Code of Practice

for the Specification and Application of Intumescent Coatings for the Fire Protection of Structural Steel

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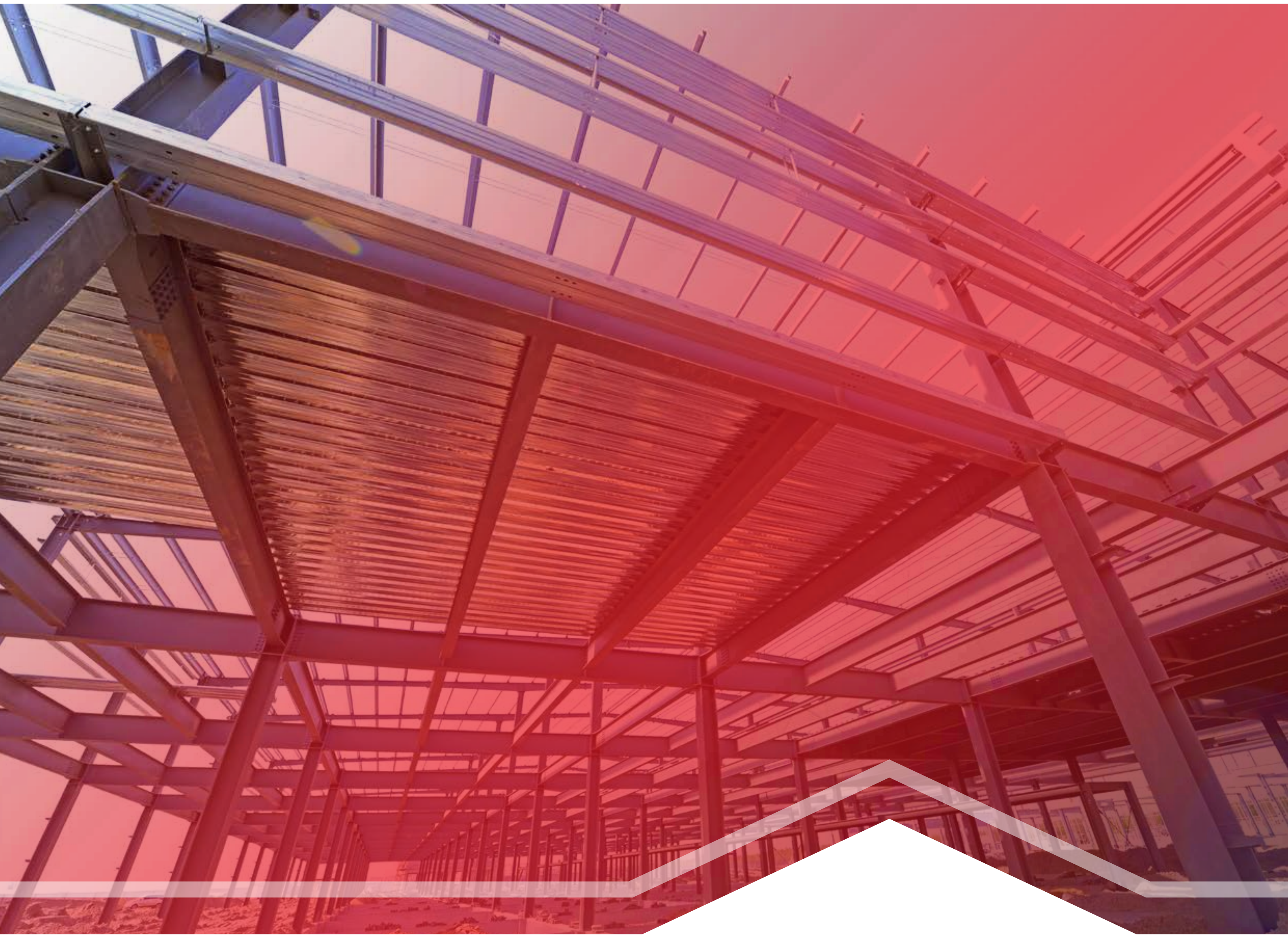

Fire Protection Association New Zealand
www.fpanz.org

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Association for Specialist Fire Protection (ASFP):

The ASFP is a UK trade association established in 1976 for manufacturers and installers of passive fire protection products. It provides technical guidance on the design, specification, and installation of passive fire protection and its first publication was the ASFP 'Yellow Book', which is referred to extensively in this publication along with other ASFP Technical Guidance Documents and Advisory notes. FPANZ acknowledges the assistance of ASFP in the production of this document by reference to ASFP publications, and both organisations mark this as the start of continued cooperation and development to improve and promote built in fire protection.

Foreword

This Code of Practice for the Specification and Application of Intumescent Coatings has been created by a working group drawn from the FPANZ Passive Fire Protection Special Interest Group (SIG), a voluntary group of leading industry professionals.

The Passive SIG's prime function is to help maintain the highest standards within the New Zealand passive fire protection industry.

FPANZ would like to thank the coatings working group for its vision and hard work in creating this document and acknowledges the positive effect this Code will have on the passive fire protection industry in New Zealand.

Paul Ryan – Passive Special Interest Group Chair / FPANZ Board Member

About FPANZ

Established in February 1975, the Fire Protection Association New Zealand (FPANZ) is the primary organization which represents the fire protection industry in New Zealand. As a not-for-profit, its mission is:

'To provide a professional forum and be the unified voice of the fire protection industry by drawing on our expertise and collective knowledge to reduce the impact of fire in New Zealand.'

FPANZ's membership base includes those involved in fire alarms, sprinklers, hand-operated firefighting equipment, passive fire protection, system design, installation and maintenance, inspection and certification, evacuation schemes, fire equipment manufacturing and distribution, insurance, fire engineering, Fire and Emergency New Zealand and Territorial Authorities.

Document History

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It is the intention of FPANZ that this document will be reviewed periodically.
Any reviews and feedback for future revisions can be submitted to info@fpanz.org for consideration

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1. Definitions

Applicator	The company responsible for the application of the intumescent coating system.
Accidental Limit State (ALS)	Corresponds to the ability of the structure to resist accidental loads and to maintain integrity and performance. NOTE: Some international Standards (for example EN) reference Accidental Limit State (ALS) for calculations on steel loads during a fire. ALS is not currently used within the New Zealand Building Code (NZBC) Acceptable Solutions, however, a structural engineer may choose to consider it as part of their design strategy.
Base Coat	See Intumescent Coating.
Building Consent Authority (BCA)	Has the meaning ascribed to it by section 7 of the Building Act 2004 and undertakes the roles described in section 12 of the Act. A building consent authority performs the following statutory functions: › issues building consents (except consents subject to a waiver or modification); › inspects building work for which it has granted a building consent; › issues notices to fix; › issues code compliance certificates; and › issues compliance schedules.
(Building) Owner	The building owner as defined by section 7 of the Building Act 2004. For the purposes of this document, an owner may also be a delegated representative, or a person who has control of the premises.
Certified Intumescent Coating System (ICS)	An Intumescent Coating or Intumescent Coating System having current evidence or a formal opinion from an accredited testing laboratory certifying that it has been tested and/or assessed as providing a fire resistance rating for the protection of structural steel in accordance with AS 1530.4 or NZS/BS 476 part 21.
Coatback	An overlap of intumescent material onto otherwise unprotected steelwork that is used to limit heat transfer. See 5.1.7.5.
Coating Manufacturer/ Supplier	The company or companies who manufacture or distribute the materials used in the intumescent fire protection system applied by the Applicator.
Composite/Non-Composite	Describes the interaction between structures. Typically, where there is no interaction between steel beams and concrete floors and the structures act independently of each other they are deemed to be Non-Composite. Composite systems include steel/concrete structures that show a high level of mechanical interactions, which generally improve the level of fire performance of the structures. In respect of trapezoidal-profiled flooring systems, if the steel beams are connected to the concrete slab in such a way that the two act as one unit, the beam is called a composite beam. Composite beams are similar to concrete T-beams where the flange of the T-beam is made of concrete slab and the web of the T-beam is made of steel section.

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1. Definitions *cont.*

Competent person	A person who is able to demonstrate that they have acquired, through suitable qualifications, training and/or experience, the knowledge and expertise necessary to be able to design, install, test and/or maintain the required system(s) in a thorough and workmanlike manner in accordance with sound trade practice. Such a person is expected to work only within their area of knowledge and expertise.
Compliance Documents	The term 'Compliance Documents' had a particular meaning in the Building Act 2004 in relation to documents issued by MBIE. The Act was amended in November 2013 and that collective term was replaced by the terms 'Acceptable Solution' and 'Verification Method'. Acceptable Solutions and Verification Methods are issued by MBIE and, if followed, must be accepted by a building consent authority (BCA) as evidence of compliance with the Building Code.
Compliance Schedule	A document that contains specific information about, and procedures for, specified systems within a building as required under section 100 of the Building Act 2004. Under section 103 of the Building Act, a compliance schedule must: a) state and describe each of the specified systems covered by the compliance schedule, including a statement of the type and (if known) make of each specified system; and b) state the performance standards for the specified systems; and c) describe the inspection, maintenance, and reporting procedures to be followed by independently qualified persons or other persons in respect of the specified systems to ensure that those systems are capable of, and are, performing to the performance standards.
Contract Administrator	The person responsible for co-ordinating the various requirements of the contract and ensuring that all documentation is completed and in order. The contract administrator may be a nominee of the client or specifier, but more often would be appointed by the contractor.
Decorative Coat	A coating applied over the intumescent coat for decorative purpose only. A decorative coat may also act as a sealer or topcoat.
Designer	A collective group of designers with agreed design responsibilities typically including the architect, fire engineer, structural engineer, and/or design company responsible for the design of the structure and defining the required fire protection standards for the building. For the purposes of this document, this term may also include a person who contributes to the detailed fire protection specification documents.
Dry Film Thickness (DFT)	The thickness of a fully dried coating, usually in microns (µm).
DFT Reading	A single instrument DFT reading, often performed with an electronic DFT gauge, taken on the surface at least 25mm away from any edge or weld.
Fire Engineer/Designer	Person typically responsible for specifying the Fire Resistance Rating (FRR) needed to meet the requirements in the Building Code.

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1. Definitions *cont.*

Fire Resistance Rating (FRR)	The minimum fire resistance required of primary and/or secondary elements as determined in the standard test for fire resistance, or in accordance with a specific calculation method verified by experimental data from standard fire resistance tests. It comprises three numbers giving the time in minutes for which each of the criteria: a) Structural adequacy (carrying an applied load within defined deflection limits); b) Integrity (preventing the passage of flame or hot gases); and c) Insulation (limiting the transmission of heat) are satisfied and is presented always in that order i.e. 60/-/-. Intumescent coating systems are used on structural steel to satisfy structural adequacy requirements.
Fire Separation	A fire separation is defined in the Building Code as any building element which separates firecells, or firecells and safe paths, and provides a specific fire resistance rating.
Heated Perimeter	See Section Factor.
Inspection Test Plan	A checklist of quality control procedures which may include 'hold points' to be signed off by stakeholders before the next process of the application may proceed.
Intumescent Coating (Basecoat)	A coating that reacts to heat by swelling in a controlled manner to many times its original dry film thickness to produce a carbonaceous char layer that insulates the underlying substrate from heat source.
Intumescent Coating System (ICS)	A coating system comprising of all required coatings and surface preparations to meet the requirements and specification. Usually consisting of a primer, intumescent coat, and sealer and/or topcoat.
Limiting Steel Temperature (LST)	The maximum temperature of the critical element of a steel member prior to failure, under fire conditions. See Appendix B.
Loading Schedule	A table specifying the corresponding dry film thickness (DFT) required for the intumescent coating to achieve the fire resistance rating (FRR) required for steel members.
Main Contractor	The company responsible for the execution and completion of the overall project including works carried out by sub-contractors.
Member	An individual item of steelwork, e.g. column, beam, brace, truss etc.
Plans and Specifications	The Building Act defines Plans and Specifications as: a) the drawings, specifications, and other documents according to which a building is proposed to be constructed, altered, demolished, or removed; and b) includes the proposed procedures for inspection during the construction, alteration, demolition, or removal of a building; and c) in the case of the construction or alteration of a building, also includes— i. the intended use of the building; and ii. the specified systems that the applicant for building consent considers will be required to be included in a compliance schedule under section 100 of the Building Act; and iii. the proposed inspection, maintenance, and reporting procedures for the purposes of the compliance schedule for those specified systems.

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1. Definitions *cont.*

Primer	A protective coating, usually anti-corrosive, applied to the substrate prior to application of the basecoat. For site-applied intumescent coatings, the primer is the only part of the specification that would normally be applied in-shop.
Producer Statement	A professional opinion that specific building work, designs, or specifications comply with technical requirements that satisfy the provisions of the New Zealand Building Code or a building consent. There are currently four types of producer statements known as: › PS 1 – Design › PS 2 – Design review › PS 3 – Construction (often used by the installers of proprietary systems) › PS 4 – Construction review.
Quality Plan	A document setting out the specific quality practices, standards, and sequence of activities relevant to the contract. This document may be used as an aid to efficient management of the contract, as a 'sign-off' document verifying formal inspection and acceptance of the work, or both.
Realtime	Relating to a system that processes input data within a time frame that is sufficiently short for it to be available virtually immediately as feedback on the process that the data came from. For example, having Quality Assurance (QA) system and Loadings Schedule available on site for inspectors to check in real-time.
Sealer Coat	A coating applied over the basecoat to protect the basecoat from environmental degradation.
Section	One physical piece of steel. It may form an entire member or part of a member.
Section Factor (Hp/A)	The ratio of the heated perimeter (m) of the surface exposed to fire to the area of the cross sections (m2) of the steel. It is also a measure of the rate at which a steel section will heat up in a fire. Section factor is sometimes referred to as Heated Perimeter.
Specification	A document in which the detailed fire protection requirements are defined for all elements of the structure. A Specification may include or be supported by drawings and/or plans. The Specification may allow the use of any certified product or it may nominate a preferred supplier for the intumescent coating system, depending on the client's wishes. See also Plans and Specifications.
Specifier	A suitably competent person or company who issues a specification and/or drawings/plans for fire protection. For the purposes of this document they may also be considered to be a designer (see Designer).
Substrate	A substrate, in the context of corrosion and coatings, is the parent or base material to which a coating is applied or the material upon which a process is conducted.

