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European Technical Assessment

ETA 11/0185
of 05.08.2019



General part

Technical Assessment Body issuing the ETA: ITeC

ITeC 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

TECWOOL F®

Product family to which the construction product belongs

Rendering intended for fire resisting applications.

Manufacturer

TECRESA Protección Pasiva SL
Parque Leganés Tecnológico
Margarita Salas 6
ES-28919 Leganés (Madrid)
Spain

Manufacturing plant(s)

According to Annex N kept by ITeC.

This European Technical Assessment contains

34 pages including 3 annexes which form an integral part of this assessment

and

Annex N, which contains confidential information and is not included in the European Technical Assessment when that assessment is publicly available.

This European Technical Assessment is issued in accordance with Regulation (EU) 305/2011, on the basis of

European Assessment Document EAD 350140-00-1106.

This version replaces

ETA 11/0185, issued on 13.10.2016.

General Comments

Translations of this European Technical Assessment in other languages shall fully correspond to the original issued document.

Communication of this European Technical Assessment, including transmission by electronic means, shall be in full (excepted the confidential Annex(es)).

Specific parts of the European Technical Assessment

1 Technical description of the product

TECWOOL F® is a spray-applied fire protective rendering made of mineral wool mixed with white cement and additives, with the binder included as part of the dry mix. TECWOOL F® is sprayed dry and mixed with water at the nozzle.

The rendering considered in this ETA does not require any additional product for its installation (ETA under option 1 as described in the scope of EAD 350140-00-1106).

Properties of the applied rendering such as thickness range, density, adhesion values, etc., are described in Annexes 2 and 3.

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

TECWOOL F® is intended for the fire protection uses as described in table 1, which also shows the related environmental use conditions.

Table 1: Intended use categories related to the protected element and the environmental conditions.

| Fire protection uses | | Environmental conditions |
|------------------------------|----------------------------------|------------------------------|
| EAD 350140-00-1106 reference | Element intended to be protected | EAD 350140-00-1106 reference |
| Type 3 | Loadbearing concrete elements | Type Z ₂ |
| Type 4 | Loadbearing steel elements | Type Z ₂ |

The environmental use categories are specified in EAD 350140-00-1106, section 1.2.3:

- Type Z₂: internal conditions with temperature of at least 0 °C and humidity lower than 85 % RH.

The provisions made in this ETA are based on a working life of TECWOOL F® of at least 25 years, provided that the conditions laid down in the manufacturer's instructions for the installation, use and maintenance are met. These provisions are based upon the current state of the art and the available knowledge and experience.

The indications given as to the working life cannot be interpreted as a guarantee given by the producer or Assessment Body, but are to be regarded only as a means for choosing the appropriate product(s) in relation to the expected economically reasonable working life of the works.

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

3.1 Performance of the product

The assessment of the TECWOOL F[®] has been performed in accordance with EAD 350140-00-1106 *Renderings and rendering kits intended for fire resisting applications (September 2017)*.

Table 2: Performance of TECWOOL F[®].

| Product: TECWOOL F [®] | | Intended use: Fire resisting applications | |
|--|-------------------------------------|---|-----------------------------|
| Basic requirement | Essential characteristic | Performance | |
| BWR 2 Safety in case of fire | Reaction to fire | A1 | |
| | Resistance to fire | See Annexes | |
| | Durability | Type Z ₂ | |
| BWR 4 Safety and accessibility in use | Adhesion (bond strength) | See 3.2.4 and Annex 2 and 3 | |
| BWR 5 Protection against noise | Sound absorption | Thickness 17 mm | $\alpha_w = 0,60$; Class C |
| | | Thickness 26 mm | $\alpha_w = 0,80$; Class B |
| BWR 6 Energy economy and heat retention | Thermal conductivity | $\lambda_{U,90/90(23/50)}$ | 0,075 W/(m·K) |
| | | $\lambda_{U,90/90(23/80)}$ | 0,080 W/(m·K) |
| | Water vapour permeability (μ) | 2,1 | |

The rest of characteristics included in EAD 350140-00-1106 have not been assessed in this ETA.

3.2 Methods used for the assessment

3.2.1 Reaction to fire

The performance of TECWOOL F[®] has been tested according to EN ISO 1182¹ and EN ISO 1716².

Classification is given in accordance with EN 13501-1³ and Regulation (EU) 2016/364.

3.2.2 Resistance to fire

Resistance to fire performance, classified in accordance with EN 13501-2⁴, has been determined following the test and evaluation methods given in the annexes.

¹ EN ISO 1182 Reaction to fire tests for products. Non-combustibility test.

² EN ISO 1716 Reaction to fire tests for products. Determination of the gross heat of combustion (calorific value).

³ EN 13501-1 Fire classification of construction products and building elements. Part 1: Classification using data from reaction to fire tests.

⁴ EN 13501-2 Fire classification of construction products and building elements. Part 2: Classification using data from fire resistance tests, excluding ventilation services implemented.

3.2.3 Durability

Durability of the rendering has been assessed according to EAD 350140-00-1106, section 2.2.12, in relation to its fire protective intended uses as defined in table 1.

3.2.4 Adhesion (bond strength)

Adhesion (bond strength) has been determined in accordance with EAD 350140-00-1106, section 2.2.7, and EGOLF EA 05⁵. The adhesion of the rendering depends on the installed thickness and the preparation of the substrate. Bond strength guidance values of the rendering and the conditions under which they were achieved are given in Annexes 2 and 3.

3.2.5 Sound absorption

The sound absorption of assemblies installed according to Annex 2 has been tested according to EN ISO 354⁶. The weighted sound absorption coefficient (α_w) and rating have been determined in accordance with EN ISO 11654⁷.

3.2.6 Thermal insulation

Thermal conductivity has been tested according to EN 12667⁸ and the declared values have been determined according to EN ISO 10456⁹.

Table 3: Thermal characteristics.

| | | | |
|----------------------------|-------|---------|---|
| $\lambda_{10,dry,90/90}$ | 0,061 | (W/m·K) | Conductivity fractile value at 10°C at dry conditions, representing at least 90% of the production with a confidence level of 90% |
| $\lambda_{U,90/90(23/50)}$ | 0,075 | (W/m·K) | Design value of conductivity at 23°C and 50% R.H. |
| $\lambda_{U,90/90(23/80)}$ | 0,080 | (W/m·K) | Design value of conductivity at 23°C and 80% R.H. |

3.2.7 Water vapour permeability

Tested according to EN ISO 12572¹⁰, the declared value of the water vapour diffusion resistance coefficient (μ -value) is given in table 2.

⁵ EGOLF EA 05 (SM5:1999): Fire testing. Method for the measurement of bonding properties of fire protection materials applied to steel, concrete and steel/concrete composite structures.

⁶ EN ISO 354 Acoustics. Measurement of sound absorption in a reverberation room.

⁷ EN ISO 11654 Acoustics. Sound absorbers for use in buildings. Rating of sound absorption.

⁸ EN 12667 Thermal performance of building materials and products. Determination of thermal resistance by means of guarded hot plate and heat flow meter methods. Products of high and medium thermal resistance.

⁹ EN ISO 10456 Building materials and products. Hygrothermal properties. Tabulated design values and procedures for determining declared and design thermal values.

¹⁰ EN ISO 12572 Hygrothermal performance of building materials and products - Determination of water vapour transmission properties - Cup method

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

According to the Decision 1999/454/EC of the European Commission, the system of AVCP (see EC Delegated Regulation (EU) No 568/2014 amending Annex V to Regulation (EU) 305/2011) given in the following table applies.

Table 4: AVCP System.

| Product(s) | Intended use(s) | Level(s) or class(es) | System(s) |
|--------------------------|--|-----------------------|-----------|
| Fire protective products | For fire compartmentation and/or fire protection or fire performance | Any | 1 |

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

All the necessary technical details for the implementation of the AVCP system are laid down in the Control Plan deposited with the ITeC and agreed in accordance with EAD 350140-00-1106, section 3.

The Control Plan is a confidential part of the ETA and only handed over to the notified product certification body involved in the assessment and verification of constancy of performance.

The factory production control operated by the manufacturer shall be in accordance with the above-mentioned Control Plan.

Issued in Barcelona on 5 August 2019

by the Catalonia Institute of Construction Technology.



Ferran Bermejo Nualart
Technical Director, ITeC

ANNEX 1. Resistance to fire performance and installation provisions

A.1.1 Overview of the assessed resistance to fire performance

The assessed constructive elements fire protected with TECWOOL F® are shown in table A.1.1.

Table A.1.1: Fire protected constructive elements.

| Intended use according to EAD | | Test standard | Installation |
|-------------------------------|-------------------------------|--------------------------|--------------|
| Type 3 | Loadbearing concrete elements | EN 13381-3 ¹¹ | Annex 2 |
| Type 4 | Loadbearing steel elements | EN 13381-4 ¹² | Annex 3 |

A.1.2 Installation provisions related to the elements protected with TECWOOL F®

The installation should be carried out in accordance with the manufacturer's instructions and the provisions given in this ETA.

The product is intended for environmental use category Type Z₂. Special provisions shall be taken for temporary protection of the rendering exposed to outdoor conditions during construction.

Before application the substrate should be inspected and prepared. Surfaces to be sprayed shall be free from oil, grease, primers, sealing agents or of any other substance that will impair adhesion. If dirt is detected on the substrate, it is recommended to clean the substrate by spraying water with a hose.

Clips, hangers, supports, sleeves and other attachments to the substrate can be placed by others prior or after the application of TECWOOL F®. Ducts, piping, conduits or other suspended equipment can be installed after the application of TECWOOL F®, in which case later inspection will be required and, when necessary, reparation of the rendering.

A.1.3 Verifications on site

The thickness should be measured at sufficient points to determine the mean and minimum thickness. A suitable method for thickness measurement is given in EAD 350140-00-1106, section 2.3.4.

The density of the hardened rendering should be measured within the tolerances specified in the next annexes.

The bond strength of the rendering to the substrate should be tested on site. A suitable method is EGOLF Agreement EA 05, which can be used as a base for the site tests. The person responsible for the works will decide on the adequacy of the site tests results taking into account the reference values given in the next annex. For their acceptability, the recommendations given in EAD, section G.4, or other existing criteria can be applied, under the responsibility of the person responsible for works.

¹¹ EN 13381-3 Test methods for determining the contribution to the fire resistance of structural members. Part 3: Applied protection to concrete members.

¹² EN 13381-4 Test methods for determining the contribution to the fire resistance of structural members. Part 4: Applied passive protection to steel members.

ANNEX 2. Specification and assessment of fire protection of loadbearing concrete elements protected by TECWOOL F® (intended use Type 3)

A.2.1 Loadbearing concrete beams and columns

A.2.1.1 Classification

The constructive elements described in this annex have been tested and assessed according to EN 13381-3 and classified in accordance with EN 13501-2.

The equivalent thickness of concrete and the insulation performance are given in section A.2.1.3.

A.2.1.2 Installation requirements

The system installation should be carried out in accordance with the provisions in A.1.2 and the following specification.

A.2.1.2.1 Supporting structural element

TECWOOL F® can be applied on concrete beams and columns exposed to fire from more than one side. Specification of the supporting structural element is given in table A.2.1.

Table A.2.1: Specification of the concrete structural element.

| Element | Characteristics | Mounting and fixing |
|--------------------------------------|---|---|
| Loadbearing concrete beam and column | Height of the section ≥ 450 mm* | Reinforced concrete |
| | Width of the section ≥ 150 mm | Concrete release from the mould without agent |
| | Density: $2400 \text{ kg/m}^3 \pm 15\%$ | Surface free of oil, grease, dust, etc. |
| | Compressive strength $\geq 25,0 \text{ N/mm}^2$ | |
| | Made with any type of aggregate | |

* The height may be decreased provided the section surface remains the same or is higher, by increasing the width.

A.2.1.2.2 Fire protective rendering

TECWOOL F® is directly applied on the apparent sides of the concrete structure to be protected by following their shape. TECWOOL F® is sprayed in coats of regular thickness to reach the requested thickness according to this annex. Hairline cracks in the dry rendering are not accepted.

Specification of the fire protective rendering is given in table A.2.2.

Table A.2.2: Specification of the applied rendering.

| Product | Characteristics | Mounting and fixing |
|------------------------------------|--|--|
| TECWOOL F® (Hardened rendering) | Thickness: 12,2 mm to 38,0 mm | Rendering is kept without finishing after application It is sprayed in layers of approximately 10 mm |
| | Density: $351 \text{ kg/m}^3 \pm 15\%$ | Spray-applied rendering without: <ul style="list-style-type: none"> - Primer or bonding agent - Topcoat or sealing coat - Mechanical fixings or reinforcement - Additives out of dry mix |

A.2.1.2.3 Bonding properties of TECWOOL F® on concrete beams and columns

Assessment of the bonding properties of TECWOOL F®, when directly applied on concrete structures, has been carried out according to EGOLF EA 05 procedure.

