GLOBAL BUILDING UK

STRUCTURAL STEEL PROTECTION

FIREGUARD®

CALCIUM SILICATE FIRE PROTECTION BOARD

STEEL BEHAVIOR IN FIRE

Steel is a non-combustible material that does not release smoke or toxic gases, but its mechanical properties decrease with temperature. A steel structure, when subjected to loads and fire simultaneously, loses its load-bearing capacity and eventually collapses. This phenomenon is governed by key factors such as thermal jump, element temperature, thermal transmission coefficient, and the massivity factor A/V, which is the ratio of the surface area exposed to fire to its volume, and ductility class.

METHODS FOR DETERMINING FIRE RESISTANCE CLASSES "R"

The fire resistance of a steel structure can be assessed based on:

- comparisons with tables
- calculations

"Design of Steel Structures – Part 1-2: General Rules – Structural Fire Design".

This standard specifies that the assessment of the resistance of steel structural elements under fire can be performed using different methods or their combinations:

- complete calculation models (design methods applying engineering principles realistically for specific applications)
- simple calculation models for single elements (simplified design methods applicable to single elements, based on cautious assumptions)

Complete calculation models are based on the finite element method: the beams or their cross-sections are divided into a certain number of 3D or 2D elements. Thermal action due to fire is applied as thermal flux or fire curve, along with boundary conditions, to obtain both the temperature in each element and its expansions and deformations.

Simplified methods are calculation procedures based on simple equations that approximate temperature determination: for steel structures, they generally assume uniform temperature across the entire cross-section or in parts where it can be divided.

The following will illustrate only the simplified method defined in EN 1993-1-2, known as the "critical temperature" method.

The calculation involves identifying some fundamental parameters:
- The ductility class of sections
- The critical temperature
- The section factor (or massivity)

CRITICAL TEMPERATURE
For each element of a structure, it is possible to determine a temperature beyond which it can no longer perform its load-bearing function, known as the critical temperature θ cr : the temperature at which the design resistance "Rfi.d" equals the design action "Efi.d" due to loads applied in fire conditions, leading to the expected collapse of the structural steel element.

Assuming the temperature within the section of the structural element is uniform and that deformation verification of the structure is not required, meaning the element's resistance is not affected by instability or warping in fire conditions, the determination of the critical temperature of steel takes into account:

- the usage rate $\mu 0$ is defined as the ratio between the design action in case of fire and the design resistance in case of fire calculated for the initial moment,
- of the ductility class of the element's section.

Steel structural sections are categorized into ductility classes, numbered 1 to 4, based on their ability to undergo plastic rotation, their geometric features, the type of stress applied, and the material's mechanical properties. These classes are:

- Class 1: sections that allow full formation of a plastic hinge;
- Class 2: sections where full plastic hinge formation is expected but with limited deformation ability;
- Class 3: sections where local instability prevents plastic stress distribution and the ultimate moment matches the conventional elastic limit;
- Class 4: sections where local instability means the ultimate moment is less than the conventional elastic limit.

The critical temperature is determined by the formula:

$$\Theta_{a,cr} = 39{,}19 \ln \left[\frac{1}{0{,}9674 \mu_0^{\,3{,}833}} - 1 \right] + 482$$

The initial utilization degree μ for tensioned or flexed elements in class 1, 2, and 3 can be calculated with the following relationship:

$$\mu_0 = \frac{E_{d,fi}}{R_{d,fi,0}}$$

where Ed,fi is the design stress in case of fire, and Rd,fi,0 is the design resistance at time t=0.

Alternatively, for tensioned elements and beams where flexural-torsional instability isn't a potential collapse mode, the utilization factor can be obtained as:

$$\mu_0 = \eta_{fi} \frac{\gamma_{M,fi}}{\gamma_{M0}}$$

Where η is the reduction factor for design loads in fire situations, γ is the partial safety factor for normal temperature resistance, and γM,fi is the partial safety factor for fire resistance (=1.0).

For class 1, 2, and 3 sections with μ between 0.22 and 0.80, the critical temperature in °C is as shown in the table, while for class 4 sections, it must be limited to 350°C.

CRITICAL TEMPERATURE θa,cr BASED ON UTILIZATION RATE μ0

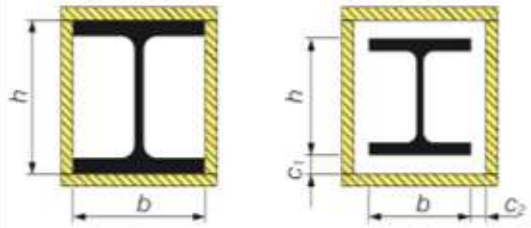
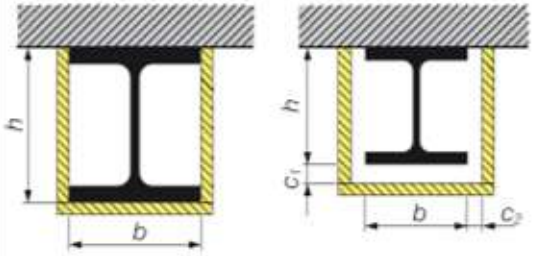
μ_0	$\Theta_{a,cr}$	μ_0	$\Theta_{a,cr}$	μ_0	$\Theta_{a,cr}$	μ_0	$\Theta_{a,cr}$	μ_0	$\Theta_{a,cr}$	μ_0	$\Theta_{a,cr}$
0,22	711	0,32	654	0,42	612	0,52	578	0,62	549	0,72	520
0,24	698	0,34	645	0,44	605	0,54	572	0,64	543	0,74	514
0,26	685	0,36	636	0,46	598	0,56	566	0,66	537	0,76	508
0,28	674	0,38	628	0,48	591	0,58	560	0,68	531	0,78	502
0,30	664	0,40	620	0,50	585	0,60	554	0,70	526	0,80	495

SECTION FACTOR (OR MASSIVENESS)
The section factor for a given element is the ratio between the surface exposed to fire and the volume of the element itself. The fire-exposed surface refers to the actual surface through which heat exchange occurs, so the section factor will vary:

- depending on the element's placement (total or partial fire exposure)
- depending on the type of protection (adhesive, box-shaped, etc.).

For elements with a constant cross-section, the section factor is given by the ratio between the perimeter of the cross-section and its area.
Below are some examples of calculating the section factor and a list of values for this parameter for commercially available profiles.

Section Factor A/V for steel elements insulated by fire protection materialp

	Description	Section Factor (Ap/V)
	Uniform thickness box coating*	$\frac{2(b+h)}{A}$
	Uniform thickness box coating exposed to fire on three sides*	$\frac{2h+b}{A}$

* - Clearance dimensions c_1 and c_2 should typically not exceed h/4 A= area of the steel cross-section

DIMENSIONING OF BOARDS
The fire resistance of steel structural elements must be conducted according to EN 13381-4 "Test methods for determining the contribution to the fire resistance of structural elements: Part 4: Applied boards on steel structures," which aims to determine the thickness of protective material needed to achieve a specific fire resistance. The results of tests conducted in accordance with EN 13381-4 are not an actual classification of the element but rather a procedure (assessment) for determining the necessary thicknesses based on the type of element to be protected.

The process for evaluating the effect of protection is divided into two phases:

- tests to be performed in an oven following standardized procedures defined by the standard
- the processing of experimental data to extend the results to real-world cases.

By repeating the same tests on elements with different massiveness and various coating thicknesses, charts are created that allow the extrapolation of coating thicknesses for all types of profiles. In particular, three series of samples are provided:

- the base series of unloaded samples
- the series for testing stickability, which means determining how well the protective system adheres to the structural element that undergoes an initial deformation
- the series of supplementary samples

The samples tested include I and H-type steel beams and columns, both loaded and unloaded. Each test continues until the steel reaches a temperature of 750°C. The test results consist of the temperatures recorded at various points on the samples throughout the test and are analyzed to assess the protective material's performance in real-world situations.

The standard provides three analysis methods:

- differential equations method,
- numerical regression method,
- graphical method.

The numerical regression method defines an equation expressing the time required to reach a specific design temperature based on the thickness of the protective material and the section factor.

The graphical method involves plotting a series of curves to interpret the protective material's effectiveness. Results are presented as tables indicating the necessary protective thicknesses to keep the steel temperature below design values, based on the section factor. These tables help professionals determine the thickness of protective materials to ensure the design's fire resistance.

The steps to be taken are:

- **determining the critical temperature** of the structural element based on load conditions, support structure, and profile type. The method for determining critical temperature is described in the previous pages.
- **determining the section factor** of the protected profile based on fire exposure (3 or 4 sides)
- **determining the protective thickness** given the required fire resistance class, based on experimental tables from laboratory assessments.

Appendix B of EN 13381-4 provides guidance on applying results to profiles with sections other than "I" or "H"; specifically:

a) for boxed protection, there's no need to alter the thickness of the protective material. Specifically, the boxed protection thickness for a hollow section profile with a given section factor Ap/V will be the same as that for an "I" or "H" section profile with the same factor A_p/V.
b) for contoured protection, the protective coating thickness must be adjusted based on the section factor of the hollow section profile, as follows:
c) determine the section factor A_p/V for the hollow structural section;
d) check the protective material thickness dp using data from "I" and "H" sections.
e) the thickness is modified as follows:

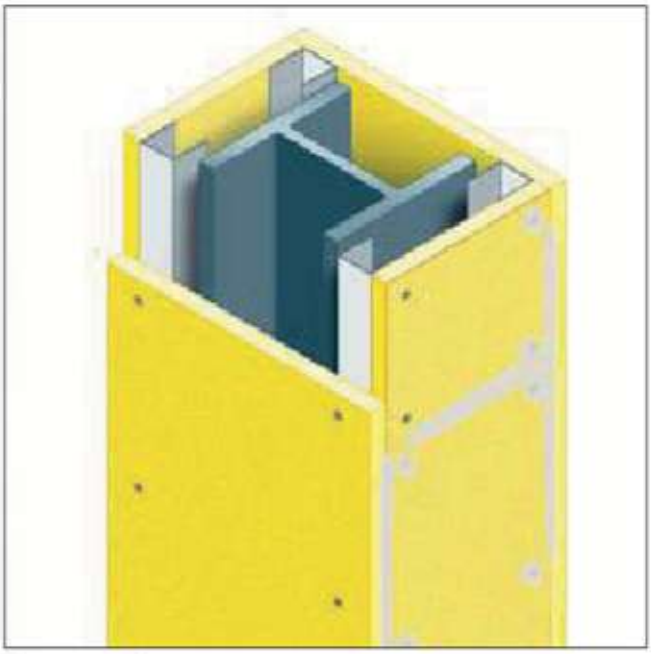
$$\textit{modified}\ \text{thickness} = d_p \left(1 + \frac{A_p / V}{1000}\right)$$

For A_p/V values up to 250 m-1.
For A/V values over 250 m-1, the modified thickness is 1.25 dp.p

Below are the required FIREGUARD® boards thicknesses for R15, R30, R45, R60, R90, R120, R180, R240, and R300 protection of steel beams and columns, based on profile section factor and critical temperature.

These data are certified through the Applus 11-2720-730 M1 assessment report conducted in accordance with EN 13381-4.

STEEL COLUMNS



FIRE REACTION: A1
FIRE RESISTANCE: R30-240

- **Support:** steel columns
- **Framework:** vertical 'C' stud 50x50x0.5mm** (UK) or 0.6mm (EU) placed at the corners of the column and inserted in 'U' channels 50x40x0.5mm** (UK) or 0.6mm (EU) located at the base and top of the steel profile.
- **Boards:** FIREGUARD® (see tables)
- **Fixings:** with phosphate-coated self-drilling screws diam. 3.5 mm at 250 mm centres
- **Finish:** joint and screw head finishing with FIREGUARD COMPOUND

**** Istituto GIORDANO Technical Report No 431915**

Assessment report Applus 11-2720-730
M1 Test standard: EN 13381-4

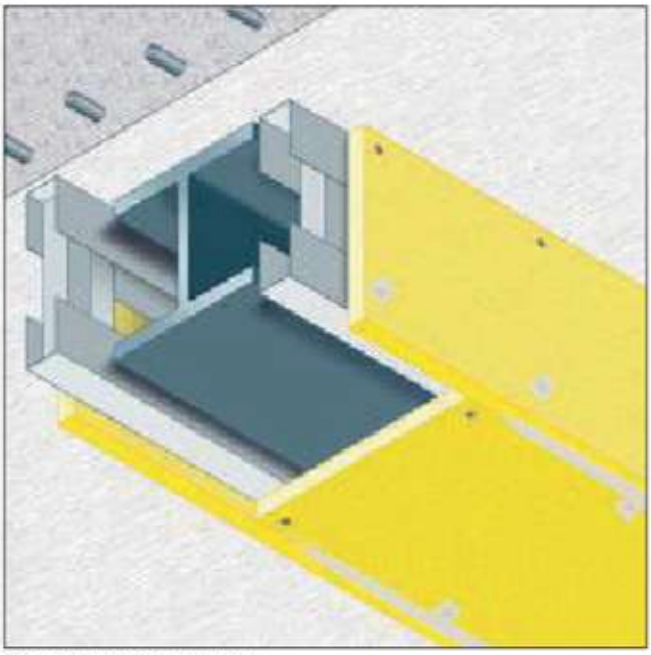
SPECIFICATION DESCRIPTION

Supply and installation of steel column protection with fire resistance of R15/30/45/60/90/120/180/240, made with FIREGUARD® boards of thickness... (see tables), maximum dimensions of 1200x2000 mm, composed of calcium silicates and sulphates, manufactured by lamination with drying control at the plant, classified as A1 (non-combustible) fire reaction, in compliance with Applus evaluation report 11-2720-730 M1 according to EN 13381-4 standard.

The boards will be attached using phosphate-coated self-drilling screws with a diameter of 3.5 mm, at an appropriate length, at 250 mm centres onto vertical 'C' profiles 50x50x0.5mm** (UK) or 0.6mm (EU) mm placed at the corners of the column, inserted in 'U' channels 50x40x0.5mm** (UK) or 0.6mm (EU) located at the base and top of the column. The joints and screw heads will be finished with FIREGUARD COMPOUND.

For application methods, refer to the dedicated 'installation manual'.

STEEL BEAMS



FIRE REACTION: A1
FIRE RESISTANCE: R30-240

- **Support:** steel beams
- **Framework:** vertical 'C' stud 75x50x0.5mm** (UK) or 0.6mm (EU) placed on either side of the steel profile at 550 mm centres, inserted in 'U' channels 75x40x0.5mm** (UK) or 0.6mm (EU) at the ceiling and lower part of the profile
- **Boards:** FIREGUARD® (see tables)
- **Fixings:** with phosphate-coated self-drilling screws diam. 3.5 mm at 250 mm centres
- **Finish:** joint and screw head finishing with FIREGUARD COMPOUND

**** Istituto GIORDANO Technical Report No 431915**

Assessment report Applus 11-2720-730
M1 Test standard: EN 13381-4

SPECIFICATION DESCRIPTION

Supply and installation of steel beam protection with fire resistance of R15/30/45/60/90/120/180/240, made with FIREGUARD® boards of thickness... (see tables), maximum dimensions of 1200x2000 mm, composed of calcium silicates and sulphates, manufactured by lamination with drying control at the plant, classified as A1 (non-combustible) fire reaction, in compliance with Applus evaluation report 11-2720-730 M1 according to EN 13381-4 standard.

The boards will be attached using phosphate-coated self-drilling screws with a diameter of 3.5 mm, at an appropriate length, at 250 mm onto vertical 'C' stud 75x50x0.5mm** (UK) or 0.6mm (EU) placed on either side of the beam, at 550 mm centres, inserted in 'U' channels 75x40x0.5mm** (UK) or 0.6mm (EU) located at the ceiling and the lower part of the beam.

The joints and screw heads will be finished with FIREGUARD COMPOUND.

For application methods, refer to the dedicated 'installation manual'.

CRITICAL TEMPERATURE $Ø_{CR}$ 350°C

FOR CLASS 4 DUCTILITY PROFILES

THICKNESS 12.7 mm
1 board 12.7 mm

THICKNESS 18.0 mm
1 board 18.0 mm

THICKNESS 25.4 mm
2 boards 12.7 mm

THICKNESS 30.7 mm
1 board 12.7 mm + 1 board 18.0 mm

THICKNESS 36.0 mm
2 boards 18.0 mm

THICKNESS 38.1 mm
3 boards 12.7 mm

THICKNESS 43.4 mm
2 boards 12.7 mm + 1 board 18.0 mm

THICKNESS 48.7 mm
1 board 12.7 mm + 2 boards 18.0 mm

THICKNESS 50.8 mm
4 boards 12.7 mm

THICKNESS 54.0 mm
3 boards 18.0 mm

THICKNESS 56.1 mm
3 boards 12.7 mm + 1 board 18.0 mm

THICKNESS 63.5 mm
5 boards 12.7 mm

THICKNESS 66.0 mm
1 board 12.7 mm + 3 boards 18.0 mm

THICKNESS 72.0 mm
4 boards 18.0 mm

THICKNESS 76.2 mm
6 boards 12.7 mm

THICKNESS 84.7 mm
1 board 12.7 mm + 4 boards 18.0 mm

Section Factor	PROTECTION OF BEAMS AND COLUMNS EXPOSED ON 3 OR 4 SIDES FIRE RESISTANCE CLASSIFICATION "R"								
m-1	R15	R30	R45	R60	R90	R120	R180	R240	R300
45	12,7	12,7	12,7	12,7	18,0	25,4	48,7	66,0	
50	12,7	12,7	12,7	12,7	18,0	30,7	48,7	66,0	
60	12,7	12,7	12,7	12,7	25,4	30,7	54,0	72,0	
70	12,7	12,7	12,7	18,0	25,4	36,0	54,0	72,0	
80	12,7	12,7	12,7	18,0	25,4	36,0	54,0	72,0	
90	12,7	12,7	18,0	18,0	30,7	36,0	54,0	72,0	
100	12,7	12,7	18,0	18,0	30,7	36,0	54,0	72,0	
110	12,7	12,7	18,0	25,4	30,7	38,1	56,1	72,0	
120	12,7	12,7	18,0	25,4	30,7	38,1	56,1	76,2	
130	12,7	12,7	18,0	25,4	30,7	38,1	56,1	76,2	
140	12,7	12,7	18,0	25,4	30,7	38,1	56,1	76,2	
150	12,7	12,7	18,0	25,4	30,7	43,4	56,1	76,2	
160	12,7	18,0	18,0	25,4	36,0	43,4	63,5	76,2	
170	12,7	18,0	18,0	25,4	36,0	43,4	63,5	76,2	
180	12,7	18,0	18,0	25,4	36,0	43,4	63,5	76,2	
190	12,7	18,0	18,0	25,4	36,0	43,4	63,5	76,2	
200	12,7	18,0	18,0	25,4	36,0	43,4	63,5	76,2	
210	12,7	18,0	25,4	25,4	36,0	43,4	63,5	76,2	
220	12,7	18,0	25,4	25,4	36,0	43,4	63,5	76,2	
230	12,7	18,0	25,4	25,4	36,0	43,4	63,5	76,2	
240	25,4	25,4	25,4	30,7	36,0	48,7	66,0		
250	25,4	25,4	25,4	30,7	38,1	48,7	66,0		
260	25,4	25,4	25,4	30,7	38,1	48,7	66,0		
270	25,4	25,4	25,4	30,7	38,1	48,7	66,0		
280	25,4	25,4	25,4	30,7	38,1	48,7	66,0		
290	25,4	25,4	25,4	30,7	38,1	48,7	66,0		
300	25,4	25,4	25,4	30,7	38,1	48,7	66,0		
310	25,4	25,4	25,4	30,7	38,1	48,7	66,0		
320	25,4	25,4	25,4	30,7	38,1	48,7	72,0		
330	25,4	25,4	25,4	30,7	38,1	48,7	72,0		
340	25,4	25,4	25,4	30,7	38,1	48,7	72,0		
350	25,4	25,4	25,4	30,7	38,1	48,7	72,0		
360	25,4	25,4	25,4	30,7	38,1	48,7	72,0		
370	25,4	25,4	25,4	30,7	38,1	48,7	72,0		
380	25,4	25,4	25,4	30,7	38,1	48,7	72,0		
390	25,4	25,4	25,4	30,7	38,1	48,7	72,0		
400	25,4	25,4	25,4	30,7	38,1	48,7	72,0		
410	25,4	25,4	25,4	30,7	38,1	48,7	72,0		
420	25,4	25,4	25,4	30,7	38,1	48,7	72,0		
430	25,4	25,4	25,4	30,7	38,1	48,7	72,0		
440	25,4	25,4	25,4	30,7	38,1	48,7	72,0		
450	25,4	25,4	25,4	30,7	38,1	48,7	72,0		

