EUROPEAN ASSESSMENT DOCUMENT

EAD 210046-00-1201

February 2018

THIN METAL COMPOSITE SHEET

www.eota.eu

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This European Assessment Document (EAD) has been developed taking into account up-to-date technical and scientific knowledge at the time of issue and is published in accordance with the relevant provisions of Regulation (EU) No 305/2011 as a basis for the preparation and issuing of European Technical Assessments (ETA).

Contents

1 SCOPE OF THE EAD

1.1 Description of the construction product

The EAD applies to the thin metal composite sheet (hereafter TMCS). TMCS consists of two thin layers of a metallic skin, which are sandwiching a core in a continuous co-extrusion process. External face of metallic skin can be pre-coated or not. The joining of metallic skins with core is achieved either by adhesive film or a by binder (chemical and mechanical action). Total thickness of thin metal composite sheet is 2 – 8 mm.

TMCS is composed by:

- Faced skins made of:
    - Aluminium alloy sheets according to EN 485-2 or EN 485-4, surface treated (coil coated according to EN 1396, anodized according to EN ISO 7599) or not, with nominal thickness of external/internal sheet (faced skins) ≥ 0,2 mm (± 8 %).
    - Stainless steel sheets according to EN 10088-1 or EN 10088-2 with nominal symmetric thicknesses of sheet (faced skins) from 0,2 up to 0,4 mm (± 5 %).
- Solid core made mainly of low density polyethylene, other polymer blended with or without flame retardant minerals, minerals with binder etc.
- Adhesive layer of bonding faced skins and core through a continuous industrial process.

The product is not covered by a harmonized European standard (hEN).

The product is not covered by EN 14509, because thermal conductivity of its core is larger than specified one in Cl. 1 of EN 14509 and the product is not intended as self-supporting element.

The product is not fully covered by ETAG 016 used as EAD. The product doesn't comply with definition of self-supporting composite lightweight panel given in ETAG 016-1, Cl. 3.2, and assessment of durability of product complies with EOTA TR 038, which differs from ETAG 016.

The product is not covered by EAD 090062 (ETAG 034 conversion) because in the EAD 090062 other extra assessments are considered for the TMCS taking into account the specific use as part of a cladding kit.

Concerning product packaging, transport, storage, maintenance, replacement and repair it is the responsibility of the manufacturer to undertake the appropriate measures and to advise his clients on the transport, storage, maintenance, replacement and repair of the product as he considers necessary.

It is assumed that the product will be installed according to the manufacturer's instructions or (in absence of such instructions) according to the good practice of the building professionals.

Relevant manufacturer's stipulations having influence on the performance of the product covered by this European Assessment Document are to be considered for the determination of the performance and detailed in the ETA.

1.2 Information on the intended use(s) of the construction product

1.2.1 Intended use(s)

The product (TMCS) is intended to be used for manufacturing of:

- Cladding elements (cassettes/coffering, panels) in external and internal wall cladding kits
- Parts (filling elements) of partition kits
- Filling elements in external or internal supported ceilings
- Rail filling
- Substrate boards for information and orientation systems.

1.2.2 Working life/Durability

The assessment methods included or referred to in this EAD have been written based on the manufacturer's request to take into account a working life of TMCS for the intended use of 25 years when installed in the works, provided that they are subject to appropriate installation. These provisions are based upon the current state of the art and the available knowledge and experience.

When assessing the product, the intended use as foreseen by the manufacturer is to be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works. [1])

The indications given as to the working life of the construction product cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by EOTA when drafting this EAD nor by the Technical Assessment Body issuing an ETA based on this EAD, but are regarded only as a means for expressing the expected economically reasonable working life of the product.

1.3 Specific terms used in this EAD

For the purposes of this document, the terms and definitions given in ISO 6707-1 and EOTA TR 038 apply.

1.3.1 Cassette (coffering)

Spatial element made by (multi)folding of the edges, generally perpendicular to the face of original board, into requested shape and dimensions. Folded edges can be additionally joined together at the corners or not. Folded edges contribute to stiffness of element and its ability to distribute embedded loadings to supporting subframe. Element on its backside can contain attached additional internal reinforcement.

1.3.2 Skin

Covering parts of product made of flat, lightly corrugated or corrugated coating, metal sheet.

1.3.3 Core

Material positioned between two skins. This material can be e.g. plastic or composite material.

1.3.4 Self-supporting composite lightweight panel

A prefabricated, flat or spatial non-loadbearing element of specified dimensions that, by virtue of its material, shape, construction and/or fixing, supports all embedded loadings and transmits them to structural supports.

[1]) The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works is subject, as well as on the particular conditions of the design, execution, use and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than referred to above.

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 1 shows how the performance of thin metal composite sheet is assessed in relation to the essential characteristics.

Table 1: Essential characteristics of the product and methods and criteria for assessing the performance of the product in relation to those essential characteristics

No.	Essential characteristic	Assessment method	Type of expression of product performance
Basic Works Requirement 2: Safety in case of fire			
1	**Reaction to fire**	see 2.2.1	Class
Basic Works Requirement 4: Safety and accessibility in use			
2	**Tensile performance**		
	• Core included: Tensile strength Yield strength Elongation Tensile modulus of elasticity	2.2.2	Level Level Level Level
	• Without core: Tensile strength Yield strength Elongation		Level Level Level
3	**Tensile strength perpendicular to the face**	2.2.3	Level
4	**Flexural performance**		
	• Bending strength in four-point test arrangement • Bending modulus of elasticity in four-point test arrangement • Flexural strength in three-point test arrangement	2.2.4	Level Level
5	**Shear performance**		
	• Shear strength • Shear modulus of elasticity	2.2.5	Level Level
6	**Thickness**		
	• Total thickness of sheet • Thickness of skin	2.2.6	Level
7	**Apparent area density**	2.2.7	Level
8	**Torque peel strength**	2.2.8	Level
9	**Hard body impact resistance**	2.2.9	Level / Description
Basic Works Requirement 5: Protection against noise			
10	**Dynamic stiffness**	2.2.10	Level
Basic Works Requirement 6: Energy economy and heat retention			
11	**Coefficient of thermal conductivity**	2.2.11	Level

No.	Essential characteristic	Assessment method	Type of expression of product performance
Basic Works Requirement 7: Sustainable use of natural resources			
12	**Durability**		
	• Hygrothermal behaviour	2.2.12.1	Level / Description
	• Effect of immersion for 6 h. in boiling water at 90 °C	2.2.12.2	Level / Description
	• Effect of immersion for 500 h. in water at 20 °C	2.2.12.3	Level / Description
	• Effect of freeze-thaw cycles	2.2.12.4	Level / Description
	• Effect of long term exposure to heat (2500 hours at hot dry air 80 °C)	2.2.12.5	Level / Description
	• Creep test	2.2.12.6	Level

2.2 Methods and criteria for assessing the performance of the product in relation to essential characteristics of the product

All tests are to be performed at normal laboratory environment (+23 ± 2) °C and RH (50 ± 10) % (class 2) according to EN ISO 291, Cl. 6, if relevant test procedure does not specify other conditions. Test specimens are to be conditioned in laboratory environment for 24 hours before the test, if test procedure does not specify otherwise.

For the TMCSs with the same thickness of faced skins, which are produced in more than one thickness, the tests shall be performed minimally on samples of maximal and minimal thickness.

For the TMCSs with the same thickness, which are produced in more than one thickness of faced skins, the tests shall be performed minimally on samples of maximal and minimal thickness.

2.2.1 Reaction to fire

The TMCS shall be tested according to the test method(s) referred to in EN 13501-1 and relevant for the corresponding reaction to fire class. The product shall be classified according to the Commission Delegated Regulation (EU) No 2016/364.

