and where the bottom platen is replaced with adjustable supports.

The top loading block shall be sufficiently thick to avoid deformations of the loading block. The length of the top loading block shall be equal to or greater than the side-length of the test pieces to be tested. The width of the loading block shall be twice the thickness of the skin of the SWB-F resulting in the compressive force acting simultaneously on the skins of both test pieces constituting the paired test piece set. The width of the loading block may be larger than twice the thickness of the SWB-F skin if the in-plane compressive strength of the core material (i.e. in the direction of the x and y-axis of the SWB-F) is negligible in comparison to the shear strength of the SWB-F (an example is shown in Figure A.3).

The two adjustable supports consist of vertical and horizontal elements which form a right angle and restrict movement of the test piece set in the vertical (i.e. in the loading direction) and in the horizontal direction (in the direction of the z-axis of the SWB-F), respectively. The length of all supporting elements shall be equal to or greater than the side-length of the test pieces to be tested. The width of the vertical supporting elements shall be equal to the thickness of the skin of the SWB-F. The width of the vertical supporting elements may be larger than the thickness of the SWB-F skin if the in-plane (i.e. in the direction of the x and y-axis of the SWB-F) compressive strength of the core material (e.g. paper honeycomb) is negligible in comparison to the shear strength of the SWB-F (an example is shown in Figure A.3).

The horizontal adjustable support elements shall be designed to prevent the outer, unloaded skins of the test piece set from moving horizontally resulting in a separation of the two test pieces comprising the test piece set.



Key

- 1 test piece
- 2 loading block
- 3 adjustable supports
- F* compressive force

Figure A.3 — Example for the set-up for a simplified, symmetrical shear strength test for test SWB-F with core material with negligible in-plane compressive strength

A.1.3.3 Test piece preparation

Test pieces are tested in sets of two. The shear area [mm²] shall be determined from the length and width of the test piece. Particular care has to be taken during the preparation of the test pieces in order to minimize deviations from the specified test piece dimensions as discrepancies on test piece dimensions result in unequal loading of paired test pieces.

A.1.3.4 Procedure

A test piece set consisting of two test pieces shall be placed on the supports. The vertical supports shall be brought into close contact with the test pieces without however exerting significant pressure on the test pieces. The loading head of the compression testing machine shall be lowered such that the loading block comes into close contact with the edges of the two adjacent, inner skins of the test pieces. Thereupon a compressive force shall be applied via the loading block at a rate of 5 mm/min until the test pieces yield.

A.1.3.5 Expression of results

The results shall be expressed as minimum value, mean value and standard deviation of the following parameters:

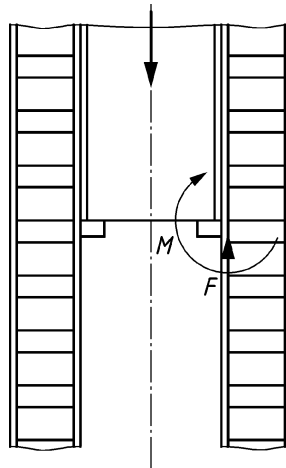
The shear strength [N/mm²] of the board calculated by dividing the compressive force [N] measured at the yielding of the test piece by a factor of two ("2") and by the mean area [mm²] of the test piece.

Furthermore, the failure mode shall be stated as part of the test results.

A.1.4 Determination of the load bearing capacity of shelf supports

A.1.4.1 Principle

A centred compressive force is applied at a given strain rate simultaneously to a set of shelf supports embedded in two squarely cut, symmetrically arranged test pieces as shown schematically in Figure A.4. The compressive force results in bending moments and shear forces acting on the shelf supports. The resulting maximum force is measured, divided by a factor of two (“2”) and reported as the load bearing capacity of a shelf support.



