

14 a 16 de Agosto
Centro de Exposições São Paulo Expo

CONSTRU
METAL
2019



**Construção em Aço: Soluções para o
Desenvolvimento Sustentável**

**Fire protecting structural steel using
intumescent coatings for LEED projects**

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Global Infrastructure Manager**



CONTENTS

- Introduction to Jotun
- Fire Protection & Intumescent Coatings
- Fire Testing & Standards
- Steel sections and Hp/A
- Coating Systems
- Standards of Finish
- LEED v4 contribution
- CPD Education



INTRODUCTION TO JOTUN

A GLOBAL PAINT SOLUTIONS COMPANY
ESTABLISHED IN NORWAY IN 1926



FACTS & FIGURES



40
factories



+9000
Employees



+100
Countries



2.1 bill.
in sales



950+
Coating Advisors
NACE/ FROSIO
Qualified



+200
R&D staff

CENTRAL LAB

- Norway

REGIONAL LABS

- UAE (Dubai)
- India
- USA
- Turkey
- Malaysia
- China
- South Korea
- United Kingdom

SINGLE SOURCE SOLUTION



STEEL PROTECTION COATINGS

Anti Corrosion



DECORATIVE PAINTS

Interior/ Exterior



CONCRETE PROTECTION COATINGS

Anti Carbonation



FLOOR COATINGS

Light/ Heavy Duty



ARCHITECTURAL POWDER COATINGS

Facades/Rebar

FIRE PROTECTION

Thin Film Intumescent Coatings

PURPOSE OF FIRE PROTECTION

- **Primary Functions**



Delay building
collapse



Extend search
and rescue time



Preserve
life

- **Asset Protection**



Protect
structure &
inventory



Prevent
catastrophic fire



Contain or
separate the fire
from other assets

DIFFERENT TYPES OF FIRE PROTECTION

Active System



Passive System



Reactive System



CLASSIFICATIONS OF FIRE

Fire types can be classified into two main groups depending on fuel source:



Cellulosic

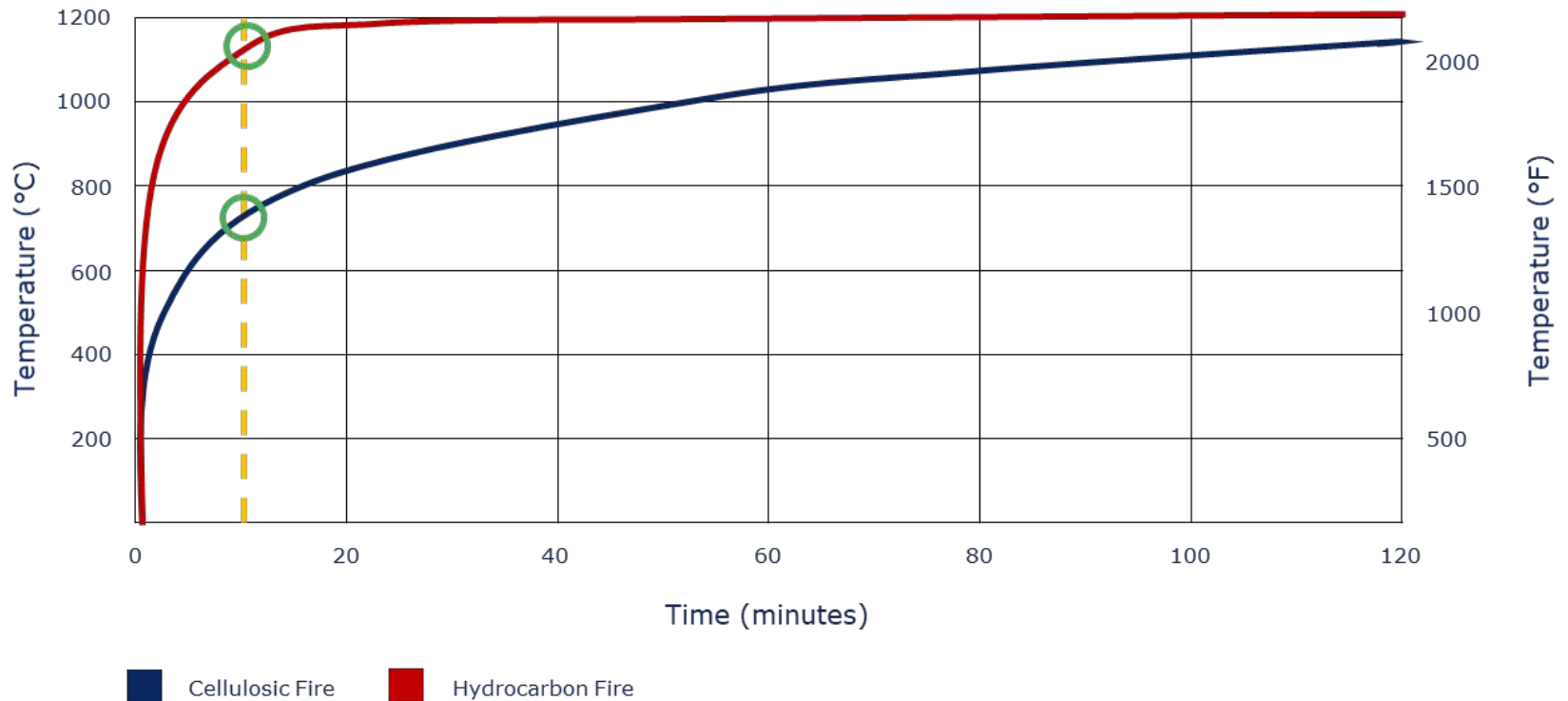


Hydrocarbon



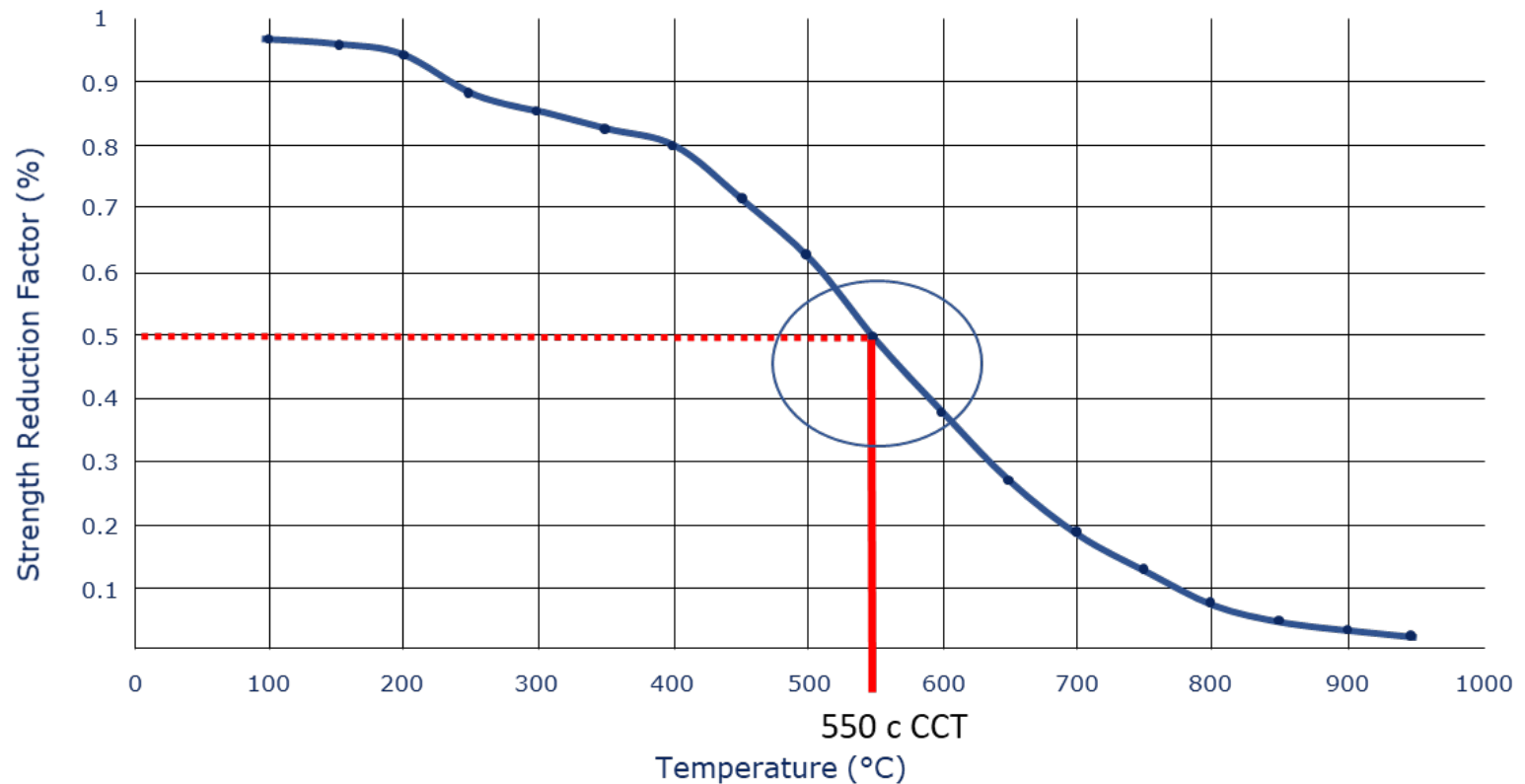
CELLULOSIC VS HYDROCARBON FIRE