CRITICAL TEMPERATURE $Ø_{CR}$ 350°C

FOR PROFILES IN DUCTILITY CLASS 1/2/3 - UTILIZATION FACTOR μ = 0.8

Protective thickness sizing according to standard EN 13381-4 with FIREGUARD®

THICKNESS 12.7 mm
1 board 12.7 mm

THICKNESS 18.0 mm
1 board 18.0 mm

THICKNESS 25.4 mm
2 boards 12.7 mm

THICKNESS 30.7 mm
1 board 12.7 mm + 1 board 18.0 mm

THICKNESS 36.0 mm
2 boards 18.0 mm

THICKNESS 38.1 mm
3 boards 12.7 mm

THICKNESS 43.4 mm
2 boards 12.7 mm + 1 board 18.0 mm

THICKNESS 48.7 mm
1 boards 12.7 mm + 2 boards 18.0 mm

THICKNESS 50.8 mm
4 boards 12.7 mm

THICKNESS 54.0 mm
3 boards 18.0 mm

THICKNESS 56.1 mm
3 boards 12.7 mm + 1 board 18.0 mm

THICKNESS 63.5 mm
5 boards 12.7 mm

THICKNESS 66.0 mm
1 board 12.7 mm + 3 boards 18.0 mm

THICKNESS 72.0 mm
4 boards 18.0 mm

THICKNESS 76.2 mm
6 boards 12.7 mm

THICKNESS 84.7 mm
1 board 12.7 mm + 4 boards 18.0 mm

Section Factor	PROTECTION OF BEAMS AND COLUMNS EXPOSED ON 3 OR 4 SIDES FIRE RESISTANCE CLASSIFICATION "R"								
m-1	R15	R30	R45	R60	R90	R120	R180	R240	R300
45	12,7	12,7	12,7	12,7	12,7	25,4	36,0	56,1	76,2
50	12,7	12,7	12,7	12,7	12,7	25,4	38,1	63,5	84,7
60	12,7	12,7	12,7	12,7	18,0	25,4	43,4	63,5	
70	12,7	12,7	12,7	12,7	18,0	30,7	48,7	63,5	
80	12,7	12,7	12,7	12,7	25,4	30,7	48,7	66,0	
90	12,7	12,7	12,7	12,7	25,4	30,7	48,7	66,0	
100	12,7	12,7	12,7	18,0	25,4	36,0	50,8	76,2	
110	12,7	12,7	12,7	18,0	25,4	36,0	50,8	76,2	
120	12,7	12,7	12,7	18,0	25,4	36,0	54,0	76,2	
130	12,7	12,7	12,7	18,0	25,4	36,0	54,0	76,2	
140	12,7	12,7	12,7	18,0	25,4	36,0	54,0	76,2	
150	12,7	12,7	18,0	18,0	30,7	36,0	54,0	76,2	
160	12,7	12,7	18,0	18,0	30,7	36,0	54,0	76,2	
170	12,7	12,7	18,0	18,0	30,7	36,0	54,0	76,2	
180	12,7	12,7	18,0	25,4	30,7	36,0	54,0	76,2	
190	12,7	12,7	18,0	25,4	30,7	36,0	54,0	76,2	
200	12,7	12,7	18,0	25,4	30,7	38,1	54,0	76,2	
210	12,7	12,7	18,0	25,4	30,7	38,1	54,0	76,2	
220	12,7	12,7	18,0	25,4	30,7	38,1	54,0	76,2	
230	12,7	12,7	18,0	25,4	30,7	38,1	56,1	76,2	
240	25,4	25,4	25,4	25,4	36,0	43,4	63,5		
250	25,4	25,4	25,4	25,4	36,0	43,4	63,5		
260	25,4	25,4	25,4	25,4	36,0	43,4	63,5		
270	25,4	25,4	25,4	25,4	36,0	43,4	63,5		
280	25,4	25,4	25,4	25,4	36,0	43,4	63,5		
290	25,4	25,4	25,4	25,4	36,0	48,7	63,5		
300	25,4	25,4	25,4	25,4	36,0	48,7	63,5		
310	25,4	25,4	25,4	25,4	36,0	48,7	63,5		
320	25,4	25,4	25,4	25,4	36,0	48,7	63,5		
330	25,4	25,4	25,4	25,4	36,0	48,7	63,5		
340	25,4	25,4	25,4	25,4	36,0	48,7	63,5		
350	25,4	25,4	25,4	30,7	36,0	48,7	63,5		
360	25,4	25,4	25,4	30,7	36,0	48,7	63,5		
370	25,4	25,4	25,4	30,7	36,0	48,7	63,5		
380	25,4	25,4	25,4	30,7	36,0	48,7	63,5		
390	25,4	25,4	25,4	30,7	36,0	48,7	63,5		
400	25,4	25,4	25,4	30,7	36,0	48,7	63,5		
410	25,4	25,4	25,4	30,7	36,0	48,7	66,0		
420	25,4	25,4	25,4	30,7	36,0	48,7	66,0		
430	25,4	25,4	25,4	30,7	36,0	48,7	66,0		
440	25,4	25,4	25,4	30,7	36,0	48,7	66,0		
450	25,4	25,4	25,4	30,7	36,0	48,7	66,0		

CRITICAL TEMPERATURE $Ø_{CR}$ 550°C

FOR PROFILES IN DUCTILITY CLASS 1/2/3 - UTILIZATION FACTOR μ = 0.6

Sizing of protective thicknesses according to EN 13381-4 standard with FIREGUARD®

THICKNESS 12.7 mm
1 board 12.7 mm

THICKNESS 18.0 mm
1 board 18.0 mm

THICKNESS 25.4 mm
2 boards 12.7 mm

THICKNESS 30.7 mm
1 board 12.7 mm + 1 board 18.0 mm

THICKNESS 36.0 mm
2 boards 18.0 mm

THICKNESS 38.1 mm
3 boards 12.7 mm

THICKNESS 43.4 mm
2 boards 12.7 mm + 1 board 18.0 mm

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THICKNESS 50.8 mm
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THICKNESS 54.0 mm
3 boards 18.0 mm

THICKNESS 56.1 mm
3 boards 2.7 mm + 1 board 18.0 mm

THICKNESS 63.5 mm
5 boards 12.7 mm

THICKNESS 66.0 mm
1 board 12.7 mm + 3 boards 18.0 mm

THICKNESS 72.0 mm
4 boards 18.0 mm

THICKNESS 76.2 mm
6 boards 12.7 mm

THICKNESS 84.7 mm
1 board 12.7 mm + 4 boards 18.0 mm

Section Factor	PROTECTION OF BEAMS AND COLUMNS EXPOSED ON 3 OR 4 SIDES FIRE RESISTANCE CLASSIFICATION "R"								
m-1	R15	R30	R45	R60	R90	R120	R180	R240	R300
45	12,7	12,7	12,7	12,7	12,7	12,7	36,0	54,0	72,0
50	12,7	12,7	12,7	12,7	12,7	18,0	36,0	56,1	76,2
60	12,7	12,7	12,7	12,7	12,7	25,4	43,4	63,5	84,7
70	12,7	12,7	12,7	12,7	18,0	25,4	43,4	63,5	
80	12,7	12,7	12,7	12,7	18,0	30,7	48,7	63,5	
90	12,7	12,7	12,7	12,7	25,4	30,7	48,7	66,0	
100	12,7	12,7	12,7	12,7	25,4	30,7	48,7	66,0	
110	12,7	12,7	12,7	12,7	25,4	30,7	48,7	76,2	
120	12,7	12,7	12,7	18,0	25,4	36,0	50,8	76,2	
130	12,7	12,7	12,7	18,0	25,4	36,0	50,8	76,2	
140	12,7	12,7	12,7	18,0	25,4	36,0	50,8	76,2	
150	12,7	12,7	12,7	18,0	25,4	36,0	54,0	76,2	
160	12,7	12,7	12,7	18,0	25,4	36,0	54,0	76,2	
170	12,7	12,7	18,0	18,0	30,7	36,0	54,0	76,2	
180	12,7	12,7	18,0	18,0	30,7	36,0	54,0	76,2	
190	12,7	12,7	18,0	18,0	30,7	36,0	54,0	76,2	
200	12,7	12,7	18,0	18,0	30,7	36,0	54,0	76,2	
210	12,7	12,7	18,0	18,0	30,7	38,1	54,0	76,2	
220	12,7	12,7	18,0	25,4	30,7	38,1	54,0	76,2	
230	12,7	12,7	18,0	25,4	30,7	38,1	54,0	76,2	
240	25,4	25,4	25,4	25,4	36,0	43,4	63,5		
250	25,4	25,4	25,4	25,4	36,0	43,4	63,5		
260	25,4	25,4	25,4	25,4	36,0	43,4	63,5		
270	25,4	25,4	25,4	25,4	36,0	43,4	63,5		
280	25,4	25,4	25,4	25,4	36,0	43,4	63,5		
290	25,4	25,4	25,4	25,4	36,0	43,4	63,5		
300	25,4	25,4	25,4	25,4	36,0	43,4	63,5		
310	25,4	25,4	25,4	25,4	36,0	43,4	63,5		
320	25,4	25,4	25,4	25,4	36,0	43,4	63,5		
330	25,4	25,4	25,4	25,4	36,0	43,4	63,5		
340	25,4	25,4	25,4	25,4	36,0	43,4	63,5		
350	25,4	25,4	25,4	25,4	36,0	43,4	63,5		
360	25,4	25,4	25,4	25,4	36,0	43,4	63,5		
370	25,4	25,4	25,4	25,4	36,0	48,7	63,5		
380	25,4	25,4	25,4	25,4	36,0	48,7	63,5		
390	25,4	25,4	25,4	25,4	36,0	48,7	63,5		
400	25,4	25,4	25,4	25,4	36,0	48,7	63,5		
410	25,4	25,4	25,4	25,4	36,0	48,7	63,5		
420	25,4	25,4	25,4	25,4	36,0	48,7	63,5		
430	25,4	25,4	25,4	25,4	36,0	48,7	63,5		
440	25,4	25,4	25,4	30,7	36,0	48,7	63,5		
450	25,4	25,4	25,4	30,7	36,0	48,7	63,5		

CRITICAL TEMPERATURE $Ø_{CR}$ 630°C

FOR PROFILES IN DUCTILITY CLASS 1/2/3 - UTILIZATION FACTOR μ = 0.38

Sizing of protective thicknesses according to EN 13381-4 standard with FIREGUARD®

THICKNESS 12.7 mm
1 board 12.7 mm

THICKNESS 18.0 mm
1 board 18.0 mm

THICKNESS 25.4 mm
2 board 12.7 mm

THICKNESS 30.7 mm
1 board 12.7 mm + 1 board 18.0 mm

THICKNESS 36.0 mm
2 boards 18.0 mm

THICKNESS 38.1 mm
3 boards 12.7 mm

THICKNESS 43.4 mm
2 boards 12.7 mm + 1 board 18.0 mm

THICKNESS 48.7 mm
1 board 12.7 mm + 2 boards 18.0 mm

THICKNESS 50.8 mm
4 boards 12.7 mm

THICKNESS 54.0 mm
3 boards 18.0 mm

THICKNESS 56.1 mm
3 boards 12.7 mm + 1 board 18.0 mm

THICKNESS 63.5 mm
5 boards 12.7 mm

THICKNESS 66.0 mm
1 boards 12.7 mm + 3 boards 18.0 mm

THICKNESS 72.0 mm
4 boards 18.0 mm

THICKNESS 76.2 mm
6 boards 12.7 mm

THICKNESS 84.7 mm
1 board 12.7 mm + 4 boards 18.0 mm

Section Factor PROTECTION FOR BEAMS AND COLUMNS WITH 3 OR 4 SIDES EXPOSURE FIRE RESISTANCE CLASSIFICATION "R" m-1	R15	R30	R45	R60	R90	R120	R180	R240	R300
45	12,7	12,7	12,7	12,7	12,7	12,7	30,7	48,7	72,0
50	12,7	12,7	12,7	12,7	12,7	12,7	30,7	50,8	72,0
60	12,7	12,7	12,7	12,7	12,7	18,0	36,0	56,1	72,0
70	12,7	12,7	12,7	12,7	12,7	25,4	43,4	63,5	84,7
80	12,7	12,7	12,7	12,7	18,0	25,4	43,4	63,5	84,7
90	12,7	12,7	12,7	12,7	18,0	25,4	43,4	63,5	
100	12,7	12,7	12,7	12,7	18,0	25,4	48,7	63,5	
110	12,7	12,7	12,7	12,7	25,4	30,7	48,7	66,0	
120	12,7	12,7	12,7	12,7	25,4	30,7	48,7	66,0	
130	12,7	12,7	12,7	12,7	25,4	30,7	48,7	66,0	
140	12,7	12,7	12,7	18,0	25,4	36,0	48,7	66,0	
150	12,7	12,7	12,7	18,0	25,4	36,0	50,8	66,0	
160	12,7	12,7	12,7	18,0	25,4	36,0	50,8	72,0	
170	12,7	12,7	12,7	18,0	25,4	36,0	50,8	72,0	
180	12,7	12,7	12,7	18,0	25,4	36,0	50,8	72,0	
190	12,7	12,7	12,7	18,0	25,4	36,0	54,0	72,0	
200	12,7	12,7	12,7	18,0	25,4	36,0	54,0	72,0	
210	12,7	12,7	12,7	18,0	25,4	36,0	54,0	72,0	
220	12,7	12,7	18,0	18,0	30,7	36,0	54,0	72,0	
230	12,7	12,7	18,0	18,0	30,7	36,0	54,0	72,0	
240	25,4	25,4	25,4	25,4	30,7	38,1	56,1	72,0	
250	25,4	25,4	25,4	25,4	30,7	38,1	56,1	72,0	
260	25,4	25,4	25,4	25,4	30,7	38,1	56,1	76,2	
270	25,4	25,4	25,4	25,4	30,7	38,1	56,1	76,2	
280	25,4	25,4	25,4	25,4	30,7	38,1	56,1	76,2	
290	25,4	25,4	25,4	25,4	30,7	43,4	56,1	76,2	
300	25,4	25,4	25,4	25,4	30,7	43,4	56,1	76,2	
310	25,4	25,4	25,4	25,4	30,7	43,4	63,5	76,2	
320	25,4	25,4	25,4	25,4	36,0	43,4	63,5	76,2	
330	25,4	25,4	25,4	25,4	36,0	43,4	63,5	76,2	
340	25,4	25,4	25,4	25,4	36,0	43,4	63,5	76,2	
350	25,4	25,4	25,4	25,4	36,0	43,4	63,5	76,2	
360	25,4	25,4	25,4	25,4	36,0	43,4	63,5	76,2	
370	25,4	25,4	25,4	25,4	36,0	43,4	63,5	76,2	
380	25,4	25,4	25,4	25,4	36,0	43,4	63,5	76,2	
390	25,4	25,4	25,4	25,4	36,0	43,4	63,5	76,2	
400	25,4	25,4	25,4	25,4	36,0	43,4	63,5	76,2	
410	25,4	25,4	25,4	25,4	36,0	43,4	63,5	76,2	
420	25,4	25,4	25,4	25,4	36,0	43,4	63,5	76,2	
430	25,4	25,4	25,4	25,4	36,0	43,4	63,5	76,2	
440	25,4	25,4	25,4	25,4	36,0	43,4	63,5	76,2	
450	25,4	25,4	25,4	25,4	36,0	43,4	63,5	76,2	

SECTION FACTOR VALUES AND DUCTILITY CLASSES FOR ROLLED PROFILES

PROFILE			BENDING			COMPRESSION		
C	(m-1)	(m-1)	S235	S355	S460	S235	S355	S460
C 75 x 6,1	241	286	1	1		1	1	
C 75 x 7,4	201	240	1	1		1	1	
C 75 x 8,9	170	205	1	1		1	1	
C 100 x 8	239	278	1	1		1	1	
C 100 x 10,8	179	210	1	1		1	1	
C 130 x 10,4	227	263	1	1		1	1	
C 130 x 13	177	205	1	1		1	1	
C 150 x 12,2	227	258	1	1		1	1	
C 150 x 15,6	179	205	1	1		1	1	
C 150 x 19,3	146	168	1	1		1	1	
C 180 x 14,6	220	248	1	1		1	1	
C 180 x 18,2	177	201	1	1		1	1	
C 180 x 22	148	168	1	1		1	1	
C 200 x 17,1	213	240	1	1		1	2	
C 200 x 20,5	179	202	1	1		1	1	
C 200 x 27,9	132	150	1	1		1	1	
C 230 x 19,9	204	228	1	1		1	2	
C 230 x 22	183	205	1	1		1	1	
C 230 x 30	138	156	1	1		1	1	
C 250 x 22,8	199	222	1	1		2	3	
C 250 x 30	153	171	1	1		1	1	
C 250 x 37	128	144	1	1		1	1	
C 250 x 45	103	116	1	1		1	1	
C 310 x 30,8	174	193	1	1		2	4	
C 310 x 37	146	162	1	1		1	1	
C 310 x 45	121	135	1	1		1	1	
C 380 x 50,4	132	145	1	1		1	2	
C 380 x 60	112	124	1	1		1	1	
C 380 x 74	90	100	1	1		1	1	

PROFILE			BENDING			COMPRESSION		
CH	(m-1)	(m-1)	S235	S355	S460	S235	S355	S460
CH 76x38x7	221	265	1	1		1	1	
CH 102x51x10	193	232	1	1		1	1	
CH 127x64x15	169	203	1	1		1	1	
CH 152x76x18	169	203	1	1		1	1	
CH 152x89x24	131	161	1	1		1	1	
CH 178x76x21	164	192	1	1		1	1	
CH 178x89x27	132	158	1	1		1	1	
CH 203x76x24	159	185	1	1		1	1	
CH 203x89x30	132	155	1	1		1	1	
CH 229x76x26	161	184	1	1		1	1	
CH 229x89x33	132	153	1	1		1	1	
CH 245x76x28	163	184	1	1		1	1	
CH 245x89x36	132	151	1	1		1	1	
CH 305x89x42	132	149	1	1		1	1	
CH 305x102x46	122	140	1	1		1	1	
CH 305x102x55	124	139	1	1		1	2	
CH 432x102x65	117	130	1	1		1	2	

