

# TYPE APPROVAL CERTIFICATE

**This is to certify:****That the Structural Fire Protection**with type designation(s)  
**FIRESTOP**

Issued to

**Trelleborg Offshore Norway AS.**  
**KROKSTADELVA, Norway**is found to comply with  
**DNV GL offshore standards****Application :****Approved for use as a system for hydrocarbon fire protection of steel hollow sections/pipes.**  
**Tested according to ISO 834-3.****Product(s) approved by this certificate is/are accepted for installation on all vessels classed**  
**by DNV GL.**Issued at **Høvik** on **2017-11-29**This Certificate is valid until **2022-11-28.**DNV GL local station: **Oslo Maritime and CAP**for **DNV GL**Approval Engineer: **Nanna Jacobsen**

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**Mårten Schei-Nilsson**  
**Head of Section**

This Certificate is subject to terms and conditions overleaf. Any significant change in design or construction may render this Certificate invalid.  
The validity date relates to the Type Approval Certificate and not to the approval of equipment/systems installed.



## Product description

### "FIRESTOP"

is a rubber based insulation system for passive fire protection.

The system considered in this certificate is composed of four layers:

- Layer 1: Corrosion protection / bonding layer
- Layer 2: Fire insulation
- Layer 3: Fireshield
- Layer 4: Wear protection

## Application/Limitation

The thickness of "FIRESTOP" system to be applied to avoid temperatures to rise on the steel substrate less than 75°C, 100°C, 117°C, 150°C, 175 °C, 200°C, 250°C, 300°C, 350°C and 400°C for 'hollow' sections/pipes, are given in appendix table 1-10.

The system considered in this certificate is not defined as non-combustible and should not be used in accommodation or in enclosed areas.

The approval refers only to the fire resistance properties of the system.

The application of the system is to be performed in accordance with the manufacturer's application manual. Alternative corrosion protection/ bonding layer may be used provided they have been tested and approved by the manufacture.

Each product is to be supplied with its manual for installation/application and maintenance.

## Type Approval documentation

Certification in accordance with Class Programme DNVGL-CP-0338, October 2015.

Test report No. 101010.36 - HC, Version 2, "Insulated steel pipes according to ISO 834-3 and IMO 754", dated 22 November 2012 by SINTEF NBL, Trondheim, Norway

Evaluation report No. 101010.36 - Evaluation, Version 2.2, "HC fire section factor interpolation" dated 19 March 2013 by SINTEF NBL, Trondheim, Norway

Dwg. No. KRO-001874 Rev. 1 from manufacturer

## Tests carried out

Tested according to IMO Res. A.754(18)/ISO 834-3 with HC-curve according to ISO 834-3.

## Marking of product

The product or packing is to be marked with name and address of manufacturer and type designation.

## Periodical assessment

DNV GL's surveyor is to be given permission to perform Periodical Assessments at any time during the validity of this certificate and at least every second year. The arrangement is to be in accordance with procedure described in Class Programme DNVGL-CP-0338, Section 4.

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**Appendix to certificate F-20381 for trelleborg Offshore Norway AS**

**Table 1**

Thickness of "FIRESTOP" system for fire protection of "hollow" sections for a critical temperature rise of **75°C:**

| Hp/A  | Time [min] |    |    |    |    |    |    |    |    |     |     |     |
|-------|------------|----|----|----|----|----|----|----|----|-----|-----|-----|
|       | 10         | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |
| 147,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 145,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 140,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 135,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 130,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 125,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 120,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 115,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 110,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 105,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 100,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 95,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 90,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 85,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 83,6  |            |    |    |    |    |    |    |    |    |     |     |     |
| 81,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 80,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 75,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 70,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 65,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 60,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 55,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 50,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 45,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 44,5  |            |    |    |    |    |    |    |    |    |     |     |     |

The maximum thickness of protection material up to the required Hp/A [ $\text{m}^{-1}$ ] shall be used.

