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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



DRAFT International Standard

ISO/DIS 17880

Cellular plastics — Self-supporting metal faced sandwich panels

*Plastiques — Panneaux sandwich à parements métalliques
autoportants*

ICS: 83.140.99

ISO/TC 61/SC 10

Secretariat: **SCC**

Voting begins on:
2024-06-25

Voting terminates on:
2024-09-17

This document is circulated as received from the committee secretariat.

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 61, *Plastics*, Subcommittee SC 10, *Cellular plastics*.

Introduction

This document has been developed with cellular plastics as the core, but this document has been modified to include other materials such as mineral wool.

Cellular plastics — Self-supporting metal faced sandwich panels

1 Scope

This document specifies requirements for factory made, self-supporting, double skin metal-faced insulating sandwich panels where the insulating core materials are intended to be but not limited to cellular plastics and mineral wool as defined below.

The sandwich panels are intended for discontinuous laying in the following applications:

- a) roofs and roof cladding;
- b) external walls and wall cladding.

The insulating core materials covered by this document are rigid polyurethane foam (PUR), polyisocyanurate foam (PIR), expanded polystyrene foam (EPS), extruded polystyrene foam (XPS), phenolic foam (PF), and mineral wool. Sandwich panels with edge details that utilize different materials from the main insulating core are included in this document.

Sandwich panels used in outdoor cold storage applications are included in this document.

This document does not cover the following:

- a) sandwich panels with a declared thermal conductivity for the insulating core material greater than 0,06 W/m²K at 10 °C;
- b) sandwich panels consisting of two or more clearly defined layers of different insulating core materials (multi-layered);
- c) sandwich panels with perforated facing(s);
- d) curved sandwich panels;
- e) indoor cold storage applications

The products covered by this Document shall be controlled by the manufacturer under system 1 of ISO 12576-1. Its purpose is to provide uniform methods that are used to determine whether a production or a consignment of a thermal insulating material should be accepted as conforming to the relevant specification requirements.

System 1 of ISO 12576-1 defines the manufacturer's declaration of conformity, based on the manufacturer's factory production control, based on ISO9001:2000, without any participation of a third party.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 140-3, *Acoustics — Measurement of sound insulation in buildings and of building elements — Part 3: Laboratory measurements of airborne sound insulation of building elements*

ISO 354, *Acoustics — Measurement of sound absorption in a reverberation room*

ISO 717-1, *Acoustics — Rating of sound insulation in buildings and of building elements — Part 1: Airborne sound insulation*

- ISO 834-1, *Fire-resistance tests — Elements of building construction — General requirements*
- ISO 834-3, *Fire-resistance tests — Elements of building construction — Part 3: Commentary on test method and guide to the application of the outputs from the fire-resistance test*
- ISO 834-4, *Fire-resistance tests — Elements of building construction — Part 4: Specific requirements for loadbearing vertical separating elements*
- ISO 834-5, *Fire-resistance tests — Elements of building construction — Part 5: Specific requirements for loadbearing horizontal separating elements*
- ISO 834-8, *Fire-resistance tests — Elements of building construction — Part 8: Specific requirements for non-loadbearing vertical separating elements*
- ISO 1182, *Reaction to fire tests for products — Non-combustibility test*
- ISO 4898, *Rigid cellular plastics — Thermal insulation products for buildings — Specifications*
- ISO 6270-1, *Paints and varnishes — Determination of resistance to humidity — Part 1: Condensation (single-sided exposure)*
- ISO 6361-2, *Wrought aluminium and aluminium alloys — Sheets, strips and plates — Part 2: Mechanical properties*
- ISO 6361-3, *Wrought aluminium and aluminium alloys — Sheets, strips and plates — Part 3: Strips: Tolerances on shape and dimensions*
- ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*
- ISO 6946, *Building components and building elements — Thermal resistance and thermal transmittance — Calculation methods*
- ISO 9229, *Thermal insulation — Vocabulary*
- ISO 9445-2, *Continuously cold-rolled stainless steel — Tolerances on dimensions and form — Part 2: Wide strip and plate/sheet*
- ISO 10211-1, *Thermal bridges in building construction — Heat flows and surface temperatures — Part 1: General calculation methods*
- ISO 10211-2, *Thermal bridges in building construction — Calculation of heat flows and surface temperatures — Part 2: Linear thermal bridges*
- ISO 10456, *Building materials and products — Procedures for determining declared and design thermal values*
- ISO 11654, *Acoustics — Sound absorbers for use in buildings — Rating of sound absorption*
- ISO 11925-2, *Reaction to fire tests — Ignitability of products subjected to direct impingement of flame — Part 2: Single-flame source test*
- ISO 12468-1, *External exposure of roofs to fire — Part 1: Test method*
- ISO 12468-2, *External exposure of roofs to fire — Part 2: Classification of roofs*
- ISO 12491, *Statistical methods for quality control of building materials and components*
- ISO 13943, *Fire safety — Vocabulary*
- ISO 13784-1, *Reaction to fire test for sandwich panel building systems — Part 1: Small room test*
- ISO 13784-2, *Reaction-to-fire tests for sandwich panel building systems — Part 2: Test method for large rooms*
- ISO 13785-1, *Reaction-to-fire tests for façades — Part 1: Intermediate-scale test*
- ISO 13785-2, *Reaction-to-fire tests for façades — Part 2: Large-scale test*

ISO 16163, *Continuously hot-dipped coated steel sheet products — Dimensional and shape tolerances*

ISO 16544, *Thermal insulating products for building applications — Conditioning to moisture equilibrium under specified temperature and humidity conditions*

ISO 22111, *Bases for design of structures — General requirements*

ISO 29465, *Thermal insulating products for building applications — Determination of length and width*

ISO 29466, *Thermal insulating products for building applications — Determination of thickness*

ISO 29469, *Thermal insulating products for building applications — Determination of compression behaviour*

ISO 29470, *Thermal insulating products for building applications — Determination of the apparent density*

ISO 29765, *Thermal insulating products for building applications — Determination of tensile strength perpendicular to faces*

EN 508-1, *Roofing products from metal sheet — Specification for self-supporting products of steel, aluminium or stainless steel sheet — Part 1: Steel*

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

EN 1172, *Copper and copper alloys — Sheet and strip for building purposes*

EN 1396, *Aluminium and aluminium alloys — Coil coated sheet and strip for general applications — Specifications*

EN 10088-1, *Stainless steels — Part 1: List of stainless steels*

EN 10143, *Continuously hot-dip metal coated steel sheet and strip — Tolerances on dimensions and shape*

EN 10169, *Continuously organic coated (coil coated) steel flat products — Technical delivery conditions*

EN 10346, *Continuously hot-dip coated steel flat products for cold forming - Technical delivery conditions*

EN 12865, *Hygrothermal performance of building components and building elements — Determination of the resistance of external wall systems to driving rain under pulsating air pressure*

EN 13501-1, *Fire classification of construction products and building elements — Part 1: Classification using test data from reaction to fire tests*

EN 14135, *Coverings — Determination of fire protection ability*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 9229 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1 auto-adhesion

self-adhesion of the core to the face(s) occurring automatically without the use of an adhesive

3.2 bending moment capacity,

maximum bending moment recorded during a test on an individual panel

3.3 bending resistance

characteristic value of bending moment capacity determined on the basis of a test series

3.4

bond, bonding

adhesion between the face(s) and the core normally provided by an approved adhesive

3.5

core

layer of material, having thermal insulating properties, which is bonded between two metal faces, creating a sandwich panel

3.6

durability

ability of the panel to withstand the environmental effects and accommodate the consequent decrease in mechanical strength with time caused by factors such as temperature, humidity, freeze-thaw cycles and their various combinations

3.7

edge, longitudinal edge

side of the panel where adjacent panels join together in the same plane

3.8

face, facing

flat, lightly profiled or profiled thin metal sheet firmly bonded to the core

3.9

flat facing

facing without any rolled or pressed profile, or raised strengthening rib

3.10

incompletely bonded face

metal face whose bond to the core is adequate for sandwich action but does not include the entire surface of the core

Note 1 to entry: An example is a trapezoidally profiled face that has voids between the raised profiles and the core.

3.11

incompletely bonded panel

panel in which one or both faces is incompletely bonded

3.12

joint

interface between two panels where the meeting edges have been designed to allow the panels to join together in the same plane

Note 1 to entry: The joint may incorporate interlocking parts that enhance the mechanical properties of the system as well as improving the thermal, acoustic and fire performance and restricting air movement.

Note 2 to entry: The term 'joint' does not refer to a junction between cut panels or a junction where the panels are not installed in the same plane.

3.13

lamella

core material consisting of mineral wool that has been cut and orientated with the fibres perpendicular to the facings prior to bonding

3.14

lightly profiled facing

facing with a rolled or pressed profile not exceeding 5 mm in depth

3.15

pre-manufactured, pre-formed

component or material that is supplied to the manufacturer ready for direct incorporation into the sandwich panel as a core

3.16

sandwich panel

building product consisting of two metal faces positioned on either side of a core that is a thermally insulating material, which is firmly bonded to both faces so that the three components act compositely when under load

3.17

self-supporting panel

panel capable of supporting, by virtue of its materials and shape, its self-weight and in the case of panels fixed to spaced structural supports all applied loadings (e.g. snow, wind, internal air pressure), and transmitting these loadings to the supports

3.18

shift

period of production during a working day, normally 6 h to 8 h but can be less

3.19

side lap

folded area of one or both facing materials along the longitudinal edge of the panel which engages with the adjacent panel to form an interlocking or overlapping joint

3.20

wrinkling strength

the characteristic value of wrinkling stress

3.21

wrinkling stress

the stress in the compressed face of a panel undergoing failure in bending, where the failure mode takes the form of a "wrinkle" extending over the full width of the panel near the section of maximum bending moment

4 Symbols and abbreviated terms

For the purposes of this document, the following symbols and abbreviations apply.

