



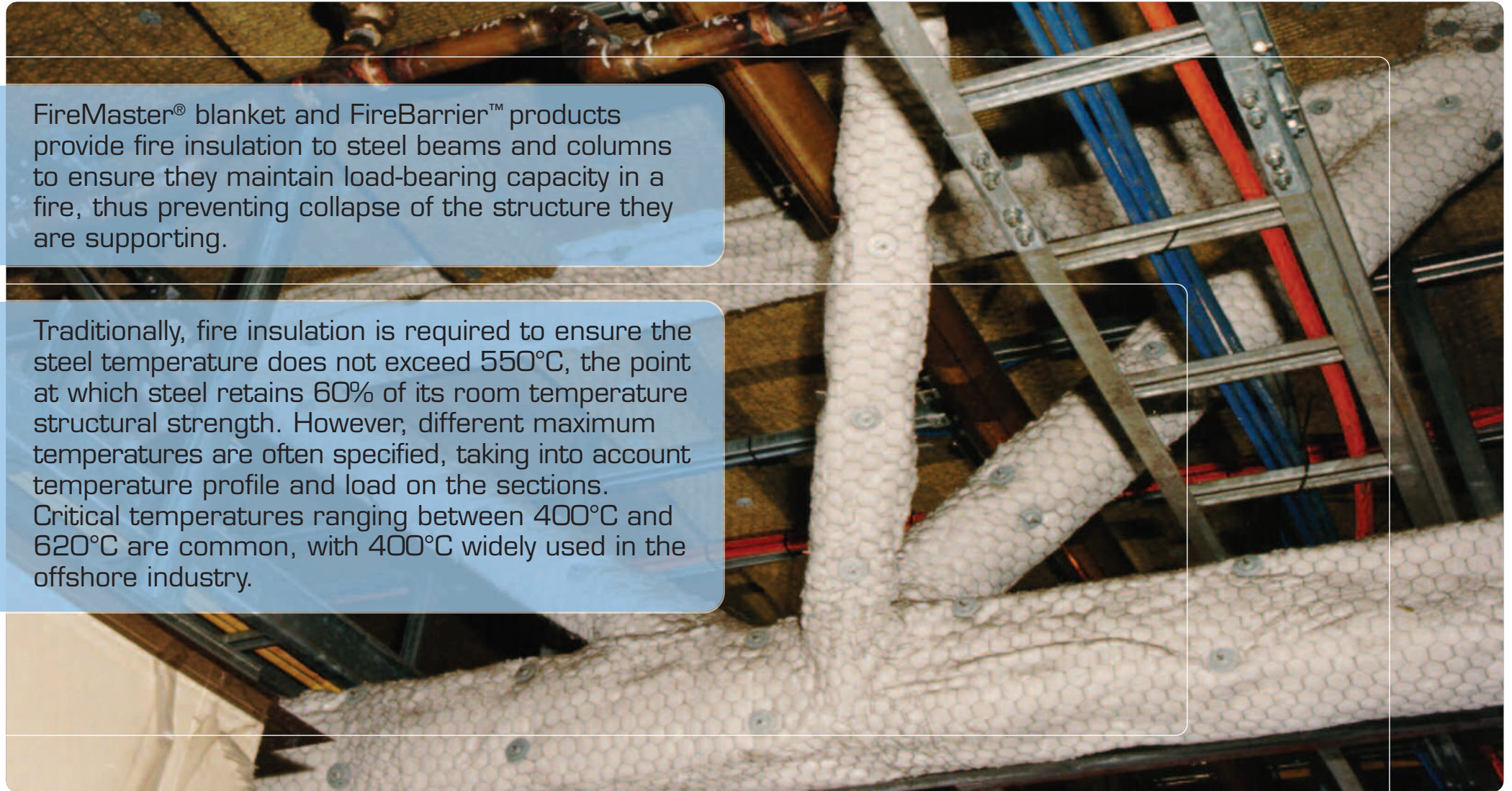
FireMaster[®]
structural steel
fire protection