The indicated values are representative of cohesive failure near the rendering surface. These values are guidance values, and they do not reflect a statistical evaluation, nor minimum guaranteed values.

Table A.2.3: Tensile bond strength on concrete substrates.

| Surface | Thickness of TECWOOL F® (mm) | Mean tensile bond strength (MPa) | Failure mode |
|--|------------------------------|----------------------------------|--------------|
| Concrete substrate | 12,0 | 0,0390 | Cohesive |
| concrete substrate according EGOLF EA 05 | 37,0 | 0,0204 | Cohesive |

A.2.1.3 Assessment of the fire performance of TECWOOL F® on concrete beams and columns

A.2.1.3.1 General

The assessment method used to assess the fire protection performance of TECWOOL F® when applied on concrete elements is according to clause 13 of EN 13381-3.

A.2.1.3.2 Insulation performance

The average temperature of the 12,2 mm protected concrete beam unexposed surface exceeded 140°C the initial temperature at minute 129.

Insulation criteria were maintained for the 38,0 mm protected concrete beam over the entire test duration (360 minutes).

A.2.1.3.3 Stickability performance

The stickability of TECWOOL F® when applied on concrete beams and columns is determined according to the requirements of clause 13.5 of EN 13381-3.

At no time the maximum recorded temperatures of the exposed surface of the 12,2 mm protected concrete were more than 50% above the mean value of the recorded temperatures of the concrete exposed surface (no stickability failure occurs).

At no time the maximum recorded temperatures of the exposed surface of the 38,0 mm protected concrete were more than 50% above the mean value of the recorded temperatures of the concrete exposed surface (no stickability failure occurs).

A.2.1.3.4 Protection of concrete beams and columns

The insulation efficiency of the 12,2 mm and 38,0 mm thickness protective material when applied on concrete beams and columns as specified in table A.2.1, subject to the thermal exposure under the standard time-temperature curve as defined in paragraph 5.1.1 of EN 1363-1, is given in the next tables in a range of concrete temperatures within 350 °C – 650 °C.

Table A.2.4: Concrete depth vs critical temperature for 12,2 mm thickness of TECWOOL F®.

| Temperature (°C) | Depth of critical temperatures inside the concrete (mm) | | | | | | | |
|------------------|---|--------|--------|---------|---------|---------|---------|---------|
| | 30 min | 60 min | 90 min | 120 min | 150 min | 180 min | 210 min | 240 min |
| 350 | -- | -- | -- | -- | 40 | 64 | -- | -- |
| 400 | -- | -- | -- | -- | -- | 53 | 70 | -- |
| 450 | -- | -- | -- | -- | -- | 33 | 60 | 74 |
| 500 | -- | -- | -- | -- | -- | -- | 44 | 64 |
| 550 | -- | -- | -- | -- | -- | -- | -- | 51 |
| 600 | -- | -- | -- | -- | -- | -- | -- | 28 |
| 650 | -- | -- | -- | -- | -- | -- | -- | -- |

Table A.2.5: Concrete depth vs critical temperature for 38,0 mm thickness of TECWOOL F®.

| Temperature (°C) | Depth of critical temperatures inside the concrete (mm) | | | | | | | |
|------------------|---|--------|--------|---------|---------|---------|---------|---------|
| | 30 min | 60 min | 90 min | 120 min | 150 min | 180 min | 210 min | 240 min |
| 350 | -- | -- | -- | -- | -- | -- | -- | -- |
| 400 | -- | -- | -- | -- | -- | -- | -- | -- |
| 450 | -- | -- | -- | -- | -- | -- | -- | -- |
| 500 | -- | -- | -- | -- | -- | -- | -- | -- |
| 550 | -- | -- | -- | -- | -- | -- | -- | -- |
| 600 | -- | -- | -- | -- | -- | -- | -- | -- |
| 650 | -- | -- | -- | -- | -- | -- | -- | -- |

A.2.1.3.5 Equivalent thickness of concrete

The equivalent thickness of concrete induced by the protective rendering TECWOOL F®, applied at 12,2 mm and 38,0 mm on concrete beams or columns, is determined according to Annex C of EN 13381-3 and given in the table A.2.6.

Table A.2.6: Equivalent thickness of concrete induced by TECWOOL F®.

| Time period (minutes) | | 30 | 60 | 90 | 120 | 180 | 240 |
|---------------------------------------|-----------------------|----|----|----|-----|-----|-----|
| Equivalent thickness of concrete (mm) | Tecwool F® at 12,2 mm | 31 | 45 | 50 | 47 | 40 | -- |
| | Tecwool F® at 38,0 mm | 71 | 75 | 89 | 92 | 98 | 91 |

The equivalent thickness of concrete H_{eq} in function of the thickness of TECWOOL F® is given in figures A.2.1, A.2.2, A.2.3, A.2.4 and A.2.5 for a time period of 30, 60, 90, 120 and 180 minutes respectively.

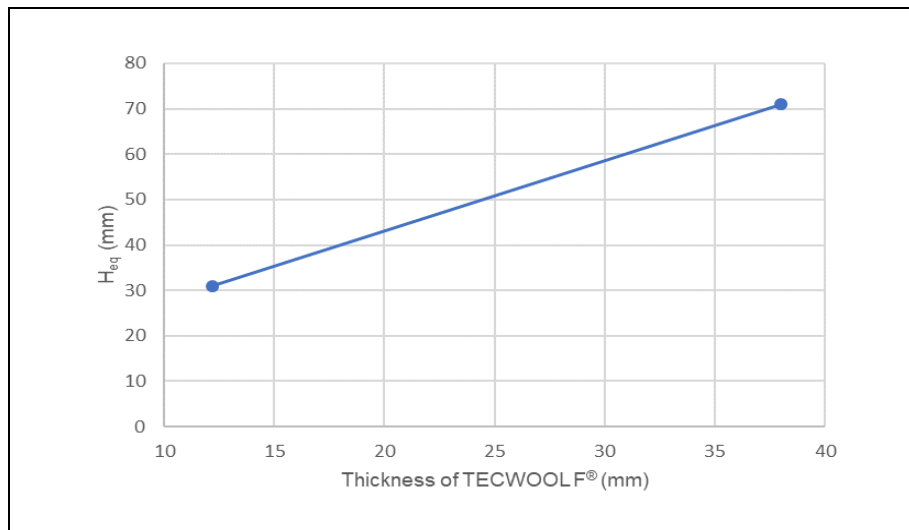


Figure A.2.1: Equivalent thickness of concrete (30 minutes).

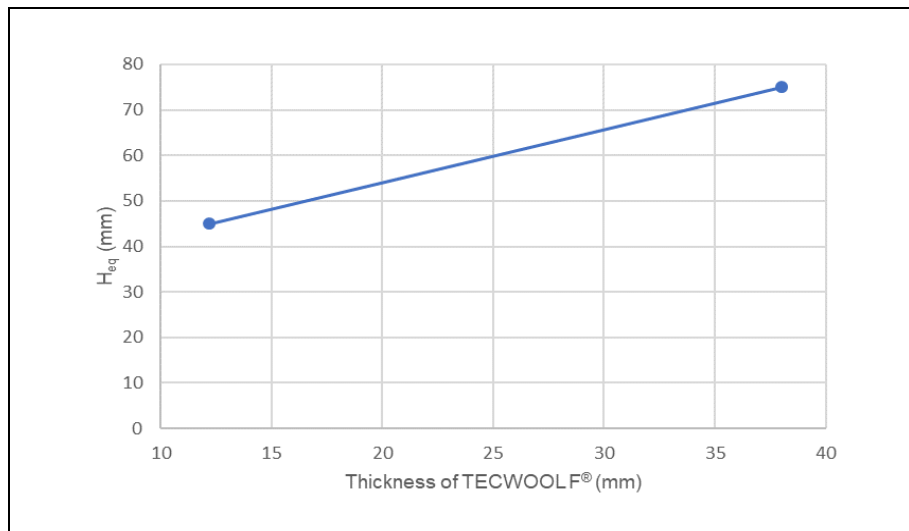


Figure A.2.2: Equivalent thickness of concrete (60 minutes).

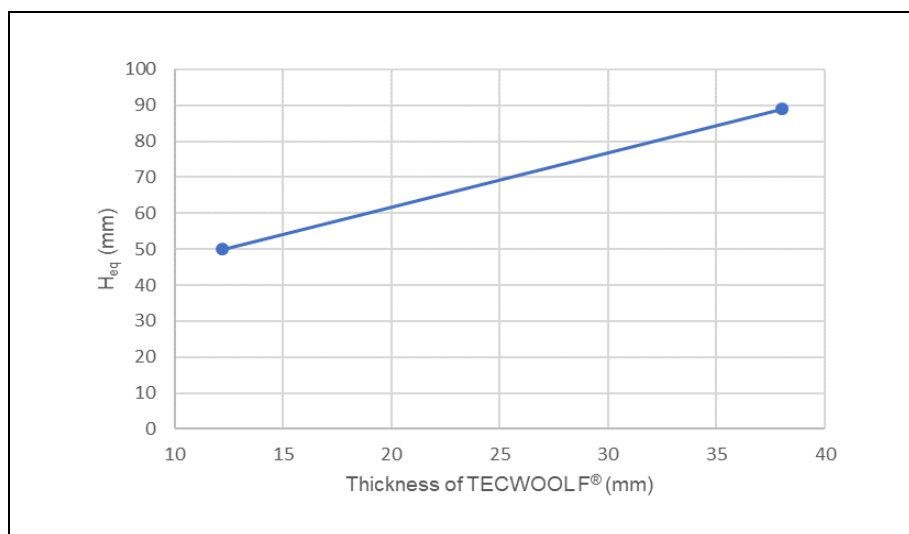


Figure A.2.3: Equivalent thickness of concrete (90 minutes).

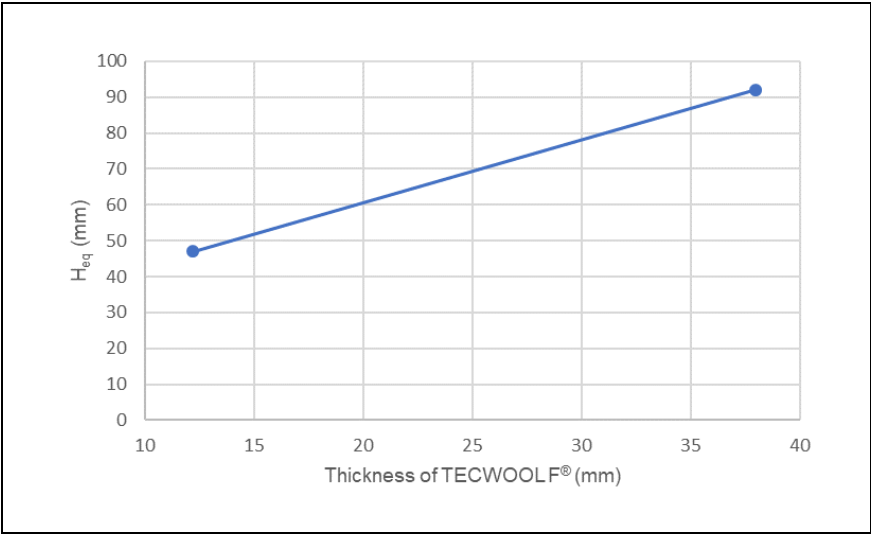


Figure A.2.4: Equivalent thickness of concrete (120 minutes).

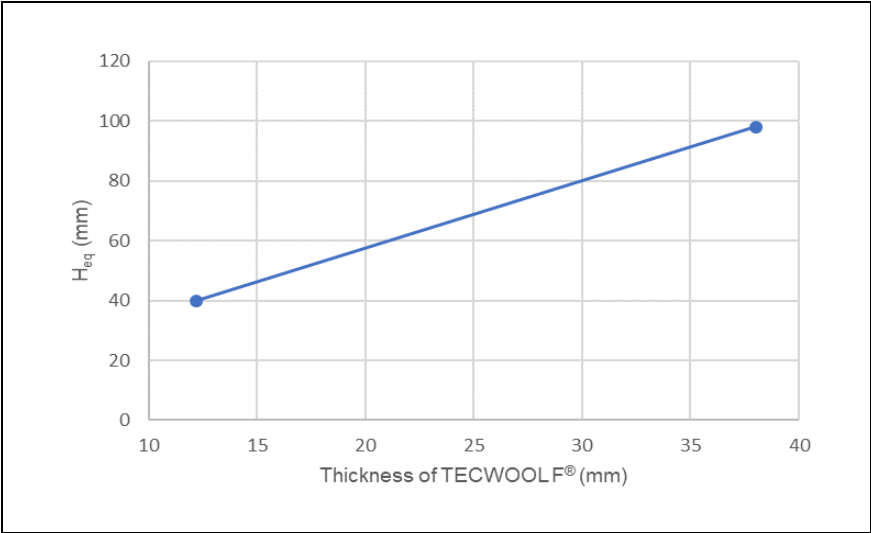


Figure A.2.5: Equivalent thickness of concrete (180 minutes).