PROFILE			BENDING			COMPRESSION		
H	(m-1)	(m-1)	S235	S355	S460	S235	S355	S460
H 100x100x6x8	139	185	1	1		1	1	
H 125x125x6,5x9	125	167	1	1		1	1	
H 150x75x5x7	210	252	1	1		1	1	
H 150x150x7x10	113	151	1	1		1	1	
H 175x175x7,5x11	102	136	1	1		1	1	
H 200x100x4,5x7	218	262	1	1		2	4	
H 200x100x5,5x8	187	225	1	1		1	2	
H 200x200x8x12	94	126	1	2		1	2	
H 200x200x12x12	84	113	1	2		1	2	
H 250x125x5x8	194	233	1	1		4	4	
H 250x125x6x9	169	203	1	1		2	4	
H 250x250x11x11	91	122	3	3		3	3	
H 250x250x9x14	82	109	1	2		1	2	
H 250x250x14x14	73	97	1	3		1	3	
H 300x150x5,5x8	183	219	1	3		4	4	
H 300x150x6,5x9	160	192	1	2		3	4	
H 300x300x12x12	84	112	3	4		3	4	
H 300x300x10x15	76	101	1	3		1	3	
H 300x300x15x15	68	91	2	3		2	3	
H 350x175x6x9	165	198	1	3		4	4	
H 350x175x7x11	139	167	1	1		4	4	
H 350x350x13x13	77	103	3	4		3	4	
H 350x350x10x16	72	96	2	3		2	3	
H 350x350x16x16	63	85	3	3		3	3	
H 350x350x12x19	61	81	1	3		1	3	
H 350x350x19x19	54	72	1	3		1	3	
H 400x300x10x16	81	104	1	3		2	3	
H 400x400x15x15	66	89	3	4		3	4	
H 400x400x11x18	63	85	3	3		3	3	
H 400x400x18x18	56	75	3	3		3	3	
H 400x400x13x21	55	73	1	3		1	3	
H 400x400x21x21	48	64	1	3		1	3	
H 400x400x18x28	42	55	1	1		1	1	
H 400x400x20x35	35	46	1	1		1	1	
H 400x400x30x50	25	33	1	1		1	1	
H 500x200x9x14	120	140	1	1		4	4	
H 500x200x10x16	107	125	1	1		4	4	
H 500x200x11x19	94	109	1	1		3	4	
H 500x300x11x15	90	111	1	3		3	4	
H 500x300x11x18	80	99	1	2		3	4	
H 600x300x12x17	87	104	1	2		4	4	
H 600x300x12x20	79	95	1	1		4	4	
H 600x300x14x23	69	83	1	1		2	4	
H 700x300x13x20	81	96	1	1		4	4	
H 700x300x13x24	73	86	1	1		4	4	
H 800x300x14x22	79	91	1	1		4	4	
H 800x300x14x26	72	83	1	1		4	4	
H 900x300x15x23	78	89	1	1		4	4	
H 900x300x16x28	69	78	1	1		4	4	
H 900x300x18x34	59	67	1	1		4	4	

VALUES OF SECTION FACTORS AND DUCTILITY CLASSES FOR ROLLED PROFILES

PROFILE			BENDING			COMPRESSION		
HD	(m-1)	(m-1)	S235	S355	S460	S235	S355	S460
HD 260 x 68,2	88	117	2	3	3	2	3	3
HD 260 x 93,0	66	88	1	1	2	1	1	2
HD 260 x 114	55	73	1	1	1	1	1	1
HD 260 x 142	46	60	1	1	1	1	1	1
HD 260 x 172	39	51	1	1	1	1	1	1
HD 320 x 74,2	96	127	3	4	4	3	4	4
HD 320 x 97,6	74	98	1	3	3	1	3	3
HD 320 x 127	58	77	1	1	2	1	1	2
HD 320 x 158	48	63	1	1	1	1	1	1
HD 320 x 198	39	51	1	1	1	1	1	1
HD 320 x 245	33	43	1	1	1	1	1	1
HD 320 x 300	28	36	1	1	1	1	1	1
HD 360 x 134	63	85	2	3	3	2	3	3
HD 360 x 147	58	78	1	3	3	1	3	3
HD 360 x 162	53	71	1	2	3	1	2	3
HD 360 x 179	49	65	1	1	2	1	1	2
HD 360 x 196	45	60	1	1	1	1	1	1
HD 400 x 187	47	64	1	2	3	1	2	3
HD 400 x 216	42	56	1	1	1	1	1	1
HD 400 x 237	38	52	1	1	1	1	1	1
HD 400 x 262	35	47	1	1	1	1	1	1
HD 400 x 287	32	43	1	1	1	1	1	1
HD 400 x 314	30	40	1	1	1	1	1	1
HD 400 x 347	28	37	1	1	1	1	1	1
HD 400 x 382	25	34	1	1	1	1	1	1
HD 400 x 421	23	31	1	1	1	1	1	1
HD 400 x 463	22	29	1	1	1	1	1	1
HD 400 x 509	20	27	1	1	1	1	1	1
HD 400 x 551	19	25	1	1	1	1	1	1
HD 400 x 592	18	23	1	1	1	1	1	1
HD 400 x 634	17	22	1	1	1	1	1	1
HD 400 x 677	16	21	1	1	1	1	1	1
HD 400 x 744	15	20	1	1	1	1	1	1
HD 400 x 818	14	18	1	1	1	1	1	1
HD 400 x 900	13	17	1	1	1	1	1	1
HD 400 x 990	12	16	1	1	1	1	1	1
HD 400 x 1086	11	15	1	1	1	1	1	1

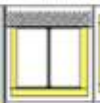
PROFILE			BENDING			COMPRESSION		
HE	(m-1)	(m-1)	S235	S355	S460	S235	S355	S460
HE 100 AA	181	245	1	3	3	1	3	3
HE 100 A	138	185	1	1	1	1	1	1
HE 100 B	115	154	1	1	1	1	1	1
HE 100 M	65	85	1	1	1	1	1	1
HE 120 AA	182	247	2	3	4	2	3	4
HE 120 A	137	185	1	1	2	1	1	2
HE 120 B	106	141	1	1	1	1	1	1
HE 120 M	61	80	1	1	1	1	1	1
HE 140 AA	172	233	3	3	4	3	3	4

PROFILE			BENDING			COMPRESSION		
HE	(m-1)	(m-1)	S235	S355	S460	S235	S355	S460
HE 140 A	129	174	1	2	3	1	2	3
HE 140 B	98	130	1	1	1	1	1	1
HE 140 M	58	76	1	1	1	1	1	1
HE 160 AA	150	203	3	3	4	3	3	4
HE 160 A	120	161	1	2	3	1	2	3
HE 160 B	88	118	1	1	1	1	1	1
HE 160 M	54	71	1	1	1	1	1	1
HE 180 AA	141	190	3	3	4	3	3	4
HE 180 A	115	155	1	3	3	1	3	3
HE 180 B	83	110	1	1	1	1	1	1
HE 180 M	52	68	1	1	1	1	1	1
HE 200 AA	130	175	3	4	4	3	4	4
HE 200 A	108	145	1	3	3	1	3	3
HE 200 B	77	102	1	1	1	1	1	1
HE 200 M	49	65	1	1	1	1	1	1
HE 220 AA	122	165	3	4	4	3	4	4
HE 220 A	99	134	1	3	3	1	3	3
HE 220 B	72	97	1	1	1	1	1	1
HE 220 M	47	62	1	1	1	1	1	1
HE 240 AA	114	154	3	4	4	3	4	4
HE 240 A	91	122	1	3	3	1	3	3
HE 240 B	68	91	1	1	1	1	1	1
HE 240 M	39	52	1	1	-	1	1	-
HE 260 AA	108	146	3	4	4	3	4	4
HE 260 A	88	117	2	3	3	2	3	3
HE 260 B	66	88	1	1	2	1	1	2
HE 260 M	39	51	1	1	1	1	1	1
HE 280 AA	104	139	3	4	4	3	4	4-
HE 280 A	84	113	2	3	4	2	3	4
HE 280 B	64	85	1	1	2	1	1	2
HE 280 M	38	50	1	1	1	1	1	1
HE 300 AA	97	131	3	4	4	3	4	4
HE 300 A	78	105	2	3	3	2	3	3
HE 300 B	60	80	1	1	3	1	1	3
HE 300 M	33	43	1	1	1	1	1	1
HE 320 AA	95	127	3	4	4	3	4	4
HE 320 A	74	98	1	3	3	1	3	3
HE 320 B	58	77	1	1	2	1	1	2
HE 320 M	33	43	1	1	1	1	1	1
HE 340 AA	94	123	3	4	4	3	4	4
HE 340 A	72	94	1	3	3	1	3	3
HE 340 B	57	75	1	1	1	1	1	1
HE 340 M	34	43	1	1	1	1	1	1
HE 360 AA	92	120	3	4	4	3	4	4
HE 360 A	70	91	1	2	3	1	2	3
HE 360 B	56	73	1	1	1	1	1	1
HE 360 M	34	44	1	1	1	1	1	1
HE 400 AA	90	115	3	3	4	3	3	4
HE 400 A	68	87	1	1	3	1	2	3
HE 400 B	56	71	1	1	1	1	1	1
HE 400 M	36	45	1	1	1	1	1	1
HE 450 AA	91	114	3	3	4	3	4	4
HE 450 A	66	83	1	1	1	1	2	3

VALUES FOR SECTION FACTORS AND DUCTILITY CLASSES OF ROLLED PROFILES

PROFILE			BENDING			COMPRESSION		
HE	(m-1)	(m-1)	S235	S355	S460	S235	S355	S460
HE 450 B	55	69	1	1	1	1	1	2
HE 450 M	38	47	1	1	1	1	1	1
HE 500 AA	91	113	2	3	3	2	4	4
HE 500 A	65	80	1	1	1	1	3	4
HE 500 B	54	67	1	1	1	1	2	2
HE 500 M	39	48	1	1	1	1	1	1
HE 550 AA	88	108	1	3	3	3	4	4
HE 550 A	65	79	1	1	1	2	4	4
HE 550 B	55	67	1	1	1	1	2	3
HE 550 M	41	50	1	1	1	1	1	1
HE 600 AA	88	106	1	3	3	3	4	4
HE 600 A	65	79	1	1	1	2	4	4
HE 600 B	56	67	1	1	1	1	3	4
HE 600 M	42	51	1	1	1	1	1	1
HE 600 x 337	37	44	1	1	1	1	1	1
HE 600 x 399	32	38	1	1	1	1	1	1
HE 650 AA	88	105	1	3	3	4	4	4
HE 650 A	65	78	1	1	1	3	4	4
HE 650 B	56	66	1	1	1	2	3	4
HE 650 M	44	52	1	1	1	1	1	2
HE 650 x 343	38	45	1	1	1	1	1	1
HE 650 x 407	33	39	1	1	1	1	1	1
HE 700 AA	86	102	1	2	3	4	4	4
HE 700 A	64	76	1	1	1	3	4	4
HE 700 B	55	65	1	1	1	2	4	4
HE 700 M	45	53	1	1	1	1	2	3
HE 700 x 352	39	46	1	1	1	1	1	1
HE 700 x 418	34	40	1	1	1	1	1	1
HE 800 AA	84	98	1	2	3	4	4	4
HE 800 A	66	76	1	1	1	4	4	4
HE 800 B	57	66	1	1	1	3	4	4
HE 800 M	48	55	1	1	1	1	3	4
HE 800 x 373	41	48	1	1	1	1	2	2
HE 800 x 444	35	41	1	1	1	1	1	1
HE 900 AA	81	93	1	1	2	4	4	4
HE 900 A	65	74	1	1	1	4	4	4
HE 900 B	57	65	1	1	1	3	4	4
HE 900 M	50	57	1	1	1	2	4	4
HE 900 x 391	43	49	1	1	1	1	3	4
HE 900 x 466	37	42	1	1	1	1	1	2
HE 1000 AA	79	90	1	1	-	4	4	-
HE 1000 x 249	71	81	1	1	2	4	4	4
HE 1000 A	66	74	1	1	2	4	4	4
HE 1000 B	57	65	1	1	1	4	4	4
HE 1000 M	52	59	1	1	1	3	4	4
HE 1000 x 393	47	53	1	1	1	2	4	4
HE 1000 x 415	44	50	1	1	1	2	3	4
HE 1000 x 438	42	48	1	1	1	1	3	4
HE 1000 x 494	38	43	1	1	1	1	2	3
HE 1000 x 584	33	37	1	1	1	1	1	2

PROFILE			BENDING			COMPRESSION		
HL	(m-1)	(m-1)	S235	S355	S460	S235	S355	S460
HL 920 x 345	52	62	1	1	1	4	4	4
HL 920 x 368	49	58	1	1	1	3	4	4
HL 920 x 390	46	55	1	1	1	3	4	4
HL 920 x 420	43	51	1	1	1	2	4	4
HL 920 x 449	41	48	1	1	1	2	4	4
HL 920 x 491	37	44	1	1	1	1	3	4
HL 920 x 537	35	41	1	1	1	1	2	3
HL 920 x 588	32	37	1	1	1	1	1	2
HL 920 x 656	29	34	1	1	1	1	1	2
HL 920 x 725	26	31	1	1	1	1	1	1
HL 920 x 787	25	29	1	1	1	1	1	1
HL 920 x 970	20	24	1	1	1	1	1	1
HL 1000 AA	63	73	1	1	2	4	4	4
HL 1000 A	58	68	1	1	2	4	4	4
HL 1000 B	51	59	1	1	1	4	4	4
HL 1000 M	46	54	1	1	1	3	4	4
HL 1000 x 443	43	50	1	1	1	2	4	4
HL 1000 x 483	40	46	1	1	1	2	4	4
HL 1000 x 539	36	42	1	1	1	1	2	4
HL 1000 x 554	35	41	1	1	1	1	2	3
HL 1000 x 591	33	39	1	1	1	1	2	3
HL 1000 x 642	31	36	1	1	1	1	1	2
HL 1000 x 748	27	31	1	1	1	1	1	1
HL 1000 x 883	23	27	1	1	-	1	1	-
HL 1100 A	59	68	1	1	2	4	4	4
HL 1100 B	52	60	1	1	1	4	4	4
HL 1100 M	47	55	1	1	1	4	4	4
HL 1100 R	42	48	1	1	1	2	4	4

PROFILE			BENDING			COMPRESSION		
HP	(m-1)	(m-1)	S235	S355	S460	S235	S355	S460
HP 200 x 43	112	150	3	3	4	3	3	4
HP 200 x 53	90	121	1	3	3	1	3	3
HP 220 x 57	88	119	2	3	3	2	3	3
HP 260 x 75	80	108	3	3	4	3	3	4
HP 260 x 87	70	94	1	3	3	1	3	3
HP 305 x 79	91	121	3	4	4	3	4	4
HP 305 x 88	81	109	3	4	4	3	4	4
HP 305 x 95	76	101	3	3	4	3	3	4
HP 305 x 110	66	88	2	3	3	2	3	3
HP 305 x 126	58	78	1	2	3	1	2	3
HP 305 x 149	50	67	1	1	2	1	1	2
HP 305 x 180	42	56	1	1	1	1	1	1
HP 305 x 186	41	55	1	1	1	1	1	1
HP 305 x 223	35	47	1	1	1	1	1	1
HP 320 x 88	81	108	3	4	4	3	4	4

VALUES OF SECTION FACTORS AND DUCTILITY CLASSES OF ROLLED PROFILES

PROFILE			BENDING			COMPRESSION		
HP	(m-1)	(m-1)	S235	S355	S460	S235	S355	S460
HP 320 x 103	70	94	2	3	4	2	3	4
HP 320 x 117	62	83	1	3	3	1	3	3
HP 320 x 147	51	68	1	1	2	1	1	2
HP 320 x 184	42	55	1	1	1	1	1	1
HP 360 x 84	98	132	4	4	4	4	4	4
HP 360 x 109	77	103	3	4	4	3	4	4
HP 360 x 133	64	86	3	3	4	3	3	4
HP 360 x 152	56	76	2	3	3	2	3	3
HP 360 x 174	50	67	1	3	3	1	3	3
HP 360 x 180	48	65	1	3	3	1	3	3
HP 400 x 122	70	95	3	4	4	3	4	4
HP 400 x 140	61	83	3	4	4	3	4	4
HP 400 x 158	55	74	2	3	4	2	3	4
HP 400 x 176	50	67	1	3	3	1	3	3
HP 400 x 194	46	62	1	3	3	1	3	3
HP 400 x 213	42	57	1	2	3	1	2	3
HP 400 x 231	39	53	1	1	2	1	1	2

PROFILE			BENDING			COMPRESSION		
INP	(m-1)	(m-1)	S235	S355	S460	S235	S355	S460
INP 80	266	322	4	4		4	4	
INP 100	236	283	1	1		1	1	
INP 120	210	251	1	1		1	1	
INP 140	189	225	1	1		1	1	
INP 160	173	205	1	1		1	1	
INP 180	158	188	1	1		1	1	
INP 200	147	174	1	1		1	1	
INP 220	136	161	1	1		1	1	
INP 240	127	150	1	1		1	1	
INP 260	119	140	1	1		1	1	
INP 280	111	131	1	1		1	1	
INP 300	105	123	1	1		1	1	
INP 320	99	116	1	1		1	1	
INP 340	94	110	1	1		1	1	
INP 360	89	104	1	1		1	1	
INP 380	85	99	1	1		1	1	
INP 400	81	94	1	1		1	1	
INP 450	73	84	1	1		1	1	
INP 500	66	77	1	1		1	1	
INP 550	61	71	1	1		1	1	
INP 600	56	64	1	1		1	1	

PROFILE			BENDING			COMPRESSION		
IPE	(m-1)	(m-1)	S235	S355	S460	S235	S355	S460
IPE 80 A	317	389	1	1	-	1	1	-
IPE 80	270	330	1	1	-	1	1	-
IPE A 100	286	349	1	1	-	1	1	-
IPE 100	247	300	1	1	-	1	1	-
IPE A 120	271	329	1	1	1	1	1	2
IPE 120	230	279	1	1	1	1	1	1
IPE A 140	260	314	1	1	1	1	2	3
IPE 140	215	259	1	1	1	1	1	2
IPE A 160	245	295	1	1	1	1	3	4
IPE 160	200	241	1	1	1	1	1	2
IPE A 180	227	274	1	1	1	2	3	4
IPE 180	188	226	1	1	1	1	2	3
IPE O 180	168	202	1	1	1	1	1	2
IPE A 200	210	253	1	1	1	2	4	4
IPE 200	176	211	1	1	1	1	2	3
IPE O 200	158	190	1	1	1	1	1	2
IPE A 220	193	231	1	1	1	2	4	4
IPE 220	165	198	1	1	1	1	2	4
IPE O 220	149	179	1	1	1	1	2	2
IPE A 240	178	214	1	1	2	2	4	4
IPE 240	153	184	1	1	1	1	2	4
IPE O 240	139	167	1	1	1	1	2	3
IPE A 270	171	205	1	1	2	3	4	4
IPE 270	147	176	1	1	1	2	3	4
IPE O 270	127	152	1	1	1	1	2	3
IPE A 300	160	192	1	2	3	3	4	4
IPE 300	139	167	1	1	1	2	4	4
IPE O 300	121	145	1	1	1	1	3	4
IPE A 330	149	178	1	1	2	3	4	4
IPE 330	131	157	1	1	1	2	4	4
IPE O 330	114	137	1	1	1	1	3	4
IPE A 360	138	165	1	1	2	4	4	4
IPE 360	122	146	1	1	1	2	4	4
IPE O 360	107	127	1	1	1	1	3	4
IPE A 400	133	158	1	1	2	4	4	4
IPE 400	116	137	1	1	1	3	4	4
IPE O 400	103	122	1	1	1	2	3	4
IPE A 450	127	149	1	1	2	4	4	4
IPE 450	110	130	1	1	1	3	4	4
IPE O 450	94	110	1	1	1	2	4	4
IPE A 500	118	138	1	1	1	4	4	4
IPE 500	104	121	1	1	1	3	4	4
IPE O 500	89	104	1	1	1	2	4	4
IPE A 550	111	129	1	1	2	4	4	4
IPE 550	97	113	1	1	1	4	4	4
IPE O 550	85	98	1	1	1	2	4	4
IPE A 600	103	119	1	1	2	4	4	4
IPE 600	91	105	1	1	1	4	4	4
IPE O 600	73	85	1	1	1	2	4	4
750 x 137	101	116	1	2	-	4	4	-
750 x 147	94	109	1	1	2	4	4	4
750 x 173	81	93	1	1	1	4	4	4
750 x 196	72	83	1	1	1	4	4	4

