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UBAtc Assessment Operator:
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Technical Assessment Body issuing the European Technical Assessment: UBAtc.
UBAtc has been designated according to Article 29 of Regulation (EU) No 305/2011 and is member of EOTA (European Organisation for Technical Assessment)

Trade name of the construction product:	PROMASPRAY® C450
Product family to which the construction product belongs:	Fire protective products – Renderings and rendering kits intended for fire resisting applications
Manufacturer:	ETEX Building Performance NV Bormstraat 24 B-2830 Tisselt (Belgium)
Manufacturing plant(s):	ETEX Building Performances production plant 22 and 24
Website:	www.promat-international.com
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of:	European Assessment Document (EAD): EAD 350140-00-1106
This version replaces:	ETA 13/0379 issued on 2013/06/27
This European Technical Assessment contains:	38 pages, including 2 annexes, which form an integral part of the document.

European Organisation for Technical Assessment

Legal bases and general conditions

1 This European Technical Assessment is issued by UBAtc (Union belge pour l'Agrément technique de la construction, i.e. Belgian Union for technical Approval in construction), in accordance with:

- Regulation (EU) No 305/2011[1] of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC
- Commission Implementing Regulation (EU) No 1062/2013[2] of 30 October 2013 on the format of the European Technical Assessment for construction products
- European Assessment Document: 350140-00-1106

2 Under the provisions of Regulation (EU) No 305/2011, UBAtc is not authorized to check whether the provisions of this European Technical Assessment are met once the ETA has been issued.

3 The responsibility for the conformity of the performances of the products with this European Technical Assessment and the suitability of the products for the intended use remains with the holder of the European Technical Assessment.

4 Depending on the applicable Assessment and verification of constancy of performance (AVCP) system, (a) notified body(ies) may carry out third-party tasks in the process of assessment and verification of constancy of performance under this Regulation once the European Technical Assessment has been issued.

5 This European Technical Assessment allows the manufacturer of the construction product covered by this ETA to draw up a declaration of performance for the construction product.

6 CE marking should be affixed to all construction products for which the manufacturer has drawn up a declaration of performance.

7 This European Technical Assessment is not to be transferred to other manufacturers, agents of manufacturers, or manufacturing plants other than those indicated on page 1 of this European Technical Assessment.

8 The European Technical Assessment holder confirms to guarantee that the product(-s) to which this assessment relates, is/are produced and marketed in accordance with and comply with all applicable legal and regulatory provisions, including, without limitation, national and European legislation on the safety of products and services. The ETA-holder shall notify the UBAtc immediately in writing of any circumstance affecting the aforementioned guarantee. This assessment is issued under the condition that the aforementioned guarantee by the ETA-holder will be continuously observed.

9 According to Article 11(6) of Regulation (EU) No 305/2011, when making a construction product available on the market, the manufacturer shall ensure that the product is accompanied by instructions and safety information in a language determined by the Member State concerned which can be easily understood by users. These instructions and safety information should fully correspond with the technical information about the product and its intended use which the manufacturer has submitted to the responsible Technical Assessment Body for the issuing of the European Technical Assessment.

10 Pursuant to Article 11(3) of Regulation (EU) No 305/2011, manufacturers shall adequately take into account changes in the product-type and in the applicable harmonised technical specifications. Therefore, when the contents of the issued European Technical Assessment do not any longer correspond to the product-type, the manufacturer should refrain from using this European Technical Assessment as the basis for their declaration of performance.

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13 Subject to the application introduced, this European Technical Assessment is issued in English and may be issued by the UBAtc in its official languages. The translations correspond fully to the English reference version circulated in EOTA.

14 A European Technical Approval was issued by UBAtc on 27 June 2013. Compared with that European Technical Approval, the current European Technical Assessment, issued on 12 May 2018, comprises no technical changes, but – given that EAD 350140-00-1106 replaced ETA-Guideline 018-3 in the meantime, editorial changes have been made to ensure the ETA corresponds with the requirements of the EAD. In addition, one production facility has been removed, another one has been added.

[1] OJEU, L 88 of 2011/04/04

[2] OJEU, L 289 of 2013/10/31

Technical Provisions

1 Technical description of the product

1.1 General

This ETA covers a fire protective final assembly comprising the dry mix and the bonding agent, option 3 as described in the clause 1.1 of EAD 350140-00-1106 intended for:

- Internal use (EAD 350140-00-1106, type Z_2)
- Internal use (EAD 350140-00-1106, type Z_1)
- External use, but not exposed to UV and Rain (EAD 350140-00-1106, type Y)

PROMASPRAY® C450 is a lightweight rendering that provides fire resistance to load bearing steel, to load bearing concrete, to steel/concrete floors and to metal floor and roof decks.

PROMASPRAY® C450 is a spray applied, single package factory controlled dry premix, based on vermiculite and Portland cement for internal and external use. Application is through batch mix. When requested the surface may be smoothed using a trowel. Small repairs may be realised by trowel application.

PROMASPRAY® C450 can be applied in thicknesses between 10 mm and 55 mm), according to the requirements given in Annex 2. If more than 12 mm thickness is required it may be necessary to apply the material in more than one coat.

The dry density of the hardened mortar is depending on the spraying direction. When filling the mould by spraying upwards in the mould, the obtained density is 365 ± 15%. When filling the mould by spraying downwards the density is 390 ± 15%

PROMASPRAY® C450 is manufactured at ETEX Building Performance's production plants 22 and 24 (known at UBAtc).

1.1.1 Dry mix

Properties	Test method	
Description	Visual	Flocky powder
Fingerprint	XRD and DSC	See technical records, kept by approval body
Colour	Visual	Off white
Apparent density	Internal test method	185-255 g/l

1.1.2 Fresh mortar (when batch mixed)

Properties	Test method	
Mixing ratio		20-24 litres/bag
Density after mixing	Internal test method based on EN 1015-6	480-640 kg/m³
Density after spraying	Internal test method based on EN 1015-6	680-980 kg/m³
Slump (on material from mixer)	Internal test method	55-75 mm

1.1.3 Rendering

Properties	Test method	
Description	Visual	Monolithic sprayed texture
Colour	Visual	Off white
Density	Manufacturer's internal test method based on EN 1015-10	Spray application using the batch mix method: spraying upwards: 365 kg/m³ ± 15%. spraying downwards: 390 kg/m³ ± 15%

1.2 Conditioning

PROMASPRAY® C450 is available in 12,5 kg bags. It has to be mixed with 20 to 24 litres of potable water per bag when the batch mix method applied

1.3 Ancillary products

Ancillary products referred to in this ETA, as a part of installation provisions or in the framework of determining performances (e.g. fire resistance test), are not covered by this ETA and cannot be CE-marked on the basis of it.

Depending on the nature of the structure to be protected, PROMASPRAY® C450 may require a bonding agent. A styrene acrylic copolymer bonding agent such as Cafco® SBR Bonding Latex or PSK101 may be required according to the requirements given in Annex 2.

Depending on the nature of structures to be protected PROMASPRAY® C450 may require a latt such as GRIFF LATT or RIBLATH + Paper or similar according to the requirements given in Annex 2.

For PROMASPRAY® C450 applications with a thickness over 12mm the use of a plastic coated galvanised 50 x 50 mm hexagonal mesh such as CAFCO Plastic Coated Galvanised mesh fixed for example with Cafco Helical CD Weld Pins may be required, according to the requirements given in Annex 2.

Small locally damaged areas can be hand applied repaired using the PROMASPRAY® C450 patching mix.

2 Specification of the intended use(s) in accordance with the applicable EAD

2.1 Intended uses

This ETA covers fire protective rendering PROMASPRAY® C450 intended for:

- Internal use (EAD 350140-00-1106, type Z_2)
- Internal use (EAD 350140-00-1106, type Z_1)
- External use, but not exposed to UV and Rain (EAD 350140-00-1106, type Y)

PROMASPRAY® C450 is intended for the fire protection of construction elements or to be used in assemblies as specified in Table 1.

Table 1 : Intended use

Protection of	EAD 350140-00-1106 reference
Horizontal membrane protection	Type 1
Vertical membrane protection	Type 2
Load-bearing concrete elements	Type 3
Load-bearing steel elements	Type 4
Load-bearing flat concrete profiled sheet composite elements	Type 5
Load-bearing concrete filled hollow steel columns	Type 6
Load-bearing timber elements	Type 7
Fire separating assemblies with no load-bearing requirements	Type 8
Technical services assemblies in buildings	Type 9
Uses not covered by types 1-9	Type 10

Table 1 shows the possible intended uses of the renderings. Not all of these have been assessed in the framework of this ETA with regard to fire resistance performance. Annex 2 shows a list of the uses for which fire resistance assessment was carried out. This ETA covers assemblies installed in accordance with the provisions given in Annex 2.

The provisions made in this European Technical Assessment are based on an assumed intended working life of 25 years, provided that the assembled product is subject to appropriate use and maintenance, in accordance with this ETA.

Indications given regarding the working life cannot be interpreted as a guarantee given by the producer or the UBAtc, but shall be regarded only as a means for choosing the appropriate product(s) in relation to the expected economically reasonable working life of the construction works.

2.2 Assumptions

2.2.1 Manufacturing directives

This European Technical Assessment is issued for PROMASPRAY® C450 on the basis of agreed data/information, deposited with the UBAtc, which identifies the product that has been assessed. Changes to the product/production process which could result in the deposited data/information being incorrect should be notified to the UBAtc before the changes are introduced.

The raw materials are mixed in a continuous process. The mix is put into bags. Each bag is marked in accordance with paragraph 6 of this ETA. PROMASPRAY® C450 bags are examined for visual defects and non-compliant bags are rejected.

2.2.2 Installation

2.2.2.1 *General*

The fire protection rendering shall be installed according to the manufacturer's instructions that may be found in the PROMASPRAY® C450 Application Guide. It is the manufacturer's responsibility to provide correct information about the application to the users.

Minimum requirements for satisfactory installing of the product in respect of training, competence and experience are identified in the installation and application instructions. On request of the applicator, the manufacturer may provide a technical training on site for the use of the PROMASPRAY® C450 product.

2.2.2.2 *Tools and equipment for application*

2.2.2.2.1 General

The PROMASPRAY® C450 is premixed with water until constant volume and then pumped to a nozzle where compressed air is used to spray the wet mix to the substrate.

2.2.2.2.2 Mixer

A paddle of ribbon-type plaster mixer, with a safety cover, rubber tipped blades and provisions for quick dumping of mix directly into the pump hopper is required. Mixers with a 150 litres capacity or larger with minimum operating speeds of 20-30 rpm are required.

A water metering device is required to ensure constant quality of the mix. All water meters shall be calibrated to ensure proper water to product ratio. PROMASPRAY® C450 requires about 20 – 24 litres / 12,5 kg bag. The mixing time is 3 minutes. After mixing a wet mixer density of the fresh mortar between 480 and 640 kg/m³ is obtained.

2.2.2.2.3 Pumps

A spraying machine based on a metal rotor/flexible stator, e.g. Mono pump is recommended/ The pump speed is in the range of 100 – 600 rpm.

Hoses, couplings, nozzles and other additional equipment must respect the instructions of the ETA holder

2.2.2.3 *Requirements for substrate*

2.2.2.3.1 Inspection of substrate

Before application, the substrate should be inspected and prepared. The inspection consists of the verification of the surfaces to be sprayed. The following conditions should not exist before applying PROMASPRAY® C450

- Oily steel decks (residual roll oils)
- Loose mill scale, loose rust or dirt
- Concrete form oils
- Foreign materials that may prevent proper bonding to the substrate.

The substrate shall be chemically resistant to Portland cement.

The substrate shall be rigid, free of deformations or excessive vibrations before PROMASPRAY® C450 has set. Mid span deflection of deck spans should not be greater than L/240.

PROMASPRAY® C450 may be applied directly to clean bare steel structural members or steel structural members with generic primers (see 2.2.2.3.2).

Supports made of galvanised steel or concrete may first be treated with a styrene acrylic copolymer bonding agent such as Cafco® SBR Bonding Latex.

Clips, hangers, supports, sleeves and other attachments to the substrate shall be placed by others prior to the application of PROMASPRAY® C450. Ducts, piping, conduit or other suspended equipment shall be installed after the application of PROMASPRAY® C450.

2.2.2.3.2 Accepted corrosion protection primers

Corrosion protection primers that have been a part of the test assemblies and thus are covered by this ETA are within the following two generic families:

- short/medium oil alkyd primers
- two component epoxy primers

Non-primed galvanized steel has also been a part of the test assemblies and is covered by this ETA.

2.2.2.3.3 Bonding agents

Bonding agents for PROMASPRAY® C450 are described in clause 1.3.

2.2.2.4 Additional bonding reinforcement

For general use in construction industry, PROMASPRAY® C450 does not require any form of mesh reinforcement. In some cases, as described in the installation manual, meshes will be required.

2.2.2.5 Environmental conditions during mixing, application and construction

An air and substrate temperature of 40°C minimum shall be maintained for 24 hours prior to application, during application and for a minimum of 24 hours after application. Substrate temperature should be at least 2°C above dew point. Maximum air and substrate temperature is 45°C.

Envisage an adequate ventilation to allow the product to dry after being sprayed. In closed areas, where the ventilation is inadequate, it is necessary to install a ventilation and air circulation device sufficient to obtain a renewing of air at least 4 times per hour. During winter time, special considerations shall be taken according to recommendations from the manufacturer.

