



Sustainable Certified Structural Steel Fire Protection Solutions

Can it be achieved at reduced costs?

Chris Partington





Carboline – A Global Company



- › A wholly owned subsidiary of RPM International Inc.
- › Headquartered in St. Louis, Missouri
- › Over 75 years of specializing in the manufacturing of high-performance coatings and linings.
- › Over 45 years specializing in passive fireproofing materials
- › Fireproofing brands



The only manufacturer with both Mortar and Intumescent fireproofing products.

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Sustainable Certified Structural Steel Fire Protection Solutions

- My general experience of a sustainable certified solutions in the construction industry is that it will cost significantly more than a traditional solution and possibly less performance
- Has anybody else had that experience ?
- Why should it cost more?
- High Research and Development and testing costs
- New unique raw materials
- Higher productions costs
- Initial lower sales volumes / low returns on investment



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Why do we need to protect structural steel in a fire?

- Structural collapse
- Steel does not burn, but it starts to lose its structural strength at temperatures above 300 °C.
- Structural Steel members can ONLY achieve Structural Adequacy
- 30/-/- 60/-/- 90/-/- 120/-/- 180/-/- 240/-/-



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How do we protect structural steel in a fire?

- Early engagement of a structural fire engineer
- Early engagement with manufacturers
- Detailed Specification
- Early engagement with applicators
- Selection of sustainable certified solutions with relevant building code compliance
- Calculation of product thicknesses based on steel size, FRL and LST
- Calculation of limiting steel temperatures (LST) based on the design load
- 3RD Party inspection company with relevant qualifications – NACE 3



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What do we use to protect structural steel in a fire?

Vermiculite or Perlite Spray

Gypsum or cement-based material with the addition of vermiculite or perlite



Board systems



Intumescent coating system



Which solution should I use?

- The Australian structural steel fire protection market is generally a 2-hour requirement
- Predominately solutions are applied on site (SPRAY Solutions)
- Usually, steelwork is hidden
- Initial cost is usually the driving factor
- Vermiculite / Perlite SPRAY type solution will generally be the most economical solution above 60/-/-
- Vermiculite / Perlite SPRAY dramatically more economical at 3 and 4 hours
- However, for larger projects factory application using intumescent coating systems can be extremely beneficial giving you a faster construction path



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Which solution should I use?

- **Vermiculite / Perlite** traditional spray fire protection for structural steel works by creating a protective coating that insulates the steel from heat and fire. When exposed to high temperatures, forming a thick layer of insulation that slows down the heat transfer to the steel, allowing it to retain its structural integrity for a longer period. This helps prevent the steel from failing prematurely and ensures the building's stability during a fire.
- Don't offer corrosion protection – so may need additional surface preparation and primers
- Don't offer colour if exposed – so topcoats will be required if a specific colour is required



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Vermiculite compared to Perlite

- **Internal atmosphere** – VERMICULITE / PERLITE + PLASTER GYPSUM
- **External atmosphere** VERMICULITE / PERLITE + CEMENT

- **VERMICULITE** – Brown / Red, heat expanded material made from mined mica has a high-water holding capacity
- **PERLITE** – White made from volcanic rock, doesn't absorb water

- Traditional Vermiculite materials contain a large amount of cellulose product i.e. paper
- Latest technology based on PERLITE and using EPS and fibers. – assisting to give reduced product thicknesses and extended steel section ranges



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Typical Application Equipment Measurement of Spray solutions



Figure 14 Fireproofing depth gauge sample (illustration only)



Compliance to the building code

- Products need to be tested to AS1530.4-2014
- Majority of products are tested to BS476 or EN13381-4 or 8 and equivalency is shown to AS1530.4
- Products assessed to AS4100 – Structural Steel Standard
- AS4100 allows for materials to be assessed to a regression analysis
- **OR** the use of EN13381-4 or 8 assessments to be used with a local assessment



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Calculation of Limiting Steel Temperature AS4100