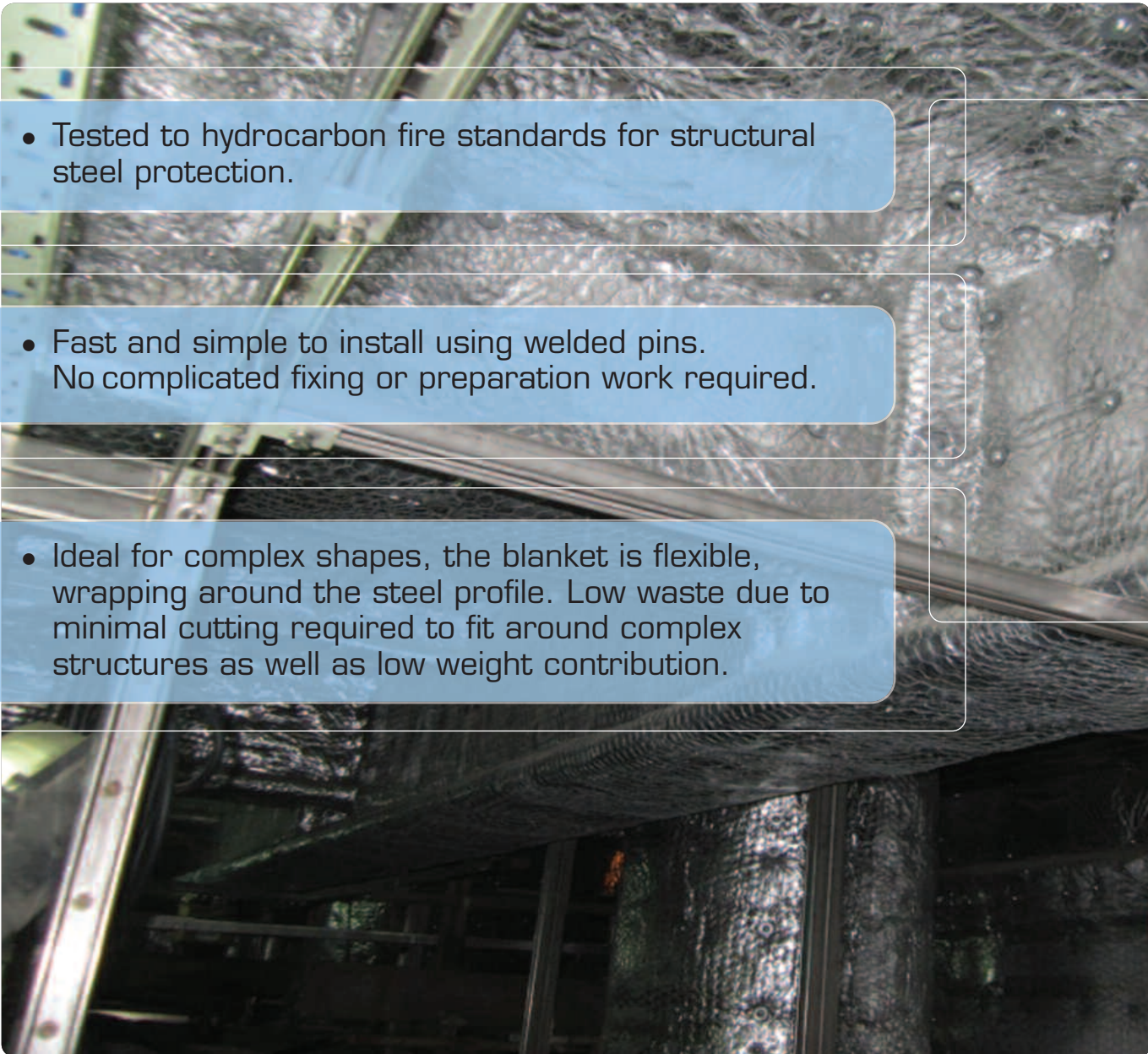
FireMaster® structural steel fire protection

Fire insulation to steel beams and columns

FireMaster® blanket and FireBarrier™ products provide fire insulation to steel beams and columns to ensure they maintain load-bearing capacity in a fire, thus preventing collapse of the structure they are supporting.