As given in clause 1.1, the product is intended for conditions Z_2., Z_1 and Y.. Special provisions for temporarily protection of the exposed rendering being subjected to rain during construction shall be taken.

2.2.2.6 Application of rendering

Application instructions provided by the ETA-holder should be respected.

Where an approved primer is present or on metal lath or on concrete an application of a styrene acrylic copolymer bonding agent such as Cafco® SBR Bonding Latex may be required.

PROMASPRAY® C450 should be sprayed in coats of regular thickness, depending on the requested thickness as follows:

The thickness of the initial coat of PROMASPRAY® C450 is 9 to 17 mm. Subsequent coats, with thickness between 19 and 25 mm, can be applied until the final thickness is achieved. Allow the material to set between coats. If the surface of the applied PROMASPRAY® C450 is dry, pre-wet this surface with a water mist before applying the next coat.

When spraying beams PROMASPRAY® C450 is sprayed first on top side of the lower flange. Thereafter the section can be sprayed in any order.

Spray application of PROMASPRAY® C450 results in a bold textured finish. If a smoother finish is desired, the final spray applied coat of PROMASPRAY® C450 can be either lightly trowelled or during spraying the air pressure can be increased, improving the appearance but also resulting in a higher density of the top coat.

Depending on the temperature on the jobsite and the relative humidity, PROMASPRAY® C450 will obtain an initial set in about 3 to 6 hours.

2.2.2.7 Site tests

The adhesion of the dry rendering to the substrate should be tested on site. A suitable method for site measurement is based on EGOLF Agreement EA 05:1999.

The person responsible for works will decide on the adequacy of the site tests results taking into account the reference values given in clause 3.7. For their acceptability, whether recommendations given in EAD 350140-00-1106, or other existing criteria may be applied, under the responsibility of the person responsible for works.

The thickness should be measured at a frequency sufficient to determine the mean and minimum thickness. A suitable method for thickness measurement is given in EAD 350140-00-1106, clause 5.0.2 (for non-fire tests). The location of the measurements, with a minimum of 10 per controlled specimen, will be geometrically uniformly distributed over the surface of the controlled specimen, and shall include visible cracks.

The density of the rendering should be measured and be within the tolerances specified in table 1. A suitable method for density measurement is given in EAD 350140-00-1106, clause 5.0.2, except that the number of samples may be reduced to an appropriate level.

2.2.2.8 Surface treatments and protection

This ETA covers only rendering without topcoats.

The resistance to mechanical impact from hard and soft bodies have not been assessed. The use of the rendering is therefore limited to applications where the rendering is protected from such impacts. The accessible structure exposed to friction or impact related to the activity on site should be covered with adapted protection depending on the site configuration. The protection is to be independent from the PROMASPRAY® C450 rendering.

The vapour permeability of the product has not been assessed.

2.2.2.9 Assembly

PROMASPRAY® C450 rendering shall be applied as specified in the assemblies in Annex 2.

2.3 Recommendations

2.3.1 Recommendations on packaging, transport and storage

PROMASPRAY® C450 shall be stored in a dry environment. It should be stored off the ground, under a weatherproof cover, and protected from damp surfaces or areas of high humidity.

PROMASPRAY® C450 should be protected from frost, heat above 45°C and strong radiant sunlight.

The temperature of the PROMASPRAY® C450 dry mix at the mixing should be at least 4°C.

PROMASPRAY® C450 may be stored up to 12 months from date of manufacture under dry conditions. Material damaged by moisture (open or damaged bags) should not be used. Throw away bags that have been exposed to water.

2.3.2 Recommendations on use, maintenance and repair

This assessment is based on the assumption that damage, for example caused by accidental impact, is repaired. It is further assumed that replacement of components during maintenance/repair will be undertaken using materials specified by this ETA.

PROMASPRAY® C450 that has been damaged or removed may be repaired by spraying. Small areas can be repaired by hand trowelling of PROMASPRAY® C450 Patching Mix to the affected areas. The maximum area that can be patched by hand trowelling is 0,3 m². If the thickness of the patch is greater than 13mm, multiple coats will be necessary

Use water spray to pre-wet the area before commencing repair procedures. The previous surface should be rough in texture to achieve the best possible adhesion.

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

3.1 Reaction to fire

The fire protective rendering PROMASPRAY® C450 has a reaction to fire classification A1 according to EN 13501-1:2007.

3.2 Fire resistance

The resistance to fire performance PROMASPRAY® C450, according to EN 13381-3, EN 13501-2, EN 13381-4 and EN 13381-5 for various thicknesses and intended uses of the fire protective renderings, is presented in Annex 2.

3.3 Content, emission and/or release of dangerous substances

No performance assessed.

3.4 Water vapour permeability

No performance assessed.

3.5 Mechanical resistance and stability

No performance assessed.

3.6 Resistance to impact/movement

No performance assessed.

3.7 Adhesion

Adhesion tests have been performed in accordance with EAD 350140-00-1106 and EGOLF Agreement EA 05:1999. The adhesion/cohesion of the PROMASPRAY® C450 fire protective product depends on the installed thickness and on the preparation of the substrate.

Almost all adhesion tests lead to cohesive failures. As an example, the tensile bonding strength of PROMASPRAY® C450on several substrates are given in the table below.

These values are guidance values and do not reflect a statistical evaluation, or minimum guaranteed values.

Surface	Thickness (mm)	Tensile bond strength (kPa)	
		Avg	Sdev
Steel Unprimed	50	15.52	4.38
Steel Unprimed	15	24.12	6.22
Steel Alkyd primer	50	18.21	5.83
Steel Alkyd primer	15	16.75	4.43
Steel Epoxy primer	50	20.94	6.67
Steel Epoxy primer	15	26.47	5.97
Concrete (release agent : emulsion)	17	51,97	2.3
Concrete (release agent : Emulsion)	53	48.83	5.2
Concrete (release agent : Mineral oil)	17	49.61	3.5
Concrete (release agent : Mineral oil)	53	45.54	5.6

3.8 Airborne sound insulation

No performance assessed.

3.9 Sound absorption

No performance assessed.

3.10 Impact sound insulation

No performance assessed.

3.11 Thermal insulation

No performance assessed.

3.12 Aspects of durability, serviceability and identification

PROMASPRAY® C450 has been assessed for a working life of 25 years for the intended use Z_2 (internal use), Z_1 (Internal use in humid environment) and Y (External use, but not exposed to UV and rain).

3.13 Serviceability

This characteristic is not relevant for the intended uses. No performance assessed.

4 Assessment and verification of constancy of performance (AVCP) system applied

4.1 Assessment and verification of constancy of performance

4.1.1 For fire protective uses

The system of assessment and verification of constancy of performance is specified in the EC Decision 99/454/EC[3], as amended by EC Decision 2001/596/EC[4] (system 1).

4.1.2 Uses subject to reaction to fire regulations

The systems of assessment and verification of constancy of performance are specified in the EC Decision 99/454/EC, as amended by EC Decision 2001/596/EC, depending on the class(es) declared.

4.2 Responsibilities

4.2.1 Tasks of the manufacturer

4.2.1.1 Factory production control

4.2.1.1.1 General

The ETA-holder exercises permanent internal control of the production. All the elements, requirements and provisions adopted by the ETA-holder are being documented in a systematic manner in the form of written policies and procedures. This factory production control system ensures that the products are in conformity with the European Technical Assessment (ETA).

The personnel involved in the production process have been identified, sufficiently qualified and trained to operate and maintain the production equipment. Machinery equipment is being regularly maintained and this is being documented. All processes and procedures of production are being recorded at regular intervals.

The ETA-holder maintains a traceable documentation of the production process from purchasing or delivery of raw or basic raw materials up to the storage and delivery of finished products.

The factory production control system for the product includes relevant design specifications, including adequate drawings and written instructions for:

– type and quality of all materials
– packaging and transport protection

The production control system specifies how the control measures are carried out, and at which frequencies.

Products that do not comply with requirements as specified in the ETA are being separated from the conforming products and marked as such. The ETA-holder registers non-compliant production and action(-s) taken to prevent further non-conformities. External complaints are also being documented, as well as actions taken.

[3] OJ L 178, 14.7.1999, p.52
[4] OJ L 209, 2.8.2001, p.33

4.2.1.1.2 Maintenance, calibration of testing equipment

All testing equipment is being maintained, calibrated and/or checked against equipment or test specimens traceable to relevant international or nationally recognised reference test specimens (standards).

The ETA-holder ensures that handling, preservation and storage of test equipment is such that its accuracy and fitness for purpose is maintained

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

4.2.1.2 Other tasks of the ETA-holder

The following table specifies properties that should be controlled and minimum frequencies of control. The test method and threshold have been laid down in the control plan.

4.2.1.2.1 Dry mix

Property	Test method	Minimum frequency of tests
Incoming materials	Verification of the declaration of conformity, based on ETA-Holder's specification	Every batch supplied
Bulk density of dry mix	ETA-Holder's specification	five times per day (24h) at regular intervals
General dry grading	ETA-Holder's specification	once per day

4.2.1.2.2 Fresh mortar

Properties	Test method	Minimum frequency of tests
Density	ETA-Holder's specification	five times per day (24h) at regular intervals
Foam Concentration	ETA-Holder's specification	five times per day (24h) at regular intervals
Setting time	ETA-Holder's specification	five times per day (24h) at regular intervals

4.2.1.2.3 Rendering (hardened mortar)

Properties	Test method	Minimum frequency of tests
Density	As established in assessment tests	once per month
Adhesion / Cohesion	As established in assessment tests	once per month
Insulation Efficiency	Time to 500°C	once per month

4.2.2 Tasks of notified bodies

4.2.2.1 Assessment of the performance of the construction product

The assessment tests have been conducted by the assessment body in accordance with EAD 350140-00-1106, chapter 2 , as relevant, and the technical assessment body has assessed the results of these tests, as part of the ETA issuing procedure. In accordance with Regulation (EU) N° 305/2011, Annex V, 1.6, notified bodies and manufacturers shall not undertake the assessment of the performance of the product.

4.2.2.2 Initial inspection of the manufacturing plant and of the factory production control system and continuous surveillance, assessment and evaluation of the factory production control system

Assessment of the factory production control system is the responsibility of the notified body.

An assessment shall be carried out of the production unit to demonstrate that the factory production control is in conformity with the ETA and any subsidiary information. This assessment shall be based on an initial inspection of the factory. The relevant production unit has been specified in the ETA.

Subsequently continuous surveillance of factory production control is necessary to ensure continuing conformity with the ETA. It is recommended that Surveillance inspections shall be conducted at least twice a year.

4.3 Other marking and/or information

Each bag of dry mix is marked with the product name and a traceability code.

UBAtc asbl is a non-profit organization according to Belgian law. It is a Technical Assessment Body notified by the Belgian notifying authority, the Federal Public Services Economy, SMEs, Self-Employed and Energy, on 17 July 2013 in the framework of Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC and is member of the European Organisation for Technical Assessment, EOTA (www.eota.eu).

This European Technical Assessment has been issued by UBAtc asbl, in Sint-Stevens-Woluwe, on the basis of the technical work carried out by the Assessment Operator, BCCA.

On behalf of UBAtc asbl,

Peter Wouters,
director

On behalf of the Assessment Operator, BCCA, responsible for the technical content of the ETA,

Benny De Blaere,
director general

The most recent version of this European Technical Assessment may be consulted on the UBAtc website (www.ubatc.be).

Annexes

Annex I: References

Reference number 350140-00-1106
Document title Fire protective products – Renderings and rendering kits intended for fire resisting applications.

Reference number EN 13501-1:2002
Document title Fire classification of construction products and building elements - Part 1: Classification using test data from reaction to fire tests

Reference number EN 13501-2:2003
Document title Fire classification of construction products and building elements - Part 2: Classification using data from fire resistance tests, excluding ventilation services

Reference number EN 13501-3:2005
Document title Fire classification of construction products and building elements - Part 3: Classification using data from fire resistance tests on products and elements used in building service installations: fire resisting ducts and fire dampers

Reference number EN 13501-4:2005
Document title Fire classification of construction products and building elements - Part 3: Classification using data from fire resistance tests on products and elements used in building service installations: fire resisting ducts and fire dampers

Reference number EGOLF EA5:1999 (2007)
Document title Method for the measurement of bonding properties of fire protection materials applied to steel, concrete and steel / concrete composite structures

Reference number EN 1015-6:1998
Document title Methods of test for mortar for masonry – Part 6: Determination of bulk density of fresh mortar

Reference number EN 1015-10:1999
Document title Methods of test for mortar for masonry – Part 6: Determination of dry bulk density of hardened mortar

Annex II : Fire resistance performances and assembly methods for uses of renderings covered by this ETA

A 2.1 Overview of fire resistance performances for PROMASPRAY® C450 assemblies

The fire protective assemblies given in Table A2.1 have been assessed within the framework of this ETA. Assemblies and applications installed according to the provisions given in this Annex 2 are covered by this ETA.

