PPG STEELGUARD 951

Secondary Attachments

1.0 INTRODUCTION

The purpose of this guide sheet is to ensure consistent recommendations for common construction detailing interfaces where PPG STEELGUARD 951 is the primary method of fire protection used on primary structural steelwork on conventional infrastructure construction projects. If there are any local/national codes of practice for secondary attachments to IFRM's, then they take precedence over these guidelines.

2.0 INTUMESCENT FIRE RESISTIVE MATERIALS (IFRM's)

Intumescent coatings, such as PPG STEELGUARD 951, are classed as reactive coatings. They have been used successfully in infrastructure construction projects since the late 1970's and MUST comply with local and national regulations relating to construction and fire resistive products. Products offered globally also must comply with all local, regional, national and international regulations and standards.

Whilst fire is no different the world over, testing and classification of construction products can differ greatly between one another. There is no, globally recognized "best-case-fits-all" method, and no standard/regulation is deemed as safer or 'better' than another. It is important however, to ensure that construction products such as STEELGUARD 951 meet the local and national regulations in the country it is to be sited. This could be different to the country it is applied in for off-site application carried out in other countries for cross-border projects. Fire testing standards are not usually interchangeable, so it is important to ensure that IFRM's such as STEELGUARD 951 have been tested to the exact test standards in accordance with local & national regulations. Differing standards must not be used for the same product on the same project – as this can cause the structure to be under-protected.

These fire standards, however, do not specify that the coating must demonstrate the exact same performance when interfacing with other construction materials to satisfy the requirements of the test.

There are virtually limitless combinations of material types, thicknesses and fixing arrangements that are adopted in typical commercial construction projects, and it is not the responsibility of a coatings manufacturer to test their products in any such arrangement over which they have no input or control of in the project design.

These recommendations should only act as a guide and are based upon our own experience and expertise.

3.0 RECOMMENDATIONS

The recommendations outlined herein are meant solely as a guideline and do not encompass every conceivable construction detail. However, the generalized information provided is intended to aid contractors in the installation of items in proximity to STEELGUARD 951 protected steelwork. It is also essential to consider the potential implications for the fire protection performance of the structural element. In instances where an item is located within the expansion gap, a determination must be made by a qualified individual, such as the project's fire engineer, to assess whether the item may affect the structural stability duration of the construction element during a fire event.

3.1 Timber

The attachment of timber to STEELGUARD 951 coated steel structures, including web infills or battens, may hinder the formation of char on the coating. It is advisable to seek guidance regarding the fire performance of the timber from a qualified professional or the timber supplier, as the coatings manufacturer does not assume responsibility for this aspect.

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3.2 Battens

In instances where timber battens are employed to secure non-fire-rated plasterboard encasements to steel columns and beams, no additional considerations are necessary regarding this fit-out detail.

The non-fire-rated plasterboard offers a preliminary insulation period during the initial phases of a fire, after which it, along with the timber battens, will be consumed, thereby permitting the newly exposed intumescent coating to respond and expand as intended.

3.3 Web infills and packers

In locations where significant timber interfaces are present, such as full depth web infills, noggins, and packers, a gap of 10 times the DFT will generally need to be provided to allow for full expansion of the STEELGUARD 951 during a fire.

3.4 Pressed metal fixings

Pressed metal framing systems are commonly used due to their light weight, dimensional consistency, and ease of handling. When they are retrofitted to interface with IFRM coatings, the guidance in this section should be followed:

3.4.1 Board encasement framing

In situations where a proprietary steel framing system is employed for steel encasement, STEELGUARD 951 does not necessitate additional considerations to guarantee that the designated system attains its anticipated fire resistance rating when utilized alongside non-fire-rated plasterboard encasement.

3.4.2 Stud partitions

In instances where metal stud partitions are employed and header rails are attached to the bottom flange of steel beams, or when stud sections are affixed to columns safeguarded with STEELGUARD 951, it is advisable to isolate both types of attachment from the protected member. This can be achieved by utilizing a fire-resistant board that meets the necessary fire resistance rating as stipulated for the specific area of the building where the installation takes place.