SECTION 12 FIRE

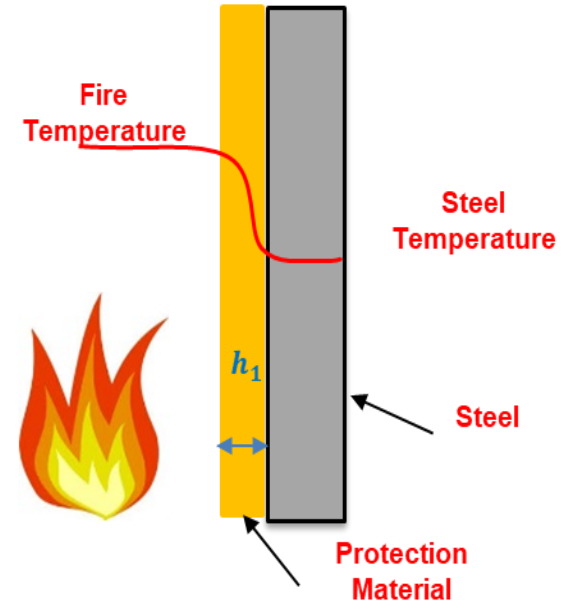
12.1 REQUIREMENTS

This Section applies to steel building elements required to have a fire-resistance level (FRL).

For protected steel members and connections, the thickness of protection material (h_i) shall be greater than or equal to that required to give a period of structural adequacy (PSA) equal to the required FRL.

For unprotected steel members and connections, the exposed surface area to mass ratio (k_{sm}) shall be less than or equal to that required to give a PSA equal to the required FRL.

The period of structural adequacy (PSA) shall be determined in accordance with Clause 12.3, using the variations of the mechanical properties of steel with temperature as specified in Clause 12.4.



Calculation of Limiting Steel Temperature

- ▶ Steel loses strength immediately upon heating, this becomes critical from a structural adequacy perspective starting from 300°C.
- ▶ At a temperature of 550°C steel will retain approximately 50% of its room temperature load capacity.
- ▶ Empirically, for steel supporting floor loads:
 - ▶ 550°C is considered to be the failure temperature for structural steel columns exposed on 4 sides.
 - ▶ 620°C for structural steel beams.
- ▶ Empirically, steel supporting roof loads can have critical steel temperatures from 700°C.
- ▶ Failure temperatures can be as high as 750°C or even higher for partially exposed members and/or under loaded sections.

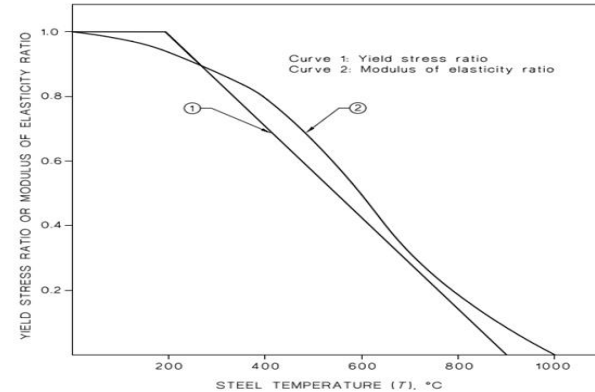
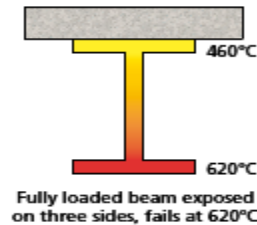


FIGURE 12.4 VARIATION OF MECHANICAL PROPERTIES OF STEEL WITH TEMPERATURE



What Limiting Steel Temperature Should I use?

Geometry	Temperature Guidance Deg C	
	Traditional	YB Rev 6
3-Sided Beam	620	580
4-Sided Beam	550	550
Hangers & Tension Rods	400	550
Columns	550	500
Hollow Columns	520	500

Guidance from ASFP Yellow Book



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Product thickness Versus LST - Beam section factor 200