The mounting and fixing conditions for the tests are specified in Annex E.

The class of reaction to fire of the product is given in the ETA.

2.2.2 Tensile performance

Tensile performance (tensile strength, yield strength, elongation and modulus of elasticity) of the TMCS are to be determined on two sets consisting of five test specimens at least.

Test is to be performed on one set of test specimens with continuous core and on one set of test specimens with discontinued core.

The shape and dimensions of test specimen of type 1B according to in EN ISO 527-2, Cl. 6.1, Tab. 1 and Fig. 1, with total length l_3 = 200 mm and gauge length L_0 = 50 mm are to be used.

Discontinuation of core is to be performed by drilling of core in prepared test specimens in axis of gauge length in axial plane parallel with surface of specimen by drill bit with nominal diameter of 0,5 mm less than nominal thickness of core of TMCS. Residuum of the core in bored hole is to be removed carefully.

All test specimens are to be conditioned according EN ISO 527-1, Cl. 8, for 16 hours at least and controlled according to EN ISO 16012. Dimensions of cross-section of gauge length are to be recorded. The thickness of the faced skins for set of test specimens with discontinued core by a caliper is to be measured.

Then the test of tensile performance according to EN ISO 527-1, Cl. 9 with test speed 1 mm/min (EN ISO 527-2, Cl. 8) with external deformation measurement (EN ISO 527-1, Cl. 10.2.1) is to be performed.

Separate values of tensile strength σ_t [MPa] and yield strength σ_m [MPa] according to EN ISO 527-1, Cl. 10.1; elongation ε [%] according to EN ISO 527-1, Cl. 10.2.1 and modulus of elasticity E_t [GPa] according to EN ISO 527-1, Cl. 10.3.2 are to be calculated.

Tensile strength and yield strength of set of test specimens with discontinued core are to be evaluated from total thickness of faced skins only.

Tensile modulus of elasticity is to be tested and evaluated only for set of test specimens with core.

Following characteristics with regard to provisions of EN ISO 527-1, Cl. 10.5 and 10.6 are to be calculated separately for case with core (index “cplx” - ComPLeX) and without core (index “sans”):

- Average values and estimation of standard deviation σ_n of tensile strength $\sigma_{t,av}$ [MPa], yield strength $\sigma_{m,av}$ [MPa], elongation ε_{av} [%] and tensile modulus of elasticity $E_{t,av}$ [GPa];
- Characteristic value of tensile strength $\sigma_{t,k}$ and yield strength $\sigma_{m,k}$, given in [MPa] as 95 % quartile on confidence level 75 % for V_x as unknown according to EN 1990, Annex D, Cl. 7.2;
- One-sided bottom confidence level at the confidence level 95 % according to ISO 2602, Cl. 6.2 for tensile modulus of elasticity $E_{t,0,95}$ [GPa] for case with core only;
- Two-sided confidence interval at the confidence level 95 % according to ISO 2602, Cl. 6.2 for elongation $\varepsilon_{0,975}$ [%].

Following characteristics are given separately for product with and without core in table in the ETA:

- Average value of tensile strength $\sigma_{t,av}$ [MPa], estimation of standard deviation σ_n, characteristic value $\sigma_{t,k}$ [MPa];
- Average value of yield strength $\sigma_{m,av}$ [MPa], estimation of standard deviation σ_n, characteristic value $\sigma_{m,k}$ [MPa];
- Average value of elongation ε_{av} [%]:, estimation of standard deviation σ_n [%], two-sided confidence interval $\varepsilon_{0,975}$ [%];
- Only for test with core: average value of tensile modulus of elasticity $E_{t,av}$ [GPa], estimation of standard deviation σ_n [GPa], one-sided bottom confidence level $E_{t,0,95}$ [GPa].

2.2.3 Tensile strength perpendicular to face

Tensile strength perpendicular to face is to be determined on five test specimens at least by testing in accordance with the test method given in Annex A. The dimensions of test specimen and test procedure are given in Annex A.

Following characteristics of tensile strength perpendicular to face with regard to provisions of EN ISO 527-1, Cl. 10.5 and 10.6 are to be calculated:

- Average value $\sigma_{mt,av}$ and estimation of standard deviation σ_n
- Characteristic value of tensile strength perpendicular to face $\sigma_{mt,k}$, given as 95 % quartile on confidence level 75 % for V_x as unknown according to EN 1990, Annex D, Cl. 7.2

Following characteristics are given separately in table in the ETA:

- Average value of tensile strength perpendicular to face $\sigma_{mt,av}$ [MPa], estimation of standard deviation σ_n [MPa], characteristic value $\sigma_{mt,k}$ [MPa].

2.2.4 Flexural performance

2.2.4.1 Bending performance in four-point test arrangement

Bending strength in four-point test arrangement and bending modulus of elasticity in four-point test arrangement, both in initial state, are to be determined by testing of six test specimens of dimensions

400 x 100 mm [±0,5 mm], which shall be cut from TMCS by water jet cutting machine in total number of 36 pieces (6 for test in initial state and per 6 for each test after conditioning according to 2.2.12).

The bending strength in four-point test arrangement of the TMCS in initial state is to be tested in normal laboratory conditions 23/50 with schema of load distribution given on Fig. 1.

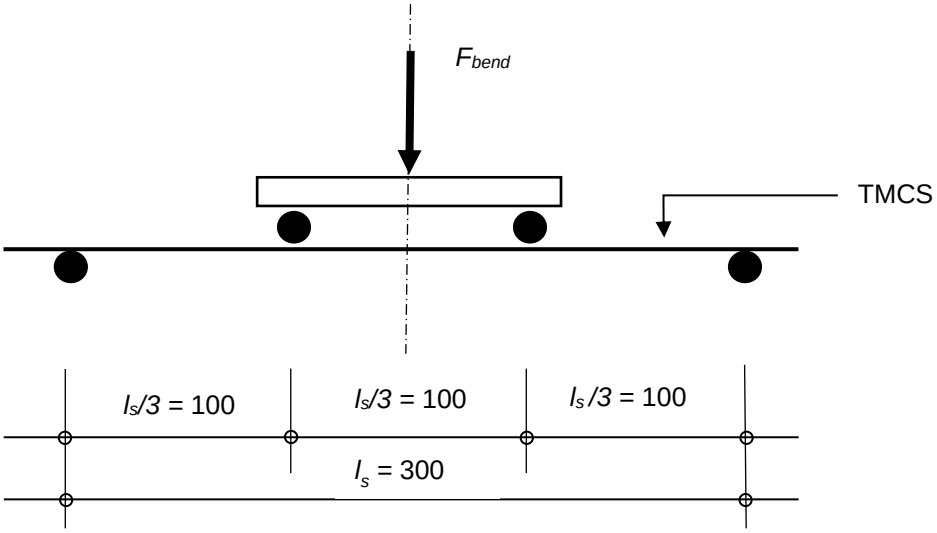

Fig. 1: Schema of load distribution of bending performance in four-point test arrangement

Test specimen is to be placed on support with two cylindrical braces of diameter 20 mm attached to in span of 300 mm. The test device, consisting of two cylindrical braces of diameter 20 mm attached to rail in distance of 100 mm, distributing test load from test machine into test specimen, shall be fixed to traverse of test machine to avoid additional load.

Bending test is to be performed on universal test machine of class 0.5 with application of load at uniform speed of 5 mm/min. Deflection has to be measured in the middle of span by appropriate measurement device with accuracy 0.01 mm in minimum. Test is stopped when breakage or irreversible deflection of test specimen occur.

Single values of test load at failure in four-point test arrangement in initial state $F_{bend,INI}$ [kN] and working diagram F_{bend} / f_m (i.e. load / deformation in the middle of span) shall be recorded.