In a cellulosic fire, temperature reaches 550°C in under 10 mins



STEEL STRENGTH IN FIRE

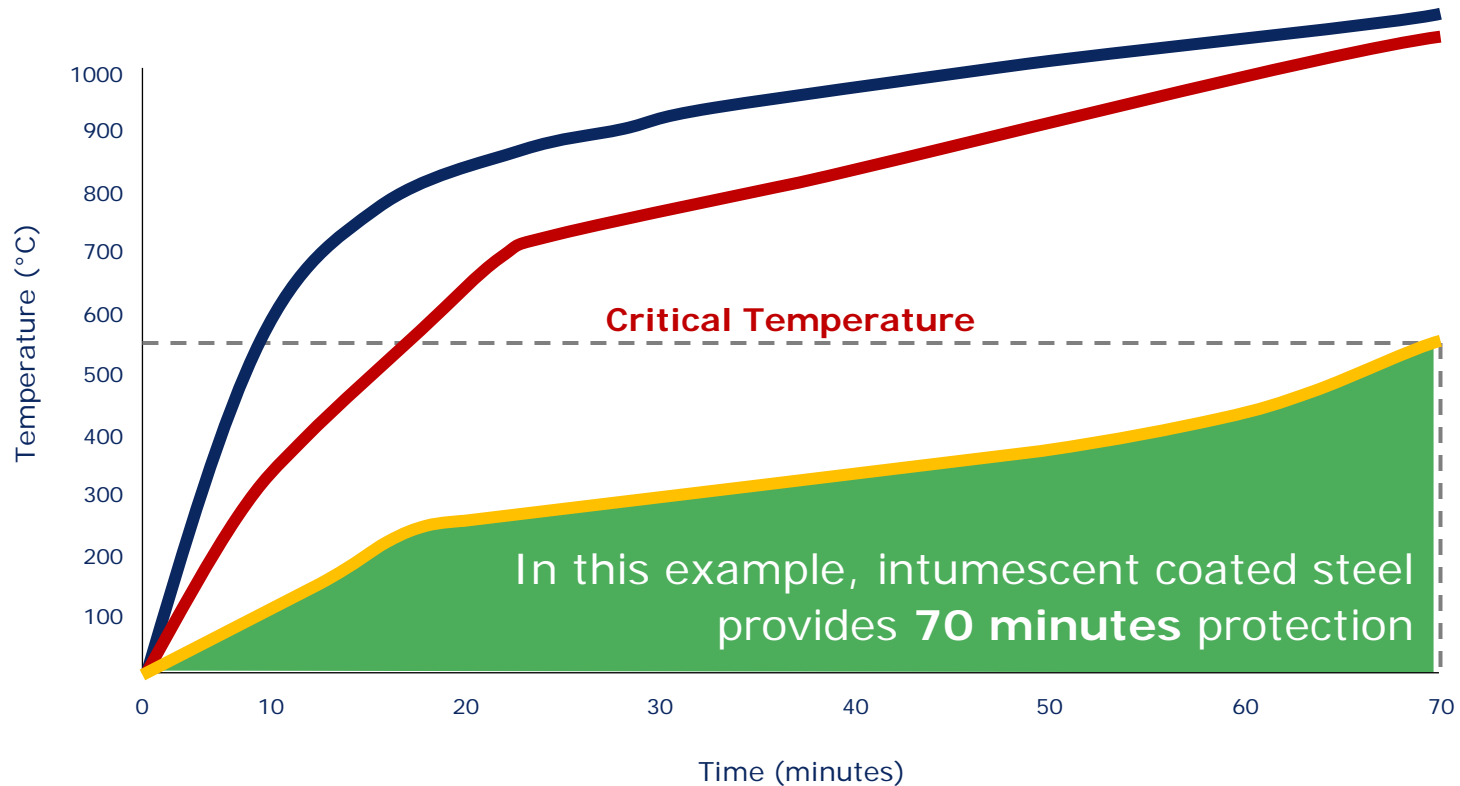
Steel loses its strength as the temperature increases



