Promat®

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Passive Fire Protection for Structural Steel

Tackling common specification challenges

etex inspiring ways of living

Protecting structural steel

Steel structures are essential to modern architecture, offering unrivalled strength and versatility. However, although steel itself is non-combustible, it still needs protecting from the effects of fire.

When exposed to extreme heat, steel loses its structural integrity rapidly, potentially leading to catastrophic collapse. This weakness necessitates robust fire protection measures to ensure building safety and occupant survival.

At Promat, our expertise goes beyond standard test methods, addressing complex design challenges that conventional fire standards often overlook. With decades of experience in fire testing, assessment, and third party certification, we offer architects and engineers peace of mind that buildings can maintain structural integrity in the event of a fire.

Our approach combines innovative materials, advanced testing, and sophisticated calculation techniques to deliver tailored fire protection for steel beams, columns and attachments. Having extensive experience working with architects, this guide covers six common scenarios which often cause headaches in the design phase:

- Specifying the correct fire protective board
- Understanding the limitations of testing and certification
- Compartmentation
- Interfacing structural steel with partitions and other building elements
- Assist with the design of non-standard protection systems
- Interfacing with brackets and other connections

Using the advice on these areas contained herein, architects can confidently create ambitious, innovative buildings while ensuring optimal fire safety and to help the Principal Designer and their design team through Gateway 2 and the Principle Contractor to prepare for Gateway 3 of the 'Golden Thread'.

Specifying the correct fire protective board

CHALLENGE

Fire protective boards come in different thicknesses that offer varying levels of passive fire protection, which are given as time values measured in minutes, to correspond with a building's fire resistance period requirements.

The required fire resistance period varies from building to building and the Building Regulations: Part B provides baseline requirements based on building height, use, and other factors. Fire safety officers, insurers and in the case of more complex projects, fire safety engineers, may determine longer fire resistance periods due to fire load, proximity to other buildings or evacuation strategies.

Cost and sustainability factors often dictate that the minimum thickness of board that delivers the required level of fire protection should be specified. In the case of structural steel, its load bearing capacity, and the way this degrades with increasing temperature, make specifying the correct thickness of product essential to the fire safety of the overall structure.

SOLUTION

When the required fire resistance period for a project has been established, choosing the correct board for standard steel members depends on the section factor and limiting temperature for a particular column or beam.

Section factors are calculated by dividing cross sectional area by volume of steel per unit length, representing the ratio of heated surface area to the volume.

Limiting temperature is the maximum temperature a steel member can reach before it loses its load-bearing capacity, with higher stress levels giving lower limiting temperatures. These are complex calculation which are typically carried out by a structural engineer.

When fire resistance period, section factor and limiting temperature are known, the correct thickness of board can be determined using manufacturers tables like the ones shown below.

FIRE PROTECTION THICKNESS: PROMATECT®-250 FOR COLUMN AND BEAM CLADDINGS*

550°C

A/V Ratio	Fire resistance period (minutes)				Board Thickness (mm)	
	30	60	90	120	Single Layer	Double Layer
	350	135	65	-	15	-
		280	120	75	20	-
		350	185	110	25	-
			350	140	-	15 + 15
				175	-	15 + 20
				235	-	20 + 20
				350	-	20 + 25
					-	25 + 25

600°C

A/V Ratio	Fire resistance period (minutes)				Board Thickness (mm)	
	30	60	90	120	Single Layer	Double Layer
	350	165	75	50	15	-
		350	140	85	20	-
			220	125	25	-
			350	170	-	15 + 15
				215	-	15 + 20
				290	-	20 + 20
				350	-	20 + 25
					-	25 + 25

*Source: UL-EU-01220-CPR. Test standard: EN 13381-4: 2013.

Understanding the limitations of testing and certification

CHALLENGE

The situation around the testing and certification of passive fire protection for structural steel members is complex. Put simply, the test standards are not an accurate reflection of the reality of any actual building project, which makes applying the standards to make compliant specifications a challenge for architects.

