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European Technical Assessment

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I General Part

Technical Assessment Body issuing the ETA:

Technical and Test Institute for Construction Prague

Trade name of the construction product

**MARMOLINE MONOSIS ENERGY SAVING
SYSTEM - THERMO WHITE**

Product family to which the construction product belongs

Product area code: 4
External Thermal Insulation Composite
Systems with rendering on expanded
polystyrene (EPS) or extruded polystyrene
(XPS) or mineral wool (MW) for the use as
external insulation to walls of buildings

Manufacturer

NORDIA S.A.
364, Kifissias Ave. & Delfon Str.
152 33 Chalandri (Athens)

Manufacturing plant(s)

GREECE
NORDIA S.A.
Marmoline Plant
1st km Country Road Markopoulou Oropou
190 11 POLYDENDRI ATTIKIS
GREECE

This European Technical Assessment contains

33 pages including 7 Annexes which form an
integral part of this Assessment.

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Assessment Document (EAD)

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II Specific part

1 Technical description of the product

1.1 Definition and composition of the kit

This product is an ETICS (External Thermal Insulation Composite System) with rendering - a kit comprising components which are factory-produced by the manufacturer or component suppliers. The ETICS manufacturer is ultimately responsible for all components of the ETICS specified in this ETA.

The ETICS kit comprises a prefabricated insulation product of expanded polystyrene (EPS) or extruded polystyrene (XPS) or mineral wool (MW) to be bonded or mechanically fixed onto a wall. The methods of fixing and the relevant components are specified in the table below. The insulation product is faced with a rendering system consisting of one or more layers (site applied), one of which contains reinforcement. The rendering system is applied directly to the insulating boards, without any air gap or disconnecting layer.

The ETICS may include special fittings (e.g. base profiles, corner profiles ...) to treat details of ETICS (connections, corners, parapets, sills ...). Assessment and performance of these components is not addressed in this ETA, however the ETICS manufacturer is responsible for adequate compatibility and performance within the ETICS when the components are delivered as a part of the kit.

Composition of the ETICS

Table No. 1

	Components	Coverage (kg/m ²)	Thickness (mm)
Insulation products with associated methods of fixing	Bonded ETICS (fully or partially bonded) with supplementary anchors. National application documents shall be taken into account).		
	<ul style="list-style-type: none"> • Insulation product: EPS according to EN 13163 (expanded polystyrene EPS TR100) see Annex No. 1 for product characteristics 	/	50 to 300
	<ul style="list-style-type: none"> • Insulation product: XPS according to EN 13164 (extruded polystyrene XPS TR400) see Annex No. 2 for product characteristics 	/	50 to 300
	<ul style="list-style-type: none"> • Adhesives: <ul style="list-style-type: none"> - THERMO WHITE cement based powder requiring addition of water 0.27 l/kg 	3.0 to 5.0 (dry)	/
	Mechanically fixed ETICS with anchors and supplementary adhesive (see Cl. 3.3.5 and Annex No. 6 for possible associations EPS or XPS or MW /anchors) National application documents shall be taken into account).		
	<ul style="list-style-type: none"> • Insulation product: EPS according to EN 13163 (expanded polystyrene EPS TR100) see Annex No. 1 for product characteristics 	/	50 to 300
	<ul style="list-style-type: none"> • Insulation product: XPS according to EN 13164 (extruded polystyrene XPS TR400) see Annex No. 2 for product characteristics 	/	50 to 300
	<ul style="list-style-type: none"> • Insulation product: MW according to EN 13162 (mineral wool MW TR7.5) see Annex No. 3 for product characteristics 	/	70 to 200
	<ul style="list-style-type: none"> • Insulation product: MW according to EN 13162 (mineral wool MW TR10) see Annex No. 4 for product characteristics 	/	50 to 200
	<ul style="list-style-type: none"> • Adhesives: <ul style="list-style-type: none"> - THERMO WHITE cement based powder requiring addition of water 0.27 l/kg 	3.0 to 5.0 (dry)	/

Components	Coverage (kg/m ²)	Thickness (mm)
<ul style="list-style-type: none"> • Anchors see Annex No. 6 for individual product characteristics. In addition to the following list. Other anchors can be used provided that they comply with the requirements introduced in the Annex No. 6. 		
<ul style="list-style-type: none"> - Ejotherm STR U 2G plastic screw-in anchors - EJOT H1 eco plastic nailed-in anchors - EJOT H3 plastic nailed-in anchors - EJOT H4 eco plastic nailed-in anchors - BRAVOLL® PTH-KZ 60/8 plastic nailed-in anchors - BRAVOLL® PTH-S plastic screw-in anchors - BRAVOLL® PTH-SX plastic screw-in anchors - BRAVOLL® PTH-X, PTH-EX plastic nailed-in anchors - TFIX-8M plastic nailed-in anchors - KI-10N, KI-10NS plastic nailed-in anchors - Koelner KI-10N, KI-10NS plastic nailed-in anchors - TFIX-8S, TFIX-8ST plastic screw-in anchors - KOELNER TFIX-8P plastic nailed-in anchors - Thermoschraubdübe KEW TSDL-V, - KEW TSD-V plastic nailed-in anchors - ThermoScrew TS U8 Gecko plastic screw-in anchors 	<p>ETA-04/0023</p> <p>ETA-11/0192</p> <p>ETA-14/0130</p> <p>ETA-11/0192</p> <p>ETA-05/0055</p> <p>ETA-08/0267</p> <p>ETA-10/0028</p> <p>ETA-13/0951</p> <p>ETA-07/0336</p> <p>ETA-07/0291</p> <p>ETA-07/0221</p> <p>ETA-11/0144</p> <p>ETA-13/0845</p> <p>ETA-12/0148</p> <p>ETA-16/0100</p>	