A.2.2 Loadbearing concrete slabs and walls

A.2.2.1 Classification

The constructive elements described in this annex has been tested and assessed according to EN 13381-3 and classified in accordance with EN 13501-2.

The equivalent thickness of concrete and the insulation performance are given in section A.2.2.3.

A.2.2.2 Installation requirements

The system installation should be carried out in accordance with the provisions in A.1.2 and the following specification.

A.2.2.2.1 Supporting structural element

TECWOOL F[®] can be applied on concrete slabs exposed to fire from one side, both in horizontal (floors) and vertical (walls) orientation. Specification of the supporting structural element is given in table A.2.7.

Table A.2.7: Specification of the concrete structural element.

| Element | Characteristics | Mounting and fixing |
|------------------------------------|--|--|
| Loadbearing concrete slab and wall | Thickness of the slab/wall ≥ 140 mm Density: $2400 \text{ kg/m}^3 \pm 15 \%$ Compressive strength $\geq 25 \text{ N/mm}^2$ Made with any type of aggregate | Reinforced concrete. Concrete released from the mould without agent. Surface free of oil, grease, dust, etc. |

A.2.2.2.2 Fire protective rendering

TECWOOL F[®] is directly applied on the concrete structure in coats of regular thickness to reach the requested thickness according to this annex. Hairline cracks in the dry rendering are not accepted.

Specification of the fire protective rendering is given in table A.2.8.

Table A.2.8. Specification of the applied rendering.

| Product | Characteristics | Mounting and fixing |
|--|--|---|
| TECWOOL F [®] (Hardened rendering) | Thickness: 12,1 mm to 35,2 mm Density: $351 \text{ kg/m}^3 \pm 15 \%$ | Rendering is kept without finishing after application It is sprayed in layers of 10 mm Spray-applied rendering without: <ul style="list-style-type: none"> - Primer or bonding agent - Topcoat or sealing coat - Mechanical fixings or reinforcement - Additives out of dry mix |

A.2.2.2.3 Bonding properties of TECWOOL F® on concrete slabs and walls

Assessment of the bonding properties of TECWOOL F®, when directly applied on concrete structures, has been carried out according to EGOLF EA 05 procedure.

The indicated values are representative of cohesive failure near the rendering surface. These values are guidance values, and they do not reflect a statistical evaluation, nor minimum guaranteed values.

Table A.2.9. Tensile bond strength on concrete substrates.

| Surface | Thickness of TECWOOL F® (mm) | Mean tensile bond strength (MPa) | Failure mode |
|--|------------------------------|----------------------------------|--------------|
| Concrete substrate according EGOLF EA 05 | 12,0 | 0,0390 | Cohesive |
| | 37,0 | 0,0204 | Cohesive |

A.2.2.3 Assessment of the fire performance of TECWOOL F® on concrete slabs and walls

A.2.2.3.1 General

The assessment method used to assess the fire protection performance of TECWOOL F® when applied on concrete elements is according to clause 13 of EN 13381-3.

A.2.2.3.2 Insulation performance

Insulation criteria were maintained for the 12,1 mm protected concrete slab over the entire test duration (306 minutes).

Insulation criteria were maintained for the 35,2 mm protected concrete slab over the entire test duration (360 minutes).

A.2.2.3.3 Stickability performance

The stickability of TECWOOL F® when applied on concrete slabs and walls is determined according to the requirements of paragraph 13.5 of EN 13381-3.

A.2.2.3.3.1 Stickability criteria for slab with TECWOOL F® 12,1 mm

At no time the maximum recorded temperatures of the concrete exposed surface were more than 50% above the mean value of the recorded temperatures of the concrete exposed surface (no stickability failure occurs).

A.2.2.3.3.2 Stickability criteria for slab with TECWOOL F® 35,2 mm

At no time the maximum recorded temperatures of the concrete exposed surface were more than 50% above the mean value of the recorded temperatures of the concrete exposed surface (no stickability failure occurs).

A.2.2.3.4 Protection of concrete slabs and walls

The insulation efficiency of the 12,1 mm and 35,2 mm thicknesses protective material when applied on concrete slabs and walls as specified in table A.2.7, subject to the thermal exposure under the standard time-temperature curve as defined in clause 5.1.1 of EN 1363-1, is given in the next tables in a range of concrete temperatures within 350 °C – 650 °C.

Table A.2.10: Concrete depth vs critical temperature for 12,1 mm thickness of TECWOOL F®.

| Temperature (°C) | Depth of critical temperatures inside the concrete (mm) | | | | | | | | | |
|------------------|---|-------|-------|--------|--------|--------|--------|--------|--------|--------|
| | 30min | 60min | 90min | 120min | 150min | 180min | 210min | 240min | 270min | 300min |
| 350 | -- | -- | -- | -- | -- | 28 | 42 | 52 | 58 | 63 |
| 400 | -- | -- | -- | -- | -- | 21 | 30 | 41 | 49 | 56 |
| 450 | -- | -- | -- | -- | -- | -- | 24 | 30 | 41 | 47 |
| 500 | -- | -- | -- | -- | -- | -- | 19 | 26 | 32 | 40 |
| 550 | -- | -- | -- | -- | -- | -- | -- | 22 | 27 | 33 |
| 600 | -- | -- | -- | -- | -- | -- | -- | 18 | 24 | 28 |
| 650 | -- | -- | -- | -- | -- | -- | -- | -- | 20 | 25 |

Table A.2.11: Concrete depth vs critical temperature for 35,2 mm thickness of TECWOOL F®.

| Temperature (°C) | Depth of critical temperatures inside the concrete (mm) | | | | | | | | | |
|------------------|---|-------|-------|--------|--------|--------|--------|--------|--------|--------|
| | 30min | 60min | 90min | 120min | 150min | 180min | 210min | 240min | 270min | 300min |
| 350 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 400 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 450 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 500 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 550 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 600 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| 650 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |

A.2.2.3.5 Equivalent thickness of concrete

The equivalent thickness of concrete induced by the protective rendering TECWOOL F®, applied at 12,1 mm and 35,2 mm on concrete slabs and walls, is determined according to Annex C of EN 13381-3 and given in table A.2.12.

Table A.2.12: Equivalent thickness of concrete induced by TECWOOL F®.

| Time period (minutes) | | 30 | 60 | 90 | 120 | 180 | 240 |
|---------------------------------------|-----------------------|----|-----|-----|-----|-----|-----|
| Equivalent thickness of concrete (mm) | Tecwool F® at 12,1 mm | 41 | 50 | 53 | 52 | 42 | 27 |
| | Tecwool F® at 35,2 mm | 85 | 100 | 114 | 121 | 126 | 132 |

The equivalent thickness of concrete H_{eq} in function of the thickness of TECWOOL F® is given in figures A.2.6, A.2.7, A.2.8, A.2.9, A.2.10 and A.2.11 for a time period of 30, 60, 90, 120, 180 and 240 minutes respectively.

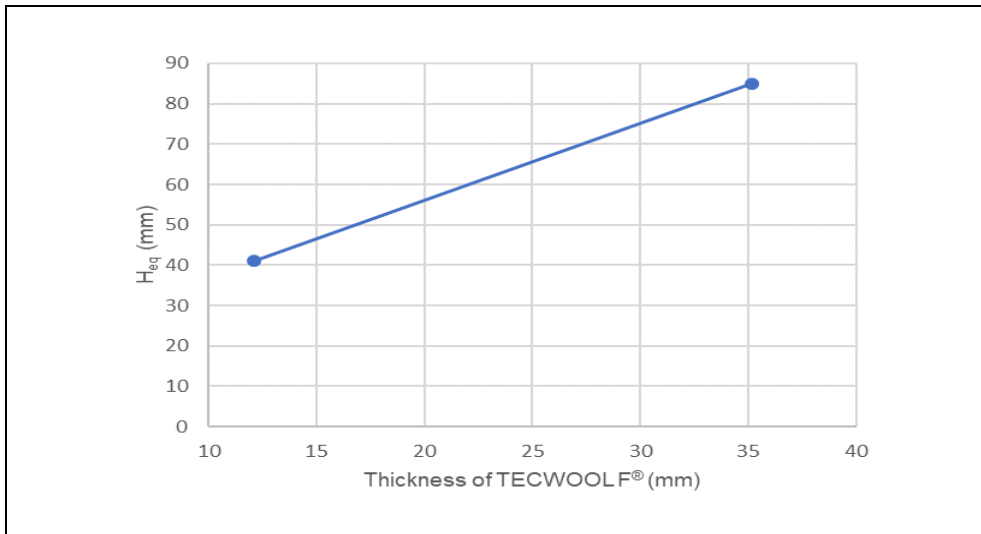


Figure A.2.6: Equivalent thickness of concrete (30 minutes).

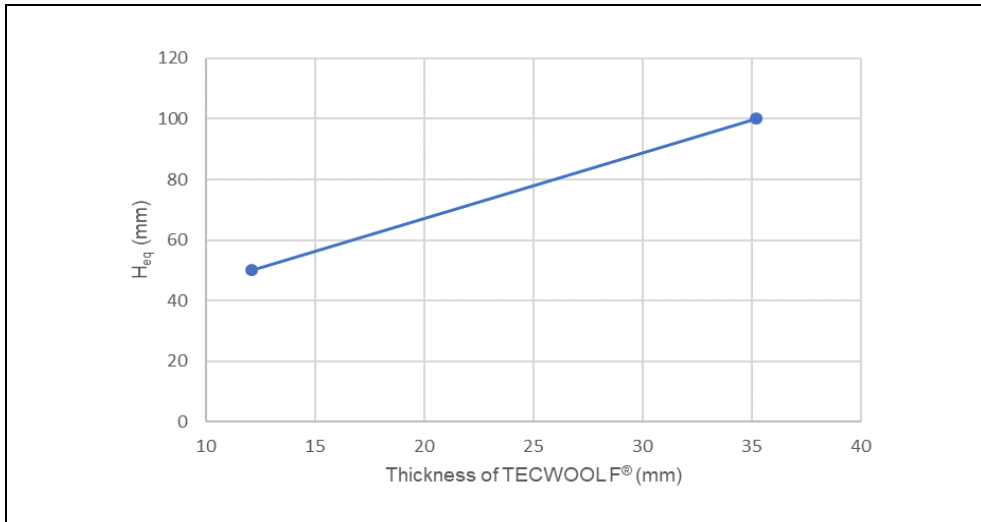


Figure A.2.7: Equivalent thickness of concrete (60 minutes).

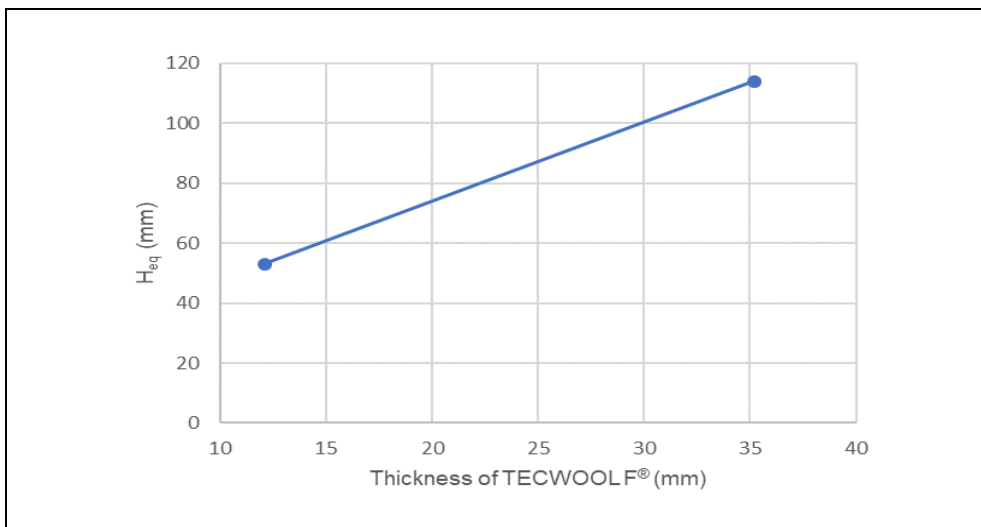


Figure A.2.8: Equivalent thickness of concrete (90 minutes).

