HEMPEL
Trust is earned

A guide to specifying

Passive fire protection

Specified to **Last**

Introduction

As the construction industry grows more complex, passive fire protection (PFP) systems have become critical to the safety and resilience of buildings, particularly those with significant structural steel frameworks.

This guide explores the most significant regulatory trends shaping PFP, including the shift towards performance-based standards, the rise of environmentally sustainable solutions, and the drive for international standards harmonisation.

For specifiers, keeping up with these trends is essential to ensure that projects are not only compliant but also equipped with fire protection solutions that align with today's safety and environmental expectations.

Dive into this guide to better understand the key factors influencing PFP regulations and to learn how to make informed choices that balance safety, sustainability, and innovation in fire protection.

Trends in **PFP regulations**

In recent years, the field of PFP has seen significant shifts in regulations, driven largely by some grave fire incidents and evolving building practices.

The Grenfell Tower fire in London and the Lacrosse Building fire in Melbourne exposed critical weaknesses in fire safety, particularly in high-rise and high-density buildings. The rapid spread of flames in these incidents, fueled by cladding systems and insufficient passive fire protection, underscored the urgent need for stricter standards. In response, countries like the UK and Australia have introduced more rigorous fire safety regulations, requiring specifiers to ensure comprehensive protection for structural elements, particularly those that are crucial in supporting building integrity.

Amid these changes, fire protection standards are moving away from prescriptive require-ments, which specify exact materials or thicknesses, towards performance-based approaches that emphasise results.

This shift allows for more flexibility in how fire resistance is achieved but also places greater responsibility on specifiers to ensure that chosen PFP solutions meet performance benchmarks. Performance-based standards, now common in Europe and parts of North America, require a deep understanding of fire dynamics and structural behaviour, along with advanced modelling tools to ensure compliance.

Furthermore, we are seeing a push towards harmonising fire protection standards internationally. Efforts to create alignment, using standards like ISO 834 and EAD 350402-00-1106, aim to simplify compliance for global construction projects. However, regional variations in building codes and environmental factors still make uniformity challenging, requiring specifiers working across countries to stay well-informed on local requirements to ensure consistent fire safety.

The basics of **cellulosic fires**

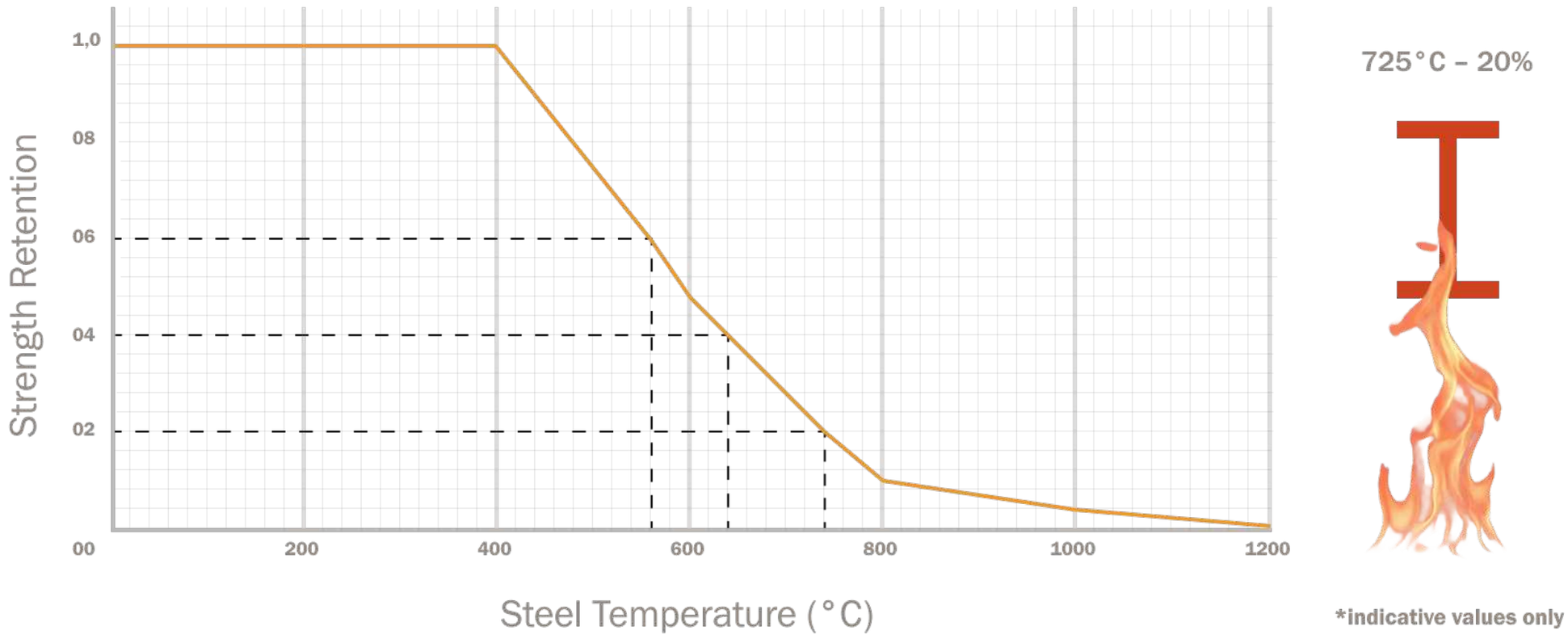
Fires are typically categorised based on their fuel sources, with cellulosic and hydrocarbon fires being the most common types encountered in buildings and industrial settings.