<i>A</i>	cross-sectional area (may be full width of panel or per unit width)
<i>B</i>	flexural rigidity (may be full width of panel or per unit width), overall width of the panel/specimen
<i>C</i>	ratio
<i>D</i>	overall depth of the panel
<i>E</i>	modulus of elasticity
<i>F</i>	force, load, support reaction
<i>G</i>	shear modulus, permanent action
<i>I</i>	moment of inertia
<i>L</i>	span, distance, width of support (L_s)
<i>M</i>	bending moment
<i>N</i>	axial compressive force
<i>Q</i>	variable action
<i>R</i>	resistance, sound reduction index (R_w), reflectivity (R_G), tensile strength (R_{DUR} , R_{24})

S	shear rigidity, value of a load effect, effect of an action
T	temperature
U	thermal transmittance, thermal transmittance including the influence of the joints $U_{d,s}$
V	shear force
a	distance apart of clips
b	width of test specimen, width of plate, width of ribs/valleys, bowing
d	depth of face profile or stiffeners, depth of core (d_c)
e	distance between centroids of faces, base of natural logarithms ($e = 2,718\ 282$)
f	strength, yield stress, thermal transmittance contribution factor (f_{joint})
h	height of profile, thickness (e.g. glue)
k	correction factor
l	length, deviation
m	mass
n	number of tests, number of screws, number of webs
p	pitch of profile
q	live load
r	radius
s	length of web (s_{w1})
t	thickness of face sheet
v	variance factor
w	deflection, displacement, compression, cover width
x, y, z	coordinates
α	coefficient of thermal expansion, sound absorption (α_w)
β	design parameter
δ	deviation
φ	angle
γ	shear strain, partial safety factor
λ	thermal conductivity, λ_{Design} (design value)
φ	creep coefficient
θ	design parameter
σ	stress, compressive strength σ_m , standard deviation

τ	shear stress
Ψ	combination coefficient, linear thermal transmittance of joints
ρ	coefficient, density

Subscripts

C	core
D	declared value (R_D)
F	face, action (γ_F)
G	self-weight, degree
M	material (γ_M)
Q	variable action
S	sandwich part of the cross-section
adj	adjusted
b	bending, elastic extension
c	compression, core, carrier, clip ($f_{\text{joint},c}$)
d	design
e	external, additional thickness of main profiles (Δe)
eff	effective
f	load, facing (λ_{fi})
i	internal (λ_{fi})
i,	j index
k	characteristic value
lin	linear
m	material
n	nominal
nc	without clip ($f_{\text{joint},nc}$)
obs	observed (e.g. result)
q	uniform load
s	support (L_s = support width), stiffeners, surface (R_{s1})
t	tension, time
tol	tolerance (normal or special)
tr	traffic (C_{tr})

u	ultimate (F_u)
v	shear, variance
w	wind, web, wrinkling (σ_w), weighted (R_w)
y	yield
0	basic value, unit width, time (e.g. $t = 0$)
1	external face, upper face
2	internal face, lower face

Abbreviations

CG	cellular glass
EPS	expanded polystyrene
FPC	factory production control
TT	type test
NPD	no performance determined
PCS	gross calorific potential
PUR	rigid polyurethane foam (the abbreviation PUR includes polyisocyanurate foam (PIR))
PF	phenolic foam
XPS	extruded polystyrene foam

5 Requirements, properties and test methods

5.1 Requirements for component materials

5.1.1 General

The product shall be manufactured with materials and components conforming to [5.1.2](#) to [5.1.4](#).

5.1.2 Metal facings

5.1.2.1 Steel

5.1.2.1.1 Steel faces

Steel faces (other than stainless steel) shall have minimum yield strength of 220 N/mm² and shall conform to the requirements of the appropriate standard given in [Table 1](#).

For steels according to [Table 1](#), the steel grade, nominal thickness and tolerance system of each face shall be declared. Tolerances on thickness shall be according to the —special or —normal tolerances as described in the relevant standards.

Table 1 — Standards for steel with metallic coating

Metallic coating	Standard
Zinc, Zinc-Magnesium, 5 % Al-Zn, 55 % Al-Zn and Aluminium-silicon	EN 10346
Differential zinc coating shall be permitted for the external face of a panel exposed to the climate for all core materials.	

Organic protective coatings shall be selected according to their durability in the application environment.

Organic coated steel sheets shall conform to the requirements of EN 10169. Multi-layer coatings shall conform to EN 508-1.

The panel manufacturer shall state the metal grade, thickness and tolerance system of each face. Tolerances on thickness shall be according to “special” or “normal” tolerances as described in the relevant standards. The thickness of steel facing sheets shall be determined in accordance with ISO 16163.

NOTE Not all steels in [Table 1](#) are suitable for sandwich panels in all the intended end uses.

5.1.2.1.2 Back face coating

If the metal face is bonded over its whole area to a rigid foam core with a closed cell structure, the reverse side metallic coating mass shall be a minimum of 50 g/m².

When relevant to intended end use application, resistance of metallic protective coatings and organic back face coat (duplex coating) against corrosion shall be ensured by laboratory tests. Minimum resistance of backing coat shall be CPI2 according to EN 10169. Additionally, to the requirements in EN 10169 only slight colour change (DE ≤ 2,0) shall be acceptable in the condensation-water test (ISO 6270-1) over 1 000 h.

NOTE The requirements in [5.1.2.1.2](#) are only applicable to back face coatings.

5.1.2.2 Stainless steel faces

Stainless steel facings shall have a minimum yield strength of 220 N/mm². The chemical composition of stainless steel faces and their physical properties shall conform to EN 10088-1.

The panel manufacturer shall state the metal grade, thickness and tolerance system of each face. Tolerances on thickness shall be according to “special” or “normal” tolerances as described in the relevant standards. The thickness of stainless steel facing sheets shall be determined in accordance with ISO 9445-2.

NOTE Not all stainless steels in EN 10088-1 are suitable for sandwich panels in all the intended end uses. Reference can be made to EN 508-3, grades suitable for roofing.

5.1.2.3 Aluminium faces

Aluminium facings shall have a design value of the stress at the 0,2 %-strain limit $\beta_{0,2}$ (for simplification called “yield strength”) of 140 N/mm². The chemical composition, temper and mechanical properties of aluminium shall conform to ISO 6361-2.

Organic coated aluminium sheets shall conform to the requirements of EN 1396.

The panel manufacturer shall state the metal grade, thickness and tolerance system of each face. Tolerances on thickness shall be according to “special” or “normal” tolerances as described in the relevant standards. The thickness of aluminium facing sheets shall be determined in accordance with ISO 6361-3.

NOTE Not all aluminium alloys covered by EN 485-2 or EN 1396 are suitable for sandwich panels in all the intended end uses. Reference can be made to EN 508-2.

5.1.2.4 Copper faces

Copper facings shall have a design value of the stress at the 0,2 %-strain limit $\beta_{0,2}$ (for simplification called “yield strength”) of 180 N/mm². The chemical composition, temper, mechanical properties and thickness tolerances of copper faces shall conform to EN 1172.

NOTE Only R240 and R290 grades in EN 1172 satisfy the requirement of 180 N/mm².

The panel manufacturer shall state the metal grade, thickness and tolerance system of each face. Tolerances on thickness shall be according to “special” or “normal” tolerances as described in the relevant standards. The thickness of copper facing sheets shall be determined in accordance with EN 1172.

5.1.3 Core materials

5.1.3.1 Thermal performance

The declared and design thermal conductivity of core materials shall be determined in accordance with [5.2.2](#).

5.1.3.2 Thermal stability of core materials

The thermal stability of the core materials in a sandwich panel shall be evaluated through the durability testing in accordance with [5.2.3](#)

5.1.4 Adhesives and bonding

Adhesives and bonding shall conform to [5.2.1.6](#) and [5.2.3.1](#).

The adhesion between the core and the faces of the sandwich panel has a fundamental role in the satisfactory performance of the sandwich panel. The surface preparation of the facing material shall be appropriate for the adhesive or the method of adhesion.

5.2 Properties of sandwich panels

5.2.1 Mechanical resistance of the sandwich panel

5.2.1.1 General

For mechanical properties, unless stated otherwise, the mean value and the characteristic value (5 % fractile value assuming a confidence level of 75 % for each population of test results) shall be determined according to ISO 12491.

Declared values shall be given to either two or three significant figures.

5.2.1.2 Shear strength (f_{cv}) and shear modulus (G_c)

The declared values of the shear strength and shear modulus of the core shall be determined using the appropriate test procedures from [A.3](#) or [A.4](#) in accordance with [Table 2](#). The same test procedure shall be used to determine both the shear strength and shear modulus of a panel. In principle, each test method is suitable for panels with flat, lightly profiled or profiled facings.

The declared value of the shear strength shall be less than or equal to the characteristic value and shall be declared by the manufacturer in megapascals (MPa).

Only the mean value of the shear modulus obtained from the available test results shall be declared. The 5 %-fractile value shall be recorded for FPC purposes in accordance with [A.3](#) or [A.4](#).