3.4.3 Over-cladding / Encasement

Where cladding systems or timber framing are to be used in conjunction with STEELGUARD 951, a gap of 10 times the DFT will generally need to be provided to allow for full expansion of the STEELGUARD 951 during a fire. This guidance also applies to the gap required between the cladding/framing and the flat surfaces of the protected steel section, as well as to flange tips.

3.4.4 Expansion Gap Guidance

The recommended standard for expansion gaps, as per PPG, aligns with the guidance provided by ASFP:

- An expansion gap of 15mm (600 mils) around intumescent materials is deemed adequate by industry and ASFP standards.
- Non-fire rated plasterboard can be applied to the STEELGUARD 951, which offers fire protection for durations of up to 120 minutes, provided it is installed using a metal framed encasement system.

There is no requirement to apply fire protection to the encasement system. For fire protection durations exceeding 120 minutes, a gap of 50mm (2000 mils) is necessary.

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5.0 FIRE-RESISTING ELEMENTS

When a fire-resisting element or construction is situated in close proximity or direct contact with steelwork that has been treated with STEELGUARD 951, additional protection may not be necessary, provided that the fire-resisting element meets the required fire resistance duration. During the application of STEELGUARD 951 on-site, a common scenario may involve three sides of a column being accessible for application, while the fourth side remains inaccessible or limited for effective intumescent application. If this side is adjacent to a fire-resisting construction, such as blockwork, it will help safeguard the exposed face of the column during a fire. Typically, it is advisable to utilize an intumescent mastic sealer to fill any gaps between the column and the blockwork.

In cases where blockwork is constructed up to a column that has been treated with STEELGUARD 951, and the gap is smaller than the specifications outlined in the ASFP guidance, the coating on that face will expand and seal the gap in the event of a fire. Nevertheless, it is generally recommended to apply an intumescent mastic sealer to address any gaps between the column and the blockwork.

If the gap exceeds the capacity of an intumescent mastic sealer, alternative fire protection methods, such as boarding or insulation, may be necessary to safeguard the restricted face. Contractors are encouraged to consult with the manufacturers of sealers, boarding, and insulation materials to ensure compliance with safety standards.

6.0 STEEL ATTACHMENTS

Where steel attachments are in contact with STEELGUARD 951, the following guidance should be followed:

6.1 Flange clamps and similar minor attachments

According to ASFP Advisory Note 21, the application of coat back may be disregarded for minor attachments with a surface area of less than 3000mm^2 per linear metre or square metre of the primary section (equivalent to 1.7 square inches per linear foot or square foot of the primary section). It is essential that the primary beam is a solid web beam. The recommendation to omit coat back for unprotected members does not extend to protected beams that are cell beams, as their failure mode typically involves web buckling. Consequently, any rise in web temperature resulting from conduction from an unprotected beam could lead to premature failure. Attachments exceeding this size are classified as primary and must therefore be equipped with fire protection.

6.2 Brackets

In instances where the individual contact areas of retrofitted bracket attachments do not surpass 8000 mm^2 per linear meter (12.5 sq. inch per linear foot) of the protected member or per square meter of surface area, no additional considerations are necessary. However, if the contact areas exceed this threshold, it is essential to adhere to regional industry guidelines concerning the protection of secondary attachments, rather than relying solely on further engineering assessments.

6.3 Treatment of Attachments

The treatment of attachments or fixtures, such as Z bars that are typically galvanized, requires them to be cleaned and lightly abraded with abrasive paper before applying an approved epoxy primer. Once the primer has dried, these components should be coated with STEELGUARD 951 to match the thickness of the steel to which they are affixed.

6.4 Metal Stud Partitions

In instances where metal stud partitions are employed, such as in a Structural Framing System (SFS), it is advisable to install header rails on the bottom flange of steel beams or to attach stud sections to columns that are safeguarded with STEELGUARD 951. It is recommended that both types of attachments be isolated from the primary steel member by incorporating a fire-resistant board that meets the necessary fire resistance rating.