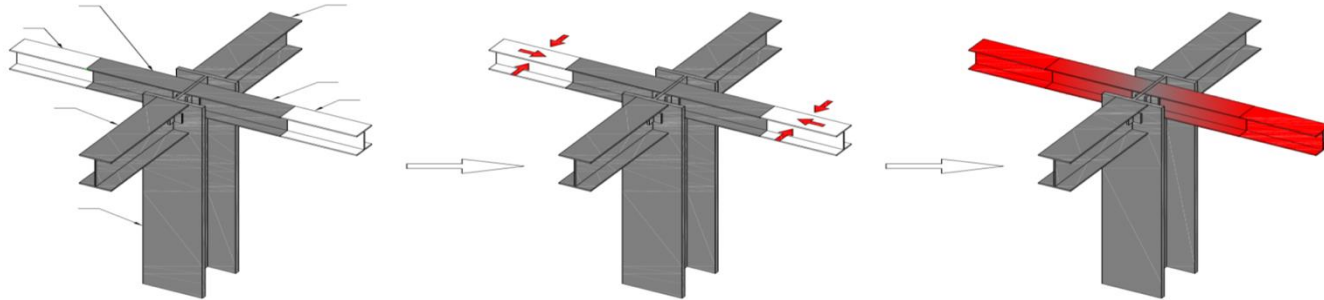
Deg C LST	350	400	450	500	550	600	650	700	750
60/-/-	11	11	10	10	10	10	10	10	10
120/-/-	26	25	23	20	18	16	14	13	11
180/-/-	35	33	30	28	27	27	26	25	23

Product thicknesses based on **PERLIFOC HP ECO+**

Coat back on non fire rated secondary steelwork

The potential for heat transfer from unprotected structural steel into protected structural steel must be considered. It is normally considered good practice to protect the adjoining 500mm of 'unprotected' structural steel to limit unwanted heat transfer. Board systems, the end of the system should be capped off to prevent passage of fire into the web of a beam or column. This means filling the end of the boxed system with at least the same board thickness, as used for the primary protection of the steel element, using tested fixing systems

Spray systems the unprotected steel should be masked prior to application of the spray such that a clean edge is achieved for the full depth of the sprayed system. Profiled board systems will be expected to have a square edge



ASFP Guidance – manufacturers having product specific evidence

Junction between different materials



ASFP Guidance – manufacturers having product specific evidence



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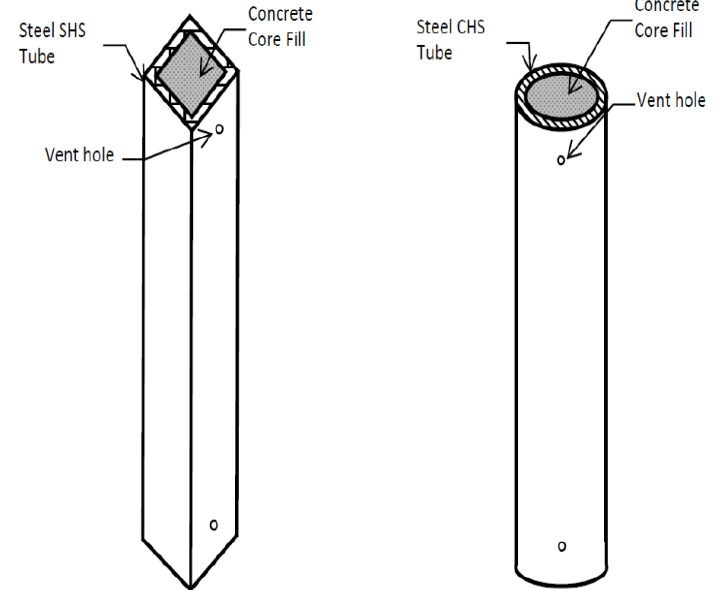


Concrete Core Filled Hollow Sections EN13381-6

Core-Filling is a viable solution to fire protect high Hp/A hollow section steel unable to achieve the desired FRL (usually 120 minutes)

Provides additional option between:

- ▶ Upgrading the steel size
 - ▶ Lowering DFTs
 - ▶ A grout or standard concrete mix (<40MPa) loosely packed concrete is adequate.
 - ▶ Mix lowers the Hp/A of the steel member and justifies a significant reduction in required dry film thickness to meet high FRLs.
-
- ▶ Benefit of core-filling hollow section steel:
 - ▶ Lowers the Hp/A value
 - ▶ The mix adds thermal resistance to the structural steel
 - ▶ Forms a composite column with higher compressive capacity
 - ▶ Lower film builds can have aesthetic advantages in terms of level of finish



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Detailed Specification

NULLIFIRE / Carboline have a highly trained and knowledgeable team that would be happy to provide a tailored specification for your project. It is important to provide all the correct information, including any plans, so that the specification is correctly detailed.