Table 2 — Alternative shear test methods

Test procedure	Core and face materials	Equation for evaluation		Comments
		Shear strength	Shear modulus	
A.3 – 2 load points (on small sample)	All core and face materials	A.5	A.7	Basic procedure. May be used in all situations unless practical requirements dictate otherwise.
A.4 – 2 load points (on full panel)	All core materials. Flat or lightly profiled faces	A.10	A.7	Alternative to A.3 . For panels with one or two profiled faces wrinkling of the faces may occur
	One or both faces profiled	A.12	A.11	
A.4 – Vacuum chamber or air bag loading	All core materials. Flat or lightly profiled faces	A.10	A.13	Alternative to the use of 2 load points.
	One or both faces profiled	A.15	A.14	

5.2.1.3 Creep coefficient (ϕ_t)

The creep coefficient shall be determined according to [A.6](#) and expressed as a number.

The creep coefficient shall be determined for all sandwich panels used as a roof designed to carry long term or permanent loads e.g. snow and self-weight.

5.2.1.4 Compressive strength (σ_m) or compressive stress (σ_{10})

The compressive strength of the core σ_m or its compressive stress at 10 % deformation σ_{10} (whichever is reached first) shall be determined in accordance with the method given in [A.2](#) and shall be declared by the manufacturer in megapascals (MPa).

5.2.1.5 Shear strength after long-term loading (f_{cv} long-term)

The shear strength after long term loading shall be determined in accordance with [A.3.6](#). This value shall be determined for all sandwich panels used as a roof designed to carry long term or permanent loads e.g. snow and self-weight. The declared value shall be less than or equal to the characteristic value (f_{cv}) and shall be declared by the manufacturer in megapascals (MPa).

NOTE The reduction obtained from the small-scale long-term test can be applied to panels where the shear strength has been determined on the basis of large-scale tests to [A.4](#) or calculated on the basis of [A.3.5.3](#).

5.2.1.6 Cross panel tensile strength (f_{ct})

The characteristic value for tensile strength and cross panel tensile strength perpendicular to the panel faces shall be greater than 0,018 MPa when tested in accordance with [A.1](#) and shall be declared by the manufacturer in megapascals (MPa).

The declared values shall be less than or equal to the characteristic value.

NOTE Low tensile strength can reduce the wrinkling strength and increase its variability. Account is taken of this in [A.5.5.5](#) (k_2 factor).

5.2.1.7 Bending moment capacity (M_u) and wrinkling stress (σ_w)

The bending moment capacity shall be obtained by testing according to [A.5](#)

For panels with flat, lightly profiled or profiled faces, the wrinkling stress shall be calculated in accordance with [A.5.5](#) and the wrinkling strength shall be declared by the manufacturer in megapascals (MPa).

The declared wrinkling stress should generally be determined on the basis of the results of bending tests. However, [A.5.5.3](#) also allows a conservative value of the wrinkling stress to be calculated according to [Equation A.20](#) and declared.

Wrinkling stress is related to bending moment by a simple mathematical relationship so that it is not necessary to declare both the bending resistance and the wrinkling strength.

For a panel with a profiled face in compression, the bending resistance shall be declared together with the span of the test specimen. Optionally the wrinkling stress can be declared.

If it is intended that design shall be carried out on the basis of calculations in accordance with [Annex E](#), it is preferable to declare the wrinkling strength wherever possible.

NOTE Declaration of the bending moment is essential for design on the basis of testing.

5.2.1.8 Bending moment capacity and wrinkling stress over a central support

The bending moment capacity over a central support shall be determined in accordance with [A.7](#). For sandwich panels with flat or lightly profiled faces, the wrinkling stress shall then be calculated in accordance with [A.5.5](#).

The bending moment capacity over a central support is required when sandwich panels which are continuous over two or more spans are to be designed by calculation in accordance with [Annex E](#). In such cases, the comparison of the design values of resistance according to [E.2](#) is usually carried out in terms of stresses. If the sandwich panel has one or more profiled faces, the determination of the ultimate compressive (wrinkling) stress from the bending moment capacity requires calculation in accordance with [E.7.5](#). It is recommended that this calculation is carried out at the time of testing.

5.2.2 Thermal transmittance

The thermal transmittance value for the panel (U), incorporating the manufacturer's declared thermal conductivity for the core material ($\lambda_{\text{Declared}}$) and the joints and any profiled facings, shall be determined in accordance with [A.11](#).

Both $\lambda_{\text{Declared}}$ and the $U_{\text{d,s}}$ -value shall be declared.

5.2.3 Durability and other long-term effects

5.2.3.1 Reduction of tensile strength with time as a consequence of ageing (durability)

Sandwich panels shall satisfy the criteria for reduction in tensile strength in accordance with the relevant test method DUR1 and DUR2 (see [Table 3](#)) as described in [Annex B](#).

Durability tests shall be applied to sandwich panels designed for external applications. They are based on the accelerated ageing effect of temperature or humidity, which from long-term experience are critical for each core material.

The durability tests may be used to assess the performance of internal sandwich panels.

NOTE 1 These tests evaluate the reduction of tensile strength as a result of temperature or humidity on a pass/fail basis.

NOTE 2 The durability requirement covers the performance of all essential structural components of the panel, for example backface coatings, adhesion layers and core material.

PUR sandwich panels manufactured using the blowing agents covered within ISO 4898 and a combination of these blowing agents, but excluding CO₂ blown foams shall be considered to satisfy the durability requirements without testing. PUR sandwich panels manufactured with other blowing agents shall be tested according to test DUR1 and the colour reflectivity levels shall be declared ([B.2.5](#)).

Table 3 — Durability tests and deemed to satisfy criteria

Insulating core material	Test method (Annex B)	Note
Polystyrene (EPS or XPS)	DUR1	DUR1 including wedge test (B.5)
Polyurethane (PUR), – auto-adhesive bond	DUR1	No test required for sandwich panels manufactured using the blowing agents covered within ISO 4898, but excluding foams blown solely by CO ₂ Other blowing agents shall be tested to DUR1
Polyurethane (PUR), – adhesive bond	DUR1	No test required for sandwich panels manufactured using the blowing agents covered within ISO 4898, but excluding CO ₂ blown foams. Other blowing agents shall be tested to DUR1 including the wedge test (B.4) The wedge test (B.4) shall be carried out
Phenolic (PF)	DUR1, thermal shock B.6 and repeated loading B.5	PF sandwich panels with an adhesive bond shall be tested to DUR1 including the wedge test (B.4)
Mineral Wool (MW)	DUR2	DUR2 including the wedge test (B.5)

5.2.3.2 Resistance to point loads and access loads –roof sandwich panels

The ability of a sandwich panel to resist point loads and access loads shall be determined in accordance with [A.10.1](#). For applications where there will be more frequent access than occasional foot traffic (see NOTE), the procedure described in [A.10.2](#) shall also be carried out.

NOTE 1 Point loads are loads resulting from a single person walking on the panel, for occasional access both during and after erection.

5.2.4 Fire characteristics

5.2.4.1 Reaction to fire

The reaction to fire of sandwich panels shall be determined according to ISO 13784-1 using the ignition source specified in 8.1 of ISO 13784-1 with burner heat output programme specified in 10.2 and Figure 8 of ISO 13784-1 (i.e. 100 kW for 10 min followed by 300 kW for another 10 minutes) that gives a heat attack along the connections of the sandwich panels (first 10 min. by 100 kW) and ceiling jet flame attack to the connections between vertical panels and ceiling panels (10 min. by 300 kW).

NOTE 1 A vocabulary of terms and definitions for fire safety is given in ISO 13943.

If the sandwich panel system is large (i.e. the height is equal or greater than 4 m), the reaction to fire of a sandwich panel system shall be determined according to ISO 13784-2 with the burner heat output specified in 10.3 and Figure 6 of ISO 13784-2 for heat attack along the vertical connections of the sandwich panels and ceiling jet flame attack to the connections between vertical panels and ceiling panels.

NOTE 2 Tests described in ISO/TS 23657 “Reaction to fire test for sandwich panel building systems — Intermediate-scale box test” can be conducted for a screening purpose, before conducting the test of ISO 13784-1 or ISO 13784-2.

Surface flammability of sandwich panels can be tested according to EN 13823. In this case, the method of specimen mounting, and additional information is given in Annex [C.1](#).

If the core of the sandwich panels is made of non-combustible materials, the non-combustibility shall be examined according to ISO 1182.

If ISO/EN 11925-2 ignitability test is required, the test method is given in Annex [C.2](#) for information.

In case the sandwich panel is attached as cladding for exterior walls as a façade, the reaction to fire of the façade should be determined by ISO 13785-1 or ISO 13785-2.

5.2.4.2 Fire resistance

The fire resistance of sandwich panels shall be determined according to ISO 834-1. Additional test arrangements shall apply according to ISO 834-3, ISO 834-4, ISO 834-5, ISO 834-8 and ISO 834-9, depending on the nature and use of the sandwich panels.

In case fire resistance test ISO 834-5 – Roof is required, the test method is given in Annex C.3 for information.

5.2.4.3 External fire performance – roofs

Where sandwich panels are required to external fire performance as roof coverings, the resistance to external fire shall be determined according to ISO 12468-1 and ISO 12468-2.

In case the test for external fire performance of roof by CEN/TS 1187 is required, the test method is given in Annex C.4 for information.

5.2.4.4 Criteria or classification for fire characteristics

Sandwich panels should follow the local/national/regional criteria or classification for fire characteristics, if these are defined, for use in these areas.