Traditionally, fire insulation is required to ensure the steel temperature does not exceed 550°C, the point at which steel retains 60% of its room temperature structural strength. However, different maximum temperatures are often specified, taking into account temperature profile and load on the sections. Critical temperatures ranging between 400°C and 620°C are common, with 400°C widely used in the offshore industry.

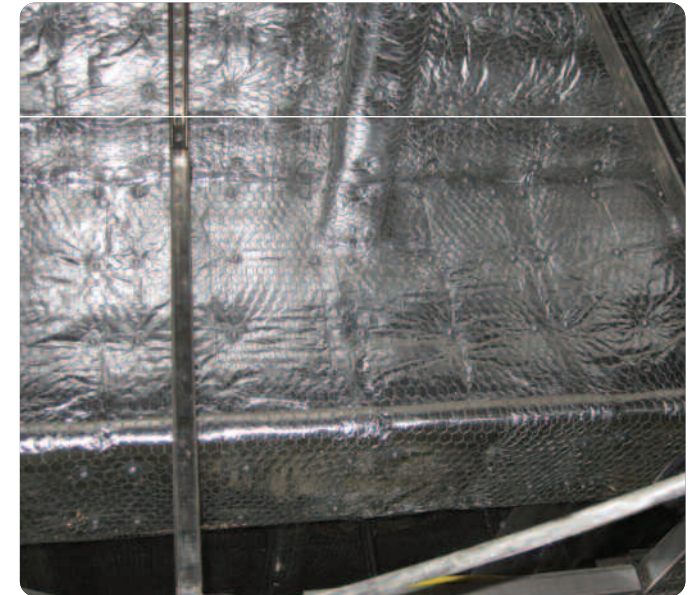




- Tested to hydrocarbon fire standards for structural steel protection.

- Fast and simple to install using welded pins. No complicated fixing or preparation work required.