	Components	Coverage (kg/m ²)	Thickness (mm)
Insulation products with associated methods of fixing	- KEW TSBD plastic anchors	ETA- 08/0314	
	- KEW DSH 10 K plastic anchors	ETA-14/0129	
	- KEW TSD 8 plastic nailed-in anchors	ETA-04/0030	
	- KEW TSD-V KN plastic nailed-in anchors	ETA-13/0075	
	- WK THERM 8 plastic nailed-in anchors	ETA-11/0232	
	- eco drive plastic screw-in anchors	ETA-13/0107	
	- eco drive S plastic screw-in anchors	ETA-13/0107	
	- WK THERM S plastic screw-in anchors	ETA-13/0724	
	- LMX-8; LMX-10; LTX-8; LTX-10 plastic nailed-in anchors	ETA-16/0509	
	- FIXPLUG 10, FIXPLUG 8 plastic nailed-in anchors	ETA-15/0373	
	- Fischer TERMOZ 8U plastic screw-in anchors	ETA-02/0019	
	- Fischer Termoz PN 8 plastic nailed-in anchors	ETA-09/0171	
	- Fischer Termoz CN 8 plastic nailed-in anchors	ETA-09/0394	
	- Fischer TERMOFIX CF 8 plastic nailed-in anchors	ETA-07/0287	
	- Fischer termoz SV II ecotwist plastic screw-in anchors	ETA-12/0208	
	- fischer termoz CS 8 plastic screw-in anchors	ETA-14/0372	
	- fischer termoz CS 8 DT 110 V plastic screw-in anchors	ETA-14/0372	
	- termoz SV II ecotwist plastic screw-in anchors	ETA-12/0208	
	- Hilti ETICS nailed-in anchor SDK-FV 8 plastic nailed-in anchors	ETA-07/0302	
	- Hilti ETICS screwed-in anchor D 8-FV plastic screw-in anchors	ETA-07/0288	
	- HTH plastic screw-in anchors	ETA-15/0464	
	- HTR-M plastic screw-in anchors	ETA-16/0116	
- HTR-P plastic screw-in anchors	ETA-16/0116		

	Components	Coverage (kg/m ²)	Thickness (mm)
Base coat	<ul style="list-style-type: none"> - THERMO WHITE cement based powder requiring addition of water 0.27 l/kg 	3.0 to 5.0 (dry)	3.0 to 5.0
Reinforcement	<ul style="list-style-type: none"> • Standard mesh applied in single layer see Annex No. 7 for product characteristics: - R 131 A101 - M 160 	1.1 – 1.2 m ² /m ² of ETICS	/
Key coat	<ul style="list-style-type: none"> - Marmoline MST 11 ready to use liquid 	0.1 l/m ²	/
Finishing coats	<ul style="list-style-type: none"> • Ready to use paste - acrylic binder: - Marmoline SVR 1.5 VALUE floated structure particle size 1.5 mm - Marmoline SVR 1.0 VALUE floated structure particle size 1.0 mm 	2.0 to 2.3 1.7 to 2.0	1.5 1.0
Ancillary materials	Remain under the manufacturer's responsibility		

2 Specification of the intended use(s) in accordance with the applicable European Assessment Document (hereinafter "EAD")

2.1 Intended use

This ETICS is intended for use as external insulation of buildings' walls. The walls are made of masonry (bricks, blocks, stones ...) or concrete (cast on site or as prefabricated panels). The characteristics of the walls shall be verified prior to use of the ETICS, especially regarding conditions for reaction to fire classification and for fixing of the ETICS either by bonding or mechanically. The ETICS is designed to give the wall to which it is applied satisfactory thermal insulation.

The ETICS is made of non load-bearing construction elements. It does not contribute directly to the stability of the wall on which it is installed, but it can contribute to durability by providing enhanced protection from the effect of weathering.

The ETICS can be used on new or existing (retrofit) vertical walls. It can also be used on horizontal or inclined surfaces which are not exposed to precipitation.

The ETICS is not intended to ensure the airtightness of the building structure.

The choice of the method of fixing depends on the characteristics of the substrate, which may need preparation (see cl. 7.2.1 of the ETAG 004) and shall be done in accordance with the national instructions.

The ETICS belong to Category *SW2*, according to EOTA Technical Report No 034.

2.2 Manufacturing

The European Technical Assessment is issued for the ETICS on the basis of agreed data/information, deposited with the Technical and Test Institute Prague, which identifies the ETICS that has been assessed and judged.

2.3 Design and installation

The installation instructions including special installation techniques and provisions for the qualification of the personnel are given in the manufacturer's technical documentation.

Design, installation and execution of ETICS are to be in conformity with national documents. Such documents and the level of their implementation in Member States' legislation are different. Therefore, the assessment and declaration of performance are done taking into account general assumptions introduced in the chapters 7.1 and 7.2 of ETAG 004 used as EAD, which summarize how information introduced in the ETA and related documents is intended to be used in the construction process and gives advice to all parties interested when normative documents are missing.

2.4 Packaging, transport and storage

The information on packaging, transport and storage is given in the manufacturer's technical documentation. It is the responsibility of the manufacturer(s) to ensure that this information is made known to the concerned people.

2.5 Use, maintenance and repair

The finishing coat shall normally be maintained in order to fully preserve the ETICS performance. Maintenance includes at least:

- visual inspection of the ETICS,
- repairing of localized damaged areas due to accidents,
- the aspect maintenance with products adapted and compatible with the ETICS (possibly after washing or ad hoc preparation).

Necessary repairs should be performed as soon as the need has been identified.

It is important to be able to carry out maintenance as far as possible using readily available products and equipment, without spoiling appearance. Only products which are compatible with the ETICS shall be used.

The information on use, maintenance and repair is given in the manufacturer's technical documentation. It is the responsibility of the manufacturer(s) to ensure that this information is made know to the concerned people.

3 Performance of the product and references to the methods used for its assessment

The performances of the kit as described in this chapter are valid provided that the components of the kit comply with Annexes 1 - 7.

3.1 Safety in case of fire (BWR 2)

3.1.1 Reaction to fire (ETAG 004 - clause 5.1.2.1, EN 13501-1)

Table No. 2

Configuration	Organic content / heat of combustion	Flame retardant content	Euroclass according to EN 13501-1
Adhesive	- / 0.06 MJ/kg	No flame retardant	B – s1, d0
Boards of: EPS expanded polystyrene or XPS extruded polystyrene Maximal density of 33 kg/m ³	/	In quantity ensuring Euroclass E according to EN 13501-1	
Base coat render	- / 0.30 MJ/kg	No flame retardant	
Glass fibre mesh	- / 8.17 MJ/kg		
Finishing coats	- / 1.68 MJ/kg		

Note: A European reference fire scenario has not been laid down for facades. In some Member States, the classification of ETICS according to EN 13501-1 might not be sufficient for the use in facades. An additional assessment of ETICS according to national provisions (e.g. on the basis of a large scale test) might be necessary to comply with Member State regulations, until the existing European classification system has been completed.