Cellulosic fires, which are fuelled by everyday building materials like wood, paper, and textiles, burn at a slower rate than hydrocarbon fires but can still reach extremely high temperatures — well above the tolerance of unprotected steel.

Steel, while robust under normal conditions, begins to lose approximately 40% of its load-bearing capacity at 550°C.

In a cellulosic fire, unprotected steel can reach this critical temperature within minutes, risking collapse and endangering lives and assets.

Structural steel loses strength at elevated temperatures



How intumescent **coatings work**

Intumescent coatings are a specialised type of PFP solution designed to shield structural steel from the heat of a fire. When exposed to high temperatures, these coatings undergo a chemical reaction that causes them to expand (or “intumesce”) significantly in volume, forming a thick, insulating char layer. This char acts as a thermal barrier, slowing the transfer of heat to the steel underneath.

The science behind intumescent coatings is complex but effective: as the coating expands, it traps air and creates an insulating layer that significantly delays the steel from reaching critical failure temperatures.

This extended protection can provide anywhere from 30 to 240 minutes of additional fire resistance, depending on the coating’s composition and thickness.

Challenges in PFP specifications **& how to address them**

Specifying PFP can be tricky. In this section, we'll look at the main challenges, like meeting fire safety standards, keeping an appealing aesthetics, and ensuring sustainability – and share practical ways to overcome them.

Getting the fire protection standards and ratings right

When specifying PFP solutions, a fundamental consideration is the required fire resistance rating, typically measured in time increments (e.g., 30, 60, 90 or 120 minutes or beyond).

These ratings indicate the duration that a coating can protect steel from reaching critical temperatures in a fire event. The required rating affects the type and thickness of the coating specified. For example, higher ratings generally necessitate a thicker layer of intumescent coating, which insulates the steel for longer periods under extreme heat.

In many regions, fire protection ratings are mandated by local building codes. In the EU, for instance, fire protection standards are stringent, often requiring a minimum 60-minute rating for structural steel in multi-story buildings. In the Middle East, British standards are frequently applied, which emphasise a 120-minute protection requirement in many high-risk applications. Specifiers need to carefully assess the structural requirements and local standards to determine the appropriate level of fire resistance.

Lasting fire protection in challenging environments

Durability under specific conditions is a critical regulatory focus. Coatings must be carefully matched to their environmental exposure category to ensure they deliver long-lasting fire protection. Choosing the appropriate intumescent coating for each environment is vital to prevent premature degradation and to ensure compliance with local regulations.

However, durability in fire protection goes beyond the intumescent layer; it is about the synergy of the entire coating system — primer, intumescent coating, and topcoat. Each layer plays a distinct yet complementary role in protecting steel from various environmental and mechanical stresses. The primer is crucial for preventing corrosion, forming the foundational barrier against environmental aggressors such as humidity and salt. The intumescent coating provides the fire-retardant properties, while the topcoat shields the entire system from external factors like UV exposure, chemicals, and physical wear.