Hp/A = Ratio between Heat perimeter and cross sectional Area of the section, [ $\text{m}^{-1}$ ]

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**Table 2**

Thickness of "FIRESTOP" system for fire protection of "hollow" sections for a critical temperature rise of **100°C:**

| Hp/A  | Time [min] |    |    |    |    |    |    |    |    |     |     |     |
|-------|------------|----|----|----|----|----|----|----|----|-----|-----|-----|
|       | 10         | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |
| 147,0 |            |    |    |    |    |    |    |    |    |     |     |     |

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|       |  |  |  |  |  |  |  |  |  |  |  |  |
|-------|--|--|--|--|--|--|--|--|--|--|--|--|
| 145,0 |  |  |  |  |  |  |  |  |  |  |  |  |
| 140,0 |  |  |  |  |  |  |  |  |  |  |  |  |
| 135,0 |  |  |  |  |  |  |  |  |  |  |  |  |
| 130,0 |  |  |  |  |  |  |  |  |  |  |  |  |
| 125,0 |  |  |  |  |  |  |  |  |  |  |  |  |
| 120,0 |  |  |  |  |  |  |  |  |  |  |  |  |
| 115,0 |  |  |  |  |  |  |  |  |  |  |  |  |
| 110,0 |  |  |  |  |  |  |  |  |  |  |  |  |
| 105,0 |  |  |  |  |  |  |  |  |  |  |  |  |
| 100,0 |  |  |  |  |  |  |  |  |  |  |  |  |
| 95,0  |  |  |  |  |  |  |  |  |  |  |  |  |
| 90,0  |  |  |  |  |  |  |  |  |  |  |  |  |
| 85,0  |  |  |  |  |  |  |  |  |  |  |  |  |
| 83,6  |  |  |  |  |  |  |  |  |  |  |  |  |
| 81,0  |  |  |  |  |  |  |  |  |  |  |  |  |
| 80,0  |  |  |  |  |  |  |  |  |  |  |  |  |
| 75,0  |  |  |  |  |  |  |  |  |  |  |  |  |
| 70,0  |  |  |  |  |  |  |  |  |  |  |  |  |
| 65,0  |  |  |  |  |  |  |  |  |  |  |  |  |
| 60,0  |  |  |  |  |  |  |  |  |  |  |  |  |
| 55,0  |  |  |  |  |  |  |  |  |  |  |  |  |
| 50,0  |  |  |  |  |  |  |  |  |  |  |  |  |
| 45,0  |  |  |  |  |  |  |  |  |  |  |  |  |
| 44,5  |  |  |  |  |  |  |  |  |  |  |  |  |

The maximum thickness of protection material up to the required  $H_p/A$  [ $m^{-1}$ ] shall be used.

$H_p/A$  = Ratio between Heat perimeter and cross sectional Area of the section, [ $m^{-1}$ ]

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**Table 3**

Thickness of "FIRESTOP" system for fire protection of "hollow" sections for a critical temperature rise of **117°C**:

| Hp/A  | Time [min] |    |    |    |    |    |    |    |    |     |     |     |
|-------|------------|----|----|----|----|----|----|----|----|-----|-----|-----|
|       | 10         | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |
| 147,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 145,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 140,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 135,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 130,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 125,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 120,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 115,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 110,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 105,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 100,0 |            |    |    |    |    |    |    |    |    |     |     |     |

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|             |  |  |  |  |  |  |  |  |  |  |  |  |
|-------------|--|--|--|--|--|--|--|--|--|--|--|--|
| <b>95,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>90,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>85,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>83,6</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>81,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>80,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>75,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>70,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>65,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>60,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>55,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>50,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>45,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>44,5</b> |  |  |  |  |  |  |  |  |  |  |  |  |

The maximum thickness of protection material up to the required  $H_p/A$  [ $m^{-1}$ ] shall be used.

$H_p/A$  = Ratio between Heat perimeter and cross sectional Area of the section, [ $m^{-1}$ ]

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**Table 4**

Thickness of "FIRESTOP" system for fire protection of "hollow" sections for a critical temperature rise of **150°C**:

| Hp/A  | Time [min] |    |    |    |    |    |    |    |    |     |     |     |
|-------|------------|----|----|----|----|----|----|----|----|-----|-----|-----|
|       | 10         | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |
| 147,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 145,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 140,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 135,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 130,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 125,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 120,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 115,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 110,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 105,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 100,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 95,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 90,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 85,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 83,6  |            |    |    |    |    |    |    |    |    |     |     |     |
| 81,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 80,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 75,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 70,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 65,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 60,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 55,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 50,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 45,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 44,5  |            |    |    |    |    |    |    |    |    |     |     |     |

The maximum thickness of protection material up to the required Hp/A [ $\text{m}^{-1}$ ] shall be used.