Table No. 3

Configuration	Organic content / heat of combustion	Flame retardant content	Euroclass according to EN 13501-1
Adhesive	- / 0.06 MJ/kg	No flame retardant	A2 – s1, d0
Boards of: MW mineral wool Maximal density of 120 kg/m ³	/	In quantity ensuring Euroclass E according to EN 13501-1	
Base coat render	- / 0.30 MJ/kg	No flame retardant	
Glass fibre mesh	- / 8.17 MJ/kg		
Finishing coats	- / 1.68 MJ/kg		

Note: A European reference fire scenario has not been laid down for facades. In some Member States, the classification of ETICS according to EN 13501-1 might not be sufficient for the use in facades. An additional assessment of ETICS according to national provisions (e.g. on the basis of a large scale test) might be necessary to comply with Member State regulations, until the existing European classification system has been completed.

3.2 Hygiene, health and environment (BWR 3)

3.2.1 Water absorption (ETAG 004 - clause 5.1.3.1)

- Insulation product: **EPS (TR100), XPS (TR400)**

Base coat: **THERMO WHITE**

Water absorption after 1 hour < 1 kg/m²

Water absorption after 24 hours < 0.5 kg/m²

- Rendering system:

Table No. 4

		Water absorption after 24 hours	
		< 0.5 kg/m ²	≥ 0.5 kg/m ²
Rendering system: Base coat THERMO WHITE + finishing coats as indicated here:	Marmoline SVR 1.5 VALUE	X	
	Marmoline SVR 1.0 VALUE		

- Insulation product: **MW (TR7.5, TR10)**

Base coat: **THERMO WHITE**

Water absorption after 1 hour < 1 kg/m²

Water absorption after 24 hours < 0.5 kg/m²

- Rendering system:

Table No. 5

		Water absorption after 24 hours	
		< 0.5 kg/m ²	≥ 0.5 kg/m ²
Rendering system: Base coat THERMO WHITE + finishing coats as indicated here:	Marmoline SVR 1.5 VALUE	X	
	Marmoline SVR 1.0 VALUE		

3.2.2 Watertightness (ETAG 004 - clause 5.1.3.2)

3.2.2.1 Hygrothermal behaviour

Pass (without defects).

3.2.2.2 Freeze-thaw behaviour

Freeze-thaw resistant - according to the water absorption test result.

3.2.3 Impact resistance (ETAG 004 - clause 5.1.3.3)

Table No. 6

Render coating: base coat of thickness 3 mm THERMO WHITE + single standard reinforcement + finishing coats listed hereafter:	Insulation product:			
	XPS (TR400)	EPS (TR100)	MW (TR10)	MW (TR7.5)
Marmoline SVR 1.5 VALUE	Category III			Category II
Marmoline SVR 1.0 VALUE				

3.2.4 Water vapour permeability (ETAG 004 - clause 5.1.3.4)

Table No. 7

Rendering system: base coat THERMO WHITE + single standard reinforcement + finishing coats listed hereafter:	Equivalent air layer thickness s_d
Marmoline SVR 1.5 VALUE	≤ 0.28 m
Marmoline SVR 1.0 VALUE	

3.2.5 Release of dangerous substances (ETAG 004 - clause 5.1.3.5, EOTA TR034)

Kit not assessed according to EOTA TR 034.

3.3 Safety and accessibility in use (BWR 4)

3.3.1 Bond strength between base coat and insulation product (ETAG 004 - clause 5.1.4.1.1)

- Insulation product: **EPS (TR100), XPS (TR400)**
 - Initial state: bond strength ≥ 0.080 MPa and a cohesive failure in the insulation product
 - After hygrothermal cycles: bond strength ≥ 0.080 MPa and cohesive failure in the insulation product
 - After freeze-thaw cycles: test not required (see Cl. 3.2.1 of this ETA)

- Insulation product: **MW (TR7.5), MW (TR10)**
 - Initial state: bond strength ≥ 0.014 MPa but cohesive failure in the insulation product
 - After hygrothermal cycles: bond strength ≥ 0.004 MPa but cohesive failure in the insulation product
 - After freeze-thaw cycles: test not required (see Cl. 3.2.1 of this ETA)

3.3.2 Bond strength between adhesive and substrate / insulation product (ETAG 004 - clauses 5.1.4.1.2, 5.1.4.1.3)

Table No. 8

		Initial state	48 hrs. immersion in water + 2 hrs. 23°C/50% RH	48 hrs. immersion in water + 7 days 23°C/50% RH
THERMO WHITE	Concrete	≥ 0.25 MPa	≥ 0.08 MPa	≥ 0.25 MPa
	XPS TR400 (Extruded polystyrene)	≥ 0.08 MPa failure in the insulation product	≥ 0.03 MPa failure in the insulation product	≥ 0.08 MPa failure in the insulation product
	EPS TR100 (Expanded polystyrene)			
	MW TR7.5 MW TR10 (Mineral wool)	< 0.08 MPa and failure in insulation product	< 0.03 MPa and failure in insulation product	< 0.08 MPa and failure in insulation product

3.3.3 Bond strength after ageing (ETAG 004 - clauses 5.1.7.1)

- Insulation product: **EPS (TR100), XPS (TR400)**
 - After ageing by hygrothermal cycles: bond strength ≥ 0.080 MPa and cohesive failure in the insulation product
 - After freeze-thaw cycles: test not required (see Cl. 3.2.2.2 of this ETA)

- Insulation product: **MW (TR7.5), MW (TR10)**
 - After ageing by hygrothermal cycles: bond strength ≥ 0.004 MPa but cohesive failure in the insulation product
 - After freeze-thaw cycles: test not required (see Cl. 3.2.2.2 of this ETA)

3.3.4 Fixing strength (ETAG 004 - clause 5.1.4.2)

Test not required (no limitation of ETICS length).