This layered approach ensures compliance with local regulations and prolongs the asset's lifespan in environments of high corrosivity, such as coastal or semi-exposed industrial areas (C4 and C5).

For example, in semi-exposed environments, water-based intumescent coatings might be susceptible to failure due to prolonged exposure to moisture. A robust solvent-based intumescent coating, paired with a corrosion-resistant primer and a durable topcoat, addresses this challenge effectively.

Moreover, advanced fire protection coatings such as those leveraging Hempel's technologies can withstand on-site challenges even without immediate application of the topcoat. During construction, steel beams coated with advanced primers and intumescent layers can resist mechanical damage from e.g. crane hoisting or transportation and tolerate exposure to the elements for months without topcoat. And finally, the flexibility of innovative fire protection systems allows for on-site repairs, a critical feature for maintaining coating integrity after damage during installation.

Balancing structural and aesthetic requirements

Another common challenge of specifying PFP coatings is achieving a balance between structural fire protection and the aesthetic vision of the project. Intumescent coatings, while functional, do not always produce the smoothest surface finish and can result in an “orange peel” effect. This makes it essential to set clear expectations with designers early in the project about what can realistically be achieved.

For instance, if the steel beams will not be visible, such as in concealed areas, a topcoat may not be necessary, and surface smoothness becomes less critical. However, when beams are exposed — like in airports or other architectural projects — specifiers must carefully select a system and application process that ensures the desired colour, smoothness, and overall appearance.

By addressing both fire protection and aesthetic requirements during the planning stage, specifiers can achieve a solution that extends the lifecycle of the fire protection system while meeting visual expectations where needed.

HEET Dynamic: Make fast and confident estimates

Specifier software tools, like Hempel’s HEET Dynamic, support specifiers by aligning product choices with both regulatory standards and environmental demands. By using these tools, estimators can reduce the risk of estimation errors, ensuring that the chosen PFP coatings meet performance requirements even in complex or high-risk projects.

HEET Dynamic integrates with BIM systems to streamline the specification of PFP coatings. It automates DFT calculations, ensuring precise alignment with structural and regulatory requirements.

How it works

Using project-specific data, HEET Dynamic performs real-time dry film thickness (DFT) calculations, automating PFP load assessments to reduce manual errors. Its BIM integration further simplifies specification by seamlessly incorporating PFP coating requirements into structural designs.

Key benefits

HEET Dynamic boosts efficiency by delivering faster, accurate calculations, ensuring regulatory compliance, and reducing estimation errors. Its intuitive interface makes it easy for both experienced engineers and newcomers to use, enabling fast, accurate, and easy decision-making.

Project-specific PFP estimations

By enabling project-specific design temperature calculations, Hempel’s Structural Fire Design (SFD) feature ensures more precise and cost-efficient specification of intumescent coatings – tailored to the exact needs of each project.

The rise of sustainability standards in fire protection coatings

Sustainability has also become a driving force in PFP regulation. As the construction industry intensifies its focus on environmental impact, many regions now require use of low-VOC (volatile organic compound) products and coating solutions with a reduced carbon footprint. VOC emissions are known to contribute to environmental pollution and can pose health risks to applicators and building occupants.