5.2.5 Dimensional tolerances for sandwich panels

The dimensional tolerances for sandwich panels shall be in accordance with Table 4.

Table 4 — Dimensional tolerances for sandwich panels

Dimension	Tolerance (maximum permissible)	Measurement method
Thickness of the sandwich panel ^a	$D \leq 100 \text{ mm}$ $\pm 2 \text{ mm}$ $D > 100 \text{ mm}$ $\pm 2 \%$	D.2.1
Deviation from flatness (according to the length of measurement L)	For $L = 200 \text{ mm}$ – Deviation from flatness 0,6 mm For $L = 400 \text{ mm}$ – Deviation from flatness 1,0 mm For $L > 700 \text{ mm}$ – Deviation from flatness 1,5 mm	D.2.2
Depth of metal profile (ribs) (mm)	$5 < h \leq 50 \text{ mm}$ $\pm 1 \text{ mm}$ $50 < h \leq 100 \text{ mm}$ $\pm 2,5 \text{ mm}$	D.2.3
Depth of stiffeners and light profiling	$d_s \leq 1 \text{ mm}$ $\pm 30 \%$ of d_s $1 \text{ mm} < d_s \leq 3 \text{ mm}$ $\pm 0,3 \text{ mm}$ $3 \text{ mm} < d_s \leq 5 \text{ mm}$ $\pm 10 \%$ of d_s	D.2.4
Length of the sandwich panel	$L \leq 3 \text{ m}$ $\pm 5 \text{ mm}$ $L > 3 \text{ m}$ $\pm 10 \text{ mm}$	D.2.5
Cover width of the sandwich panel	$w \pm 2 \text{ mm}$	D.2.6
Deviation from squareness	$0,006 \times w$ (nominal cover width)	D.2.7
Deviation from straightness (on length)	1 mm per metre, maximum 5 mm	D.2.8
Bowing	2 mm per metre length, maximum 20 mm 8,5 mm per metre width for flat or lightly profiled – $h \leq 10 \text{ mm}$ 10 mm per metre width for profiles – $h > 10 \text{ mm}$	D.2.9
Pitch of the profile (p)	If $h \leq 50 \text{ mm}$ $p: 2 \text{ mm}$ If $h > 50 \text{ mm}$ $p: 3 \text{ mm}$	D.2.10
Width of the ribs (b_1) and width of the valleys (b_2)	For b_1 1 mm For b_2 2 mm	D.2.11
^a For calculation of the thickness of sandwich panels with profiled facings, see Figure D.1 .		

5.2.6 Water permeability (optional characteristic)

The water permeability (resistance to driving rain) of a complete assembly of sandwich panels shall be assessed, i.e. the assembly that is to be installed in a building, including the product and its coatings, factory applied seals, standard joints, site applied seals, representative flashings, and a method of fixing as appropriate to the test.

The resistance classification of a sandwich panel assembly to driving rain under pulsating air pressure shall be determined according to [A.12](#). The test method shall be used for both external wall and roof applications.

Sandwich panels covered by this document are metal faced. When correctly manufactured and if satisfying an appropriate visual inspection, they may be deemed to be impermeable to water. The water tightness of the assembly is a function of its installation. Water permeability is only relevant to the joints and fixings.

5.2.7 Air permeability

The air permeability of a complete assembly of sandwich panels shall be assessed, i.e. the assembly that is to be installed in a building, including the product and its coatings; factory applied seals, standard joints, site applied seals, representative flashings and a method of fixing as appropriate to the test.

The measurement of air permeability of a sandwich panel assembly shall conform to [A.13](#) (ISO 14857). The test method shall be used for both external wall and roof applications.

Sandwich panels covered by this document are metal faced. When correctly manufactured and when an inspection shows the sandwich panel to be free of holes, it is impermeable to air. Air leakage in sandwich panel assemblies is a result of the design and/or installation process. Air permeability is only relevant to the joints and fixings.

5.2.8 Water vapour permeability (optional characteristic)

The water vapour transmission coefficient for the metal facings used is considered to be infinity. Metal faced sandwich panels are therefore considered to be impermeable to water vapour.

5.2.9 Airborne sound insulation ($R_w(C;C_{tr})$) (optional characteristic)

The airborne sound insulation of a sandwich panel assembly shall be determined according to [A.14](#). The result shall be declared as a $R_w(C;C_{tr})$ rating to ISO 717-1.

C is a spectrum adaptation term calculated with A-weighted pink noise. C_{tr} is a spectrum adaptation term calculated with A-weighted urban traffic noise.

5.2.10 Sound absorption (α_w) (optional characteristic)

The sound absorption of a sandwich panel assembly shall be determined according to [A.15](#). The result shall be declared as single number rating to ISO 11654.

5.3 Actions and safety level requirements

5.3.1 Mechanical resistance to design loads

The product shall have sufficient mechanical resistance to the design loads arising from the actions of self-weight, snow, wind, temperature and pressure gradients and access, where these loads shall be factored such that, either alone or in combination, they do not impair the performance of the product in service.

The safety of the product shall be verified by design procedures based on the limit state concept. This requires that the 'design value of the resistance' shall be greater than the 'design value of the effect of the actions' and shall be satisfied at both the serviceability limit state and the ultimate limit state. Verification shall be by calculation in accordance with ISO 22111 and [Annex E](#).

Information shall be produced (in accordance with ISO 22111) which gives all values necessary for both mechanical design and the production of load tables together with the corresponding characteristic values obtained during initial type testing and factory production control. For the purpose of this ISO Standard provision of this information shall be regarded as part of the product.

5.3.2 Actions and combinations of actions

In design for mechanical resistance the following actions: permanent actions, variable actions and actions due to long-term effects, shall be taken into account in the calculations. They shall be considered either individually or in combination using the combination factors in ISO 22111 and [Annex E](#).

6 Testing, assessment and sampling methods

6.1 General

The conformity of a sandwich panel to the requirements of this document and to the stated values including classes shall be demonstrated by:

- type testing (TT);
- factory production control (FPC) by the manufacturer, including product assessment.

The principle of grouping of products into families may be used in order to obtain more uniform characteristic values and material safety factors as the parameters within a range of similar products are varied, or to reduce testing costs.

Where the manufacturer produces products that have the same physical and chemical characteristics on more than one production line or in more than one factory there shall be no need to repeat ITT for the different production lines.

If there is a difference between the characteristic values for products from two different lines, the worst values shall be used.

6.2 Type testing – TT

6.2.1 Initial type evaluation

Type testing shall be conducted to show conformity to this Document in accordance with [Table 4](#).

Whenever a change occurs in the product, raw material or supplier of the components, or the production process (subject to the definition of a family), which would change significantly one or more characteristics, the type tests shall be repeated for the appropriate characteristic(s).

In addition, type testing shall be performed at the beginning of the production of a new panel type (unless a member of the same family) or at the beginning of a new method of production where this may affect the declared properties or conformity of the product.

Characteristics which are required for specific applications, e.g. permeabilities or acoustics, shall be tested on a 'where required' basis.

6.2.2 Sampling for TT and audit testing purposes

6.2.2.1 General

Samples shall be representative of the product to be placed on the market and the manufacturer shall keep satisfactory records as part of his factory production control.

All samples shall preferably be from the same batch or, if this is not practicable, the manufacturer shall ensure availability of sufficient proof allowing comparison of the TT or audit test results with those for samples from other batches.

The number of test specimens (for TT) shall be in accordance with the test methods in [Table 5](#). The sample taken, i.e. panel, shall be a simple random sample, drawn from a finite panel population.

Where test specimens are obtained from a single panel, the specimens shall be taken from a range of positions covering the width of the panel. At least one specimen shall be taken from the middle of the panel and at least one specimen from close to the edge of the panel, with the first cut edge not greater than 10 % of the cover width of the panel from an outside edge.

Conditioning of the test specimens, before or after the test, shall not be carried out unless otherwise specified in the test method.

The minimum age of specimens for initial type tests shall be at least 24 h. The date and time of production shall be recorded at the time of sampling.

NOTE Test specimens are very sensitive to the process of cutting and the accuracy of testing, in particular for tensile test measurements. Considerable care is required in the cutting process, especially if the core material is relatively weak or has brittle tendencies. The cutting can be carried out with a band saw with a fine-toothed blade. It may be advantageous to sandwich the specimen between two pieces of plywood or similar material in order to reduce vibration during the cutting process. It is suggested that specimens should be carefully inspected after cutting. Specimens that show evidence of delamination caused by the cutting process should be rejected (up to a maximum of 30 % of those cut for any family of tests).

6.2.2.2 Sampling marking and records

All samples intended for TT purposes shall be marked as follows:

- date and time of sampling;
- production line or unit;
- identification mark.

The sampling records shall provide at least the following information:

- manufacturing plant;
- place of sampling;
- stock or batch quantity (from which the samples have been taken);
- quantity of samples;
- reference to this ISO Standard;
- marking of the product by the manufacturer;
- identification mark of the samples;
- properties to be tested;
- place and date;
- signature(-s) of the person(-s) responsible for sampling.

NOTE If a third party is responsible for sampling, the sampling records of that third party may be used.

6.2.2.3 Testing and compliance criteria – TT

All characteristics in [Table 5](#), where relevant, shall be subject to TT tests.

Unless the test method requires otherwise, all testing shall be carried out under ambient laboratory conditions, without any special conditions.