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1. Definitions *cont.*

Territorial Authority	Has the meaning ascribed to it by section 7 of the Building Act 2004 and undertakes the roles described in section 12 of the Act. A territorial authority performs the following statutory functions: › performs the functions of a building consent authority and issues building consents; › issues project information memoranda; › issues certificates of acceptance; › issues and amends compliance schedules; and › administers and enforces annual building warrants of fitness.
Tie Coat	A coat of paint used to bond two otherwise incompatible coats.
Topcoat	Usually an architectural coating either applied over the basecoat to protect it and provide the required finish or applied over the sealer coat for a required finish. A topcoat can also be the sealer coat.
Volatile Organic Compound (VOC)	An organic compound that evaporates or vaporises readily and is harmful to the environment and/or hazardous. Typically, VOCs are released from coatings during curing. Usually measured in g/l.
Wet Film Thickness (WFT)	The measured thickness of an applied wet coating, usually in microns (µm).

2. Abbreviations

ACA	Australasian Corrosion Association
ASFP	Association for Specialist Fire Protection (UK)
BCA	Building Consent Authority
BWOF	Building Warrant of Fitness
CBIP	(NZ) Certification Board for Inspection Personnel
CCC	Code Compliance Certificate
DFT	Dry Film Thickness
ECI	Early Contractor Involvement
FABIG	Fire and Blast Information Group (UK)
FPANZ	Fire Protection Association New Zealand
FRR	Fire Resistance Rating
Hp/A	Heated Perimeter to Area ratio (also known as Section Factor)
ICATS	Industrial Coating Applicator Training Scheme (UK)
ICS	Intumescent Coating System
LTFMM	Life to First Major Maintenance
LST	Limiting Steel Temperature
NACE	National Association of Corrosion Engineers (US/international)
NZBC	New Zealand Building Code
PS1	Producer Statement – Design
PS2	Producer Statement – Design Review
PS3	Producer Statement – Construction
PS4	Producer Statement – Construction Review
QA/QC	Quality Assurance/Quality Control
QMS	Quality Management System
SCI	Steel Construction Institute (UK)
SSPC	Society for Protective Coatings (US)
VOC	Volatile Organic Compound
WFT	Wet Film Thickness

3. Introduction

The use of Intumescent (reactive) Coatings Systems (ICSs) for the fire protection of structural steel elements is well established in New Zealand and throughout the world. ICSs are highly technical products where the correct specification and application of each component are fundamental to the overall performance of the system.

3.1 Scope

This Code of Practice is intended to establish good practice technical and process guidelines for the specification, application, and quality control of intumescent coating systems for the fire protection of structural steel. The objective is to achieve consistency across the industry, to describe what industry considers to be good practice, and to support the process needed to ensure that an ICS will perform correctly when required.

The use of ICSs for non-steel building elements is not covered by this document.

This document is primarily intended to describe how intumescent coatings should be specified and applied so buildings will satisfy the performance requirements of the NZ Building Code.

To achieve this, it is important that the level of fire resistance rating is adequate for the structure, and that there is objective evidence that intumescent coatings have been applied correctly.

3.2 Roles and Responsibilities of Stakeholders

From concept through to completion and handover, a variety of stakeholders will be involved in the specification, approval, application, and maintenance of ICSs, for both new and existing buildings.

The key stakeholders this document refers to are:

- Designer – A collective group which includes Structural Engineer, Architect, Fire Engineer
- Manufacturer(s)/Supplier(s)
- Local Territorial Authority (Building Consent Authority)
- Client/Building Owner
- Main Contractor
- Applicator(s)

Appendix A summarises the 'chain of responsibilities' for each of these key stakeholders, and their expected responsibilities at each stage of a typical project. The definitions of section 1 are also relevant.

When other stakeholders (consultants, third-party inspectors, etc.) are involved, the key stakeholder who has contracted them is generally responsible for defining their roles and responsibilities.

It is considered good practice to hold a pre-job meeting to ensure responsibilities are well-defined, documented, and understood by all parties involved.

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3. Introduction *cont.*

3.3 Intumescent Coating System

An ICS usually has three main component layers: primer, intumescent coating, and sealer/topcoat. In some cases, additional coating types (e.g. for enhanced corrosion protection or aesthetics) are applied in one or more layers.

To perform satisfactorily, an ICS needs to be applied to correctly prepared steel, in the correct environmental conditions, and in accordance with the coating manufacturers' instructions.

3.3.1 WHAT IS AN INTUMESCENT COATING

An intumescent coating is a material that swells when exposed to the heat produced by a fire. The coating has special chemicals suspended within a binder. As the binder is exposed to elevated temperatures it softens allowing the chemicals to react. This reaction forms a thick solid foam-like char that can be over 50 times the original film thickness. This char burns very slowly and provides thermal protection to the underlying substrate by insulating it from heat transfer.

3.3.2 TYPES OF INTUMESCENT COATING

There are two generic types of intumescent coatings: thin film and thick film:

a) **Thin film intumescent coatings** – the most common coatings – are comparatively easy to apply, and often have a good aesthetic finish. They are waterborne or solvent-based and are primarily for internal use, although some are suitable for exterior applications. A sealer coat is often required to protect the intumescent coating from extended weathering during the construction phase unless the coating system has been tested and proven for durability and performance under such conditions.

b) **Thick film intumescent coatings** – often (but not exclusively) epoxy-based coatings – are typically used in exterior applications, severe service environments, or when a longer period of fire resistance is required.

In most instances, certified thick or thin film intumescent coatings are used in New Zealand. Certified coatings are formally assessed for the fire protection of structural steel by an accredited laboratory in accordance with either AS 1530.4 or NZS/BS 476 part 21, the standards cited in the NZ Building Code Acceptable Solutions and Verification Methods.

3.3.3 SUITABILITY OF AN INTUMESCENT SOLUTION

An intumescent coating solution will not always be suitable, especially where there is insufficient space available for the coating to fully expand. Examples may also include partitioning along the line of a structural steel frame. In such cases alternative measures should be considered (for example, boarding systems, flexible blanket systems, concrete encasement).

4. Regulatory and Certification Considerations

4.1 NZ Building Act / Code

The New Zealand Building Act and Building Code do not specify how buildings are to meet the functional and performance requirements within the Building Code. Instead, designers preparing 'plans and specifications' for a proposed building have to demonstrate that the building will comply with the Building Code requirements before a building consent is issued.

Designers often follow the guidance in an Acceptable Solution when preparing a building's plans and specifications or follow a Verification Method to check the proposed building design will comply with the Building Code. Alternative Solutions are another design path that Designer may chose to satisfy compliance. If the designer complies with these documents, a Building Consent Authority (BCA) must accept that the proposed building will comply with the Building Code and issue a building consent. Those responsible for the construction must demonstrate they have complied with the consented plans and specifications before a Code Compliance Certificate is issued.

Intumescent coating systems (ICSs) provide one way of protecting the structural system from fire so as to avoid collapse during and after a fire. Some of the compliance documents cite standards that can be used to select an appropriate ICS or specify how it is to be applied. In particular, testing standards AS 1530.4 and NZS/BS 476 part 21 can be used to verify that an ICS will provide the required protection.

Documenting the performance of a specific ICS will therefore typically reference the manufacturer's literature, which in turn will reference a fire test that has been performed to demonstrate the ICS will provide the required fire resistance rating. The manufacturer's documentation and test certificates may need to be included in a consent application. The need for this should be clarified during pre-lodgement discussions with the BCA.

Testing and certification regimes and documents other than AS 1530.4 and NZS/BS 476 part 21 may also be acceptable. However, it is strongly recommended that the acceptability of these less common compliance paths be established with the BCA during pre-lodgement discussions.

4.2 Regulatory Compliance

It is good practice to ensure that measures that will provide regulatory compliance are built into every contract at the design and specification stages. Where a building design incorporates an ICS as part of the fire engineering design and structural fire protection requirements, the building consent and tender documentation needs to be final and complete.

The application for consent needs to include enough detail to demonstrate how a building constructed to the proposed design complies, and how the building can be constructed to comply with the building consent. This includes providing information such as plans,

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4. Regulatory and Certification Considerations *cont.*

specifications, and enough information supporting the design to satisfy the Building Consent Authority that all the relevant Code requirements have been met.

The regulatory requirements can be broken into three sections:

a) Building consent application (Processing);

b) Construction and inspection (Realtime); and

c) Code Compliance Certification.

Further information of each of these sections can be found in Appendix C: Intumescent Coating Systems – Regulatory Documentation Requirements.

4.2.1 IMPORTANCE OF THE COATING SPECIFICATION FOR COMPLIANCE

The project specifications allow all aspects of the passive fire/ fire safety installation to be properly and easily co-ordinated and enables all stakeholders in the contractual chain to understand their legal and contractual responsibilities.

The following contractual requirements for the specification of the ICS should therefore be covered by the project specifications:

- Design Review:
  - Fire Resistance Ratings (periods) required
  - Structural steel drawings detailing members to be protected and to what extent
  - Structural steel section sizes
  - Design LST(s)
  - Nature of any partial protection provided by concrete floors, fire-rated walls, etc.
- Environmental requirements
- Products to be used
- Primer Film Thickness
- Intumescent dry film thickness (loadings)
- Sealer/topcoats (if required)
- Health and safety provisions
- Environmental protection regulations
- Quality Assurance and Quality Control provisions.

Using the information provided above, a project-specific coating specification can be created that includes, but is not limited to:

- Contract information
- Project name and location
- Environment of application
  - Corrosion category
  - Expected weather conditions during construction
  - Special environmental factors

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4. Regulatory and Certification Considerations *cont.*

- Substrate material and FRR required
- Who the specification has been produced for
- Surface preparation requirements
- Coatings
  - Intumescent coating system(s) selected/specified
  - Primer and topcoat selected/specified (if applicable)
  - Finish colour (if important)
  - Expected coverage
  - WFT and DFT required to achieve FRRs specified
  - Mix ratio (if applicable)
  - Minimum and maximum time to re-coat, including environmental conditions for drying or limitations for application
  - Loading schedule
  - Manufacturers' specified minimum and maximum allowable thicknesses of primer, intumescent paint, and topcoats (where applicable)
- Specifier information
  - Specifier's name
  - Date specification created
- Product Technical Data Sheets for all coatings being specified
- Safety Data Sheets for all coatings being specified and any on-site exclusion zones during their use or spray application
- Relevant Test Certificates
- Structural steel references where noted on general drawings
- Excluded fixings – e.g. requirement for no timber blocking ICS expansion
- Order of system installation, where this is important (e.g. before erection of dry wall)
- Any other site-specific requirements for safety or compliance (for example an exclusion zone around the area of application).

The detailed coating specification may be created pre- or post-consent. In the latter case, the final coating specification should be submitted to the BCA as a design/consent amendment.

It is desirable that the necessary completion documentation (e.g. PS3, PS4) is defined in the consent and tender details.

4.2.2 COMPLIANCE SCHEDULE REQUIREMENTS

Buildings that contain certain safety and essential systems ('Specified Systems') require a Compliance Schedule to be issued by the BCA/TA. The Building (Specified Systems, Change the use, and Earthquake-prone Buildings) Regulations 2005 defines a range of systems as Specified Systems, including Fire Separations under - *SS 15 Other fire safety systems or features.*

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4. Regulatory and Certification Considerations *cont.*

SS 15/3 includes fire separations and requires that they be listed on a Compliance Schedule where the fire separation forms part of the means of escape from fire which contains one or more of the Specified Systems 1 to 6, 9, and 13.

Where an ICS forms part of a fire separation or is included within structural element's design to support a fire separation (such as a fire wall or floor), details of the ICS are required to be included within the building's Compliance Schedule.

Other structural elements may be protected with an ICS but not required to be listed as a Specified System.

However, because all ICSs require ongoing inspection and maintenance to ensure that they continue to perform as required throughout the life of a building, it is considered good practice that all ICSs appear on the Compliance Schedule, (see sections 8 and 5.1.3).

Once a building has been completed in accordance with the building consent the building's owner will be issued with a Compliance Schedule at the same time as their Code Compliance Certificate. The Compliance Schedule lists the building's Specified Systems, the performance standards, and the inspection, maintenance, and reporting procedures necessary to keep them in good working order.

A Compliance Schedule for ICSs includes:

- a detailed description of each Specified System (member with an ICS)
- location information for each ICS (e.g. as-built drawings, plans)
- performance standards for each ICS
- the inspection and maintenance procedures required to ensure the ICSs continue to function as intended.