The bending strength in four-point test arrangement in initial state $R_{bend,INI}$ [MPa] is to be calculated for each test specimen according to equation:

$$R_{bend,INI} = \frac{F_{bend,INI} \times l_s}{b \times t^2}$$

where
- $F_{bend,INI}$ is the breaking load in four-point test arrangement in initial state, in N;
- l_s is the span between the axis of support, in mm;
- b is the width of the test specimen, in mm;
- t is the total thickness of TMCS, in mm.

The average value $R_{bend,INI,av}$ and estimation of standard deviation σ_n of bending strength at failure in four-point test arrangement are to be calculated.

The bending modulus of elasticity in four-point test arrangement E_{bend} is to be calculated and expressed in [GPa] for each tested specimen according to following equation:

$$E_{bend} = 0{,}213 \times \frac{{l_s}^3}{b \times t^3} \times \frac{(F_2 - F_1)}{(f_2 - f_1)}$$

where F_2 and F_1 are loads, taken from two points within the linear section of the plot, below the limit of proportionality (10 % - 40 % of F_{max}), in kN;

l_s is the span between the axes of supports, in mm;

b is the width of the test specimen, in mm;

t is the total thickness of the test specimen, in mm;

f_1 and f_2 are deflections corresponding to the selected loads F_1 and F_2, in mm, taken from working diagram.

If front and rear sheet facing of TMCS differs, test of bending strength in four-point arrangement is to be performed and evaluated for each facing separately.

Average value $E_{bend,av}$ and estimation of standard deviation σ_n of bending modulus of elasticity in four-point test arrangement are to be calculated.

Following characteristics with regard to provisions of EN ISO 527-1, Cl. 10.5 and 10.6 are to be calculated:

- Characteristic value of bending strength in four-point test arrangement $R_{bend,INI,k}$ given as 95 % quartile on confidence level 75 % for V_x as unknown according to EN 1990, Annex D, Cl. 7.2
- One-sided bottom confidence level at the confidence level 95 % according to ISO 2602, Cl. 6.2 for bending modulus of elasticity in four-point test arrangement $E_{bend,0.95}$.

Following characteristics are given separately for product in table in the ETA:

- Average value of bending strength in four-point test arrangement $R_{bend,INI,av}$ [MPa]:, estimation of standard deviation σ_n [MPa], characteristic value $R_{bend,INI,k}$ [MPa]:,
- Average value of bending modulus of elasticity in four-point test arrangement $E_{bend,av}$ [GPa], estimation of standard deviation σ_n [GPa], one-sided bottom confidence level $E_{bend,0.95}$ [GPa].

2.2.4.2 Flexural strength in three-point test arrangement

Flexural strength in three-point test arrangement in initial state is to be determined on six test specimens by testing in accordance with the test method given in EN 12467. The test specimens of dimensions 300 × 50 mm shall be cut from TMCS by water jet cutting machine.

The flexural strength in three-point test arrangement in initial state is to be tested according to EN 12467, Cl. 7.3.2.3, in normal laboratory conditions 23/50.

Single values of test load in at failure three-point test arrangement $F_{flex,INI}$ [kN] shall be recorded.

The flexural strength in three-point test arrangement in initial state $R_{flex,INI}$ [MPa] is to be calculated for each test specimen according to equation:

$$R_{flex,INI} = \frac{3 \times F_{flex,INI} \times l_s}{2 \times b \times t^2}$$

where $F_{flex,INI}$ is the breaking load in three-point test arrangement, in N;

l_s is the span between the axis of support, in mm;

b is the width of the test specimen, in mm;

t is the total thickness of the test specimen, in mm.

Average value $R_{flex,INI,av}$ and estimation of standard deviation σ_n of flexural strength in three-point test arrangement are to be calculated.

If front and rear sheet facing of TMCS differs, test of flexural strength in three-point arrangement is to be performed and evaluated for each facing separately.

Following characteristic with regard to provisions of EN ISO 527-1, Cl. 10.5 and 10.6 is to be calculated:

- Characteristic value of flexural strength in three-point test arrangement $R_{flex,k}$, given as 95 % quartile on confidence level 75 % for V_x as unknown according to EN 1990, Annex D, Cl. 7.2

Following characteristics are given for product in the ETA:

- Average value of flexural strength in three-point test arrangement $R_{flex,INI,av}$ [MPa], estimation of standard deviation σ_n [MPa], characteristic value $R_{flex,k}$ [MPa].

2.2.5 Shear performance

The shear strength and shear modulus of elasticity of the TMCS are to be determined on five test specimens at least by testing in accordance with the test method given in Annex B.

Following characteristics with regard to provisions of EN ISO 527-1, Cl. 10.5 and 10.6 are to be calculated:

- Average values and estimation of standard deviation σ_n of shear strength $\sigma_{s,av}$ and shear modulus of elasticity G_{av}
- Characteristic value of shear strength $\sigma_{s,k}$, given as 95 % quartile on confidence level 75 % for V_x as unknown according to EN 1990, Annex D, Cl. 7.2
- One-sided bottom confidence level at the confidence level 95 % according to ISO 2602, Cl. 6.2 for shear modulus of elasticity $G_{0.95}$.

Following characteristics are given separately in table in the ETA:

- Average value of shear strength $\sigma_{s,av}$ [MPa]:, estimation of standard deviation σ_n [MPa], characteristic value $\sigma_{s,k}$ [MPa]:,
- Average value of shear modulus of elasticity G_{av} [MPa]:, estimation of standard deviation σ_n [MPa], one-sided bottom confidence level $G_{0.95}$ [MPa].

2.2.6 Thickness

2.2.6.1 Total thickness of sheet

The total thickness of given type of the TMCS is to be determined by test using method A according to ISO 23529, Cl. 9.1, on five test specimens at least. Three measurements at least on each test specimen shall be performed.

The median (ISO 3534-1, Cl. 1.13) and estimation of standard deviation σ_n of all measurements on all test specimens shall be evaluated. The two-sided confidence interval of thickness at the confidence level 95 % according to ISO 2602, Cl. 6.2 shall be calculated with accuracy 0,1 mm.

The median and two-sided confidence interval of thickness $d_{0,975}$ [mm] are given in the ETA.

2.2.6.2 Thickness of skin

The thickness of both skins (top and bottom) of given type of the TMCS is to be determined by test according to EN 485-1, Cl. 6.7, on five test specimens of each skin at least. Three measurements at least on each test specimen shall be performed.

Test specimens after test of torque peel strength can be used. Inner side of skin in tested area shall be smoothed carefully before test by abrasive paper of grain 200 or smoother to remove remains of core and adhesive.

The median (ISO 3534-1, Cl. 1.13) and estimation of standard deviation σ_n of all measurements on all test specimens of given skin shall be evaluated and calculated with accuracy 0,01 mm for each skin separately.

The median of thickness $d_{0,975}$ [mm] for each skin separately is given in the ETA.

2.2.7 Apparent area density

The apparent area density for given thickness of TMCS is to be determined by test according to EN 1602 on five test specimens at least. Instead of volume V, only area A [m^2] of test specimen in equation according to EN 1602, Cl. 8, is to be used.

The average value and estimation of standard deviation σ_n of all test results shall be calculated. The two-sided confidence interval of apparent area density at the confidence level 95 % according to ISO 2602, Cl. 6.2 shall be calculated with accuracy in three valid digits.

The two-sided confidence interval of apparent area density $g_{0,975}$ [kg/m^2] is given in the ETA.

2.2.8 Torque peel strength

The torque peel strength of the TMCS in initial state is to be determined on six test specimens by testing in accordance with the method given in ASTM D 1781-98. The test specimens of dimensions given in EOTA TR 038, Cl. 4.1.1, shall be cut from TMCS by water jet cutting machine.