These components can be installed before or after the application of STEELGUARD 951 to the primary member.

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7.0 COAT-BACK AND HEAT-TRANSFER

Coat-back refers to a fire protection material that is applied to secondary components, such as attachments and unprotected secondary steelwork, which typically do not require fire protection. However, if the secondary item connected to the primary steelwork is deemed to need fire protection, the application of coat-back becomes necessary. This material aims to minimize heat transfer through conduction from the secondary steelwork or attachment. An intumescent coat-back is generally applied over a specified length of the secondary item, extending from the connection point to the primary member. Depending on the size of the attachment, the coat-back may cover the entire component. The thickness of the intumescent material on the secondary item should match that of the primary steelwork.

It is essential to consider the potential heat transfer from unprotected steel to the protected structural steel. Best practices suggest protecting the adjacent 500mm (20 inches) of unprotected structural steel to mitigate unwanted heat transfer, in accordance with ASFP Advisory Note 21 (2022).

8.0 PROTECTION OF BOLT HEADS

Correct surface preparation of all areas prior to painting is critical to ensure performance of the coating system and the correct preparation of bolt heads is no exception. however, it is appreciated that abrasive blast cleaning is impractical. All bolts and connectors must be prepared in accordance with the correct PPG coatings specification. Generally, bolts/ fasteners are supplied in one of the following conditions:

- Black/self-color bolts – untreated steel bolts
- Zinc-plated bolts – electro zinc plated bolts
- Galvanized bolts – hot-dipped galvanized steel bolts
- Sherardized bolts – zinc coated bolts

Due to the increased mass of steel around connection points, the critical steel failure temperature in these areas (in fire conditions) are normally lower than the rest of the steel member. The DFT of STEELGUARD 951 applied in these connection areas should however be the same as for the whole parent section.

Bolt Type	Environment (ISO12944)	Surface preparation & pretreatment immediately prior to application of STEELGUARD 951
Black / Self-colour Bolts	C1 - C4	Ensure surfaces to be coated are clean, dry, sound and free from contamination prior to coating. As part of this process apply and remove PPG PREP 88 cleaner/degreaser. Mechanically prepare to ISO 8501-1 St 3 standard Apply suitable approved surface tolerant primer @ 50µm (2 mils) minimum DFT prior to application of PFP
Zinc Plated & Sheradised Bolts	C1 – C4	Ensure surfaces to be coated are clean, dry, sound and free from contamination prior to coating. As part of this process, apply and remove PPG PREP 88 cleaner/degreaser. PPG STEELGUARD solvent borne coatings can then be applied directly to zinc-plated bolts for C1 and C2 internal conditions. For C2 external, C3 and C4 environments, apply suitable approved surface-tolerant primer at 50µm (2 mils) minimum DFT prior to application of PFP. Waterborne coatings are only suitable for C1 and C2 internal conditions, however, a suitable approved surface-tolerant primer at 50µm (2 mils) minimum DFT is required prior to application of PFP.
Galvanized Bolts	C1 – C4	Ensure surfaces to be coated are clean, dry, sound and free from contamination prior to coating. As part of this process, apply and remove PPG PREP 88 cleaner/degreaser with the assistance of abrasive pads such as Scotchbrite to remove stubborn, often invisible, salt contamination. Wash down and allow to dry. STEELGUARD 951 will require the application of a tie coat such as PPG SIGMACOVER 280 at 50µm (2 mils) DFT prior to application.

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With reference to ASFP TGD 11 (2014); "In the case of site applied intumescent fire protection, bolted connections can be coated at the same time as the main structure but special provision has to be made for the coating of bolts / connections, which may require cleaning and a special adhesion primer before application of the intumescent depending on the type of bolt, so the intumescent manufacturer's recommendations should always be meticulously followed. In all cases, therefore, both the design engineer and the coating supplier should be consulted for advice. The protection thickness on bolt heads and connections should be the same as that on adjacent steel sections."