3.3.5 Wind load resistance (ETAG 004 - clause 5.1.4.3)

- Insulation product: **EPS (TR100), XPS (TR400)**

Table No. 9

Anchor description	Trade name		See Annex No. 6		Hilti D 8-FV (ETA 07/0288)
			Surface assembly	Countersunk assembly	Special assembly
	Plate diameter (mm)		60 or more	60 or more	60 or more
EPS	Thickness (mm)		≥ 50	≥ 100	≥ 100
	Tensile strength perpendicular to faces (kPa)		≥ 109.0 in dry condition		≥ 104.0 in dry condition
Maximal load	Anchors placed at the body of the insulation product	R_{panel}	min. value: 0.44 kN mean value: 0.46 kN	min. value: 0.44 kN mean value: 0.46 kN	min. value: 0.39 kN mean value: 0.41 kN
	Anchors placed at joints of the insulation product	R_{joint}	min. value: 0.44 kN mean value: 0.47 kN	min. value: 0.44 kN mean value: 0.47 kN	No performance assessed

Table No. 10

Anchor description	Trade name		Hilti HTH (ETA-15/0464)	fischer termoz SV II ecotwist (ETA12/0208)
	Assembly method		Special assembly	Special assembly
	Plate diameter (mm)		60	60 or more
EPS	Thickness (mm)		≥ 100	≥ 100
	Tensile strength perpendicular to faces (kPa)		≥ 151.9 in dry condition	≥ 95.6 in dry condition
Maximal load	Anchors placed at the body of the insulation product	R_{panel}	min. value: 0.64 kN mean value: 0.68 kN	min. value: 0.49 kN mean value: 0.53 kN
	Anchors placed at joints of the insulation product	R_{joint}	min. value: 0.54 kN mean value: 0.60 kN	min. value: 0.44 kN mean value: 0.48 kN

- Insulation product: **MW panel (TR10)** single density panels

Table No. 11

Anchor description	Trade name		see Annex No. 6			
	Plate stiffness (kN/mm)		≥ 0.3		≥ 0.5	
	Assembly method		Surface	Countersunk	Surface	Countersunk
	Plate diameter (mm)		≥ 60		≥ 60	
Insulation product description	Thickness (mm)		≥ 60	≥ 100	≥ 50	≥ 100
	Tensile strength (kPa)		≥ 13.4 (dry) ≥ 6.1 (wet)		≥ 9.9 (dry)	
Maximal load	Anchors placed at the body of the insulation product	R_{panel} (dry)	min.: 0.40 kN mean: 0.41 kN		min.: 0.48 kN mean: 0.55 kN	
		R_{panel} (wet)	min.: 0.20 kN mean: 0.24 kN		No performance assessed	
	Anchors placed at joints of the insulation product	R_{joint} (dry)	min.: 0.29 kN mean: 0.34 kN		min.: 0.39 kN mean: 0.43 kN	
		R_{joint} (wet)	min.: 0.19 kN mean: 0.21 kN		No performance assessed	

Table No. 12

Anchor description	Trade name		BRAVOLL PTH-60/8 + BRAVOLL® IT PTH 100	BRAVOLL PTH-60/8 + BRAVOLL® IT PTH 140	Koelner TFIX - 8 S + Koelner KWL 090
	Assembly method		Surface	Surface	Surface
	Plate diameter (mm)		100	140	90
Insulation product description	Thickness (mm)		≥ 100	≥ 100	≥ 80
	Tensile strength (kPa)		≥ 15.2 (dry)		≥ 17.0 (dry)
Maximal load	Anchors placed at the body of the insulation product	R_{panel} (dry)	min.: 0.68 kN mean: 0.78 kN	min.: 0.90 kN mean: 0.93 kN	min.: 0.64 kN mean: 0.67 kN
		R_{panel} (wet)	No performance assessed		
	Anchors placed at joints of the insulation product	R_{joint} (dry)	min.: 0.50 kN mean: 0.64 kN	min.: 0.63 kN mean: 0.69 kN	min.: 0.56 kN mean: 0.59 kN
		R_{joint} (wet)	No performance assessed		

Table No. 13

Anchor description	Trade name		BRAVOLL PTH-60/8 + BRAVOLL® ZT 100	EJOT STR U 2G + VT 2G	Klimas Wkret-met screw-in plug eco-drive W
	Assembly method		Countersunk		
	Plate diameter (mm)		100	112.5	≥ 110
Insulation product description	Thickness (mm)		≥ 100	≥ 100	≥ 100
	Tensile strength (kPa)		≥ 15.2 (dry)	≥ 5.3 (dry)	≥ 14.5 (dry)
Maximal load	Anchors placed at the body of the insulation product	R_{panel} (dry)	min.: 0.71 kN mean: 0.81 kN	min.: 0.78 kN mean: 0.91 kN	min.: 0.70 kN mean: 0.72 kN
		R_{panel} (wet)	No performance assessed		
	Anchors placed at joints of the insulation product	R_{joint} (dry)	min.: 0.65 kN mean: 0.74 kN	min.: 0.60 kN mean: 0.70 kN	min.: 0.52 kN mean: 0.56 kN
		R_{joint} (wet)	No performance assessed		

- Insulation product: **MW panel (TR10)** multi-layered panels

Table No. 14

Anchor description	Trade name		see Annex No. 6	
	Plate stiffness (kN/mm)		≥ 0.4	≥ 0.6
	Assembly method		Surface	Surface
	Plate diameter (mm)		≥ 60	≥ 60
Insulation product description	Thickness (mm)		≥ 80	≥ 100
	Tensile strength (kPa)		≥ 10.0 (dry)	≥ 15.9 (dry)
Maximal load	Anchors placed at the body of the insulation product	R _{panel} (dry)	min.: 0.38 kN mean: 0.41 kN	min.: 0.48 kN mean: 0.56 kN
		R _{panel} (wet)	No performance assessed	
	Anchors placed at joints of the insulation product	R _{joint} (dry)	min.: 0.32 kN mean: 0.37 kN	min.: 0.39 kN mean: 0.42 kN
		R _{joint} (wet)	No performance assessed	

- Insulation product: **MW panel (TR7.5)** single density panels

Table No. 15

Anchor description	Trade name		see Annex No. 6	
	Plate stiffness (kN/mm)		≥ 0.3	
	Assembly method		Surface	
	Plate diameter (mm)		≥ 60	
Insulation product description	Thickness (mm)		≥ 50	
	Tensile strength (kPa)		≥ 13.2 (dry)	≥ 8.7 (wet)
Maximal load	Anchors placed at the body of the insulation product	R _{panel} (dry)	min.: 0.42 kN mean: 0.47 kN	
		R _{panel} (wet)	min.: 0.25 kN mean: 0.27 kN	
	Anchors placed at joints of the insulation product	R _{joint} (dry)	min.: 0.20 kN mean: 0.23 kN	
		R _{joint} (wet)	min.: 0.14 kN mean: 0.18 kN	