The building's owner is then responsible for ensuring that all the inspection, maintenance, and reporting procedures for the Specified Systems stated in their building's Compliance Schedule have been carried out, and that those systems are performing, and will continue to perform, to the specified performance standards.

Every year the building owner is required to supply the relevant Territorial Authority with a Building Warrant of Fitness (BWOF), which certifies that the inspection, maintenance, and reporting procedures of the Compliance Schedule have been fully complied with for the previous year.

The design life and Life to First Major Maintenance requirements of an ICS will depend on a range of factors and may be building specific. For further information see 5.1.3.

5. Guidance for Specifying an Intumescent Coating System

5.1 Factors affecting performance

5.1.1 ENVIRONMENTAL CONSIDERATIONS

It is vital to ensure that the correct ICS is specified for the environmental conditions each system will be exposed to, both during the application and construction phase, and during its in-service period.

Consideration of the application environment and subsequent timeframes for project completion will also be necessary.

For example, it is necessary to consider the implications for an ICS applied to a steel frame that will be located internally to an office building in a C1-C2 interior zone (see Table 1) but during construction it may be exposed for a period to an environment such as a C3-C4 exterior zones until the building envelope is completed. The ICS manufacturer should be consulted for advice in such situations.

Table 1: AS/NZS 2312.1 Corrosion Categories

AS/NZS 2312.1 Category	Corrosivity Rating	Examples of typical environments	
		Interior	Exterior
C1	Very Low	Offices, shops, hotels, controlled internal air-conditioned environments	N/A
C2	Low	Warehouses, sports halls	Arid/Rural/Urban
C3	Medium	Food processing plants, breweries, dairies	Coastal low salinity
C4	High	Swimming pools, livestock buildings, industrial plants	Sea shore (calm)
C5 - I (industrial)	Very High	Plating shops, chemical sites	Within chemical plants
C5 - M (marine)	Very High	N/A	Sea shore (surf)/offshore

Specifiers may wish to consult corrosion experts familiar with the specification of coating systems or corrosion prevention (e.g. ACA, NACE, SSPC, or similar industry qualifications), protective coating manufacturers, or corrosion engineers. Table 2 gives some general guidance.

The designer (e.g. structural engineer) should define the required corrosion class areas to comply with SNZ TS 3404: 2018 which is to be used in conjunction with AS/NZS 2312.1:2014 and AS/NZS 2312.2:2014 within a project during the design phase, in order to have consistency of environmental classification for the coating system selection and performance.

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5. Guidance for Specifying an Intumescent Coating System *cont.*

Table 2: General suitability of various intumescent/fire rating coatings per environment

Fireproofing type	Interior, C1-C2	Interior, C3	Exterior, C1-C4	Exterior, C5
Single Pack, Waterborne	Suitable	Not suitable	Not suitable	Not suitable
Single Pack, Solvent-based	Suitable	Suitable	Supplier approval required	Not suitable
Cementitious, Low Density	Suitable	Not suitable	Not suitable	Not suitable
Cementitious, High Density	Suitable	Suitable	Suitable	Suitable
Two Pack, Hybrid Solvent-based	Suitable	Suitable	Suitable	Supplier approval required
Two Pack, Epoxy	Suitable	Suitable	Suitable	Suitable
NOTE: This information has been compiled by coating manufacturers and is generic and indicative only. In all cases the coating manufacturer's specific product technical data sheets take precedence.				

5.1.1.1 Awareness of weathering resistance during the construction phase

The final built environment can be quite different to the construction phase environment. Special attention needs to be given to this. Steelwork that will be interior enclosed C1 once the building is completed may well be exterior exposed C3-C5 and fully open to the weather, humidity, and other environmental influences (e.g. seaside, chemicals) for an extended period during construction. Site-specific consideration needs to be given to the ICS's ability to withstand such exposure (see also Table 3).

For example, most single-pack intumescent coatings have a limited tolerance to contact with moisture (condensation) or water (rain/pooling) without an appropriate sealer. Even short-term contact can result in permanent damage to some unsealed intumescent coatings. Each product has its own limitations and guidance should be sought from the supplier.

The use of appropriate seal coats and/or topcoats can help with enhancing the weather protection of the ICS. Where continuous exposure to the elements is likely during the construction phase, sealing and/or top coating will be necessary, unless otherwise proven. Refer to the ICS manufacturer for guidance.

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5. Guidance for Specifying an Intumescent Coating System *cont.*

Table 3: Typical short-term durability for rain/moisture exposure of different Intumescent Coatings

Type of Topcoat	Waterborne single pack intumescent	Solvent-based single pack intumescent	Hybrid intumescent	Epoxy Intumescent
No Topcoat	Not suitable	Up to 6 months*	Up to 6 months	No limitations
Waterborne Acrylic	Up to 3 months	Not recommended	Not compatible	No limitations**
50µm of Polyurethane	Up to 6 months	Up to 12 months	Up to 12 months	No limitations
150µm of Polyurethane	Up to 6 months	Up to 10 years	Up to 10 years	No limitations

** 6 months is not feasible with all solvent-based products, but only those specifically formulated to give that durability. Standard product durability will be about 3 months. Actual weather conditions will vary these estimated figures.*

*** A waterborne acrylic topcoat is not expected to improve durability on exposure, so the durability will be similar to that without a topcoat.*

NOTES:

1. *The durability periods above all rely on the intumescent coating being fully dry before it is exposed to any weathering. It is also essential that any single pack materials do not have prolonged contact with water/moisture, e.g. ponding or running water, even with a polyurethane topcoat applied.*
2. *This information is generic and indicative only. In all cases the coating manufacturer's specific product technical data sheets take precedence.*

5.1.2 ENVIRONMENTAL SPECIAL CASES

Special case environments and environmental factors that will influence the assignment of a corrosion category include:

- Exterior zones exposed to weather/salt spray
- Industrial corrosive atmospheres
- Humid/damp environments
- Extreme temperatures
- Frequent washing and/or cleaning
- Splash zones
- Abrasion/impact/vibrations
- Hard to clean/inspect zones
- Ease of maintenance

5.1.3 DESIGN LIFE AND LIFE TO FIRST MAJOR MAINTENANCE

For a Building Code acceptable solution approach, the applied ICS must comply with Building Code clauses C6 (Structural Stability) and B2 (Durability). Clause B2 and Acceptable Solution B2/AS1 set the minimum durability periods for building elements that have normal maintenance as not less than 50, 15, or 5 years depending on the ease of access and remediation.

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5. Guidance for Specifying an Intumescent Coating System *cont.*

However, any need to substantially remove and reinstate the intumescent coating at any stage in the life of a building will involve considerable cost and disruption. Therefore, serious consideration should be given to specifying an ICS that will last for the design life of the building (normally 50 years), allowing for the normal maintenance generally recognised as necessary to achieve the expected durability.

Advice should be sought from manufacturers and suppliers as to the appropriate ICS to be specified, including the expected design life and Life to First Major Maintenance (LTFMM) for the ICS. This will consider factors such as:

a) Environmental classification (see Table 1);

b) Interior vs exterior systems;

c) Type of intumescent coating;

d) Whether a protective topcoat is required or not; and

e) Durability (B2/AS1) requirements – 5, 15, or 50 years.

For example, a thin film acrylic intumescent coating designed for installation in C1 interior environments may not have an LTFMM specified, as they are typically installed in areas free from human impact and damage and are intended to last the design life of the building.

For C3 or C4 exterior environments, however, where a thin film acrylic ICS typically has a protective topcoat installed, the LTFMM is generally limited to the life span of the sealer/topcoat applied over the intumescent coating in line with AS/NZS 2312:2002.

In this situation, the LTFMM is critical; if the sealer/topcoat is compromised, the underlying thin film acrylic intumescent coating is exposed to the environment. This can lead to loss of adhesion or complete failure of the intumescent coating.

The ICS manufacturer should provide a maintenance guide to ensure the continued effectiveness and compliance of an ICS. An appropriate schedule of inspection should also be specified.

The above information should allow the whole-of-life costs to be adequately considered for the project, especially where there is a choice of ICS.

The inspection and maintenance requirements for each ICS need to be documented in the building's Compliance Schedule (see 4.2.2). As a guide, an ICS should be inspected at least annually as part of the BWOF inspection process.

For additional guidance on building refurbishment or changes of required FRR, see 6.4.11.

5.1.4 REPAIR PROCEDURE

A copy of the repair procedure/specification (which is typically straightforward) should be included in the project operations and maintenance manual. Where possible, it is recommended that the original supplier be consulted before carrying out any repairs in case the recommended repair procedures have changed since installation.

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5. Guidance for Specifying an Intumescent Coating System *cont.*

5.1.5 REQUIRED FIRE RESISTANCE RATING

Responsibility for determining the fire resistance ratings necessary for structural elements to meet Building Code requirements typically lies with the project's fire engineer. This needs to be determined before specification of the intumescent coating.

A structural engineer is typically responsible for providing the structural steel section sizes. The design team collectively is responsible for identifying which steel members are required to have a fire resistance rating, and which of these will be protected by an ICS.

Typical fire resistance rating periods required for stability (X/-/-) are 30, 60, 90, or 120 minutes.

5.1.6 LIMITING STEEL TEMPERATURE

The designer (typically a structural engineer) is required to determine the LST as part of the structural design package. Temperature values can also be determined from performance-based approaches which consider the structural utilisations from appropriate analyses carried out by a structural or fire engineer.

Consideration should be given to the relevant guidelines and safety factors of the overarching structural design standard used for the project (which for an installation to the NZ Building Code will normally be NZS 3404 and AS/NZS 1170:2002 – Part 0) as modified by the Acceptable Solutions and Verification Methods for NZBC clause B1.

Attention should also be given to weld and bolt connections. There is no specific method for calculating such junctions within NZS 3404. However, these members will have differing yield performance and should be given consideration by the designer(s).

For more information on the effect of LST, see Appendix B.

5.1.7 DESIGN

The following sections are a summary of the design considerations for projects where an Intumescent Coating System will be used. Further information can be found in a variety of resources including the ASFP Yellow Book or ASFP Technical Guidance Document 11: Annex D.

5.1.7.1 Junctions between different passive fire protection systems

In addition to ensuring that all aspects of intumescent coating applications are compatible, considerable design focus should be exercised at, and around, the junctions between different passive fire protection systems and different construction methodologies/products.

Where an intumescent coating system meets a spray system, the spray system should overlap the intumescent system by 100mm, similarly where an intumescent coating system meets a boarded system then the board system should overlap the intumescent system by 100mm and be capped off using the same board system as shown in Figure 1.

CONTINUED OVERLEAF

5. Guidance for Specifying an Intumescent Coating System *cont.*

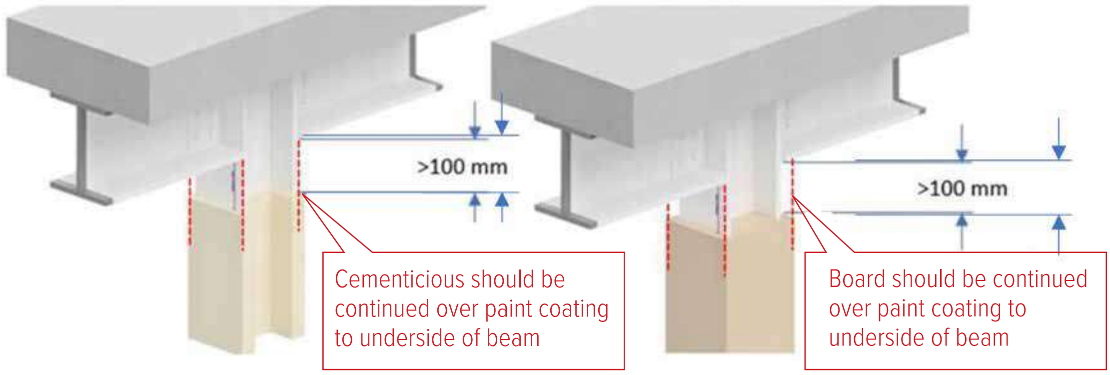

Figure 1: Left - Junction between cementitious (column) and intumescent coating (beam). Right - Junction between boarding system (column) and intumescent coating (beam).

The construction advice of manufacturers of all passive fire protection systems involved should be sought regarding any proposed arrangement, as their product may have specific requirements or exclusions.

See ASFP Technical Guidance Document 8 for additional details and suggestions.

5.1.7.2 Standoff distances

Timber noggins/joists, battens and wall framing are often used in conjunction with structural steel. If timber is fixed directly to and over intumescent coated steelwork, the coating underneath the timber will not be able to intumesce to achieve the required fire resistance rating.

Where cladding systems or timber framing are to be used in conjunction with an intumescent coating for protecting steel members from fire, a gap of 50 times the DFT of the intumescent coating will generally need to be provided (for thin film intumescent coatings) to allow for full expansion of the intumescent coating during a fire. Gap sizes may be reduced only where the intumescent coating manufacturer has specific test evidence to justify a reduction for the specified period of fire resistance. This guidance also applies to the gap between the cladding/framing and the flat surfaces of the protected steel section, as well as to flange tips.

This standoff distance may be achieved by various means, including:

a) 'Z' clips or equal angles attached to the main steel member itself to offset the framing from the fire-rated member. These are considered fixings (see 5.1.7.6);

b) Achieving the required FRR by boarding with fire-rated materials; or

c) Metal track stud affixed to the primary member onto which cladding/framing systems are then attached.