There are also commercially available 'bolt caps', both proprietary technology AND manufactured using STEELGUARD 951 as the construction material - which can be fixed over the bolt to produce a removable aesthetic option if needed. Please consult your local PPG representative for further information. No surface pre-treatment of the bolts is required when using this method.

9.0 ADJACENT FIRE PROTECTION SYSTEMS

The following is from ASFP Technical Guidance Document 8 (2010): Code of practice for junctions between different fire protection systems when applied to load bearing structural steel elements.

ASFP considers it best practice to completely protect individual steel or structural elements of construction with the same fire protection system. Mixing of fire protection systems should be avoided on single steel elements. The fire testing of all possible interfaces is impractical. Manufacturers should be contacted for relevant advice on any system being added next to an existing system.

So, in general, the use of different fire protection systems on individual steel or structural elements of construction should be avoided.

- Note that off-site sprayed beams are not treated at the connection point and care with interfaces will be needed.
- The failure temperatures in fire are different for universal beams, cellular beams and universal columns. The abutting systems should be suitably selected.
- The existing fire protection system, to be abutted or overlapped, must be fully cured and chemically compatible with any other system to be in contact with it.
- Overlapping or abutting different systems needs careful consideration since they may behave in different ways in fire. For example, 'shrink back' of any system in fire, at junctions.
- The specific procedure will be affected by whichever fire protection system is first applied on site, and by the interval before a second system can be added.

10.0 DECKING AND FILLING OF VOIDS

A prevalent method of construction in multi-storey buildings involves the use of steel deck floors, which consist of reinforced concrete poured over profiled steel decking. This decking serves as both formwork during the construction phase and as external reinforcement upon completion. The two primary profiles of steel decking are shallow types, such as dovetail or re-entrant, which reach depths of up to 175mm (7 inches) and are suitable for short spans, and deep deck types, characterized by a trapezoidal shape, which can be as deep as 225mm (9 inches) and are designed for longer spans.

10.1 Filling the Voids

In the case of a dovetail profile, the void is minimal, and typically no further action is required.

Conversely, trapezoidal profiles exhibit a relatively larger void, necessitating certain measures to mitigate the effects of increased heating on the top flange. The options available include:

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- Filling the void between the beam's top flange and the deck with an appropriate material.
- Leaving the void unfilled while enhancing the fire protection thickness on the remaining sections of the beam.
- Utilizing an intumescent coating, ensuring that the upper surface of the top flange has a coating thickness consistent with that of the other beam components.

It is essential to fill all voids when the beam is part of a compartment wall. (ASFP Yellow Book, 2014, p. 90)

The table below gives an overview of how to treat voids for **BS476 ONLY** – all other fire standards require the voids filling.

<table>
<tr><th colspan="5">BS476 Fire Standard</th></tr>
<tr><td colspan="5">Dovetail or Re-entrant Deck</td></tr>
<tr><td colspan="2">Composite or Non-composite beam</td><td colspan="3">No action required</td></tr>
<tr><td colspan="5">Trapezoidal Deck</td></tr>
<tr><td rowspan="2">Beam Type</td><td rowspan="2">Fire protection on beam</td><td colspan="3">Fire resistance (minutes)</td></tr>
<tr><td>Up to & including 60 minutes</td><td>Up to & including 90 minutes</td><td>Over 90 minutes</td></tr>
<tr><td>Composite</td><td>Reactive coating and Passive (non-reactive)</td><td>Increase thickness by 20% or assess thickness using A/V increased by 30%*</td><td>Increase thickness by 30% or assess thickness using A/V increased by 50%*</td><td>Fill voids *</td></tr>
<tr><td>Non-composite</td><td colspan="4">Fill voids</td></tr>
</table>

*The least onerous option may be used

Table 1. ASFP Yellow Book 5th edition recommendation for beams and voids, page 91

In some instances, for beams below 90 minutes may surpass the allowable certified dry film thickness (DFT) for the coating in which case the voids should be filled without increasing the DFTs by the given factors.