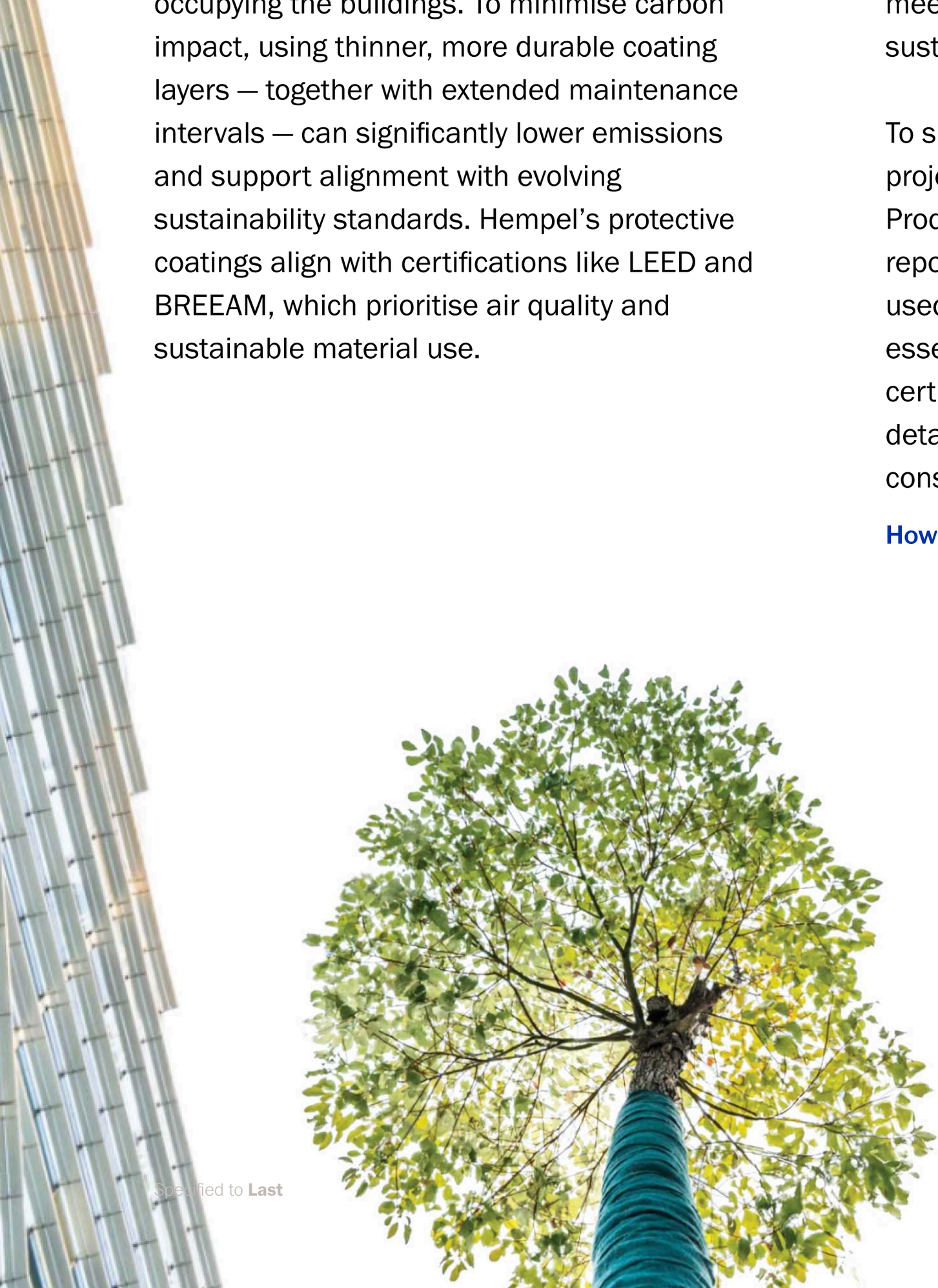
By minimising the release of volatile compounds, low-VOC products improve air quality, creating healthier environments for both those applying the coatings and those occupying the buildings. To minimise carbon impact, using thinner, more durable coating layers — together with extended maintenance intervals — can significantly lower emissions and support alignment with evolving sustainability standards. Hempel's protective coatings align with certifications like LEED and BREEAM, which prioritise air quality and sustainable material use.

However, sustainability goes beyond VOC reduction. Hempel's PFP solutions are formulated to deliver superior performance with low loadings, meaning less material and fewer coats of paint are needed to achieve the same level of protection. This results in reduced environmental waste and resource use without compromising safety.

In Europe, frameworks such as REACH encourage the use of sustainable materials, while many green building certifications now consider both fire safety and environmental impact in their criteria. This shift has spurred innovation in sustainable PFP solutions that meet safety requirements while supporting sustainability goals.