Where cladding systems/timber framing and intumescent coatings are to be used together a proving test needs to be documented, or a formal assessment obtained, from an accredited laboratory in accordance with AS 1530.4 or NZS/BS 476 part 21.

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5. Guidance for Specifying an Intumescent Coating System *cont.*

5.1.7.3 Web openings (Cellular and castellated beams)

Long-span beams wit h multiple web openings, commonly known as 'cellular beams' or (historically) 'castellated beams', have numerous openings in the web to accommodate services such as pipes and ducts through ceiling voids. The openings can be any shape, however circular openings are most common.

The introduction of openings in the web of the steel beam means the structural capability of the beam differs from that of a solid beam. Cellular beams can display complex failure mechanisms in a fire compared to a solid beam. It has become clear that the limiting temperature of such beams is not the same as for unperforated sections. Instead, the geometry of the beam defines the limiting temperature, so every cellular beam needs to be assessed on its own merits.

Some cellular beam manufacturers will supply limiting temperatures for their products. Generalised (or universal) solutions are not appropriate.

Alternative calculation of Area/Volume can be used in lieu of Hp/A for Cellular beams whereby the Area/Volume is calculated to account for openings.

It is good practice to obtain advice from a structural engineer.

Cellular beams are most commonly protected using thin film intumescent coatings. The Association for Specialist Fire Protection (ASFP) and the Steel Construction Institute (SCI) have developed structural models for beams with circular and rectangular web openings which enable the calculation of the limiting temperature as a function of beam geometry and load. As an alternative solution under the NZBC compliance regime, these models might be used to determine the correct intumescent coating thickness for the required fire resistance rating period.

Further information on determining product thickness, and fire test and assessment procedures for cellular beams protected with intumescent coatings can be obtained from the ASFP Yellow Book section 4 and online resources from www.steelconstruction.info

5.1.7.4 Deck voids

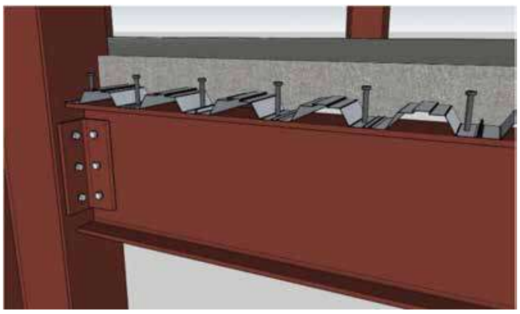

Figure 2: Trapezoidal decking

Trapezoidal profiled flooring systems, as shown in Figure 2, create voids between the slab soffit and the (unprotected) top surface of the beam, which provides a direct

CONTINUED OVERLEAF

5. Guidance for Specifying an Intumescent Coating System *cont.*

heat path into the steel member in a fire scenario. Such decking sheets are typically fixed to the top flange of the beam by a series of shear studs involving an electric arc welding procedure that relies on electrical conduction being maintained through the connection between the stud, decking sheet and top flange, preventing the beams being protected with intumescent material prior to the sheets being fitted.

To cater for the additional heat transfer to the exposed top flange of the steel beam two approaches are typically employed. These can be either:

a) Fill the void between the top flange of the beam and the deck with a certified fire stopping product, as shown in Figure 3; or

b) Leave the void unfilled but increase the thickness of the fire protection coating on the rest of the beam, see Table 4.

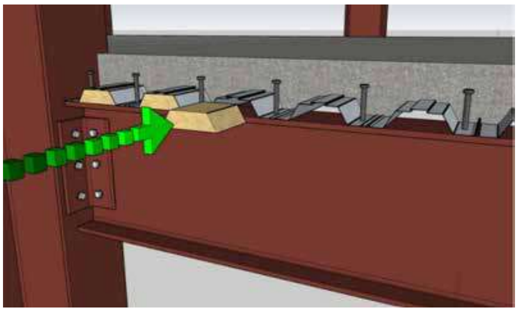

Figure 3: Filling voids in trapezoidal profiled decking

Either approach can be used successfully but will have an effect on cost of materials, labour, and time.

When using the default LST of Appendix B, Table 4 provides conservative guidance on filling the voids from trapezoidal decking. A more detailed analysis may be able to rationalise the design with the aim of reducing the required thickness of coating to achieve the required performance outcome.

Table 4: Recommendations for dry film thickness adjustment for trapezoidal decking when using default LST of Appendix B (from ASFP Yellow Book 5th Edition)

Beam Type	Fire Resistance Required		
Composite	30-60min	90min	Over 90min
	Increase DFT by 20% or Increase Hp/A by 30% and assess DFT	Increase DFT by 30% or Increase Hp/A by 50% and assess DFT	Fill voids
Non-composite	Fill voids		

If the LSTs are to be calculated individually for each steel beam, rather than using default LSTs of Appendix B, the beams with exposed voids will need to account for this by reducing the calculated LST. Table 5 shows the adjustments that typically need to be made to the LST.

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5. Guidance for Specifying an Intumescent Coating System *cont.*

Table 5: Typical trapezoidal decking temperature modifications for beams with specified limiting temperatures (ASFP Yellow Book 5th Edition)

Beam Type	Temperature reductions to calculated LST required for fire resistance			
	30min	60min	90min	Over 90min
Composite	50°C	70°C	90°C	Fill voids
Non-composite	Fill voids			

It should be noted that the use of re-entrant or ‘dovetail’ profiled decking sheets as shown in Figure 4 requires no additional considerations in the use of intumescent coating as the top flange can be regarded as being fully protected by the floor system.

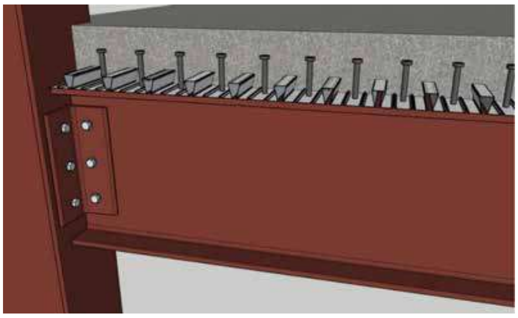

Figure 4: Re-entrant or ‘dovetail’ profiled decking

It is likely to be necessary to consult either a fire engineer, structural engineer, and/or supplier for further clarification when using trapezoidal decking systems. More information can be found in the ASFP Yellow Book Annex 3.5.

5.1.7.5 Junctions between protected and unprotected steel

The potential for heat transfer from unprotected structural steel into protected structural steel also needs to be considered. Unless specified otherwise by a competent person, it is necessary to protect the adjoining 500mm of ‘unprotected’ structural steel with an intumescent coating to limit unwanted heat transfer. Such ‘coatbacks’ should be specified in the tender information supplied for the project. The structural engineer needs to confirm at the design stage whether coatbacks are required, or not, and this should be thoroughly documented.

See ASFP Technical Guidance Document 8, section 3 and ASFP Advisory Note 21 for further detail.

5.1.7.6 Fixings

Where it may be necessary to make attachments to steel members (e.g. suspended ceilings, light fittings, services, angles, brackets, seismic bracing), consideration of direct heat transfer into the steel member is required. In such occurrences, the question arises as to how big the attachments can be, and also the frequency/

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5. Guidance for Specifying an Intumescent Coating System *cont.*

spacing at which they are attached, before the steel member and ICS may become compromised in a fire scenario.

In the first instance, it is recommended that these scenarios are eliminated through careful design and co-ordination on site.

If it is unavoidable, then ICS manufacturers may have specific testing with permissible fixings onto their ICS. Considerations should include cross sectional area, primary steel section length and surface square metre, Hp/A of intersecting members, and coatback requirements as per 5.1.7.5.

5.1.7.7 Fire Separations and Fire Walls

Although highly unlikely to achieve the necessary insulation rating (-/-/X) or integrity rating (-/X/-) of the required FRR of a fire separation, an intumescent coated steel beam can sometimes be detailed as forming part of a fire wall. Where this occurs, the Designer should carefully consider the fire separation rating requirements, and the performance of the element concerned in this configuration.

An integrated system may be necessary, and it is recommended that the designer considers this.

Particular caution should be exercised with intumescent coated beams in conjunction with fire walls where the beams have service penetrations. Unless tested and certified as a combination in accordance with AS 1530.4 or NZS/BS 476 part 21 by a suitably accredited laboratory, this arrangement is not advisable because both systems are certified to different criteria. In such situations, it is recommended that the stand-off distances of 5.1.7.2 be observed, and a suitable fire rated board system be used along with an AS 1530.4 / AS 4072.1 certified passive fire system.

Because of the uncertainty about the most robust method of installing partitioning to the underside of structural steel beams coated with an ICS, and the possible impact this may have on any performance, it is recommended that the beam or column is treated for fire protection and acoustic separation as if there were no other treatment to the steel to replace the level of protection designed to be provided by the ICS, and also meet the performance requirements of the partitioning.

Boxing out the beam or column with an independently tested framed or unframed system that will provide the required level of fire protection to the beam/column ensures that the beams/columns are protected and that the performance requirements of the compartmentation are maintained. For further information please refer to ASFP Advisory Note 18.

Steel beams do not provide any fire rating for integrity (-/X/-) or insulation (-/-/X) by default, and are therefore not able to be considered an Acceptable Solution.

5.1.8 ACCESS

For the correct application of an ICS, access to the structural steel must be allowed for, especially in the case of on-site application. When applying coatings via spray gun, good practice requires the application operator to be within arm's-length of the item being painted and at such a height they do not need to raise the spray gun above their head.

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5. Guidance for Specifying an Intumescent Coating System *cont.*

An allowance for the erection and maintenance of appropriate scaffolding or access machinery should be considered, as well as interference by/to other trades that may be working in the vicinity.

Environmental protection and health and safety requirements for the project, and any of these particular to the ICSs specified, should also be considered at this point.

5.1.9 SURFACE PREPARATION

Generally, the structural steel will be blasted and primed by the steel manufacturer/blast shop off-site. However, if this is not the case, the coating specification will need to include blasting standards and procedures, along with criteria for the primer application.

Whether applied off-site or on-site the surface preparation level should be at a minimum of:

a) Solvent clean (SSPC-SP 1);
b) Abrasive blast (minimum SSPC-SP 10 or AS 1627.4 Class Sa 2 ½);
c) Clean/de-dust the substrate; then
d) Primer applied before blasted surface deteriorates.

For more information on blast cleaning standards refer to NACE/SSPC, ISO 8501.1, AS 1627.4 or AS/NZS 2312.1.

Only in exceptional cases, such as small localised areas, may it be possible to apply intumescent coatings onto un-blasted steel. In such cases it will be necessary to obtain the manufacturer's input and supporting test evidence before commencing application.

In the more common case of in-shop blasting and priming, the same surface preparation as above will be specified. It is recommended that after transportation, site storage and erection, further measures are specified to ensure cleanliness and remaining within the recoat window of the primer prior to application of the intumescent coating.

5.1.10 PRODUCT SELECTION

To be used in New Zealand, intumescent coatings should have test certification or a formal assessment from an accredited independent laboratory in accordance with AS 1530.4 or NZS/BS 476 part 21. Evidence of such compliance should be provided by the ICS manufacturer or supplier.

An ICS can include a primer, intumescent coating, and topcoat. Occasionally, build and sealer coats will also be required. It is essential that all proposed components are carefully evaluated for performance and compatibility (see 5.1.10.2) before being specified. Particular attention should be paid to any limitations stated in the manufacturers' technical data sheets.

5.1.10.1 Primer Selection

Primer selection depends on the corrosion protection level required for the environment, whether the primer is to be applied on-site or in-shop, and the time interval between primer application and intumescent application.

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5. Guidance for Specifying an Intumescent Coating System *cont.*

The primer needs to be compatible within the intumescent coating system. Confirmation should be sought from the manufacturer of the proposed intumescent coating as to suitability and compatibility.

Primers may have specific requirements such as DFT or recoat windows. These specific requirements need to be obtained from the manufacturer(s) and included within the coating specification.

Particular care needs to be taken with zinc-rich primers where weathering exposure can lead to the formation of zinc salts, which may affect inter-coat adhesion. This may be mitigated by washing, applying a tie coat, or other manufacturer-specified procedures.

5.1.10.2 Compatibility between coats

To ensure that an intumescent coating will perform its intended function in a fire, it is imperative that all the elements that make up the ICS are compatible and have been tested in actual fire conditions by an accredited laboratory in accordance with AS 1530.4 or NZS/BS 476.21, and for durability. Before specifying an intumescent coating that has elements sourced from multiple suppliers, evidence of compatibility needs to be obtained.

5.1.11 UPGRADING EXISTING NON FIRE-RATED STEELWORK TO AN ICS

Where existing steelwork requires refurbishment or upgrading, good practice is often to completely remove the existing coating system and replace it with a new ICS. This is because there is often no definitive way to ensure that any existing non fire-rated coating system will perform adequately in a fire, the adequacy of the surface preparation beneath the existing coating, or whether it will be compatible with any new fire-rated coating system being installed.

It is recommended to consult with the ICS manufacturer prior to specification and deciding on a course of remediation. It is possible some existing coatings might not have to be completely removed if they can be assessed or tested on site.