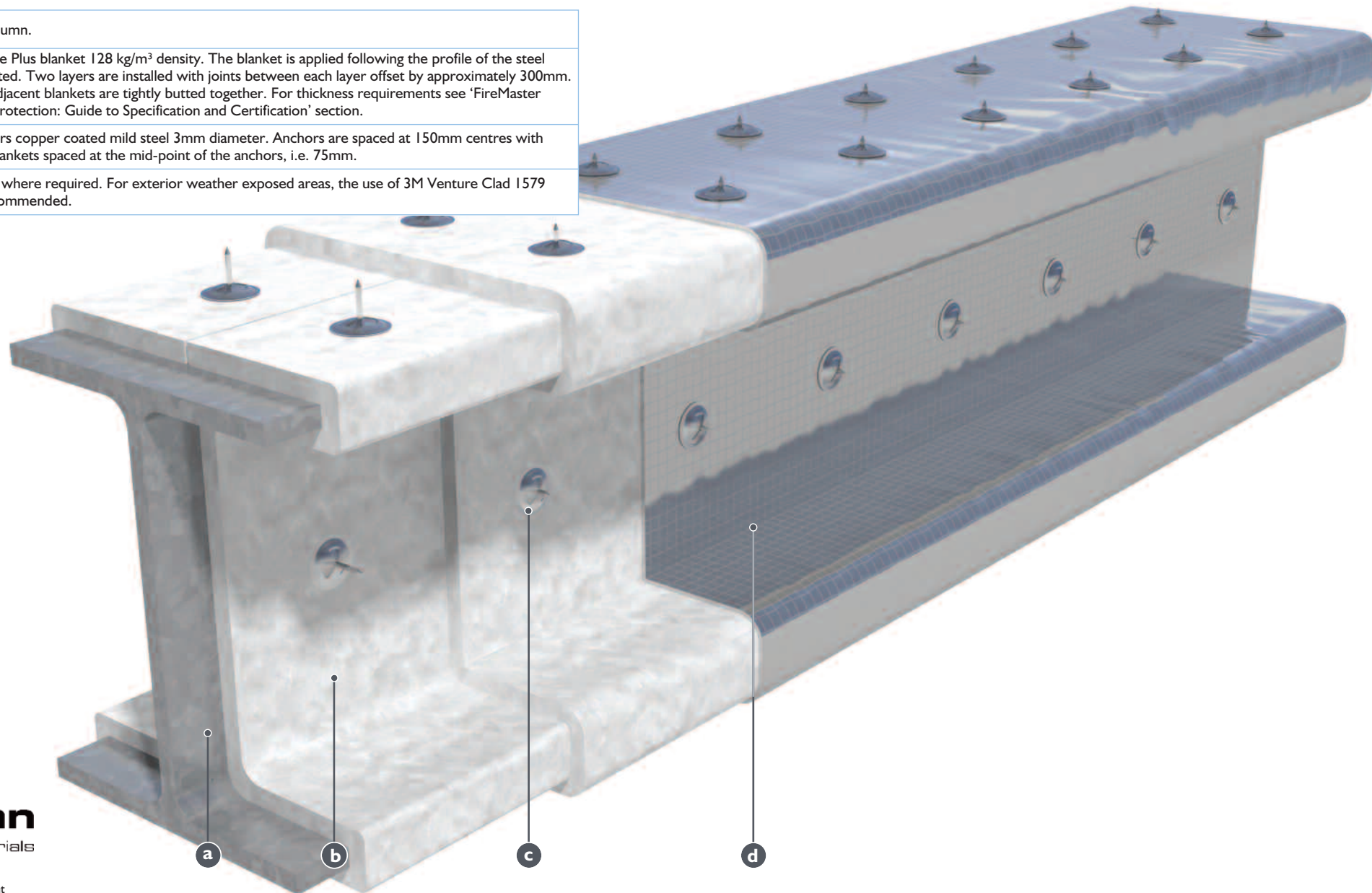
- Ideal for complex shapes, the blanket is flexible, wrapping around the steel profile. Low waste due to minimal cutting required to fit around complex structures as well as low weight contribution.



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Fire insulation to steel beams and columns