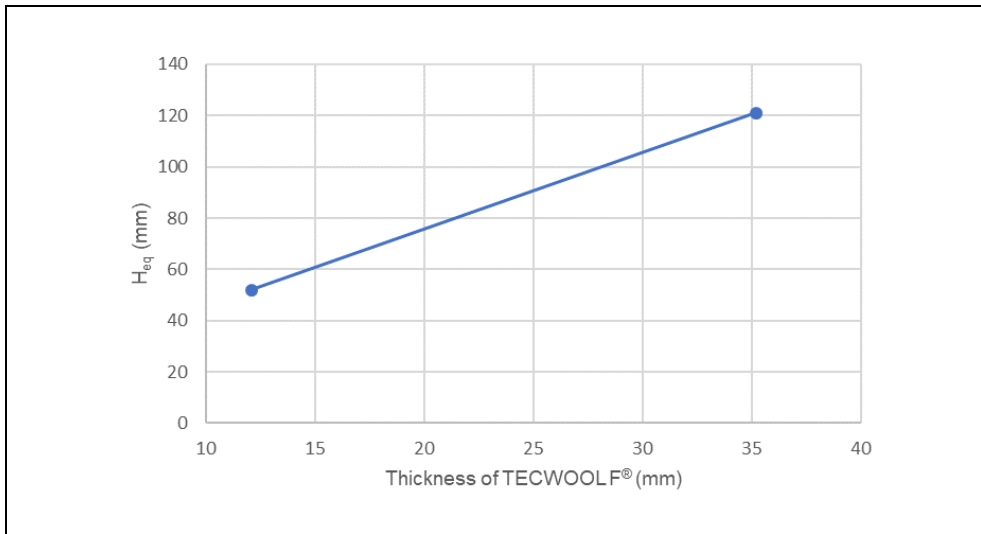


Figure A.2.9: Equivalent thickness of concrete (120 minutes).

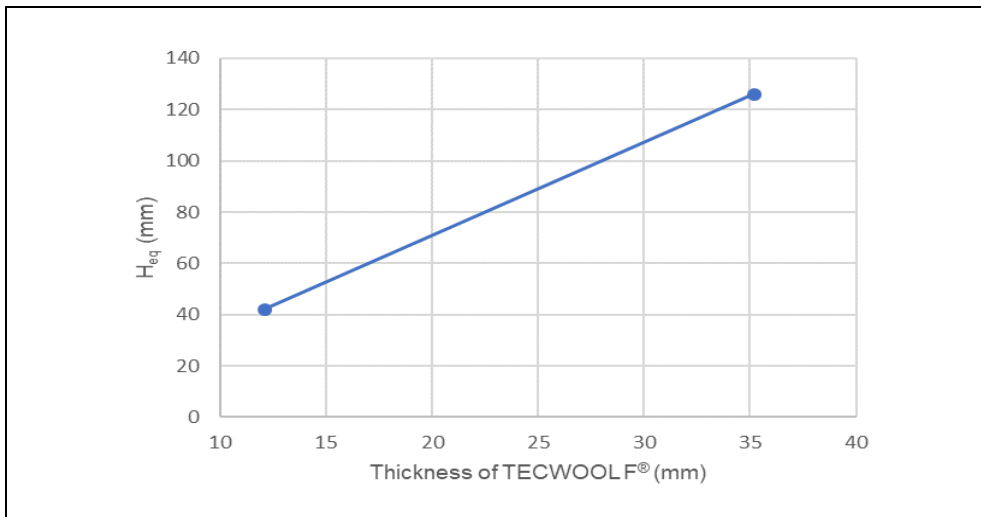


Figure A.2.10: Equivalent thickness of concrete (180 minutes).

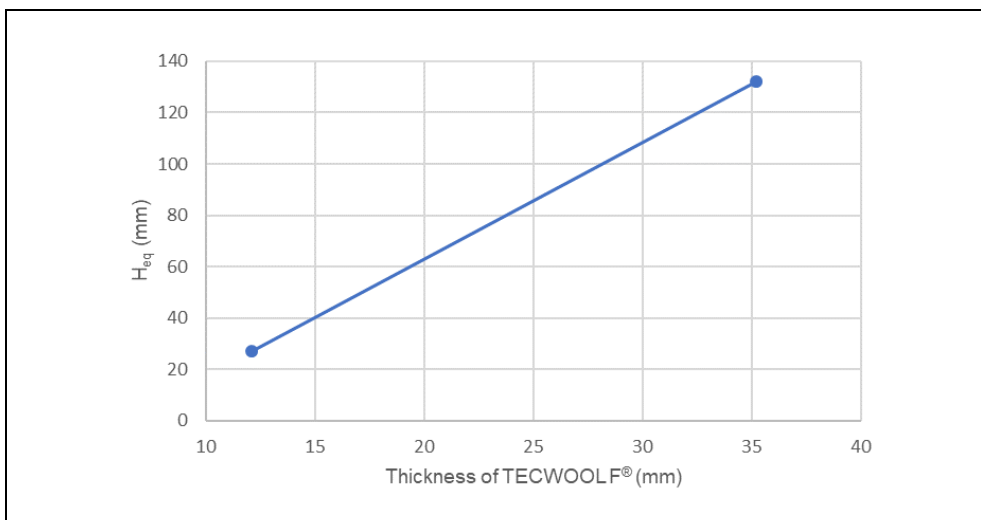


Figure A.2.11: Equivalent thickness of concrete (240 minutes).

ANNEX 3. Specification and assessment of fire protection of loadbearing steel elements protected by TECWOOL F® (intended use Type 4)

A.3.1 Classification

The system described in this annex has been tested and evaluated according to EN 13381-4 and classified in accordance with EN 13501-2.

The assessment of the required thickness of TECWOOL F® rendering for the relevant resistance to fire period, at the design temperature within the range of 300 °C to 700 °C and in function of the section factor of the steel element, is given in section A.3.3.

A.3.2 Installation requirements

The product installation should be carried out in accordance with the provisions in A.1.2 and the following specification.

A.3.2.1 Supporting structure

The supporting structure consists of load-bearing steel elements with the following characteristics:

- 'H' or 'I' section beams and columns (table A.3.3 to table A.3.9 of this ETA).

The maximum beam depth is limited to 450 mm and the maximum column depth to 600 mm.

Note: The protection thickness given for H/I sections also apply to steel sections of other shapes (e.g. U, L and T-sections) under consideration of the same section factor.

- Hollow section beams and columns (table A.3.10 to table A.3.16 of this ETA).
- Structural steel grades (S designation) in accordance with EN 10025¹³ excluding S185.
- Section factors as given in table A.3.3 to table A.3.16 of this ETA.

Steel elements with a section factor lower than 67 m⁻¹ shall be protected with the thickness of TECWOOL F® rendering given for an element with section factor equal to 67 m⁻¹.

- Three-sided fire exposure for beams and four-sided fire exposure for columns.

In case of beams or columns with fewer sides exposed to fire, thickness of the rendering can be applied according to table A.3.3 to table A.3.16 under consideration of the section factor calculated for the relevant case.

¹³ EN 10025-1 to 6 Hot rolled products of structural steels.

A.3.2.2 Surface of steel elements

The steel sections must be blast cleaned to EN ISO 8501-1¹⁴ SA2½ or equivalent. The surface shall be bare, clean, dry and free of dust.

TECWOOL F® is assessed for direct application on the steel elements.

A.3.2.3 Fire protective rendering

TECWOOL F® is applied on the apparent sides of the steel structural element to be protected by following their shape. TECWOOL F® is sprayed according to table A.3.1 to reach the requested thickness according to this annex. Hairline cracks in the dry rendering are not accepted.

Table A.3.1: Specification of the applied rendering.

| Product | Characteristics | Mounting and fixing |
|------------------------------------|--|--|
| TECWOOL F® (Hardened rendering) | Thickness: 10 mm to 69 mm Density: 348 kg/m ³ ± 15 % | Rendering is kept without finishing after application. For minimum thickness application, it is sprayed in one single layer. For medium thickness application, it is sprayed in two layers. For maximum thickness application, it is sprayed in three layers. Spray-applied rendering without: <ul style="list-style-type: none"> - Bonding agent - Topcoat or sealing coat - Mechanical fixings or reinforcement - Additives out of dry mix |

A.3.2.4 Bonding properties of TECWOOL F® on steel elements

Assessment of the bonding properties of TECWOOL F®, when applied on steel structures, has been carried out according to EGOLF EA 05 procedure.

The indicated values are representative of cohesive failure near the rendering surface. These values are guidance values, and they do not reflect a statistical evaluation, nor minimum guaranteed values.

Table A.3.2: Tensile bond strength on steel substrates.

| Surface | Thickness of TECWOOL F® (mm) | Mean tensile bond strength (MPa) | Failure mode |
|---------------------------------------|------------------------------|----------------------------------|--------------|
| Steel substrate according EGOLF EA 05 | Minimum | 0,0055 | Cohesive |
| | Maximum | 0,0028 | Cohesive |

¹⁴ EN ISO 8501-1 Preparation of steel substrates before application of paints and related products. Visual assessment of surface cleanliness. Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings.

A.3.3 Assessment of the fire performance of TECWOOL F® on steel structures

The assessment of the fire resistance performance of TECWOOL F® when applied on steel structures has been done according to EN 13381-4, Annex E.5 Numerical Regression Analysis.

The resistance to fire performance of I/H sections beams and columns is given in tables A.3.3 to A.3.9.

The resistance to fire performance of hollow section (HS) beams and columns is given in tables A.3.10 to A.3.16, calculated in accordance with Annex A, section A.3, of EN 13381-4.

Table A.3.3: Resistance to fire of H and I sections.

| Section Factor (m ⁻¹) | Resistance to fire period of 30 minutes | | | | | | | | |
|--------------------------------------|--|--------|--------|--------|--------|--------|--------|--------|--------|
| | Minimum thickness (mm) of TECWOOL F® at the design temperature | | | | | | | | |
| | 300 °C | 350 °C | 400 °C | 450 °C | 500 °C | 550 °C | 600 °C | 650 °C | 700 °C |
| 67 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 70 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 80 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 90 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 100 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 110 | 11 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 120 | 12 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 130 | 12 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 140 | 13 | 11 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 150 | 13 | 11 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 160 | 14 | 12 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 170 | 14 | 12 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 180 | 14 | 12 | 11 | 10 | 10 | 10 | 10 | 10 | 10 |
| 190 | 15 | 13 | 11 | 10 | 10 | 10 | 10 | 10 | 10 |
| 200 | 15 | 13 | 11 | 10 | 10 | 10 | 10 | 10 | 10 |
| 210 | 15 | 13 | 12 | 10 | 10 | 10 | 10 | 10 | 10 |
| 220 | 15 | 13 | 12 | 10 | 10 | 10 | 10 | 10 | 10 |
| 230 | 15 | 14 | 12 | 11 | 10 | 10 | 10 | 10 | 10 |
| 240 | 16 | 14 | 12 | 11 | 10 | 10 | 10 | 10 | 10 |
| 250 | 16 | 14 | 12 | 11 | 10 | 10 | 10 | 10 | 10 |
| 260 | 16 | 14 | 13 | 11 | 10 | 10 | 10 | 10 | 10 |
| 270 | 16 | 14 | 13 | 11 | 10 | 10 | 10 | 10 | 10 |
| 280 | 16 | 14 | 13 | 12 | 10 | 10 | 10 | 10 | 10 |
| 290 | 16 | 15 | 13 | 12 | 10 | 10 | 10 | 10 | 10 |
| 300 | 16 | 15 | 13 | 12 | 11 | 10 | 10 | 10 | 10 |
| 310 | 16 | 15 | 13 | 12 | 11 | 10 | 10 | 10 | 10 |
| 320 | 16 | 15 | 13 | 12 | 11 | 10 | 10 | 10 | 10 |
| 330 | 17 | 15 | 14 | 12 | 11 | 10 | 10 | 10 | 10 |
| 340 | 17 | 15 | 14 | 12 | 11 | 10 | 10 | 10 | 10 |
| 350 | 17 | 15 | 14 | 12 | 11 | 10 | 10 | 10 | 10 |
| 360 | 17 | 15 | 14 | 12 | 11 | 10 | 10 | 10 | 10 |
| 370 | 17 | 15 | 14 | 13 | 11 | 10 | 10 | 10 | 10 |
| 380 | 17 | 15 | 14 | 13 | 11 | 10 | 10 | 10 | 10 |
| 390 | 17 | 15 | 14 | 13 | 12 | 10 | 10 | 10 | 10 |
| 400 | 17 | 16 | 14 | 13 | 12 | 11 | 10 | 10 | 10 |
| 410 | 17 | 16 | 14 | 13 | 12 | 11 | 10 | 10 | 10 |
| 420 | 17 | 16 | 14 | 13 | 12 | 11 | 10 | 10 | 10 |
| 430 | 17 | 16 | 14 | 13 | 12 | 11 | 10 | 10 | 10 |
| 440 | 17 | 16 | 14 | 13 | 12 | 11 | 10 | 10 | 10 |
| 495 | 18 | 16 | 15 | 13 | 12 | 11 | 10 | 10 | 10 |

Table A.3.4: Resistance to fire of H and I sections.