5.1.12 STANDARD OF ARCHITECTURAL FINISH

The aesthetics of the finished ICS can vary depending on the application method and ease of access. The standard of finish required by the client should be included in the coating specification and agreed upon before commencing application. Refer to AS/NZS 5131, particularly for architecturally exposed steelwork. To ensure everyone agrees on the visual standard, the use of samples or test patches is recommended. Typically, the type of finishes that can be required are:

a) **Basic finish** – The coating system itself achieves the required performance for fire and corrosion protection. No requirements for aesthetics;

b) **Decorative finish** – As for a basic finish, however a satisfactory level of aesthetics is required when viewed from 5m. It will be smooth and even with minor ‘orange peel’/ brush marks. No visible runs or sags; or

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5. Guidance for Specifying an Intumescent Coating System *cont.*

c) **Architectural finish** – The coating is to have a very high level of aesthetics (even, smooth, gloss level) when viewed from 2m. This finish level should apply to visible steel only.

The applicator will typically provide a basic finish, unless otherwise specified in the contractual documents.

5.1.13 VERIFICATION AND SPECIFICATION OF DRY FILM THICKNESSES (LOADINGS)

Intumescent coatings typically undergo a series of type tests to ensure that they behave appropriately for each steel section shape in the event of a fire. These tests confirm the required loadings and are summarised into a table for the steel section shape, FRR, Section Factor (Hp/A), and LST. Proven test certification, or a formal assessment from an accredited laboratory in accordance with AS 1530.4 or NZS/BS 476 part 21 needs to be provided for the intumescent coating chosen.

The specification of the necessary DFT should be provided by the intumescent coating's manufacturer/supplier, after they have received the following information:

- Fire Resistance Rating required
- Structural steel drawings identifying the elements to be protected
- Structural steelwork section sizes, weights, and lengths
- Nature of partial fire protection if any, provided by concrete floor slabs, fire-resistant walls etc.
- LSTs, if they fall outside of the accepted defaults (see Appendix B).

5.2 Considerations for management of the coating application

An ICS can be installed on-site, or off-site, or a combination of both. There are advantages and disadvantages for each. When deciding on the most appropriate intumescent coating system and its method of application, consideration should be given to the potential for disruption to and from other on-site trades and activities, health and safety/environmental implications (e.g. VOCs, overspray, spray drift, work at heights), cartage to site, storage and erection on site, and repairs required after installation.

The responsibility for all aspects of the ICS project (including design, specification, scheduling, application, repair, and quality assurance) should be clearly defined and agreed between the stakeholders involved. See Appendix A for recommendations.

6. Guidance for the Application of Intumescent Coatings

Intumescent coating systems are a highly critical and specialised building component, designed to protect the structural adequacy of the building's load-bearing elements during a fire event. They need to be installed by specialist applicators who know and understand not only the practicalities of coatings and application, but who will also provide the necessary attention to detail in the application and be underpinned by a robust quality management system.

The following sections cover application requirements and describe the practical procedures and measures that will be needed for compliance.

6.1 Choice of applicator and inspector

A protective intumescent coating is a critical factor in ensuring the design of a building and/or structure meets the minimum requirements for compliance. Such work should be carried out only by skilled professionals who can demonstrate the following as a minimum:

a) The applicator (company) holds a formal Quality Management System accreditation (various schemes and levels are available, up to ISO 9001); and

b) The applicator (company) is a member of a relevant professional body with a code of ethics (for example, FPANZ); and

c) The applicator (or application supervisor) holds an accredited Coating Inspection certification (such as NACE Level 1 or CBIP); and

d) The applicator (coatings sprayer/operator) holds an accredited coatings application certificate (such as SSPC Train the Painter: white paper - thin film intumescent coating application module, or ICATS Industrial Coatings Applicator).

NOTE: it is recognised that it will take some time for the industry to fully achieve the above.

Where one or more of the above criteria has not been met, an accredited third-party coatings inspector should be engaged to oversee the project.

In the absence of the above, it may prove difficult to obtain a PS4 or Certificate of Code Compliance.

Some ICS suppliers require specialised product training to be undertaken in order to become a certified applicator of specific coatings. It is advisable to seek guidance from the supplier on this and any other specific requirements they may have.

6.2 Preparation of the substrate and primer

This section outlines the factors that need to be considered to ensure that the substrate and primer meet all the requirements for intumescent coatings.

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6. Guidance for the Application of Intumescent Coatings *cont.*

Generally, structural steel will require solvent cleaning (degreasing) and abrasive blast cleaning before being primed and this will usually be done off-site at a dedicated blast and paint company. This allows the steel to arrive to site complete with the correct blast profile and primer ready for the intumescent coating to be applied after any necessary remedials are carried out.

In the unusual circumstance that the steel arrives to site as black steel, the specified method will need to be followed to ensure the level of cleanliness and profile is achieved before applying the primer. This is often a higher cost method than off-site preparation and primer application.

Note: Some intumescent coatings can, in limited situations, be applied directly to un-primed steel.

The applicator who has applied the primer needs to supply documentation for the steelwork including the type of primer, date of application, conformance to the specification, and average dry film thickness of the primer in accordance with AS/NZS 2312.1 or SSPC-PA 2 methodology. It is important that the primer DFT falls within the acceptable range for the ICS to be applied over it. The level and percentage of readings to be taken should be nominated in the contractual documents.

In a case where the primer dry film thickness is found to be outside the specification, the on-site contractor should consult the specifier and coating supplier/manufacturer before proceeding.

6.2.1 HANDLING, TRANSPORTATION, AND STORAGE OF SHOP-PRIMED STEELWORK

Generally, steelwork that is primed only will be more resistant to damage during transport and storage than steelwork that has had the full intumescent coating system applied. Either way, the contractor is required to implement protective measures and appropriate care during the transport, storage, and erection of the steelwork. Further information can be found in SNZ TS 3404:2018 section 4.3 or ASFP Technical Guidance Document 11 section 3.2.

To protect the primer from early onset failure, where steelwork is stored for a prolonged period and exposed to the weather it is advisable to stack and cover it to eliminate ponding of water and to periodically wash it down to remove any surface contamination.

6.2.2 REMEDIAL WORKS OF PRIMED STEEL ON SITE

6.2.2.1 Repair of transportation or erection damage

A pre-inspection of the steelwork is necessary to assess the extent of damage from transportation, storage, erection, and site modifications including on-site welding and fabrication. The repair of any damaged steelwork is typically straightforward, most often consisting of either spot power tool cleaning to a minimum of SSPC-SP 3 or spot abrasive blasting to a minimum of SSPC-SP 6, before applying a remedial spot prime to the damaged area.

In all cases the applicator should seek clarification from the intumescent coating supplier before commencing works.

CONTINUED OVERLEAF

6. Guidance for the Application of Intumescent Coatings *cont.*

6.2.2.2 Contaminated and/or corroded primer

Primed steel that has foreign contamination, such as concrete splatter, dust, dirt, salt deposits etc., from either transportation, construction, or delays will need to be thoroughly cleaned.

In the case of a primer showing early-onset corrosion, it will be necessary to clarify and confirm the repair procedure with the primer and/or intumescent coating supplier.

6.2.2.3 Primer compatibility

The compatibility of the ICS with the primer should have been established prior to any works being started. No further application should be carried out until such compatibility has been confirmed in writing by the primer and/or intumescent coating supplier.

Where the primer is incompatible, either a tie coat or removal and re-application of a compatible primer will be required. The new primer or tie coat needs to be confirmed or specified by the intumescent coating supplier.

The applicator needs to satisfy themselves, and document, that the underlying substrate and coatings are all compatible, within the latest specification, clean, and correctly applied or remediated before commencing the application of subsequent coatings.

6.2.2.4 Primer dry film thickness confirmation

The coating inspection methodology, percentage of steelwork, and level of traceability should be defined clearly before any primer is applied.

For steel primed off-site, documentation provided for the steelwork should include, at a minimum, a summary of the average dry film thickness of the primer. Nevertheless, the on-site coating applicator should take their own readings to confirm the dry film thickness of the primer for traceability, and as a duty of care.

Any discrepancies identified in the dry film thickness of the primer need to be clarified, and an average dry film thickness needs to be confirmed and agreed upon by the relevant parties before starting with the intumescent coating application. By proceeding with the intumescent coating application, the applicator is implicitly accepting the condition and DFT of the primer.

6.2.2.5 Sealing of inaccessible areas

Inaccessible design and building features that leave gaps or other defects where moisture ingress may occur should be sealed to prevent blistering or degradation of the intumescent coating after application.

6.2.3 PREPARATION OF GALVANISED STEELWORK AND BOLTED CONNECTIONS

Preparation for galvanised steelwork and/or bolted connections should be clearly described in the coating specification. If not, or further clarification is required, and the applicator should consult the primer and/or intumescent coatings supplier.

CONTINUED OVERLEAF

6. Guidance for the Application of Intumescent Coatings *cont.*

6.2.4 THERMAL METAL SPRAY COATINGS

It is not advisable to use thermal metal spray coatings on steelwork that is to have intumescent coatings applied over it. There is an increased risk of delamination associated with coatings over 300µm DFT applied onto thermal metal sprayed substrates. In situations where this cannot be avoided, the intumescent coatings supplier needs to be consulted for advice.

6.3 Preparation for the Application of the Intumescent Coating

This section sets out the factors that need to be considered before commencing application of intumescent coatings. It is primarily aimed at on-site application, however the considerations for off-site application will be similar.

6.3.1 ALLOCATION OF RESPONSIBILITY

For any application contract it is critical that responsibility for every stage is clearly defined and identified for administration tasks, progress updates, compliance, and quality assurance. Responsibilities need to be allocated to the correct stakeholder to ensure that all work is carried out correctly and safely.

Key responsibilities that need to be assigned are:

- Coating Specification - system durability and fire protection performance, product, and procedural standards
- Choice of supplier and product and/or ensuring compatibility between coats
- Preparation of method statements, schedules, procedures, and programme
- Health and safety and/or environmental compliance
- Compliance with all relevant legislation
- Quality Assurance and Quality Control – Inspections, corrective actions, documentation, and records.

It is the overall responsibility of the intumescent coating applicator to ensure that the intumescent coating system is applied to meet the required specifications.

6.3.2 INTERACTION WITH OTHER SERVICES

Whenever possible, it is advisable to have a clean and sufficient area free of other trades and services made available for the applicator to ensure the least amount of disruption to other contractors on site. During application of any coating by spray it is recommended a generous exclusion zone be established.

6.3.3 HEALTH AND SAFETY

The applicator has a legal responsibility to act in full compliance with all relevant health and safety and environmental legislation throughout the application process.

Many coatings contain chemicals and VOC's that carry health and environmental risks. It is imperative that the latest Safety Data Sheets for any products used are obtained from the supplier, consulted, followed, and made readily available on-site.

CONTINUED OVERLEAF

6. Guidance for the Application of Intumescent Coatings *cont.*

6.3.4 MATERIAL SUPPLY

It is advisable to confirm with the material supplier before commencing application that sufficient stock is available on hand, or within a lead time that meets the requirements of the construction programme. If product becomes unavailable at any stage of the application programme, it is crucial that any alternative product proposed is confirmed as compatible with the system. In such cases, details of the alternative coating specification should be submitted to the BCA as a design/consent amendment.

All materials supplied must be within their shelf life and clearly marked with the manufacture date and batch number for traceability.

6.3.5 STORAGE

Any product storage on site needs to be done in accordance with the manufacturer's technical data sheet and any requirements of the Health and Safety at Work (Hazardous Substances) Regulations. As a general guide the following should be observed:

a) All materials stored between 5°C and 30°C;

b) Material containers should remain unopened until required and used in date order;

c) Material should be stored off the ground and protected from the elements; and

d) All materials should be stored in a suitably bunded and/or flammable goods containment area.

Note: Any waterborne product that is or has been frozen will not be fit for purpose and will need to be discarded.

6.3.6 EQUIPMENT

The applicator should ensure that all equipment required for surface preparation, application, and quality control of all elements of the ICS are available, in good working order, and that current test and/or calibration certificates are available. The applicator needs to ensure that all equipment operators have relevant training and are familiar with current technical data sheets and method statements. This should all be verified and signed off by the supervisor before commencing work.

6.3.7 ENVIRONMENTAL CONDITIONS

No application should take place while environmental conditions are outside the environmental limits specified by the coating manufacturer for the particular product. The minimum environmental conditions that need to be monitored are:

a) Air temperature;
b) Steel temperature;
c) Dew point; and
d) Relative humidity.

Steel temperatures should be at least 3°C above the dew point to ensure that no moisture is present on the surface during application. Working outside of the stipulated environmental conditions can have detrimental effects on both the film formation and the integrity of the coating, as well as on long term performance.

CONTINUED OVERLEAF

6. Guidance for the Application of Intumescent Coatings *cont.*

It is particularly important, where application is to be carried out in a partially clad building, that the applicator and/or main contractor ensure the building is watertight or other measures are taken to ensure that any areas where coatings are to be applied are not directly exposed to external weather conditions that the coating is not able to tolerate during the curing time.

For further clarification or information on the required environmental conditions consult the coating supplier.

6.4 Application

This section sets out the factors that need to be considered during application of intumescent coatings. It is primarily aimed at on-site application, however the considerations for off-site application will be similar.

6.4.1 PRE-INSPECTION

It is necessary for a pre-inspection to be carried out by the applicator to confirm the following:

- Substrate preparation as per coating specification
- Correct primer has been applied and is compatible
- Primer condition and recoat window
- Primer dry film thickness
- Primed surface is clean and dry
- Each steel section is adequately identified and marked up for traceability and different intumescent coating thicknesses

If any of the above is found to be unsatisfactory, refer to 6.2 and 6.3 for guidance on remediation.