Hp/A = Ratio between Heat perimeter and cross sectional Area of the section, [ $\text{m}^{-1}$ ]

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**Table 5**

Thickness of "FIRESTOP" system for fire protection of "hollow" sections for a critical temperature rise of **175°C**:

| Hp/A  | Time [min] |    |    |    |    |    |    |    |    |     |     |     |
|-------|------------|----|----|----|----|----|----|----|----|-----|-----|-----|
|       | 10         | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |
| 147,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 145,0 |            |    |    |    |    |    |    |    |    |     |     |     |

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|              |  |  |  |  |  |  |  |  |  |  |  |  |
|--------------|--|--|--|--|--|--|--|--|--|--|--|--|
| <b>140,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>135,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>130,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>125,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>120,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>115,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>110,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>105,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>100,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>95,0</b>  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>90,0</b>  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>85,0</b>  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>83,6</b>  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>81,0</b>  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>80,0</b>  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>75,0</b>  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>70,0</b>  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>65,0</b>  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>60,0</b>  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>55,0</b>  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>50,0</b>  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>45,0</b>  |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>44,5</b>  |  |  |  |  |  |  |  |  |  |  |  |  |

The maximum thickness of protection material up to the required  $H_p/A$  [ $m^{-1}$ ] shall be used.

$H_p/A$  = Ratio between Heat perimeter and cross sectional Area of the section, [ $m^{-1}$ ]

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**Table 6**

Thickness of "FIRESTOP" system for fire protection of "hollow" sections for a critical temperature rise of **200°C**:

| Hp/A  | Time [min] |    |    |    |    |    |    |    |    |     |     |     |
|-------|------------|----|----|----|----|----|----|----|----|-----|-----|-----|
|       | 10         | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |
| 147,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 145,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 140,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 135,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 130,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 125,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 120,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 115,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 110,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 105,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 100,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 95,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 90,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 85,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 83,6  |            |    |    |    |    |    |    |    |    |     |     |     |
| 81,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 80,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 75,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 70,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 65,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 60,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 55,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 50,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 45,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 44,5  |            |    |    |    |    |    |    |    |    |     |     |     |

The maximum thickness of protection material up to the required Hp/A [ $\text{m}^{-1}$ ] shall be used.

Hp/A = Ratio between Heat perimeter and cross sectional Area of the section, [ $\text{m}^{-1}$ ]



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**Table 7**

Thickness of "FIRESTOP" system for fire protection of "hollow" sections for a critical temperature rise of **250°C**:

| Hp/A  | Time [min] |    |    |    |    |    |    |    |    |     |     |     |
|-------|------------|----|----|----|----|----|----|----|----|-----|-----|-----|
|       | 10         | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |
| 147,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 145,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 140,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 135,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 130,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 125,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 120,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 115,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 110,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 105,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 100,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 95,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 90,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 85,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 83,6  |            |    |    |    |    |    |    |    |    |     |     |     |
| 81,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 80,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 75,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 70,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 65,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 60,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 55,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 50,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 45,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 44,5  |            |    |    |    |    |    |    |    |    |     |     |     |

The maximum thickness of protection material up to the required Hp/A [ $\text{m}^{-1}$ ] shall be used.

Hp/A = Ratio between Heat perimeter and cross sectional Area of the section, [ $\text{m}^{-1}$ ]

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**Table 8**

Thickness of "FIRESTOP" system for fire protection of "hollow" sections for a critical temperature rise of **300°C**:

| Hp/A  | Time [min] |    |    |    |    |    |    |    |    |     |     |     |
|-------|------------|----|----|----|----|----|----|----|----|-----|-----|-----|
|       | 10         | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |
| 147,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 145,0 |            |    |    |    |    |    |    |    |    |     |     |     |