| Section Factor (m ⁻¹) | Resistance to fire period of 45 minutes | | | | | | | | |
|--------------------------------------|--|--------|--------|--------|--------|--------|--------|--------|--------|
| | Minimum thickness (mm) of TECWOOL F® at the design temperature | | | | | | | | |
| | 300 °C | 350 °C | 400 °C | 450 °C | 500 °C | 550 °C | 600 °C | 650 °C | 700 °C |
| 67 | 11 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 70 | 12 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 80 | 13 | 11 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 90 | 14 | 12 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 100 | 15 | 13 | 11 | 10 | 10 | 10 | 10 | 10 | 10 |
| 110 | 16 | 14 | 12 | 10 | 10 | 10 | 10 | 10 | 10 |
| 120 | 17 | 14 | 12 | 11 | 10 | 10 | 10 | 10 | 10 |
| 130 | 17 | 15 | 13 | 11 | 10 | 10 | 10 | 10 | 10 |
| 140 | 18 | 16 | 14 | 12 | 10 | 10 | 10 | 10 | 10 |
| 150 | 18 | 16 | 14 | 12 | 11 | 10 | 10 | 10 | 10 |
| 160 | 19 | 16 | 15 | 13 | 11 | 10 | 10 | 10 | 10 |
| 170 | 19 | 17 | 15 | 13 | 12 | 10 | 10 | 10 | 10 |
| 180 | 19 | 17 | 15 | 14 | 12 | 11 | 10 | 10 | 10 |
| 190 | 20 | 17 | 16 | 14 | 12 | 11 | 10 | 10 | 10 |
| 200 | 20 | 18 | 16 | 14 | 13 | 11 | 10 | 10 | 10 |
| 210 | 20 | 18 | 16 | 15 | 13 | 12 | 10 | 10 | 10 |
| 220 | 20 | 18 | 16 | 15 | 13 | 12 | 11 | 10 | 10 |
| 230 | 20 | 18 | 17 | 15 | 14 | 12 | 11 | 10 | 10 |
| 240 | 21 | 19 | 17 | 15 | 14 | 12 | 11 | 10 | 10 |
| 250 | 21 | 19 | 17 | 15 | 14 | 13 | 11 | 10 | 10 |
| 260 | 21 | 19 | 17 | 16 | 14 | 13 | 12 | 10 | 10 |
| 270 | 21 | 19 | 17 | 16 | 14 | 13 | 12 | 11 | 10 |
| 280 | 21 | 19 | 18 | 16 | 15 | 13 | 12 | 11 | 10 |
| 290 | 21 | 19 | 18 | 16 | 15 | 13 | 12 | 11 | 10 |
| 300 | 21 | 20 | 18 | 16 | 15 | 14 | 12 | 11 | 10 |
| 310 | 22 | 20 | 18 | 16 | 15 | 14 | 12 | 11 | 10 |
| 320 | 22 | 20 | 18 | 17 | 15 | 14 | 13 | 11 | 10 |
| 330 | 22 | 20 | 18 | 17 | 15 | 14 | 13 | 12 | 11 |
| 340 | 22 | 20 | 18 | 17 | 15 | 14 | 13 | 12 | 11 |
| 350 | 22 | 20 | 18 | 17 | 15 | 14 | 13 | 12 | 11 |
| 360 | 22 | 20 | 18 | 17 | 16 | 14 | 13 | 12 | 11 |
| 370 | 22 | 20 | 19 | 17 | 16 | 14 | 13 | 12 | 11 |
| 380 | 22 | 20 | 19 | 17 | 16 | 15 | 13 | 12 | 11 |
| 390 | 22 | 20 | 19 | 17 | 16 | 15 | 13 | 12 | 11 |
| 400 | 22 | 20 | 19 | 17 | 16 | 15 | 14 | 12 | 11 |
| 410 | 22 | 20 | 19 | 17 | 16 | 15 | 14 | 13 | 11 |
| 420 | 22 | 21 | 19 | 17 | 16 | 15 | 14 | 13 | 12 |
| 430 | 22 | 21 | 19 | 18 | 16 | 15 | 14 | 13 | 12 |
| 440 | 22 | 21 | 19 | 18 | 16 | 15 | 14 | 13 | 12 |
| 495 | 23 | 21 | 19 | 18 | 17 | 15 | 14 | 13 | 12 |

Table A.3.5: Resistance to fire of H and I sections.

| Section Factor (m ⁻¹) | Resistance to fire period of 60 minutes | | | | | | | | |
|--------------------------------------|--|--------|--------|--------|--------|--------|--------|--------|--------|
| | Minimum thickness (mm) of TECWOOL F® at the design temperature | | | | | | | | |
| | 300 °C | 350 °C | 400 °C | 450 °C | 500 °C | 550 °C | 600 °C | 650 °C | 700 °C |
| 67 | 16 | 13 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 70 | 16 | 13 | 11 | 10 | 10 | 10 | 10 | 10 | 10 |
| 80 | 18 | 15 | 12 | 10 | 10 | 10 | 10 | 10 | 10 |
| 90 | 19 | 16 | 14 | 12 | 10 | 10 | 10 | 10 | 10 |
| 100 | 20 | 17 | 15 | 13 | 11 | 10 | 10 | 10 | 10 |
| 110 | 21 | 18 | 16 | 14 | 12 | 10 | 10 | 10 | 10 |
| 120 | 22 | 19 | 17 | 15 | 13 | 11 | 10 | 10 | 10 |
| 130 | 22 | 20 | 17 | 15 | 13 | 12 | 10 | 10 | 10 |
| 140 | 23 | 20 | 18 | 16 | 14 | 13 | 11 | 10 | 10 |
| 150 | 23 | 21 | 18 | 16 | 15 | 13 | 12 | 10 | 10 |
| 160 | 24 | 21 | 19 | 17 | 15 | 14 | 12 | 11 | 10 |
| 170 | 24 | 22 | 19 | 17 | 16 | 14 | 13 | 11 | 10 |
| 180 | 24 | 22 | 20 | 18 | 16 | 15 | 13 | 12 | 11 |
| 190 | 25 | 22 | 20 | 18 | 16 | 15 | 13 | 12 | 11 |
| 200 | 25 | 23 | 20 | 19 | 17 | 15 | 14 | 13 | 11 |
| 210 | 25 | 23 | 21 | 19 | 17 | 16 | 14 | 13 | 12 |
| 220 | 25 | 23 | 21 | 19 | 17 | 16 | 14 | 13 | 12 |
| 230 | 26 | 23 | 21 | 19 | 18 | 16 | 15 | 13 | 12 |
| 240 | 26 | 23 | 21 | 20 | 18 | 16 | 15 | 14 | 13 |
| 250 | 26 | 24 | 22 | 20 | 18 | 17 | 15 | 14 | 13 |
| 260 | 26 | 24 | 22 | 20 | 18 | 17 | 15 | 14 | 13 |
| 270 | 26 | 24 | 22 | 20 | 19 | 17 | 16 | 14 | 13 |
| 280 | 26 | 24 | 22 | 20 | 19 | 17 | 16 | 15 | 13 |
| 290 | 26 | 24 | 22 | 21 | 19 | 17 | 16 | 15 | 14 |
| 300 | 27 | 24 | 22 | 21 | 19 | 18 | 16 | 15 | 14 |
| 310 | 27 | 25 | 23 | 21 | 19 | 18 | 16 | 15 | 14 |
| 320 | 27 | 25 | 23 | 21 | 19 | 18 | 17 | 15 | 14 |
| 330 | 27 | 25 | 23 | 21 | 20 | 18 | 17 | 15 | 14 |
| 340 | 27 | 25 | 23 | 21 | 20 | 18 | 17 | 16 | 14 |
| 350 | 27 | 25 | 23 | 21 | 20 | 18 | 17 | 16 | 15 |
| 360 | 27 | 25 | 23 | 21 | 20 | 18 | 17 | 16 | 15 |
| 370 | 27 | 25 | 23 | 22 | 20 | 19 | 17 | 16 | 15 |
| 380 | 27 | 25 | 23 | 22 | 20 | 19 | 17 | 16 | 15 |
| 390 | 27 | 25 | 23 | 22 | 20 | 19 | 17 | 16 | 15 |
| 400 | 27 | 25 | 24 | 22 | 20 | 19 | 18 | 16 | 15 |
| 410 | 27 | 25 | 24 | 22 | 20 | 19 | 18 | 16 | 15 |
| 420 | 27 | 25 | 24 | 22 | 20 | 19 | 18 | 17 | 15 |
| 430 | 27 | 26 | 24 | 22 | 21 | 19 | 18 | 17 | 15 |
| 440 | 28 | 26 | 24 | 22 | 21 | 19 | 18 | 17 | 16 |
| 495 | 28 | 26 | 24 | 23 | 21 | 20 | 18 | 17 | 16 |

Table A.3.6: Resistance to fire of H and I sections.

| Section Factor (m ⁻¹) | Resistance to fire period of 90 minutes | | | | | | | | |
|--------------------------------------|--|--------|--------|--------|--------|--------|--------|--------|--------|
| | Minimum thickness (mm) of TECWOOL F® at the design temperature | | | | | | | | |
| | 300 °C | 350 °C | 400 °C | 450 °C | 500 °C | 550 °C | 600 °C | 650 °C | 700 °C |
| 67 | 25 | 21 | 18 | 15 | 13 | 11 | 10 | 10 | 10 |
| 70 | 26 | 22 | 19 | 16 | 13 | 11 | 10 | 10 | 10 |
| 80 | 28 | 24 | 21 | 18 | 15 | 13 | 12 | 10 | 10 |
| 90 | 29 | 25 | 22 | 19 | 17 | 15 | 13 | 11 | 10 |
| 100 | 30 | 26 | 23 | 21 | 18 | 16 | 14 | 13 | 11 |
| 110 | 31 | 27 | 24 | 22 | 19 | 17 | 15 | 14 | 12 |
| 120 | 32 | 28 | 25 | 23 | 20 | 18 | 16 | 15 | 13 |
| 130 | 32 | 29 | 26 | 23 | 21 | 19 | 17 | 16 | 14 |
| 140 | 33 | 30 | 27 | 24 | 22 | 20 | 18 | 16 | 15 |
| 150 | 33 | 30 | 27 | 25 | 23 | 21 | 19 | 17 | 16 |
| 160 | 34 | 31 | 28 | 25 | 23 | 21 | 19 | 18 | 16 |
| 170 | 34 | 31 | 28 | 26 | 24 | 22 | 20 | 18 | 17 |
| 180 | 34 | 31 | 29 | 26 | 24 | 22 | 20 | 19 | 17 |
| 190 | 35 | 32 | 29 | 27 | 25 | 23 | 21 | 19 | 18 |
| 200 | 35 | 32 | 29 | 27 | 25 | 23 | 21 | 20 | 18 |
| 210 | 35 | 32 | 30 | 27 | 25 | 23 | 22 | 20 | 19 |
| 220 | 35 | 33 | 30 | 28 | 26 | 24 | 22 | 20 | 19 |
| 230 | 36 | 33 | 30 | 28 | 26 | 24 | 22 | 21 | 19 |
| 240 | 36 | 33 | 31 | 28 | 26 | 24 | 23 | 21 | 20 |
| 250 | 36 | 33 | 31 | 29 | 27 | 25 | 23 | 21 | 20 |
| 260 | 36 | 33 | 31 | 29 | 27 | 25 | 23 | 22 | 20 |
| 270 | 36 | 34 | 31 | 29 | 27 | 25 | 23 | 22 | 20 |
| 280 | 36 | 34 | 31 | 29 | 27 | 25 | 24 | 22 | 21 |
| 290 | 37 | 34 | 32 | 29 | 27 | 26 | 24 | 22 | 21 |
| 300 | 37 | 34 | 32 | 30 | 28 | 26 | 24 | 23 | 21 |
| 310 | 37 | 34 | 32 | 30 | 28 | 26 | 24 | 23 | 21 |
| 320 | 37 | 34 | 32 | 30 | 28 | 26 | 24 | 23 | 21 |
| 330 | 37 | 34 | 32 | 30 | 28 | 26 | 25 | 23 | 22 |
| 340 | 37 | 35 | 32 | 30 | 28 | 26 | 25 | 23 | 22 |
| 350 | 37 | 35 | 32 | 30 | 28 | 27 | 25 | 23 | 22 |
| 360 | 37 | 35 | 33 | 30 | 29 | 27 | 25 | 24 | 22 |
| 370 | 37 | 35 | 33 | 31 | 29 | 27 | 25 | 24 | 22 |
| 380 | 37 | 35 | 33 | 31 | 29 | 27 | 25 | 24 | 22 |
| 390 | 37 | 35 | 33 | 31 | 29 | 27 | 26 | 24 | 23 |
| 400 | 38 | 35 | 33 | 31 | 29 | 27 | 26 | 24 | 23 |
| 410 | 38 | 35 | 33 | 31 | 29 | 27 | 26 | 24 | 23 |
| 420 | 38 | 35 | 33 | 31 | 29 | 27 | 26 | 24 | 23 |
| 430 | 38 | 35 | 33 | 31 | 29 | 28 | 26 | 24 | 23 |
| 440 | 38 | 35 | 33 | 31 | 29 | 28 | 26 | 25 | 23 |
| 495 | 38 | 36 | 34 | 32 | 30 | 28 | 27 | 25 | 24 |

Table A.3.7: Resistance to fire of H and I sections.