Meanwhile, the Building Safety Act 2022, established the new role of “Principal Designer” putting the onus firmly on those responsible to ensure designs properly incorporate fire protection standards. The Act introduces a new gateway approval process, requiring architects to demonstrate compliance with fire safety requirements before progressing, adding complexity to the design process.

The effectiveness of fire protection to steel members is evaluated through EN13381-4, 8 & 9 testing standards. These standards apply to 3- and 4-sided protection and are usually limited to a maximum beam depth of 600mm. There are many instances where steelwork falls outside of this scope.

SOLUTION

Where no tested solution exists, early engagement with the manufacturer is essential. Bringing in technical specialists to work with the project team and fire engineer, can provide a solution that can meet the demands of the project, drawing on existing tested solutions. This then needs approval from the fire engineer that it meets the needs of the passive fire protection system required.

EN 13381-4, 8 & 9 standards cover 3 or 4 side protection, but steel elements are often exposed on just one side, when they are integrated into a concrete floor for example. More complex situations occur when a steel column or beam is placed in a corner with two-sided exposure.

The number of possible permutations makes specific testing impractical. With knowledge and experience from large numbers of representative fire tests, Promat is uniquely placed to provide you with accurate technical advice in any situation.

Similarly, having executed specific tests on high depth beams of all sizes, up to 2000mm in depth, and designed special installation methods for these, Promat provides assured solutions for deep beams too.

Compartmentation

CHALLENGE

Compartmentation uses passive fire protection to stop the spread of fire between sections of a building, but also protects the structure, including structural steel.

The challenge for specifying the correct level of passive fire protection comes from the fact, that where structural steelwork runs along compartment lines, the regulations are confusing and sometimes conflicting.

This is because fire protection for compartmentation aims to stop the spread of fire, whereas fire protection for structural steel aims to limit any rise in temperature within the steel member to maintain its structural integrity in fire conditions.

Compartmentation is required to limit temperature rises outside the compartment to 140°C with a single hotspot of 180°C, however there is no test standard for this when also protecting steelwork.

For structural steel, limiting temperatures typically range from 350-700°C.

While intumescent paint is commonly used to protect steel, the Association for Specialist Fire Protection, warns that it is unlikely to be able to provide the increased fire resistance required on compartment lines.

SOLUTION

With intumescent paints not recommended, fire protective board should be applied to any structural steel that sits on compartment lines.

To be certain of providing a compliant solution that delivers both effective compartmentation and the appropriate level of passive fire protection for structural steel, architects should seek a fully tested solution for the exact requirements of a particular project.

Although test standards to match every individual scenario do not exist, some manufacturers of passive fire protection carry out their own 3rd party verified testing.

Promat has undertaken bespoke fire testing to prove thickness of board required to provide compartmentation & this is included within 3rd party certification for our PROMATECT®-250 product.

This extensive testing has been carried out in accordance with EN 1364-1 and includes partition type tests, testing of insulation performance across boarded beams, and boards fixed either side of openings in blockwork.

It should be noted that steel members which breach compartment lines are only covered by this testing if encased for their full length.

Interfacing structural steel with partitions and other building elements

CHALLENGE

The challenges posed by the fire protection of interfaces of structural steel with other building elements are best considered in two main categories: SFS interfaces and partition interfaces.

As SFS systems carry significant loadings these in turn are transferred to the primary structure for the building. Because of the many ways this can be designed, the specification of passive fire protection with SFS interfaces needs to be undertaken on a project-by-project basis. Although a fire protection specialist can work on the encasement detail once the structural requirements and initial design has been done, ideally the two design should be designed in tandem. One major issue here is that no specific test standards exist for this application.

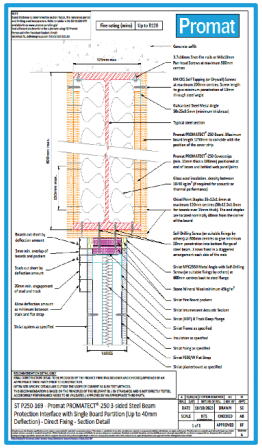
While there are test standards for standard steel encasements and for partitions, both these cases are treated in isolation. This creates an issue where interfaces occur, as there can often be a lack of clarity around the required level of protection for the junction itself.