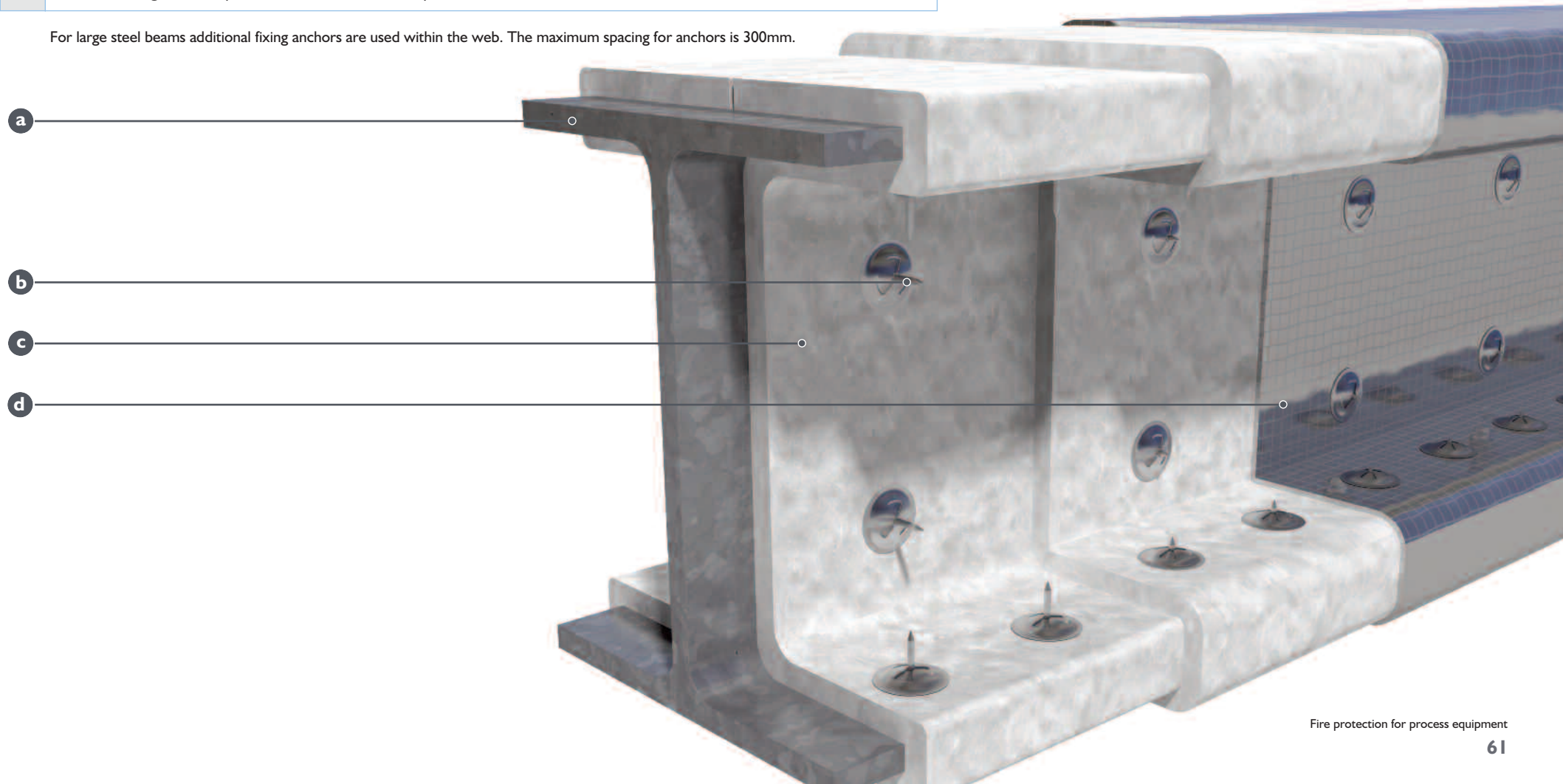
| | |
|----------|---|
| a | Steel beam or column. |
| b | FireMaster Marine Plus blanket 128 kg/m ³ density. The blanket is applied following the profile of the steel section as illustrated. Two layers are installed with joints between each layer offset by approximately 300mm. Joints between adjacent blankets are tightly butted together. For thickness requirements see 'FireMaster Structural Steel Protection: Guide to Specification and Certification' section. |
| c | Steel fixing anchors copper coated mild steel 3mm diameter. Anchors are spaced at 150mm centres with joints between blankets spaced at the mid-point of the anchors, i.e. 75mm. |
| d | Exterior cladding where required. For exterior weather exposed areas, the use of 3M Venture Clad I579 GCW-WM is recommended. |



Fire insulation to steel beams and columns - alternative fixings

| | |
|----------|---|
| a | Steel beam or column. |
| b | Steel fixing anchors copper coated mild steel 3mm diameter. Anchors are spaced at 150mm centres with joints between blankets spaced at the mid-point of the anchors, i.e. 75mm. |
| c | FireMaster Marine Plus Blanket 128 kg/m ³ density. The blanket is applied following the profile of the steel section as illustrated. Two layers are installed with joints between each layer offset by approximately 300mm. Joints between adjacent blankets are tightly butted together. For thickness requirements see 'FireMaster Structural Steel Protection: Guide to Specification And Certification' section. |
| d | Exterior cladding where required. For exterior weather exposed areas, the use of 3M Venture Clad 1579 GCW-WM is recommended. |

For large steel beams additional fixing anchors are used within the web. The maximum spacing for anchors is 300mm.