Correct specifications should include the following:

- Client Details
- Project Details
- Corrosivity Category
- Member Types and Sizes
- FRL
- Steel critical failure temperature
- Finish Required
- Steel Preparation Required
- Top Seal Required
- Product Technical Data Sheet Attached
- Any other requirements such as core-filling or meshing



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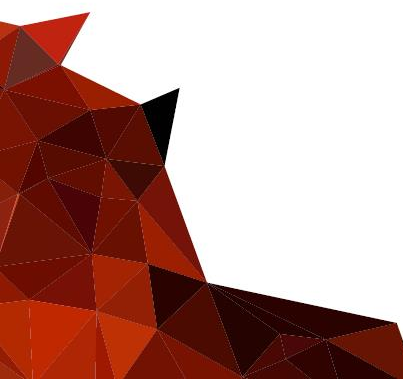
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Next Generation Sustainable Certified Spray Solutions



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PERLIFOC HP ECO + Case study

Nullifire Smart Protection

carboline

Part of TREMCO Construction Products Group

PERLIFOC HP ECO+

PROTECCIÓN CONTRA INCENDIOS

Materia de alta resistencia. Aplicación de pintura contra el fuego. Disponible también en spray. Hecho de materiales reciclados. Reciclos aptos y seguros.

SUSTAINABLE FIRE PROTECTION

PERLIFOC HP ECO+ has 30% plus reduction in product thickness and is compliant to AS1530.4 - 2014 / AS4100 - 2020

PERLIFOC HP ECO + is a sustainable alternative to Vermiculite spray with its unique CRADLE2CRADLE certificate, which facilitates obtaining points in the LEED, BREEAM & WELL certifications.

US GREEN BUILDING COUNCIL LEED

BREEAM

WELL

CERTIFIED cradle to cradle SILVER

Download our Brochures

Perlifoc HP Eco+

Fire Protection

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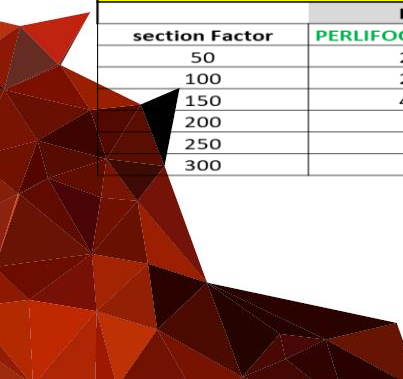
- Perlite & Gypsum based solution
- 480 KG / M3 Density
- Internal and semi exposed environments
- Works for the construction environment
- Robust material once cured
- **LEED, BREEAM, WELL, C2C, EPD Certification**
- Structural Steel, Concrete and Metal decking
- AS1530.4-2014 / AS4100-2020
- EN13381-3, EN13381-4, EN13381-5, EN 13501-1, EN 1364-1, EN13501-2 (annex I).