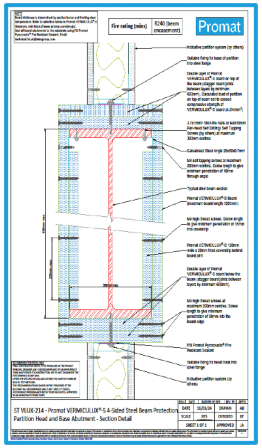
It is important to note that while SFS fire protection solutions based on the application of boards are complex, these are still preferable to paint or spray options. Intumescent paints require space around the structure to allow expansion. This decreases the usable internal area of the building and impacts on compartmentation, thermal and acoustic performance. Sprays offer considerably lower compressive values than boards and lack a fixed continuous surface against which to position and fix the head track.

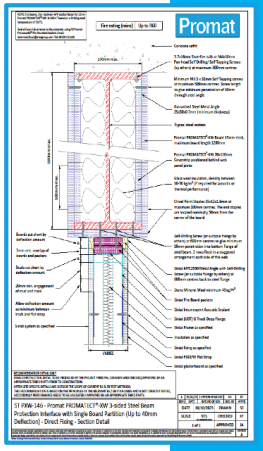
Promat specification packs provide details for standard Siniat partition connections to Promat beams encasements, but for interfaces that vary from the standard, specific design is required. Promat have undertaken adhoc testing on partition and encased beam interfaces to help designers complete this. Deflection of the beam under fire load should also be considered. Our boards can protect to a wide range of limiting temperatures to help limit deflection, as advised by the project team.

SOLUTION

For SFS interfaces an element of design is required and the best policy is to keep as close to a standard encasement as possible. As there are no official test standards, partnering with a specialist fire protection provider who has undertaken their own 3rd party verified testing, is recommended. Remagin have carried out a range of structural testing fixing through Promat boards to allow them to design to a wide range of scenarios. This includes fixing through the board into the steel, or into Z sections.







Designing non-standard protection systems

THE CHALLENGE

One common example of a non-standard situation is the use of cellular beams. These present a complex challenge as they can be manufactured by cutting shaped apertures in the web of the parent sections, and re-welding the parts together, or by welding three plates together with holes pre-cut in the web plate. Additional complexity can arise where beams are asymmetrical, having different sized upper and lower portions or flanges.

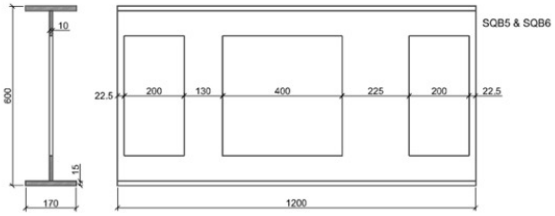
This means that for cellular beams, structural capability and behaviour in a fire differs from solid beams with failure generally occurring at lower temperatures, and this needs to be assessed under ambient and fire conditions. Although there is test data available for some types of cellular beams, there are many possible scenarios where this data does not apply, and individual judgements need to be made.

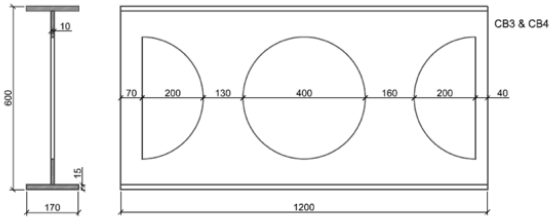
Other frequently occurring non-standard applications include offset partition interfaces, where once again there is no specific test standard