For mechanical properties, unless stated otherwise, the mean value and the characteristic value (5 % fractile value assuming a confidence level of 75 %) for each population of the test results shall be determined according to ISO 12491 using the equation and fractile factors in [A.17.3](#).

The results of all type tests shall be recorded and held by the manufacturer for at least 10 years after the last date of production of the product(s) to which they belong.

Table 5 — Number of samples to be tested and compliance criteria

Characteristic	Requirement	Assessment method	Tested panel thickness	Min. no. of samples	Compliance criteria
Mechanical properties of a face	5.1.2	EN ISO 6892-1 ^a		3 ^a	
Technical properties of a panel and its core material					
Shear strength and modulus	5.2.1.2	A.3 or A.4	Minimum, maximum and intermediate suggested	3	
Compressive strength and modulus	5.2.1.4	A.2		6	
Cross panel tensile strength: (and modulus ^b)	5.2.1.6	A.1		6	
Bending moment capacity and wrinkling stress	5.2.1.7	A.5		3	Statement of declared values
Reduced shear strength ^c	5.2.1.5	A.3.2		1/10 ^d	Statement of declared values
Bending moment capacity and wrinkling stress over a central support	5.2.1.8	A.7	(Max,Min,I)	3	-
Creep coefficient ^c	5.2.1.3	A.6	Max	1	[Number]
Cross panel tensile modulus at elevated temperatures ^{b f}		A.1.6	(Max,Min,I)	3	
Density		A.8	(Max,Min,I)		The average value shall be declared
Thermal transmittance	5.2.2	A.11	(Max,Min,I) ^g	See A.11	Limit value according to A.10
Durability ^e	5.2.3	Annex B	Max, Min		Pass (see 5.2.3 and Annex B)

^a These values are required to adjust test results in accordance with [A.5.5.4](#).

^b Required for design purposes only – not declared.

^c Roof applications only.

^d 1/10 = a single test series with 10 specimens. Only tests on maximum panel thickness are sufficient.

^e When the performance is intended to be declared.

^f Not declared. Required to calculate the wrinkling stress at elevated temperatures.

^g Alternatively use manufacturers' declared values. Values shall be in the same orientation as in the panel).

Table 5 (continued)

Characteristic	Requirement	Assessment method	Tested panel thickness	Min. no. of samples	Compliance criteria
Reaction to fire	5.2.4.1	ISO 1716, ISO 1182		As specified in ISO 1716, EN ISO 1182	Follow the local/national/regional criteria or classification for fire characteristics, if these are defined, for use in these areas.
		ISO 13784-1 and/or ISO 13784-2	Min, Max	As specified in ISO 13784-1 and/or ISO 13784-2	Follow the local/national/regional criteria or classification for fire characteristics, if these are defined, for use in these areas.
		EN 13823 (SBI) ISO 11925-2	Min, Max – see Table C.1		Follow the local/national/regional criteria or classification for fire characteristics, if these are defined, for use in these areas. Specific conditions see C.1
Fire resistance ^e	5.2.4.2	ISO 834-1 Additional test arrangements shall apply according to ISO 834-3, ISO 834-4, ISO 834-5, ISO 834-8 and ISO 834-9	Manufacturer choice	1	Follow the local/national/regional criteria or classification for fire characteristics, if these are defined, for use in these areas. Specific conditions see C.3
^a These values are required to adjust test results in accordance with A.5.5.4 . ^b Required for design purposes only – not declared. ^c Roof applications only. ^d 1/10 = a single test series with 10 specimens. Only tests on maximum panel thickness are sufficient. ^e When the performance is intended to be declared. ^f Not declared. Required to calculate the wrinkling stress at elevated temperatures. ^g Alternatively use manufacturers' declared values. Values shall be in the same orientation as in the panel).					

Table 5 (continued)

Characteristic	Requirement	Assessment method	Tested panel thickness	Min. no. of samples	Compliance criteria
External fire performance-roofs ^e	5.2.4.3	ISO 12468-1 and ISO 12468-2	Manufacturer choice	As specified in ISO 12468-1 and ISO 12468-2	Follow the local/national/regional criteria or classification for fire characteristics, if these are defined, for use in these areas. Specific conditions see C.4
Water permeability ^e	5.2.6	EN 12865	Manufacturer choice	1	EN 12865 and in accordance with A.12
Air permeability ^e	5.2.7	ISO 14857	Manufacturer choice	1	ISO 14857 and in accordance with A.13
Airborne sound insulation ^e	5.2.9	ISO 10140	Manufacturer choice	1	Declaration $R_w(C;C_{tr})$ (see A.14)
Sound absorption ^e	5.2.10	ISO 354	Manufacturer choice	1	ISO 11654 (see A.15)
Dimensional tolerances	5.2.5	Annex D	Manufacturer choice	1	-
^a These values are required to adjust test results in accordance with A.5.5.4 . ^b Required for design purposes only – not declared. ^c Roof applications only. ^d 1/10 = a single test series with 10 specimens. Only tests on maximum panel thickness are sufficient. ^e When the performance is intended to be declared. ^f Not declared. Required to calculate the wrinkling stress at elevated temperatures. ^g Alternatively use manufacturers' declared values. Values shall be in the same orientation as in the panel).					

6.2.3 Shortened testing programme – ITT (product change)

6.2.3.1 General

If there is only a change of the core material or the adhesive for a panel family, a shortened test programme (not the whole range of TT) – see [Table 6](#) may be used to compare the values of shear strength and modulus; tensile strength and modulus; compression strength and modulus of the core; and creep against the values from the original TT.

Provided that all of these characteristic material values for the new core material are better than or equal to the values declared as a result of the original TT test, the existing declared values for the mechanical properties of the panel may be retained without further TT.

If there is only a change in the grade of the facing material a shortened test programme to compare the bending moment capacity values shall be used (see [Table 6](#)).

6.2.3.2 Calculation and comparison criteria – mechanical properties

The shortened test programme requires that the following characteristics are tested in accordance with [Table 6](#):

- shear strength f_{cv} (see [Equation \(A.5\)](#)) and shear modulus of the core G_c (see [Equation \(A.7\)](#));

- tensile strength f_{ct} (see [Equation \(A.1\)](#)) and tensile modulus of the core E_{ct} (see [Equation \(A.2\)](#));
- compression strength f_{cc} (see [Equation \(A.3\)](#)) and compression modulus of the core E_{cc} (see [Equation \(A.4\)](#));
- creep coefficient;
- bending moment capacity and wrinkling stress (see 6.2.5.1).

If the performance of the above 6 characteristics are better than or equal to the values from the existing TT but there is a reduced performance with respect to creep, where relevant, then the existing values of tensile, shear and compression strength may be retained but the creep test shall be repeated and a new creep coefficient shall be declared.

6.2.3.3 No shortened programme - Other characteristics

Where there is a change of the core material or the adhesive for a panel family, there is no shortened test programme for the remaining characteristics listed in [Table 5](#) – density, thermal transmittance, durability, fire, permeability and sound. New ITT tests shall be carried out where applicable.

In the case of the fire characteristics any requirement for a retest shall be in accordance with the direct application rules, [C.1.3](#) – reaction to fire and [C.3](#) – fire resistance.

Table 6 — Shortened testing programme, test specimens, type of the test and conditions for ITT

Characteristic	Requirement	Assessment method	Tested panel thickness	Min. no. of samples	Compliance criteria
Shear strength and modulus	5.2.1.2	A.3 or A.4	Maximum	3	G_c and $f_{cv} \geq$ original value
Creep coefficient ^c	5.2.1.3	A.6	Maximum	1	[Number $\leq$ original value]
Compressive strength and modulus	5.2.1.4	A.2	Maximum	6	E_{cc} and $f_{cc} \geq$ original value
Cross panel tensile strength: (and modulus ^b)	5.2.1.6	A.1	Maximum	3	E_{ct} and $f_{ct} \geq$ original value
Cross panel tensile strength at elevated temperatures (f_{ct})	5.2.1.6	A.1.6	Maximum	1	E_{ct} and $f_{ct} \geq$ original value
Bending moment capacity (M_w) and wrinkling stress	5.2.1.7	A.5	Maximum	1	[Number $\geq$ original value]

6.3 Factory Production Control (FPC)

6.3.1 General

The manufacturer shall establish, document and maintain an FPC system to ensure that the products placed on the market conform to the stated performance characteristics. The FPC system shall consist of procedures, regular inspections and tests and/or assessments and the use of the results to control raw and other incoming materials or components, equipment, the production process and the product.

An FPC system conforming to the requirements of ISO 9001, and made specific to the requirements of this Document, shall be considered to satisfy the above requirements.

Unless correlation factors are determined between test method used in type testing and if different test method used in FPC, all FPC tests shall be carried out using the test procedure that was used for the corresponding Type tests. The correlation between test method used in Type testing and alternative method used in FPC shall be defined by determining characteristic values for both methods with a relevant number of samples from the same batch of products.

The results of tests requiring action shall be recorded, as shall any action taken.

When products of the same family (see 6.1) are produced using the same process equipment, the manufacturer may use common Type test results providing conformity can be shown, in which case factory production control procedures shall be the same.

Where a manufacturer operates different production lines or units in the same factory or production lines or units in different factories and these are covered by a single overall FPC system, the manufacturer shall keep control records for each separate production line or unit.

In addition to the test results, the following minimum information shall also be recorded:

- date and place of manufacture;
- type of product;
- product specification, including materials and components.