Table A2.1

Assemblies assessed within the framework of this ETA	Classification according to EN 13501-2	Test Standard	Intended use category according to EAD 350140-00-1106	Installation details	Date of addition to this ETA
Protection of load-bearing concrete elements, thickness 14 to 54 mm	Assessment: See Annex A.2.2	ENV 13381-3:2002 Annex C	Type 3	Annex A.2.2	2013-06-27
Protection of load-bearing steel deck roof, thickness 25 mm	REI 60, RE 60, R 90	EN 1365-2:1999	Type 4	Annex A.2.3	2013-06-27
Protection of load-bearing steel elements, thickness 10 to 58 mm	Assessment: See Annex A.2.4	ENV 13381-4:2002 Annex C	Type 4	Annex A.2.4	2013-06-27
Protection of load-bearing composite concrete/profiled steel sheet elements, thickness 11 to 56 mm	Assessment: See Annex A.2.5	ENV 13381-5:2002	Type 5	Annex A.2.5	2013-06-27

Annex 2.2: Specification and assessment of fire protection of a load bearing concrete assembly (intended use type 3) protected by PROMASPRAY® C450 rendering, thickness 14 to 54 mm.

A.2.2.1 Date of addition to this ETA

This annex was added to the ETA 13/0379 on 2013-06-27. This assembly was not covered by this ETA prior to the addition of this annex.

A.2.2.2 Classification

The assembly described in this annex has been tested and assessed according to ENV 13381-3:2002 and classified in accordance with EN 13501-2.

The maximum duration of the exposure to the standard time temperature curve as defined in EN 1363-1, §5.1.1, is 360 min, depending on the type of concrete structures and the thickness of the PROMASPRAY® C450 applied.

The assessment of the insulation efficiency and the equivalent thickness of concrete is given in A.2.3.4.

A.2.2.3 Installation requirements

A.2.2.3.1 Supporting structure

PROMASPRAY® C450 shall be applied by using a bonding agent or key coat such as Cafco® SBR Bonding Latex to dense concrete beams and slabs, and to walls that are exposed on 1 side only.

Specifications for the components are given in Table A.2.3.3.1

Table A.2.3.3.1

Element	Identification	Characteristics	Mounting and fixing
Load bearing concrete beam	Concrete, siliceous aggregates	Strength class C25/30 Density 2303 kg/m³ ± 15 % Width of the beam ≥ 150 mm	Casted with release agent applied in the mould, belonging to the families of mineral oil or emulsions. Surface shall be free of dust and bare.
Load bearing concrete slabs	Concrete, siliceous aggregates	Strength class C25/30 Density 2303 kg/m³ ± 15 % Thickness: ≥ 120 mm	Casted with release agent applied in the mould, belonging to the families of mineral oil or emulsions. Surface shall be free of dust and bare.
Load bearing concrete wall exposed on one side	Concrete, siliceous aggregates	Strength class C25/30 Density 2303 kg/m³ ± 15 % Thickness: ≥ 120 mm	Casted with release agent applied in the mould, belonging to the families of mineral oil or emulsions. Surface shall be free of dust and bare.

A.2.2.3.2 Bonding agent prior to application of PROMASPRAY® C450

Whatever is the release agent used to cast the concrete as mentioned above, no bonding agent was applied, before the application of PROMASPRAY® C450.

A.2.2.3.3 Fire protective rendering

PROMASPRAY® C450 is applied on the apparent sides of the concrete structures to be protected, by following its shape.

PROMASPRAY® C450 is sprayed, in one or more layers of 15 mm to 20 mm each to reach the required thickness, with one day between 2 successive layers. During the application, the thickness of the protective material is regularly controlled with a thickness gauge. After reaching the required thickness, it is kept without finishing.

Each bag of PROMASPRAY® C450 was mixed with potable water, prior to injection in the tank. The ration between PROMASPRAY® C450 and water was 1 bag (12.5 kg) / 19 to 23 litres of water.

Specifications for the components are given in Table A.2.3.3.3

Table A.2.3.3.3

Element	Identification	Characteristics	Mounting and fixing
Rendering	PROMASPRAY® C450	Average thicknesses: from 14 to 54 mm, according to the assessment rules. Density: 310 to 333 kg/m³	Sprayed, using the batch mix method, in one or more layers with thicknesses between 15 mm and 20 mm, without finishing

A.2.2.4 Assessment of the fire performance of PROMASPRAY® C450 on concrete structures

A.2.2.4.1 Protection of concrete slabs and walls

The insulation efficiency of the protective material when applied on slabs and walls is determined in function of :

- the thickness of protective material applied (mm) ;
- the standard concrete temperature comprised between [300,650] (°C) ;
- the duration of the thermal exposure under the standard time temperature curve as defined in EN 1363-1, 5.1.1

A.2.2.4.1.1 Concrete slab protected by 14 mm of PROMASPRAY® C450

Depth (mm)	Temperatures inside concrete slab (°C) Duration of exposure under EN 1363-1 (min)											
	30	60	90	120	150	180	210	240	270	300	330	360
0	283	357	418	469	511	559	605	651	689	733	775	807
15	113	178	248	310	366	416	461	503	543	582	619	653
30	84	135	178	233	284	331	373	413	449	483	516	548
45	65	111	142	180	225	269	309	346	381	414	446	477
60	49	91	120	141	170	210	246	280	312	343	373	404
75	38	72	99	117	133	161	192	222	253	283	313	342
120	23	37	56	74	90	95	96	99	110	130	149	165

A.2.2.4.1.2 Concrete slab protected by 54 mm of PROMASPRAY® C450

Depth (mm)	Temperatures inside concrete slab (°C) Duration of exposure under EN 1363-1 (min)											
	30	60	90	120	150	180	210	240	270	300	330	360
0	56	78	100	121	139	153	164	175	186	197	208	219
15	41	59	75	85	96	107	116	124	132	141	149	159
30	37	52	66	76	87	98	107	114	121	127	133	139
45	35	48	61	72	82	93	101	108	115	121	127	133
60	33	42	54	64	74	84	92	99	105	110	115	120
75	31	38	47	56	65	74	82	90	96	102	106	110
120	30	32	36	43	49	56	62	67	72	77	82	86

A2.2.4.2 Protection of rectangular concrete beams of minimum 150 x 150 mm.

The insulation efficiency of the protective material when applied on rectangular beams or columns of minimum 150 x 150 mm is determined in function of :

- the thickness of protective material applied (mm) ;
- the standard concrete temperature comprised between [300,650] (°C) ;
- along a vertical, horizontal and diagonal axis ;

the duration of the thermal exposure under the standard time temperature curve as defined in EN 1363-1, 5.1.1

NOTE : The results below are valid for concrete beams cast whatever is the release agent used : emulsion or mineral oil

A2.2.4.2.1 Concrete beam protected with 19mm PROMASPRAY® C450

Along a vertical axis

Depth (mm)	Temperatures inside concrete beam along vertical axis (°C)						
	Duration of exposure under EN 1363-1 (min)						
	30	60	90	120	150	180	210
0	159	218	277	344	416	493	570
17	99	163	244	321	395	463	524
75	51	103	133	168	212	278	343
150	41	80	116	134	159	187	239
450	33	59	91	101	123	140	154

Along an horizontal axis

Depth (mm)	Temperatures inside concrete beam along horizontal axis (°C)						
	Duration of exposure under EN 1363-1 (min)						
	30	60	90	120	150	180	210
0	158	219	269	315	365	419	482
17	75	116	156	199	246	296	351
75	41	80	116	134	159	187	239

Along a diagonal axis

Depth (mm)	Temperatures inside concrete beam along diagonal axis (°C)						
	Duration of exposure under EN 1363-1 (min)						
	30	60	90	120	150	180	210
44	98	158	235	309	382	450	512
78	66	118	161	214	278	344	410
106	51	103	133	168	212	278	343

A.2.2.4.2.2 Concrete beam protected with 54mm PROMASPRAY® C450

Along a vertical axis

Depth (mm)	Temperatures inside concrete beam along vertical axis (°C)											
	Duration of exposure under EN 1363-1 (min)											
	30	60	90	120	150	180	210	240	270	300	330	360
0	54	87	103	137	162	187	214	244	275	306	339	373
17	44	76	97	115	140	167	197	229	261	293	326	359
75	31	52	75	93	108	122	140	159	180	202	228	257
150	28	43	63	79	94	110	118	133	147	161	175	190
450	27	36	54	72	88	96	99	100	101	116	125	132

Along an horizontal axis

Depth (mm)	Temperatures inside concrete beam along horizontal axis (°C)											
	Duration of exposure under EN 1363-1 (min)											
	30	60	90	120	150	180	210	240	270	300	330	360
0	50	71	92	110	136	159	178	195	213	232	251	275
17	38	60	82	94	107	123	140	158	176	195	215	237
75	28	43	63	79	94	110	118	133	147	161	175	190

Along a diagonal axis

Depth (mm)	Temperatures inside concrete beam along diagonal axis (°C)											
	Duration of exposure under EN 1363-1 (min)											
	30	60	90	120	150	180	210	240	270	300	330	360
44	45	76	99	119	142	169	199	230	260	291	323	355
78	35	61	84	104	119	138	160	184	210	238	268	298
106	31	52	75	93	108	122	140	159	180	202	228	257

A.2.2.4.3 Equivalent thickness of concrete for the protective product PROMASPRAY® C450

The equivalent thicknesses of concrete induced by the protective material PROMASPRAY® C450 , has been determined according to requirements of Annex C of standard ENV 13381-3:2002 and according to requirements of Annex A of document NF EN 1992-1-2 : "Eurocode 3 : Design of concrete structures – Part 1-2 : General rules – Structural fire design" – October 2005.

Type of concrete structure	Thickness of PROMASPRAY-C450 (mm)	Equivalent thickness of concrete (mm)					
		Duration of exposure under EN 1363-1					
		30 min	60 min	90 min	120 min	180 min	240 min
Slab	14	33	43	46	46	45	44
	54	66	>85	>85	>85	>85	>85
Beam	19	17	39	51	52	50	*
	54	23	69	78	88	111	116

* : Duration of exposure not covered

A.2.2.4.4 Stickability of protective product PROMASPRAY® C450 on concrete structures

The stickability of protective material PROMASPRAY® C450 when has been determined according to requirements of paragraph 13.5. of standard ENV 13381-3:2002, in function of :

- the thickness of protective material applied (mm) ;
- the concrete structure, beam or slab ;
- the type of release agent used to cast the concrete.

Type of concrete structure	Type of release agent	Thickness of PROMASPRAY-C450 (mm)	Maximum interface temperature (°C)
Slab	Mineral oil	14	778*
	Emulsion	14	853*
	Mineral oil	54	236*
	Emulsion	54	235*
Beam	Mineral oil	19	650**
	Emulsion	19	637**
	Mineral oil	54	380*
	Emulsion	54	380*

** : No fall-down of material till end of reference test*
*** : No fall-down of material till collapse of the beam during reference test*

Annex 2.3: Specification of a load-bearing steel deck roof (intended use type 4) protected by the PROMASPRAY® C450 rendering, 25 mm in thickness, sprayed on a metallic lath.

A.2.3.1 Date of addition to this ETA

This annex was added to the ETA 13/0379 on 2013-06-27. This assembly was not covered by this ETA prior to the addition of this annex.

A.2.3.2 Classification

The assembly described in this annex has been tested according to EN 1365-2 and classified **REI 60**, **RE 60** and **R90** in accordance with EN 13501-2:2007 + A1:2009.

A2.3.3 Installation requirements

A.2.3.3.1 Description

The supporting structure is a loadbearing continuous steel deck roof, protected by a fire protective spray, covering two consecutive spans, supported at both ends and at the midspan, covered with Insulation boards and a roof membrane at the top side and protected by a protective spray provided with a reinforcement mesh at the fire exposed side. The specimen length is 6100 mm, the span length is 2 x 2890 mm and the exposed length is 2 x 2870 mm.

Description of the steel deck roof :

- **(1)** Steal beam
- **(2)** Mineral Wool, placed between the flanges of the steel beam
- **(3)** Profiled steel sheet – material : galvanised steel – Type : Color Profil 101.275.825 HR – dimensions 825 mm x 6100 mm – height : 101 mm – Thickness : 1 mm – Weight : 12.60 kg/m²
- Fixed with **(4)** nails, HILTI NK 20 R – length 20mm, diameter 3.5 mm; centre/centre distance : 275 mm at midspan, and **(5)** steel screws, length 35 mm; diameter 3.5 mm, centre/centre distance 275 at both ends.
- **(6)** Insulation : PIR-Foam (Recticel Eurothane Powerdeck) thickness 60 mm – covered with aluminium foil (50µm) on both sides – weight 1.8 kg/m², positioned on top of the profiled steel sheet with **(7)** stress plate (type SFS IF 70x70 – thickness 1 mm) and screw length 110 mm diameter 6.5 mm
- **(8)** Triangular insulation strip – Polyurethane, dimensions 50mm x 50 mm x 1200 mm – density 72 kg/m³ on the insulation at the edges of the roof
- **(9)** Roof membrane type Derbicoat S, Thickness 3 mm, reinforced with glass fibre (50 g/m²) weight 3.4 kg/m². Fixed on top of the insulation with **(10)** cold glue (type DERBIBOND NT©) density 1.15 kg/l
- **(11)** Reinforcement mesh, type GRIP LATT Plus 6000 – weight 1.27 kg/m², fixed with **(12)** self-drilling screws, length 32mm diameter 3.9 mm, under the profiled steel sheet, with centre/centre distances in longitudinal direction 200mm, and transversal directions 275 mm
- **(13)** Fire protective rendering : PROMASPRAY® C450 – Thickness 25 mm sprayed on the reinforcement mesh
- **(14)** Fire protective rendering : PROMASPRAY® C450 – Thickness 20 mm sprayed on the steel beam.