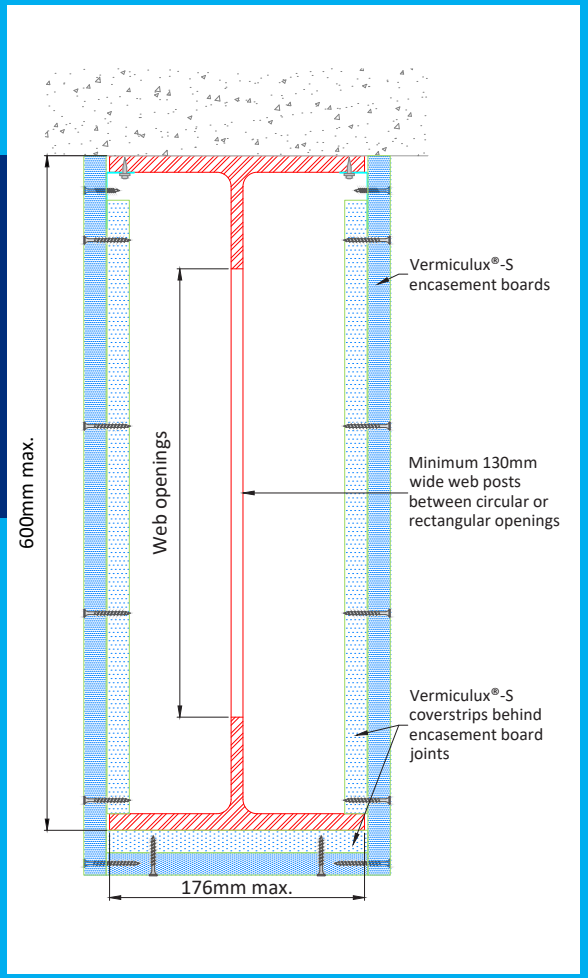
THE SOLUTION

On non-standard systems it is important for architects, to work with expert teams to deliver an evaluated solution that extrapolates existing tested solutions to create bespoke passive fire protection design. The best advice is to seek out qualified professionals – holding the ASFP Level 3 in Passive Fire Protection – and with the industry experience to understand the bespoke testing of a tailored system, which will meet the required approval by a fire engineer.

Where cellular beams are concerned, limiting temperatures must be calculated from a structural model by a specialist manufacturer or structural engineer. Once a limiting temperature is established, ASFP Yellow Book 5 is an excellent resource, laying out how to determine the section factors necessary to determine the correct level of fire protection required. Promat has carried out 3rd party testing to validate this approach. This includes the application of firestopping to the web openings, to maintain the overall effectiveness of the solution.







Interfacing with brackets and other connections

CHALLENGE

Brackets and other mounting hardware components are often connected to structural steel to provide secure attachment points for mechanical systems, services, architectural features and façade elements. While this ensures loads are safely transferred to the main structural elements of a building, any appendages directly attached to the steel beams and columns can have ramifications for the fire protective encasements surrounding those members.

SOLUTION

The best advice is to follow the guidance provided by ASFP in their Advisory Note 21: ASFP Position on Coatback with Respect to Attachments and Unprotected Secondary beams fixed to Protected Primary Beams. This recommends that penetrations of fire protective encasement by brackets is kept below 3,000mm²/m.

Another recommended solution is to ensure that where any bracketry is connected to the structural steel, these locations should coincide with the board joints for the steelwork encasements. This will allow the encasement boards to be notched around the ties with the smallest possible gaps between the ties and the boards – to a maximum of 6mm.

Any small remaining gaps must be firestopped to maintain a compliant solution. In the cases of small gaps like this a sealant can be used, but it is important to use the right product for the environment, accounting for factors like moisture, movement and vibration.