3.3.6 Render strip tensile test

No performance assessed for glass fibre mesh: R 131 A101

- Base coat: **THERMO WHITE**

Table No. 16

		Glass fibre mesh: M 160 (manufacturer: SAINT-GOBAIN ADFORS CZ s.r.o.)						
		Crack width W_{typ} [mm]/ number of cracks at relative elongation ϵ						
Load direction		$\epsilon = 0.3 \%$	$\epsilon = 0.5 \%$	$\epsilon = 0.8 \%$	$\epsilon = 1.0 \%$	$\epsilon = 1.5 \%$	$\epsilon = 2.0 \%$	
Plane side of the test specimen								
Warp	Sample No. 1	$\leq 0.05/16$	$\leq 0.05/26$	$\leq 0.05/30$	$\leq 0.05/30$	$\leq 0.05/15$ $\leq 0.10/15$	Failure of the test specimen	
	Sample No. 2	$\leq 0.05/16$	$\leq 0.05/24$	$\leq 0.05/27$	$\leq 0.05/28$	$\leq 0.05/17$ $\leq 0.10/12$		
	Sample No. 3	$\leq 0.05/13$	$\leq 0.05/23$	$\leq 0.05/25$	$\leq 0.05/27$	$\leq 0.05/14$ $\leq 0.10/13$		
Weft	Sample No. 1	$\leq 0.05/14$	$\leq 0.05/20$	$\leq 0.05/21$	$\leq 0.05/23$	$\leq 0.05/11$ $\leq 0.10/12$		
	Sample No. 2	$\leq 0.05/10$	$\leq 0.05/16$	$\leq 0.05/18$	$\leq 0.05/21$	$\leq 0.05/10$ $\leq 0.10/12$		
	Sample No. 3	$\leq 0.05/10$	$\leq 0.05/17$	$\leq 0.05/18$	$\leq 0.05/21$	$\leq 0.05/11$ $\leq 0.10/13$		
Coarse side of the test specimen								
Warp	Sample No. 1	$\leq 0.05/4$	$\leq 0.05/19$	$\leq 0.05/29$	$\leq 0.05/29$	$\leq 0.05/21$ $\leq 0.10/10$	Failure of the test specimen	
	Sample No. 2	$\leq 0.05/4$	$\leq 0.05/17$	$\leq 0.05/25$	$\leq 0.05/27$	$\leq 0.05/19$ $\leq 0.10/9$		
	Sample No. 3	$\leq 0.05/4$	$\leq 0.05/17$	$\leq 0.05/24$	$\leq 0.05/25$	$\leq 0.05/18$ $\leq 0.10/8$		
Weft	Sample No. 1	$\leq 0.05/5$	$\leq 0.05/13$	$\leq 0.05/18$	$\leq 0.05/18$	$\leq 0.05/14$ $\leq 0.10/7$		
	Sample No. 2	$\leq 0.05/4$	$\leq 0.05/11$	$\leq 0.05/15$	$\leq 0.05/15$	$\leq 0.05/12$ $\leq 0.10/8$		
	Sample No. 3	$\leq 0.05/3$	$\leq 0.05/11$	$\leq 0.05/16$	$\leq 0.05/15$ $\leq 0.10/1$	$\leq 0.05/13$ $\leq 0.10/8$		

The characteristic crack width W_{rk} [mm] at a render strain value of 0.8%, determined with simple Method II pursuant to ETAG 004, cl. 5.5.4.1.

Table No. 17

	Characteristic width of cracks W_{rk} [mm] at render strain value of 0.8%			
	Plane side of the test specimen		Coarse side of the test specimen	
	Warp direction	Weft direction	Warp direction	Weft direction
R 131 A101	No performance assessed			
M 160	0.05	0.05	0.05	0.05

3.4 Protection against noise (BWR 5)

3.4.1 Airborne sound insulation

No performance assessed.

3.5 Energy economy and heat retention (BWR 6)

3.5.1 Thermal resistance

The thermal transmittance of the substrate wall covered by the ETICS is calculated in accordance with the standard EN ISO 6946:

$$U_c = U + \chi_p \times n$$

Where:

- $\chi_p \times n$ has only to be taken into account if it is greater than 0.04 W/(m².K)
- U_c global (corrected) thermal transmittance of the covered wall (W/ (m².K)
- n number of anchors (through insulation product) per 1 m²
- χ_p local influence of thermal bridge caused by an anchor. The values listed below can be taken into account if not specified in the anchor's ETA:
 - = 0.002 W/K for anchors with a stainless steel screw covered by plastic anchors and for anchors with an air gap at the head of the screw
($\chi_p \times n$ negligible for $n < 20$)
 - = 0.004 W/K for anchors with a galvanized steel screw with the head covered by a plastic material
($\chi_p \times n$ negligible for $n < 10$)
 - = negligible for anchors with plastic nails (reinforced or not with glass fibres ...)

U thermal transmittance of the current part of the covered wall (excluding thermal bridges) (W/ (m².K)) determined as follows:

$$U_c = \frac{1}{R_i + R_{render} + R_{substrate} + R_{se} + R_{si}}$$

Where:

R_i thermal resistance of the insulation product (according to declaration in reference to EN 13163 or EN 13164) in (m².K)/W

R_{render} thermal resistance of the rendering system (about 0.02 in (m².K)/W) or determined by test according to EN 12667 or EN 12664

$R_{substrate}$ thermal resistance of the substrate of the building (concrete, brick ...) in (m².K)/W

R_{se} external superficial thermal resistance in (m².K)/W

R_{si} internal superficial thermal resistance in (m².K)/W

The value of thermal resistance of each insulation product shall be given in the manufacturer's documentation along with the possible range of thicknesses. In addition, the point thermal conductivity of anchors shall be given when anchors are used in the ETICS.

3.6 Sustainable use of natural resources (BWR 7)

No performance assessed.

4 Assessment and verification of constancy of performance (hereinafter AVCP) system applied, with reference to its legal base

According to the European Commission decision 97/556/EC amended by the European Commission decision 2001/596/EC, the AVCP systems 1 and 2+ are valid (further described in Annex V to Regulation (EU) No. 305/2011).