To support specifiers aiming for green building projects, Hempel provides Environmental Product Declarations (EPDs) — transparent reports on the sustainability of raw materials used in our coatings. These EPDs are an essential requirement for projects pursuing certifications like LEED or BREEAM. For more details on how Hempel supports sustainable construction, visit this link.

How Hempel supports sustainable construction ›



CASE

How Raiz Club's steel structure stood **resilient against a major fire**

Gabriel, the owner of Raiz Club, envisioned a trendy nightspot in the centre of Ponta Delgada, the capital of the Azores, where design seamlessly blended with safety.

> *Without the protection of the intumescent coating the Fire Department believe that the structure would have collapsed. Thanks to this added protection the structure is in place and we can rebuild as good as new.*
>
> ***Gabriel, owner Raiz Club,***
> *Ponta Delgada*

His dream came to life in a modern industrial space featuring exposed steel beams, glass walls, and steel staircases connecting two floors. It was important to Gabriel, that the steelwork was not only protected against corrosion and fire, but also looked good, to enhance the ambience of the club.

One night, after closing, a fire broke out at Raiz Club, destroying many fixtures and causing significant damage. The fire burned for three hours before being brought under control and finally extinguished by the fire crews. Thankfully, no one was inside, and fortunately, no one got hurt.

Despite the interior damage, the steel structure remained intact thanks to the use of Hempel's intumescent coating system that protected the steel from the heat and gave firefighters extra time they needed to control the fire.

What to consider when choosing a fire protection **system for your project**

Choosing the right intumescent coating system for a steel structure involves balancing several critical factors. To make an informed choice, it's essential to understand how fire protection requirements, environmental conditions, and practical constraints affect your options.

The table below outlines the common options for cellulosic fire protection systems, highlighting their functions, advantages, and potential limitations.

Fire protection system

WATER-BORNE
ACRYLIC PFP

UPSIDES

- Suitable for indoor environments and closed quarters.
- Usually low DFT.
- Environmentally friendly due to low VOC.

DOWNSIDES

- Only for interior use as it is water sensitive.
- Multiple coats may be needed to reach the required DFT.
- Longer drying times may occur in tropical climates due to high atmospheric humidity.
- Can be applied only after the steel is erected.

SOLVENT-BORNE
ACRYLIC PFP

UPSIDES

- More resistant to weather conditions, as well as temperature and humidity changes.
- Low DFT.
- Faster drying times.
- Can be applied semi-exposed in a building (with topcoat).

DOWNSIDES

- Only suitable for C1-C3 environments.
- Multiple coats may be needed to reach the required DFT.
- Higher VOC compared to water-borne.
- Can usually be applied only after the steel is erected.

EPOXY
PFP

UPSIDES

- Excellent corrosion performance and mechanical properties.
- Can be used in the harshest environments.
- 100% volume solids, and low VOC.
- Can be applied offsite.