The torque peel strength of the TMCS in initial state is to be tested according to ASTM D 1781-98 in normal laboratory conditions 23/50.

Single values of torque peel strength in initial state T_{INI} [N.m/m] shall be calculated.

The average value $T_{INI,av}$ [N.m/m], estimation of standard deviation σ_n [N.m/m] and two-sided confidence interval of torque peel strength in initial state $T_{INI,0,975}$ [N.m/m], are to be calculated and given in the ETA.

2.2.9 Hard body impact resistance

The test of resistance to hard body impact for given thickness of the TMCS is to be performed according to ISO 7892 with amendments and modifications as described in Annex C on two sets consisting at least from three test specimens for given nominal thickness. The test is to be performed on one set conditioned for 24 hour at normal conditions 23/55 and on one set conditioned for 24 hours at -20 °C.

Hard body impact is to be applied to the exposed (outer) surface of the TMCS. The dimensions of test specimens are given in Annex C.

The hard body impact resistance is tested for impact energy 1; 3; 5 and 10 N*m. Before start of test manufacturer can select one or more levels from this range of impact energy for performing of test. If he doesn't, all impact energies are to be tested.

The hard body impact resistance is expressed as impact energy E [N*m], which caused no damage (no collapse, no penetration, no projection and no degradation) of any of 3 test specimens.

Hard body impact energy E [N*m] that caused no damage on the TMCS is given for given nominal thickness in the ETA.

2.2.10 Dynamic stiffness

The dynamic stiffness for given thickness of TMCS is to be performed on test specimens by testing in accordance with the test method given in EN 29052-1 (eq. ISO 9052-1). The dimensions and number of test specimens are given in EN 29052-1, Cl. 6 (eq. ISO 9052-1).

The dynamic stiffness s' [MPa/m] of TMCS is given in the ETA.

2.2.11 Coefficient of thermal conductivity

The coefficient of thermal conductivity for given thickness of TMCS is to be determined on two test specimens by testing in accordance with the test method given in EN 12664. The dimensions and number of test specimens are given in EN 12664, Cl. 6.

The coefficient of thermal conductivity λ [W/(m·K)] of TMCS is given in the ETA.

2.2.12 Durability

The durability of TMCS is to be determined for given thickness of TMCS by following tests:

- Hygrothermal behaviour
- Effect of immersion for 6 hours in boiling water at 90 °C
- Effect of immersion for 500 hours in water at 20 °C
- Effect of freeze-thaw cycles
- Effect of long term exposure to heat (2500 hours at hot dry air 80 °C)
- Creep test.

2.2.12.1 Hygrothermal behaviour

The hygrothermal behaviour of the TMCS is to be determined by tests of test specimens conditioned according to EOTA TR 038, Cl. 5.1, of:

- torque peel strength according to 2.2.12.1.1
- bending strength in four-point test arrangement according to 2.2.12.1.1.

Following defects shall be noted and recorded before, during and after the all tests:

- Delamination of individual layers of TMCS,
- Deterioration or cracking or breakage on TMCS.

The following characteristics related to hygrothermal behaviour on the TMCS are given in the ETA:

- Average value of torque peel strength after hygrothermal cycles $T_{h,av}$ [N.m/m] and of bending strength in four-point test arrangement after hygrothermal cycles $R_{h,av}$ [MPa]
- Relative change of torque peel strength after hygrothermal cycles ΔT_h [%] and relative change of bending strength in four-point test arrangement after hygrothermal cycles ΔR_h [%]
- Description of defects of test specimen, if occur during test of hygrothermal behaviour, or statement “Without defects“.

2.2.12.1.1 Torque peel strength

The test is to be performed on six conditioned test specimens by testing in accordance with 2.2.8. After hygrothermal cycles the test of torque peel strength (see 2.2.8) is to be performed and evaluated and average value of torque peel strength after hygrothermal cycles $T_{h,av}$ [N.m/m] calculated.

The relative change of torque peel strength after hygrothermal cycles, given in % in integer, is to be calculated according to equation:

$$\Delta_{T_h} = \frac{T_{h,av}}{T_{INI,av}} \times 100$$

2.2.12.1.2 Bending strength in four-point test arrangement

The test is to be performed on six conditioned test specimens by testing in accordance with 2.2.4.1. After hygrothermal cycles the test of bending strength in four-point test arrangement (see 2.2.4.1) is to be performed and evaluated and average value of bending strength in four-point test arrangement after hygrothermal cycles $R_{h,av}$ [MPa] calculated.

The relative change of bending strength in four-point test arrangement after hygrothermal cycles, given in % in integer, is to be calculated according to equation:

$$\Delta_{R_h} = \frac{R_{h,av}}{R_{bend,INI,av}} \times 100$$

2.2.12.2 Effect of immersion for 6 hours in boiling water at 90 °C

The effect of immersion for 6 hours in boiling water at 90 °C on the TMCS is to be determined by tests of test specimens conditioned according to EOTA TR 038, Cl. 5.2, of:

- torque peel strength according to 2.2.12.2.1
- bending strength in four-point test arrangement according to 2.2.12.2.2.

Following defects shall be noted and recorded before, during and after the all tests:

- Delamination of individual layers of TMCS,
- Deterioration or cracking or breakage on TMCS.

The following characteristics related to immersion for 6 hours in boiling water at 90 °C on the TMCS are given in the ETA:

- Average value of torque peel strength after immersion for 6 hours in boiling water at 90 °C $T_{i,6h,90°C,av}$ [N.m/m] and of bending strength in four-point test arrangement after immersion for 6 hours in boiling water at 90 °C $R_{i,6h,90°C,av}$ [MPa]
- Relative change of torque peel strength after immersion for 6 hours in boiling water at 90 °C $\Delta T_{i,6h,90°C}$ [%] and relative change of bending strength in four-point test arrangement after immersion for 6 hours in boiling water at 90 °C $\Delta R_{i,6h,90°C}$ [%]
- Description of defects of test specimen, if occur during test of effect of immersion for 6 hours in boiling water at 90 °C, or statement “Without defects“.

2.2.12.2.1 Torque peel strength

The test is to be performed on six conditioned test specimens by testing in accordance with 2.2.8. After immersion of test specimens for 6 hours in boiling water at 90 °C the test of torque peel strength (see 2.2.8) is to be performed and evaluated and average value of torque peel strength after immersion for 6 hours in boiling water at 90 °C $T_{i,6h,90°C,av}$ [N.m/m] calculated.

The relative change of torque peel strength after immersion for 6 hours in boiling water at 90 °C, given in % in integer, is to be calculated according to equation:

$$\Delta_{T_{i,6h,90\,℃}} = \frac{T_{i,6h,90\,℃,av}}{T_{INI,av}} \times 100$$

2.2.12.2.2 Bending strength in four-point test arrangement

The test is to be performed on six conditioned test specimens by testing in accordance with 2.2.4.1. After immersion for 6 hours in boiling water at 90 °C the test of bending strength in four-point test arrangement (see 2.2.4.1) is to be performed and evaluated and average value of bending strength in four-point test arrangement after immersion for 6 hours in boiling water at 90 °C $R_{i,6h,90°C,av}$ [MPa] calculated.

The relative change of bending strength in four-point test arrangement after immersion for 6 hours in boiling water at 90 °C, given in % in integer, is to be calculated according to equation:

$$\Delta_{R_{i,6h,90°C}} = \frac{R_{i,6h,90°C,av}}{R_{bend,INI,av}} \times 100$$

2.2.12.3 Effect of immersion for 500 hours in water at 20 °C

The effect of immersion for 500 hours in water at 20 °C on the TMCS is to be determined by tests of test specimens conditioned according to EOTA TR 038, Cl. 5.3, of:

- torque peel strength according to 2.2.12.3.1
- bending strength in four-point test arrangement according to 2.2.12.3.1.