VALUES FOR SECTION FACTORS AND DUCTILITY CLASSES OF LAMINATED PROFILES

PROFILE			BENDING			COMPRESSION		
J	(m-1)	(m-1)	S235	S355	S460	S235	S355	S460
J 76 x 76 x 13	142	190	1	1		1	1	
J 76 x 76 x 15	123	166	1	1		1	1	
J 89 x 89 x 19	109	146	1	1		1	1	
J 102 x 44 x 7	263	311	1	1		1	1	
J 102 x 102 x 23	106	141	1	1		1	1	
J 114 x 114 x 27	101	135	1	1		1	1	
J 127 x 76 x 16	158	195	1	1		1	1	
J 127 x 114 x 27	109	143	1	1		1	1	
J 127 x 114 x 29	100	131	1	1		1	1	
J 152 x 127 x 37	92	119	1	1		1	1	
J 203 x 152 x 52	85	108	1	1		1	1	
J 254 x 114 x 37	133	157	1	1		1	1	
J 254 x 203 x 82	68	88	1	1		1	1	

PROFILE			BENDING			COMPRESSION		
MC	(m-1)	(m-1)	S235	S355	S460	S235	S355	S460
MC 150 x 17,9	161	189	1	1		1	1	
MC 150 x 22,5	132	158	1	1		1	1	
MC 150 x 22,8	135	165	1	1		1	1	
MC 150 x 24,3	123	147	1	1		1	1	
MC 150 x 26,8	115	141	1	1		1	1	
MC 180 x 28,4	122	146	1	1		1	1	
MC 180 x 33,8	104	125	1	1		1	1	
MC 200 x 12,6	282	311	1	1		2	4	
MC 200 x 27,8	136	157	1	1		1	1	
MC 200 x 29,8	127	147	1	1		1	1	
MC 200 x 31,8	122	143	1	1		1	1	
MC 200 x 33,9	115	135	1	1		1	1	
MC 230 x 35,6	120	139	1	1		1	1	
MC 230 x 37,8	113	132	1	1		1	1	
MC 250 x 12,5	342	365	1	1		4	4	
MC 250 x 33	141	161	1	1		1	1	
MC 250 x 37	126	144	1	1		1	1	
MC 250 x 42,4	113	131	1	1		1	1	
MC 250 x 50	96	113	1	1		1	1	
MC 250 x 61,2	79	93	1	1		1	1	
MC 310 x 15,8	322	341	1	1		4	4	
MC 310 x 46	121	137	1	1		1	1	
MC 310 x 52	107	121	1	1		1	1	
MC 310 x 60	93	106	1	1		1	1	
MC 310 x 67	83	95	1	1		1	1	
MC 310 x 74	76	87	1	1		1	1	
MC 330 x 47,3	126	143	1	1		1	1	
MC 330 x 52	115	131	1	1		1	1	
MC 330 x 60	101	115	1	1		1	1	
MC 330 x 74	82	94	1	1		1	1	
MC 460 x 63,5	125	138	1	1		1	3	
MC 460 x 68,2	117	129	1	1		1	2	
MC 460 x 77,2	104	114	1	1		1	1	
MC 460 x 86	93	103	1	1		1	1	

PROFILE			BENDING			COMPRESSION		
PFC	(m-1)	(m-1)	S235	S355	S460	S235	S355	S460
PFC 100x50x10	192	231	1	1		1	1	
PFC 125x65x15	168	202	1	1		1	1	
PFC 150x75x18	165	198	1	1		1	1	
PFC 150x90x24	128	158	1	1		1	1	
PFC 180x75x20	168	197	1	1		1	1	
PFC 180x90x26	136	163	1	1		1	1	
PFC 200x75x23	159	184	1	1		1	1	
PFC 200x90x30	129	153	1	1		1	1	
PFC 230x75x26	164	187	1	1		1	2	
PFC 230x90x32	134	156	1	1		1	1	
PFC 260x75x28	169	191	1	1		1	2	
PFC 260x90x35	137	158	1	1		1	1	
PFC 300x90x41	131	148	1	1		1	2	
PFC 300x100x46	121	138	1	1		1	1	
PFC 380x100x54	125	140	1	1		2	3	
PFC 430x100x64	117	129	1	1		1	3	

PROFILE			BENDING			COMPRESSION		
S	(m-1)	(m-1)	S235	S355	S460	S235	S355	S460
S 75 x 8,5	195	249	1	1		1	1	
S 75 x 11,2	151	196	1	1		1	1	
S 100 x 11,5	186	232	1	1		1	1	
S 100 x 14,1	153	193	1	1		1	1	
S 130 x 15	175	215	1	1		1	1	
S 150 x 18,6	165	201	1	1		1	1	
S 150 x 25,7	121	149	1	1		1	1	
S 200 x 27,4	146	175	1	1		1	1	
S 200 x 34	117	142	1	1		1	1	
S 250 x 37,8	130	155	1	1		1	1	
S 250 x 52	95	114	1	1		1	1	
S 310 x 47,3	122	143	1	1		1	2	
S 310 x 52	111	131	1	1		1	1	
S 310 x 60,7	96	113	1	1		1	1	
S 310 x 74	79	94	1	1		1	1	
S 380 x 64	111	128	1	1		1	3	
S 380 x 74	95	111	1	1		1	1	
S 460 x 81,4	103	117	1	1		2	3	
S 460 x 104	81	93	1	1		1	1	
S 510 x 98,2	94	107	1	1		2	3	
S 510 x 112	83	95	1	1		1	2	
S 510 x 128	74	85	1	1		1	1	
S 510 x 143	67	77	1	1		1	1	
S 610 x 119	92	104	1	1		4	4	
S 610 x 134	82	93	1	1		2	3	
S 610 x 149	74	84	1	1		1	2	
S 610 x 158	72	82	1	1		2	3	
S 610 x 180	63	72	1	1		1	1	

SECTION FACTOR VALUES AND DUCTILITY CLASSES FOR ROLLED SECTIONS

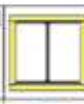
PROFILE			BENDING			COMPRESSION		
U	(m-1)	(m-1)	S235	S355	S460	S235	S355	S460
U 40 x 20	273	328	1	1		1	1	
U 50 x 25	254	305	1	1		1	1	
U 60 x 30	232	279	1	1		1	1	
U 65 x 42	190	237	1	1		1	1	

PROFILE			BENDING			COMPRESSION		
UB	(m-1)	(m-1)	S235	S355	S460	S235	S355	S460
UB 127 x 76 x 13	200	246	1	1	-	1	1	-
UB 152 x 89 x 16	194	237	1	1	-	1	2	-
UB 178 x 102 x 19	188	230	1	1	1	1	2	4
UB 203 x 102 x 23	173	207	1	1	1	1	3	4
UB 203 x 133 x 25	169	210	1	2	3	1	2	4
UB 203 x 133 x 30	143	178	1	1	1	1	2	2
UB 254 x 102 x 22	218	254	1	1	-	3	4	-
UB 254 x 102 x 25	192	224	1	1	-	2	4	-
UB 254 x 102 x 28	173	201	1	1	-	2	4	-
UB 254 x 146 x 31	164	200	1	2	-	2	4	-
UB 254 x 146 x 37	140	171	1	1	-	2	4	-
UB 254 x 146 x 43	122	149	1	1	-	1	2	-
UB 305 x 102 x 25	225	257	1	1	-	4	4	-
UB 305 x 102 x 28	200	229	1	1	-	4	4	-
UB 305 x 102 x 33	174	198	1	1	-	3	4	-
UB 305 x 127 x 37	155	181	1	1	-	2	4	-
UB 305 x 127 x 42	138	162	1	1	-	2	3	-
UB 305 x 127 x 48	122	143	1	1	-	1	2	-
UB 305 x 165 x 40	150	183	1	1	-	4	4	-
UB 305 x 165 x 46	133	161	1	1	-	3	4	-
UB 305 x 165 x 54	115	139	1	1	-	2	3	-
UB 356 x 127 x 33	195	225	1	1	-	4	4	-
UB 356 x 127 x 39	167	193	1	1	-	4	4	-
UB 356 x 171 x 45	152	182	1	2	-	4	4	-
UB 356 x 171 x 51	136	162	1	1	-	4	4	-
UB 356 x 171 x 57	122	146	1	1	-	3	4	-
UB 356 x 171 x 67	105	126	1	1	-	2	4	-
UB 406 x 140 x 39	189	217	1	2	-	4	4	-
UB 406 x 140 x 46	162	186	1	1	-	4	4	-
UB 406 x 178 x 54	143	168	1	2	3	4	4	4
UB 406 x 178 x 60	129	153	1	1	1	4	4	4
UB 406 x 178 x 67	117	138	1	1	1	3	4	4
UB 406 x 178 x 74	106	125	1	1	1	2	4	4
UB 457 x 152 x 52	158	181	1	1	2	4	4	4
UB 457 x 152 x 60	139	159	1	1	1	4	4	4
UB 457 x 152 x 67	125	143	1	1	1	4	4	4
UB 457 x 152 x 74	114	130	1	1	1	4	4	4
UB 457 x 152 x 82	104	119	1	1	1	3	4	4
UB 457 x 191 x 67	128	150	1	1	2	4	4	4
UB 457 x 191 x 74	117	137	1	1	1	4	4	4
UB 457 x 191 x 82	106	125	1	1	1	3	4	4
UB 457 x 191 x 89	98	115	1	1	1	3	4	4

PROFILE			BENDING			COMPRESSION		
UB	(m-1)	(m-1)	S235	S355	S460	S235	S355	S460
UB 457 x 191 x 98	90	105	1	1	1	2	4	4
UB 533 x 210 x 82	121	141	1	1	3	4	4	4
UB 533 x 210 x 92	109	126	1	1	1	4	4	4
UB 533 x 210 x101	100	116	1	1	1	4	4	4
UB 533 x210 x109	93	108	1	1	1	3	4	4
UB 533 x 210 x122	84	97	1	1	1	2	4	4
UB 610 x 229 x101	111	129	1	1	2	4	4	4
UB 610 x 229 x113	100	116	1	1	1	4	4	4
UB 610 x 229 x125	91	106	1	1	1	4	4	4
UB 610 x 229 x140	82	95	1	1	1	3	4	4
UB 610 x 305 x149	80	97	1	1	2	4	4	4
UB 610 x 305 x179	68	81	1	1	1	3	4	4
UB 610 x 305 x238	52	62	1	1	1	1	2	3
UB 686 x 254 x125	101	117	1	1	2	4	4	4
UB 686 x 254 x140	91	105	1	1	1	4	4	4
UB 686 x 254 x152	84	97	1	1	1	4	4	4
UB 686 x 254 x170	76	88	1	1	1	4	4	4
UB 762 x 267 x147	95	109	1	1	2	4	4	4
UB 762 x 267 x173	81	93	1	1	1	4	4	4
UB 762 x 267 x197	72	83	1	1	1	4	4	4
UB 838 x 292 x176	88	101	1	1	2	4	4	4
UB 838 x 292 x194	80	92	1	1	2	4	4	4
UB 838 x 292 x226	69	79	1	1	1	4	4	4
UB 914 x 305 x201	82	94	1	1	-	4	4	-
UB 914 x 305 x224	74	85	1	1	2	4	4	4
UB 914 x 305 x253	66	76	1	1	1	4	4	4
UB 914 x 305 x289	59	67	1	1	1	4	4	4
UB 914 x 419 x343	51	61	1	1	1	3	4	4
UB 914 x 419 x388	46	54	1	1	1	2	4	4
UB 1016 x 305 x222	79	90	1	1	-	4	4	-
UB 1016 x 305 x249	71	81	1	1	2	4	4	4
UB 1016 x 305 x272	66	74	1	1	2	4	4	4
UB 1016 x 305 x314	58	65	1	1	1	4	4	4
UB 1016 x 305 x349	52	59	1	1	1	3	4	4
UB 1016 x 305 x393	47	53	1	1	1	2	4	4
UB 1016 x 305 x415	44	50	1	1	1	2	3	4
UB 1016 x 305 x438	42	48	1	1	1	1	3	4
UB 1016 x 305 x494	38	43	1	1	1	1	2	3
UB 1016 x 305 x584	33	37	1	1	1	1	1	2

PROFILE			BENDING			COMPRESSION		
UBP	(m-1)	(m-1)	S235	S355	S460	S235	S355	S460
UBP 203x203x45	106	142	2	3	4	2	3	4
UBP 203x203x54	90	120	1	3	3	1	3	3
UBP 254x254x63	94	126	3	3	4	3	3	4
UBP 254x254x71	84	112	2	3	4	2	3	4
UBP 254x254x85	71	95	1	3	3	1	3	3
UBP 305x305x79	90	121	3	4	4	3	4	4
UBP 305x305x88	81	109	3	4	4	3	4	4

VALUES OF SECTION FACTORS AND DUCTILITY CLASSES OF ROLLED PROFILES

PROFILE			BENDING			COMPRESSION		
UBP	(m-1)	(m-1)	S235	S355	S460	S235	S355	S460
UBP 305x305x95	76	101	3	3	4	3	3	4
UBP 305x305x110	66	88	2	3	3	2	3	3
UBP 305x305x126	58	78	1	2	3	1	2	3
UBP 305x305x149	50	67	1	1	2	1	1	2
UBP 305x305x186	41	55	1	1	1	1	1	1
UBP 305x305x223	35	47	1	1	1	1	1	1
UBP 356x368x109	77	103	3	4	4	3	4	4
UBP 356x368x133	64	86	3	3	4	3	3	4
UBP 356x368x152	56	76	2	3	3	2	3	3
UBP 356x368x174	50	67	1	3	3	1	3	3

PROFILE			BENDING			COMPRESSION		
UC	(m-1)	(m-1)	S235	S355	S460	S235	S355	S460
UC 152 x 152 x 23	156	208	3	3	4	3	3	4
UC 152 x 152 x 30	122	162	1	1	3	1	1	3
UC 152 x 152 x 37	101	134	1	1	1	1	1	1
UC 203 x 203 x 46	104	139	1	3	3	1	3	3
UC 203 x 203 x 52	93	124	1	2	3	1	2	3
UC 203 x 203 x 60	82	109	1	1	2	1	1	2
UC 203 x 203 x 71	71	93	1	1	1	1	1	1
UC 203 x 203 x 86	60	79	1	1	1	1	1	1
UC 254 x 254 x 73	82	109	1	3	3	1	3	3
UC 254 x 254 x 89	69	91	1	1	2	1	1	2
UC 254 x 254 x 107	58	77	1	1	1	1	1	1
UC 254 x 254 x 132	48	64	1	1	1	1	1	1
UC 254 x 254 x 167	40	52	1	1	1	1	1	1
UC 305 x 305 x 97	75	99	1	3	3	1	3	3
UC 305 x 305 x 118	62	83	1	2	3	1	2	3
UC 305 x 305 x 137	54	72	1	1	1	1	1	1
UC 305 x 305 x 158	48	63	1	1	1	1	1	1
UC 305 x 305 x 198	39	52	1	1	1	1	1	1
UC 305 x 305 x 240	33	44	1	1	1	1	1	1
UC 305 x 305 x 283	29	38	1	1	1	1	1	1
UC 356 x 368 x 129	66	88	2	3	3	2	3	3
UC 356 x 368 x 153	56	75	1	2	3	1	2	3
UC 356 x 368 x 177	49	66	1	1	2	1	1	2
UC 356 x 368 x 202	44	58	1	1	1	1	1	1
UC 356 x 406 x 235	39	52	1	1	1	1	1	1
UC 356 x 406 x 287	32	43	1	1	1	1	1	1
UC 356 x 406 x 340	28	37	1	1	1	1	1	1
UC 356 x 406 x 393	25	33	1	1	1	1	1	1
UC 356 x 406 x 467	22	29	1	1	1	1	1	1
UC 356 x 406 x 551	19	25	1	1	1	1	1	1
UC 356 x 406 x 634	17	22	1	1	1	1	1	1

PROFILE			BENDING			COMPRESSION		
UPE	(m-1)	(m-1)	S235	S355	S460	S235	S355	S460
UPE 80	209	258	1	1		1	1	
UPE 100	204	248	1	1		1	1	
UPE 120	195	233	1	1		1	1	
UPE 140	187	223	1	1		1	1	
UPE 160	180	212	1	1		1	1	
UPE 180	173	203	1	1		1	1	
UPE 200	165	193	1	1		1	1	
UPE 220	155	180	1	1		1	1	
UPE 240	148	171	1	1		1	1	
UPE 270	142	163	1	1		1	2	
UPE 300	124	141	1	1		1	1	
UPE 330	113	128	1	1		1	1	
UPE 360	107	121	1	1		1	1	
UPE 400	100	112	1	1		1	1	

PROFILE			BENDING			COMPRESSION		
UPN	(m-1)	(m-1)	S235	S355	S460	S235	S355	S460
UPN 80	186	227	1	1		1	1	
UPN 100	185	222	1	1		1	1	
UPN 120	174	206	1	1		1	1	
UPN 140	167	196	1	1		1	1	
UPN 160	160	188	1	1		1	1	
UPN 180	154	179	1	1		1	1	
UPN 200	148	171	1	1		1	1	
UPN 220	139	160	1	1		1	1	
UPN 240	134	154	1	1		1	1	
UPN 260	126	145	1	1		1	1	
UPN 280	123	141	1	1		1	1	
UPN 300	119	136	1	1		1	1	
UPN 320	98	111	1	1		1	1	
UPN 350	103	116	1	1		1	1	
UPN 380	107	120	1	1		1	1	
UPN 400	99	111	1	1		1	1	

PROFILE			BENDING			COMPRESSION		
W	(m-1)	(m-1)	S235	S355	S460	S235	S355	S460
W 100 x 100 x 19.3	127	169	1	1	-	1	1	-
W 130 x 130 x 23.8	126	168	1	1	-	1	1	-
W 130 x 130 x 28.1	109	144	1	1	-	1	1	-
W 150 x 100 x 13.5	231	289	1	3	-	1	3	-
W 150 x 100 x 18.0	175	219	1	1	-	1	1	-
W 150 x 100 x 24.0	138	172	1	1	-	1	1	-
W 150 x 150 x 22.5	160	213	3	3	4	3	3	4
W 150 x 150 x 29.8	123	164	1	2	3	1	2	3
W 150 x 150 x 37.1	101	134	1	1	1	1	1	1