Table No. 18

Product(s)	Intended use(s)	Level(s) or class(es) (Reaction to fire)	System(s)
External thermal insulation composite systems/kits (ETICS) with rendering	In external wall subject to fire regulations	A1 ⁽¹⁾ , A2 ⁽¹⁾ , B ⁽¹⁾ , C ⁽¹⁾	1
		A1 ⁽²⁾ , A2 ⁽²⁾ , B ⁽²⁾ , C ⁽²⁾ , D, E, (A1 to E) ⁽³⁾ , F	2+
	In external wall not subject to fire regulations	Any	2+

⁽¹⁾ Products/materials for which a clearly identifiable stage in the production process results in an improvement of the reaction to fire classification (e.g. an addition of fire retardants or a limiting of organic material)

⁽²⁾ Products/materials not covered by footnote (1)

⁽³⁾ Products/materials that do not require to be tested for reaction to fire (e.g. Products/materials of Classes A1 according to Commission Decision 96/603/EC)

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD:

In order to help the Notified Body to make an evaluation of conformity, the Technical Assessment Body issuing the ETA shall supply the information detailed below. This information together with the requirements given in EC Guidance Paper B will generally form the basis on which the factory production control (FPC) is assessed by the Notified Body.

This information shall initially be prepared or collected by the Technical Assessment Body and shall be agreed with the manufacturer. The following gives guidance on the type of information required:

1) ETA

Where confidentiality of information is required, this ETA makes reference to the manufacturer's technical documentation which contains such information.

2) Basic manufacturing process

The basic manufacturing process is described in sufficient detail to support the proposed FPC methods.

The different components of the ETICS are generally manufactured using conventional techniques. Any critical process or treatment of the components which affects performance are highlighted in the manufacturer's documentation.

3) Product and materials specifications

The manufacturer's documentation includes:

- detailed drawings (possibly including manufacturing tolerances),
- incoming (raw) materials specifications and declarations,
- references to European and/or international standards,
- technical data sheets.

4) Control Plan (as a part of FPC)

The manufacturer and the Technical and Test Institute for Construction Prague have agreed a Control Plan which is deposited with the Technical and Test Institute for Construction Prague in documentation which accompanies the ETA. The Control Plan specifies the type and frequency of checks/tests conducted during production and on the final product. This includes the checks conducted during manufacture on properties that cannot be inspected at a later stage and for checks on the final product.

Products not manufactured by the ETICS manufacturer shall also be tested according to the Control Plan. It must be demonstrated to the Notified Body that the FPC system contains elements securing that the ETICS manufacturer takes products conforming to the Control Plan from his supplier(s).

Where materials/components are not manufactured and tested by the supplier in accordance with agreed methods, then where appropriate they shall be subject to suitable checks/tests by the ETICS manufacturer referring to the Control Plan once again.

In cases where the provisions of the European Technical Assessment and its Control Plan are no longer fulfilled, the Notified Body shall withdraw the certificate and inform the Technical and Test Construction Institute Prague without delay.

Issued in Prague on 18/07/2020


Ing. Mária Schaan
Head of the Technical Assessment Body



Annexes:

- Annex No. 1 Insulation product characteristics EPS (TR100)
- Annex No. 2 Insulation product characteristics XPS (TR400)
- Annex No. 3 Insulation product characteristics for mechanically fixed ETICS with additional bonding – MW board single density (TR10)
- Annex No. 4 Insulation product characteristics for mechanically fixed ETICS with additional bonding – MW board of multi-layered (TR10)
- Annex No. 5 Insulation product characteristics for mechanically fixed ETICS with additional bonding – MW board (TR7.5)
- Annex No. 6 Anchors, description of individual product characteristics contained in the ETA
- Annex No. 7 Description of glass fibre mesh

Annex No. 1 Insulation product characteristics EPS (TR100)

Description and characteristics		Regulation	Declared characteristics of EPS boards	
			Class, level according to EN 13163	Value
Reaction to fire		EN 13501	E	Apparent density $\leq 33 \text{ kg/m}^3$
Thermal resistance		EN 12667	Defined in CE mark in accordance with EN 13163	
Thickness		EN 823	T(2)	$\pm 2 \text{ mm}$
Length		EN 822	L(2)	$\pm 2 \text{ mm}$
Width			W(2)	$\pm 2 \text{ mm}$
Squareness		EN 824	S(2)	$\pm 2 \text{ mm/m}$
Flatness		EN 825	P(3)	3 mm
Surface		ETAG 004	Cut surface (homogenous, without coating)	
Dimensional stability	Under defined temperature and humidity conditions	EN 1604	DS(70,-)1	1%
			DS(70,90)1	1%
	Under constant laboratory conditions	EN 1603	DS(N)2	0.2%
Short term water absorption at partial immersion		EN 1609	---	$< 1 \text{ kg/m}^2$
Diffusion factor (μ)		EN 13163	MU 20 – 40 MU 30 – 70	20 - 70
Tensile strength perpendicular to the faces of insulation product		EN 1607	TR100	$\geq 100 \text{ kPa}$
Shear strength		EN 12090	SS20	$\geq 20 \text{ kPa}$
Shear modulus of elasticity			GM1000	$\geq 1000 \text{ kPa}$

Note: Classes and levels for individual characteristics comply with EN 13163: 2012+A1:2015. Only insulation products of the same or better declared characteristics, as stated in the table above, can be used in this ETICS.

Reaction to fire E has to be proved for every insulation product also at 10 mm products thickness.

Annex No. 2 Insulation product characteristics XPS (TR400)

Description and characteristics		Regulation	Declared characteristics of XPS boards	
			Class, level according to EN 13164	Value
Reaction to fire		EN 13501	E	Apparent density $\leq 33 \text{ kg/m}^3$
Thermal resistance		EN 12667	Defined in CE mark in accordance with EN 13164	
Thickness		EN 823	T(3)	$\pm 1 \text{ mm}$
Length		EN 822	-	$\pm 8 \text{ mm}$
Width			-	$\pm 8 \text{ mm}$
Squareness		EN 824	-	$\leq 5 \text{ mm/m}$
Flatness		EN 825	-	$\leq 6 \text{ mm}$
Dimensional stability	Under defined temperature and humidity conditions	EN 1604	DS(70,-)	1%
			DS(70,90)	1%
Short term water absorption at partial immersion		EN 1609	---	$< 1 \text{ kg/m}^2$
Diffusion factor (μ)		EN 13164	MU50	≤ 50
Tensile strength perpendicular to the faces of insulation product		EN 1607	TR400	$\geq 400 \text{ kPa}$
Shear strength		EN 12090	SS24	$\geq 0.24 \text{ MPa}$
Shear modulus of elasticity			-	$\geq 6.7 \text{ MPa}$

Note: Classes and levels for individual characteristics comply with EN 13164: 2012+A1:2015. Only insulation products of the same or better declared characteristics, as stated in the table above, can be used in this ETICS.