Key

M resulting momentum

F resulting shear force

Figure A.4 — Testing procedure for determination of the load bearing capacity of shelf supports

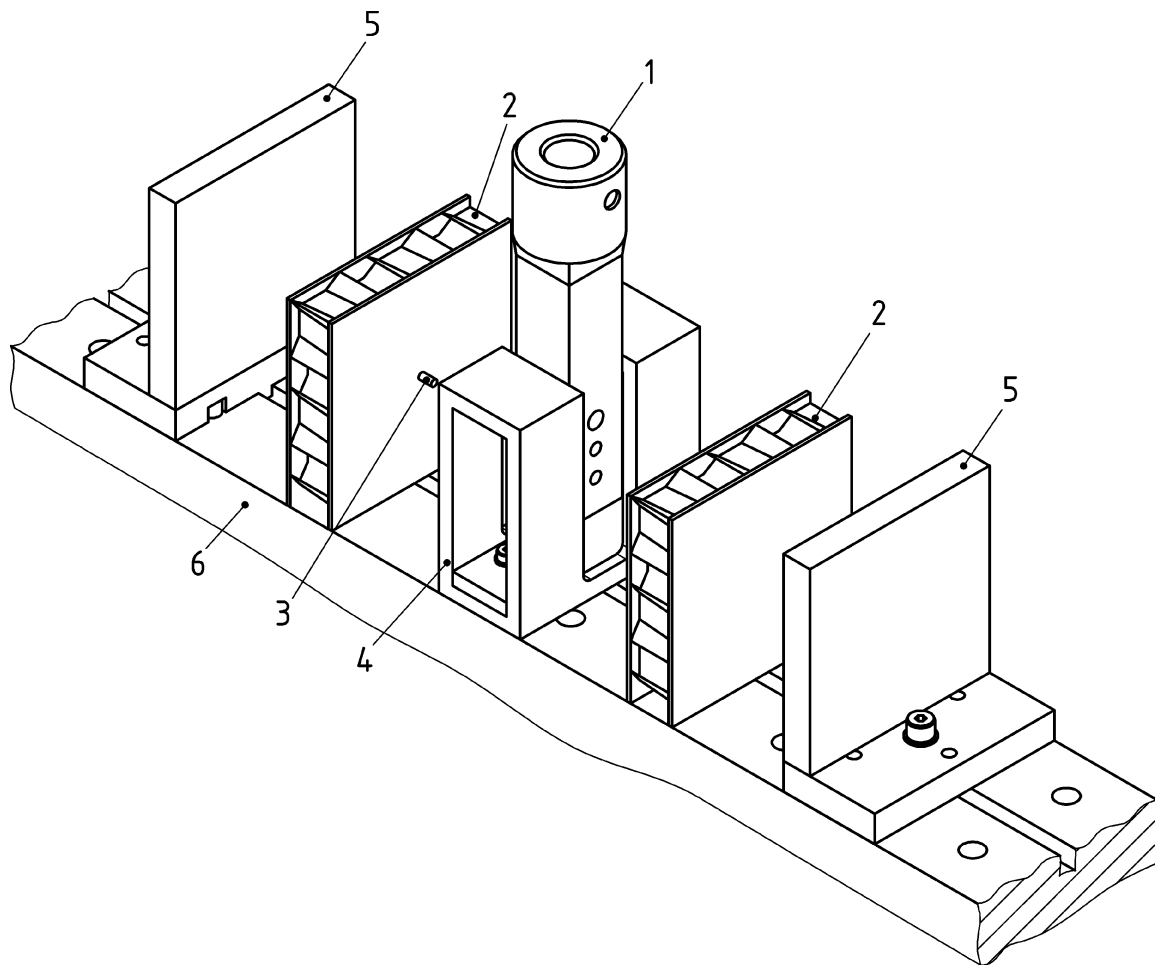
A.1.4.2 Apparatus and test set-up

A.1.4.2.1 Compression testing machine

Compression testing machine, with force and displacement measuring and recording devices as described in EN 826 where the top platen is replaced with a fixture firmly holding a loading block (see A.1.4.2.2) and where the bottom platen is combined with adjustable horizontal supports.

A.1.4.2.2 Loading block, guiding device for the loading block and the test piece support assembly

The test set-up is depicted in Figure A.5 in its unassembled, i.e. open state and in Figure A.7 in the assembled state, i.e. prior to the start of a test. The test set-up consists of a steel loading block with a square load-transferring face, a guiding device for the loading block designed to guide and stabilize the loading block without restricting its vertical movement and support elements which stabilize the test pieces.