6.3.2 Results of FPC tests

Each individual value of a declared mechanical property determined by FPC shall be equal to or higher than the value declared as a result of Type testing. If one or more values are lower, a statistical evaluation of this property shall either be carried out over the previous year and the 5 % fractile value determined or, if FPC of this property has been carried out for less than one year, all available results shall be included in the evaluation. This 5 % fractile value shall be equal to or higher than the declared value.

For each declared value, if the fractile value is lower than the declared value, additional FPC tests shall be carried out on material from the same batch and a corrected 5 % fractile value determined. If this value is lower than the declared value, the batch shall be rejected.

If sustained FPC results indicate that the declared value cannot be attained, either the declared value shall be reduced on the basis of the existing Type tests, or a new set of Type tests shall be carried out and a new value for the relevant property shall be declared.

Where values shall be reduced, any related characteristics that are not subject to FPC shall be adjusted.

NOTE The number of additional tests required is at the discretion of the manufacturer.

Where the results of FPC consistently exceed the declared value, these results may be used to determine a 5 % fractile value which may be used as the basis for an increase in the declared value.

6.3.3 Equipment

Tests to demonstrate conformity of the finished product to this document shall be carried out using equipment described in the relevant test methods referred to in this document.

All weighing, measuring and testing equipment necessary to achieve, or produce evidence shall be calibrated or verified and regularly inspected according to documented procedures, frequencies and criteria. Calibration and/or checking shall be against equipment or test specimens traceable to relevant international or nationally recognised reference test specimens (standards). Where no such reference test specimens exist, the basis used for internal checks and calibration shall be documented.

All equipment used in the manufacturing process shall be regularly inspected and maintained to ensure use, wear or failure does not cause inconsistency in the manufacturing process.

Inspections and maintenance shall be carried out and recorded in accordance with the manufacturer's written procedures and the records retained for the period defined in the manufacturer's FPC procedures.

The manufacturer shall ensure that handling, preservation and storage of test equipment is such that its accuracy and fitness for purpose is maintained.

When production is intermittent, the manufacturer shall ensure that any test equipment which may be affected by the interruption is suitably checked and/or calibrated before use.

The calibration of all test equipment shall be repeated if any repair or failure occurs which could upset the calibration of the test equipment.

6.3.4 Raw materials and components

6.3.4.1 General

The specifications of all incoming raw materials and components shall be documented, as shall the inspection scheme for verifying their conformity.

The manufacturer shall have written procedures, which specify how non-acceptable raw materials and components shall be dealt with. Any such events shall be recorded as they occur and these records shall be kept for the period defined in the manufacturer's written procedures.

Metal facings shall be in accordance with [6.3.4.2](#), pre-manufactured core components with [6.3.4.3](#) and adhesives with [6.3.4.4](#).

6.3.4.2 Metal facings

Where provided by the facing manufacturer, declarations shall be according to EN 10204, document Type 3.1, and shall be provided for every mother coil. For all metals that do not have a guaranteed yield stress, material certification shall be provided for every batch.

6.3.4.3 Prefabricated lamella and preformed core material

Pre-formed material for the cores of sandwich panels shall undergo factory production control testing (see [Table 5](#)). The panel manufacturer shall determine or obtain a manufacturer's declaration for the following properties in accordance with the relevant insulation product standard:

- tolerances (particularly consistency of thickness);
- thermal conductivity.

NOTE In the context of this Document, declaration means the supplier's formal declaration of the properties.

6.3.4.4 Adhesives

The panel manufacturer shall obtain the supplier's declaration for the following:

- description and specification;
- viscosity/speed;
- shelf life.

6.3.5 Product testing and assessment – FPC

6.3.5.1 General

The manufacturer shall establish procedures to ensure that the stated values of all of the characteristics are maintained in accordance with [6.3.5.2](#) and [6.3.5.3](#).

The factory production control procedures shall be organised so that every product type appears in the statistical control in approximate proportion to the volume of production.

6.3.5.2 FPC procedures for panels

The minimum factory production control procedure for the manufacture of panels shall include testing according to [Table 7](#).

Factory production control tests shall be carried out either on aged specimens or on specimens taken immediately after production.

The number of test specimens for FPC shall be in accordance with the test methods in [Table 7](#).

The specimens shall be taken from a range of positions covering the width of the panel. At least one specimen shall be taken from the middle of the panel and at least one specimen from close to the edge of the panel, with the first cut edge not greater than 10 % of the cover width of the panel from an outside edge.

NOTE 1 Test specimens are very sensitive to the process of cutting and the accuracy of testing in particular for tensile test measurements. Considerable care is required in the cutting process, especially if the core material is relatively weak or has brittle tendencies. The cutting can be carried out with a band saw with a fine-toothed blade. It may be advantageous to put the specimen between two pieces of plywood or similar material in order to reduce vibration during the cutting process. It is suggested that specimens should be carefully inspected after cutting.

Those specimens that show evidence of delamination caused by the cutting process shall be rejected (up to a maximum of 30 % of those cut for any family of tests).

For panels without joints in the core, if [Equation \(A.20\)](#) ([A.5.5.3](#)) is used it is not necessary to carry out the wrinkling stress tests. Then the FPC control of the tension and compression moduli shall be carried out in accordance with [Table 7](#).

If the wrinkling stress and ultimate bending moment is controlled at least once per week then there is no requirement to control the tension and compression moduli.

Table 7 — FPC procedures for panels

Characteristic	Assessment method	Minimum number of specimens	Minimum frequency
Density of core material	A.8	3	1 per shift/6 or 8 h ^a
Cross-panel tensile strength and modulus (with faces)	A.1	3	1 per shift/6 or 8 h ^a
Compressive strength and modulus of core material	A.2	3	1 per week ^a
Shear strength and modulus of core material ^e	A.3	3	1 per week ^a
Tensile strength of face material (or declaration – 6.3.4.2)	-	3	All deliveries
Thickness of face material (or declaration – 6.3.4.2)	-	3	All deliveries
Shear strength and modulus of the core material based on the testing of a complete panel	A.4	1	1 per 2 weeks ^a
Wrinkling stress (optional see text above)	A.5	1	1 per week ^a
Dimensional control:	-		
— Panel thickness	D.2.1		
— Deviation from flatness	D.2.2		
— Depth of profile	D.2.3		
— Depth of stiffeners	D.2.4		

^a Where production volumes are below 2 000 m² per shift, the manufacturer shall only test every 2 000 m² or at least every three months. Dimensional control tests and permeability inspections, however, shall be carried out every shift.

^b This can be an alternative for panels with MW lamella core material and other panels with joints in the core, see [A.4.1](#)

^c Manufacturer's specification record (see [6.3.5.3](#)) or supplier's statement of fire performance of components.

^d Procedure tests λ_i (single test result of thermal conductivity) in accordance with the appropriate product standard for the core material ([A.10.2.1.1](#)) and shall be representative of the material at the time of manufacture of the panel.

^e Where a complete shear panel test has been used in TT to measure the shear strength and modulus it shall also be used in FPC.

NOTE 1 The control of the thickness of pre-formed core material or lamellas and the positioning of the joints between individual slabs are of fundamental importance and is frequently checked (e.g. every 2 h).

NOTE 2 Typical allowable difference in cutting thickness between adjacent pre-manufactured pieces for fabrication with stiff platens is $\pm 0,5$ mm.

Table 7 (continued)

Characteristic	Assessment method	Minimum number of specimens	Minimum frequency
— Length of panel — Cover width — Deviation from squareness — Deviation from straightness — Bowing (curvature) — Pitch of profile — Width of valleys/ribs	D.2.5 D.2.6 D.2.7 D.2.8 D.2.9 D.2.10 D.2.11	1	1 per shift/6 h or 8 h
Reaction to fire – (6.3.5.3) ^c	-	-	Specification Record
Resistance to fire – (6.3.5.3) ^c			
External fire performance – (6.3.5.3) ^c			
Thermal insulation performance	A.10.2.1.1 ^d	1	1 per month
Water permeability – 5.2.6 Air permeability – 5.2.7 Water vapour permeability – 5.2.8	Visual inspection ^a	-	-
^a Where production volumes are below 2 000 m ² per shift, the manufacturer shall only test every 2 000 m ² or at least every three months. Dimensional control tests and permeability inspections, however, shall be carried out every shift. ^b This can be an alternative for panels with MW lamella core material and other panels with joints in the core, see A.4.1 ^c Manufacturer’s specification record (see 6.3.5.3) or supplier’s statement of fire performance of components. ^d Procedure tests λ _i (single test result of thermal conductivity) in accordance with the appropriate product standard for the core material (A.10.2.1.1) and shall be representative of the material at the time of manufacture of the panel. ^e Where a complete shear panel test has been used in TT to measure the shear strength and modulus it shall also be used in FPC. NOTE 1 The control of the thickness of pre-formed core material or lamellas and the positioning of the joints between individual slabs are of fundamental importance and is frequently checked (e.g. every 2 h). NOTE 2 Typical allowable difference in cutting thickness between adjacent pre-manufactured pieces for fabrication with stiff platens is ±0,5 mm.			