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|       |  |  |  |  |  |  |  |  |  |  |  |  |
|-------|--|--|--|--|--|--|--|--|--|--|--|--|
| 140,0 |  |  |  |  |  |  |  |  |  |  |  |  |
| 135,0 |  |  |  |  |  |  |  |  |  |  |  |  |
| 130,0 |  |  |  |  |  |  |  |  |  |  |  |  |
| 125,0 |  |  |  |  |  |  |  |  |  |  |  |  |
| 120,0 |  |  |  |  |  |  |  |  |  |  |  |  |
| 115,0 |  |  |  |  |  |  |  |  |  |  |  |  |
| 110,0 |  |  |  |  |  |  |  |  |  |  |  |  |
| 105,0 |  |  |  |  |  |  |  |  |  |  |  |  |
| 100,0 |  |  |  |  |  |  |  |  |  |  |  |  |
| 95,0  |  |  |  |  |  |  |  |  |  |  |  |  |
| 90,0  |  |  |  |  |  |  |  |  |  |  |  |  |
| 85,0  |  |  |  |  |  |  |  |  |  |  |  |  |
| 83,6  |  |  |  |  |  |  |  |  |  |  |  |  |
| 81,0  |  |  |  |  |  |  |  |  |  |  |  |  |
| 80,0  |  |  |  |  |  |  |  |  |  |  |  |  |
| 75,0  |  |  |  |  |  |  |  |  |  |  |  |  |
| 70,0  |  |  |  |  |  |  |  |  |  |  |  |  |
| 65,0  |  |  |  |  |  |  |  |  |  |  |  |  |
| 60,0  |  |  |  |  |  |  |  |  |  |  |  |  |
| 55,0  |  |  |  |  |  |  |  |  |  |  |  |  |
| 50,0  |  |  |  |  |  |  |  |  |  |  |  |  |
| 45,0  |  |  |  |  |  |  |  |  |  |  |  |  |
| 44,5  |  |  |  |  |  |  |  |  |  |  |  |  |

The maximum thickness of protection material up to the required  $H_p/A$  [ $m^{-1}$ ] shall be used.

$H_p/A$  = Ratio between Heat perimeter and cross sectional Area of the section, [ $m^{-1}$ ]

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**Table 9**

Thickness of "FIRESTOP" system for fire protection of "hollow" sections for a critical temperature rise of **350°C**:

| Hp/A  | Time [min] |    |    |    |    |    |    |    |    |     |     |     |
|-------|------------|----|----|----|----|----|----|----|----|-----|-----|-----|
|       | 10         | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |
| 147,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 145,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 140,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 135,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 130,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 125,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 120,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 115,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 110,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 105,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 100,0 |            |    |    |    |    |    |    |    |    |     |     |     |

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|             |  |  |  |  |  |  |  |  |  |  |  |  |
|-------------|--|--|--|--|--|--|--|--|--|--|--|--|
| <b>95,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>90,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>85,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>83,6</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>81,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>80,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>75,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>70,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>65,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>60,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>55,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>50,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>45,0</b> |  |  |  |  |  |  |  |  |  |  |  |  |
| <b>44,5</b> |  |  |  |  |  |  |  |  |  |  |  |  |

The maximum thickness of protection material up to the required  $H_p/A$  [ $m^{-1}$ ] shall be used.

$H_p/A$  = Ratio between Heat perimeter and cross sectional Area of the section, [ $m^{-1}$ ]

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**Table 10**

Thickness of "FIRESTOP" system for fire protection of "hollow" sections for a critical temperature rise of **400°C**:

| Hp/A  | Time [min] |    |    |    |    |    |    |    |    |     |     |     |
|-------|------------|----|----|----|----|----|----|----|----|-----|-----|-----|
|       | 10         | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |
| 147,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 145,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 140,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 135,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 130,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 125,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 120,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 115,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 110,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 105,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 100,0 |            |    |    |    |    |    |    |    |    |     |     |     |
| 95,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 90,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 85,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 83,6  |            |    |    |    |    |    |    |    |    |     |     |     |
| 81,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 80,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 75,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 70,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 65,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 60,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 55,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 50,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 45,0  |            |    |    |    |    |    |    |    |    |     |     |     |
| 44,5  |            |    |    |    |    |    |    |    |    |     |     |     |

The maximum thickness of protection material up to the required Hp/A [ $\text{m}^{-1}$ ] shall be used.

Hp/A = Ratio between Heat perimeter and cross sectional Area of the section, [ $\text{m}^{-1}$ ]