PERLIFOC HP ECO+ thickness comparison to vermiculite spray

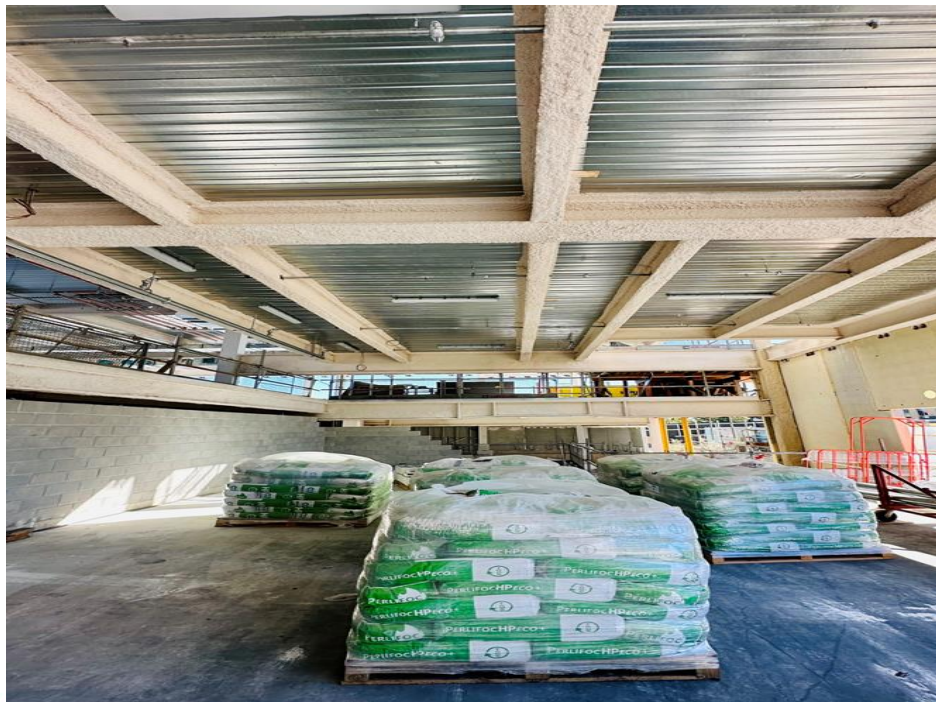
120 Min mm DFT									
section Factor	I Columns 550 Deg			I Beam 620 Deg C			Hollow Column 550 Deg C		
	PERLIFOC HP ECO +	Vermiculite	% Change	PERLIFOC HP ECO +	Vermiculite	% Change	PERLIFOC HP ECO +	Vermiculite	% Change
50	9	21	133	10	17	70	10	23	130
100	11	22	100	10	18	80	12	24	100
150	15	27	80	13	23	77	17	30	76
200	18	29	61	16	26	62	22	34	55
250	21	30	43	18	27	50	26	37	42
300	24	31	29	20	28	40	29	38	31

180 Min mm DFT									
section Factor	I Columns 550 Deg			I Beam 620 Deg C			Hollow Column 550 Deg C		
	PERLIFOC HP ECO +	Vermiculite	% Change	PERLIFOC HP ECO +	Vermiculite	% Change	PERLIFOC HP ECO +	vermiculite	% Change
50	16	37	131	14	32	128	17	41	141
100	21	38	81	19	33	73	23	41	78
150	26	41	58	25	37	48	29	48	66
200	27	43	59	27	39	44	33	52	58
250	29	44	52	28	41	46	36	55	53
300	30	45	50	30	41	36	38	56	47

240 Min mm DFT									
section Factor	I Columns 550 Deg			I Beam 620 Deg C			Hollow Column 550 Deg C		
	PERLIFOC HP ECO +	Vermiculite	% Change	PERLIFOC HP ECO +	Vermiculite	% Change	PERLIFOC HP ECO +	Vermiculite	% Change
50	24	53	120	21	48	128	25	58	132
100	29	54	86	28	49	75	32	59	84
150	40	56	40	34	52	52	41 (140)	64	56
200				41 (185)	53	29			
250									
300									



PERLIFOC HP ECO+ Case Study Burnside Shopping Centre SA



- 2000T (20,000m²)
Structural steel framed building
- FRL 120/-/-
- Buchan Group Architect
- Walbridge & Gilbert Engineers
- Hansen Yunken
- Adelaide Fire Doors
- 120,000 Kg of PERLIFOC HP ECO+



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Learnings

- A reduced cost sustainable certified solution is available compared to traditional vermiculite solutions
- Early engagement of a structural fire engineer + Calculation of limiting Steel temperatures
- Early engagement with manufacturers
- Detailed Specification
- Early engagement with applicators
- 3RD Party inspection company with relevant qualifications NACE 3, ICORR
- Coatback for secondary and possibly tertiary member
- Connections between different system are compliant
- Concrete filled section compliant to EN13381-6



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Thank You – Please Visit us at Stand 310

Chris Partington| Passive Fire Protection Manager

Nullifire | Perlifoc

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