Key

- 1 loading head
- 2 SWB-F test pieces
- 3 shelf support
- 4 guiding device for loading head
- 5 adjustable horizontal supports
- 6 base plate

Figure A.5 — Unassembled test set-up for determination of the load bearing capacity of shelf supports

A.1.4.3 Shelf support

Testing shall be performed using reference shelf supports manufactured from hardened steel with chamfered ends (0,5 mm) and conforming to the dimensions given in Figure A.6

Dimensions in millimetres

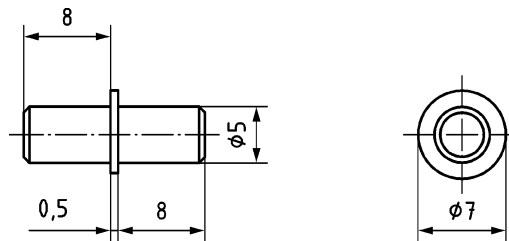


Figure A.6 — Reference steel shelf support

For other purposes (e.g. evaluation of specific furniture designs) testing may be performed with specific commercial shelf supports.

The limited ability to compare and transfer results obtained when testing with commercial shelf supports has to be considered (e.g. caused by different performance of different shelf supports or by quality variations between or even within batches of shelf support).

The loading block and other parameters (e.g. hole for installation of shelf support) may have to be modified in order to accommodate testing of special shelf supports (e.g. shelf supports with shelf-fixing plugs). The specific test configuration shall be described in the test report.

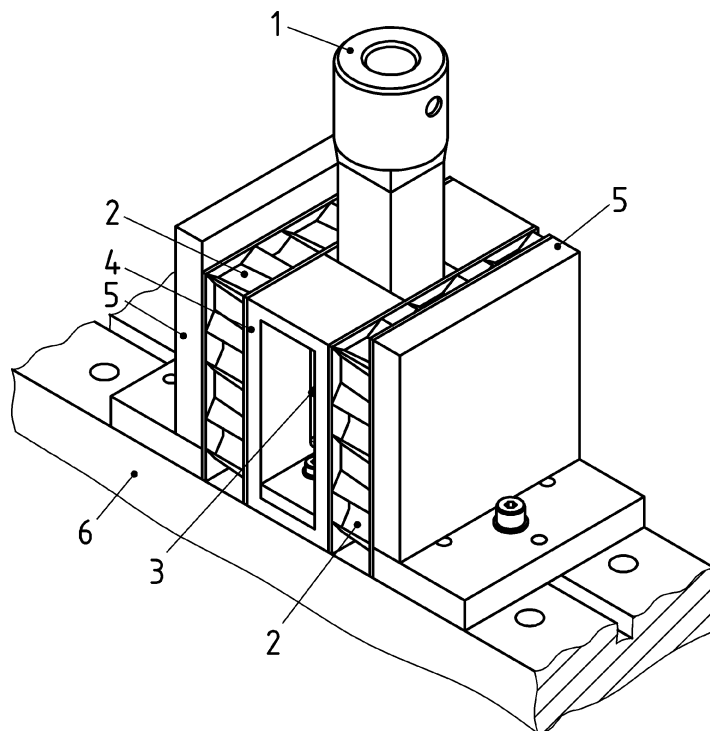
A.1.4.4 Test piece preparation

A hole measuring $(5 \pm 0,1)$ mm in diameter and (10 ± 1) mm in depth shall be drilled into the loaded surface of each test piece in a central position.

A suitable sampling procedure shall be employed when selecting test pieces from SWB-F with non-homogeneous core material to ensure that the load bearing capacity in the weakest region of the board is determined.

A.1.4.5 Procedure

After insertion of the shelf supports into the predrilled holes two test pieces shall be placed in the testing machine in an upright position as shown in Figure A.7. Vertical orientation of the test piece shall be selected at random or selected on the basis of the designated application, when skin and/or core material are anisotropic.



Key

- 1 loading head
- 2 SWB-F test pieces
- 3 shelf support
- 4 guiding device for loading head
- 5 adjustable horizontal supports
- 6 base plate

Figure A.7 — Assembled test set-up for determination of the load bearing capacity of shelf supports

The horizontal supporting elements shall be positioned and fixed maintaining gaps of 0,5 mm to 1 mm between the loading block (including its guiding device) and the surface of the test pieces (see Figure A.7). A compressive force shall be applied at a rate of 5 mm/min in the centre to the loading block until the assembly yields or until a drop-off of the force of 20 % in comparison to the maximum force is observed.

A.1.4.6 Calculation and expression of results

The results shall be expressed as minimum value, mean value and standard deviation of the load bearing capacity [N] of shelf supports which is derived by dividing the maximum measured force by a factor of two ("2").