An additional uniform distributed load of 70 kg/m² is applied during the test

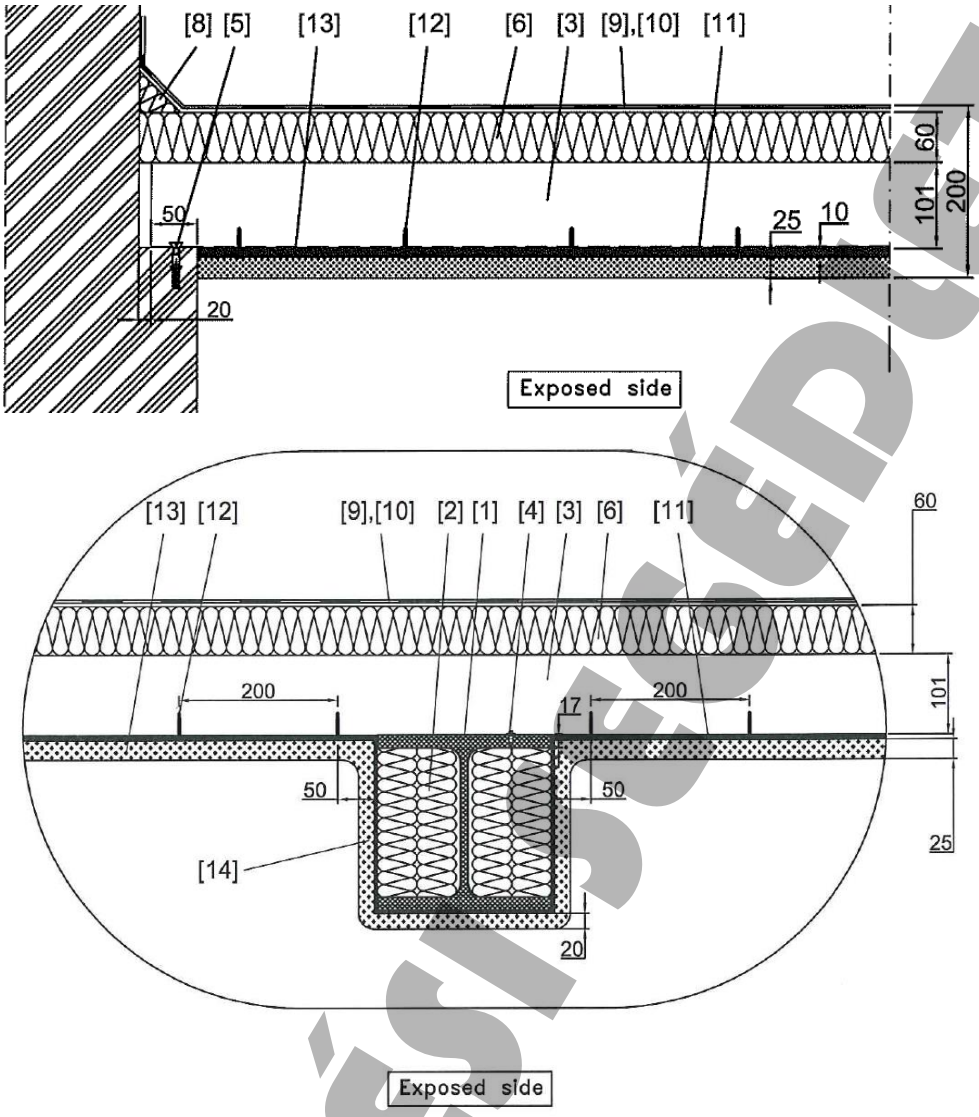
A.2.3.3.2 Fire protective rendering

The fire protective product PROMASPRAY® C450 is applied by spraying.

A layer of PROMASPRAY® C450 is sprayed directly on the metallic lath until the required thickness is reached.

During the application, the thickness of protective material is regularly checked with a thickness gauge.

A.2.3.3.3 – Drawings



Legend : see A.2.3.3.1

Annex 2.4. Specification and assessment of fire protection of load bearing steel elements (intended use type 4) protected by PROMASPRAY® C450 rendering.

A.2.4.1 Date of addition to this ETA

This annex was added to the ETA 13/0379 on 2013-06-27. This assembly was not covered by this ETA prior to the addition of this annex.

A.2.4.2 Classification

The assembly described in this annex has been tested and assessed according to ENV 13381-4:2002 and classified in accordance with EN 13501-2.

The maximum duration of the exposure to the standard time temperature curve as defined in EN 1363-1, §5.1.1, is 240 min, depending on the section factor of the load bearing steel element, the critical temperature and the thickness of the PROMASPRAY® C450. The critical temperature is assessed from 350°C up to 750°C in steps of 50°C as well as for a temperature of 620°C.

The assessment of the required thickness of PROMASPRAY® C450 in function of the section factor, the critical temperature of the steel and the exposure time is given in A.2.4.4.

A.2.4.3 Installation requirements

A.2.4.3.1 Supporting structure

PROMASPRAY® C450 is directly applicable to I-section and hollow section beams and columns, with a maximum section factor between 70 and 320 m^{-1}, exposed on 3 or 4 sides.

PROMASPRAY® C450 is also directly applicable to rectangular, square or circular hollow sections, under condition that the required thickness is corrected according to the ENV 13381-4:2002, Annex B, B.1.1.3.

PROMASPRAY® C450 is applicable to load bearing steel elements for critical steel temperatures of 350°C up to 750°C.

Specifications for the components are given in Table A.2.4.3.1

Table A.2.4.3.1

Element	Identification	Characteristics	Mounting and fixing
Load bearing steel sections	Steel, grade according to EN 10025-1 and ENV 13381-4:2002	Section factor between 70 m^{-1} (1) and 320 m^{-1} I/H sections, Circular, rectangular and square hollow sections. Protection contoured; three- or four- sided	surface of steel: see A.2.4.3.2 Surface shall be clean, dry and free of dust

(1) A steel member with section factor ≤ 70 m^{-1} shall be protected with the thickness of PROMASPRAY® C450 determined for the steel member with section factor equal to 70 m^{-1} ;

A.2.4.3.2. Surface of steel members

PROMASPRAY® C450 sprayed product can be applied directly on steel members with no pre-treatment other than light wire brushing by hand prior to the application of the protection.

The following primers against corrosion were used :

Table A.2.4.3.2

Primer	Type	
1	Steel alkyd primer	Water based synthetic latex barrier product, applied by brush over the primer to a nominal dry film thickness of 125 µm
2	Steel epoxy primer	A mixture of Cafco cement-based vermiculite spray, nominal density 750 kg/m³, and a bonding latex diluted at 50% by water, applied over the primer by spraying.

A.2.4.3.3. Bonding agent prior to application of PROMASPRAY® C450

No bonding agent was applied to the bare steel surfaces before the application of PROMASPRAY® C450 .

A.2.4.3.4 Fire protective rendering

PROMASPRAY® C450 is applied on the apparent sides of the steel member to be protected, by following its shape.

PROMASPRAY® C450 is sprayed using the batch mix method, in one or more layers, each with a maximum thickness of 20 mm, whatever is the required thickness. During the application, the thickness of the protective material is regularly controlled with a thickness gauge. After reaching the required thickness, it is kept without finishing.

Specifications for the components are given in Table A.2.4.3.4

Table A.2.4.3.4			
Element	**Identification**	**Characteristics**	**Mounting and fixing**
Rendering	PROMASPRAY® C450	Average thicknesses: from 10 to 55 mm, according to the assessment rules. Measured density between 323 and 352 kg/m³ (with a moisture content between 2.1% and 4.6% by dry weight)	Sprayed, using the batch mix method, in one or more layers with maximum thickness of 20 mm, without finishing

A.2.4.4 Assessment

A.2.4.4.1 Fire performance of PROMASPRAY® C450 on steel structures

The assessment method used to assess the fire protection performances of product PROMASPRAY® C450 when applied on steel structures is as follows :

Type of structure	Standard used for assessment
Steel	ENV 13381-4:2002 / Annex H Numerical regression analysis

The analysis is done for I-section beams and columns loaded to 60% of the design moment resistance and hollow section beams and columns.

A.2.4.4.2.1 Required minimum thicknesses of PROMASPRAY® C450 applied to I-section beams and columns, for a fire resistance period of 15 min

Section factor (m^{-1})	Design temperatures (°C)									
	350	400	450	500	550	600	620	650	700	750
70	10	10	10	10	10	10	10	10	10	10
75	10	10	10	10	10	10	10	10	10	10
80	10	10	10	10	10	10	10	10	10	10
85	10	10	10	10	10	10	10	10	10	10
90	10	10	10	10	10	10	10	10	10	10
95	10	10	10	10	10	10	10	10	10	10
100	10	10	10	10	10	10	10	10	10	10
105	10	10	10	10	10	10	10	10	10	10
110	10	10	10	10	10	10	10	10	10	10
115	10	10	10	10	10	10	10	10	10	10
120	10	10	10	10	10	10	10	10	10	10
125	10	10	10	10	10	10	10	10	10	10
130	10	10	10	10	10	10	10	10	10	10
135	10	10	10	10	10	10	10	10	10	10
140	10	10	10	10	10	10	10	10	10	10
145	10	10	10	10	10	10	10	10	10	10
150	10	10	10	10	10	10	10	10	10	10
155	10	10	10	10	10	10	10	10	10	10
160	10	10	10	10	10	10	10	10	10	10
165	10	10	10	10	10	10	10	10	10	10
170	10	10	10	10	10	10	10	10	10	10
175	10	10	10	10	10	10	10	10	10	10
180	10	10	10	10	10	10	10	10	10	10
185	10	10	10	10	10	10	10	10	10	10
190	10	10	10	10	10	10	10	10	10	10
195	10	10	10	10	10	10	10	10	10	10
200	10	10	10	10	10	10	10	10	10	10
205	10	10	10	10	10	10	10	10	10	10
210	10	10	10	10	10	10	10	10	10	10
215	10	10	10	10	10	10	10	10	10	10
220	10	10	10	10	10	10	10	10	10	10
225	10	10	10	10	10	10	10	10	10	10
230	10	10	10	10	10	10	10	10	10	10
235	10	10	10	10	10	10	10	10	10	10
240	10	10	10	10	10	10	10	10	10	10
245	10	10	10	10	10	10	10	10	10	10
250	10	10	10	10	10	10	10	10	10	10
255	10	10	10	10	10	10	10	10	10	10
260	10	10	10	10	10	10	10	10	10	10
265	10	10	10	10	10	10	10	10	10	10
270	10	10	10	10	10	10	10	10	10	10
275	10	10	10	10	10	10	10	10	10	10
280	10	10	10	10	10	10	10	10	10	10
285	10	10	10	10	10	10	10	10	10	10
290	11	10	10	10	10	10	10	10	10	10
295	11	10	10	10	10	10	10	10	10	10
300	11	10	10	10	10	10	10	10	10	10
305	11	10	10	10	10	10	10	10	10	10
310	11	10	10	10	10	10	10	10	10	10
315	11	10	10	10	10	10	10	10	10	10
320	11	10	10	10	10	10	10	10	10	10

A.2.4.4.2.2 Required minimum thicknesses of PROMASPRAY® C450 applied to I-section beams and columns, for a fire resistance period of 30 min

Section factor (m^{-1})	Design temperatures (°C)									
	350	400	450	500	550	600	620	650	700	750
70	10	10	10	10	10	10	10	10	10	10
75	10	10	10	10	10	10	10	10	10	10
80	10	10	10	10	10	10	10	10	10	10
85	10	10	10	10	10	10	10	10	10	10
90	10	10	10	10	10	10	10	10	10	10
95	10	10	10	10	10	10	10	10	10	10
100	10	10	10	10	10	10	10	10	10	10
105	10	10	10	10	10	10	10	10	10	10
110	10	10	10	10	10	10	10	10	10	10
115	11	10	10	10	10	10	10	10	10	10
120	11	10	10	10	10	10	10	10	10	10
125	11	10	10	10	10	10	10	10	10	10
130	12	10	10	10	10	10	10	10	10	10
135	12	10	10	10	10	10	10	10	10	10
140	12	10	10	10	10	10	10	10	10	10
145	12	11	10	10	10	10	10	10	10	10
150	13	11	10	10	10	10	10	10	10	10
155	13	11	10	10	10	10	10	10	10	10
160	13	11	10	10	10	10	10	10	10	10
165	13	12	10	10	10	10	10	10	10	10
170	13	12	10	10	10	10	10	10	10	10
175	14	12	11	10	10	10	10	10	10	10
180	14	12	11	10	10	10	10	10	10	10
185	14	12	11	10	10	10	10	10	10	10
190	14	13	11	10	10	10	10	10	10	10
195	14	13	11	10	10	10	10	10	10	10
200	15	13	11	10	10	10	10	10	10	10
205	15	13	12	10	10	10	10	10	10	10
210	15	13	12	10	10	10	10	10	10	10
215	15	13	12	11	10	10	10	10	10	10
220	15	14	12	11	10	10	10	10	10	10
225	15	14	12	11	10	10	10	10	10	10
230	15	14	12	11	10	10	10	10	10	10
235	16	14	12	11	10	10	10	10	10	10
240	16	14	13	11	10	10	10	10	10	10
245	16	14	13	11	10	10	10	10	10	10
250	16	14	13	12	10	10	10	10	10	10
255	16	14	13	12	11	10	10	10	10	10
260	16	15	13	12	11	10	10	10	10	10
265	16	15	13	12	11	10	10	10	10	10
270	16	15	13	12	11	10	10	10	10	10
275	16	15	13	12	11	10	10	10	10	10
280	17	15	13	12	11	10	10	10	10	10
285	17	15	14	12	11	10	10	10	10	10
290	17	15	14	12	11	10	10	10	10	10
295	17	15	14	12	11	10	10	10	10	10
300	17	15	14	13	11	10	10	10	10	10
305	17	15	14	13	12	10	10	10	10	10
310	17	15	14	13	12	10	10	10	10	10
315	17	16	14	13	12	10	10	10	10	10
320	17	16	14	13	12	11	10	10	10	10