Promat Fire Protection Boards

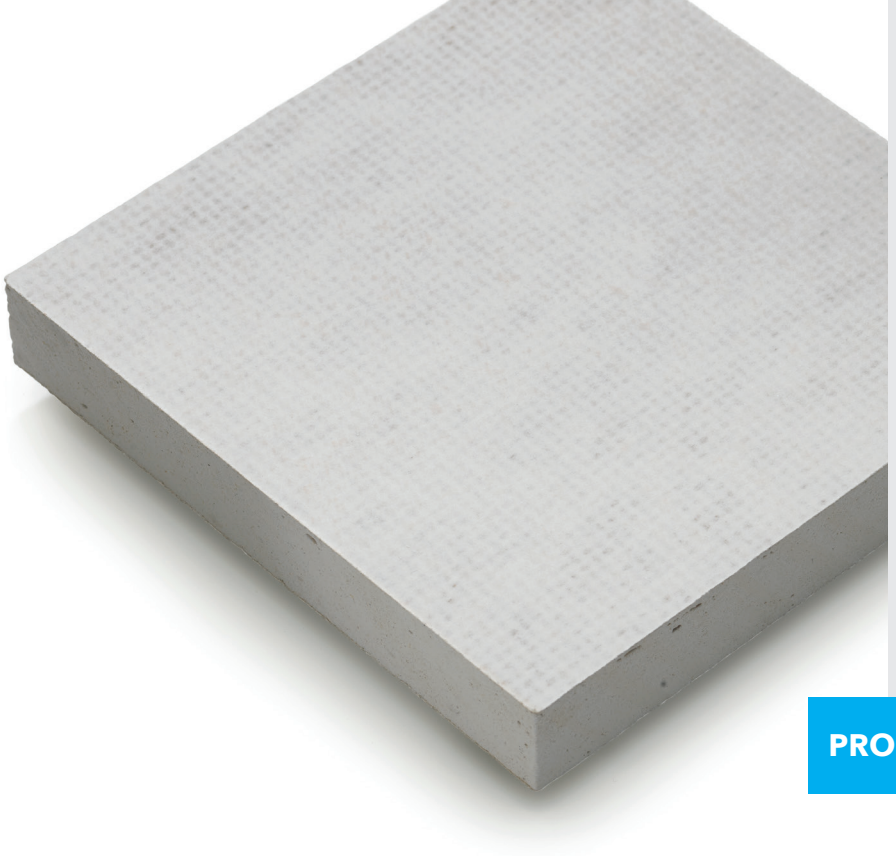
Made from reinforced calcium silicate, Promat fire protection boards are produced in a highly controlled factory environment, with strict tolerances for relevant properties including thickness, enabling accurate fire resistance levels (FRLs) for different variants. FRL ratings indicate how long, expressed in minutes, a Promat board can maintain its fire protection properties during a standardised fire test.

Promat boards enable single-layer protection for all but the most extreme situations. The high quality of the materials used leads to thinner and lighter boards than others which offer the same level of protection. This adds up to major savings on installation time and costs associated with transportation and storage. Installation is very simple involving just saw cutting, screwing and stapling.

Some boards include a 'finished face' allowing the direct application of paint. Calcium Silicate boards dry out, so they can be applied before a building is weatherproof.

Promat offers different board systems to meet specific requirements for durability and mechanical strength. These properties are assured by European Technical Assessments (ETAs) in accordance with European Assessment Documents (EADs).

PROMATECT®-XW



PROMATECT®-XW in use

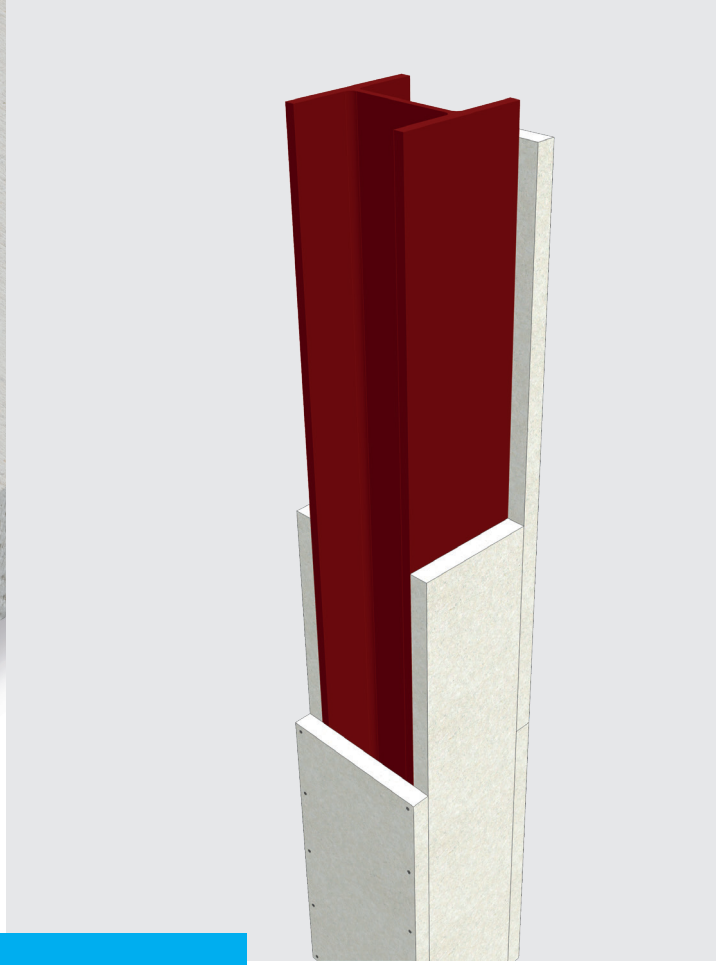
PROMATECT®-XW IS AN A1 NON-COMBUSTIBLE BOARD PROVIDING UP TO 60 MINUTES OF FIRE PROTECTION FOR STRUCTURAL STEEL. IT HAS EXCELLENT DIMENSIONAL STABILITY, REDUCING THE RATE AT WHICH STEELWORK HEATS UP DURING A FIRE, ALLOWING IT TO MAINTAIN LOAD-BEARING CAPACITY LONGER.