6.4.2 MIXING

Intumescent coatings are highly structured products. Use of the correct mixing technique is essential to achieve a uniform consistency allowing the product to be applied correctly and easily. It is best to consult with the coatings supplier to confirm any specific mixing requirements.

6.4.3 THINNING

Most intumescent coating systems cannot be thinned. In some circumstances, the intumescent material may require partial thinning. Over-thinning can be detrimental to not only the coating application but also the long-term performance of the coating, typically leaving the DFT short of what is necessary for compliance. Consult the coatings supplier before thinning the product and stay within the parameters they advise. Only thinners permitted by the coating manufacturer should be used.

CONTINUED OVERLEAF

6. Guidance for the Application of Intumescent Coatings *cont.*

6.4.4 ENVIRONMENTAL MONITORING

The environmental conditions listed in 6.3.7 should be monitored and recorded before, during, and after application. It is necessary that these be recorded at a maximum of 4 hr intervals and form part of the installation's QA documentation.

6.4.5 MASKING AND OVERSPRAY

The application contractor should ensure that areas of steel not requiring fire protection are adequately masked off. Any other sensitive or critical areas (car parks, hospitals, air vents, etc.) which may be subject to overspray or airborne VOC's should also be appropriately protected.

6.4.6 APPLICATION OF THE INTUMESCENT COATING

The application of all coatings should be carried out fully in accordance with manufacturers' technical data sheet requirements and the applicator's method statement. These in turn need to reflect the fire rating schedule's DFT requirements.

While airless spray is generally the preferred and most economic method of application for most coatings, the use of this method on site may be limited, in which case the coating specification may need to either include provision for sheeting-in to protect adjacent buildings and the surrounding environment from overspray, or concede to the more costly use of brush or roller application instead.

Where spray is not possible, a larger number of coats by brush or roller will normally be required. The manufacturer's specified minimum and maximum overcoating times must be observed. The surface finish quality from brush or roller application may be unacceptable, particularly for visible steelwork. It is suggested a sample be provided in advance to the specifier for confirmation before proceeding.

Recommended thicknesses are typically provided on manufacturer's technical data sheets, along with the maximum achievable thickness per coat by the different methods of application.

Application operators need to be fully trained and proficient in the use of the equipment.

6.4.7 FILM THICKNESS DETERMINATION

Whatever the method of application employed; it is essential to ensure that the correct DFT of each coat of the coating specification is achieved. This is particularly important in the case of a site-applied intumescent coating because this is the part of the ICS that confers the necessary fire protection for the structure.

6.4.7.1 Wet Film Gauges

Wet Film Gauge readings should be taken throughout application of the ICS. Although these measurements are not particularly accurate, and are only useful for the coating that is being applied, they provide assurance that the applicator has applied enough coating to minimise any film deficiencies.

CONTINUED OVERLEAF

6. Guidance for the Application of Intumescent Coatings *cont.*

6.4.7.2 Dry Film Gauges

To confirm the thickness of the intumescent coating it is necessary to know the average thickness of the primer. This should either have been supplied by the primer applicator or determined by additional baseline readings. After application of the intumescent coating, the average primer DFT should be subtracted from the measurements taken on the intumescent coating, to determine the true intumescent DFT.

Alternatively, adding the measured average primer DFT to the required DFT of intumescent coating will give the required DFT for the combined primer plus any site-applied intumescent coating.

The DFT measurement and acceptance should be carried out in accordance with 6.5.5.

It is important to confirm that the correct DFT of the intumescent coating has been applied before proceeding with application of the sealer/topcoat, as any deficiency in intumescent coating DFT is best corrected at this stage.

6.4.8 REPAIR OF INTUMESCENT DRY FILM THICKNESS DEFICIENCIES

If the DFT of the intumescent coating does not achieve the nominal thickness stated in the Loading Schedule, further application of the coating will be needed. If this is carried out within the recoat window of the intumescent coating then, after ensuring the surface is clean and free of any contamination, additional coating can be applied as per 6.4.6.

6.4.9 APPLICATION OF SEALER AND/OR TOPCOATS

Some ICSs require a sealer/topcoat to be applied, depending on the final environmental exposure conditions. Where a sealer/topcoat is specified, it should be applied in accordance with the manufacturer's technical data sheet.

Sealer/top coats are usually very thin; however, it is important to apply the correct DFT because this is a key factor in the durability of the system. The application should be carefully monitored to ensure the correct DFT is applied, and to ensure full sealing of the intumescent coat.

It is common for the sealer/topcoat alone to provide the decorative finish. Occasionally, additional coats will be required for either a specific finish or extra protection for the intumescent coating. The sealer coat or decorative topcoats should meet the specified finish requirements as outlined in 5.1.12. Sealer/topcoats applied incorrectly and/or outside of the coating specification may compromise the intumescent coating's performance.

6.4.10 REPAIR OF THE COMPLETE INTUMESCENT COATING SYSTEM

Damage to an ICS can typically occur during building fit-out post-application. Remedial work on a complete ICS will depend on the extent of the damage. Recommendations are as follows.

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6. Guidance for the Application of Intumescent Coatings *cont.*

6.4.10.1 Minor damage

Small chips and scrapes will not significantly affect the system's performance unless the service environment is wet or exposed to the weather. It is recommended that repairs are carried out at the earliest opportunity and as per the original coating specification.

Where the ICS is damaged down to the substrate, with rust showing, the substrate is typically cleaned to a minimum of SSPC-SP 3 and the surrounding (intact) coatings are lightly abraded. The coatings are then reinstalled as spot coatings to the damaged area as per the coating specification.

If only the intumescent coating is damaged, a fresh coating of the specified intumescent material is applied, or a suitable repair coating, before reapplying the sealer and/or topcoats to reinstate the originally specified system.

If only the sealer coat or topcoat is damaged, these can be abraded and spot recoated.

6.4.10.2 Major damage

In the unlikely event that major repairs are required (i.e. due to water or chemical attack), the intumescent coating manufacturer should be consulted for specialist advice.

6.4.11 CHANGE IN FIRE RATING REQUIREMENTS OR EXTENDING LIFE OF INTUMESCENT COATING

Over the life of a building it is likely that the applied ICS may need to be reviewed. Typical reasons are: building upgrade, refurbishment, change of use, change in required fire rating, structural alterations, or simply extending the life of an applied ICS.

Where this occurs, the works would be subject to a building consent and so would involve the full design process of this Code of Practice.

When reviewing existing ICSs in these circumstances, the following should be considered:

Initial Steps:

a) Establish the fire resistance requirement of the structural steel members. This should be provided by the design team as outlined elsewhere in this document;

b) Identify the existing fire protection system. This may involve destructive testing and/or laboratory samples to verify;

c) Consult the manufacturer and assess the likely contribution of the existing ICS to the required fire resistance, including the suitability of the existing system for continued use;

d) Check corrosion and durability of the existing steel and any applied ICS or primer; and

e) Depending on the outcomes of the above assessment, all areas and parts of the system which fail to meet the new design requirements for fire resistance should be repaired, over-clad, or removed and replaced with a system capable of fulfilling the new requirements in accordance with manufacturer's instructions and a certified solution.

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6. Guidance for the Application of Intumescent Coatings *cont.*

Possible outcomes may include:

f) Manufacturers (and applicator, if applicable) re-certify the existing ICS as compliant with all the new requirements;

g) As near as reasonably practicable consideration (ANARP) – the design team may choose to evaluate any existing ICS on an ANARP basis, in accordance with Building Act;

h) Removal and full replacement with a new ICS;

i) Additional ICS applied over the existing ICS, subject to manufacturer's instructions and a compatibility assessment;

j) Partial replacement of existing ICS – a combination of h) and i); or

k) Existing ICS is over-clad with fire rated board system or other system type to avoid compatibility issues.

6.5 Quality Assurance

This section identifies, but is not limited to, all of the standards, requirements, and factors that need to be considered to ensure that the application of the ICS is completed in accordance with the specification and meets with the specified levels of quality.

6.5.1 QUALITY MANAGEMENT SYSTEM

A Quality Management System (QMS) is the overall management system (documented) which provides adequate and appropriate control over an organisation's activities to ensure outcomes meet the desired and quantified levels of quality. Figure 5 shows the structural overview of a typical QMS.

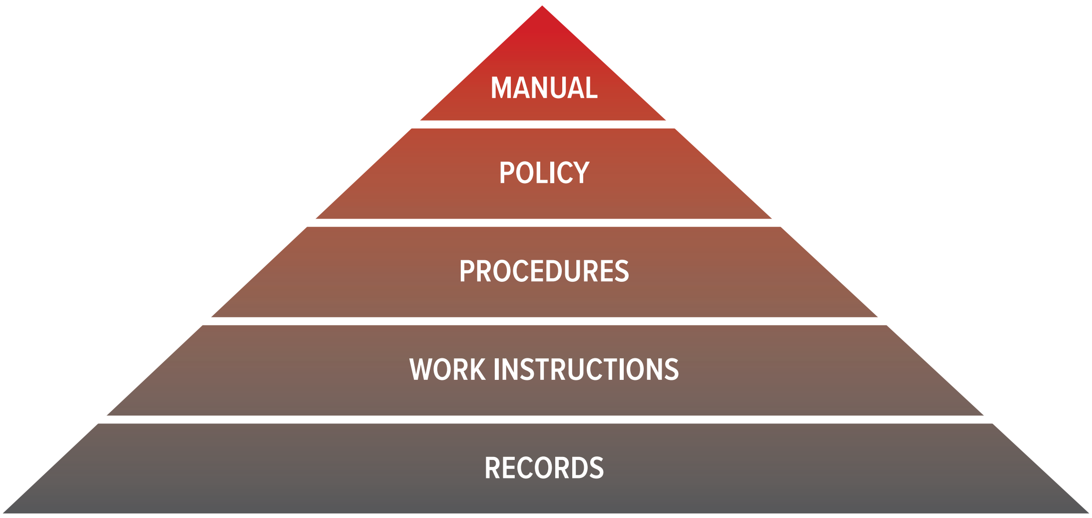

Figure 5: Overview of a quality management system.

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6. Guidance for the Application of Intumescent Coatings *cont.*

- **MANUAL** – The organisation's roadmap of the overall QMS. The quality manual contains such information as organisation structure, departmental structure, responsibilities, and accountabilities.
- **POLICY** – An overarching plan (direction) for achieving an organisation's goals. A statement of intent.
- **PROCEDURES** – The documented steps in a process and how these steps are to be performed to ensure effective implementation and compliant outcomes.
- **WORK INSTRUCTIONS** – Very detailed instruction as to how to perform a task. This is where the Project Quality Plan would sit to detail any hold and witness points requiring authoritative acceptance sign off. (See definition of quality plan in 6.5.4)
- **RECORD** – A document or form which, once completed and signed, provides evidence of an activity or signatory approval. For example, a quality plan (see 6.5.4).

6.5.2 QUALITY CONTROL CONSIDERATIONS AND EQUIPMENT

Quality control measures need to be adequate to provide assurance that each stage of a process is being completed as stipulated in the specification, and in accordance with the manufacturers' technical data sheets.

Some of the equipment and devices that would be expected to be part of a quality control process include:

6.5.2.1 Surface preparation

- Electronic profile gauge
- Pictorial standards
- Comparator plates
- Replica tape (e.g. Testex)
- Micrometers

6.5.2.2 Coatings

- Wet film thickness gauges
- Dry film thickness gauges

6.5.2.3 Environmental conditions

- Thermometers (dry/wet, steel substrate)
- Whirling hygrometer or electronic equivalent

6.5.3 INTUMESCENT COATING QUALITY ASSURANCE

The manufacturer should provide evidence and verification of the intumescent coating for product quality, performance, and fitness for purpose.

More information can be found in the ASFP Technical Guidance Document 11 Annex C.

6.5.4 QUALITY PLAN

Contractors and applicators need to have a well-established system to ensure that the correct procedures are carried out for quality workmanship and compliance. A Quality

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6. Guidance for the Application of Intumescent Coatings *cont.*

Plan is a verification document that can be used to confirm that every stage in the process is performed correctly, and that the required documentation has been completed.

The quality plan is a comprehensive authentication process which can be completely tailored to a project, and the needs of the contractor. The quality plan can also be included with the project records as evidence of compliance.

This section outlines the minimum information the applicator needs to provide. It can be produced as a simple table and is helpful because it:

- Summarises quality requirements in the specification and suppliers' technical data sheets
- Often includes referenced standards/methods to be used, and requirements
- Records conformance
- Can be used as an inspection checklist and/or summary verification document

A sample site quality plan/checklist is shown in Appendix D.

6.5.4.1 Inspection Test Plan

Most construction projects are complex and will have a variety of steel section sizes, each in different configurations and requiring a different dry film thickness of intumescent coating. It is recommended that in order to make the inspection test plan as straightforward as possible, before commencing the job the following documents should be made available:

- Plans and drawings of the structure
- List of itemised steelwork and required dry film thickness – Loading schedule
- Primer coat confirmed dry film thickness or measurements.

6.5.5 DRY FILM THICKNESS MEASUREMENT

It should be clearly stated whether the final DFT reading achieved refers individually to the primer, intumescent coating, and/or topcoat, or to the ICS as a whole. Clear confirmation needs to be provided that the DFT is in accordance with the required specifications.