A.2.4.4.2.3 Required minimum thicknesses of PROMASPRAY® C450 applied to I-section beams and columns, for a fire resistance period of 60 min

Section factor (m^{-1})	Design temperatures (°C)									
	350	400	450	500	550	600	620	650	700	750
70	14	12	10	10	10	10	10	10	10	10
75	15	13	11	10	10	10	10	10	10	10
80	16	14	12	10	10	10	10	10	10	10
85	17	14	12	11	10	10	10	10	10	10
90	17	15	13	11	10	10	10	10	10	10
95	18	16	13	12	10	10	10	10	10	10
100	19	16	14	12	10	10	10	10	10	10
105	19	17	15	13	11	10	10	10	10	10
110	20	17	15	13	11	10	10	10	10	10
115	20	18	16	14	12	10	10	10	10	10
120	21	18	16	14	12	11	10	10	10	10
125	21	19	16	15	13	11	11	10	10	10
130	22	19	17	15	13	12	11	10	10	10
135	22	19	17	15	14	12	11	10	10	10
140	22	20	18	16	14	12	12	11	10	10
145	23	20	18	16	14	13	12	11	10	10
150	23	21	18	16	15	13	12	11	10	10
155	23	21	19	17	15	13	13	12	10	10
160	24	21	19	17	15	14	13	12	10	10
165	24	22	19	17	16	14	13	12	10	10
170	24	22	20	18	16	14	13	12	11	10
175	25	22	20	18	16	14	14	13	11	10
180	25	22	20	18	16	15	14	13	11	10
185	25	23	20	18	17	15	14	13	11	10
190	26	23	21	19	17	15	14	13	12	10
195	26	23	21	19	17	15	15	14	12	10
200	26	23	21	19	17	16	15	14	12	10
205	26	24	21	19	18	16	15	14	12	10
210	26	24	22	20	18	16	15	14	12	10
215	27	24	22	20	18	16	16	14	13	11
220	27	24	22	20	18	16	16	15	13	11
225	27	24	22	20	18	17	16	15	13	11
230	27	25	22	20	19	17	16	15	13	11
235	27	25	23	21	19	17	16	15	13	11
240	28	25	23	21	19	17	16	15	14	11
245	28	25	23	21	19	17	17	16	14	12
250	28	25	23	21	19	17	17	16	14	12
255	28	26	23	21	19	18	17	16	14	12
260	28	26	23	21	20	18	17	16	14	12
265	28	26	24	22	20	18	17	16	14	12
270	29	26	24	22	20	18	17	16	14	12
275	29	26	24	22	20	18	18	16	15	13
280	29	26	24	22	20	18	18	17	15	13
285	29	26	24	22	20	19	18	17	15	13
290	29	27	24	22	21	19	18	17	15	13
295	29	27	24	22	21	19	18	17	15	13
300	29	27	25	23	21	19	18	17	15	13
305	30	27	25	23	21	19	18	17	15	13
310	30	27	25	23	21	19	18	17	16	14
315	30	27	25	23	21	19	19	17	16	14
320	30	27	25	23	21	19	19	18	16	14

A.2.4.4.2.4 Required minimum thicknesses of PROMASPRAY® C450 applied to I-section beams and columns, for a fire resistance period of 90 min

Section factor (m^{-1})	Design temperatures (°C)									
	350	400	450	500	550	600	620	650	700	750
70	22	19	16	14	12	10	10	10	10	10
75	23	20	17	15	13	11	10	10	10	10
80	24	21	18	16	14	12	11	10	10	10
85	25	22	19	17	15	13	12	11	10	10
90	26	23	20	18	15	13	13	11	10	10
95	27	23	21	18	16	14	13	12	10	10
100	28	24	21	19	17	15	14	13	11	10
105	28	25	22	20	17	15	15	13	11	10
110	29	26	23	20	18	16	15	14	12	10
115	30	26	23	21	19	17	16	15	13	10
120	30	27	24	22	19	17	16	15	13	11
125	31	27	25	22	20	18	17	16	14	11
130	32	28	25	23	20	18	17	16	14	12
135	32	29	26	23	21	19	18	16	14	12
140	33	29	26	24	21	19	18	17	15	13
145	33	30	27	24	22	19	19	17	15	13
150	34	30	27	25	22	20	19	18	16	14
155	34	31	27	25	23	20	19	18	16	14
160	35	31	28	25	23	21	20	18	16	14
165	35	31	28	26	23	21	20	19	17	15
170	35	32	29	26	24	21	21	19	17	15
175	36	32	29	27	24	22	21	20	17	16
180	36	33	29	27	24	22	21	20	18	16
185	36	33	30	27	25	22	22	20	18	16
190	37	33	30	28	25	23	22	20	18	17
195	37	34	30	28	25	23	22	21	19	17
200	37	34	31	28	26	23	22	21	19	17
205	38	34	31	28	26	24	23	21	19	17
210	38	34	31	29	26	24	23	22	19	18
215	38	35	32	29	27	24	23	22	20	18
220	39	35	32	29	27	24	23	22	20	18
225	39	35	32	30	27	25	24	22	20	18
230	39	36	32	30	27	25	24	23	20	19
235	39	36	33	30	28	25	24	23	21	19
240	40	36	33	30	28	25	24	23	21	19
245	40	36	33	31	28	26	25	23	21	19
250	40	36	33	31	28	26	25	23	21	20
255	40	37	34	31	28	26	25	24	21	20
260	40	37	34	31	29	26	25	24	22	20
265	41	37	34	31	29	26	25	24	22	20
270	41	37	34	32	29	27	26	24	22	20
275	41	38	34	32	29	27	26	24	22	21
280	41	38	35	32	29	27	26	25	22	21
285	41	38	35	32	30	27	26	25	23	21
290	42	38	35	32	30	27	26	25	23	21
295	42	38	35	32	30	27	26	25	23	21
300	42	38	35	33	30	28	27	25	23	21
305	42	39	35	33	30	28	27	25	23	22
310	42	39	36	33	30	28	27	25	23	22
315	42	39	36	33	31	28	27	26	23	22
320	43	39	36	33	31	28	27	26	24	22

A.2.4.4.2.5 Required minimum thicknesses of PROMASPRAY® C450 applied to I-section beams and columns, for a fire resistance period of 120 min

Section factor (m^{-1})	Design temperatures (°C)									
	350	400	450	500	550	600	620	650	700	750
70	30	26	22	20	17	15	14	13	11	10
75	31	27	24	21	18	16	15	14	12	10
80	32	28	25	22	19	17	16	15	13	11
85	33	29	26	23	20	18	17	16	14	11
90	35	30	27	24	21	19	18	17	14	12
95	36	31	28	25	22	20	19	17	15	13
100	37	32	29	26	23	21	20	18	16	14
105	38	33	30	27	24	21	20	19	17	15
110	38	34	30	27	25	22	21	20	17	15
115	39	35	31	28	25	23	22	20	18	16
120	40	36	32	29	26	23	22	21	19	17
125	41	36	33	30	27	24	23	21	19	17
130	42	37	33	30	27	25	24	22	20	18
135	42	38	34	31	28	25	24	23	20	19
140	43	38	35	32	29	26	25	23	21	19
145	44	39	35	32	29	26	25	24	21	20
150	44	40	36	33	30	27	26	24	22	20
155	45	40	36	33	30	27	26	25	22	21
160	45	41	37	34	31	28	27	25	23	21
165	46	41	37	34	31	28	27	26	23	22
170	46	42	38	35	32	29	28	26	24	22
175	47	42	38	35	32	29	28	26	24	22
180	47	43	39	36	32	30	28	27	24	23
185	48	43	39	36	33	30	29	27	25	23
190	48	43	40	36	33	30	29	28	25	24
195	48	44	40	37	34	31	30	28	25	24
200	49	44	40	37	34	31	30	28	26	24
205	49	45	41	38	34	31	30	29	26	25
210	50	45	41	38	35	32	31	29	26	25
215	50	45	41	38	35	32	31	29	27	25
220	50	46	42	39	35	32	31	29	27	26
225	51	46	42	39	36	33	32	30	27	26
230	51	46	42	39	36	33	32	30	28	26
235	51	47	43	39	36	33	32	30	28	27
240	52	47	43	40	37	34	32	31	28	27
245	52	47	43	40	37	34	33	31	28	27
250	52	48	44	40	37	34	33	31	29	27
255	52	48	44	41	37	34	33	31	29	28
260	53	48	44	41	38	35	33	32	29	28
265	53	48	44	41	38	35	34	32	29	28
270	53	49	45	41	38	35	34	32	30	28
275	53	49	45	42	38	35	34	32	30	29
280	54	49	45	42	39	36	34	32	30	29
285	54	49	45	42	39	36	34	33	30	29
290	54	50	46	42	39	36	35	33	30	29
295	54	50	46	43	39	36	35	33	31	29
300	55	50	46	43	39	36	35	33	31	30
305	55	50	46	43	40	37	35	33	31	30
310	55	50	46	43	40	37	35	34	31	30
315	55	51	47	43	40	37	36	34	31	30
320	55	51	47	44	40	37	36	34	32	30

A.2.4.4.2.6 Required minimum thicknesses of PROMASPRAY® C450 applied to I-section beams and columns, for a fire resistance period of 180 min

Section factor (m^{-1})	Design temperatures (°C)									
	350	400	450	500	550	600	620	650	700	750
70	45	39	35	31	28	24	23	22	19	17
75	47	41	36	33	29	26	25	23	21	19
80	49	43	38	34	31	27	26	24	22	20
85	50	44	39	36	32	29	27	26	23	21
90	52	46	41	37	33	30	29	27	24	22
95	53	47	42	38	34	31	30	28	25	23
100	55	49	44	39	36	32	31	29	26	25
105	56	50	45	41	37	33	32	30	27	26
110	57	51	46	42	38	34	33	31	28	27
115	58	52	47	43	39	35	34	32	29	27
120	-	53	48	44	40	36	35	33	30	28
125	-	54	49	45	41	37	36	33	31	29
130	-	55	50	46	42	38	36	34	31	30
135	-	56	51	46	42	39	37	35	32	31
140	-	57	52	47	43	39	38	36	33	32
145	-	57	52	48	44	40	39	36	34	32
150	-	-	53	49	45	41	39	37	34	33
155	-	-	54	50	45	41	40	38	35	34
160	-	-	55	50	46	42	41	38	35	34
165	-	-	55	51	47	43	41	39	36	35
170	-	-	56	52	47	43	42	39	37	36
175	-	-	57	52	48	44	42	40	37	36
180	-	-	57	53	49	45	43	41	38	37
185	-	-	58	53	49	45	43	41	38	37
190	-	-	-	54	50	46	44	42	39	38
195	-	-	-	55	50	46	44	42	39	38
200	-	-	-	55	51	47	45	43	40	39
205	-	-	-	56	51	47	45	43	40	39
210	-	-	-	56	52	48	46	43	40	40
215	-	-	-	57	52	48	46	44	41	40
220	-	-	-	57	53	48	47	44	41	41
225	-	-	-	58	53	49	47	45	42	41
230	-	-	-	58	53	49	47	45	42	41
235	-	-	-	58	54	50	48	45	42	42
240	-	-	-	-	54	50	48	46	43	42
245	-	-	-	-	55	50	49	46	43	42
250	-	-	-	-	55	51	49	46	43	43
255	-	-	-	-	55	51	49	47	44	43
260	-	-	-	-	56	51	50	47	44	44
265	-	-	-	-	56	52	50	47	44	44
270	-	-	-	-	56	52	50	48	45	44
275	-	-	-	-	57	52	51	48	45	45
280	-	-	-	-	57	53	51	48	45	45
285	-	-	-	-	57	53	51	49	46	45
290	-	-	-	-	58	53	51	49	46	45
295	-	-	-	-	58	54	52	49	46	46
300	-	-	-	-	58	54	52	49	46	46
305	-	-	-	-	58	54	52	50	47	46
310	-	-	-	-	-	54	53	50	47	47
315	-	-	-	-	-	55	53	50	47	47
320	-	-	-	-	-	55	53	50	47	47

A.2.4.4.2.7 Required minimum thicknesses of PROMASPRAY® C450 applied to I-section beams and columns, for a fire resistance period of 240 min