Structural Steel buckling and collapsing starting at around 550°C



THIN FILM INTUMESCENT COATINGS



Furnace
 Uncoated Steel
 Intumescent coated Steel

THIN FILM INTUMESCENT COATINGS

Used for protection of Architecturally Exposed Structural Steel (AESS)



- Provide good aesthetics
- Reduces column footprint dimensions
- Schedule improvement from faster installation
- Weight saving
- Easy maintenance

BUILDING CODES, FIRE TESTING & STANDARDS



FIRE DESIGN BUILDING CODES

Eg: NFPA 5000 code for fire safety in buildings

Table 7.2.1.1 Fire Resistance Ratings for Type I Through Type V Construction (hr)

Construction Element	Type I		Type II			Type III	
	442	332	222	111	000	211	200
Exterior Bearing Walls^a							
Supporting more than one floor, columns, or other bearing walls	4	3	2	1	0 ^b	2	2
Supporting one floor only	4	3	2	1	0 ^b	2	2
Supporting a roof only	4	3	2	1	0 ^b	2	2
Interior Bearing Walls							
Supporting more than one floor, columns, or other bearing walls	4	3	2	1	0	1	0
Supporting one floor only	3	2	2	1	0	1	0
Supporting roofs only	3	2	1	1	0	1	0
Columns							
Supporting more than one floor, columns, or other bearing walls	4	3	2	1	0	1	0
Supporting one floor only	3	2	2	1	0	1	0
Supporting roofs only	3	2	1	1	0	1	0
Beams, Girders, Trusses, and Arches							
Supporting more than one floor, columns, or other bearing walls	4	3	2	1	0	1	0
Supporting one floor only	2	2	2	1	0	1	0
Supporting roofs only	2	2	1	1	0	1	0
Floor/Ceiling Assemblies	2	2	2	1	0	1	0
Roof/Ceiling Assemblies	2	1½	1	1	0	1	0
Interior Nonbearing Walls	0	0	0	0	0	0	0
Exterior Nonbearing Walls^c	0 ^b	0 ^b	0 ^b	0 ^b	0 ^b	0 ^b	0 ^b

Fire resistance ratings are typically set by an architect/engineer using a simple look-up table.

Ratings are based on:

- **Type of Construction**
 - Safety classification
 - Construction materials
- **Fire Resistant Construction Code**
 - Floor area and stories
 - Building occupancy type
 - Provision of suppression systems
- **Specific Construction Element**
 - Structure purpose of the element

E.g. For an office building, 50m high with a sprinkler system, required fire rating is 120 minutes for load-bearing structural elements

THE JOTUN FURNACE

- For R&D to test newly developed products
- Also used to support existing products:
 - Raw Material evaluations
 - Topcoat/Primer interactions
 - Test on sections of 1 m beams or up to 1.8 m on columns
- Screening tests in small-scale furnaces
 - Plates 30x20 cm
 - Formulation adjustments
- Indicative tests in medium scale furnaces
 - 1 m sections
 - DFT range
 - Massivity range



FIRE TESTING IN OUR R&D FURNACE



COLUMNS FIRE TESTING USING THIRD-PARTY LAB



FIRE TESTING FOR INTUMESCENT CERTIFICATION

All intumescent products should be independently fire tested to BS476 Parts 20 and 21 Or UL 263 by:



The Building Research Establishment



Warrington Fire Research Centre



Underwriters Laboratory



FIRE PROTECTION

Steel sections & Hp/A

DETERMINING THICKNESS OF INTUMESCENT PAINT



- Typical information required:
 - Standard for approval
 - Fire resistance Period
 - Steel section type
 - Number of sides exposed
 - Steel section size
 - Limiting Steel temperature / CCT

- We can then determine the DFT taken from the Certifier/UL loading tables

- Further information can decide type of product
 - Environmental exposure - degree of corrosion
 - Durability requirements

STEEL SECTION FACTOR AND HEATING

■ Area of cross section (A)

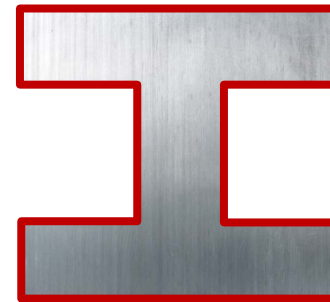
■ Heated perimeter of cross section (H_p)