| Section Factor (m ⁻¹) | Resistance to fire period of 120 minutes | | | | | | | | |
|--------------------------------------|--|--------|--------|--------|--------|--------|--------|--------|--------|
| | Minimum thickness (mm) of TECWOOL F® at the design temperature | | | | | | | | |
| | 300 °C | 350 °C | 400 °C | 450 °C | 500 °C | 550 °C | 600 °C | 650 °C | 700 °C |
| 67 | 35 | 30 | 26 | 22 | 19 | 17 | 15 | 13 | 11 |
| 70 | 36 | 31 | 27 | 23 | 20 | 18 | 16 | 14 | 12 |
| 80 | 38 | 33 | 29 | 25 | 22 | 20 | 18 | 16 | 14 |
| 90 | 39 | 34 | 30 | 27 | 24 | 22 | 19 | 17 | 16 |
| 100 | 40 | 36 | 32 | 28 | 26 | 23 | 21 | 19 | 17 |
| 110 | 41 | 37 | 33 | 30 | 27 | 24 | 22 | 20 | 18 |
| 120 | 42 | 37 | 34 | 31 | 28 | 25 | 23 | 21 | 19 |
| 130 | 42 | 38 | 35 | 32 | 29 | 26 | 24 | 22 | 20 |
| 140 | 43 | 39 | 35 | 32 | 30 | 27 | 25 | 23 | 21 |
| 150 | 43 | 40 | 36 | 33 | 30 | 28 | 26 | 24 | 22 |
| 160 | 44 | 40 | 37 | 34 | 31 | 29 | 27 | 25 | 23 |
| 170 | 44 | 41 | 37 | 34 | 32 | 29 | 27 | 25 | 23 |
| 180 | 45 | 41 | 38 | 35 | 32 | 30 | 28 | 26 | 24 |
| 190 | 45 | 41 | 38 | 35 | 33 | 30 | 28 | 26 | 25 |
| 200 | 45 | 42 | 39 | 36 | 33 | 31 | 29 | 27 | 25 |
| 210 | 45 | 42 | 39 | 36 | 34 | 31 | 29 | 27 | 25 |
| 220 | 46 | 42 | 39 | 36 | 34 | 32 | 30 | 28 | 26 |
| 230 | 46 | 42 | 39 | 37 | 34 | 32 | 30 | 28 | 26 |
| 240 | 46 | 43 | 40 | 37 | 35 | 32 | 30 | 28 | 27 |
| 250 | 46 | 43 | 40 | 37 | 35 | 33 | 31 | 29 | 27 |
| 260 | 46 | 43 | 40 | 38 | 35 | 33 | 31 | 29 | 27 |
| 270 | 47 | 43 | 40 | 38 | 35 | 33 | 31 | 29 | 28 |
| 280 | 47 | 44 | 41 | 38 | 36 | 33 | 31 | 30 | 28 |
| 290 | 47 | 44 | 41 | 38 | 36 | 34 | 32 | 30 | 28 |
| 300 | 47 | 44 | 41 | 38 | 36 | 34 | 32 | 30 | 28 |
| 310 | 47 | 44 | 41 | 39 | 36 | 34 | 32 | 30 | 29 |
| 320 | 47 | 44 | 41 | 39 | 36 | 34 | 32 | 31 | 29 |
| 330 | 47 | 44 | 41 | 39 | 37 | 35 | 33 | 31 | 29 |
| 340 | 47 | 44 | 42 | 39 | 37 | 35 | 33 | 31 | 29 |
| 350 | 47 | 44 | 42 | 39 | 37 | 35 | 33 | 31 | 29 |
| 360 | 48 | 45 | 42 | 39 | 37 | 35 | 33 | 31 | 30 |
| 370 | 48 | 45 | 42 | 40 | 37 | 35 | 33 | 31 | 30 |
| 380 | 48 | 45 | 42 | 40 | 37 | 35 | 33 | 32 | 30 |
| 390 | 48 | 45 | 42 | 40 | 38 | 35 | 34 | 32 | 30 |
| 400 | 48 | 45 | 42 | 40 | 38 | 36 | 34 | 32 | 30 |
| 410 | 48 | 45 | 42 | 40 | 38 | 36 | 34 | 32 | 30 |
| 420 | 48 | 45 | 43 | 40 | 38 | 36 | 34 | 32 | 31 |
| 430 | 48 | 45 | 43 | 40 | 38 | 36 | 34 | 32 | 31 |
| 440 | 48 | 45 | 43 | 40 | 38 | 36 | 34 | 32 | 31 |
| 495 | 48 | 46 | 43 | 41 | 39 | 37 | 35 | 33 | 31 |

Table A.3.8: Resistance to fire of H and I sections.

| Section Factor (m ⁻¹) | Resistance to fire period of 180 minutes | | | | | | | | |
|--------------------------------------|--|--------|--------|--------|--------|--------|--------|--------|--------|
| | Minimum thickness (mm) of TECWOOL F® at the design temperature | | | | | | | | |
| | 300 °C | 350 °C | 400 °C | 450 °C | 500 °C | 550 °C | 600 °C | 650 °C | 700 °C |
| 67 | 54 | 47 | 41 | 37 | 33 | 29 | 26 | 24 | 21 |
| 70 | 55 | 48 | 42 | 38 | 34 | 30 | 27 | 24 | 22 |
| 80 | 57 | 50 | 45 | 40 | 36 | 33 | 30 | 27 | 25 |
| 90 | 59 | 52 | 47 | 42 | 38 | 35 | 32 | 29 | 27 |
| 100 | 60 | 54 | 48 | 44 | 40 | 37 | 34 | 31 | 29 |
| 110 | 61 | 55 | 50 | 46 | 42 | 38 | 35 | 33 | 30 |
| 120 | 62 | 56 | 51 | 47 | 43 | 40 | 37 | 34 | 32 |
| 130 | 62 | 57 | 52 | 48 | 44 | 41 | 38 | 35 | 33 |
| 140 | 63 | 58 | 53 | 49 | 45 | 42 | 39 | 36 | 34 |
| 150 | 63 | 58 | 54 | 50 | 46 | 43 | 40 | 37 | 35 |
| 160 | 64 | 59 | 54 | 51 | 47 | 44 | 41 | 38 | 36 |
| 170 | 64 | 59 | 55 | 51 | 48 | 45 | 42 | 39 | 37 |
| 180 | 65 | 60 | 56 | 52 | 48 | 45 | 42 | 40 | 37 |
| 190 | 65 | 60 | 56 | 52 | 49 | 46 | 43 | 40 | 38 |
| 200 | 65 | 61 | 57 | 53 | 49 | 46 | 44 | 41 | 39 |
| 210 | 66 | 61 | 57 | 53 | 50 | 47 | 44 | 42 | 39 |
| 220 | 66 | 61 | 57 | 54 | 50 | 47 | 45 | 42 | 40 |
| 230 | 66 | 62 | 58 | 54 | 51 | 48 | 45 | 43 | 40 |
| 240 | 66 | 62 | 58 | 55 | 51 | 48 | 46 | 43 | 41 |
| 250 | 67 | 62 | 58 | 55 | 52 | 49 | 46 | 44 | 41 |
| 260 | 67 | 62 | 59 | 55 | 52 | 49 | 46 | 44 | 42 |
| 270 | 67 | 63 | 59 | 55 | 52 | 49 | 47 | 44 | 42 |
| 280 | 67 | 63 | 59 | 56 | 53 | 50 | 47 | 45 | 42 |
| 290 | 67 | 63 | 59 | 56 | 53 | 50 | 47 | 45 | 43 |
| 300 | 67 | 63 | 60 | 56 | 53 | 50 | 48 | 45 | 43 |
| 310 | 67 | 63 | 60 | 56 | 53 | 51 | 48 | 46 | 43 |
| 320 | 68 | 64 | 60 | 57 | 54 | 51 | 48 | 46 | 44 |
| 330 | 68 | 64 | 60 | 57 | 54 | 51 | 48 | 46 | 44 |
| 340 | 68 | 64 | 60 | 57 | 54 | 51 | 49 | 46 | 44 |
| 350 | 68 | 64 | 60 | 57 | 54 | 51 | 49 | 47 | 44 |
| 360 | 68 | 64 | 61 | 57 | 54 | 52 | 49 | 47 | 45 |
| 370 | 68 | 64 | 61 | 58 | 55 | 52 | 49 | 47 | 45 |
| 380 | 68 | 64 | 61 | 58 | 55 | 52 | 49 | 47 | 45 |
| 390 | 68 | 64 | 61 | 58 | 55 | 52 | 50 | 47 | 45 |
| 400 | 68 | 65 | 61 | 58 | 55 | 52 | 50 | 47 | 45 |
| 410 | 68 | 65 | 61 | 58 | 55 | 53 | 50 | 48 | 45 |
| 420 | 68 | 65 | 61 | 58 | 55 | 53 | 50 | 48 | 46 |
| 430 | 68 | 65 | 61 | 58 | 55 | 53 | 50 | 48 | 46 |
| 440 | 69 | 65 | 62 | 58 | 56 | 53 | 50 | 48 | 46 |
| 495 | 69 | 65 | 62 | 59 | 56 | 54 | 51 | 49 | 47 |

Table A.3.9: Resistance to fire of H and I sections.

| Section Factor (m ⁻¹) | Resistance to fire period of 240 minutes | | | | | | | | |
|--------------------------------------|--|--------|--------|--------|--------|--------|--------|--------|--------|
| | Minimum thickness (mm) of TECWOOL F® at the design temperature | | | | | | | | |
| | 300 °C | 350 °C | 400 °C | 450 °C | 500 °C | 550 °C | 600 °C | 650 °C | 700 °C |
| 67 | - | 65 | 57 | 51 | 46 | 41 | 38 | 34 | 31 |
| 70 | - | 66 | 58 | 52 | 47 | 43 | 39 | 35 | 32 |
| 80 | - | 68 | 61 | 55 | 50 | 46 | 42 | 38 | 35 |
| 90 | - | - | 63 | 58 | 53 | 48 | 44 | 41 | 38 |
| 100 | - | - | 65 | 60 | 55 | 50 | 47 | 43 | 40 |
| 110 | - | - | 67 | 61 | 57 | 52 | 49 | 45 | 42 |
| 120 | - | - | 68 | 63 | 58 | 54 | 50 | 47 | 44 |
| 130 | - | - | - | 64 | 60 | 55 | 52 | 48 | 45 |
| 140 | - | - | - | 65 | 61 | 57 | 53 | 50 | 47 |
| 150 | - | - | - | 66 | 62 | 58 | 54 | 51 | 48 |
| 160 | - | - | - | 67 | 63 | 59 | 55 | 52 | 49 |
| 170 | - | - | - | 68 | 64 | 60 | 56 | 53 | 50 |
| 180 | - | - | - | 69 | 64 | 61 | 57 | 54 | 51 |
| 190 | - | - | - | - | 65 | 61 | 58 | 55 | 52 |
| 200 | - | - | - | - | 66 | 62 | 59 | 55 | 52 |
| 210 | - | - | - | - | 66 | 63 | 59 | 56 | 53 |
| 220 | - | - | - | - | 67 | 63 | 60 | 57 | 54 |
| 230 | - | - | - | - | 67 | 64 | 60 | 57 | 54 |
| 240 | - | - | - | - | 68 | 64 | 61 | 58 | 55 |
| 250 | - | - | - | - | 68 | 65 | 61 | 58 | 55 |
| 260 | - | - | - | - | 69 | 65 | 62 | 59 | 56 |
| 270 | - | - | - | - | 69 | 66 | 62 | 59 | 56 |
| 280 | - | - | - | - | - | 66 | 63 | 60 | 57 |
| 290 | - | - | - | - | - | 66 | 63 | 60 | 57 |
| 300 | - | - | - | - | - | 67 | 63 | 60 | 58 |
| 310 | - | - | - | - | - | 67 | 64 | 61 | 58 |
| 320 | - | - | - | - | - | 67 | 64 | 61 | 58 |
| 330 | - | - | - | - | - | 68 | 64 | 61 | 59 |
| 340 | - | - | - | - | - | 68 | 65 | 62 | 59 |
| 350 | - | - | - | - | - | 68 | 65 | 62 | 59 |
| 360 | - | - | - | - | - | 68 | 65 | 62 | 59 |
| 370 | - | - | - | - | - | 68 | 65 | 62 | 60 |
| 380 | - | - | - | - | - | 69 | 66 | 63 | 60 |
| 390 | - | - | - | - | - | 69 | 66 | 63 | 60 |
| 400 | - | - | - | - | - | 69 | 66 | 63 | 60 |
| 410 | - | - | - | - | - | 69 | 66 | 63 | 61 |
| 420 | - | - | - | - | - | - | 66 | 63 | 61 |
| 430 | - | - | - | - | - | - | 67 | 64 | 61 |
| 440 | - | - | - | - | - | - | 67 | 64 | 61 |
| 495 | - | - | - | - | - | - | 68 | 65 | 62 |

Table A.3.10: Resistance to fire of hollow sections.