A.1.5 Pull through resistance

A.1.5.1 Principle

The pull through resistance of SWB-F is quantified by measuring the resistance of the board to indentation by a defined indenter which is designed to simulate the head of a fastener. Following the principles and set-up described in 8.3.3.2 for measuring the resistance of SWB-F to a concentrated static point load a compressive force is applied via the indenter in the direction of the z-axis to a ring-shaped zone of the upper skin of a SWB-F. The indenter is positioned in a predrilled pilothole on the upper skin of the board. The test piece is supported on a ring-shaped rigid support. The resulting maximum force is measured and reported.

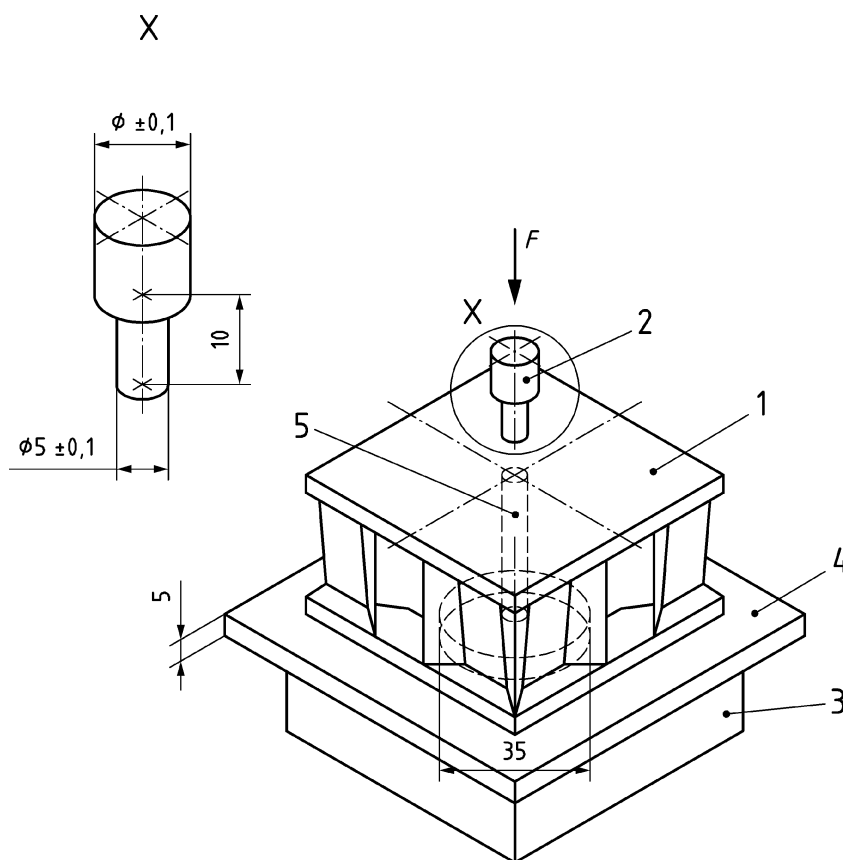
A.1.5.2 Apparatus and test set-up

Compression testing machine, with force and displacement measuring devices as described in EN 826 where the top platen is replaced with a fixture to which the indenter can be firmly attached. An indenter manufactured from hardened steel with sharp edges (i.e. not rounded or chamfered edges) the dimensions provided in Figure A.8. On the top of the bottom platen, a 5 mm thick support platen with a centrally located hole measuring 35 mm diameter has to be placed. The centre of the aforementioned hole shall be aligned with the loading direction.

A.1.5.3 Test piece preparation

A suitable sampling procedure shall be employed when selecting test pieces from SWB-F with non-homogeneous core material to ensure that the pull through resistance in the weakest region of the board is determined.

A centrally located pilothole measuring $5^{+0,3}_0$ mm in diameter shall be drilled parallel to the z-axis into a test piece at the intersection of the diagonals (see Figure A.8).



Key

- 1 test piece
- 2 indenter
- 3 bottom platen
- 4 support platen
- 5 predrilled pilothole
- F compressive force

Figure A.8 — Test configuration for determination of the embedment strength

A.1.5.4 Procedure

The test piece shall be placed centrally on top of bottom support platen. The axis of the pilothole shall be aligned with the loading direction (i.e. the axis of the indenter). The loading head of the compression testing machine shall be lowered such that the lower section of the indenter (i.e. stem measuring 5 mm in diameter) shall be slowly inserted into the pilothole and the outer ring of the indenter comes into close contact with the surface of the test piece. Thereupon a compressive force shall be applied via the indenter at a rate of 5 mm/min until the test piece yields.