SECTION FACTORS AND DUCTILITY CLASSES FOR ROLLED PROFILES

PROFILE			BENDING			COMPRESSION		
W	(m-1)	(m-1)	S235	S355	S460	S235	S355	S460
W 200 x 100 x 15.0	261	313	1	3	-	3	4	-
W 200 x 100 x 19.3	204	245	1	1	-	1	2	-
W 200 x 100 x 22.5	179	215	1	1	-	1	2	-
W 200 x 135 x 26.6	161	200	1	1	3	1	2	4
W 200 x 135 x 31.3	139	172	1	1	1	1	2	2
W 200 x 165 x 35.9	124	160	1	1	3	1	1	3
W 200 x 165 x 41.7	108	140	1	1	1	1	1	1
W 200 x 200 x 46.1	104	139	1	3	3	1	3	3
W 200 x 200 x 52	93	123	1	1	3	1	1	3
W 200 x 200 x 59	83	110	1	1	2	1	1	2
W 200 x 200 x 71	70	93	1	1	1	1	1	1
W 200 x 200 x 86	59	78	1	1	1	1	1	1
W 200 x 200 x 100	53	69	1	1	1	1	1	1
W 250 x 100 x 17.9	264	308	1	3	-	4	4	-
W 250 x 100 x 22.3	213	248	1	1	-	3	4	-
W 250 x 100 x 25.3	190	222	1	1	-	2	4	-
W 250 x 100 x 28.4	172	200	1	1	-	2	4	-
W 250 x 145 x 32.7	159	194	1	1	-	2	4	-
W 250 x 145 x 38.5	136	166	1	1	-	2	3	-
W 250 x 145 x 44.8	119	144	1	1	-	1	2	-
W 250 x 200 x 49.1	111	144	1	3	-	1	3	-
W 250 x 200 x 58	95	123	1	1	-	1	1	-
W 250 x 200 x 67	84	108	1	1	-	1	1	-
W 250 x 250 x 73	82	109	1	2	3	1	2	3
W 250 x 250 x 80	75	100	1	2	3	1	2	3
W 250 x 250 x 89	68	90	1	1	2	1	1	2
W 250 x 250 x 101	61	81	1	1	1	1	1	1
W 250 x 250 x 115	55	72	1	1	1	1	1	1
W 250 x 250 x 131	49	64	1	1	1	1	1	1
W 250 x 250 x 149	44	57	1	1	1	1	1	1
W 250 x 250 x 167	40	52	1	1	1	1	1	1
W 310 x 100 x 21.0	263	301	1	2	-	4	4	-
W 310 x 100 x 23.8	234	267	1	1	-	4	4	-
W 310 x 100 x 28.3	200	228	1	1	-	4	4	-
W 310 x 100 x 32.7	174	198	1	1	-	3	4	-
W 310 x 165 x 38.7	158	192	1	2	-	4	4	-
W 310 x 165 x 44.5	139	168	1	1	-	3	4	-
W 310 x 165 x 52	120	145	1	1	-	2	4	-
W 310 x 200 x 60	107	133	1	1	-	1	3	-
W 310 x 200 x 67	96	120	1	1	-	1	2	-
W 310 x 200 x 74	87	109	1	1	-	1	1	-
W 310 x 250 x 79	86	111	1	2	-	1	2	-
W 310 x 250 x 86	79	103	1	1	-	1	2	-
W 310 x 310 x 97	75	99	1	3	3	1	3	3
W 310 x 310 x 107	68	91	1	3	3	1	3	3
W 310 x 310 x 117	62	83	1	2	3	1	2	3
W 310 x 310 x 129	57	76	1	1	2	1	1	2
W 310 x 310 x 143	52	69	1	1	1	1	1	1
W 310 x 310 x 158	48	64	1	1	1	1	1	1
W 310 x 310 x 179	43	57	1	1	1	1	1	1
W 310 x 310 x 202	39	51	1	1	1	1	1	1
W 310 x 310 x 226	35	46	1	1	1	1	1	1
W 310 x 310 x 253	32	42	1	1	1	1	1	1
W 310 x 310 x 283	29	38	1	1	1	1	1	1

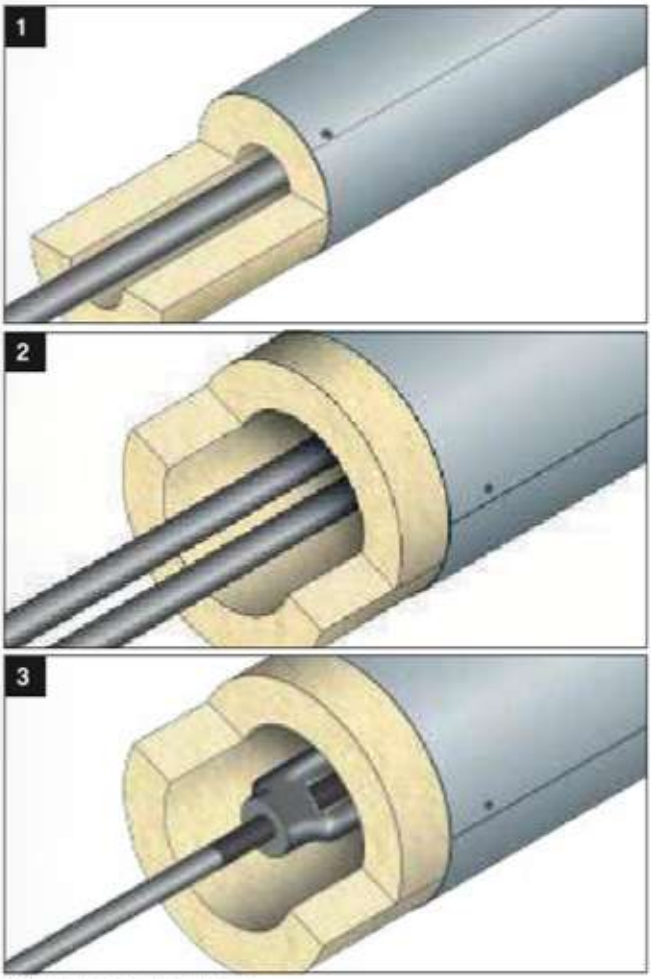
PROFILE			BENDING			COMPRESSION		
W	(m-1)	(m-1)	S235	S355	S460	S235	S355	S460
W 310 x 310 x 313	27	35	1	1	1	1	1	1
W 310 x 310 x 342	25	32	1	1	1	1	1	1
W 360 x 130 x 32.9	198	228	1	1	-	4	4	-
W 360 x 130 x 39.0	167	193	1	1	-	4	4	-
W 360 x 170 x 44	153	183	1	2	-	4	4	-
W 360 x 170 x 51	136	163	1	1	-	4	4	-
W 360 x 170 x 57.8	123	147	1	1	-	3	4	-
W 360 x 200 x 64	110	135	1	1	-	2	4	-
W 360 x 200 x 72	99	122	1	1	-	2	3	-
W 360 x 200 x 79+	90	111	1	1	-	1	2	-
W 360 x 250 x 91	83	105	1	1	-	1	2	-
W 360 x 250 x 101	75	95	1	1	-	1	2	-
W 360 x 250 x 110	70	88	1	1	-	1	1	-
W 360 x 250 x 122	63	80	1	1	-	1	1	-
W 360 x 370 x 134	63	85	2	3	3	2	3	3
W 360 x 370 x 147	58	78	1	3	3	1	3	3
W 360 x 370 x 162	53	71	1	2	3	1	2	3
W 360 x 370 x 179	49	65	1	1	2	1	1	2
W 360 x 370 x 196	45	60	1	1	1	1	1	1
W 360 x 410 x 216	42	56	1	1	1	1	1	1
W 360 x 410 x 237	38	52	1	1	1	1	1	1
W 360 x 410 x 262	35	47	1	1	1	1	1	1
W 360 x 410 x 287	32	43	1	1	1	1	1	1
W 360 x 410 x 314	30	40	1	1	1	1	1	1
W 360 x 410 x 347	28	37	1	1	1	1	1	1
W 360 x 410 x 382	25	34	1	1	1	1	1	1
W 360 x 410 x 421	23	31	1	1	1	1	1	1
W 360 x 410 x 463	22	29	1	1	1	1	1	1
W 360 x 410 x 509	20	27	1	1	1	1	1	1
W 360 x 410 x 551	19	25	1	1	1	1	1	1
W 360 x 410 x 592	18	23	1	1	1	1	1	1
W 360 x 410 x 634	17	22	1	1	1	1	1	1
W 360 x 410 x 677	16	21	1	1	1	1	1	1
W 360 x 410 x 744	15	20	1	1	1	1	1	1
W 360 x 410 x 818	14	18	1	1	1	1	1	1
W 360 x 410 x 900	13	17	1	1	1	1	1	1
W 360 x 410 x 990	12	16	1	1	1	1	1	1
W 360 x 410 x 1086	11	15	1	1	1	1	1	1
W 410 x 140 x 38.8	189	217	1	1	-	4	4	-
W 410 x 140 x 46.1	161	185	1	1	-	4	4	-
W 410 x 180 x 53	145	171	1	1	3	4	4	4
W 410 x 180 x 60	131	154	1	1	1	4	4	4
W 410 x 180 x 67	116	137	1	1	1	3	4	4
W 410 x 180 x 75	106	125	1	1	1	2	4	4
W 410 x 180 x 85	94	110	1	1	1	2	3	4
W 410 x 260 x 100	86	106	1	1	-	2	4	-
W 410 x 260 x 114	76	93	1	1	-	1	3	-
W 410 x 260 x 132	66	82	1	1	-	1	2	-
W 410 x 260 x 149	59	73	1	1	-	1	1	-
W 460 x 150 x 52	159	182	1	1	2	4	4	4
W 460 x 150 x 60	140	160	1	1	1	4	4	4
W 460 x 150 x 68	123	141	1	1	1	4	4	4
W 460 x 190 x 74	117	137	1	1	1	4	4	4
W 460 x 190 x 82	106	125	1	1	1	3	4	4

SECTION FACTOR VALUES AND DUCTILITY CLASSES OF ROLLED PROFILES

PROFILE			BENDING			COMPRESSION		
W	(m-1)	(m-1)	S235	S355	S460	S235	S355	S460
W 460 x 190 x 89	98	115	1	1	1	3	4	4
W 460 x 190 x 97	91	107	1	1	1	2	4	4
W 460 x 190 x 106	84	99	1	1	1	1	3	4
W 460 x 280 x 113	84	103	1	1	-	2	4	-
W 460 x 280 x 128	74	92	1	1	-	2	3	-
W 460 x 280 x 144	67	82	1	1	-	1	2	-
W 460 x 280 x 158	62	76	1	1	-	1	2	-
W 460 x 280 x 177	55	68	1	1	-	1	1	-
W 460 x 280 x 193	51	63	1	1	-	1	1	-
W 460 x 280 x 213	47	58	1	1	-	1	1	-
W 460 x 280 x 235	43	53	1	1	-	1	1	-
W 460 x 280 x 260	39	48	1	1	-	1	1	-
W 530 x 165 x 66	145	165	1	1	-	4	4	-
W 530 x 165 x 74	128	146	1	1	-	4	4	-
W 530 x 165 x 85	115	130	1	1	-	4	4	-
W 530 x 210 x 92	108	126	1	1	-	4	4	-
W 530 x 210 x 101	99	115	1	1	-	4	4	-
W 530 x 210 x 109	93	108	1	1	-	3	4	-
W 530 x 210 x 123	83	96	1	1	-	2	4	-
W 530 x 210 x 138	74	87	1	1	-	1	3	-
W 530 x 315 x 150	73	89	1	1	-	2	4	-
W 530 x 315 x 165	67	82	1	1	-	2	3	-
W 530 x 315 x 182	61	75	1	1	-	1	3	-
W 530 x 315 x 196	57	69	1	1	-	1	2	-
W 530 x 315 x 219	52	63	1	1	-	1	1	-
W 530 x 315 x 248	46	56	1	1	-	1	1	-
W 530 x 315 x 272	42	52	1	1	-	1	1	-
W 530 x 315 x 300	39	47	1	1	-	1	1	-
W 610 x 180 x 82	132	149	1	1	-	4	4	-
W 610 x 180 x 92	118	133	1	1	-	4	4	-
W 610 x 230 x 101	110	128	1	1	-	4	4	-
W 610 x 230 x 113	100	116	1	1	-	4	4	-
W 610 x 230 x 125	91	105	1	1	1	4	4	4
W 610 x 230 x 140	82	95	1	1	1	3	4	4
W 610 x 230 x 153	75	87	1	1	1	3	4	4
W 610 x 325 x 155	78	95	1	2	3	4	4	4
W 610 x 325 x 174	70	85	1	1	2	3	4	4
W 610 x 325 x 195	63	76	1	1	1	2	4	4
W 610 x 325 x 217	57	69	1	1	1	2	3	4
W 610 x 325 x 241	53	64	1	1	1	1	3	4
W 610 x 325 x 262	48	58	1	1	1	1	2	3
W 610 x 325 x 285	45	54	1	1	1	1	1	2
W 610 x 325 x 341	38	46	1	1	1	1	1	1
W 610 x 325 x 415	32	38	1	1	1	1	1	1
W 610 x 325 x 455	30	36	1	1	1	1	1	1
W 610 x 325 x 498	27	33	1	1	1	1	1	1
W 610 x 325 x 551	25	30	1	1	1	1	1	1
W 690 x 250 x 125	101	116	1	1	-	4	4	-
W 690 x 250 x 140	91	105	1	1	-	4	4	-
W 690 x 250 x 152	84	97	1	1	1	4	4	4
W 690 x 250 x 170	76	88	1	1	1	4	4	4
W 690 x 250 x 192	68	78	1	1	1	3	4	4
W 760 x 265 x 147	94	109	1	1	-	4	4	-
W 760 x 265 x 161	87	100	1	1	1	4	4	4

PROFILE			BENDING			COMPRESSION		
W	(m-1)	(m-1)	S235	S355	S460	S235	S355	S460
W 760 x 265 x 173	81	93	1	1	1	4	4	4
W 760 x 265 x 185	76	88	1	1	1	4	4	4
W 760 x 265 x 196	72	83	1	1	1	4	4	4
W 760 x 265 x 220	65	74	1	1	1	3	4	4
W 840 x 295 x 176	88	101	1	1	-	4	4	-
W 840 x 295 x 193	80	92	1	1	2	4	4	4
W 840 x 295 x 210	74	85	1	1	1	4	4	4
W 840 x 295 x 226	69	79	1	1	1	4	4	4
W 840 x 295 x 251	63	72	1	1	1	4	4	4
W 920 x 310 x 201	82	94	1	1	-	4	4	-
W 920 x 310 x 223	74	85	1	1	2	4	4	4
W 920 x 310 x 238	70	80	1	1	1	4	4	4
W 920 x 310 x 253	66	76	1	1	1	4	4	4
W 920 x 310 x 271	62	71	1	1	1	4	4	4
W 920 x 310 x 289	59	67	1	1	1	4	4	4
W 920 x 310 x 313	55	62	1	1	1	3	4	4
W 920 x 420 x 345	52	62	1	1	1	4	4	4
W 920 x 420 x 368	49	58	1	1	1	3	4	4
W 920 x 420 x 390	46	55	1	1	1	3	4	4
W 920 x 420 x 420	43	51	1	1	1	2	4	4
W 920 x 420 x 449	41	48	1	1	1	2	4	4
W 920 x 420 x 491	37	44	1	1	1	1	3	4
W 920 x 420 x 537	35	41	1	1	1	1	2	3
W 920 x 420 x 588	32	37	1	1	1	1	1	2
W 920 x 420 x 656	29	34	1	1	1	1	1	2
W 920 x 420 x 725	26	31	1	1	1	1	1	1
W 920 x 420 x 787	25	29	1	1	1	1	1	1
W 920 x 420 x 970	20	24	1	1	1	1	1	1
W 1000 x 300 x 222	79	90	1	1	-	4	4	-
W 1000 x 300 x 249	71	81	1	1	2	4	4	4
W 1000 x 300 x 272	66	74	1	1	2	4	4	4
W 1000 x 300 x 314	57	65	1	1	1	4	4	4
W 1000 x 300 x 350	52	59	1	1	1	3	4	4
W 1000 x 300 x 393	47	53	1	1	1	2	4	4
W 1000 x 300 x 415	44	50	1	1	1	2	3	4
W 1000 x 300 x 438	42	48	1	1	1	1	3	4
W 1000 x 300 x 494	38	43	1	1	1	1	2	3
W 1000 x 300 x 584	33	37	1	1	1	1	1	2
W 1000 x 400 x 296	63	73	1	1	2	4	4	4
W 1000 x 400 x 321	58	68	1	1	2	4	4	4
W 1000 x 400 x 371	51	59	1	1	1	4	4	4
W 1000 x 400 x 412	46	54	1	1	1	3	4	4
W 1000 x 400 x 443	43	50	1	1	1	2	4	4
W 1000 x 400 x 483	40	46	1	1	1	2	4	4
W 1000 x 400 x 539	36	42	1	1	1	1	2	4
W 1000 x 400 x 554	35	41	1	1	1	1	2	3
W 1000 x 400 x 591	33	38	1	1	1	1	2	3
W 1000 x 400 x 642	31	36	1	1	1	1	1	2
W 1000 x 400 x 748	27	31	1	1	1	1	1	1
W 1000 x 400 x 883	23	27	1	1	-	1	1	-
W 1100 x 400 x 343	59	68	1	1	2	4	4	4
W 1100 x 400 x 390	52	60	1	1	1	4	4	4
W 1100 x 400 x 433	47	55	1	1	1	4	4	4
W 1100 x 400 x 499	42	48	1	1	1	2	4	4

REFRACTORY CERAMIC FIBER SHELLS "T-REX / C 25"



FIRE REACTION: A1
FIRE RESISTANCE: R120

- **Support: steel bars Ø 16 mm up to max Ø 35 mm**
- **Protective Covering: "T-REX / C 25" shells**
- **Fastening: with 4.2 x 13 mm self-drilling screws, every 200 mm**
- **Finish: finished product**

NOTE: You can hang loads such as lighting fixtures and accessories up to a maximum of 5 kg with a suspension spacing of 1.5 meters.

1 - Tensioner cover shell
2 - MAXI tensioner cover shell
3 - Tensioner cover

***Test reports with evaluation of the critical temperature on the rod according to Eurocode 3 class 4 profiles (T≤ 350°C).**

Test Report: I.G. 355341 - 5/10/2018
Evaluation Report: CP-T REX - 10/2018 Test
Standard: EN 1363-1*

SPECIFICATION DESCRIPTION

Supply and installation of fire-resistant protection for steel rods with certified R 30/120 fire resistance on bars with a diameter from 16 to 30 mm (*). The protection will be made with "T-REX / C 25" shells, consisting of a refractory ceramic fiber mix, covered with a 0.25 mm thick galvanized steel sheet, in accordance with test report I.G. 355341.

The shells will be attached using phosphated self-drilling screws every 200 mm.

The supply includes special tensioner covers "T-REX / C 25". For installation instructions, refer to the installation manual. NOTE: (*) extensions are available for larger diameters.

APPLICATION
Insert the insulating element of the shells onto the rod.
Tighten the metal shell and screw the self-drilling screws every 200 mm into the pre-drilled holes. Continue with a slight overlap of the metal shell with the previous shell.