Section Factor = H_p/A (m^{-1})

Also expressed as A/V (m^{-1})

=

Heated surface area (A) /
Cross-sectional volume (V)



**THICK
STEEL**

Heavy section
Low H_p/A value
Intumescent 450 microns



**THIN
STEEL**

Lighter section
High H_p/A value
Intumescent 1200 microns

STEEL AND HEATING



LOW H_p/A
 $75H_p/A$

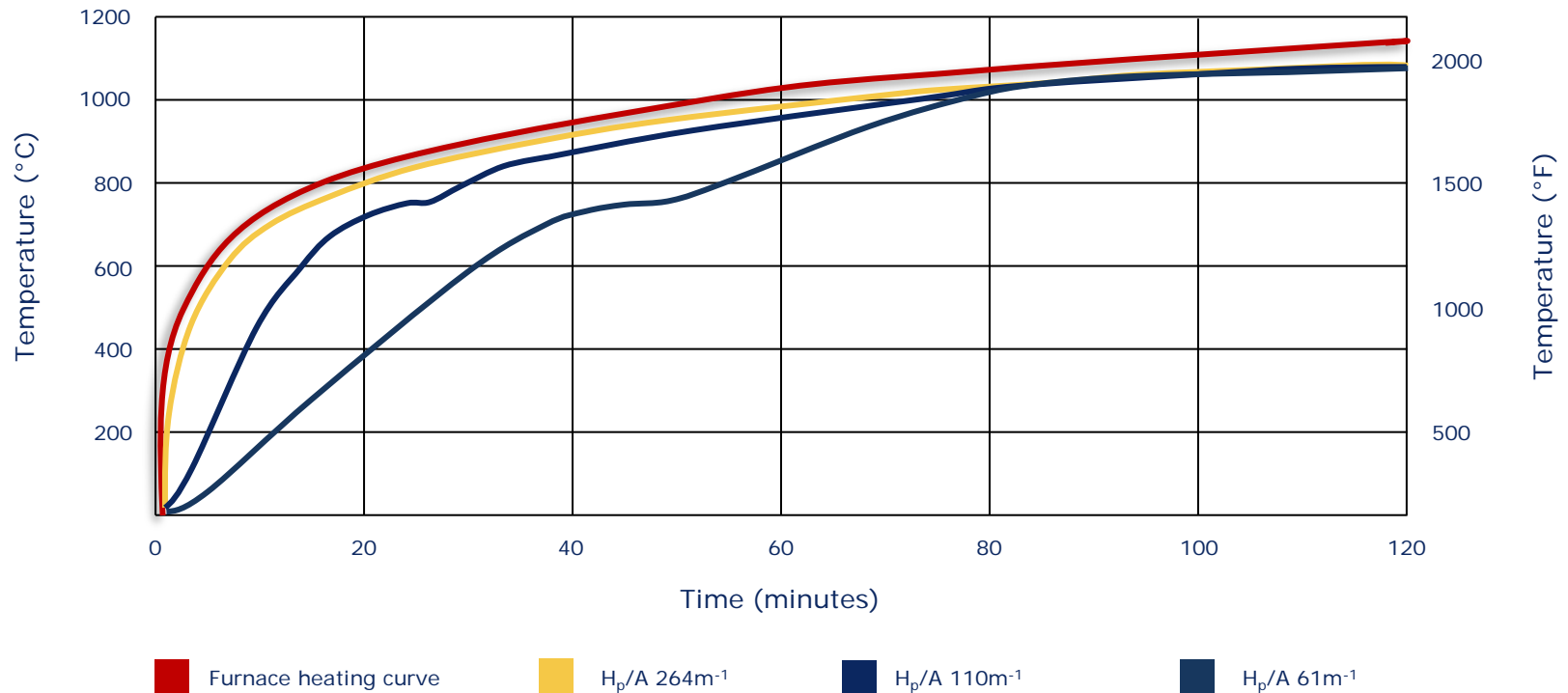
High inherent fire resistance
Lower film thickness required