A suitable gauge should be used for taking DFT readings. The gauge needs to have a range appropriate for the specified DFT of the entire ICS, and all readings taken should be recorded. Most modern electronic gauges have the capability to directly link to software, making this process straightforward. The gauge needs to be calibrated prior to use following the equipment manufacturer's instructions. Current calibration certificates should be included in the documentation package.

DFT readings should be taken only when the coating is sufficiently hard to prevent the probe indenting the surface, but before any additional coatings are applied.

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6. Guidance for the Application of Intumescent Coatings *cont.*

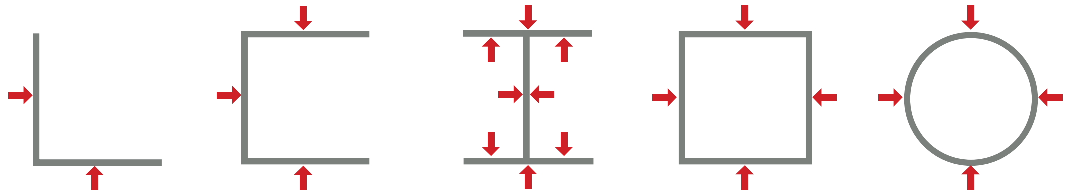
6.5.5.1 Frequency and location of readings

Readings should be taken on every steel section as follows and as shown in Figure 6:

- I-Sections, T-Sections, Channels, Angles, and Square or Rectangle Hollow Sections:
  - **Webs:** One reading per metre length on each face
  - **Outer Flanges:** One reading per metre length on each face
  - **Inner Flanges:** One reading per metre length on each face
  - **Square/Rectangle Hollow Sections:** One reading per metre length on each face

Note: Readings should not be taken within 25mm of any edge or web/flange junction.

- **Circular Hollow Sections:** Four readings per metre length spread evenly around the section



6.5.5.2 Dry Film Thickness survey

It is not practicable (access, time, cost) for 100% of intumescent coated structural steelwork to have its DFT measured and recorded.

The recommended minimum percentage of steel to be measured is 10% of all intumescent coated steel members, in a mix of section sizes, including a representative sample of difficult-to-access through to easy-to-access locations. The survey should consider any adverse trends that become apparent, and additional attention/measurement should be applied to these areas.

It is recommended to confirm at an early stage in the project the percentage of steel to be surveyed and the requirements, if any, for a third-party coating inspector.

6.5.5.3 Dry Film Thickness acceptance criteria

The recommended acceptance criteria are as follows, assuming that the specified DFT is a nominal value:

a) The average measured DFT of any member shall be equal to or greater than the specified nominal DFT for the FRR required, but shall not exceed 110% of the manufacturer's maximum specified DFT;

b) The average measured DFT on any face of any member shall not be less than 80% of the specified nominal value for the FRR required;

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6. Guidance for the Application of Intumescent Coatings *cont.*

c) Individual DFT readings less than 80% of the specified nominal value are acceptable provided that they are isolated and contribute to no more than 10% of the readings on that member.

   A reading is considered isolated if additional readings taken within a 150-300mm radius of the low reading are found to be greater than 80% of the nominated value. In areas, where the additional readings are also found to be less than 80%, the area should be noted and remediated; and

d) No DFT reading shall be less than 50% (or suppliers' minimum allowance) of the nominal value.

6.5.5.4 Dry Film Thickness correction procedure

a) Where the DFT of the intumescent coating is found to be less than what is acceptable, refer to 6.4.8; and

b) Where the DFT of the intumescent coating is found to exceed the manufacturer's maximum specified DFT, guidance should be sought from the intumescent coating manufacturer.

In either of these situations, remedial work will be required by the contractor/applicator, and a corrective action or non-conformance, as applicable, should be raised in their QMS.

7. Records

Detailed and accurate records are important for any coating contract, but for fire protection projects they are an essential contract requirement. Because the work can extend over a lengthy period of time, may be undertaken in several locations, and may possibly involve more than one product supplier and/or sub-contractor, evidence of compliance with the specification will often rely on the existence of a detailed and accurate dossier of information and records.

Such records will also be necessary to demonstrate compliance with regulatory requirements. However, the mere existence of records (of lower level of detail as described in this document) may be insufficient to provide complete confidence that the work has been carried out to the required standards. Therefore, wherever possible, key stages in the application process should be witnessed by a QA representative or independent third party.

Validation may be through recognised third-party certification schemes or through first-hand inspection and acceptance (using a sign-off procedure, for example as suggested in Appendix D). Alternatively, a combination of both may be used.

Copies of these records should be given to the building owner or facilities manager as part of the commissioning documents. The main contractor should also be provided with these records and a copy lodged with the Building Consent Authority as part of the final approvals process.

Where appropriate, site records should contain, but are not limited to, the following information:

- Basic contract information
- Verification of specification and products
- Record of materials and batch numbers
- Substrate inspection records
- Environmental conditions – daily logs of temperatures, dew points, and humidity
- Dry film thickness per coat and for the full intumescent coating system. Measurements should include:
  - Member identification
  - Number of readings
  - Maximum/minimum and average recorded
  - Any supplementary readings or information
- Variations, corrective actions, and concessions

Records should typically include date, time, stage in process, site location, and the name and contact details of the person who made the record.

Record keeping should occur throughout the project and be reviewed/updated at regular intervals.

8. Post-Project Completion

In most cases, correctly applied intumescent coating systems exposed internally in corrosivity category C1 should not require any maintenance over the design life of the building, other than for decorative purposes, or where mechanical damage has occurred.

For all other corrosion categories (C2-C5), the building owner should establish periodic inspection and maintenance contracts in accordance with the requirements of the Compliance Schedule (see 4.2.2). The advice of the intumescent coating manufacturer on the LTFMM should always be sought.

8.1 Maintenance and Inspection

8.1.1 INTERNAL COATINGS

Typically, internal coatings are designed for the life of the building provided that they are used in no more than a dry C1 environment. However, it is recommended to have access points provided throughout the building to allow periodic BWOF inspection of the coatings (see 5.1.3 for further discussion).

8.1.2 EXTERIOR COATINGS

Exterior coatings should have an appropriate washing schedule that will vary according to the microenvironment. Irrespective of the coating system life, all exterior areas sheltered from rain-washing should be washed down with freshwater on a quarterly basis, and on a yearly cycle all painted surfaces should be washed with a suitable cleaning agent followed by rinsing with freshwater. This will remove salt, dirt, and contamination build-up on painted areas.

8.1.2.1 Example maintenance schedule

- Year 1: Thoroughly inspect all painted areas and repair areas of damage/ coating breakdown according to the original paint specification or approved equivalent.
- Year 4/5: Repeat full inspection and repair areas of damage/coating breakdown as per year 1.
- Year 6/7: Repeat condition survey and repair as necessary to maintain integrity of painted areas.
- Year 9/10: A full inspection by a qualified Coatings Inspector or Coatings Technician should be undertaken to arrive at a condition status. This survey should address future maintenance requirements beyond the initial system lifetime, and at this point decisions on touch-ups/repair of areas or full recoating can be made.

Further specific information on maintenance and repairs should be obtained from the coating manufacturer or a qualified Coatings Inspector/Technician.

Appropriate maintenance details should be prepared by the contractor and included in the Compliance Schedule.

9. References

New Zealand Standards

- NZS/BS 476.21:1987 – Fire tests on building materials and structures - Methods for determination of the fire resistance of loadbearing elements of construction
- NZS 3404 Parts 1 and 2:1997 – Steel Structures Standard (NOTE: the 2009 revision of NZS 3404 was withdrawn)
- SNZ TS 3404:2018 – Durability requirements for steel structures and components

Joint Australian/New Zealand Standards

- AS/NZS 2312.1:2014 – Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings – Part 1: Paint coatings
- AS/NZS 2312.2:2014 – Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings – Part 2: Hot dip galvanizing
- AS/NZS 3750.0:2008 (R2019) – Paints for steel structures - Introduction and list of Standards
- AS/NZS 5131:2016 Structural steelwork – Fabrication and erection
- AS/NZS ISO 9001:2016 – Quality management systems – requirements
- AS/NZS 1170: 2002 – Part 0 – Structural Design Actions – General Principles.

Australian Standards

- AS 1530.4:2014 Methods for fire tests on building materials, components and structures – Fire-resistance tests for elements of construction (Latest version, not yet referenced in the NZBC Acceptable Solutions and Verification Methods – see below)
- AS 1530.4:2005 Methods for fire tests on building materials, components and structures – Fire-resistance tests for elements of construction (Superseded version currently referenced in the NZBC Acceptable Solutions and Verification Methods)
- AS 1627.1:2003 (R2017) – Metal finishing - Preparation and pretreatment of surfaces - Removal of oil, grease and related contamination
- AS 1627.4:2005 (R2017) – Metal finishing - Preparation and pretreatment of surfaces - Abrasive blast cleaning of steel
- AS 1627.9:2002 (R2017) – Metal finishing - Preparation and pretreatment of surfaces - Pictorial surface preparation standards for painting steel surface
- AS 3894.3:2002 (R2013) – Site testing of protective coatings - Determination of dry film thickness
- AS 4072.1:2005 (R2016) – Components for the protection of openings in fire-resistant separating elements. Part 1: Service penetrations and control joints

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9. References *cont.*

Other International Standards and Design Guides

- ASFP Technical Guidance Document TGD 8:2010 – Code of practice for junctions between different fire protection systems when applied to load bearing structural steel elements
- ASFP Technical Guidance Document TGD 10:2008 – Code of practice for the refurbishment and upgrading of fire protection of Structural steelwork
- ASFP Technical Guidance Document TGD 11:2014 – Code of practice for the specification and on-site installation of intumescent coatings for fire protection of structural steelwork
- ASFP Technical Guidance Document TGD 13:2010 – Code of practice for the over-cladding of reactive coatings when used as fire protection to steel structural sections
- ASFP Yellow Book 2014 – Fire protection for structural steel in buildings, 5th edition
- BS 5950-8:1990 Structural use of steelwork in building - Part 8: Code of practice for fire resistant design
- ISO 8501.1:2007 – Preparation of steel substrates before application of paints and related products - Visual assessment of surface cleanliness - Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings
- ISO 12944 series – Paints and varnishes - Corrosion protection of steel structures by protective paint systems
- SSPC-PA 2:2018 – Paint application standard No. 2 – Procedure for Determining Conformance to Dry Coatings Thickness
- SSPC-SP 1: 2016 Surface Preparation Standard No. 1 – Solvent Cleaning
- SSPC-SP 3: 2018 Surface Preparation Standard No. 3 – Power Tool Cleaning
- SSPC-SP 6/NACE No. 3: 2007 Surface Preparation Standard No. 6 – Commercial Blast Cleaning
- NACE No.2/SSPC-SP 10: 2006 – Joint Surface Preparation Standard – Near White Metal Blast Cleaning

New Zealand Legislation and Associated Documents

- New Zealand Building Act 2004
- New Zealand Building Regulations 1992 (The New Zealand Building Code)
- New Zealand Building Code Acceptable Solutions and Verification Methods
- Building (Specified Systems, Change the use, and Earthquake-prone Buildings) Regulations 2005
- Health and Safety at Work (Hazardous Substances) Regulations 2017

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9. References *cont.*

Other Useful Documents

- ASFP Advisory Note 12 – ASFP - BCF Best practice guide for specifying reactive coating fire protection for steel structures
- ASFP Advisory Note 18: ASFP Position on Installing Partitioning to the Underside of Structural Steel Sections Coated with a Reactive Fire Protection System
- Advisory Note 19: ASFP Position on the Use of Critical Steel Temperatures above 650°C
- ASFP Advisory Note 20: ASFP Position on Portal Frame Buildings
- ASFP Advisory Note 21: ASFP Position on Coatback with Respect to Unprotected Secondary Beams Fixed to Protected Primary Beams
- BRANZ SR288:2013 – Update of New Zealand's atmospheric corrosivity map
- CEPE/EAIPC/EAPFP 2015 Applicator Best Practice Guide – European industry best practice guide on the application of intumescent coatings to constructional steel
- FABIG Technical Note 13: 2014 – Design Guidance for Hydrocarbon Fires
- FPA Australia Good Practice Guide GPG-01:2012 – Specification and application of intumescent coating systems (ICS) for the fire protection of structural steel
- HERA Report R4-133:2011 – New Zealand steelwork corrosion and coatings guide
- ICorr/CED/CT06:2017 – On-site and off-site application of intumescent fire and corrosion protection coatings for steel structures: Guidance on selection, specifications and use.