Following defects shall be noted and recorded before, during and after the all tests:

- Delamination of individual layers of TMCS,
- Deterioration or cracking or breakage on TMCS.

The following characteristics related to immersion for 500 hours in water at 20 °C of the TMCS are given in the ETA:

- Average value of torque peel strength after immersion for 500 hours in water at 20 °C $T_{i,500h,20°C,av}$ [N.m/m] and of bending strength in four-point test arrangement after immersion for 6 hours in boiling water at 90 °C $R_{i,500h,20°C,av}$ [MPa]
- Relative change of torque peel strength after immersion for 500 hours in water at 20 °C $\Delta T_{i,500h,20°C}$ [%] and relative change of bending strength in four-point test arrangement after immersion for 6 hours in boiling water at 90 °C $\Delta R_{i,500h,20°C}$ [%]
- Description of defects of test specimen, if occur during test of effect of immersion for 500 hours in water at 20 °C, or statement “Without defects“.

2.2.12.3.1 Torque peel strength

The test is to be performed on six conditioned test specimens by testing in accordance with 2.2.8. After immersion of test specimens for 500 hours in water at 20 °C the test of torque peel strength (see 2.2.8) is to be performed and evaluated and average value of torque peel strength after immersion for 500 hours in water at 20 °C $T_{i,500h,20°C,av}$ [N.m/m] calculated.

The relative change of torque peel strength after immersion for 500 hours in water at 20 °C, given in % in integer, is to be calculated according to equation:

$$\Delta_{T_{i,500h,20\,℃}} = \frac{T_{i,500h,20\,℃,av}}{T_{INI,av}} \times 100$$

2.2.12.3.2 Bending strength in four-point test arrangement

The test is to be performed on six conditioned test specimens by testing in accordance with 2.2.4.1. After immersion for 500 hours in water at 20 °C the test of bending strength in four-point test arrangement (see 2.2.4.1) is to be performed and evaluated and average value of bending strength in four-point test arrangement after immersion for 500 hours in water at 20 °C $R_{i,500h,20°C,av}$ [MPa] calculated.

The relative change of bending strength in four-point test arrangement after immersion for 500 hours in water at 20 °C, given in % in integer, is to be calculated according to equation:

$$\Delta_{R_{i,500h,20°C}} = \frac{R_{i,500h,20°C,av}}{R_{bend,INI,av}} \times 100$$

2.2.12.4 Effect of freeze – thaw cycles

The effect of freeze – thaw cycles on the TMCS is to be determined by tests of tests specimens conditioned according to EOTA TR 038, Cl. 5.4, of.

- torque peel strength according to 2.2.12.4.1
- bending strength in four-point test arrangement according to 2.2.12.4.1.

Following defects shall be noted and recorded before, during and after the all tests:

- Delamination of individual layers of TMCS,
- Deterioration or cracking or breakage on TMCS.

The following characteristics related to effect of freeze - thaw cycles on the TMCS are given in the ETA:

- Average value of torque peel strength after 50 freeze – thaw cycles $T_{f/t,av}$ [N.m/m] and of bending strength in four-point test arrangement after 50 freeze – thaw cycles $R_{f/t,av}$ [MPa]
- Relative change of torque peel strength after 50 freeze – thaw cycles $\Delta T_{f/t}$ [%] and relative change of bending strength in four-point test arrangement after 50 freeze – thaw cycles $\Delta R_{f/t}$ [%]
- Description of defects of test specimen, if occur during test of effect of freeze – thaw cycles, or statement “Without defects“.

2.2.12.4.1 Torque peel strength

The test is to be performed on six conditioned test specimens by testing in accordance with 2.2.8. After cycling of test specimens for 50 cycles according to EOTA TR 038, Cl. 5.4.2, the test of torque peel strength (see 2.2.8) is to be performed and evaluated and average value of torque peel strength after freeze – thaw cycles $T_{f/t,av}$ [N.m/m] calculated.

The relative change of torque peel strength after 50 freeze – thaw cycles, given in % in integer, is to be calculated according to equation:

$$\Delta_{T_{f/t}} = \frac{T_{\frac{f}{t},av}}{T_{INI,av}} \times 100$$

2.2.12.4.2 Bending strength in four-point test arrangement

The test is to be performed on six conditioned test specimens by testing in accordance with 2.2.4.1. After 50 freeze – thaw cycles the test of bending strength in four-point test arrangement (see 2.2.4.1) is to be performed and evaluated and average value of bending strength in four-point test arrangement after freeze – thaw cycles $R_{f/t,av}$ [MPa] calculated.

The relative change of bending strength in four-point test arrangement after 50 freeze – thaw cycles, given in % in integer, is to be calculated according to equation:

$$\Delta_{R_{f/t}} = \frac{R_{\frac{f}{t},av}}{R_{bend,INI,av}} \times 100$$

2.2.12.5 Effect of long term exposure to heat (2500 hours at hot dry air 80 °C)

The effect of long term exposure to heat (2500 hours at hot dry air 80 °C) on the TMCS is to be determined by tests of test specimens conditioned according to EOTA TR 038, Cl. 5.5, of:

- torque peel strength according to 2.2.12.5.1
- bending strength in four-point test arrangement according to 2.2.12.5.1.

Following defects shall be noted and recorded before, during and after the all tests:

- Delamination of individual layers of TMCS,
- Deterioration or cracking or breakage on TMCS.

The following characteristics related to effect of long term exposure to heat (2500 hours at hot dry air 80 °C) on the TMCS are given in the ETA:

- Average value of torque peel strength after exposure to heat for 2500 hours at hot dry air 80 °C $T_{lt,80°C,av}$ [N.m/m] and of bending strength in four-point test arrangement after exposure to heat for 2500 hours at hot dry air 80 °C $R_{lt,80°C,av}$ [MPa]
- Relative change of torque peel strength after exposure to heat for 2500 hours at hot dry air 80 °C $\Delta T_{lt,80°C}$ [%] and relative change of bending strength in four-point test arrangement after exposure to heat for 2500 hours at hot dry air 80 °C $\Delta R_{lt,80°C}$ [%]
- Description of defects of test specimen, if occur during test of effect of freeze – thaw cycles, or statement “Without defects“.

2.2.12.5.1 Torque peel strength

The test is to be performed on six conditioned test specimens by testing in accordance with 2.2.8. After ageing of test specimens for 2500 hours at hot dry air 80 °C according to EOTA TR 038, Cl. 5.5.2, the test of torque peel strength (see 2.2.8) is to be performed and evaluated and average value of torque peel strength after exposure to heat for 2500 hours at hot dry air 80 °C $T_{lt,80°C,av}$ [N.m/m] calculated.

The relative change of torque peel strength after exposure to heat for 2500 hours at hot dry air 80 °C, given in % in integer, is to be calculated according to equation:

$$\Delta_{T_{lt,80\,℃}} = \frac{T_{lt,80\,℃,av}}{T_{INI,av}} \times 100$$

2.2.12.5.2 Bending strength in four-point test arrangement

The test is to be performed on six conditioned test specimens by testing in accordance with 2.2.4.1. After ageing of test specimens for 2500 hours at hot dry air 80 °C the test of bending strength in four-point test arrangement (see 2.2.4.1) is to be performed and evaluated and average value of bending strength in four-point test arrangement after ageing for 2500 hours at hot dry air 80 °C $R_{lt,80\,℃,av}$ [MPa] calculated.