Section factor (m^{-1})	Design temperatures (°C)									
	350	400	450	500	550	600	620	650	700	750
70	-	53	47	42	38	34	33	30	28	26
75	-	55	49	44	40	36	34	32	29	28
80	-	57	51	46	42	38	36	34	31	29
85	-	-	53	48	43	39	38	35	32	31
90	-	-	55	50	45	41	39	37	34	32
95	-	-	57	51	47	42	41	38	35	34
100	-	-	58	53	48	44	42	40	36	35
105	-	-	-	55	50	45	43	41	38	36
110	-	-	-	56	51	46	45	42	39	38
115	-	-	-	57	52	48	46	43	40	39
120	-	-	-	-	53	49	47	44	41	40
125	-	-	-	-	55	50	48	45	42	41
130	-	-	-	-	56	51	49	46	43	42
135	-	-	-	-	57	52	50	47	44	43
140	-	-	-	-	58	53	51	48	45	44
145	-	-	-	-	-	54	52	49	46	45
150	-	-	-	-	-	55	53	50	47	46
155	-	-	-	-	-	56	54	51	47	47
160	-	-	-	-	-	56	54	52	48	48
165	-	-	-	-	-	57	55	52	49	48
170	-	-	-	-	-	58	56	53	50	49
175	-	-	-	-	-	-	57	54	50	50
180	-	-	-	-	-	-	57	54	51	50
185	-	-	-	-	-	-	58	55	52	51
190	-	-	-	-	-	-	-	56	52	52
195	-	-	-	-	-	-	-	56	53	52
200	-	-	-	-	-	-	-	57	53	53
205	-	-	-	-	-	-	-	57	54	54
210	-	-	-	-	-	-	-	58	54	54
215	-	-	-	-	-	-	-	-	55	55
220	-	-	-	-	-	-	-	-	55	55
225	-	-	-	-	-	-	-	-	56	56
230	-	-	-	-	-	-	-	-	56	56
235	-	-	-	-	-	-	-	-	57	57
240	-	-	-	-	-	-	-	-	57	57
245	-	-	-	-	-	-	-	-	58	58
250	-	-	-	-	-	-	-	-	58	58
255	-	-	-	-	-	-	-	-	-	-
260	-	-	-	-	-	-	-	-	-	-
265	-	-	-	-	-	-	-	-	-	-
270	-	-	-	-	-	-	-	-	-	-
275	-	-	-	-	-	-	-	-	-	-
280	-	-	-	-	-	-	-	-	-	-
285	-	-	-	-	-	-	-	-	-	-
290	-	-	-	-	-	-	-	-	-	-
295	-	-	-	-	-	-	-	-	-	-
300	-	-	-	-	-	-	-	-	-	-
305	-	-	-	-	-	-	-	-	-	-
310	-	-	-	-	-	-	-	-	-	-
315	-	-	-	-	-	-	-	-	-	-
320	-	-	-	-	-	-	-	-	-	-

A.2.4.4.3.1 Required minimum thicknesses of PROMASPRAY® C450 applied to hollow section beams and columns, for a fire resistance period of 15 min

Section factor (m^{-1})	Design temperatures (°C)									
	350	400	450	500	550	600	620	650	700	750
70	11	11	11	11	11	11	11	11	11	11
75	11	11	11	11	11	11	11	11	11	11
80	11	11	11	11	11	11	11	11	11	11
85	11	11	11	11	11	11	11	11	11	11
90	11	11	11	11	11	11	11	11	11	11
95	11	11	11	11	11	11	11	11	11	11
100	11	11	11	11	11	11	11	11	11	11
105	11	11	11	11	11	11	11	11	11	11
110	11	11	11	11	11	11	11	11	11	11
115	11	11	11	11	11	11	11	11	11	11
120	11	11	11	11	11	11	11	11	11	11
125	11	11	11	11	11	11	11	11	11	11
130	11	11	11	11	11	11	11	11	11	11
135	11	11	11	11	11	11	11	11	11	11
140	11	11	11	11	11	11	11	11	11	11
145	11	11	11	11	11	11	11	11	11	11
150	12	12	12	12	12	12	12	12	12	12
155	12	12	12	12	12	12	12	12	12	12
160	12	12	12	12	12	12	12	12	12	12
165	12	12	12	12	12	12	12	12	12	12
170	12	12	12	12	12	12	12	12	12	12
175	12	12	12	12	12	12	12	12	12	12
180	12	12	12	12	12	12	12	12	12	12
185	12	12	12	12	12	12	12	12	12	12
190	12	12	12	12	12	12	12	12	12	12
195	12	12	12	12	12	12	12	12	12	12
200	12	12	12	12	12	12	12	12	12	12
205	12	12	12	12	12	12	12	12	12	12
210	12	12	12	12	12	12	12	12	12	12
215	12	12	12	12	12	12	12	12	12	12
220	12	12	12	12	12	12	12	12	12	12
225	12	12	12	12	12	12	12	12	12	12
230	12	12	12	12	12	12	12	12	12	12
235	12	12	12	12	12	12	12	12	12	12
240	12	12	12	12	12	12	12	12	12	12
245	12	12	12	12	12	12	12	12	12	12
250	12	12	12	12	12	12	12	12	12	12
255	12	12	12	12	12	12	12	12	12	12
260	12	12	12	12	12	12	12	12	12	12
265	13	12	12	12	12	12	12	12	12	12
270	13	12	12	12	12	12	12	12	12	12
275	13	12	12	12	12	12	12	12	12	12
280	13	12	12	12	12	12	12	12	12	12
285	13	12	12	12	12	12	12	12	12	12
290	13	12	12	12	12	12	12	12	12	12
295	13	12	12	12	12	12	12	12	12	12
300	13	12	12	12	12	12	12	12	12	12
305	13	12	12	12	12	12	12	12	12	12
310	13	12	12	12	12	12	12	12	12	12
315	13	12	12	12	12	12	12	12	12	12
320	13	12	12	12	12	12	12	12	12	12

A.2.4.4.3.2 Required minimum thicknesses of PROMASPRAY® C450 applied to hollow section beams and columns, for a fire resistance period of 30 min

Section factor (m^{-1})	Design temperatures (°C)									
	350	400	450	500	550	600	620	650	700	750
70	11	11	11	11	11	11	11	11	11	11
75	11	11	11	11	11	11	11	11	11	11
80	11	11	11	11	11	11	11	11	11	11
85	11	11	11	11	11	11	11	11	11	11
90	11	11	11	11	11	11	11	11	11	11
95	11	11	11	11	11	11	11	11	11	11
100	11	11	11	11	11	11	11	11	11	11
105	11	11	11	11	11	11	11	11	11	11
110	11	11	11	11	11	11	11	11	11	11
115	12	11	11	11	11	11	11	11	11	11
120	12	11	11	11	11	11	11	11	11	11
125	13	11	11	11	11	11	11	11	11	11
130	13	11	11	11	11	11	11	11	11	11
135	13	12	11	11	11	11	11	11	11	11
140	14	12	11	11	11	11	11	11	11	11
145	14	12	11	11	11	11	11	11	11	11
150	15	13	12	12	12	12	12	12	12	12
155	15	13	12	12	12	12	12	12	12	12
160	15	13	12	12	12	12	12	12	12	12
165	15	14	12	12	12	12	12	12	12	12
170	16	14	12	12	12	12	12	12	12	12
175	16	14	12	12	12	12	12	12	12	12
180	16	14	13	12	12	12	12	12	12	12
185	17	15	13	12	12	12	12	12	12	12
190	17	15	13	12	12	12	12	12	12	12
195	17	15	14	12	12	12	12	12	12	12
200	17	15	14	12	12	12	12	12	12	12
205	18	16	14	12	12	12	12	12	12	12
210	18	16	14	13	12	12	12	12	12	12
215	18	16	14	13	12	12	12	12	12	12
220	18	16	15	13	12	12	12	12	12	12
225	19	17	15	13	12	12	12	12	12	12
230	19	17	15	14	12	12	12	12	12	12
235	19	17	15	14	12	12	12	12	12	12
240	19	17	16	14	13	12	12	12	12	12
245	20	18	16	14	13	12	12	12	12	12
250	20	18	16	14	13	12	12	12	12	12
255	20	18	16	14	13	12	12	12	12	12
260	20	18	16	15	13	12	12	12	12	12
265	20	18	16	15	13	12	12	12	12	12
270	20	18	16	15	13	12	12	12	12	12
275	20	18	17	15	14	12	12	12	12	12
280	21	19	17	15	14	12	12	12	12	12
285	21	19	17	15	14	12	12	12	12	12
290	21	19	17	15	14	12	12	12	12	12
295	21	19	17	15	14	13	12	12	12	12
300	21	19	17	16	14	13	12	12	12	12
305	21	19	17	16	14	13	12	12	12	12
310	21	19	17	16	14	13	12	12	12	12
315	21	19	18	16	14	13	12	12	12	12
320	21	19	18	16	15	13	13	12	12	12

A.2.4.4.3.3 Required minimum thicknesses of PROMASPRAY® C450 applied to hollow section beams and columns, for a fire resistance period of 60 min

Section factor (m^{-1})	Design temperatures (°C)									
	350	400	450	500	550	600	620	650	700	750
70	15	13	11	11	11	11	5	11	11	11
75	16	14	12	11	11	11	6	11	11	11
80	17	15	12	11	11	11	7	11	11	11
85	18	15	13	11	11	11	7	11	11	11
90	19	16	14	12	11	11	8	11	11	11
95	20	17	15	13	11	11	8	11	11	11
100	20	18	15	13	11	11	9	11	11	11
105	21	18	16	14	12	11	10	11	11	11
110	22	19	17	15	13	11	10	11	11	11
115	22	20	17	15	13	12	11	11	11	11
120	23	20	18	16	14	12	11	11	11	11
125	24	21	18	16	14	13	12	11	11	11
130	24	22	19	17	15	13	12	11	11	11
135	25	22	20	17	15	13	13	12	11	11
140	25	23	20	18	16	14	13	12	11	11
145	26	23	21	18	16	14	14	13	11	11
150	27	24	21	19	17	15	14	13	12	12
155	27	24	22	19	17	15	14	13	12	12
160	28	25	22	20	18	16	15	14	12	12
165	28	25	22	20	18	16	15	14	12	12
170	29	26	23	21	19	17	16	15	12	12
175	29	26	23	21	19	17	16	15	13	12
180	29	26	24	21	19	17	16	15	13	12
185	30	27	24	22	20	18	17	16	14	12
190	30	27	25	22	20	18	17	16	14	12
195	31	28	25	23	20	18	17	16	14	12
200	31	28	25	23	21	19	18	17	14	12
205	32	28	26	23	21	19	18	17	15	12
210	32	29	26	24	22	19	19	17	15	12
215	32	29	26	24	22	20	19	18	15	13
220	33	30	27	24	22	20	19	18	16	13
225	33	30	27	25	23	20	19	18	16	13
230	33	30	27	25	23	21	20	18	16	14
235	34	31	28	25	23	21	20	19	17	14
240	34	31	28	26	23	21	20	19	17	14
245	35	31	29	26	24	22	21	19	17	14
250	35	32	29	26	24	22	21	20	17	15
255	35	32	29	26	24	22	21	20	17	15
260	35	32	29	27	24	22	21	20	18	15
265	35	32	29	27	25	22	21	20	18	15
270	36	32	30	27	25	23	22	20	18	15
275	36	33	30	27	25	23	22	20	18	16
280	36	33	30	27	25	23	22	21	18	16
285	36	33	30	28	25	23	22	21	19	16
290	36	33	30	28	26	23	22	21	19	16
295	37	33	30	28	26	23	22	21	19	16
300	37	33	31	28	26	24	23	21	19	16
305	37	34	31	28	26	24	23	21	19	17
310	37	34	31	28	26	24	23	22	19	17
315	37	34	31	29	26	24	23	22	19	17
320	37	34	31	29	26	24	23	22	20	17

A.2.4.4.3.4 Required minimum thicknesses of PROMASPRAY® C450 applied to hollow section beams and columns, for a fire resistance period of 90 min

Section factor (m^{-1})	Design temperatures (°C)									
	350	400	450	500	550	600	620	650	700	750
70	24	20	17	15	13	11	10	11	11	11
75	25	21	19	16	14	12	11	11	11	11
80	26	23	20	17	15	13	12	11	11	11
85	27	24	21	18	16	14	13	12	11	11
90	28	25	22	19	17	15	14	12	11	11
95	29	26	23	20	18	15	15	13	11	11
100	30	27	23	21	18	16	15	14	12	11
105	31	28	24	22	19	17	16	15	13	11
110	32	28	25	23	20	18	17	15	13	11
115	33	29	26	23	21	18	18	16	14	12
120	34	30	27	24	22	19	18	17	15	12
125	35	31	28	25	22	20	19	17	15	13
130	36	32	28	26	23	20	19	18	16	13
135	36	32	29	26	24	21	20	19	16	14
140	37	33	30	27	24	22	21	19	17	15
145	38	34	30	28	25	22	21	20	18	15
150	39	35	31	28	25	23	22	20	18	16
155	39	35	32	29	26	23	22	21	19	16
160	40	36	32	29	27	24	23	21	19	17
165	41	36	33	30	27	24	23	22	19	17
170	41	37	34	31	28	25	24	22	20	18
175	42	38	34	31	28	26	24	23	20	18
180	43	38	35	32	29	26	25	23	21	19
185	43	39	35	32	29	27	26	24	21	19
190	44	39	36	33	30	27	26	24	22	20
195	44	40	36	33	30	28	26	25	22	20
200	45	41	37	34	31	28	27	25	23	21
205	45	41	37	34	31	28	27	26	23	21
210	46	42	38	35	32	29	28	26	23	21
215	47	42	38	35	32	29	28	27	24	22
220	47	43	39	36	33	30	29	27	24	22
225	48	43	39	36	33	30	29	27	25	23
230	48	44	40	37	34	31	29	28	25	23
235	49	44	40	37	34	31	30	28	25	23
240	49	45	41	37	34	31	30	28	26	24
245	50	45	41	38	35	32	31	29	26	24
250	50	45	42	38	35	32	31	29	26	24
255	50	46	42	39	35	32	31	29	27	25
260	50	46	42	39	36	33	31	30	27	25
265	51	46	42	39	36	33	32	30	27	25
270	51	47	43	39	36	33	32	30	27	25
275	51	47	43	40	36	33	32	30	28	26
280	51	47	43	40	37	34	32	31	28	26
285	52	47	43	40	37	34	33	31	28	26
290	52	47	44	40	37	34	33	31	28	26
295	52	48	44	40	37	34	33	31	28	26
300	52	48	44	41	38	34	33	31	29	27
305	53	48	44	41	38	35	33	32	29	27
310	53	48	44	41	38	35	34	32	29	27
315	53	48	45	41	38	35	34	32	29	27
320	53	49	45	42	38	35	34	32	29	27