Structural steel fire protection system

A guide to specification and certification

FireMaster® structural steel fire protection system

The thickness of insulation that is required to be applied to steelwork to provide fire protection will depend on a number of factors. These are:

1. Fire load and duration
2. Critical temperature specified for the steel; i.e. the maximum permitted temperature for the steel section during the fire
3. The “section factor” of the steelwork; a relationship of external surface exposed to fire to the steel sectional area

Critical steel temperature

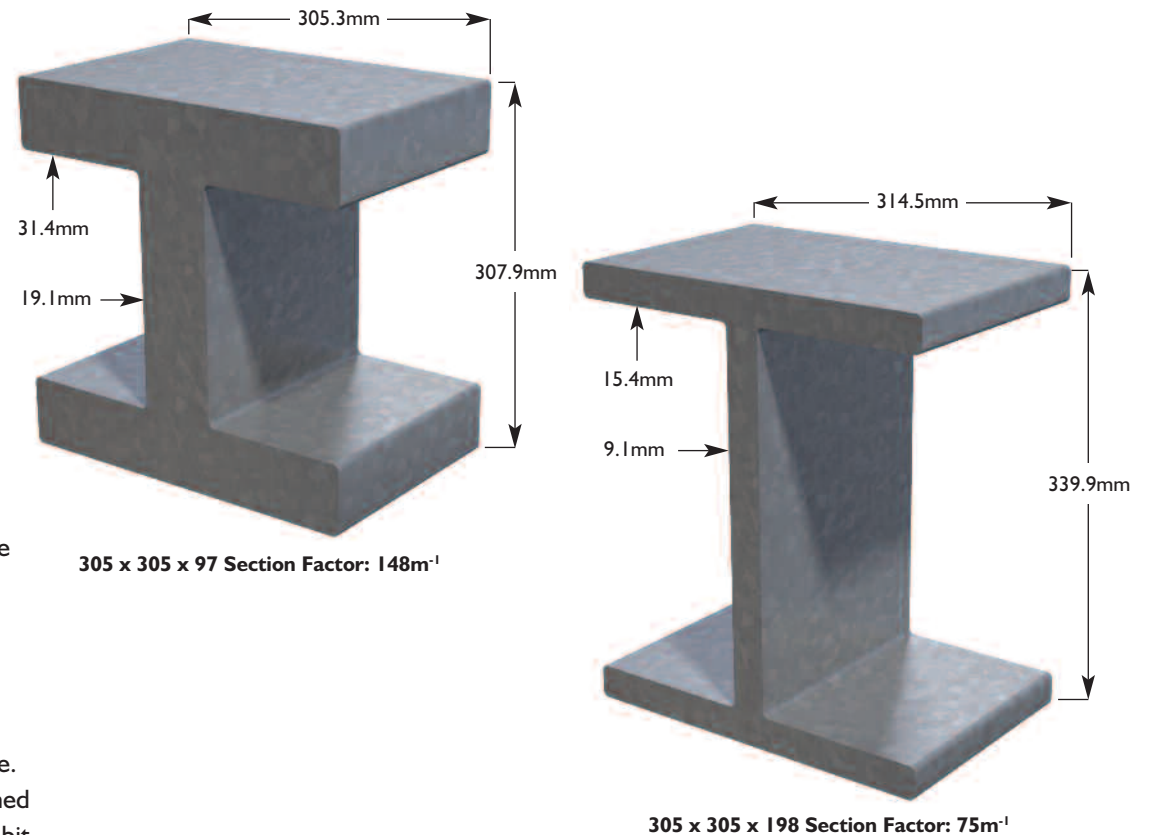
Steelwork is insulated against fire to maintain its temperatures below a specified critical temperature limit to ensure its loadbearing function is maintained. The limit usually commonly applied to supporting structural steel offshore on for example, living quarters is 400°C for a 60 minute period.

This limit is also often applied to process plant equipment. Other temperature limits may be applied depending on the function of the structure. For example support steelwork for emergency shutdown valves is usually limited to a maximum temperature of 200°C for 60 minutes. Secondary steelwork in process areas may have a maximum steel temperature of 550°C specified for 60 minutes.