The relative change of bending strength in four-point test arrangement after ageing for 2500 hours at hot dry air 80 °C, given in % in integer, is to be calculated according to equation:

$$\Delta_{R_{lt,80\,℃}} = \frac{R_{lt,80\,℃,av}}{R_{bend,INI,av}} \times 100$$

2.2.12.6 Creep test

The creep behaviour of the TMCS is to be determined on three test specimens for given thickness of TMCS by test procedure according to Annex D.

The single values of creep coefficient φ_t [-] of each test specimen for each tested thickness of TMCS are given in the ETA.

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

3.1 System(s) of assessment and verification of constancy of performance to be applied

For the products covered by this EAD with regard to intended use as internal and external wall and ceiling finishes the applicable European legal act is Decision 1998/437/EC.

The system is: **3**

In addition, with regard to reaction to fire for products covered by this EAD the applicable European legal act is Decision 1998/437/EC.

The systems are: **1, 3, 4**

For the products covered by this EAD with regard to their intended use for manufacturing of elements for kits for exterior wall claddings the applicable European legal act is Decision 2003/640/EC.

The system is: **2+**

In addition, with regard to reaction to fire for products covered by this EAD the applicable European legal act is Decision 2003/640/EC.

The systems are: **1, 3, 4**

3.2 Tasks of the manufacturer

The cornerstones of the actions to be undertaken by the manufacturer of the product in the procedure of assessment and verification of constancy of performance are laid down in Table 2.

Table 2 Control plan for the manufacturer; cornerstones

No	Subject/type of control *(product, raw/constituent material, component - indicating characteristic concerned)*	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Factory production control (FPC) [including testing of samples taken at the factory in accordance with a prescribed test plan]					
1	Reaction to fire	2.2.1	Control plan	1	at modification of product process or material used
2	Tensile performances				

	• Core included:
	  • Tensile strength
	  • Yield strength
	  • Elongation
	  • Modulus of elasticity
		2.2.2.	Control plan	5	1 per year

	• Without core:
	  • Tensile strength
	  • Yield strength
	  • Elongation				

3	Tensile strength perpendicular to the face	2.2.3	Control plan	5	1 per year

No	Subject/type of control *(product, raw/constituent material, component - indicating characteristic concerned)*	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
4	Flexural performance • Bending strength in four-point test arrangement • Bending modulus of elasticity in four-point test arrangement • Flexural strength in three-point test arrangement	2.2.4	Control plan	5	at modification of product or material used
5	Shear performance • Shear strength • Modulus of elasticity	2.2.5	Control plan	5	at modification of product or material used
6	Thickness • Total thickness of sheet • Thickness of skin	2.2.6	Control plan	5	1 per day
7	Apparent area density	2.2.7	Control plan	5	1 per week
8	Torque peel test	2.2.8	Control plan	6	1 per year
9	Hard body impact resistance	2.2.9	Control plan	3	at modification of product process or material used
10	Dynamic stiffness	2.2.10	Control plan	3	at modification of product process or material used
12	Coefficient of thermal conductivity	2.2.11	Control plan	1	at modification of product process or material used
13	Durability				
	• Hygrothermal behaviour	2.2.12.1	Control plan	6	at modification of product process or material used
	• Effect of immersion for 6 hours in boiling water at 90 °C	2.2.12.2		6	
	• Effect of immersion for 500 hours in water at 20 °C	2.2.12.3		6	
	• Effect of freeze-thaw cycles	2.2.12.4		6	
	• Effect of long term exposure to heat (2500 hours at hot dry air 80 °C)	2.2.12.5		6	
	• Creep test	2.2.12.6		1	

3.3 Tasks of the notified body

The cornerstones of the actions to be undertaken by the notified body in the procedure of assessment and verification of constancy of performance for product for system 1 and/or 2+ are laid down in Table 3.

The involvement of a notified product certification body is required only under the conditions defined in Decision 1998/437/EC and Decision 2003/640/EC, in case of reaction to fire classes A1, A2, B and C of the product for which a clearly identifiable stage in the production process results in an improvement of the reaction to fire classification (e.g. a limiting of organic material and/or the addition of fire retardant).

Table 3 Control plan for the notified body; cornerstones

No	Subject/type of control *(product, raw/constituent material, component - indicating characteristic concerned)*	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Initial inspection of the manufacturing plant and of factory production control *(for systems 1 and 2+ only)*					
1	(for system 1 only) Control of the manufacturing plant and of the factory production carried out by the manufacturer regarding the constancy of performance related to reaction to fire and taking into account a limiting of organic material and/or the addition of fire retardant.	As defined in clause 2.2.1 of the EAD	Shall be stated in the Control plan		When starting the production
2	(for system 2+ only) Control of the manufacturing plant and of the factory production carried out by the manufacturer regarding the constancy of performance related to essential characteristics under the Basic Works Requirements 4, 5, 6, and 7, taking into account the use for manufacturing of elements for kits for exterior wall claddings.	As defined in clauses 2.2.2 to 2.2.12 of the EAD	Shall be stated in the Control plan		When starting the production
Continuous surveillance, assessment and evaluation of factory production control *(for systems 1 and 2+ only)*					
3	(for system 1 only) Continuous surveillance, assessment and evaluation of the factory production carried out by the manufacturer regarding the constancy of performance related to reaction to fire and taking into account a limiting of organic material and/or the addition of fire retardant.	As defined in clause 2.2.1 of the EAD	Shall be stated in the Control plan		1 per year
4	(for system 2+ only) Continuous surveillance, assessment and evaluation of the factory production carried out by the manufacturer regarding the constancy of performance related to essential characteristics under the Basic Works Requirements 4, 5, 6, and 7, taking into account the use for manufacturing of elements for kits for exterior wall claddings.	As defined in clauses 2.2.2 to 2.2.12 of the EAD	Shall be stated in the Control plan		1 per year

4 REFERENCE DOCUMENTS

As far as no edition date is given in the list of standards thereafter, the standard in its current version at the time of issuing the European Technical Assessment, is of relevance.

EN 485-1 Aluminium and aluminium alloys – Sheet, strip and plate – Part 1: Technical conditions for inspection and delivery

EN 485-2 Aluminium and aluminium alloys - Sheet, strip and plate - Part 2: Mechanical properties

EN 485-4 Aluminium and aluminium alloys. Sheet, strip and plate. Part 4: Tolerances on shape and dimensions for cold-rolled products

EN 1396 Aluminium and aluminium alloys - Coil coated sheet and strip for general applications – Specifications

EN 1602 Thermal insulating products for building applications - Determination of the apparent density

EN 1990 Eurocode: Basis of structural design

EN 10088-1 Stainless steels - Part 1: List of stainless steels

EN 10088-2 Stainless steels - Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes

EN 12664 Thermal performance of building materials and products - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Dry and moist products of medium and low thermal resistance

EN 13238 Reaction to fire tests for building products - Conditioning procedures and general rules for selection of substrates

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

EN 13823 Reaction to fire tests for building products - Building products excluding floorings exposed to the thermal attack by a single burning item

EN 14509 Self-supporting double skin metal faced insulating panels - Factory made products – Specifications

EN 29052-1 Acoustic – Determination of dynamic stiffness – Part 1: material used under floating floors in dwellings

EN ISO 291 Plastics – Standard atmospheres for conditioning and testing

EN ISO 527-1 Plastics – Determination of tensile properties – Part 1: General principles

EN ISO 527-2 Plastics – Determination of tensile properties – Part 2: Test conditions for moulding and extrusion plastics

EN ISO 1182 Reaction to fire tests for products - Non-combustibility test

EN ISO 1716 Reaction to fire tests for products - Determination of the cross heat of combustion (calorific value)

EN ISO 6892-1 Metallic materials - Tensile testing - Part 1: Method of test at room temperature

EN ISO 7599 Anodizing of aluminium and its alloys - General specifications for anodic oxidation coatings on aluminium