Reaction to fire E has to be proved for every insulation product also at 10 mm products thickness.

Annex No. 3 Insulation product characteristics for mechanically fixed ETICS with additional bonding – MW board single density (TR10)

Description and characteristics	Regulation	Declared characteristics MW board (TR10)		
		Class, level according to EN 13162	Value	
Reaction to fire	EN 13501	A1	Apparent density $\leq 120 \text{ kg/m}^3$	
Thermal resistance	Defined in CE mark in accordance with EN 13162			
Thickness	EN 823	T5	-1 % or -1 mm*, +3 mm	
Length	EN 822	---	$\pm 2 \%$	
Width		---	$\pm 1.5 \%$	
Squareness	EN 824	---	$\leq 5 \text{ mm/m}$	
Flatness	EN 825	---	$\leq 6 \text{ mm}$	
Surface	ETAG 004	No additional treatment (homogenous, without coating)		
Dimensional stability under defined temperature and humidity	EN 1604	DS(70,90)	1 %	
Water absorption	Short term water absorption	EN 1609	WS	$\leq 1.0 \text{ kg/m}^2$
	Long term water absorption	EN 12087	WL(P)	$\leq 3.0 \text{ kg/m}^2$
Diffusion factor (μ)	EN 12086 EN 13162	MU1	1	
Tensile strength perpendicular to the faces of insulation product in dry conditions	EN 1607	TR10	$\geq 10 \text{ kPa}$	
Tensile strength perpendicular to the faces of insulation product in wet conditions	ETAG 004	---	$\geq 5 \text{ kPa}$	
Shear strength	EN 12090	---	---	
Shear modulus of elasticity	EN 12090	---	---	
Dynamic stiffness	EN 29052-1	---	SD20	
Air flow resistance	EN 29053	---	AF-60	

* - highest value applies

Note: Classes and levels for individual characteristics comply with EN 13162:2012+A1:2015. Only insulation products of the same or better declared characteristics, as stated in the table above, can be used in this ETICS.

Annex No. 4 Insulation product characteristics for mechanically fixed ETICS with additional bonding – MW board of multi-layered (TR10)

Description and characteristics		Regulation	Declared characteristics MW board multi-layered (TR10)	
			Class, level according to EN 13162	Value
Reaction to fire		EN 13501	A1	Apparent density $\leq 120 \text{ kg/m}^3$
Thermal resistance		Defined in CE mark in accordance with EN 13162		
Thickness		EN 823	T5	-1 % or -1 mm*, +3 mm
Length		EN 822	---	$\pm 2 \%$
Width			---	$\pm 1.5 \%$
Squareness		EN 824	---	$\leq 5 \text{ mm/m}$
Flatness		EN 825	---	$\leq 6 \text{ mm}$
Surface		ETAG 004	No additional treatment (homogenous, without coating)	
Dimensional stability under defined temperature and humidity		EN 1604	DS(70,90)	1 %
Water absorption	Short term water absorption	EN 1609	WS	$\leq 1.0 \text{ kg/m}^2$
	Long term water absorption	EN 12087	WL(P)	$\leq 3.0 \text{ kg/m}^2$
Diffusion factor (μ)		EN 12086 EN 13162	MU1	1
Tensile strength perpendicular to the faces of insulation product in dry conditions		EN 1607	TR10	$\geq 10 \text{ kPa}$
Tensile strength perpendicular to the faces of insulation product in wet conditions		ETAG 004	---	$\geq 5 \text{ kPa}$
Shear strength		EN 12090	---	---
Shear modulus of elasticity		EN 12090	---	---
Top layer apparent density (dry)		---	---	$\geq 150 \text{ kg/m}^3$
Top layer thickness		---	---	$\geq 15 \text{ mm}$
Bottom layer apparent density (dry)		---	---	$\geq 90 \text{ kg/m}^3$

* - highest value applies

Note: Classes and levels for individual characteristics comply with EN 13162:2012+A1:2015. Only insulation products of the same or better declared characteristics, as stated in the table above, can be used in this ETICS.

Annex No. 5 Insulation product characteristics for mechanically fixed ETICS with additional bonding – MW board (TR7.5)

Description and characteristics		Regulation	Declared characteristics MW board (TR7.5)	
			Class, level according to EN 13162	Value
Reaction to fire		EN 13501	A1	Apparent density ≤ 120 kg/m ³
Thermal resistance		Defined in CE mark in accordance with EN 13162		
Thickness		EN 823	T5	-1 % or -1 mm*, +3 mm
Length		EN 822	---	± 2 %
Width			---	± 1.5 %
Squareness		EN 824	---	≤ 5 mm/m
Flatness		EN 825	---	≤ 6 mm
Surface		ETAG 004	No additional treatment (homogenous, without coating)	
Dimensional stability under defined temperature and humidity		EN 1604	DS(70,90)	1 %
Water absorption	Short term water absorption	EN 1609	WS	≤ 1.0 kg/m ²
	Long term water absorption	EN 12087	WL(P)	≤ 3.0 kg/m ²
Diffusion factor (μ)		EN 12086 EN 13162	MU1	1
Tensile strength perpendicular to the faces of insulation product in dry conditions		EN 1607	TR7.5	≥ 7.5 kPa
Tensile strength perpendicular to the faces of insulation product in wet conditions		ETAG 004	---	≥ 5 kPa
Shear strength		EN 12090	---	---
Shear modulus of elasticity		EN 12090	---	---

* - highest value applies

Note: Classes and levels for individual characteristics comply with EN 13162:2012+A1:2015. Only insulation products of the same or better declared characteristics, as stated in the table above, can be used in this ETICS.