Section factor

The section factor relates the surface area of the steel section exposed to fire to the amount of steel in the section cross-sectional area available to absorb heat from the fire. The surface area of the fire-exposed section divided by the cross-sectional area is defined as the ‘section factor’; ‘Hp/A’ or ‘F/A’. Steel sections with large section factors will exhibit faster temperature rise in a fire than those with smaller section factors as the ratio of area receiving heat to the mass of steel available to absorb that heat increases. Section Factors are calculated by dividing the external fire-exposed perimeter of the steel section by its cross sectional area.

The example, below, compares the section factors of two different sized steel columns.



| Section factor (m ⁻¹) | Insulation thickness required to maintain steel temperature to 400°C for two hours in a hydrocarbon fire |
|-----------------------------------|--|
| 75 | 50mm |
| 148 | 81mm |

The table above, illustrates the effect of section factor on insulation thickness for two different sized steel sections.

A guide to specification and certification

Fire testing of structural steelwork fire insulation is designed to relate section factor to insulation thickness for a variety of failure temperatures and this requires a large variety of sections to be fire tested. FireMaster Marine Plus blanket has been fully tested in order to generate the required thickness tables in accordance with Annex E4 of EN 13381-4 fire test procedure for structural steelwork in hydrocarbon fires.

This test standard also requires loaded beams to be fire tested in order to assess the 'stickability' of the insulation system as the beam deflects under load with increasing temperature. This is to ensure the insulation system has adequate integrity for use.

In order to assess any impact of the beam deflection on the insulation system, identically insulated reference non-loaded columns of the same section factor are also tested to allow temperature rise data to be compared in loaded and unloaded conditions.

Fire load and duration

The heat flux or temperature to which the steel is exposed will influence the thickness of insulation required for fire insulation. From the fire tests, tables are constructed using multiple linear regression analysis of the fire test data to relate fire exposure time, section factor and critical temperature to insulation thickness.

FireMaster® structural steel system fire testing and certification

The FireMaster structural steel system is testing in accordance with EN 13381-4 method using the hydrocarbon fire temperature/time curve specified in EN 1363-2 for protection periods up to 240 minutes and is Type Approved by Lloyds Register.

Insulation thickness requirements for hydrocarbon fire protection of steelwork

The table on page 56 shows the variation of thickness with section factor for hydrocarbon fire protection of structural steel with a critical temperature of 400°C for various time periods.

For other critical temperatures and time periods reference can be made to the Lloyds Register Type Approval certificate.

Additionally Morgan Thermal Ceramics provides a software package 'SectionWizard' to allow straightforward access to the fire test approved thickness data without the need to calculate section factors or look up tables, see page 65 for further details.

A guide to specification and certification

Example of thickness requirements for structural steel fire protection in hydrocarbon fires

The table below illustrates the required thickness of FireMaster Marine Plus blanket to ensure a critical steel temperature of 400°C is not exceeded for time periods in the range of 1 to 4 hours. For other critical temperatures please refer to the Type Approval certification or use our SectionWizard software.