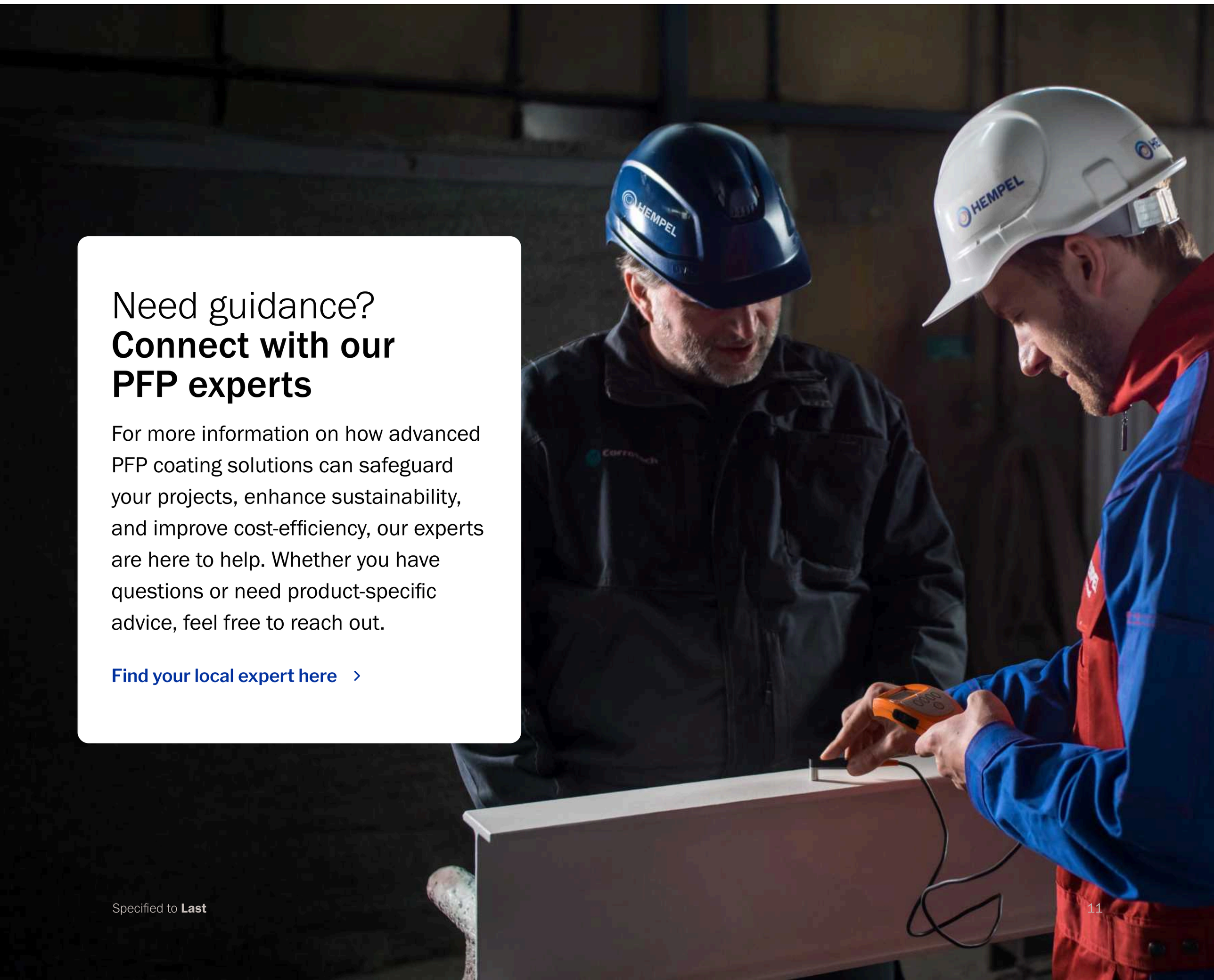
DOWNSIDES

- A "thick-film" intumescent that requires multiple layers.
- Requires specialist spraying equipment to apply.

Conclusion

As building designs evolve and environmental awareness grows, PFP is more critical than ever in safeguarding structures and people.

By staying up-to-date with evolving standards, utilising digital tools like HEET Dynamic, and working closely with fire safety experts and PFP coating advisors, specifiers can ensure their projects are well-protected against fire risks while supporting modern sustainability objectives.



Need guidance? **Connect with our PFP experts**

For more information on how advanced PFP coating solutions can safeguard your projects, enhance sustainability, and improve cost-efficiency, our experts are here to help. Whether you have questions or need product-specific advice, feel free to reach out.

Find your local expert here ›

About Hempel

As a world-leading supplier of trusted coating solutions, Hempel is a global company with strong values, working with customers in the decorative, marine, infrastructure and energy industries. Hempel factories, R&D centres and stock points are established in every region.

Across the globe, Hempel's paints and coatings can be found in almost every country of the world. They protect and beautify buildings, infrastructure and other assets, and play an essential role in our customers' businesses. They help minimise maintenance costs, improve aesthetics and increase energy efficiency.

At Hempel, our purpose is to shape a brighter future with sustainable coating solutions. We firmly believe that we will succeed as a business only if we place sustainability at our heart. Not only is it the right thing to do, it will strengthen our competitive position, make ourselves more resilient and reduce our risk.

Hempel was founded in Copenhagen, Denmark in 1915. It is majority owned by the Hempel Foundation, which ensures a solid economic base for the Hempel Group and supports cultural, social, humanitarian and scientific purposes around the world.

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