When support hangers for the rods are present, cut the metal sheet and notch the insulating element, sealing any slots with the same material.

NOTE: The shells and metal sheet covering are supplied separately.

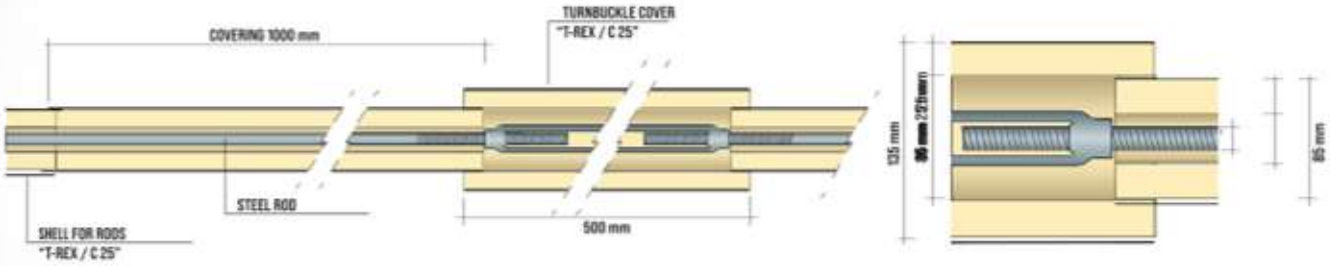
PACKAGING
In cardboard boxes.

STORAGE
Store in a dry place and protected from rain.

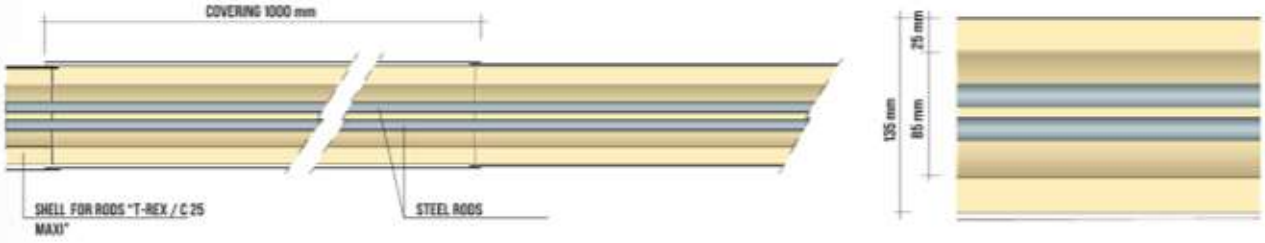
SAFETY INSTRUCTIONS
Consult the safety data sheet before use.

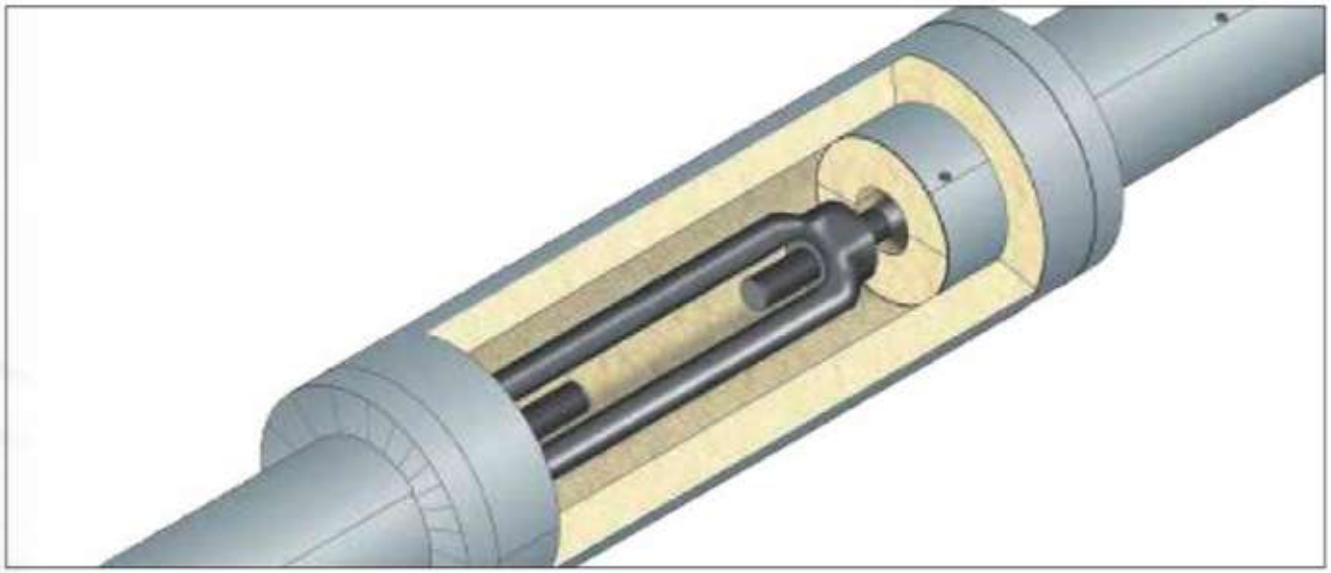
TECHNICAL SHEET		Shell		Tensioner cover
		C 25	C 25 MAXI	C 25
Internal Diameter		35 mm	85 mm	85 mm
External Diameter		85 mm	135 mm	135 mm
Thickness		25 mm		25 mm
Length		1000 mm		500 mm
Coating Length		1000 mm		500 mm
Weight		1.3 kg/m	2.6 kg/m	1.3 kg/pc
Density		> 128 kg/m³		> 128 kg/m³
Thermal Conductivity	200°C	0.088		0.088
	800°C	0.156		0.156
	1000°C	0.198		0.198
pH		9		9
Color		white		white
Odorless		yes		yes
Finish		galvanized sheet		galvanized sheet

Caps for rods up to 35 mm diameter



MAXI Caps for rods up to 35 mm diameter and for double rods

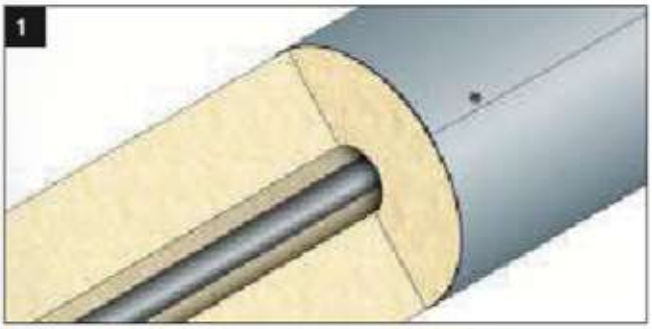


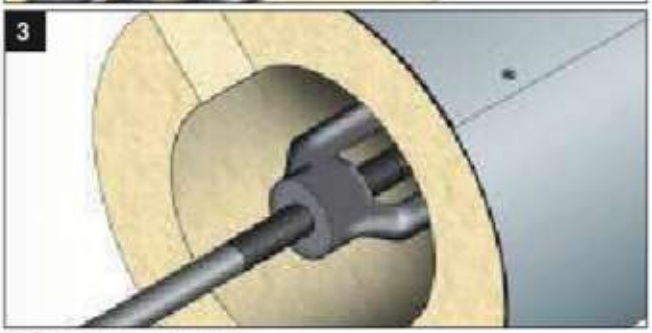


ROD LENGTHENING BASED ON CRITICAL TEMPERATURE

"T-REX / C 25"	CRITICAL TEMPERATURE (°C) INSIDE THE SHELL				
	350	400	450	500	550
Elongation (mm/m)	4.45	5.20	5.97	6.76	7.57
Fire resistance	R 120	R 120	R 120	R 120	R 120

CERAMIC FIBER SHELLS "T-REX / C 50"





FIRE REACTION: A1
FIRE RESISTANCE: R180

- **Support: steel bars Ø 16 mm up to max Ø 35 mm**
- **Protective covering: "T-REX / C 50" shells**
- **Fastening: with self-drilling screws 4.2 x 13 mm, at 200 mm centres**
- **Finish: finished product**

NOTE: It is possible to hang loads such as lighting fixtures and accessories up to a maximum of 5 kg per 1.5-meter suspension spacing.

1 - Tension rod cover
2 - Tensioner cover (for tensioners with a diameter less than 40 mm)
3 - Tensioner cover (for tensioners with a diameter greater than 40 mm)

*** Test reports with critical temperature evaluation on the rod according to Eurocode 3 profiles of class 4 (T≤ 350°C).**

Test Report: I.G. 355341 - 5/10/2018 Evaluation Report: CP-T REX - 10/2018 Test Standard: EN 1363-1*

Specification Description

Supply and installation of fire protection for steel rods with certified fire resistance R 30/180 on bars with diameters from 16 to 30 mm (*). The protection will be made with "T-REX / C 50" shells composed of a refractory ceramic fiber mixture, which will be coated with galvanized steel sheet, 0.25 mm thick, in compliance with test report I.G. 355341.

The shells will be secured with phosphate self-drilling screws, at 200 mm centres.

The supply includes special tension rod covers "T-REX / C 50". For installation methods, refer to the specific installation manual. NOTE: (*) extensions for larger diameters are possible.

APPLICATION

Insert the insulating element of the shells onto the rod.

Tighten the metal shell and screw in the self-drilling screws, at 200 mm centres, into the prepared holes. Continue by slightly overlapping the metal shell with the previous shell.

In the presence of the rod support hangers, cut the sheet and score the insulating element, filling any gaps with the same material.

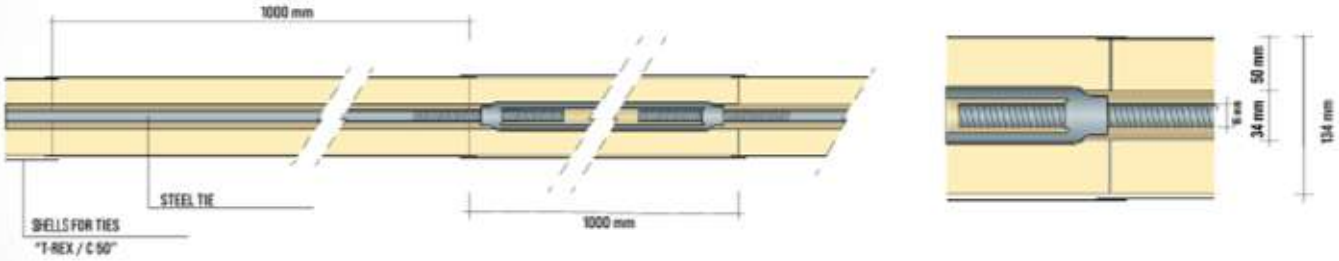
NOTE: The capsules and the sheet coating are supplied separately.

PACKAGING
In cardboard boxes.

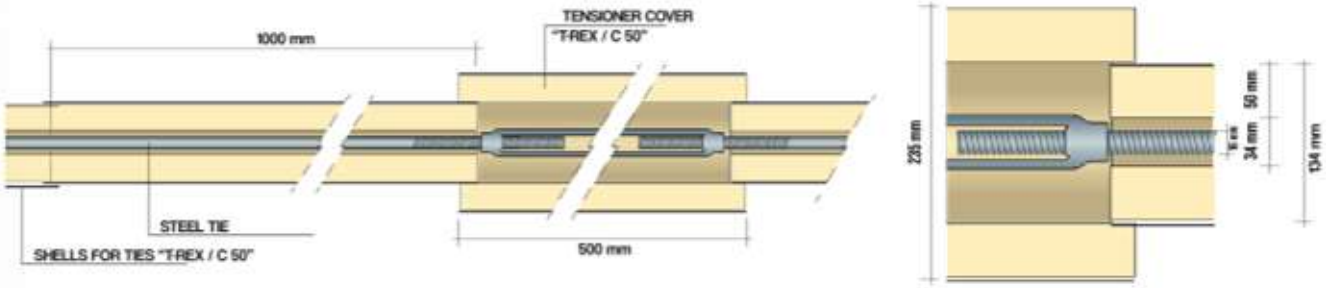
STORAGE
Store in a dry place and away from rain.

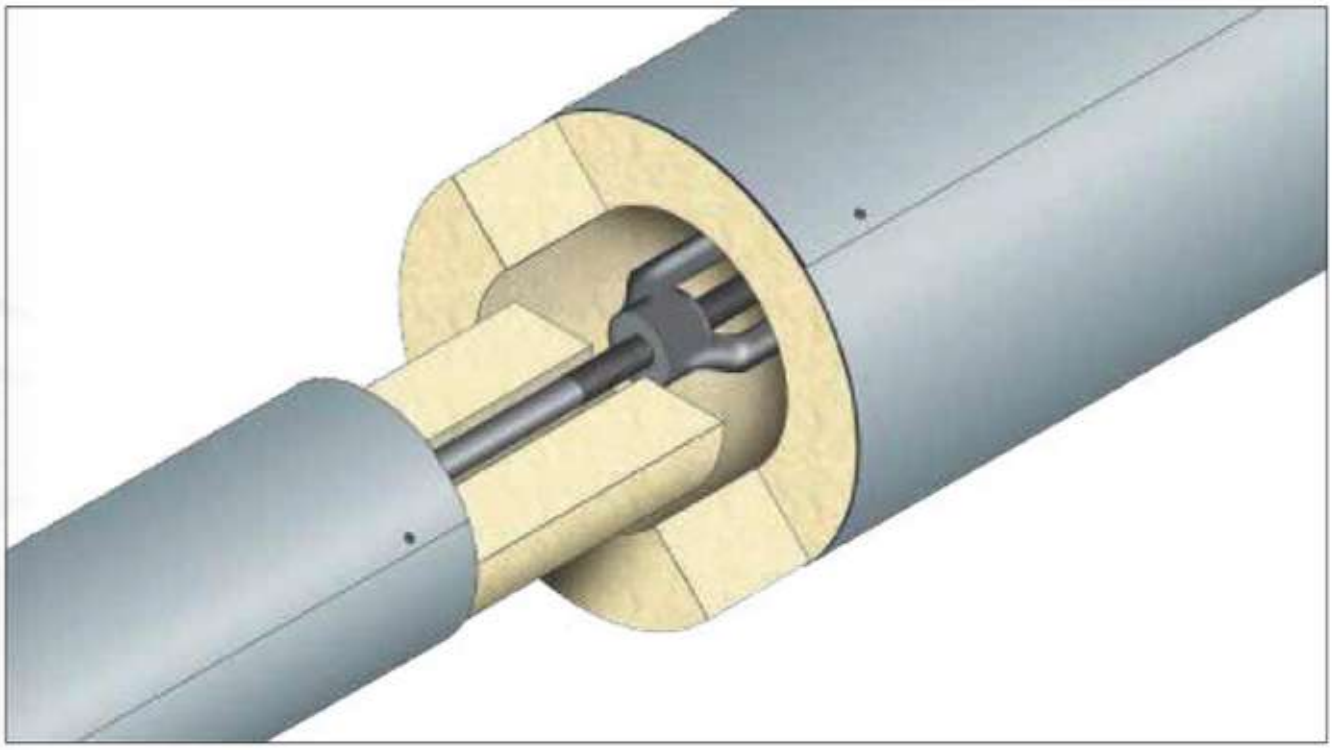
TECHNICAL SHEET		Shell C 50	Tensioner Cover C 50
Internal Diameter		34 mm	135 mm
External Diameter		134 mm	235 mm
Thickness		50 mm	50 mm
Length		1000 mm	500 mm
Coating Length		1000 mm	500 mm
Weight		2.26 kg/m	2.68 kg/pc
Density		> 128 kg/m³	> 128 kg/m³
Thermal Conductivity	200°C	0.088	0.088
	800°C	0.156	0.156
	1000°C	0.198	0.198
Ph		9	9
Color		white	white
Odorless		yes	yes
Finish		galvanized sheet metal	galvanized sheet metal

Shells for ties with tensioner covers up to Ø 40 mm



Shells for ties with tensioner covers larger than Ø 40 mm



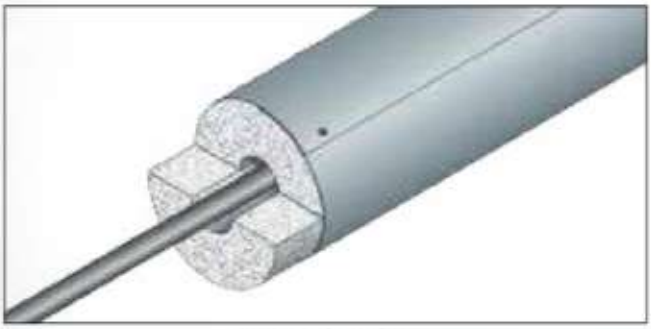


The summary table shows the tie elongations based on the critical temperature and fire resistance ratings provided by the "T-REX / C 50" shells.

TIE ELONGATION BASED ON CRITICAL TEMPERATURE

"T-REX / C 50"	CRITICAL TEMPERATURE (°C) INSIDE SHELL				
	350	400	450	500	550
Elongation (mm/m)	4.45	5.20	5.97	6.76	7.57
Fire resistance	R 180	R 180	R 180	R 180	R 180

CALCIUM SILICATE SHELLS "T-REX / S 38"



FIRE REACTION: A1
FIRE RESISTANCE: R120

- **Support: steel bars Ø 16 mm up to max Ø 35 mm**
- **Protective Covering: shell for tie rods "T-REX / S 38"**
- **Fastening: with self-tapping screws 4.2 x 13 mm, ab 200 mm centres**
- **Finish: finished product**

NOTE: it is possible to hang loads such as lighting fixtures and accessories up to a maximum of 5 kg per suspension spacing of 1.5 meters.

***Test reports with evaluation of critical temperature on the tie rod according to Eurocode 3 class 4 profiles (T≤ 350°C).**

Test report: LG. 355341 - 5/10/2018 Evaluation report: CP-T REX - 10/2018 Test standard: EN 1363-1*

SPECIFICATION DESCRIPTION

Supply and installation of fire-resistant steel tie rod protection R 30/120 certified on bars with diameters from 16 to 30 mm (*). The protection will be made with "T-REX / S 38" shells consisting of a calcium silicate-based mixture coated with galvanized steel sheet 0.25 mm thick, in accordance with test report LG. 355341. The shells will be applied with staggered joints and wrapped with sheet metal secured with phosphate-coated self-tapping screws at 200 mm centres. The supply will include appropriate tensioner covers "T-REX / S 38". For application methods, refer to the installation manual. NOTE: (*) extensions are possible for larger diameters.

APPLICATION

Slightly open the covering sheet and insert the two half-shells with staggered joints (>10 cm).
Tighten the metal casing and drive the self-tapping screws at 200 mm centres into the pre-drilled holes. Continue in sequence, maintaining the stagger of the half-shells and ensuring a slight overlap of the metal casing with the previous shell.

PACKAGING

In cardboard boxes.

STORAGE

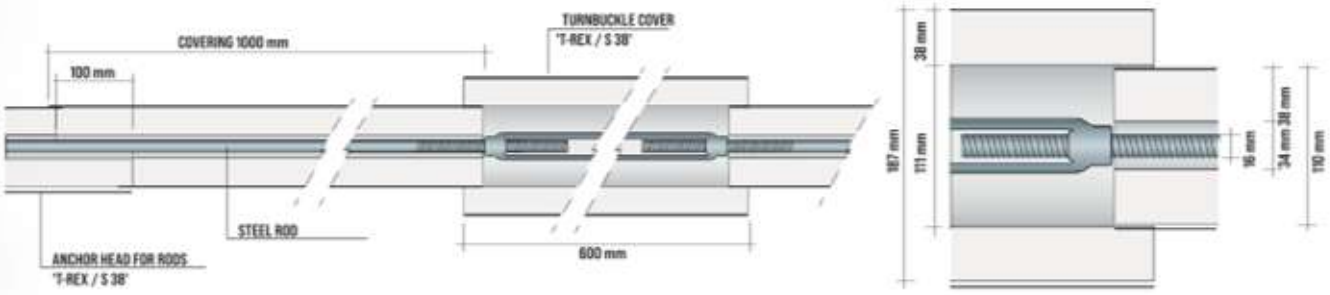
Store in a dry place and protect from rain.