A.1.5.5 Expression of results

The results shall be expressed as minimum value, mean value and standard deviation of the following parameters:

- the compressive force at the yielding of the test piece shall be reported as the pull through resistance [N] of the board;
- compressive strain corresponding to the compressive force at the yielding of the test piece;
- the compressive force [N] at a compressive strain equal to 5 % of the thickness of the SWB-F test piece shall also be reported.

Furthermore, the failure mode shall be stated as part of the test results.

Annex B
(informative)

Characterization of sandwich boards for different applications in furniture manufacturing

Guidance is provided below for the selection of board properties which are relevant for specific board applications.

Table B.1 provides a list of characteristics which are regarded as essential (e), optional (o) or irrelevant (i) for SWB-F for different applications in dry conditions.

Table B.1 — Essential (e), optional (o) and irrelevant (i) characteristics for SWB-F for different applications (general, vertical elements, horizontal elements, front elements) in dry conditions

Characteristic	SWB-F	SWB-F.VE	SWB.F.HE	SWB:F.FE
Determination of board dimensions	e	e	e	e
Moisture content	e	e	e	e
Apparent density and mass per unit area	e	o	e	e
Linear expansion due to changes in relative humidity	e	e	e	e
Behaviour under humidity variations in successive uniform climates	e	e	e	e
Moisture resistance	o	o	o	o
Bending test	e	o	e	e
Bending properties of sandwich board for shelving and similar applications	e	i	e	i
Surfaces soundness	e	e	e	e
Flatwise compressive behaviour	o	o	e	o
Resistance to an concentrated static point load	e	o	e	o
Resistance to an concentrated static point load applied in close proximity to the board edge	e	e	e	e
Impact resistance	e	e	e	e

Characteristic	SWB-F	SWB-F.VE	SWB.F.HE	SWB:F.FE
Shear strength	e	e	e	e
Integrity of board edges	e	e	e	e
Resistance of the board edge with edge-banding against a static concentrated load	e	e	e	e
Peel resistance of edge-banding	e	e	e	e
Determination of axial withdrawal resistance of fasteners	e	e	e	e
Pull through resistance of fasteners	e	e	e	o
Load bearing capacity of shelf supports	e	e	i	i
Shear resistance of a grooved board	o	o	o	i
Formaldehyde emission	e	e	e	e

Table B.2 provides a list of characteristics which are regarded as essential (e), optional (o) or irrelevant (i) for SWB-F for different applications in humid conditions.

Table B.2 — Essential (e), optional (o) and irrelevant (i) characteristics for SWB-F for different applications (general, vertical elements, horizontal elements, front elements) in humid conditions

Characteristic	SWB-F.H	SWB-F.H.VE	SWB.F.H.HE	SWB:F.H.FE
Determination of board dimensions	e	e	e	e
Moisture content	e	e	e	e
Apparent density and mass per unit area	e	o	e	e
Linear expansion due to changes in relative humidity	e	e	e	e
Behaviour under humidity variations in successive uniform climates	e	e	e	e
Moisture resistance	e	e	e	e
Bending test	e	o	e	e
Bending properties of sandwich board for shelving and similar applications	e	i	e	i
Surfaces soundness	e	e	e	e

Characteristic	SWB-F.H	SWB-F.H.VE	SWB.F.H.HE	SWB:F.H.FE
Flatwise compressive behaviour	o	o	e	o
Resistance to an concentrated static point load	e	o	e	o
Resistance to an concentrated static point load applied in close proximity to the board edge	e	e	e	e
Impact resistance	e	e	e	e
Shear strength	e	e	e	e
Integrity of board edges	e	e	e	e
Quality of edge bending	e	e	e	e
Resistance of the board edge with edge-banding against a static concentrated load	e	e	e	e
Peel resistance of edge-banding	e	e	e	e
Determination of axial withdrawal resistance of fastener	e	e	e	e
Pull through resistance of fasteners	e	e	e	o
Load bearing capacity of shelf supports	e	e	i	i
Shear resistance of a grooved board	o	o	o	i
Formaldehyde emission	e	e	e	e

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