| Section Factor (m ⁻¹) | Resistance to fire period of 30 minutes | | | | | | | | |
|--------------------------------------|--|--------|--------|--------|--------|--------|--------|--------|--------|
| | Minimum thickness (mm) of TECWOOL F® at the design temperature | | | | | | | | |
| | 300 °C | 350 °C | 400 °C | 450 °C | 500 °C | 550 °C | 600 °C | 650 °C | 700 °C |
| 67 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 70 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 80 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 90 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 100 | 11 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 110 | 12 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 |
| 120 | 13 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 |
| 130 | 14 | 12 | 11 | 11 | 11 | 11 | 11 | 11 | 11 |
| 140 | 15 | 12 | 11 | 11 | 11 | 11 | 11 | 11 | 11 |
| 150 | 15 | 13 | 11 | 11 | 11 | 11 | 11 | 11 | 11 |
| 160 | 16 | 14 | 12 | 11 | 11 | 11 | 11 | 11 | 11 |
| 170 | 16 | 14 | 12 | 11 | 11 | 11 | 11 | 11 | 11 |
| 180 | 17 | 15 | 13 | 11 | 11 | 11 | 11 | 11 | 11 |
| 190 | 17 | 15 | 13 | 11 | 11 | 11 | 11 | 11 | 11 |
| 200 | 18 | 16 | 14 | 12 | 11 | 11 | 11 | 11 | 11 |
| 210 | 18 | 16 | 14 | 12 | 11 | 11 | 11 | 11 | 11 |
| 220 | 19 | 16 | 14 | 13 | 12 | 12 | 12 | 12 | 12 |
| 230 | 19 | 17 | 15 | 13 | 12 | 12 | 12 | 12 | 12 |
| 240 | 19 | 17 | 15 | 13 | 12 | 12 | 12 | 12 | 12 |
| 250 | 20 | 17 | 16 | 14 | 12 | 12 | 12 | 12 | 12 |
| 260 | 20 | 18 | 16 | 14 | 12 | 12 | 12 | 12 | 12 |
| 270 | 20 | 18 | 16 | 14 | 13 | 12 | 12 | 12 | 12 |
| 280 | 20 | 18 | 16 | 14 | 13 | 12 | 12 | 12 | 12 |
| 290 | 20 | 18 | 16 | 15 | 13 | 12 | 12 | 12 | 12 |
| 300 | 20 | 18 | 16 | 15 | 13 | 12 | 12 | 12 | 12 |
| 310 | 20 | 18 | 17 | 15 | 13 | 12 | 12 | 12 | 12 |
| 320 | 21 | 19 | 17 | 15 | 14 | 12 | 12 | 12 | 12 |
| 330 | 21 | 19 | 17 | 15 | 14 | 12 | 12 | 12 | 12 |
| 340 | 21 | 19 | 17 | 15 | 14 | 12 | 12 | 12 | 12 |
| 350 | 21 | 19 | 17 | 15 | 14 | 13 | 12 | 12 | 12 |
| 360 | 21 | 19 | 17 | 16 | 14 | 13 | 12 | 12 | 12 |
| 370 | 21 | 19 | 17 | 16 | 14 | 13 | 12 | 12 | 12 |
| 380 | 21 | 19 | 17 | 16 | 14 | 13 | 12 | 12 | 12 |
| 390 | 21 | 19 | 18 | 16 | 14 | 13 | 12 | 12 | 12 |
| 400 | 21 | 19 | 18 | 16 | 15 | 13 | 12 | 12 | 12 |
| 410 | 21 | 19 | 18 | 16 | 15 | 13 | 12 | 12 | 12 |
| 420 | 21 | 20 | 18 | 16 | 15 | 13 | 12 | 12 | 12 |
| 430 | 22 | 20 | 18 | 16 | 15 | 13 | 12 | 12 | 12 |
| 440 | 22 | 20 | 18 | 16 | 15 | 14 | 12 | 12 | 12 |
| 495 | 22 | 20 | 18 | 17 | 15 | 14 | 13 | 12 | 12 |

Table A.3.11: Resistance to fire of hollow sections.

| Section Factor (m ⁻¹) | Resistance to fire period of 45 minutes | | | | | | | | |
|--------------------------------------|--|--------|--------|--------|--------|--------|--------|--------|--------|
| | Minimum thickness (mm) of TECWOOL F® at the design temperature | | | | | | | | |
| | 300 °C | 350 °C | 400 °C | 450 °C | 500 °C | 550 °C | 600 °C | 650 °C | 700 °C |
| 67 | 12 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 70 | 12 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 80 | 14 | 11 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| 90 | 16 | 13 | 11 | 10 | 10 | 10 | 10 | 10 | 10 |
| 100 | 17 | 14 | 12 | 10 | 10 | 10 | 10 | 10 | 10 |
| 110 | 18 | 15 | 13 | 11 | 11 | 11 | 11 | 11 | 11 |
| 120 | 19 | 16 | 14 | 12 | 11 | 11 | 11 | 11 | 11 |
| 130 | 20 | 17 | 15 | 13 | 11 | 11 | 11 | 11 | 11 |
| 140 | 20 | 18 | 15 | 13 | 12 | 11 | 11 | 11 | 11 |
| 150 | 21 | 18 | 16 | 14 | 12 | 11 | 11 | 11 | 11 |
| 160 | 22 | 19 | 17 | 15 | 13 | 11 | 11 | 11 | 11 |
| 170 | 22 | 20 | 17 | 15 | 14 | 12 | 11 | 11 | 11 |
| 180 | 23 | 20 | 18 | 16 | 14 | 13 | 11 | 11 | 11 |
| 190 | 23 | 21 | 19 | 17 | 15 | 13 | 12 | 11 | 11 |
| 200 | 24 | 21 | 19 | 17 | 15 | 14 | 12 | 11 | 11 |
| 210 | 24 | 22 | 20 | 18 | 16 | 14 | 13 | 11 | 11 |
| 220 | 25 | 22 | 20 | 18 | 16 | 15 | 13 | 12 | 12 |
| 230 | 25 | 23 | 20 | 18 | 17 | 15 | 13 | 12 | 12 |
| 240 | 26 | 23 | 21 | 19 | 17 | 15 | 14 | 12 | 12 |
| 250 | 26 | 24 | 21 | 19 | 17 | 16 | 14 | 13 | 12 |
| 260 | 26 | 24 | 22 | 20 | 18 | 16 | 15 | 13 | 12 |
| 270 | 26 | 24 | 22 | 20 | 18 | 16 | 15 | 13 | 12 |
| 280 | 26 | 24 | 22 | 20 | 18 | 17 | 15 | 14 | 12 |
| 290 | 27 | 24 | 22 | 20 | 18 | 17 | 15 | 14 | 12 |
| 300 | 27 | 24 | 22 | 20 | 19 | 17 | 15 | 14 | 13 |
| 310 | 27 | 25 | 22 | 21 | 19 | 17 | 16 | 14 | 13 |
| 320 | 27 | 25 | 23 | 21 | 19 | 17 | 16 | 14 | 13 |
| 330 | 27 | 25 | 23 | 21 | 19 | 17 | 16 | 15 | 13 |
| 340 | 27 | 25 | 23 | 21 | 19 | 18 | 16 | 15 | 13 |
| 350 | 27 | 25 | 23 | 21 | 19 | 18 | 16 | 15 | 14 |
| 360 | 27 | 25 | 23 | 21 | 19 | 18 | 16 | 15 | 14 |
| 370 | 27 | 25 | 23 | 21 | 20 | 18 | 17 | 15 | 14 |
| 380 | 28 | 25 | 23 | 21 | 20 | 18 | 17 | 15 | 14 |
| 390 | 28 | 25 | 23 | 22 | 20 | 18 | 17 | 15 | 14 |
| 400 | 28 | 26 | 24 | 22 | 20 | 18 | 17 | 16 | 14 |
| 410 | 28 | 26 | 24 | 22 | 20 | 18 | 17 | 16 | 14 |
| 420 | 28 | 26 | 24 | 22 | 20 | 19 | 17 | 16 | 14 |
| 430 | 28 | 26 | 24 | 22 | 20 | 19 | 17 | 16 | 15 |
| 440 | 28 | 26 | 24 | 22 | 20 | 19 | 17 | 16 | 15 |
| 495 | 28 | 26 | 24 | 22 | 21 | 19 | 18 | 16 | 15 |

Table A.3.12: Resistance to fire of hollow sections.

| Section Factor (m ⁻¹) | Resistance to fire period of 60 minutes | | | | | | | | |
|--------------------------------------|--|--------|--------|--------|--------|--------|--------|--------|--------|
| | Minimum thickness (mm) of TECWOOL F® at the design temperature | | | | | | | | |
| | 300 °C | 350 °C | 400 °C | 450 °C | 500 °C | 550 °C | 600 °C | 650 °C | 700 °C |
| 67 | 17 | 13 | 11 | 10 | 10 | 10 | 10 | 10 | 10 |
| 70 | 18 | 14 | 11 | 10 | 10 | 10 | 10 | 10 | 10 |
| 80 | 19 | 16 | 13 | 11 | 10 | 10 | 10 | 10 | 10 |
| 90 | 21 | 18 | 15 | 13 | 11 | 10 | 10 | 10 | 10 |
| 100 | 22 | 19 | 16 | 14 | 12 | 10 | 10 | 10 | 10 |
| 110 | 23 | 20 | 18 | 15 | 13 | 11 | 11 | 11 | 11 |
| 120 | 24 | 21 | 19 | 16 | 14 | 12 | 11 | 11 | 11 |
| 130 | 25 | 22 | 20 | 17 | 15 | 13 | 12 | 11 | 11 |
| 140 | 26 | 23 | 20 | 18 | 16 | 14 | 13 | 11 | 11 |
| 150 | 27 | 24 | 21 | 19 | 17 | 15 | 13 | 12 | 11 |
| 160 | 28 | 25 | 22 | 20 | 18 | 16 | 14 | 13 | 11 |
| 170 | 28 | 25 | 23 | 20 | 18 | 16 | 15 | 13 | 12 |
| 180 | 29 | 26 | 23 | 21 | 19 | 17 | 15 | 14 | 12 |
| 190 | 29 | 26 | 24 | 22 | 20 | 18 | 16 | 14 | 13 |
| 200 | 30 | 27 | 25 | 22 | 20 | 18 | 17 | 15 | 14 |
| 210 | 30 | 28 | 25 | 23 | 21 | 19 | 17 | 16 | 14 |
| 220 | 31 | 28 | 26 | 23 | 21 | 19 | 18 | 16 | 15 |
| 230 | 31 | 29 | 26 | 24 | 22 | 20 | 18 | 17 | 15 |
| 240 | 32 | 29 | 27 | 24 | 22 | 20 | 19 | 17 | 16 |
| 250 | 32 | 30 | 27 | 25 | 23 | 21 | 19 | 17 | 16 |
| 260 | 33 | 30 | 27 | 25 | 23 | 21 | 19 | 18 | 16 |
| 270 | 33 | 30 | 28 | 25 | 23 | 21 | 20 | 18 | 17 |
| 280 | 33 | 30 | 28 | 25 | 23 | 22 | 20 | 18 | 17 |
| 290 | 33 | 30 | 28 | 26 | 24 | 22 | 20 | 19 | 17 |
| 300 | 33 | 30 | 28 | 26 | 24 | 22 | 20 | 19 | 17 |
| 310 | 33 | 31 | 28 | 26 | 24 | 22 | 21 | 19 | 17 |
| 320 | 33 | 31 | 28 | 26 | 24 | 22 | 21 | 19 | 18 |
| 330 | 33 | 31 | 29 | 26 | 24 | 23 | 21 | 19 | 18 |
| 340 | 34 | 31 | 29 | 27 | 25 | 23 | 21 | 19 | 18 |
| 350 | 34 | 31 | 29 | 27 | 25 | 23 | 21 | 20 | 18 |
| 360 | 34 | 31 | 29 | 27 | 25 | 23 | 21 | 20 | 18 |
| 370 | 34 | 31 | 29 | 27 | 25 | 23 | 22 | 20 | 19 |
| 380 | 34 | 31 | 29 | 27 | 25 | 23 | 22 | 20 | 19 |
| 390 | 34 | 32 | 29 | 27 | 25 | 23 | 22 | 20 | 19 |
| 400 | 34 | 32 | 29 | 27 | 25 | 24 | 22 | 20 | 19 |
| 410 | 34 | 32 | 30 | 27 | 26 | 24 | 22 | 21 | 19 |
| 420 | 34 | 32 | 30 | 28 | 26 | 24 | 22 | 21 | 19 |
| 430 | 34 | 32 | 30 | 28 | 26 | 24 | 22 | 21 | 19 |
| 440 | 34 | 32 | 30 | 28 | 26 | 24 | 22 | 21 | 19 |
| 495 | 35 | 32 | 30 | 28 | 26 | 25 | 23 | 21 | 20 |

Table A.3.13: Resistance to fire of hollow sections.