EN ISO 11925-2 Reaction to fire tests - Ignitability of building products subjected to direct impingement of flame - Part 2: Single-flame source test

EN ISO 16012 Plastics - Determination of linear dimensions of test specimens

ISO 2602 Statistical interpretation of test results. Estimation of the mean. Confidence interval

ISO 3534-1 Statistics - Vocabulary and symbols - Part 1: General statistical terms and terms used in probability

ISO 6707-1 Buildings and civil engineering works – Vocabulary – Part 1: General terms

ISO 7892 Vertical building elements -- Impact resistance tests -- Impact bodies and general test procedures

ISO 9052-1 Acoustics - Determination of dynamic stiffness - Part 1: Materials used under floating floors in dwellings

ISO 23529 Rubber - General procedures for preparing and conditioning test pieces for physical test methods

ASTM D 1781-98 (2004) Standard Test Method for Climbing Drum Peel for Adhesives

ETAG 003 Internal Partition Kits

ETAG 016 Composite Light Weight Panels

ETAG 034 Kits for external wall cladding

EOTA Technical Report TR 038 Assessment procedure for durability of thin metallic composite panels

ANNEX A TENSILE STRENGTH PERPENDICULAR TO THE FACE

The test of tensile strength perpendicular to the face shall be carried out in accordance with the following test procedure on 5 test specimens at least.

Test specimens of circular shape of diameter (50 ± 0,3) mm shall be cut from TMCS by water jet cutting machine. The two circular metal plates (targets) of appropriate size shall be affixed centrically to both sides of test sample with suitable adhesive.

Test specimen is to be affixed through metal plates into clamps of test machine and test load to destruction shall be inserted.

The test speed shall be adjusted to 5 mm/min. The maximal force in destruction F_m [N] and mode of destruction shall be registered, force with accuracy in integer.

Tensile strength perpendicular to the face σ_{mt} [MPa] shall be calculated as:

$$\sigma_{mt} = \frac{F_m}{A} = \frac{4 \times F_m}{\pi \times d^2}$$

where is

F_m	maximal tension force in N,
A	sectional area of test specimen in mm^2,
d	diameter of test specimen in mm.

The single calculated values are to be rounded to two significant digits.

The test report shall contain at least characteristics mentioned bellow:

- Description of test specimen (total nominal thickness of TMCS, material and nominal thickness of faced skins, material of core composition)
- The each tested values of diameter of test specimens, related force in failure determined by test of tensile strength perpendicular to the face, description of failure mode, single values of calculated tensile strength perpendicular to face, their average value and estimation of standard deviation.

ANNEX B SHEAR PERFORMANCE

The test of shear strength and shear modulus of elasticity shell be carried out in accordance with the following test procedure on five test specimens at least.

Test specimens of rectangle shape of dimensions 120 x 50 mm shall be cut from TMCS by water jet cutting machine. Than they are be adjusted by milling cutter to the shape given on Fig. B.1.

The two metal plates of appropriate size shall be affixed to both sides of test sample with suitable adhesive (see Fig. B.2).

Test specimen is to be affixed through metal plates into clamps of test machine and test load to destruction shall be inserted. Working diagram deformation / test load shall be recorded from movement of clamps.

The test speed shall be adjusted to 1 mm/min. The maximal force in failure F_m [N] and mode of destruction shall be registered, force with accuracy in integer.

Shear strength and shear modulus of elasticity shall be calculated and expressed as follows:

- Shear strength σ_s according to EN 12090, Cl 8.2, in MPa;
- Shear modulus of elasticity G according to EN 12090, Cl. 8.3, in MPa.

The single calculated values are to be rounded to three significant digits.

The test report shall contain at least characteristics mentioned bellow:

- Description of test specimen (nominal thickness of TMCS, material and nominal thickness of faced skins, material of core composition)
- The each tested values of dimensions of test specimens, related force in failure determined by test of shear strength, description of failure mode, single values of calculated shear strength, their average value and estimation of standard deviation.

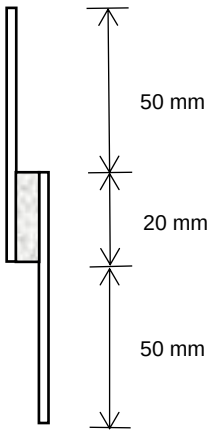

Figure B.1 Test specimen

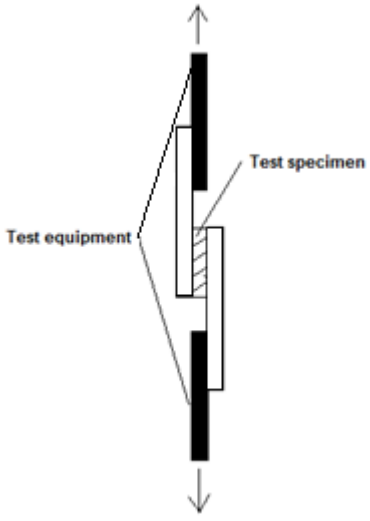

Figure B.2 Test assembly

ANNEX C HARD BODY IMAPCT RESISTANCE

The test of hard body impact resistance of the TMCS shall be carried out in accordance with the following test procedure on three test specimens for single thickness of TMCS at least. The test is to be performed on one set of test specimens conditioned for 24 hours at normal conditions 23/55 and on one set conditioned for 24 hours at -20 °C.

Each test shall be carried out on new sheet of product of dimensions 600 × 600 mm at least and consists of one impact of impact energy selected from range 1, 3, 5 and 10 N*m (see Fig. C.1) to the test specimen.

The tested specimen shall be positioned horizontally on beams (e.g. wooden) of height 80 mm at least with axial distance 500 mm without additional fixing (see Figure C.1). The top edge of the sheet is struck by hard body impactor (steel ball) in vertical direction.

The hard body impactor with mass (m) is dropped from a height (h), so that the total impact energy ($E = g \times h \times m$) corresponds with one of:

- hard body impact (5 N*m and 10 N*m) is carried out with steel ball weighing 1 kg;
- hard body impact (1 N*m, 3 N*m and 5 N*m) is carried out with steel ball weighing 0,5 kg.

The height is measured between the designated point of impact on surface of test specimen and the bottom of hard body impactor before its releasing.

The presence of any micro cracks or cracks at the impact point and at the circumference and area of the cracked zone are noted, measured and recorded. The nature of any breakage (e.g. sharp points or edges or delamination) is recorded.

The test result is expressed as type of damage or “without damage” for impact energy in *N*m*.

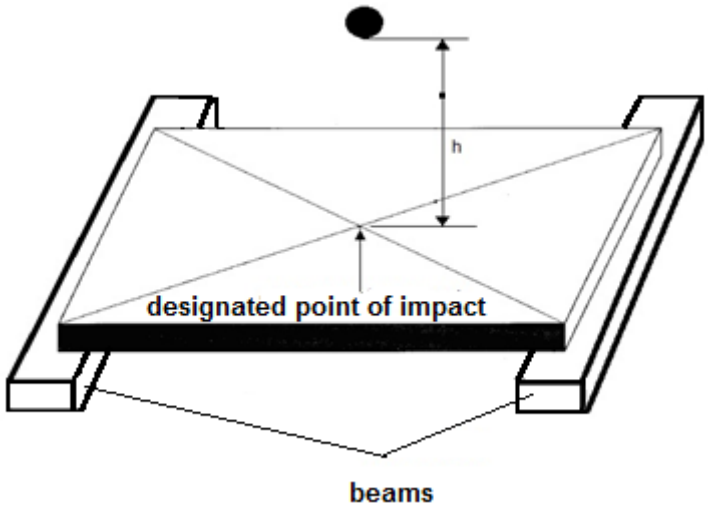

Figure C.1 Assembly for hard body impact test

The test report shall contain at least characteristics mentioned bellow:

- Description of test specimen (nominal thickness of TMCS, material and nominal thickness of faced skins, material of core composition)
- For each tested specimen conditions of test (impact energy, conditioning) and description of test result.