A.2.4.4.3.5 Required minimum thicknesses of PROMASPRAY® C450 applied to hollow section beams and columns, for a fire resistance period of 120 min

Section factor (m^{-1})	Design temperatures (°C)									
	350	400	450	500	550	600	620	650	700	750
70	32	27	24	21	18	16	15	14	12	11
75	33	29	25	23	20	17	16	15	13	11
80	35	30	27	24	21	18	17	16	14	11
85	36	32	28	25	22	19	19	17	15	12
90	38	33	29	26	23	21	20	18	16	13
95	39	34	31	27	24	22	21	19	17	14
100	40	36	32	28	25	23	22	20	18	15
105	42	37	33	29	26	23	22	21	18	16
110	43	38	34	30	27	24	23	22	19	17
115	44	39	35	31	28	25	24	23	20	18
120	45	40	36	32	29	26	25	23	21	19
125	46	41	37	33	30	27	26	24	22	20
130	47	42	38	34	31	28	27	25	22	20
135	48	43	39	35	32	29	27	26	23	21
140	49	44	39	36	33	29	28	26	24	22
145	50	45	40	37	33	30	29	27	24	22
150	51	46	41	38	34	31	30	28	25	23
155	52	46	42	38	35	32	30	28	26	24
160	52	47	43	39	36	32	31	29	26	24
165	53	48	43	40	36	33	32	30	27	25
170	54	49	44	41	37	34	32	30	28	26
175	20	49	45	41	38	34	33	31	28	26
180	56	50	46	42	38	35	34	32	29	27
185	56	51	46	43	39	35	34	32	29	27
190	57	52	47	43	40	36	35	33	30	28
195	58	52	48	44	40	37	35	33	30	29
200	-	53	48	45	41	37	36	34	31	29
205	-	54	49	45	41	38	36	34	31	30
210	-	54	50	46	42	38	37	35	32	30
215	-	55	50	46	43	39	38	35	32	31
220	-	56	51	47	43	40	38	36	33	31
225	-	56	52	48	44	40	39	36	33	32
230	-	57	52	48	44	41	39	37	34	32
235	-	58	53	49	45	41	40	37	34	33
240	-	58	53	49	45	42	40	38	35	33
245	-	-	54	50	46	42	41	38	35	34
250	-	-	54	50	46	43	41	39	36	34
255	-	-	55	51	47	43	41	39	36	34
260	-	-	55	51	47	43	42	39	36	35
265	-	-	55	51	47	43	42	40	37	35
270	-	-	56	52	48	44	42	40	37	35
275	-	-	56	52	48	44	42	40	37	36
280	-	-	56	52	48	44	43	40	37	36
285	-	-	57	52	48	45	43	41	38	36
290	-	-	57	53	49	45	43	41	38	36
295	-	-	57	53	49	45	44	41	38	37
300	-	-	57	53	49	45	44	41	38	37
305	-	-	58	54	50	46	44	42	39	37
310	-	-	58	54	50	46	44	42	39	37
315	-	-	58	54	50	46	44	42	39	38
320	-	-	58	54	50	46	45	42	39	38

A.2.4.4.3.6 Required minimum thicknesses of PROMASPRAY® C450 applied to hollow section beams and columns, for a fire resistance period of 180 min

Section factor (m^{-1})	Design temperatures (°C)									
	350	400	450	500	550	600	620	650	700	750
70	48	42	37	33	29	26	25	23	21	18
75	50	44	39	35	31	28	27	25	22	20
80	53	46	41	37	33	30	28	26	24	22
85	55	48	43	39	35	31	30	28	25	23
90	57	50	45	40	36	33	31	29	26	24
95	58	52	46	42	38	34	33	31	28	26
100	-	53	48	43	39	35	34	32	29	27
105	-	55	49	45	41	37	35	33	30	28
110	-	57	51	46	42	38	36	34	31	29
115	-	58	52	48	43	39	38	35	32	31
120	-	-	54	49	45	40	39	36	33	32
125	-	-	55	50	46	42	40	38	34	33
130	-	-	56	51	47	43	41	39	35	34
135	-	-	58	53	48	44	42	40	36	35
140	-	-	-	54	49	45	43	41	37	36
145	-	-	-	55	50	46	44	42	38	37
150	-	-	-	56	51	47	45	43	39	38
155	-	-	-	57	52	48	46	44	40	39
160	-	-	-	58	53	49	47	44	41	40
165	-	-	-	-	54	50	48	45	42	41
170	-	-	-	-	55	51	49	46	43	42
175	-	-	-	-	56	52	50	47	44	42
180	-	-	-	-	57	53	51	48	44	43
185	-	-	-	-	58	53	51	49	45	44
190	-	-	-	-	-	54	52	49	46	45
195	-	-	-	-	-	55	53	50	47	46
200	-	-	-	-	-	56	54	51	47	46
205	-	-	-	-	-	57	55	52	48	47
210	-	-	-	-	-	57	55	53	49	48
215	-	-	-	-	-	58	56	53	50	49
220	-	-	-	-	-	-	57	54	50	49
225	-	-	-	-	-	-	58	55	51	50
230	-	-	-	-	-	-	58	55	52	51
235	-	-	-	-	-	-	-	56	52	52
240	-	-	-	-	-	-	-	57	53	52
245	-	-	-	-	-	-	-	57	54	53
250	-	-	-	-	-	-	-	58	54	53
255	-	-	-	-	-	-	-	58	55	54
260	-	-	-	-	-	-	-	-	55	54
265	-	-	-	-	-	-	-	-	55	55
270	-	-	-	-	-	-	-	-	56	55
275	-	-	-	-	-	-	-	-	56	56
280	-	-	-	-	-	-	-	-	56	56
285	-	-	-	-	-	-	-	-	57	56
290	-	-	-	-	-	-	-	-	57	57
295	-	-	-	-	-	-	-	-	57	57
300	-	-	-	-	-	-	-	-	58	57
305	-	-	-	-	-	-	-	-	58	58
310	-	-	-	-	-	-	-	-	58	58
315	-	-	-	-	-	-	-	-	-	58
320	-	-	-	-	-	-	-	-	-	-

A.2.4.4.3.7 Required minimum thicknesses of PROMASPRAY® C450 applied to hollow section beams and columns, for a fire resistance period of 240 min

Section factor (m^{-1})	Design temperatures (°C)									
	350	400	450	500	550	600	620	650	700	750
70	-	57	50	45	41	36	35	33	29	28
75	-	-	53	48	43	39	37	35	31	30
80	-	-	55	50	45	41	39	37	33	32
85	-	-	58	52	47	43	41	38	35	33
90	-	-	-	54	49	45	43	40	37	35
95	-	-	-	56	51	46	45	42	38	37
100	-	-	-	58	53	48	46	44	40	39
105	-	-	-	-	55	50	48	45	42	40
110	-	-	-	-	56	51	50	47	43	42
115	-	-	-	-	58	53	51	48	45	43
120	-	-	-	-	-	55	53	50	46	45
125	-	-	-	-	-	56	54	51	47	46
130	-	-	-	-	-	57	55	52	49	48
135	-	-	-	-	-	-	57	54	50	49
140	-	-	-	-	-	-	58	55	51	50
145	-	-	-	-	-	-	-	56	52	51
150	-	-	-	-	-	-	-	57	54	53
155	-	-	-	-	-	-	-	-	55	54
160	-	-	-	-	-	-	-	-	56	55
165	-	-	-	-	-	-	-	-	57	56
170	-	-	-	-	-	-	-	-	58	57
175	-	-	-	-	-	-	-	-	-	58
180	-	-	-	-	-	-	-	-	-	-
185	-	-	-	-	-	-	-	-	-	-
190	-	-	-	-	-	-	-	-	-	-
195	-	-	-	-	-	-	-	-	-	-
200	-	-	-	-	-	-	-	-	-	-
205	-	-	-	-	-	-	-	-	-	-
210	-	-	-	-	-	-	-	-	-	-
215	-	-	-	-	-	-	-	-	-	-
220	-	-	-	-	-	-	-	-	-	-
225	-	-	-	-	-	-	-	-	-	-
230	-	-	-	-	-	-	-	-	-	-
235	-	-	-	-	-	-	-	-	-	-
240	-	-	-	-	-	-	-	-	-	-
245	-	-	-	-	-	-	-	-	-	-
250	-	-	-	-	-	-	-	-	-	-
255	-	-	-	-	-	-	-	-	-	-
260	-	-	-	-	-	-	-	-	-	-
265	-	-	-	-	-	-	-	-	-	-
270	-	-	-	-	-	-	-	-	-	-
275	-	-	-	-	-	-	-	-	-	-
280	-	-	-	-	-	-	-	-	-	-
285	-	-	-	-	-	-	-	-	-	-
290	-	-	-	-	-	-	-	-	-	-
295	-	-	-	-	-	-	-	-	-	-
300	-	-	-	-	-	-	-	-	-	-
305	-	-	-	-	-	-	-	-	-	-
310	-	-	-	-	-	-	-	-	-	-
315	-	-	-	-	-	-	-	-	-	-
320	-	-	-	-	-	-	-	-	-	-

A.2.4.4.4 Influence of primers

Insulation efficiency tests on specimens with or without primer have resulted in equivalent test results, as specified in EAD 350140-00-1106.

Annex 2.5 Specification and assessment of fire protection of load bearing composite concrete/profiled steel sheets elements (intended use type 5) protected by PROMASPRAY® C450 rendering.

A.2.5.1 Date of addition to this ETA

This annex was added to the ETA 13/0379 on 2013-06-27. This assembly was not covered by this ETA prior to the addition of this annex.

A.2.5.2 Classification

The assembly described in this annex has been tested and assessed according to ENV 13381-5:2002 and classified in accordance with EN 13501-2.

The maximum duration of the exposure to the standard time temperature curve as defined in EN 1363-1, §5.1.1, is 360 min, depending on the type of profiled steel sheet and the thickness of the applied PROMASPRAY® C450.

The assessment of the required thickness of PROMASPRAY® C450 in function of type of profiled steel sheet and the exposure time for the characteristic steel sheet temperature rise to 350°C, the equivalent thickness of concrete and the insulation performances are given in A.2.5.4

A.2.5.3 Installation requirements

A.2.5.3.1 Supporting structure

PROMASPRAY® C450 shall be applied by using a bonding agent to profiled steel sheets of composite slabs casted with dense concrete.

Two types of profiled steel sheets can be protected by PROMASPRAY® C450 sprayed product:

- Type 1 : Trapezoidal profiled steel sheets as COFRAPLUS 60 (PAB),
- Type 2 : Re-entrant (dovetails) profiled steel sheets as COFRASTRA 40 (PAB).

Specifications for the components are given in Table A.2.5.3.1

Table A.2.5.3.1

Element	Identification	Characteristics	Mounting and fixing
Profiled steel sheet	Trapezoidal profiled steel sheet Re-entrant (dovetails) profiled steel sheet	Thickness of the profiled steel sheet ≥ 0.75mm Width of the ribs ≤ 187mm Height of the ribs ≤ 87mm Galvanised Z 275	Surface shall be free of dust, oil and grease
Concrete	Concrete, siliceous aggregates	Strength class ≥ C25/30 Density 2305 kg/m³ ± 15 %	The concrete may or may not contain additional reinforcing bars for load bearing purpose

A.2.5.3.2. Surface of steel members

No specific preliminary preparation of the profiled steel sheets to be protected by PROMASPRAY® C450 is required.

However, they must be free of dust, oil and grease

A.2.5.3.3. Bonding agent prior to application of PROMASPRAY® C450

Whatever is the type of profiled galvanized steel sheets used for the composite slabs as mentioned in A.2.5.3.1, the profiled steel sheets are treated with a key coat constituted by a mixing of 1 bag (20 kg) FENDOLITE MII and 16 litres of CAFCO SBR Bonding Latex pre-diluted with potable water (Ratio 50%/50%)

It is applied in order to obtain a covering ratio of 40% approximately of the profiled steel sheets.

Then, it is kept drying for 10 hours minimum, without any further action and prior to the application of PROMASPRAY® C450

A.2.5.3.4 Fire protective rendering

PROMASPRAY® C450 is applied on the apparent sides of the profiled steel sheet to be protected, by following its corrugation, for exposure to fire from the steel side of the composite slab.

In case of application on re-entrant profiled steel sheets, dove-tails are first filled with PROMASPRAY® C450 to create an external rope h = 10/15 mm approximately. Then this external rope is roughly smoothed with a spatula, flush to the profiled steel sheets bottoms.