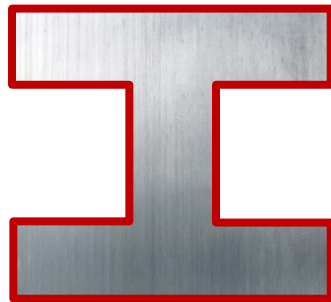
HIGH H_p/A
 $300H_p/A$

Low inherent fire resistance
Higher film thickness required

Heating rate curves for three different sized beams in the standard fire test

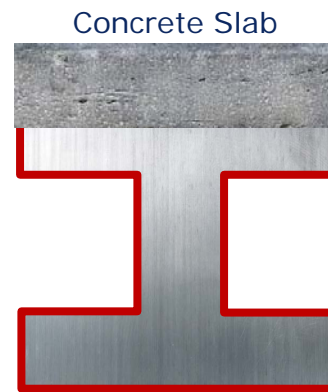


PARTIAL EXPOSURE



**4 SIDES
EXPOSED**

to heat 550 °C



**3 SIDES
EXPOSED**

to heat 620 °C



CERTIFICATE No CF 5243
JOTUN A/S

SteelMaster 1200WF

Table 4: I-Section Columns 75 Minutes (continued)										
Section Factor up to m ⁻¹	Thickness (mm) Required for a Design Temperature of									
	350°C	400°C	450°C	500°C	550°C	600°C	620°C	650°C	700°C	750°C
205	2.861	2.374	1.956	1.428	1.086	0.934	0.886	0.815	0.700	0.588
210	2.897	2.422	1.999	1.471	1.127	0.954	0.905	0.832	0.715	0.602
215	2.934	2.470	2.041	1.515	1.167	0.974	0.924	0.850	0.731	0.615
220	2.971	2.517	2.084	1.558	1.208	0.994	0.943	0.867	0.746	0.629
225	3.007	2.556	2.126	1.601	1.248	1.014	0.962	0.885	0.761	0.643
230	3.044	2.595	2.169	1.645	1.289	1.046	0.980	0.902	0.777	0.656
235	3.081	2.633	2.211	1.688	1.329	1.084	0.999	0.920	0.792	0.670
240	3.118	2.672	2.254	1.731	1.370	1.122	1.018	0.937	0.807	0.683
245	3.154	2.711	2.296	1.775	1.410	1.160	1.053	0.955	0.823	0.697
250	3.191	2.750	2.339	1.818	1.451	1.198	1.090	0.972	0.838	0.711
255	3.228	2.789	2.381	1.861	1.491	1.236	1.128	0.990	0.853	0.724
260	3.264	2.828	2.423	1.904	1.532	1.274	1.165	1.007	0.869	0.738
265	3.301	2.866	2.466	1.948	1.572	1.312	1.202	1.028	0.884	0.751
270	3.338	2.905	2.508	1.991	1.613	1.350	1.239	1.065	0.899	0.765
275	3.375	2.944	2.550	2.034	1.653	1.387	1.276	1.101	0.915	0.779
280	3.411	2.983	2.592	2.078	1.694	1.425	1.314	1.138	0.930	0.792
285	3.448	3.022	2.634	2.121	1.734	1.463	1.351	1.174	0.945	0.806
290	3.485	3.061	2.676	2.164	1.775	1.501	1.388	1.211	0.960	0.819
295	3.522	3.099	2.717	2.208	1.815	1.539	1.425	1.247	0.976	0.833