Annex No. 6 Anchors, description of individual product characteristics contained in the ETA

Trade name	Plate diameter (mm)	Characteristic pull-out resistance	Plate stiffness (kN/mm)	Load at plate rupture (kN)
Surface assembly				
Ejotherm STR U 2G	60	viz ETA-04/0023	0.60	2.08
EJOT H1 eco	60	viz ETA-11/0192	0.60	1.40
EJOT H4 eco				
EJOT H3	60	viz ETA-14/0130	0.60	1.25
BRAVOLL® PTH-KZ 60/8	60	viz ETA-05/0055	0.70	2.10
BRAVOLL® PTH-S	60	viz ETA-08/0267	0.90	2.60
BRAVOLL® PTH-SX	60	viz ETA-10/0028	0.70	1.80
BRAVOLL® PTH-X	60	viz ETA-13/0951	0.60	1.50
BRAVOLL® PTH-EX			0.60	1.40
KEW TSDL-V	60	viz ETA-12/0148	1.20	1.75
KOELNER TFIX-8M	60	viz ETA-07/0336	1.00	1.75
KOELNER KI-10, KI-10PA	60	viz ETA-07/0291	0.39	0.81
KOELNER KI-10M			0.45	0.85
KOELNER KI-10N, KI-10NS	60	viz ETA 07/0221	0.50	1.23
KOELNER TFIX-8S, TFIX-8ST	60	viz ETA-11/0144	0.60	2.04
KOELNER TFIX-8P	60	viz ETA-13/0845	0.30	1.38
WK THERM 8	60	viz ETA-11/0232	0.60	4.30
Klimas Wkret-met eco-drive	60	viz ETA-13/0107	0.60	2.80
WK THERM S	60	viz ETA-13/0724	0.60	4.30
FIXPLUG 8	60	viz ETA-15/0373	0.60	1.40
FIXPLUG 10	60	viz ETA-15/0373	0.60	1.60
LMX 8	60	viz ETA-16/0509	0.50	1.09
LMX 10	60	viz ETA-16/0509	0.50	1.02
LTX 8	60	viz ETA-16/0509	0.50	1.09
LTX 10	60	viz ETA-16/0509	0.50	1.02

Trade name	Plate diameter (mm)	Characteristic pull-out resistance	Plate stiffness (kN/mm)	Load at plate rupture (kN)
fischer TERMOZ 8U	60	viz ETA-02/0019	0.50	2.45
fischer TERMOZ 8SV	60	viz ETA-06/0180	1.10	2.13
fischer TERMOFIX CF 8	60	viz ETA-07/0287	0.50	1.65
fischer TERMOZ PN 8	60	viz ETA-09/0171	0.40	1.60
fischer TERMOZ CN 8	60	viz ETA-09/0394	0.40	1.60
fischer termoz CS 8	60	viz ETA-14/0372	0.60	1.70
Hilti SDK - FV	60	viz ETA-07/0302	0.50	1.48
Hilti D8 - FV	60	viz ETA-07/0288	-	-
T-Save HTS-P	60	viz ETA-10/0400	0.60	1.40
HTR-M	60	viz ETA-16/0116	0.60	1.40
HTR-P	60	viz ETA-16/0116	0.60	1.40
T-Save HTS-M	60	viz ETA-14/0400	0.60	1.40
Plates anchor TTH 10/60-La	60	viz ETA-09/0318	0.90	1.79
Countersunk assembly				
Ejotherm STR U 2G	60	viz ETA-04/0023	0.60	2.08
BRAVOLL® PTH-S	60	viz ETA-08/0267	0.90	2.60
BRAVOLL® PTH-SX	60	viz ETA-10/0028	0.70	1.80
fischer TERMOZ 8 SV	60	viz ETA-06/0180	1.10	2.13
fischer termoz CS 8	60	viz ETA-14/0372	0.60	1.70
eco-drive	60	viz ETA-13/0107	0.60	2.80
eco-drive S	60	Viz ETA-13/0107	0.60	2.80
KOELNER TFIX-8ST	60	viz ETA-11/0144	0.60	2.04
KEW TSBD 8	60	viz ETA-08/0314	1.60	2.22
Special assembly				
KOELNER TFIX-8P - RAWLPLUG S.A. - possible additional plates: KWL 140 KWL 110 KWL 090	60	See ETA-13/0845	0.30	1.38

ejotherm STR U ejotherm STR U 2G - EJOT Baubefestigungen GmbH - possible additional plates: SBL 140 plus VT 90	60	See ETA-04/0023	0.60	2.08
BRAVOLL® PTH-KZ 60/8 - ITW Construction Products CZ s.r.o. - possible additional plates: BRAVOLL® IT PTH 100 BRAVOLL® IT PTH 140	60	See ETA-05/0055	0.70	2.10
BRAVOLL® PTH-S - ITW Construction Products CZ s.r.o. - possible additional plates: BRAVOLL® IT PTH 100 BRAVOLL® IT PTH 140	60	See ETA-08/0267	0.90	2.60
KOELNER TFIX-8S - RAWLPLUG S.A. - possible additional plates: KWL 140 KWL 110 KWL 090	60	See ETA-11/0144	0.60	2.04

Countersunk assembly				
ejothem STR U ejothem STR U 2G - EJOT Baubefestigungen GmbH - possible additional plate: VT 2G	60	See ETA-04/0023	0.60	2.08
BRAVOLL® PTH-KZ 60/8 - ITW Construction Products CZ s.r.o. - possible additional plates: BRAVOLL® ZT 100 BRAVOLL® ZP	60	See ETA-05/0055	0.70	2.10
Klimas Wkret-met screw-in plug eco-drive W - Klimas Wkret-met Sp. z o.o.	60	See ETA-13/0107	0.60	2.80

In addition to this list, anchors with ETA according to EAD 330196-01-0604 or ETAG 014 can be used provided that such anchors meet the following requirements:

	Requirements for insulation on expanded polystyrene (EPS) or extruded polystyrene (XPS) or mineral wool (MW)	
Plate diameter	≥ 60 mm	
Plate stiffness	Surface assembly:	≥ 0.3 kN/mm
	Countersunk assembly:	≥ 0.6 kN/mm
Rupture force of anchor's plate	≥ Higher of figures R_{panel} and R_{joint} in relevant table in Cl. 3.3.5	
	Requirements for insulation on mineral wool (MW)	
Countersunk depth	≤ 50 mm in single density insulation products note: this table cannot be used for combination of countersunk assembly and multi-layered insulation products	
Nail of the anchor	Made out of metal	

Annex No. 7 Description of glass fibre mesh

	Description	Strength after ageing	
	Standard fibre mesh applied in one or two layers with aperture size (mm)	Absolute strength after ageing (N/mm)	Relative residual strength after ageing, of the strength in the as-delivered state (%)
R 131 A101	3.5 x 3.8	≥ 20	≥ 50
M 160	3.5 x 4.0		