10.2 Sealing of Decking

Certain design characteristics inherently create openings that may permit moisture infiltration, which, if left unsealed, can lead to issues such as blistering or deterioration of the intumescent coating following its application.

The junction between the top flange and the concrete decking may facilitate moisture penetration, and it may take an extended period for this area to dry, even under favorable environmental conditions for paint application. It is essential to seal this region before applying the intumescent basecoat. One effective approach is to use a moisture-resistant intumescent mastic to seal the gap prior to the application of the complete intumescent basecoat. (ASFP TGD 11, 2010, p. 20)

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11.0 STUD-WELDING

The subsequent information aligns with the ASFP Technical Guidance Document 16: 2010 Code of Practice for Off-site Applied Thin Film Intumescent Coatings, page 12. In instances where stud-welding has occurred on the upper flange of an uncoated beam, a 'blistering' effect may manifest in the coating on the inner top flange. From a fire protection perspective, these blisters do not require repair for fire resistance durations of up to 60 minutes, provided that:

- The beams are situated in a C1 (ISO 12944-2) environment.
- The blisters remain undamaged.
- The blisters are spaced at a minimum of 80mm (3 inches) apart.

Nevertheless, the choice to undertake remedial actions may be influenced by one or more of the following factors:

- Aesthetic considerations are of primary importance.
- The structure will be exposed to the elements for an extended duration.
- The intended use will occur in an environment classified as C2 to C5 (ISO 12944-2), where there may be external exposure or internal conditions conducive to condensation and/or high humidity.
- The blisters have been compromised.

12.0 CONCRETE SPILLAGE

During the process of pouring concrete for the upper floor, there are instances where concrete runoff may infiltrate the steelwork of the lower floor. In cases of substantial or continuous water flow, STEELGUARD 951 may sustain damage, even if a topcoat has been applied. Although there exists a possibility of a reaction between the STEELGUARD 951 system and wet concrete runoff, minor patches of dry residue from diluted cement and sand components, measuring less than 2mm (80 mils) in thickness, are not believed to adversely affect the intumescent reaction during a fire. If aesthetics is not a priority, this unsightly residue may be left in place. However, if appearance is a concern, the excess material must be carefully scraped away. Adhering to proper coating practices, any runs should be eliminated prior to the application of an approved topcoat. It is essential to remove significantly thicker accumulations of concrete, as they may obstruct the intumescent reaction. Should any damage occur to the STEELGUARD 951 during the concrete removal process, it is imperative to reapply the intumescent to meet the specified thickness.

For the on-site application of STEELGUARD 951, it is crucial that all concrete and other contaminants on the primer system are thoroughly removed and dried before applying the intumescent. In the event of primer damage, it will be necessary to perform touch-ups with an approved primer.

13.0 SUMMARY

This document provides guidance on various common construction details that project design teams can utilize to facilitate decision-making when fit-out programs are implemented following the application of STEELGUARD 951, which offers fire resistance for periods of up to 240 minutes.

STEELGUARD 951 is a globally certified product with each certification having differing requirements. **IT IS IMPORTANT** that only the recommendations for a particular fire standard is used in the cases where the fire standard is stated. Failure to do so could result in the application being non-compliant with certification.

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There are no restrictions imposed on the types and sub-grades of materials utilized; thus, the guidance regarding timber is intended to be applicable to all species and grades of timber or dimensional values employed in each detail. In instances where plasterboard is identified as 'non-fire-rated,' it is assumed that the guidance also pertains to scenarios where fire-rated board has been utilized for a similar detail to enhance fire protection.

This guidance is founded on testing conducted on representative unloaded structural assemblies within a UKAS accredited furnace, adhering to the standards set forth in BS 476-20 [5] and BS 476-21 [1], and overseen by a recognized external third-party certification authority.

The evaluation of the load-bearing capacity of the steel members derived from the test results, along with the analysis of the impact of the construction detailing on the tested specimens, has been performed by Chartered structural engineers.