FIRE PROTECTION Coating Systems



FIRE PROTECTION COATING SYSTEMS



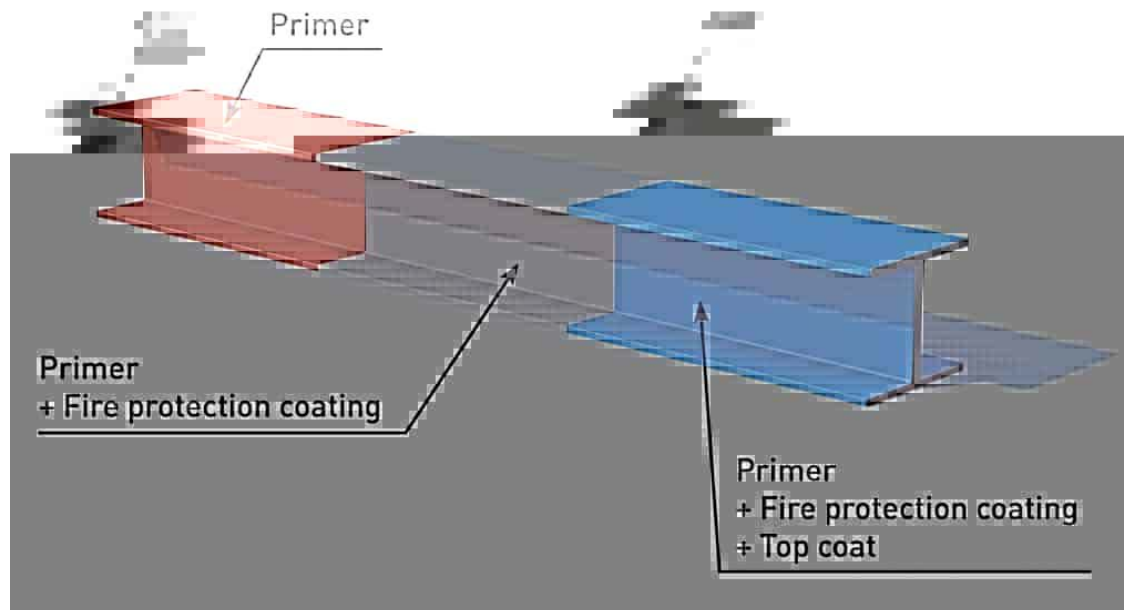
PRIMERS
Protect against
corrosion



MID COAT
Intumescent
fire protection



TOP COAT
Protect the
base coat and
provide colour



INTUMESCENT COATING SYSTEM PRIMERS

- Intumescent coatings must be applied over new primed structural steel
- The condition, age and DFT of the primer is very important
- **Compatibility** with the applied primer: Technical data sheets must be sought from the builder/steel fabricator for compatibility check
- **Special consideration** is given to aged coatings or galvanised substrate



IMPORTANCE OF COMPATIBLE TOP COAT



3605, DC,
0305-2442,
TEST # 3627,
7106,
10.07.03

3605,
1000PLAST 1K
TOP SEAL,
TEST # 3627,
7241,
10.07.03

3605,
SCLON AIR DA
TOP SEAL,
TEST # 3627,
7277,
10.07.03



Same primer &
intumescent

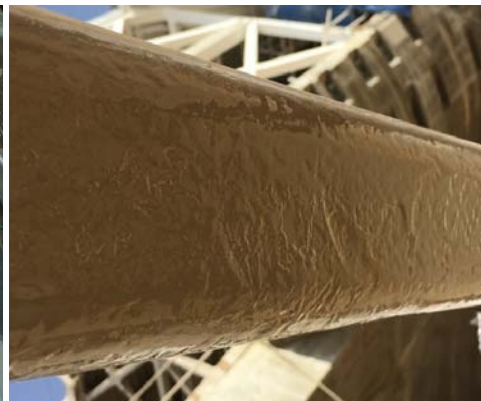


Same primer,
intumescent &
competitor's topcoat



Same primer,
intumescent &
topcoat

POOR COSMETIC FINISH



STANDARDS OF FINISH (ASFP)

2.1.11 Standards of cosmetic finish

The standard of finish required by the client should be included in the specification. Typically, the quality of finish that can be offered will fall into one of the following categories:

(i) Basic Finish:

The coating system achieves the required fire performance and corrosion protection performance, but is not required to achieve any requirement for standard of finish.

(ii) Decorative Finish:

In addition to the requirements for (i) above, a good standard of cosmetic finish is generally required, when viewed from a distance of 5 m. Minor orange peel or other texture resulting from application or localized repair is acceptable.

(iii) Bespoke Finish

In addition to the requirements for (i) above, the coating finish is required to have a standard of evenness, smoothness and gloss agreed between the specifier and contractor. When agreeing a bespoke standard of finish, the specifier and contractor should take account of the effects of steel size, section shape, design complexity and the required period of fire resistance.

The contractor will normally provide for a basic finish unless otherwise noted in the contract documents.



ON-SITE APPLICATION CONSIDERATIONS



- Ensure substrate is prepared properly
- Weather and long term exposure considerations
- Access considerations
- Consider other trades
- Correct P.P.E must be worn



Intumescent coatings are very soft and easily damaged

LEED® v4 contribution

LEED
CONTRIBUTIONS.
**SEE WHAT
PAINT ADDS
TO THE PICTURE.**



The U.S. Green Building Council's LEED® green building program is the preeminent program for the design, construction, maintenance and operations of high-performance green buildings. Learn more at usgbc.org/LEED.



LEED® v4 contribution

Intumescent coating systems



Material & Resources

Possible: 2

Credit	Building product disclosure and optimization – Environmental Product Declarations ¹	1
Credit	Building product disclosure and optimization – material ingredients	1



Indoor Environmental Quality

Possible: 3

Credit	Low-emitting materials	3
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¹An Environmental Product Declaration (EPD) is an independently verified and registered document that communicates transparent and comparable information about the life-cycle environmental impact of products. As a voluntary declaration of the life-cycle environmental impact, having an EPD for a product does not imply that the declared product is environmentally superior to alternatives.