6.3.5.3 FPC controls for fire characteristics

FPC controls for fire characteristics shall be carried out as follows:

- Panels with insulation created by foaming (chemical action) during the manufacturing process shall be controlled by recording the precise specification of all chemical components, fire retardants etc. for each production batch including origin of supply; proportions used etc. In the case of chemical systems supplied by an external manufacturer, a sufficient statement of the specification shall be provided. The panel design/type shall be recorded to confirm the panel to panel joint detail.
- Panels with pre-formed or lamella insulation produced by bonding shall be controlled by recording the precise specification of all pre-formed or lamella components for each production batch including as applicable the full chemical specification; density; fire retardants; organic content; adhesives, including backing coats etc. In the case of pre-formed or lamella and other components (i.e. adhesives) supplied by an external manufacturer a sufficient statement of the specification shall be provided. The panel design/type shall be recorded to confirm the panel to panel joint detail.

Indirect tests on components shall be carried out according to [Table 8](#).

Table 8 — Minimum testing frequencies for components for reaction to fire characteristics

Component	Test method	Frequency
Core material	Check of raw material or chemical formulation, and density (A.8)	1 per shift/6 or 8 h
Adhesive	Check for maximum amount of adhesive layer (A.9)	1 per shift/6 or 8 h
Facings	Manufacturer's declaration	1 per week

6.3.6 Factory Production Control – supplier purchases

6.3.6.1 General

Where a supplier purchases the product from a manufacturer who does not operate an FPC system as described in 6.3, either the manufacturer shall be obliged to operate such a system or the supplier shall take full responsibility for the product in accordance with 6.3.6.2.

6.3.6.2 FPC procedures – products purchased by suppliers

Where a product is purchased by a supplier under the conditions given in 6.3.6.1, the supplier shall take full responsibility for demonstrating the conformity of the product and shall operate an FPC system, including test equipment and non-compliance procedures, to ensure that conformity is maintained with the same degree of certainty as if a full FPC system in accordance with 6.3 had been operated.

Conformity shall be based on product testing of the whole panel or specimens taken from a panel in accordance with Table 9.

Values of the following characteristics shall also be provided in accordance with 6.3.4.2 and 6.3.4.3:

- compressive strength and modulus of the core material;
- shear strength and modulus of the core material;
- tensile strength of the face material (or declaration – 6.3.4.2);
- thickness of face material (or declaration – 6.3.4.2).

The frequency of testing for these characteristics shall be every 2 000 m² and at least once per delivery.

Table 9 — Supplier purchases: FPC system requirements for panels

Characteristic	Assessment method	Minimum number of specimens	Minimum frequency
Density of core material	A.8	3	All deliveries
Cross-panel tensile strength and modulus (with faces)	A.1	3	
Shear strength of complete panel ^a	A.4	1	
Dimensional control:	-	-	-
— Panel thickness	D.2.1	1	All deliveries
— Deviation from flatness	D.2.2		
— Depth of profile	D.2.3		
— Depth of stiffeners	D.2.4		
— Length of panel	D.2.5		
— Cover width	D.2.6		
^a Panels with MW lamella insulating cores and incompletely bonded panels only.			
^b Manufacturer's specification record (see 6.3.5.3) or supplier's statement of fire performance of components.			

Table 9 (continued)

Characteristic	Assessment method	Minimum number of specimens	Minimum frequency
— Deviation from squareness	D.2.7		
— Deviation from straightness	D.2.8		
— Bowing (curvature)	D.2.9		
— Pitch of profile	D.2.10		
— Width of valleys/ribs	D.2.11		
Reaction to fire – (6.3.5.3) ^b	-	-	Specification Record
Resistance to fire – (6.3.5.3) ^b	-	-	
External fire performance – (6.3.5.3) ^b or CWFT	-	-	
Thermal insulation performance – 5.2.2	A.11		Every 3 months
Water permeability – 5.2.6	Visual inspection	-	All deliveries
Air permeability – 5.2.7			
Water vapour permeability – 5.2.8			
^a Panels with MW lamella insulating cores and incompletely bonded panels only.			
^b Manufacturer’s specification record (see 6.3.5.3) or supplier’s statement of fire performance of components.			

6.4 Characteristic values from families of tests

The concept of families is described in [6.1](#). This concept is generally applied to mechanical characteristics and the parameters, which may vary within a family, include core depth, geometry of the faces, span and face material characteristics.

The evaluation of families of test results shall follow the principles given in EN 1990:2002, Annex D. The procedure that follows is a simplified version of the more general procedure given in EN 1990, which is deemed to be adequate for the purposes of this Document.

The characteristic resistances of the members of the family shall be determined on the basis of a suitable design expression ' x_{des} ' that relates the test results to all of the relevant parameters. This design expression may either be based on the appropriate formulae of structural mechanics or determined on an empirical basis. The design expression shall be modified to predict the measured resistance as accurately as possible by adjusting the coefficients in order to optimise the correlation.

NOTE 1 An optimum design expression may be determined on the basis of a regression analysis, but this is not essential. A limited amount of trial and error is sufficient to meet the requirements of this clause.

Where possible, design expressions with a linear variation between the varying parameter(s) and the required values should be preferred.

NOTE 2 This method remains valid if the required "design expression" is a constant value.

In order to calculate the standard deviation, each test result ' x ' should first be normalised by dividing it by the corresponding value predicted by the design expression.

$$x_n = \frac{x}{x_{des}}$$

The number of tests ' n ' should be taken as the total number of tests in the complete family. For a family of at least four tests, the characteristic resistance R_k shall then be obtained using the following equation:

$$R_k = x_p = x_{des} e^{(\bar{y}_n - k\sigma_{yn})}$$

Where

x_p is the 5 % fractile value of population x ; $y_n = L_n(x_n)$;

$\bar{y}_n$ is the mean value of y_n ;

k is the fractile value given in [Table A.5](#);

σ_{yn} is the standard deviation of y_n .

$$\bar{y}_n = \frac{1}{n} \sum_{i=1}^n L_n(x_{n,i})$$

7 Classification and designation

A sandwich panel shall be classified and designated in accordance with [Table 10](#) where required, for example when subject to regulatory requirements. Declared values shall be rounded to two or three significant figures.

Table 10 — Classification and designation

Clause	Designation	Units or class
5.2.1	Mechanical properties:	
	— metal grade / thickness / tolerance system	Statement
	— cross panel tensile strength	MPa
	— shear strength (core)	MPa
	— shear modulus (core)	MPa
	— creep coefficient ^a	(number)
	— compressive strength (core)	MPa
	— long term shear strength ^a	MPa
	— bending resistance ^c	kNm/m
	— wrinkling strength ^c or bending resistance ^c	MPa
	Density	kg/m ³
5.2.2	Thermal transmittance and thermal conductivity	W/m ² ·K and W/mK
5.2.3	Long term mechanical properties – Durability	Pass (colours-see Annex B) / Fail
5.2.4.2	Reaction to fire	ISO 13784-1, ISO 1716, ISO 11925-2 and EN 13823, see Annex C.1
5.2.4.3	Fire resistance	ISO 834-1 and ISO 834-8, see Annex C.3
5.2.4.4	External fire performance for roofs	ISO 12468-1 and CEN TS 1187, see Annex C.4
5.2.6	Water permeability	Class: e.g. A (1 200 Pa): B (600 Pa): C (300 Pa). ^b
5.2.7	Air permeability	C and n values ^b
5.2.9	Airborne sound insulation	Rating: $R_w(C;C_{tr})$ ^b
5.2.10	Sound absorption	Single value rating: α_w ^b
^a Characteristic only required for panels used as roofs. ^b These characteristics may be designated NPD (No Performance Determined) where the intended use is not subject to regulatory requirements. ^c Either the wrinkling strength or bending resistance shall be declared. The bending resistance shall be declared for both positive and negative bending. Where one or both faces are flat or lightly profiled, the wrinkling stress shall be declared for such faces (A.5.5.3).		

8 Marking, labelling and packaging

8.1 Marking and labelling

The following information shall be supplied by the manufacturer with or attached to every pack, or bundle of sandwich panels or supplied with the commercial documentation:

- a) name or registered identification of the manufacturer and address of production plant or identification, where applicable, of his agent within the agency of each country;
- b) number of this ISO Standard;
- c) information on the type of product including product reference/name;
- d) mass of the product in kg/m²;
- e) thickness of the product;
- f) description of the metal faces including grade of metal and coatings where applicable;
- g) description of the core material including material identification, thickness, density etc.;
- h) values of the characteristics in [Table 10](#).

8.2 Packaging, transport, storage and handling

Any instructions regarding transport, storage and handling shall be clearly visible on the package or in the accompanying documentation.

If severe service conditions are expected during transportation, storage or processing, the product shall be supplied with an additional protection of a temporary, strippable film, wax or oil.

The type, thickness, adhesion properties, formability, tear strength and light fastness shall be taken into consideration when choosing protective films. All protective films can be exposed to outdoor weathering for only a limited period without deterioration.

The packaging needs to satisfy national regulation, if any.

Annex A (normative)

Testing procedures for material properties

A.1 Cross panel tensile test

A.1.1 Principle

This test measures the cross panel tensile strength and the E-modulus of the core material.

The characteristic value of the cross panel tensile strength shall be determined in accordance with ISO 29765 and the following subclauses.

A.1.2 Apparatus

The tensile test apparatus shall be in accordance with ISO 29765.

A.1.3 Test specimens

Sampling and conditioning of the test specimens shall comply with [6.2.2](#).

The test shall be performed with the faces of the panel intact (in place) in order to include the tensile bond strength between the faces and the core or to demonstrate adequate bond.

For panels with profiled faces the specimens shall be cut from the predominant thickness (see examples in [Figure A.1](#)).