ANNEX D CREEP TEST

The test of creep shall be performed in accordance with the following test procedure on three test specimens for used thickness of TMCS at least.

Three test specimens of shape and dimension, as given in EOTA TR 038, Cl. 4.2.1, are to be mounted in test device, as given in ETOA TR 038, Cl. 2.2.1 and Fig. 1, and exposed to test load F_c in four-point bending test arrangement.

Test load F_c is to be calculated as 30 % of average value of load at failure in test of bending strength according to 2.2.4.

During the placing of the test load, the test specimen shall be propped from below in such a way that the propping can be removed quickly and smoothly in order to initiate the test.

Deflection measurements shall commence the instant that the full load is applied (w_0) and than as w_t in intervals 1; 2; 4; 8; 24 hours, 2; 4; 7; 14; 28; 56; 84 days (i.e. 2000 hours). After end of loading period, test load is to be removed carefully without any propping of test specimen and deflection $w_{t,0}$ measured in intervals 1; 2; 4; 8 and 24 hours, or finished later when no change to previous measurement is detected.

The creep coefficient φ_t [-] for the core of a panel shall be calculated using the expression:

$$\varphi_t = \frac{w_t - w_0}{w_0 - (w_t - w_{t,0})}$$

where w_t = the total deflection under load measured at time t (i.e. 84 days, about 2000 hours),

w_0 = the total initial deflection under load measured at the time t = 0

$w_{t,0}$ = the total deflection measured after removing of test load after 24 hours from end of test, or later when no change to previous measurement is detected.

The test report shall contain at least characteristics mentioned bellow:

- Description of test specimen (nominal thickness of TMCS, material and nominal thickness of faced skins, material of core composition)
- Test load
- For each tested specimen measured deformations at intervals given above and calculated creep coefficient.

ANNEX E REACTION TO FIRE – MOUNTING AND FIXING CONDITIONS

E.1 EN 13823

E.1.1 Mounting

Products that are free standing in their end use application shall be tested free standing at a distance of at least 80 mm from the backing board.

Products that in their end use application are directly fixed to a substrate shall be tested fixed as used in end use (mechanically, glued) to a substrate. Standard substrates shall meet the requirements of EN 13238.

Products that have in the end use application an air gap or a ventilated cavity behind it shall be tested with a cavity of at least 40 mm width and if required with a smaller air gap. Both distances have to be tested and the worst indicative test has to be considered for classification. The product shall be mounted on a wooden or metallic substructure, nailed or screwed together.

To ensure a ventilated air gap there has to be a joint of 10 mm between u-profile of the test device and the bottom of the product. The space between test rig backing board and backside of the supporting frame can be filled optionally with mineral wool insulation with a nominal thickness of 50 mm, a nominal density of (70 ± 20) kg/m³ and a class A2-s1,d0 according to EN 13501-1. The thermal insulation is imprisoned between the frames and the test rig backing board.

E.1.2 Joints

Product applied with horizontal and/or vertical joints shall be tested with a horizontal joint in the long wing at a height of 500 mm from the bottom edge of the specimen and/or with a vertical joint in the long wing at a distance of 200 mm from the corner line, measured when the wings are mounted ready for testing. The maximum opening width has to be tested.

E.1.3 Product orientation

Products with identical surface finishes on both sides have to be tested at one side only. Products with different surface finishes or coatings on different sides shall be tested on both sides or with the side representative for the worst performance directed to the fire. The worst performance is normally obtained with the side having the finish with the highest organic content per m² surface and the darkest colour. The side with the highest organic content shall be derived from the composition of the different finishing layers or by determining their gross calorific value according to EN ISO 1716, taking account of the respective applied dry weights of the finishing layers.

E.1.5 Field of application for the obtained classification

The results of tests are valid for:

- for products with same formulation
- of the same type, but with different dimensions of length and width;
- with a density range between the highest and lowest density tested;
- with a thickness range between the highest and lowest thickness tested
- with a joint opening width equal to or smaller than those used for the test;
- fixed with all other types of mechanical devices such as metal nails or rivets;
- each tested adhesive with equal or lower coverages than tested
- products tested on wooden frames can also be used on metallic profiles;
- products tested on metallic frames can only be used on metallic profiles;
- with a different surface texture (smooth or embossed);
- fixed at different (wider or closer) horizontal or vertical fixing centers;

- without thermal insulation in the cavity or with other types of class A2-s1,d0 according to EN 13501-1 insulation materials as long as a ventilated air gap of at least (40±1) mm directly behind the sheets is present;
- without finishes or with different finishes or coatings (e.g. different colours) as long as the test was performed considering the worst case as explained in E.1.3.

In cases where EDPM jointing strip has been used the result is also valid for other jointing material for a similar or higher fire classification.

The results of tests are valid for:

- the tested chemical composition
- tested surface structures,
- tested range of colours,
- any thickness between those tested,
- any weight per unit areas between those tested,
- any orientation and
- either each tested adhesive with equal or lower coverages than tested.

E.2 EN ISO 11925-2

The product has to be tested free standing and with surface exposure and edge exposure. An additional set of tests shall be carried out with the specimen turned at 90° round its vertical axis and the flame impinging at the bottom edge of the centreline of the underside of each different layer.

The following parameters shall be considered when preparing the test specimens:

- Chemical composition: each different composition of core, face material and coating material
- Colour: if there is a range of different colours, tests with a light, a dark and a medium colour (e.g. white, black and red) shall be performed
- Thickness: highest and lowest thickness
- Density/weight per unit area: the highest and the lowest density/weight per unit area
- Orientation: if relevant, the specimen shall be mounted and tested with vertical and with horizontal orientation.

At least two tests with any of the identified specimen configurations (based on the aforementioned parameters) shall be performed and four further tests with the most onerous specimen configuration as basis for the classification.

The results of tests are valid for:

- only the chemical composition of core and assembly of TMCS as tested,
- tested range of colours,
- any thickness between those tested,
- any weight per unit areas between those tested,

  any orientation.

E.3 EN ISO 1716

This test method is relevant for classes A1 and A2 only.

The test is to be performed on each component of TMCS separately, except of components classified as A1 without testing and/or metallic components (see EN ISO 1716, Cl. 7.1 and 9.4.1).

The number and preparation of test specimens are given in EN ISO 1716, Cl. 7. Components used in TMCS in form of thin film (e.g. adhesive, coating) manufacturer provides for test in fresh form. These components are to be applied in test laboratory in appropriate thickness to inert substrate to hard in form of film for procedure of preparation of test specimen according to EN ISO 1716, Cl. 7.2.4.

The gross heat of combustion is to be determined according to EN ISO 1716, Cl. 8, and calculated in accordance with EN ISO 1716, Cl. 9.

Parameters relevant for this test method are:

- Composition (when performing calculation of the Q_{PCS}-value),
- Density or mass per unit area,
- Thickness.

E.4 EN ISO 1182

This test method is relevant for classes A1 and A2 only. The test is to be performed for the ‘substantial components’ of the product as given in EN 13501-1, Cl. 3.1.5, only.

The non-combustibility test is to be performed according to EN ISO 1182, Cl. 7. The preparation and number of test specimens are given in EN ISO 1182, Cl. 5.

The test result is calculated and expressed in accordance with EN ISO 1182, Cl. 8.

Parameters relevant for this test method are:

- Composition,
- Density or mass per unit area,
- Thickness.
- Type and amount of flame retardant (if used).