| Section factor m ⁻¹ | Minimum thickness (mm) of FireMaster Marine Plus blanket to ensure a critical steel temperature of 400°C is not exceeded | | | | |
|--------------------------------|--|------------|-------------|-------------|-------------|
| | 60 minutes | 90 minutes | 120 minutes | 180 minutes | 240 minutes |
| 70 | 50 | 50 | 50 | 69 | 91 |
| 75 | 50 | 50 | 50 | 73 | 96 |
| 80 | 50 | 50 | 52 | 77 | 101 |
| 85 | 50 | 50 | 55 | 80 | 106 |
| 90 | 50 | 50 | 57 | 84 | 110 |
| 95 | 50 | 50 | 60 | 87 | 114 |
| 100 | 50 | 50 | 62 | 90 | 119 |
| 105 | 50 | 50 | 65 | 94 | 123 |
| 110 | 50 | 52 | 67 | 97 | 127 |
| 115 | 50 | 53 | 69 | 100 | 130 |
| 120 | 50 | 55 | 71 | 102 | 134 |
| 125 | 50 | 57 | 73 | 105 | 137 |
| 130 | 50 | 58 | 75 | 108 | 141 |
| 135 | 50 | 60 | 77 | 110 | 144 |
| 140 | 50 | 61 | 78 | 113 | 147 |
| 145 | 50 | 63 | 80 | 115 | 150 |
| 150 | 50 | 64 | 82 | 118 | |
| 155 | 50 | 65 | 83 | 120 | |
| 160 | 50 | 67 | 85 | 122 | |
| 165 | 50 | 68 | 87 | 124 | |
| 170 | 50 | 69 | 88 | 126 | |
| 175 | 51 | 70 | 90 | 128 | |
| 180 | 52 | 71 | 91 | 130 | |
| 185 | 52 | 72 | 92 | 132 | |
| 190 | 53 | 73 | 94 | 134 | |
| 195 | 54 | 74 | 95 | 136 | |
| 200 | 55 | 76 | 96 | 138 | |
| 205 | 56 | 76 | 97 | 139 | |
| 210 | 56 | 77 | 99 | 141 | |
| 215 | 57 | 78 | 100 | 143 | |

| Section factor m ⁻¹ | Minimum thickness (mm) of FireMaster Marine Plus blanket to ensure a critical steel temperature of 400°C is not exceeded | | | |
|--------------------------------|--|------------|-------------|-------------|
| | 60 minutes | 90 minutes | 120 minutes | 180 minutes |
| 220 | 58 | 79 | 101 | 144 |
| 225 | 58 | 80 | 102 | 146 |
| 230 | 59 | 81 | 103 | 147 |
| 235 | 60 | 82 | 104 | 149 |
| 240 | 60 | 83 | 105 | 150 |
| 245 | 61 | 84 | 106 | |
| 250 | 61 | 84 | 107 | |
| 255 | 62 | 85 | 108 | |
| 260 | 63 | 86 | 109 | |
| 265 | 63 | 87 | 110 | |
| 270 | 64 | 87 | 111 | |
| 275 | 64 | 88 | 112 | |
| 280 | 65 | 89 | 113 | |
| 285 | 65 | 89 | 114 | |
| 290 | 66 | 90 | 114 | |
| 295 | 66 | 91 | 115 | |
| 300 | 67 | 91 | 116 | |
| 305 | 67 | 92 | 117 | |
| 310 | 68 | 93 | 118 | |
| 315 | 68 | 93 | 118 | |
| 320 | 69 | 94 | 119 | |
| 325 | 69 | 94 | 120 | |
| 330 | 69 | 95 | 120 | |
| 335 | 70 | 96 | 121 | |
| 340 | 70 | 96 | 122 | |
| 345 | 71 | 97 | 122 | |
| 350 | 71 | 97 | 123 | |
| 355 | 71 | 98 | 124 | |
| 260 | 72 | 98 | 124 | |

SectionWizard Software

Morgan Thermal Ceramics offers technical support services to assist specification of our products. We use approved finite element packages to calculate fire insulation requirements for applications that cannot be directly addressed with fire testing alone. These calculation tools are used to supplement our existing fire testing and certification.

Available to all of our customers is the software package 'SectionWizard' (for PC only*).

This allows easy and fast specification of fire insulation requirements to steelwork or pipe sections. The software package is directly linked to our fire testing for steel sections and pipes and allows rapid specification of thickness requirements based on fire scenario, duration, critical temperature and steel section size.

Standard steel section or pipe dimensions are included in a database thus eliminating the need for calculating section factors and then referencing standard tables of thickness. Specification of fire insulation requirements can be carried out in a short time period and always in accordance with the relevant Type Approval certificate.

To obtain a copy of SectionWizard, contact your local Morgan Thermal Ceramics office.

* Compatible with MS Windows XP or Windows 7 (32 or 64 bit) Operating Systems