The board is moisture resistant, allowing installation up to 6 months before the building is weather tight.* It can be exposed on-site for up to 6 months, providing flexibility in construction schedules.

PROMATECT®-XW is quick and easy to cut and install, saving time and reducing costs. Its frameless system minimises space requirements. The single board thickness simplifies ordering and stocking. It offers a smooth, impact-resistant surface that can accept decorative finishes. PROMATECT®-XW is used to provide 3 and 4 sided encasement for I/H structural steel members, with coverage for limiting steel temperature ranging from 300°C to 650°C. PROMATECT®-XW does not require adhesives or joint fillers for installation. It provides a clean, boxed appearance and can be applied to unpainted steelwork. The board is often a thinner solution compared to other fire-resistant constructions, maximising usable space.

*The board should not be subject to water run-off from slabs or other parts of the building. The board should not be in contact with standing water.

VERMICULUX®-S



VERMICULUX®-S in use

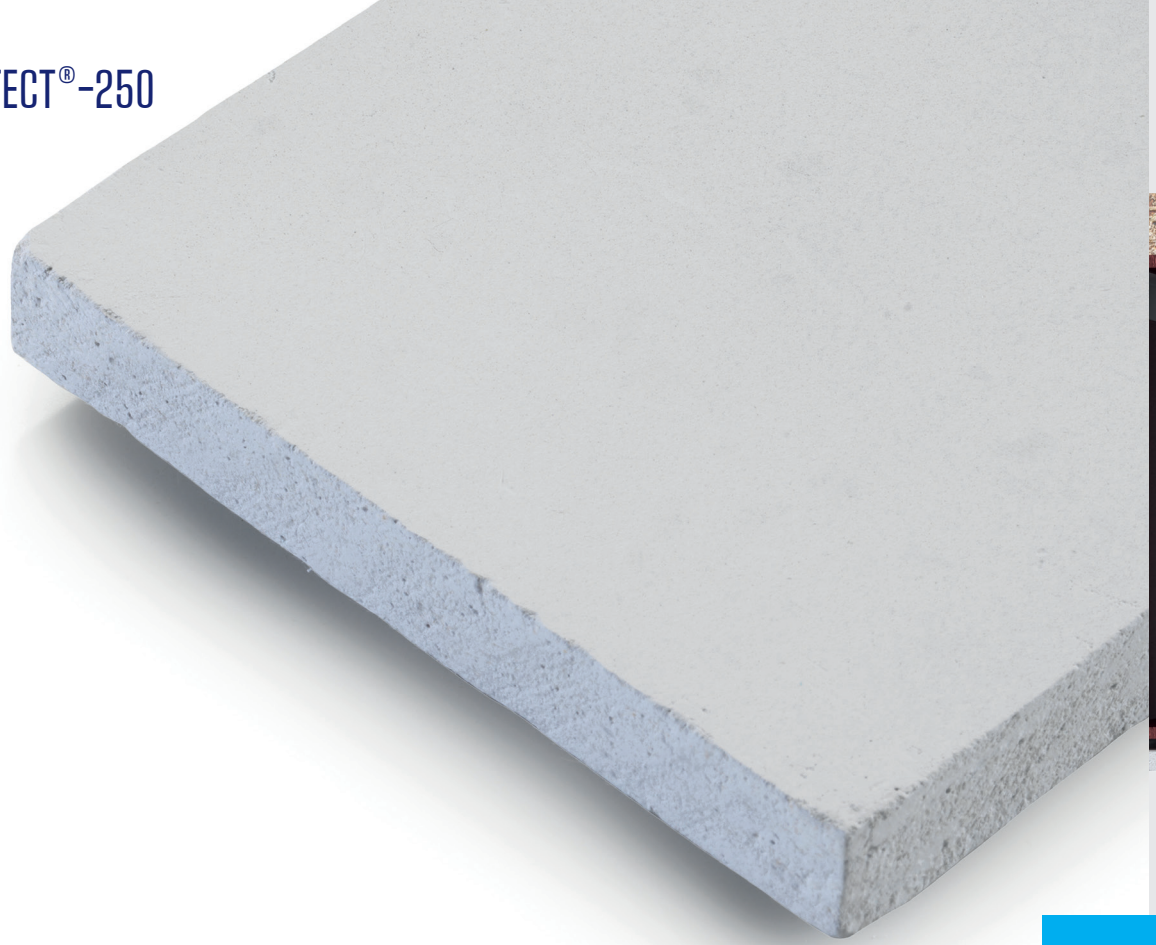
VERMICULUX®-S IS AN A1 NON-COMBUSTIBLE CALCIUM SILICATE BOARD, AVAILABLE IN DIFFERENT THICKNESSES, TO PROVIDE FIRE PROTECTION FROM 30 TO 240 MINUTES FOR STRUCTURAL STEEL, AT A LIMITING STEEL TEMPERATURE OF 550°C. THIS MAKES IT SUITABLE FOR HIGH-RISK AREAS OR BUILDINGS STORING VALUABLE ASSETS THAT REQUIRE EXTENDED FIRE PROTECTION PERIODS.

VERMICULUX®-S offers the versatility to protect various steel elements including columns, beams, hollow sections, bracing, lattice beams, and wind posts. It can be used for one to four-sided encasements. The board is lightweight (9.6-24 kg/m2) yet offers a thinner solution compared to other fire-resistant constructions, maximising usable space.