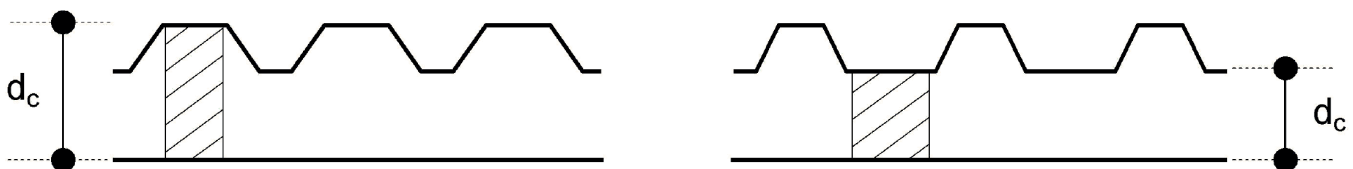


Figure A.1 — Cutting of specimens

Test specimens shall be of square cross-section having side dimensions between 100 mm and 300 mm.

For incompletely bonded panels, the specimens shall be cut from the fully-bonded part of the cross-section (see the right hand example in [Figure A.1](#)).

The dimensions of the specimen shall be measured in accordance with ISO 29465 and ISO 29466. The tolerance on side dimension shall be ± 3 mm.

NOTE 1 Test specimens are very sensitive to the process of cutting and the accuracy of testing in particular for tensile test measurements. Considerable care is required in the cutting process, especially if the core material is relatively weak or has brittle tendencies. The cutting can be carried out with a band saw with a fine toothed blade. It may be advantageous to sandwich the specimen between two pieces of plywood or similar material in order to reduce vibration during the cutting process. It is suggested that specimens should be carefully inspected after cutting. Those that show evidence of delamination caused by the cutting process shall be rejected (up to a maximum of 30 % of those cut for any family of tests).

Where it is not possible to cut a specimen with two plain faces, due to the profile of the faces, the specimen shall be prepared with an appropriately shaped filling piece, which is glued to the profiled face (see examples in [Figure A.2](#)).

NOTE 2 Additional thin layers may be adhered to the faces in order to ensure that the loading platens of the testing machine are parallel at the commencement of the tensile test.

NOTE 3 As an alternative to the use of shaped filling pieces and if the shape of the profiled face is suitable, it may be possible to glue two specimens together in such a way that the profiled faces mate.



Figure A.2 — Examples of specimens with shaped filling pieces

A.1.4 Procedure

The test shall be carried out by loading the specimen continuously or in at least 10 increments using a tensile testing machine. The deflection rate shall have a minimum value of 1 % of d_c per minute and shall not exceed 3 % of d_c per minute. During the test the extension shall be measured with a precision of 0,01 mm.

The test shall be continued until the ultimate load (F_u) is reached ([Figure A.3](#)). If the specimen does not exhibit a clearly defined ultimate load the test shall be discontinued when the relative deformation exceeds 20 %.

The tests shall be performed under normal laboratory conditions of temperature and humidity except when carrying out the test at elevated temperature ([A.1.6](#)).

A.1.5 Calculations and results

A.1.5.1 Cross panel tensile strength (f_{ct})

A load-deflection curve shall be drawn (see [Figure A.3](#)) and the tensile strength shall be calculated as follows.

The tensile strength f_{ct} is given by [Equation \(A.1\)](#):

$$f_{ct} = \frac{F_u}{A} \quad (A.1)$$

where

F_u is the ultimate load;

A is the cross-sectional area of the specimen determined from the measured dimensions.

NOTE 1 For specimens that do not exhibit a well-defined ultimate load, F_u may alternatively be defined as the load at a specified relative deformation. For polyurethane foams, 10 % relative deformation ($0,1 d_c$) may be an appropriate limit. For materials with a more rigid cell structure or of non-cellular structure, a lower value may be used.

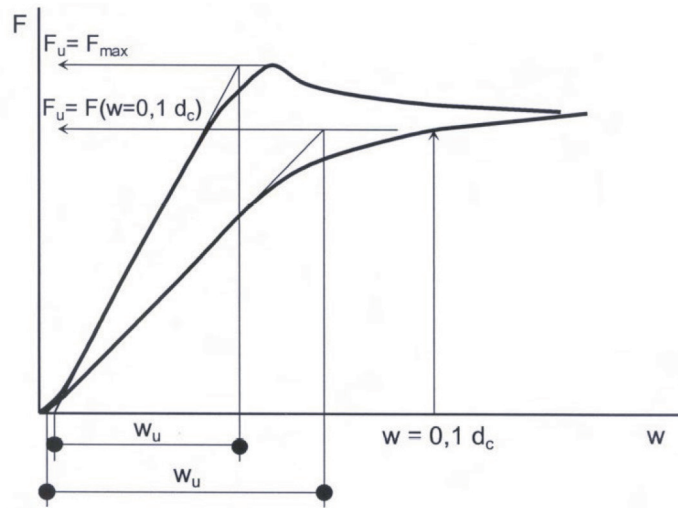


Figure A.3 — Load against deflection curve (F_u against displacement 'w')

Recording and interpretation of test results shall comply with [A.17](#).

The test report shall state the characteristic value ([6.2.2](#)) for tensile strength and shall state the failure mode, i.e. whether failure was in the adhesion layer or in the core.

NOTE 2 Special attention should be given in cases where the failure is close to the adhesion layer to determine the location of the failure.

A.1.5.2 Tensile E-modulus of the core (E_{Ct})

The test report shall also give the characteristic E-modulus for the core material.

The tensile modulus E_{Ct} is given by [Equation \(A.2\)](#):

$$E_{Ct} = \frac{F_u d_c}{w_u A} \quad (A.2)$$

where

F_u is the ultimate load;

d_c is the thickness;

w_u is the ideal displacement at ultimate load based on the linear part of the curve as shown in [Figure A.3](#);

A is the cross-sectional area of the specimen determined from the measured dimensions.

A.1.6 Cross panel tensile modulus at elevated temperature

Where required for design and TT but not for FPC procedures of external panels, the test described in [A.1.1](#) to [A.1.5](#) shall also be carried out on specimens which have been heated for 20 h to 24 h in a heating chamber at a temperature of 80 °C +3/-1 °C. The tensile test shall be carried out immediately, before the specimen has cooled.

NOTE The test may be carried out by heating the specimens together with the load distributing platens to a temperature a little above 80 °C and then carrying out the tensile test before the specimen has cooled below 80 °C (limits 80⁺³₋₁ °C).

The characteristic value for the E-modulus at elevated temperature shall be added to the test report.

A.2 Compressive strength and modulus of the core material

A.2.1 Principle

This test measures the compressive strength and E-modulus in compression of the core material.

The characteristic value of the compressive strength of the core material shall be determined in accordance with ISO 29469 and the following subclauses.

A.2.2 Apparatus

The apparatus shall be in accordance with ISO 29469.

A.2.3 Test specimens

Sampling and conditioning of the test specimens shall comply with [6.2.2](#).

Test specimens shall be prepared as described in [A.1.3](#). If the profile of the face(s) requires the use of filling pieces, then these shall not be glued to the loading platen.

A.2.4 Procedure

The specimen shall be placed between the two parallel stiff loading plates of a compression testing machine.

The deflection rate shall have a minimum value of 1 % of d_c per minute and shall not exceed 3 % of d_c per minute. During the test the displacement shall be measured with a precision of 0,01 mm and a load-deflection curve drawn (see [Figure A.3](#)).

The tests shall be performed under normal laboratory conditions of temperature and humidity.

A.2.5 Calculations and results

A.2.5.1 Compressive strength (f_{Cc})

The compressive strength f_{Cc} of the core material shall be calculated using [Equation \(A.3\)](#):

$$f_{Cc} = \frac{F_u}{A} \quad (A.3)$$

where

F_u is the ultimate load;

A is the cross-sectional area of the specimen determined from the measured dimensions.

NOTE For specimens which do not exhibit a well-defined ultimate load, F_u may alternatively be defined as the load at a specified relative deformation. For polyurethane foams, 10 % relative deformation ($0,1 d_c$) may be an appropriate limit (see [Figure A.3](#)). For materials with a more rigid cell structure or of non-cellular structure, a lower value may be used.

A.2.5.2 Compressive E-modulus of the core (E_{Cc})

The test report shall also give the characteristic E-modulus for the core material.

The compressive modulus E_{Cc} of the core material shall be calculated using [Equation \(A.4\)](#):

$$E_{Cc} = \frac{F_u d_c}{w_u A} \quad (A.4)$$

where

F_u is the ultimate load;

d_c is the thickness;

w_u is the ideal displacement at ultimate load based on the linear part of the curve as shown in [Figure A.3](#);

A the cross-sectional area of the specimen determined from the measured dimensions.

Recording and interpretation of test results shall comply with [A.17](#).

The test report shall state the characteristic value ([6.2.2](#)) for compressive strength and modulus of the core material.

A.3 Shear test on the core material

A.3.1 Principle

This test determines the shear strength and shear modulus of the core material. The ultimate load carried by the specimen failing in shear shall be measured and the shear modulus calculated from the load deflection curve.

A.3.2 Apparatus

The test apparatus is illustrated in [Figure A.4](#).

Steel load spreading plates (p) are required below the load points and over the supports. The thickness of the load spreading plates shall be between 8 mm and 12 mm.

The width L_s of the load spreading plates at the support and load points shall be a minimum of 60 mm. This value shall be increased as necessary, in order to avoid local crushing of the core and to achieve the maximum possible shear stress at failure. The clear distance between the load plate and support plate shall not be less than $1,2 d_c$.