LEED® v4 contribution

Intumescent coating systems

CATEGORY	CREDIT OPTION	THRESHOLD	CRITERIA	ACCEPTABLE DOCUMENTATION
Materials & Resources	Building Product Disclosure & Optimization – Environmental Product Declarations (Option 1)	≥20 different permanently installed products from ≥5 different manufacturers	Minimum scope <u>cradle-to-gate</u> defined for: <ul style="list-style-type: none"> LCA (ISO 14044), or Industry-wide, or Product specific 3rd party certified EPD (ISO 14025 & EN 15804 or ISO 21930) 	Product-specific Type III EPD (valued as a full product)
Materials & Resources	Building Product Disclosure & Optimization – Material Ingredient optimization (Option 2): <i>International Alternative Compliance Path – REACH Optimization</i>	≥25% by cost of the total value of permanently installed products	Have fully inventoried chemical ingredients to 100 ppm and assessed against the Authorisation list – Annex XIV, Restriction list – Annex XVII and SVHC candidate list	Self-declaration (eg: technical data sheets) stating that product has no ingredients on the REACH lists (valued at 100% of cost)
Indoor Environmental Quality	Low-emitting Materials (Option 1: Product Category Calculations) <i>Note: Interior paints is one of several material categories so total points depend on how many categories meet their respective criteria:</i> <ul style="list-style-type: none"> 2 categories = 1 point If 4 compliant = 2 points If 5 or more = 3 points 	100% of interior paints applied on-site for VOC content and ≥90% for VOC emissions, by volume	<ul style="list-style-type: none"> 14-day TVOC declared and single VOC emissions complying to table 4-1 CDPH method v1.2 VOC content meeting limits of applicable regulation, eg: CARB 2007 SCM: <ul style="list-style-type: none"> 250 g/L for industrial maintenance coatings 350 g/L for fire resistive coatings 	<ul style="list-style-type: none"> 3rd party lab confirmation for <u>VOC emissions</u> Self-declaration for <u>VOC content</u> with the test method specified and as per VOC regulation

LCA = Life Cycle Analysis; ISO = International Standards Organisation; EN = European Standard; EPD = Environmental Product Declaration
 REACH = Registration, Evaluation and Authorisation of Chemicals in EU; SVHC = Substances of Very High Concern; ppm = parts per million
 VOC = Volatile Organic Compounds; TVOC = Total Volatile Organic Compounds
 CDPH = California Department of Public Health; CARB 2007 SCM = California Air Resources Board 2007 Suggested Control Measures

Jotun's intumescent systems contribute to LEED® v4



30 - 90 minutes fire protection



- Penguard WF
- Penguard HSP E / HSP ZP E
- Jotamastic 70¹



- SteelMaster 600WF



- Hardtop Eco²

90 – 180 minutes fire protection

- Penguard WF
- Penguard HSP E / HSP ZP E
- Jotamastic 70¹

- SteelMaster 1200WF

- Hardtop Eco²
- Hardtop One²
- Hardtop Optima²

¹Sa2.5 or prepared, well adhering existing epoxy primer system + Jotamastic 70 with total dry film thickness <150µm

²Topcoats evaluated for compatibility, adhesion and fire performance to BS476 standard

CPD¹ Seminar

<https://www.ribacpd.com/jotun-paints-europe-ltd-protective-segment/4335/overview/>



Fire Protection of Steel Structures Utilizing Intumescent Coatings

This seminar looks at the use of intumescent coatings as fire protection on steel structures. It will help you to understand the following topics:

- Understand how fire protection of structural steel works
- Understand why fire protection is required
- Understand the different types of fire protection for structural steel
- Understand how to select the right fire protection products
- Understand the specification of the correct fire protection products and how to insert specification clauses to prevent pitfalls

[read less...]

RIBA² Core Curriculum: **Design, construction and technology**
 Knowledge level: **General Awareness**

Material type: Seminar

[➔ Book Seminar](#) [+ Add to shortlist](#)

¹CPD: Continuous Professional Development

²RIBA: Royal Institute of British Architects

New GBP 3 mill. R&D Centre in UK!



SteelMaster

jotun.com/steelmaster
jotun.com/greenbuildingsolutions

**EXTENDING FIRE
PROTECTION**
**ENGINEERED FOR
A BETTER ENVIRONMENT**