For layer 15 mm thick at maximum, PROMASPRAY® C450 is applied in one full layer. For higher thicknesses, it is applied in successive layers 20/25 mm thick, up to reach the goal thickness. A delay of one day at least between each layer is observed. Once the thickness is reached, PROMASPRAY® C450 spray material is kept drying without any finishing action.

A.2.5.4. Assessment of the fire performance of PROMASPRAY® C450 on composite concrete/profiled steel sheet elements.

A.2.5.4.1 General

The assessment method used to assess the fire protection performances of product PROMASPRAY® C450 when applied on composite concrete/profiled steel sheet elements is as follows :

Type of structure	Standard used for assessment
Composite concrete/Profiled steel sheet element	ENV 13381-5:2002

A.2.5.4.2 Standard profiled steel sheets temperature 350°C

The time to reach 350°C in the profiled steel sheets has been determined according to requirements of standard ENV 13381-5:2002, paragraph 13.2. and are given in table A.2.5.4.2

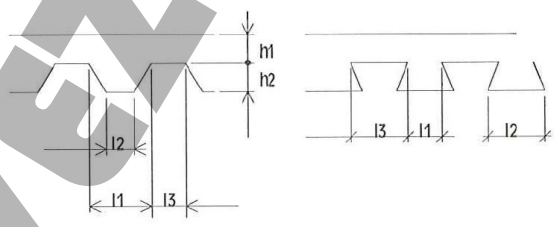
Table A. 2.5.4.2			
Type	**description**	**Thickness of PROMASPRAY® C450 in mm**	**Time to reach 350 ° In min**
1	Trapezoidal	57	150
1	Trapezoidal	13	25
2	Re-entrant	46	201
2	Re-entrant	11	74

The minimum thickness of protective material to apply to reach a standard temperature of 350°C in profiled steel sheets has been determined in accordance with requirements of classification standard EN 13501-2 – paragraph 7.4.6.6 and annex B5, by linear interpolation

Table A. 2.5.4.2-bis					
Profiled steel sheet	**Minimum thickness of PROMASPRAY® C450 to reach 350°C on profiled steel sheets (mm)**				
	Duration of exposure under thermal program EN1363-1 (min)				
	30	**60**	**90**	**120**	**180**
Trapezoidal	15	25	36	46	*
Re-entrant	11	11	15	24	40
* : duration of exposure not covered					

A.2.5.4.3 Equivalent thickness of concrete Heq

The effective thickness H_{eff} , the equivalent effective thickness H_e and the equivalent thickness of concrete H_{eq} induced by the protective material PROMASPRAY® C450 applied on both types of profiled steel sheets have been determined according to the requirements of the standard ENV 13381-5:2002, paragraph 13.3 and are given in table A.2.5.4.3.



Profiled steel sheets	Type	Actual dimensions (mm)					Effective thickness H_{eff} (mm)
		L_1	L_2	L_3	H_1	H_2	
COFRAPLUS 60	Trapezoidal	106	62	101	50	58	73
COFRAPLUS 60	Trapezoidal	106	62	101	60	58	83
COFRASTRA 40	Re-entrant	103	125	45	50	40	80
COFRASTRA 40	Re-entrant	103	125	45	60	40	90

Table A.2.5.4.3					
Profiled steel sheets	**Thickness of PROMASPRAY® C450 (mm)**	**Heff (mm)**	**He (mm)**	**Heq (mm)**	**Insulation performances (min)**
Trapezoidal	13	73	105	32	240 (1)
Trapezoidal	57	83	174	91	104 (2)
Re-entrant	11	80	147	67	240 (1)
Re-entrant	46	90	174	84	184 (2)
(1) : end of test (2) : average rise of temperature over 140°C					

The equivalent effective thickness H_e in function of the thickness of by the protective material PROMASPRAY® C450 is given in figure A2.5.4.3-1.

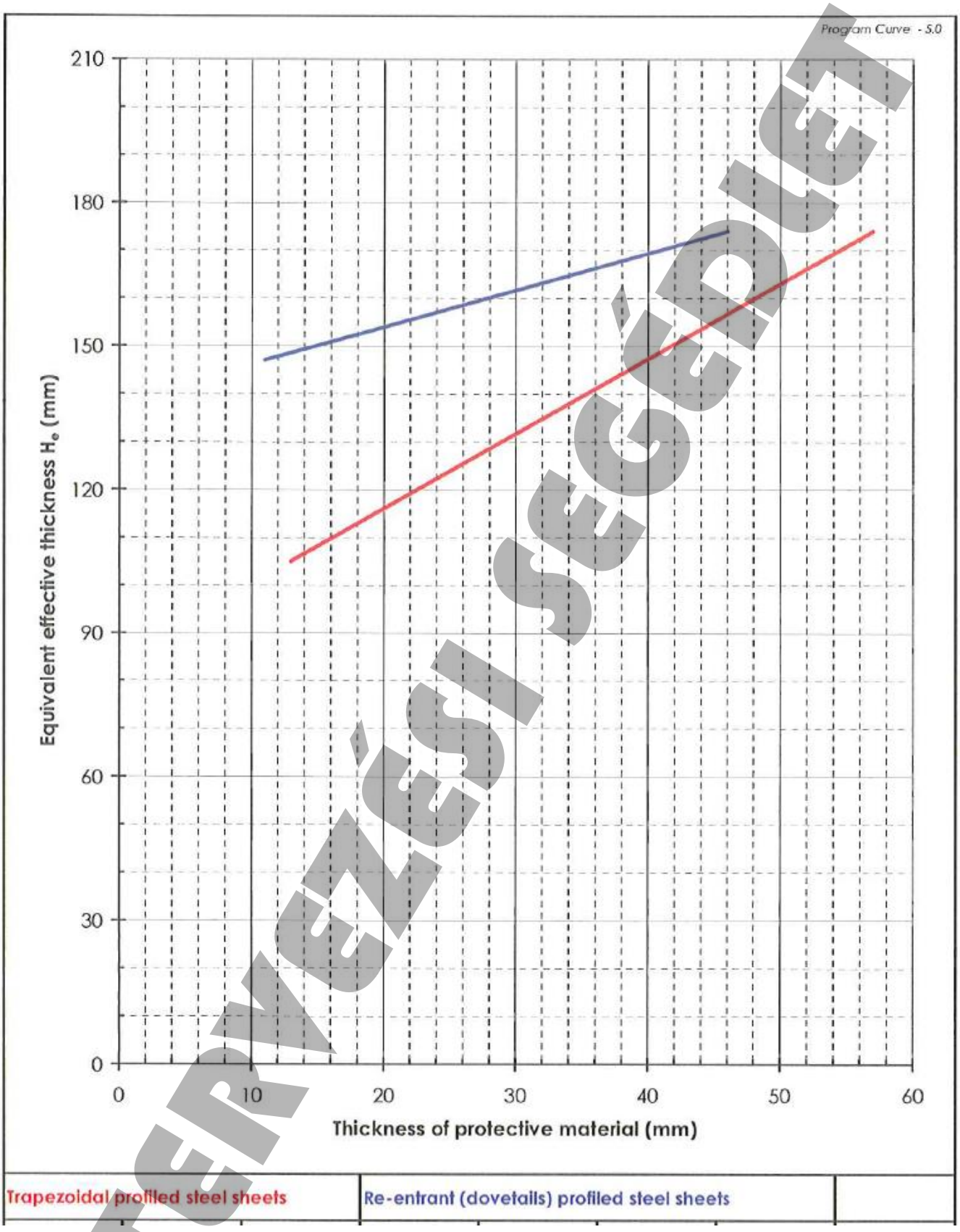


Figure A.2.5.4.3-1. The equivalent effective thickness H_e in function of the thickness of by the protective material PROMASPRAY® C450

The equivalent thickness of concrete H_{eq} in function of the thickness of by the protective material PROMASPRAY® C450 is given in figure A.2.5.4.3.-2.

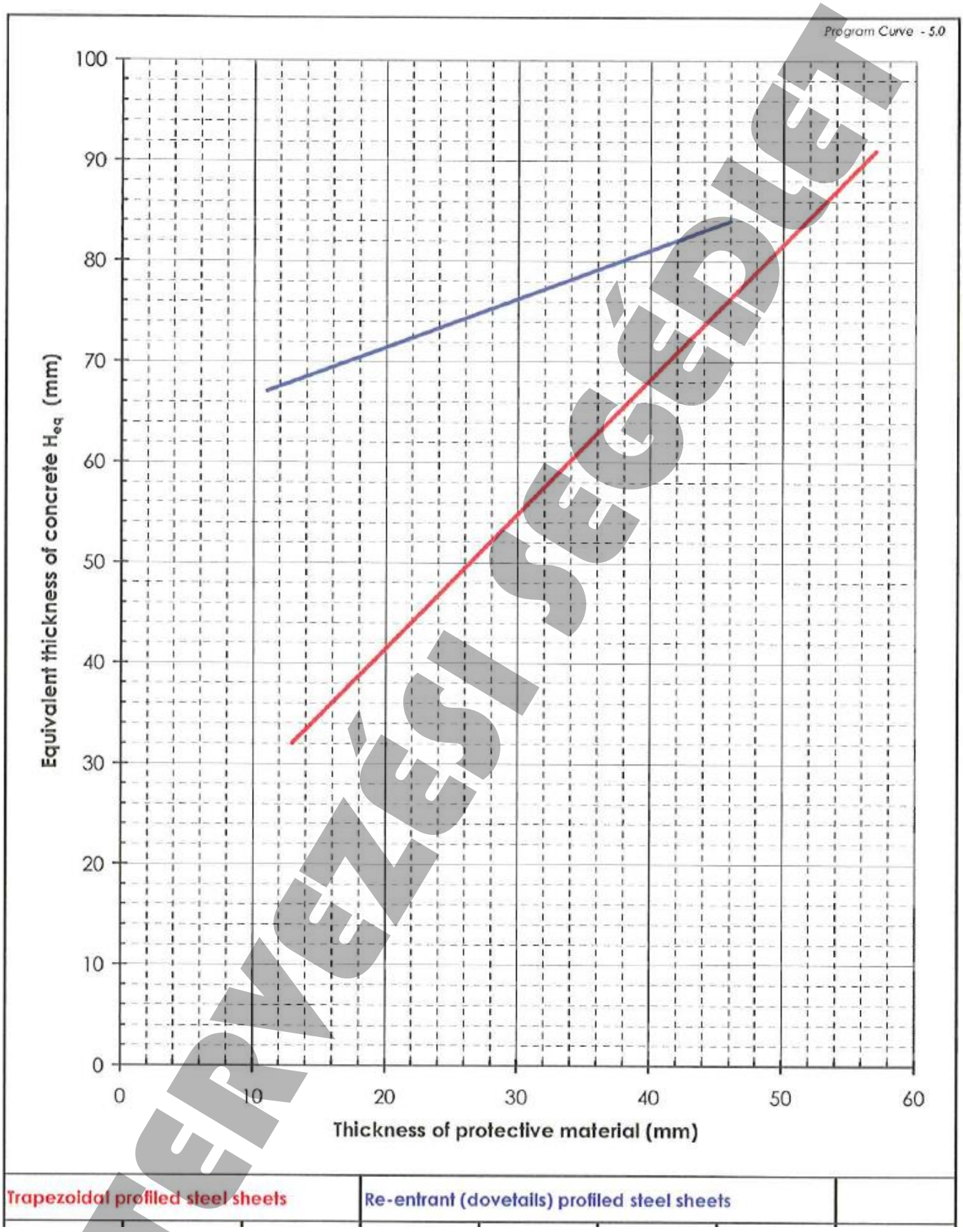


Figure A.2.5.4.3-2 The equivalent thickness of concrete H_{eq} in function of the thickness of by the protective material PROMASPRAY® C450

A.2.5.4.4 Stickability performance

The times for which the stickability of the protective material PROMASPRAY® C450 applied on both types of profiled steel sheets is ensured, have been determined according to the requirements of the standard ENV 13381-5:2002, paragraph 13.4. and are given in table A.2.5.4.4

Table A.2.5.4.4

Profiled steel sheets	Thickness of PROMASPRAY® C450 in mm	Stickability of protective material in minutes
Trapezoidal	13	137
Trapezoidal	66	150
Re-entrant	16	169
Re-entrant	73	200

A.2.5.4.5. REI classification in function of total thickness of the composite slab and minimum thickness of PROMASPRAY® C450

The minimum thickness of the protective material PROMASPRAY® C450 to apply to comply with a REI performance as shown in Table A.2.5.4.5 has been determined in accordance with the requirements of the standard EN 1994-1-2:2005, paragraph 4.3.2 and 4.3.3 by linear interpolation.

The performance R deals with a temperature of the profiled steel sheet not exceeding 350°C at the considered time.

Table A.2.5.4.5

Type	description	Total thickness range of composite slab(h1+h2)(1) (mm)	Minimum thickness of PROMASPRAY® C450 (mm)				
			REI 30	REI 60	REI 90	REI 120	REI 180
1	Trapezoidal	40 to 280	15	25	36	46	-
2	Re-entrant	40 tot 200	11	11	15	24	40*

(1) see figure 2.5.4.5
* : only for total thickness of 50 mm or higher

Figure 2.5.4.5

Trapezoidal profiled steel sheet Re-entrant (Dovetails) profiled steel sheet