| Section Factor (m ⁻¹) | Resistance to fire period of 90 minutes | | | | | | | | |
|--------------------------------------|--|--------|--------|--------|--------|--------|--------|--------|--------|
| | Minimum thickness (mm) of TECWOOL F® at the design temperature | | | | | | | | |
| | 300 °C | 350 °C | 400 °C | 450 °C | 500 °C | 550 °C | 600 °C | 650 °C | 700 °C |
| 67 | 27 | 23 | 19 | 16 | 14 | 11 | 10 | 10 | 10 |
| 70 | 28 | 24 | 20 | 17 | 14 | 12 | 10 | 10 | 10 |
| 80 | 30 | 26 | 22 | 19 | 17 | 14 | 12 | 11 | 10 |
| 90 | 32 | 28 | 24 | 21 | 18 | 16 | 14 | 12 | 11 |
| 100 | 33 | 29 | 26 | 23 | 20 | 18 | 16 | 14 | 12 |
| 110 | 34 | 30 | 27 | 24 | 21 | 19 | 17 | 15 | 14 |
| 120 | 36 | 32 | 28 | 25 | 23 | 20 | 18 | 17 | 15 |
| 130 | 37 | 33 | 29 | 26 | 24 | 22 | 20 | 18 | 16 |
| 140 | 38 | 34 | 30 | 28 | 25 | 23 | 21 | 19 | 17 |
| 150 | 38 | 35 | 31 | 29 | 26 | 24 | 22 | 20 | 18 |
| 160 | 39 | 36 | 32 | 29 | 27 | 25 | 22 | 21 | 19 |
| 170 | 40 | 36 | 33 | 30 | 28 | 25 | 23 | 21 | 20 |
| 180 | 41 | 37 | 34 | 31 | 29 | 26 | 24 | 22 | 20 |
| 190 | 41 | 38 | 35 | 32 | 29 | 27 | 25 | 23 | 21 |
| 200 | 42 | 39 | 35 | 33 | 30 | 28 | 26 | 24 | 22 |
| 210 | 43 | 39 | 36 | 33 | 31 | 28 | 26 | 24 | 22 |
| 220 | 43 | 40 | 37 | 34 | 31 | 29 | 27 | 25 | 23 |
| 230 | 44 | 40 | 37 | 35 | 32 | 30 | 27 | 26 | 24 |
| 240 | 44 | 41 | 38 | 35 | 33 | 30 | 28 | 26 | 24 |
| 250 | 45 | 42 | 39 | 36 | 33 | 31 | 29 | 27 | 25 |
| 260 | 45 | 42 | 39 | 36 | 33 | 31 | 29 | 27 | 25 |
| 270 | 45 | 42 | 39 | 36 | 34 | 31 | 29 | 27 | 26 |
| 280 | 46 | 42 | 39 | 37 | 34 | 32 | 30 | 28 | 26 |
| 290 | 46 | 42 | 39 | 37 | 34 | 32 | 30 | 28 | 26 |
| 300 | 46 | 43 | 40 | 37 | 35 | 32 | 30 | 28 | 26 |
| 310 | 46 | 43 | 40 | 37 | 35 | 32 | 30 | 28 | 27 |
| 320 | 46 | 43 | 40 | 37 | 35 | 33 | 31 | 29 | 27 |
| 330 | 46 | 43 | 40 | 38 | 35 | 33 | 31 | 29 | 27 |
| 340 | 46 | 43 | 40 | 38 | 35 | 33 | 31 | 29 | 27 |
| 350 | 46 | 43 | 41 | 38 | 35 | 33 | 31 | 29 | 27 |
| 360 | 47 | 43 | 41 | 38 | 36 | 33 | 31 | 29 | 28 |
| 370 | 47 | 44 | 41 | 38 | 36 | 34 | 32 | 30 | 28 |
| 380 | 47 | 44 | 41 | 38 | 36 | 34 | 32 | 30 | 28 |
| 390 | 47 | 44 | 41 | 38 | 36 | 34 | 32 | 30 | 28 |
| 400 | 47 | 44 | 41 | 39 | 36 | 34 | 32 | 30 | 28 |
| 410 | 47 | 44 | 41 | 39 | 36 | 34 | 32 | 30 | 29 |
| 420 | 47 | 44 | 41 | 39 | 36 | 34 | 32 | 30 | 29 |
| 430 | 47 | 44 | 41 | 39 | 37 | 34 | 32 | 31 | 29 |
| 440 | 47 | 44 | 42 | 39 | 37 | 35 | 33 | 31 | 29 |
| 495 | 48 | 45 | 42 | 40 | 37 | 35 | 33 | 31 | 30 |

Table A.3.14: Resistance to fire of hollow sections.

| Section Factor (m ⁻¹) | Resistance to fire period of 120 minutes | | | | | | | | |
|--------------------------------------|--|--------|--------|--------|--------|--------|--------|--------|--------|
| | Minimum thickness (mm) of TECWOOL F® at the design temperature | | | | | | | | |
| | 300 °C | 350 °C | 400 °C | 450 °C | 500 °C | 550 °C | 600 °C | 650 °C | 700 °C |
| 67 | 37 | 32 | 27 | 24 | 21 | 18 | 16 | 14 | 12 |
| 70 | 38 | 33 | 28 | 25 | 22 | 19 | 17 | 15 | 13 |
| 80 | 41 | 35 | 31 | 27 | 24 | 21 | 19 | 17 | 15 |
| 90 | 42 | 37 | 33 | 29 | 26 | 23 | 21 | 19 | 17 |
| 100 | 44 | 39 | 35 | 31 | 28 | 25 | 23 | 21 | 19 |
| 110 | 45 | 41 | 36 | 33 | 30 | 27 | 25 | 22 | 20 |
| 120 | 47 | 42 | 38 | 34 | 31 | 28 | 26 | 24 | 22 |
| 130 | 48 | 43 | 39 | 36 | 33 | 30 | 27 | 25 | 23 |
| 140 | 49 | 44 | 40 | 37 | 34 | 31 | 29 | 26 | 24 |
| 150 | 50 | 45 | 42 | 38 | 35 | 32 | 30 | 27 | 25 |
| 160 | 51 | 46 | 43 | 39 | 36 | 33 | 31 | 29 | 26 |
| 170 | 52 | 47 | 44 | 40 | 37 | 34 | 32 | 29 | 27 |
| 180 | 53 | 48 | 44 | 41 | 38 | 35 | 33 | 30 | 28 |
| 190 | 53 | 49 | 45 | 42 | 39 | 36 | 34 | 31 | 29 |
| 200 | 54 | 50 | 46 | 43 | 40 | 37 | 34 | 32 | 30 |
| 210 | 55 | 51 | 47 | 44 | 41 | 38 | 35 | 33 | 31 |
| 220 | 56 | 52 | 48 | 44 | 41 | 39 | 36 | 34 | 32 |
| 230 | 56 | 52 | 49 | 45 | 42 | 39 | 37 | 35 | 32 |
| 240 | 57 | 53 | 49 | 46 | 43 | 40 | 38 | 35 | 33 |
| 250 | 58 | 54 | 50 | 47 | 44 | 41 | 38 | 36 | 34 |
| 260 | 58 | 54 | 50 | 47 | 44 | 41 | 39 | 36 | 34 |
| 270 | 58 | 54 | 51 | 47 | 44 | 42 | 39 | 37 | 35 |
| 280 | 58 | 54 | 51 | 48 | 45 | 42 | 39 | 37 | 35 |
| 290 | 58 | 55 | 51 | 48 | 45 | 42 | 40 | 37 | 35 |
| 300 | 59 | 55 | 51 | 48 | 45 | 42 | 40 | 38 | 35 |
| 310 | 59 | 55 | 51 | 48 | 45 | 43 | 40 | 38 | 36 |
| 320 | 59 | 55 | 52 | 49 | 46 | 43 | 40 | 38 | 36 |
| 330 | 59 | 55 | 52 | 49 | 46 | 43 | 41 | 38 | 36 |
| 340 | 59 | 55 | 52 | 49 | 46 | 43 | 41 | 39 | 37 |
| 350 | 59 | 56 | 52 | 49 | 46 | 44 | 41 | 39 | 37 |
| 360 | 59 | 56 | 52 | 49 | 46 | 44 | 41 | 39 | 37 |
| 370 | 59 | 56 | 53 | 49 | 47 | 44 | 42 | 39 | 37 |
| 380 | 60 | 56 | 53 | 50 | 47 | 44 | 42 | 40 | 37 |
| 390 | 60 | 56 | 53 | 50 | 47 | 44 | 42 | 40 | 38 |
| 400 | 60 | 56 | 53 | 50 | 47 | 45 | 42 | 40 | 38 |
| 410 | 60 | 56 | 53 | 50 | 47 | 45 | 42 | 40 | 38 |
| 420 | 60 | 56 | 53 | 50 | 47 | 45 | 42 | 40 | 38 |
| 430 | 60 | 56 | 53 | 50 | 48 | 45 | 43 | 40 | 38 |
| 440 | 60 | 57 | 53 | 50 | 48 | 45 | 43 | 41 | 38 |
| 495 | 60 | 57 | 54 | 51 | 48 | 46 | 43 | 41 | 39 |

Table A.3.15: Resistance to fire of hollow sections.

| Section Factor (m ⁻¹) | Resistance to fire period of 180 minutes | | | | | | | | |
|--------------------------------------|--|--------|--------|--------|--------|--------|--------|--------|--------|
| | Minimum thickness (mm) of TECWOOL F® at the design temperature | | | | | | | | |
| | 300 °C | 350 °C | 400 °C | 450 °C | 500 °C | 550 °C | 600 °C | 650 °C | 700 °C |
| 67 | 58 | 50 | 44 | 39 | 35 | 31 | 28 | 25 | 23 |
| 70 | 59 | 52 | 45 | 40 | 36 | 32 | 29 | 26 | 24 |
| 80 | 62 | 54 | 48 | 43 | 39 | 35 | 32 | 29 | 27 |
| 90 | 64 | 57 | 51 | 46 | 42 | 38 | 35 | 32 | 29 |
| 100 | 66 | 59 | 53 | 48 | 44 | 40 | 37 | 34 | 32 |
| 110 | 67 | 61 | 55 | 51 | 46 | 43 | 39 | 36 | 34 |
| 120 | 69 | 63 | 57 | 52 | 48 | 44 | 41 | 38 | 35 |
| 130 | - | 64 | 59 | 54 | 50 | 46 | 43 | 40 | 37 |
| 140 | - | 66 | 60 | 56 | 52 | 48 | 45 | 41 | 39 |
| 150 | - | 67 | 62 | 57 | 53 | 49 | 46 | 43 | 40 |
| 160 | - | 68 | 63 | 59 | 54 | 51 | 47 | 44 | 42 |
| 170 | - | - | 64 | 60 | 56 | 52 | 49 | 46 | 43 |
| 180 | - | - | 66 | 61 | 57 | 53 | 50 | 47 | 44 |
| 190 | - | - | 67 | 62 | 58 | 55 | 51 | 48 | 45 |
| 200 | - | - | 68 | 63 | 59 | 56 | 52 | 49 | 46 |
| 210 | - | - | 69 | 65 | 60 | 57 | 53 | 50 | 48 |
| 220 | - | - | - | 66 | 62 | 58 | 55 | 51 | 49 |
| 230 | - | - | - | 67 | 63 | 59 | 56 | 52 | 50 |
| 240 | - | - | - | 68 | 64 | 60 | 57 | 53 | 51 |
| 250 | - | - | - | 69 | 65 | 61 | 58 | 54 | 52 |
| 260 | - | - | - | 69 | 65 | 61 | 58 | 55 | 52 |
| 270 | - | - | - | 69 | 65 | 62 | 58 | 55 | 52 |
| 280 | - | - | - | - | 66 | 62 | 59 | 56 | 53 |
| 290 | - | - | - | - | 66 | 63 | 59 | 56 | 53 |
| 300 | - | - | - | - | 66 | 63 | 60 | 57 | 54 |
| 310 | - | - | - | - | 67 | 63 | 60 | 57 | 54 |
| 320 | - | - | - | - | 67 | 63 | 60 | 57 | 54 |
| 330 | - | - | - | - | 67 | 64 | 61 | 58 | 55 |
| 340 | - | - | - | - | 68 | 64 | 61 | 58 | 55 |
| 350 | - | - | - | - | 68 | 64 | 61 | 58 | 55 |
| 360 | - | - | - | - | 68 | 65 | 61 | 58 | 56 |
| 370 | - | - | - | - | 68 | 65 | 62 | 59 | 56 |
| 380 | - | - | - | - | 68 | 65 | 62 | 59 | 56 |
| 390 | - | - | - | - | 69 | 65 | 62 | 59 | 56 |
| 400 | - | - | - | - | 69 | 65 | 62 | 59 | 57 |
| 410 | - | - | - | - | 69 | 66 | 63 | 60 | 57 |
| 420 | - | - | - | - | 69 | 66 | 63 | 60 | 57 |
| 430 | - | - | - | - | 69 | 66 | 63 | 60 | 57 |
| 440 | - | - | - | - | 69 | 66 | 63 | 60 | 57 |
| 495 | - | - | - | - | - | 67 | 64 | 61 | 58 |