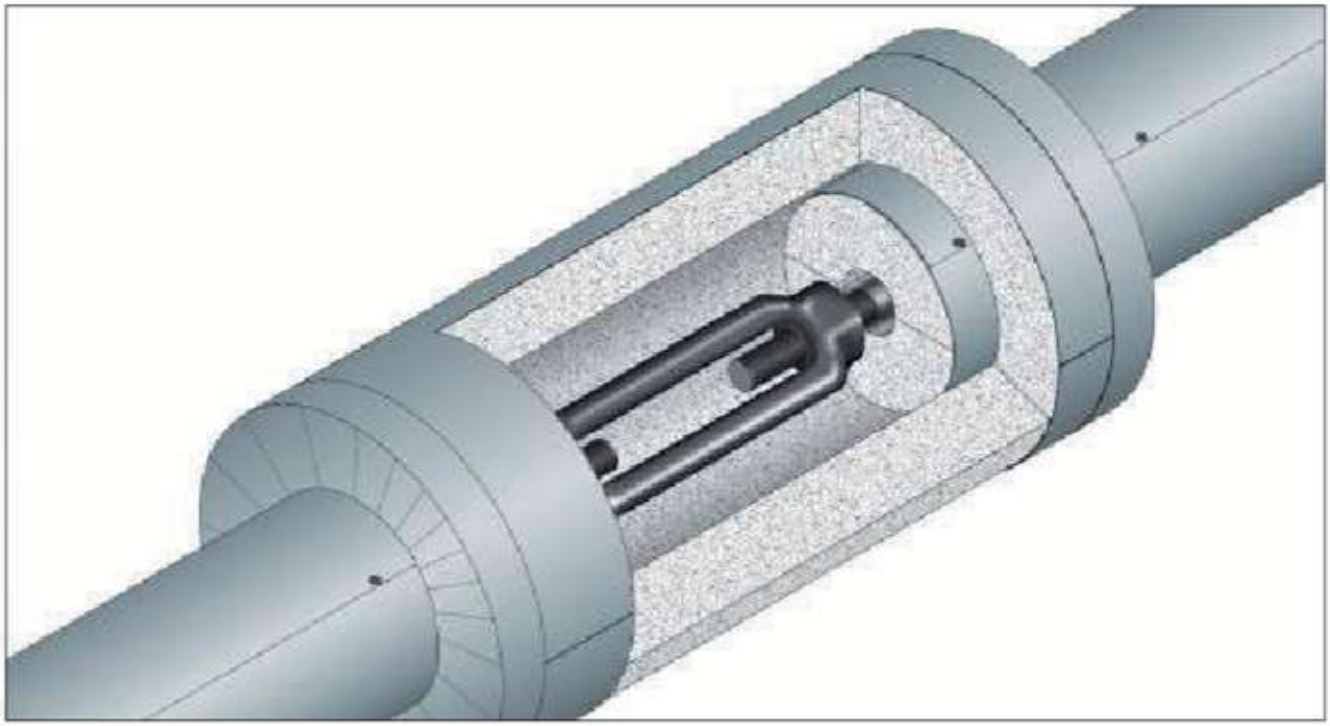
SAFETY INSTRUCTIONS

Consult the safety data sheet before use.

TECHNICAL DATA SHEET		Shell S 38	Tensioner Cover S 38
Internal Diameter		34 mm	111 mm
External Diameter		110 mm	187 mm
Thickness		38 mm	38 mm
Length		600 mm	600 mm
Coating Length		1000 mm	600 mm
Weight		3.10 kg/m	3.30 kg/pc
Density		350 kg/m^3 ± 15%	350 kg/m^3 ± 15%
Linear Thermal Expansion		5.8 x 10-6 m/mk	5.8 x 10-6 m/mk
Specific Heat		0.78 kJ/kg•k	0.78 kJ/kg•k
Thermal Conductivity	200°C	0.065	0.065
	400°C	0.120	0.120
	600°C	0.150	0.150
	800°C	0.180	0.180
Insoluble in Water		yes	yes
pH		9	9
Color		white	white
Odorless		yes	yes
Finish		galvanized sheet	galvanized sheet

Anchor heads with turnbuckle covers up to Ø 187 mm





ROD EXTENSION BASED ON CRITICAL TEMPERATURE

'T-REX / S 38'	CRITICAL TEMPERATURE (°C) INSIDE ANCHOR HEAD				
	350	400	450	500	550
Extension (mm/m)	4.45	5.20	5.97	6.76	7.57
Fire Resistance	R 120	R 120	R 120	R 120	R 120

CALCIUM SILICATE AND ROCK WOOL SLEEVES "T-REX 381-120"

FIRE REACTION: A1
FIRE RESISTANCE: R120

- **Support: steel bars diameter greater than 15 mm**
- **Protective covering: sleeve for tie rods "T-REX 381-120" thickness 55 mm**
- **Fastening: with self-tapping screws 4.2 x 13 mm, ab 200 mm centres**
- **Finish: galvanized sheet (included)**

PATENTED

Evaluation report: I.G. 403686 Test standard: EN 13381-10

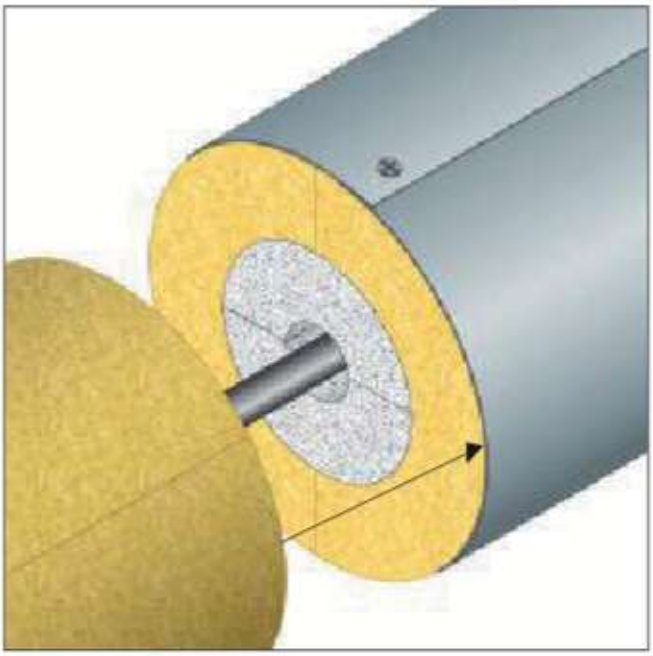
SPECIFICATIONS DESCRIPTION

Supply and installation of steel tie rod protection with certified fire resistance R 120 on bars with a diameter greater than 15 mm. The protection will be made with "T-REX 381-120" sleeves featuring a double protective layer coated with galvanized steel sheet 0.25 mm thick, in accordance with evaluation report I.G. 403686.

The sleeves will be applied with staggered joints and wrapped with sheet metal secured by phosphate-coated self-tapping screws at 200 mm centres. The supply will include special tensioner covers "T-REX 381-120". Refer to the specific "installation manual" for application methods.

DESCRIPTION

The "T-REX 381-120" sleeves are made up of a double layer of different materials suitable for the fire protection of metal tie rods. They consist of an inner shell of calcium silicate 25 mm thick and an outer shell of Rockwool 30 mm thick, covered with galvanized sheet metal 0.25 mm thick, and 1000 mm in length. The tensioner protection is made with a similar element 600 mm in length, called a tensioner cover.



The tensioner cover must overlap the calcium silicate layer by at least 50 mm on both sides of the sleeves involved, depending on the critical temperature and the length of the tie rod.

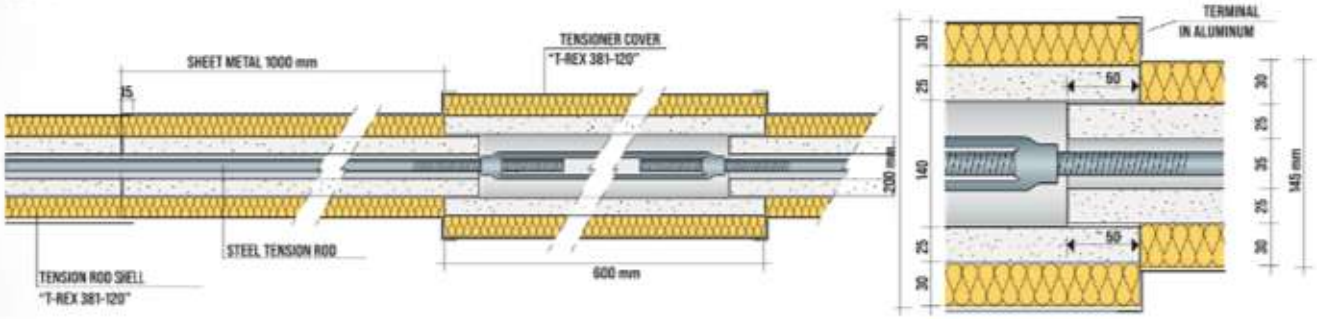
The insulating material and galvanized sheet coating are provided separately to facilitate installation. The galvanized steel sheet will be fastened with self-tapping screws, with an overlap of about 15 mm. The sleeves will be placed next to each other with the sheet overlapping by 15 mm. "T-REX 381-120" sleeves prevent the temperature of the steel tie rod from rising above 350°C, allowing them to be used under any load condition.

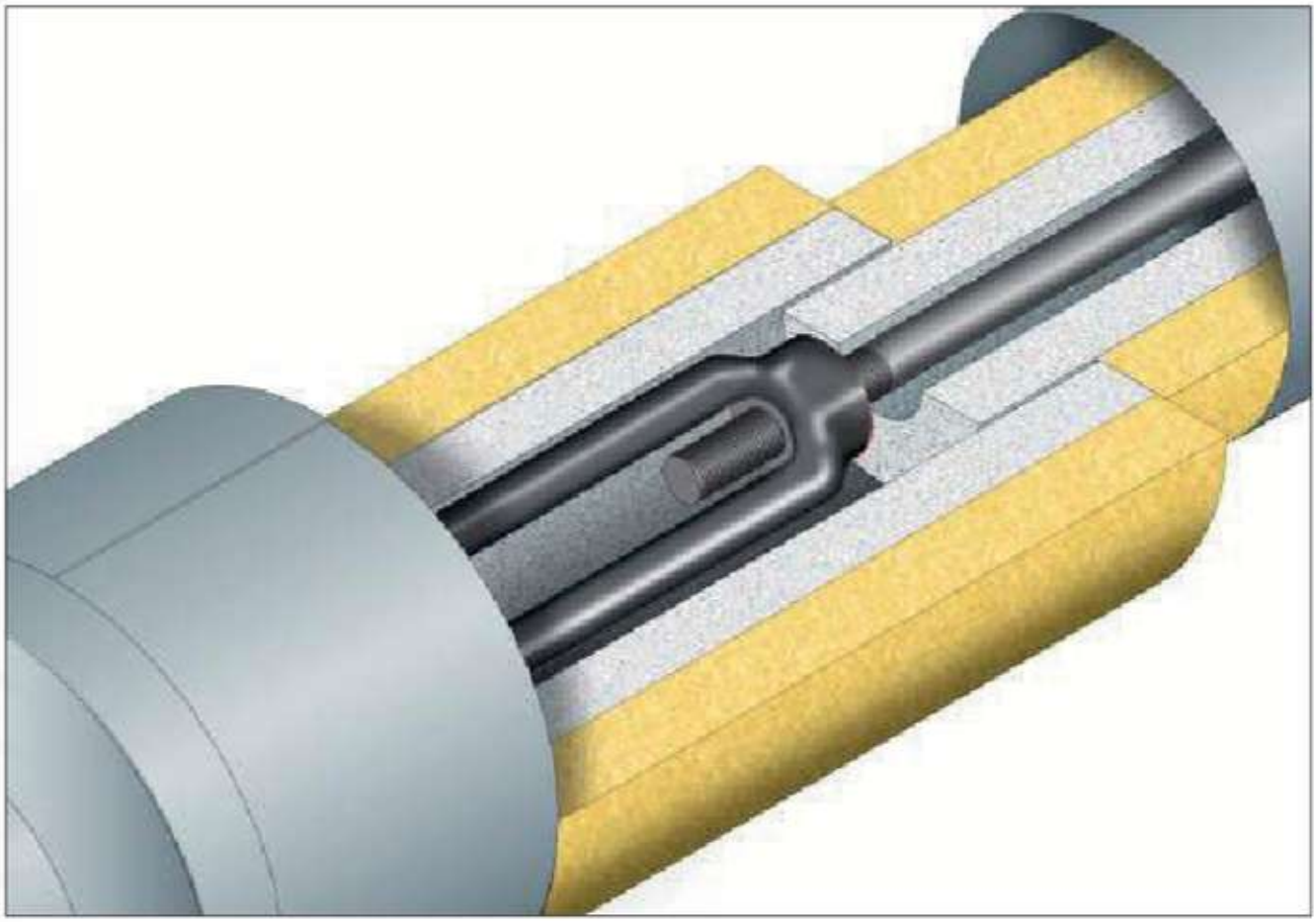
Below is the summary table with the elongations of the tie rod based on the critical temperature and fire resistance classifications provided by the "T-REX 381-120" sleeves.

EXTENSION OF TIE ROD BASED ON CRITICAL TEMPERATURE

"T-REX 381-120"	CRITICAL TEMPERATURE (°C) INSIDE SLEEVE				
	350	400	450	500	550
Elongation (mm/m)	4.45	5.20	5.97	6.76	7.57
Fire resistance	R 120	R 120	R 120	R 120	R 120

Shells for tension rods with tensioner covers





APPLICATION
Gently expand the cylindrical Rockwool shell to allow the metal rod to pass through it. Wrap the shell with galvanized steel sheeting, ensuring the edges overlap by at least 15 mm. Secure it with self-tapping screws at 200 mm centres in the designated holes. Finally, wrap the metal rod with two calcium silicate half-shells and push them inside the cylinder protected by the metal sheeting. Continue assembling the subsequent caps, ensuring the metal shell overlaps the previous cap's shell by at least 15 mm.

PACKAGING
In cardboard boxes.

STORAGE
Keep in a dry place and away from rain.

SAFETY INSTRUCTIONS
Consult the safety data sheet before use.

TECHNICAL DATA SHEET		
	Cap	**Tensioner Cover**
Internal Diameter	35 mm	90 mm
External Diameter	150 mm	200 mm
Thickness	25+30 mm	25+30 mm
Length	1200 mm	600 mm
Coating Length	1000 mm	600 mm
Weight	3.30 kg/m	3.34 kg/piece
Linear Thermal Variation	$5,8 \times 10^{-6}$ m/mk	$5,8 \times 10^{-6}$ m/mk
Insoluble in water	yes	yes
Odorless	yes	yes
Finish	galvanized sheet	galvanized sheet

CALCIUM SILICATE AND REFRACTORY CERAMIC FIBER SLEEVES "T-REX 381-180"

FIRE REACTION: A1
FIRE RESISTANCE: R180

- **Support: steel bars over 15 mm diameter**
- **Protective Covering: tie rod sleeve "T-REX 381-180" 55 mm thick**
- **Fasbening: with 4.2 x 13 mm self-tapping screws, ab 200 mm centres**
- **Finish: galvanized sheeting (included)**

PATENTED

Evaluation Report: I.G. 403686 Test
Standard: EN 13381-10

Specification Description

Supply and installation of steel tie rod protection with certified R 180 fire resistance for bars over 15 mm in diameter. The protection consists of "T-REX 381-180" sleeves with a dual protective layer covered with 0.25 mm thick galvanized steel sheeting, in compliance with evaluation report I.G. 403686.

The sleeves will be applied with staggered joints and wrapped with sheeting secured by phosphate-coated self-tapping screws at 200 mm centres. The supply includes specific tensioner covers "T-REX 381-180". Refer to the installation manual for application methods.

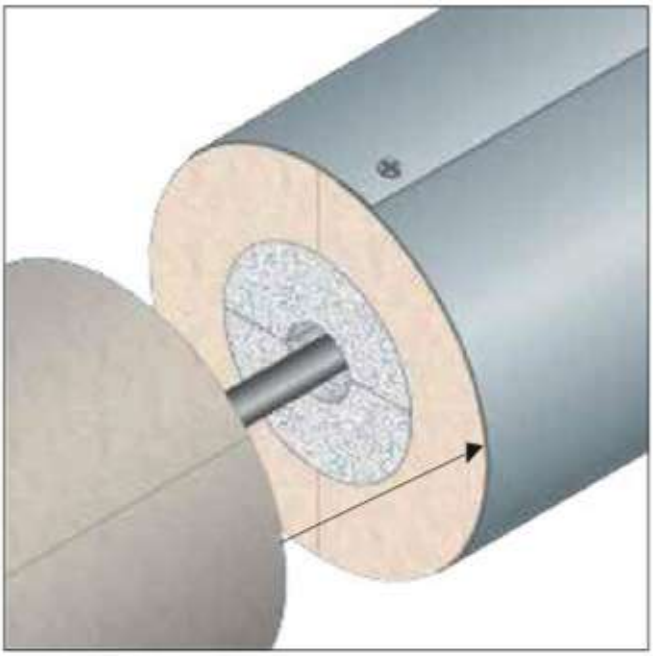
DESCRIPTION

The "T-REX 381-180" sleeves are composed of a dual layer of different materials suitable for fire protection of metal tie rods. They feature an inner shell of 25 mm thick calcium silicate and an outer shell of 30 mm thick refractory ceramic fiber, covered with 0.25 mm thick galvanized sheeting, with a length of 1000 mm. The tensioner protection is made with a similar element, 500 mm in length, called a tensioner cover.

The tensioner cover must overlap the calcium silicate side by at least 50 mm on both sides of the affected sleeves, depending on the critical temperature and the length of the tie rod.

The insulation and galvanized sheeting are provided separately to facilitate installation. The galvanized steel sheeting will be fastened with self-tapping screws with an overlap of about 15 mm. The sleeves will be aligned next to each other, and the sheeting will overlap by 15 mm. The "T-REX 381-180" sleeves prevent the temperature of the steel tie rods from exceeding 350°C, allowing them to be applied under any load condition.