VERMICULUX®-S is resistant to the effects of moisture and will not physically deteriorate when used in damp and humid conditions.* It can be installed up to 6 months before the building is weathertight** providing flexibility in construction schedules. This product is fully tested and certified and independently assessed by Warringtonfire.

*Reference ETA 19/0434. All physical property values are averages based on standard production.
**The board should not be subject to water run-off from slabs or other parts of the building. The board should not be in contact with standing water.

PROMATECT®-250



PROMATECT®-250 in use

PROMATECT®-250 IS AN A1 NON-COMBUSTIBLE BOARD PROVIDING UP TO 120 MINUTES OF FIRE PROTECTION FOR STRUCTURAL STEEL ELEMENTS. IT UTILISES PATENTED PROMAXON® MATERIAL TECHNOLOGY COMPRISING AUTOCLAVED CALCIUM SILICATE SPHERES. ITS HIGH STRENGTH MAKES IT SUITABLE FOR USE FOR THE PROTECTION OF MEZZANINE FLOORS, AND IT IS OFTEN USED IN WAREHOUSE APPLICATIONS.

PROMATECT®-250 is off-white in colour. One face is smooth and able to receive almost any form of architectural finish or treatment. The reverse face is sanded.

PROMATECT®-250 is fully tested and certified, giving architects and specifiers confidence in its performance. It's manufactured under ISO9001 and ISO14001 conditions, ensuring traceability and consistent quality.

PROMATECT®-250 is not designed for use in areas subject to continual damp or high temperatures and is suitable for internal applications only.

NOTES

NOTES

Promat®

GB Orderline
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