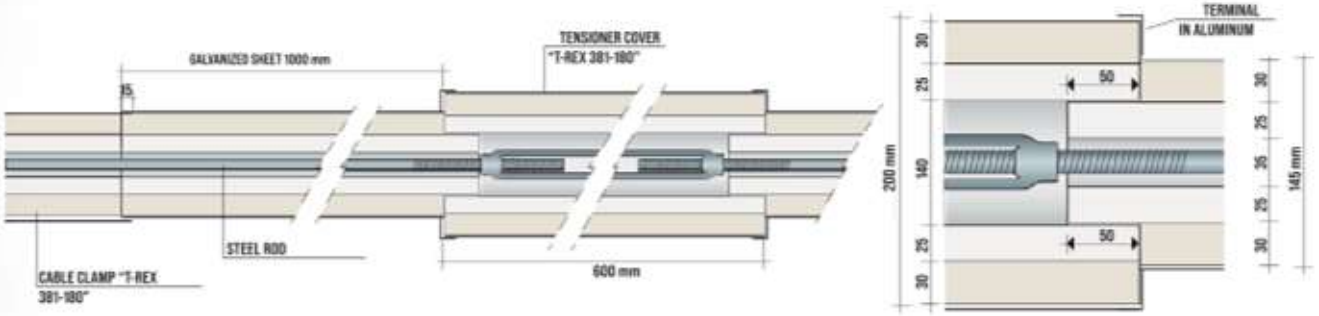
A summary table is provided with tie rod elongations based on critical temperature and the fire resistance classifications offered by the "T-REX 381-180" sleeves.

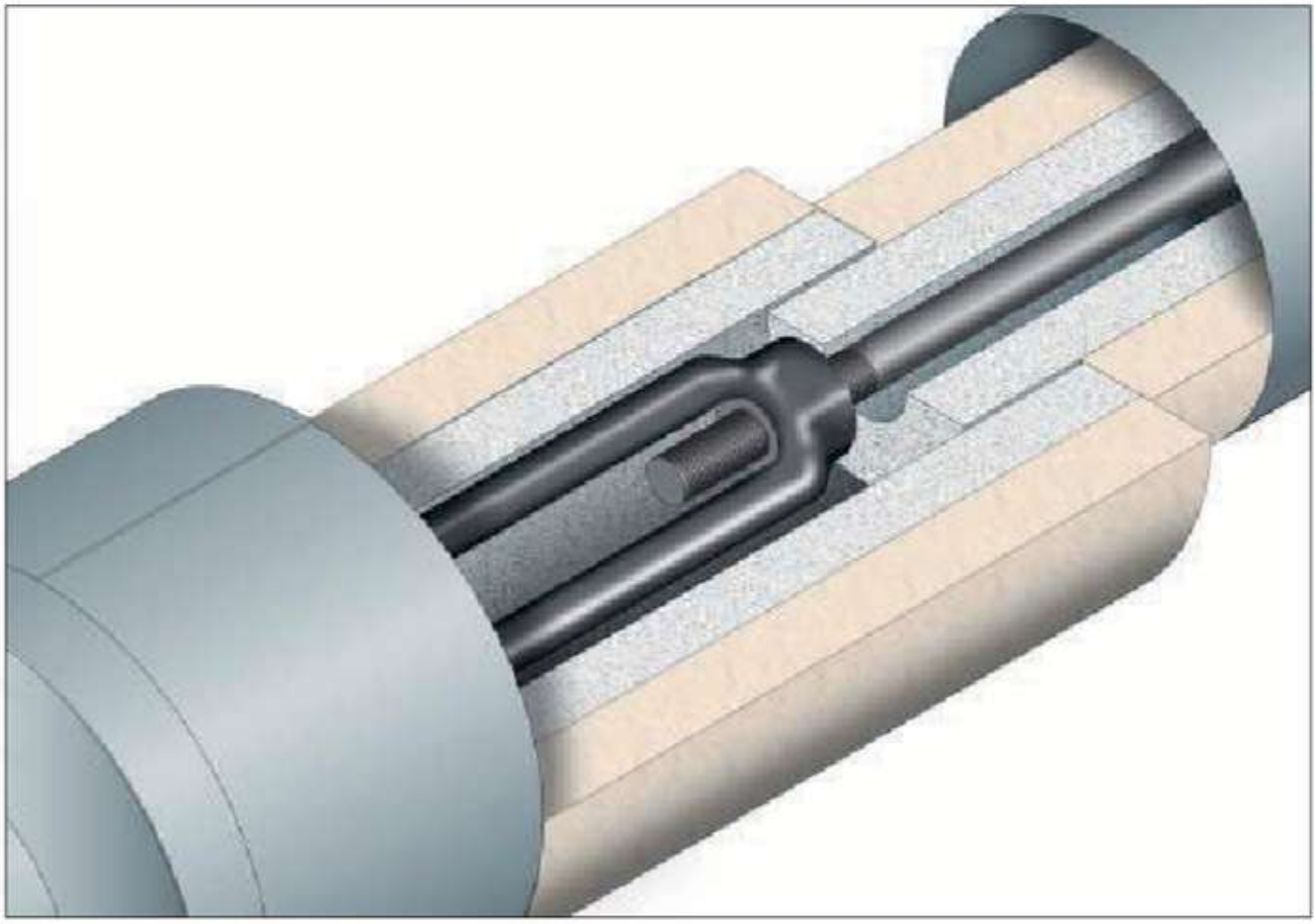


TIE ROD ELONGATION BASED ON CRITICAL TEMPERATURE

"T-REX 381-120"	CRITICAL TEMPERATURE (°C) INSIDE SLEEVE				
	350	400	450	500	550
Elongation (mm/m)	4.45	5.20	5.97	6.76	7.57
Fire Resistance	R 120	R 120	R 120	R 120	R 120

Cable Clamp with Tensioner Cover





APPLICATION
Gently widen the cylindrical shell made of refractory ceramic fiber to allow the metal rod to pass through. Wrap the shell with galvanized steel sheet, ensuring the edges overlap by at least 15 mm. Secure it using self-drilling screws every 200 mm in the pre-drilled holes. Finally, wrap the metal rod with two calcium silicate half-shells and push them into the cylinder protected by the steel sheet. Continue assembling the subsequent shells, ensuring an overlap of the metal shell by at least 15 mm over the previous shell.

PACKAGING
In cardboard boxes.

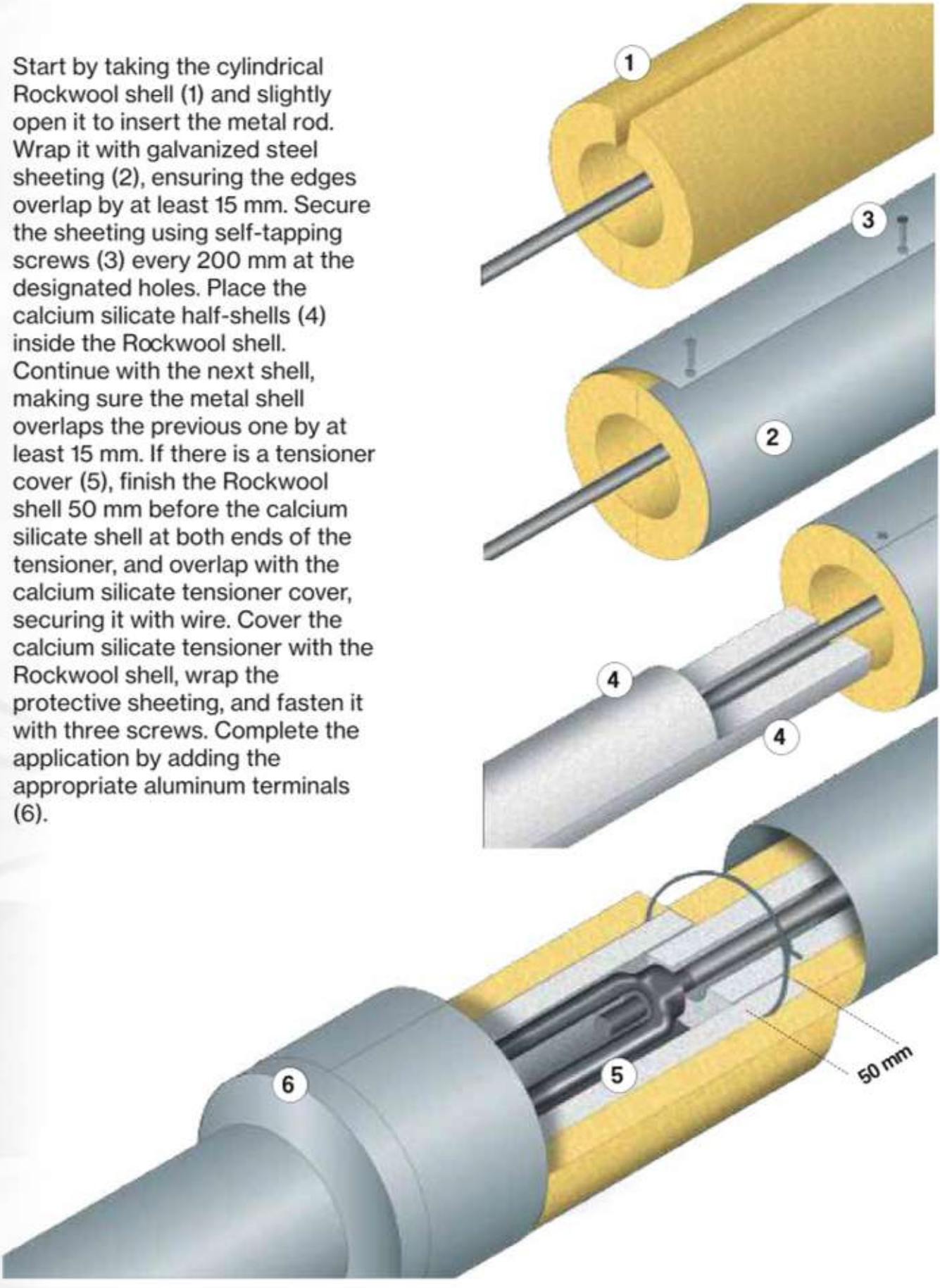
STORAGE
Store in a dry place and keep protected from rain.

SAFETY INSTRUCTIONS
Consult the safety data sheet before use.

TECHNICAL DATA SHEET		
	Shell	**Tensioner Cover**
Internal Diameter	35 mm	90 mm
External Diameter	150 mm	200 mm
Thickness	25+30 mm	25+30 mm
Length	1000 mm	600 mm
Coating Length	1000 mm	600 mm
Weight	2.55 kg/m	2.52 kg/pc.
Linear Thermal Variation	5.8×10^{-6} m/mk	5.8×10^{-6} m/mk
Insoluble in water	yes	yes
Odorless	yes	yes
Finish	galvanized sheet	galvanized sheet

ASSEMBLY GUIDE FOR 'T-REX 381' SHELLS

Start by taking the cylindrical Rockwool shell (1) and slightly open it to insert the metal rod. Wrap it with galvanized steel sheeting (2), ensuring the edges overlap by at least 15 mm. Secure the sheeting using self-tapping screws (3) every 200 mm at the designated holes. Place the calcium silicate half-shells (4) inside the Rockwool shell. Continue with the next shell, making sure the metal shell overlaps the previous one by at least 15 mm. If there is a tensioner cover (5), finish the Rockwool shell 50 mm before the calcium silicate shell at both ends of the tensioner, and overlap with the calcium silicate tensioner cover, securing it with wire. Cover the calcium silicate tensioner with the Rockwool shell, wrap the protective sheeting, and fasten it with three screws. Complete the application by adding the appropriate aluminum terminals (6).



FIREGUARD® 13

Usage: structural protection, refurbishments, walls, partitions, ceilings.

Description: FIREGUARD® 13 are made from calcium silicates and asbestos-free, and are produced by lamination with controlled drying at the plant. They provide excellent thermal insulation during fires, making them suitable for passive fire protection needs. They are non-combustible (class A1 fire reaction). FIREGUARD® 13 ensure mechanical strength and high resistance to moisture and weather elements.

Application: FIREGUARD® 13 are secured using mechanical fasteners (screws or plugs). It's important to follow the guidelines in the specific certifications regarding the types used. In cladding systems, FIREGUARD® 13 is usually certified without joint filling.

If joint filling is desired for aesthetic reasons, fasteners should be placed at 250 mm centres along the edges and in the center of the board. Use FIREGUARD COMPOUND gypsum-based filler applied with mesh tape or fiberglass tape.

TECHNICAL DATA	VALUES
CE Marking	EN15283-1
Thickness	12.7 mm
Width	1200 mm
Length	2000 mm
Weight	10.2 kg/m2 ± 10%
Modulus of Elasticity	>2500 MPa
Compression Strength	>7.0 MPa
Bending Strength	>4.5 MPa
Linear Tolerances	± 3 mm
Thickness Tolerances	± 0.8 mm
Edge	Straight
Bending Radius	1900 mm
Linear Thermal Expansion	0.013 mm/C°/m
Thermal Conductivity	0.25 W/mC°
Bacteria Resistance	0 (no growth)
Fungi Resistance	0 (no growth)
Fire Reaction	A1 (non-combustible)

FIREGUARD® 18

Usage: structural protection, refurbishments, walls, partitions, ceilings, service duct protection.

Description: FIREGUARD® 18 are made from calcium silicates and asbestos-free, and are produced by lamination with controlled drying at the plant. They offer excellent thermal insulation during fires, making them ideal for passive fire protection needs. They are non-combustible (class A1 fire reaction). FIREGUARD® 18 ensure mechanical strength and high resistance to moisture and weather elements.

Application: FIREGUARD® 18 are secured using mechanical fasteners (screws or plugs). It's important to follow the guidelines in the specific certifications regarding the types used. In cladding systems, FIREGUARD® 18 are usually certified without joint filling.

If joint filling is desired for aesthetic reasons, fasteners should be placed at 250 mm centres along the edges and in the center of the board. Use FIREGUARD COMPOUND gypsum-based filler applied with mesh tape or fiberglass tape.

TECHNICAL DATA	VALUES
CE Marking	EN15283-1
Thickness	18.0 mm
Width	1200 mm
Length	2000 mm
Weight	13.5 kg/m2 ± 10%
Modulus of Elasticity	>2500 MPa
Compression Strength	>7.0 MPa
Bending Strength	>4.5 MPa
Nail Pull-Out Resistance	>850 N
Ball Impact Resistance	No damage
Linear Tolerances	± 3 mm
Thickness Tolerances	± 0.8 mm
Edge	Straight
Linear Thermal Expansion	0.013 mm/C°/m
Thermal Conductivity	0.25 W/mC°
Bacteria Resistance	0 (no growth)
Fungi Resistance	0 (no growth)
Fire Reaction	A1 (non-combustible)

FIREGUARD® S

Use: Wall refurbishments.

Description: FIREGUARD® S are made of cement-based silicates and are asbestos-free, created in an autoclave. They provide excellent thermal insulation and maintain integrity during fires, making them ideal for passive fire protection needs. They are non-combustible (fire reaction class A1). FIREGUARD® S offer mechanical strength and high moisture resistance.

Application: FIREGUARD® S are secured using mechanical fasteners (anchors). It is essential to follow the guidelines in the specific certifications for the types used. In cladding systems, FIREGUARD® S are typically certified without joint plastering.

If joint plastering is desired for aesthetic reasons, fasteners should be placed at 250 mm centres along the board edges and centerline. Use gypsum-based FIREGUARD COMPOUND applied with mesh tape or fiberglass tape.

TECHNICAL DATA	VALUES
CE Marking	EN12467
Thickness	8 mm
Width	1200 mm
Length	2400 mm
Weight	9.8 kg/m2 ± 10%
Modulus of Elasticity	>4000 MPa
Compression Resistance	>9tMPa
Flexural Strength	>5.5 MPa
Nail Pull Resistance	>850 N
Linear Tolerances	± 3 mm
Thickness Tolerances	± 0.8 mm
Squarene	Squared
Linear Thermal Expansion	0.003 mm/C°/m
Thermal Conductivity	0.15 W/mC°
Fire Reaction	A1 (non-combustible)

NAPER S 12

Use: Ceilings.

Description: NAPER S 12 are made of cement-based silicates and are asbestos-free, created in an autoclave. They provide excellent thermal insulation and maintain integrity during fires, making them ideal for passive fire protection needs. They are non-combustible (fire reaction class A1).

NAPER S 12 offer mechanical strength and high moisture resistance.

Application: NAPER S 12 are secured using mechanical fasteners (screws). It is essential to follow the guidelines in the specific certifications for the types used. Joint and screw head smoothing should be performed using gypsum-based FIREGUARD COMPOUND applied with mesh tape or fiberglass tape.

TECHNICAL DATA	VALUES
CE Marking	EN12467
Thickness	12 mm
Width	1200 mm
Length	2000 mm
Weight	14.3 kg/m2 ± 10%
Modulus of Elasticity	>4000 MPa
Compression Resistance	>9tMPa
Flexural Strength	>5.5 MPa
Nail Pull Resistance	>850 N
Linear Tolerances	± 3 mm
Thickness Tolerances	± 0.8 mm
Squareness	Squared
Linear Thermal Expansion	0.003 mm/C°/m
Thermal Conductivity	0.15 W/mC°
Fire Reaction	A1 (non-combustible)

LASTRE FIREGUARD® DUCT

Use: ventilation and smoke evacuation ducts.

Description: FIREGUARD® DUCT boards are asbestos-free fiber cement sheets. They undergo a treatment that ensures full stability in case of fire, high mechanical strength, and resistance to atmospheric humidity. They are non-combustible (fire reaction class A1) according to Applus classification report 13/7092-2932 part 2.

Supplied in rigid boards with high mechanical stability, abrasion resistance, and good performance at high temperatures.

Application: The high mechanical strength of FIREGUARD® DUCT boards allows them to be used in the harshest conditions. They are easy to work with using mechanical or manual methods. Modern electric tools such as circular saws are recommended for fast and precise processing. The boards are glued at the edges with Fireguard Glue and screwed together.

TECHNICAL DATA	VALUES
CE Marking	EN12101-7
Thickness	30 mm
Width	1200 mm
Length	2300 mm
Weight	950 kg/m³ ± 10%
Compressive strength	>2.4 MPa
Flexural strength	>4.7 MPa
Nail pull resistance	>850 N
Ball impact resistance	No damage
Linear tolerances	± 3 mm
Thickness tolerances	± 2 mm
Linear thermal expansion	0.013 mm/°C/m
Thermal conductivity	0.29 W/m°C
Bacterial resistance	0 (no growth)
Fungal resistance	0 (no growth)
Fire reaction	A1 (non-combustible)

LASTRE FIREGUARD® 45

Use: ventilation and smoke evacuation ducts.

Description: FIREGUARD® 45 are high-density, self-supporting sheets free of asbestos, made from silicates, selected fibers, and inert additives. They undergo a treatment that makes them fully stable during fires, with high mechanical strength and resistance to atmospheric humidity. They are non-combustible (fire reaction class A1).

Supplied in rigid, self-supporting boards with high mechanical stability, abrasion resistance, and good heat and temperature performance.

Application: The high mechanical strength of FIREGUARD® 45 allows them to be used in the toughest conditions. They are easy to work with using mechanical or manual processes. Modern electric tools like circular saws are highly recommended for fast and precise work. The boards are glued at the edges with FIREGUARD GLUE and screwed together.

TECHNICAL DATA	VALUES
CE Marking	EN12101-7
Thickness	45 mm
Width	1200 mm
Length	2000 mm
Weight	700 kg/m³ ± 10%
Modulus of elasticity	>1200 MPa
Compressive strength	>2.4 MPa
Flexural strength	>3.2 MPa
Nail pull resistance	>850 N
Ball impact resistance	No damage
Linear tolerances	± 3 mm
Thickness tolerances	± 0.5 mm
Squareness	Square
Longitudinal joint depth	/
Linear thermal expansion	0.013 mm/°C/m
Thermal conductivity	0.135 W/m°C
Freeze-thaw resistance	/
Bacterial resistance	0 (no growth)
Fungal resistance	0 (no growth)
Fire reaction	A1 (non-combustible)
pH - Alkalinity level	11