Appendix A: Key Stakeholder 'Chain of Responsibilities' during a typical Project

Project Stage: Stakeholder:	Specification	Pre-Application	Application	Quality Control	Remediation	Quality Assurance	Handover & Maintenance
Designer* ***(see definitions)**	Produce detailed drawings. Confirm LSTs. Confirm FRR. Approved combined performance/fire proofing spec. Contribute to detailed project spec. Coatback requirements to be stipulated. Custom welded beam calc's confirmed.	Ensure design changes are transmitted to relevant parties as soon as they come to light. Design is finalised. Prepare and sign PS1 where required by the BCA	Design representative available to respond to technical queries.	Members of design team attend site, as necessary. Ensure Construction Monitoring is carried out in accordance with agreement with BCA and Contractors where required.		Receive and review QA documentation and review prior to sign-off.	Prepare and sign PS4 if required by BCA and CM completed throughout (to be issued with all relevant supporting evidence).
Intumescent Coating Manufacturers / Suppliers	Contribute to detailed project spec: Fire-rated and non-fire-rated systems. Liaise with design team. Confirm compatibility of ICS. Define life to first maintenance expectations.	Produce Loading Schedules from quantum take-off provided by clients or applicators. Info to include # of sides, "Comflor" or flat slab, LST & FRR. Ensure applicator meets competence requirements (duty of care). Pre-start meeting on selected projects.	Be available to troubleshoot any issues with products. Advise on remedial works to damaged areas.	No responsibility for suppliers. Limited spot checks may be conducted to reinforce applicator's records.	Supply of specification for remedial works.		Supplying suggested maintenance and inspection regimes. Verification of supply documentation, if required. Confirmation of any warranty/life to first maintenance statements by suppliers.
Building Consent Authority	"Issue building consent on reasonable grounds" Typically involves: Receive, review, and approve sufficient documentation ("plans and specifications") to demonstrate compliance with the proposed fire engineering design. Evidence includes steel specifications and fire-rated element drawings, information on the intumescent coating supplier, product details and applicator's Quality Management System.	Pre-start meeting on selected projects to set out BCA expectations including level of design information and level of Construction Monitoring required.				Receive and review QA documentation (if requested).	Code of Compliance issued on receipt of adequate QA/QC documentation. Issue of Compliance Schedule. Refer Appendix C

Appendix A *cont.*

Project Stage: Stakeholder:	Specification	Pre-Application	Application	Quality Control	Remediation	Quality Assurance	Handover & Maintenance
Client/Building Owner	Provide detailed set of requirements to design team including any specific requests over & above NZBC requirements or performance outcomes.	As per Main Contractor (if project self-managed).	As per Main Contractor (if project self-managed).				Implement a robust and documented maintenance plan as per Compliance Schedule and suppliers' recommendations.
Main Contractor	Consultation during development of deliverables (assuming Early Contractor Involvemenor Design and build).	Ensure a pre-job conference occurs to iron out any questions/ irregularities in the system, products, work environment, buildability etc. If applicator does not meet minimum qualifications specify that third party inspection is required.	Regular monitoring of QA documentation as it is being produced. Ensure product and methodology used is suitable for temporary exposure conditions anticipated during the construction phase.	Gather & collate reports issued by applicators. Coordinate and oversee third party inspections (if required).	Temporary protection to ICS during build depending on agreements.	Compile all QA/QC documentation for all trades and submit to design team and client for review and approval.	Provide all contract documentation to client, including maintenance plans.
Applicators	No input unless Early Contractor Involvement (ECI) is requested	Pre-Inspection of steel & acceptance of primer/ surface. Produce Detailed: • Methodology • Quality plan • Work breakdown Structure • Applicator's warranty • Personnel training records.	Detailed on-site checklists. Calibrated equipment. Trained/Certified applicators. Correct products on site. Ambient conditions checked and recorded (4x daily). WFT checks recorded.	Suitably trained supervisors. Well-defined QC frequency – DFT check etc. Calibrated equipment. Loading Schedule to be cross referenced to drawings. Project Spec available on site. Photographic record of defects (incl. primer).	Clearly recorded defect list. Photographic recording of remediation process. Clearly defined repair spec available on site. Close-out process for defects.	Clearly defined audit regime. Clear and concise QA reports to be prepared. Prepare as-built records. Utilise qualified Inspectors.	Issue QA reports to client for maintenance records. Issue as-built records. Issue PS3 (to be issued with all relevant supporting evidence).
Third Party Monitor		Decision made whether third Party monitoring is a requirement or not for the project. Loading schedules and specifications provided to third party agent and reviewed.		Regular QA inspections and DFT testing throughout the build at various stages of the build and application, in accordance with the specification requirements	Reinspection of any remedial works, if required		Provide statement on findings.

Appendix B: LSTs

LST: The maximum temperature of the critical element of a steel member prior to failure, under fire conditions.

LST calculation methods are defined by NZS 3404.

Typically, to allow for the correct specification of the fire protection, the following minimum information is required for steelwork:

- Fire test standard (e.g. AS 1530.4)
- Fire resistance period (e.g. 90 minutes)
- Structural member type (e.g. I-column)
- Degree of exposure (e.g. 4-sided)
- LST (e.g. xxx°C)

The LST may be used to assess the structural adequacy of steel members, including columns and beams, during a fire. The LST, which should not be exceeded during the required fire resistance period, depends upon several factors, including the structural utilisation at the Accidental Limit State (ALS) in fire, the temperature gradient within the member, the dimensions of the section, and the yield strength of the steel.

Typically, the default tested and certified LSTs according to test standards referenced by the Acceptable Solutions are:

- 550°C for typical columns in compression
- 620°C for non-composite beams supporting concrete slabs or composite slabs
- 520°C for hollow sections

It is generally acknowledged that the temperatures of 550°C and 620°C are suitable for most circumstances, but not always. For example, in the case of beams with web openings, the above generic temperatures are not applicable as these beams have additional failure mechanisms, such as web post buckling, which need to be accounted for due to their openings. Consequently, there are no generic temperatures for such beams and their LST has to be determined by a thermal and structural assessment.

Table 6 illustrates how the required Intumescent Coating thickness for an example product varies relative to LST.

The LST should be calculated by the Structural Engineer. When following the NZBC Acceptable Solutions and Verification Methods this will be as per NZS 3404 and AS/NZS 1170: 2002 – Part 0 C4.2.4.

It is in the interest of structural engineers concerned with defining LSTs to coordinate closely with passive fire protection suppliers to ensure that the potential benefits and potentially unsafe implications are understood.

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Appendix B *cont.*

Table 6: Effect of LST on the required DFT of an example intumescent coating

Degrees (°C) LST		**350**	**400**	**450**	**500**	**550**	**600**	**650**	**700**	**750**
Required Dry Film Thickness (µm)	1 hour (60/-/-) I-section column Hp/A* 150	X	1080	880	710	550	400	270	250	250
	2 hours (120/-/-) I-section column Hp/A* 150	X	6000	4740	3900	3300	2890	2370	1850	1510

** The rate of increase in temperature of a steel cross-section is determined by the ratio of the heated surface area (A) to the volume (V). This ratio, A/V, (also known as Hp/A), has units of m^{-1} and is known as the 'Section Factor'. Members with a lower Section Factor will heat up more slowly and vice versa.*

Appendix C: Intumescent Coating Systems – Regulatory Documentation Requirements

Where a building design incorporates an Intumescent Coating System (ICS) as part of the fire engineering design and structural fire protection requirements, the application for consent needs to include sufficient details to demonstrate how the proposed design complies and also how it will be constructed to comply. This includes providing information such as plans, specifications, and sufficient information to support the design and to satisfy to the Building Consent Authority (BCA) that the relevant New Zealand Building Code requirements have been met.

The following table sets out the typical minimum requirements a BCA might expect to be provided at each stage of the consenting and approvals process to support an efficient approvals process. It is necessary to ensure that sufficient documentation is provided at all stages to support the design, application, testing, inspection, and ongoing maintenance stages of the ICS over the life of the building.

Building Consent Application - Processing	Check
1. Fire Safety Report completed in accordance with the Acceptable Solutions, Verification Method or Alternative Solution clearly identifying the required fire protection for Structural adequacy for the various areas of the building.	
2. Structural drawings (or Schedules) clearly identifying each element to be treated and the Fire Resistance Ratings required to be achieved. This should be cross-referenced with the Fire Safety Report to confirm the fire protection Structural adequacy ratings are correct.	
3. Project-specific Steel Schedule identifying all of the following values as they apply to each element: a. Limiting steel temperature b. Hp/A (heated perimeter-to-area ratio) determined in accordance with NZS 3404 Steel Structures.	
4. Manufacturer's technical documentation confirming all of the following as it applies to the approved intumescent coating system (ICS): a. Limiting Hp/A (heated perimeter-to-area ratio) b. Limiting steel temperature c. Limiting coating thickness (where applicable) d. That the coating complies with the requirements of the approved fire engineering design specification and the current NZ Building Code, including the durability requirements of NZBC B2 e. Compatibility of the ICS components if products from different suppliers are to be used. *Note: The provision of technical information applies equally to all primers, undercoats, and finish coatings.*	
5. Statement from the intumescent coating supplier confirming the date and drawing set that the Loading Schedule is based upon and project-specific Steel Schedule submitted for consent.	
6. Supplier's Loading Schedule confirming/identifying all of the following: a. Intumescent Coating to be applied b. Limiting Hp/A (heated perimeter-to-area ratio) c. Limiting steel temperature d. Structural steel members to be coated e. DFT (Dry Film Thickness) to be achieved for each member f. Fire-resistance rating to be achieved for each member.	
7. Details of the Intumescent Coating(s) to be applied should include the associated Quality Assurance (QA) system specific to the method of application and site conditions	

CONTINUED OVERLEAF

Appendix C *cont.*

Building Consent Application - Processing	Check
8. Relevant design standards necessary for application, i.e. ASFP, AS/NZS standards.	
9. Exposure time for coatings prior to closing in, details on manufacturers application requirements etc.	
10. Design co-ordination statements.	
11. Quality Assurance including construction inspection expectations, roles, responsibilities.	
12. Producer Statement – Design (PS1/PS2) if applicable and required by BCA.	
Note: Steel Schedules and Loading Schedules are to include and specifically identify all cellular beams and custom-welded sections. Loading Schedules are to be additionally supported by a statement from the intumescent coating supplier on their company letterhead confirming that the dry film thicknesses specified for cellular beams and custom-welded sections include appropriate adjustments to those applying to base sections. *Technical data and test certification for intumescent coatings is to confirm product suitability where applied for the protection of cellular beams and custom-welded sections, together with all limitations as may apply to such use.*	

Construction and Inspection (Realtime)	Check
Realtime definition: Relating to a system, in which input data is processed within a reasonable time frame so that it is available virtually immediately as feedback on the process from which it is coming e.g. QA system and Loadings Schedule available on site for inspectors to check in real-time. During Inspections, the following must be available on site during the construction process:	
1. Preconstruction meeting prior to application of the ICS to ensure responsibilities are well-defined, documented, and understood by all parties involved.	
2. All documentation relating to the specific coatings to be used, QA system, Monitoring, who and when, frequency of inspections, contractor's competency/experience (approved for application of the coatings), WFT and DFT readings, etc.	
3. Up to date/real-time documentation available on site, (target: not less than 24h prior to inspection).	
4. Site notes from architect, structural engineer, fire engineer, or the specifier of the ICS.	
5. Details of any remedial process and work to be identified, actions and close out.	

Code Compliance Certificate (CCC) Documentation	Check
To enable issue of the Code Compliance Certificate, and to support ongoing maintenance, the documentation to be submitted with application for CCC is to include:	
1. Specifications and plans identifying each member that has been coated.	
2. A copy of the QA System report included as part of PS3 or as part of the third-party independent certification and/or PS4 documentation.	
3. Supplier's Loading Schedule.	
4. Manufacturers' test certification.	
5. Typical Producer Statement Requirements – Construction (PS3) from the approved applicator confirming that all coatings were applied in accordance with the approved supplier's Material Schedule, manufacturer's instructions, and the approved consent documentation.	
6. Third party inspection certification. In lieu of third party certification, provide a Construction Review (PS4) from a suitably qualified engineer confirming that all building elements identified in the approved Steel Schedule and related structural drawings have been protected with the approved ICS.	
7. Associated warranties.	
8. Recommended inspection regime for monitoring after applications and any relevant requirements including Life to First Major Maintenance	
Note: Where a PS4 from a structural engineer is provided but does not confirm or include reference to an ICS then it would be expected that third party certification be provided.	

Appendix D: Sample Site Quality Plan

SITE QUALITY & INSPECTION PLAN	
Project Details:	
Contractor Details:	

1. DESIGN AND SPECIFICATION					
Ref No.	Activity	Auth.	Process	Complete/Received	Notes
1.1	Design Criteria		Environmental Considerations		
			Building considerations		
			Drawings		
			Steel Sections		
			Fire Rating Required		
			Steel Limiting Temperatures		
			Maintenance/repair considerations		
1.2	Specification		Method Statements		
			Surface preparation		
			Coating System		
			Compatibility statements		
			Product Certification		
			Design drawings		
1.3	Assessment		Applicator		
			Third Party Inspector		
			Report		

2. SURFACE PREPARATION					
Ref No.	Activity	Auth.	Process	Complete/Received	Notes
2.1	Pre-Blast		Visual		
			DFT readings		
			Acceptance report		
			Rust Grade		
			Part ID		
			Solvent Cleaning		
2.2	Blast		Blast media		
			Surface Profile		
			De-dust		

Appendix D *cont.*

3. PRIMER APPLICATION					
Ref No.	**Activity**	**Auth.**	**Process**	**Complete/Received**	**Notes**
3.1	Pre-checks		Air Temperature		
			Steel Temperature		
			Relative Humidity		
			Dew Point		
3.2	Application		Stripe coat (if required)		
			Wet film		
3.3	Post-checks		Dry film measurements		
			Visual appearance		

4. INTUMESCENT APPLICATION					
Ref No.	**Activity**	**Auth.**	**Process**	**Complete/Received**	**Notes**
4.1	Pre-checks		Primer condition, DFT, compatibility		
			Air Temperature		
			Steel Temperature		
			Relative Humidity		
			Dew Point		
4.2	Application		Stripe coat (if required)		
			Wet film		
4.3	Post-checks		Dry film measurements		
			Visual appearance		

5. SEALER/TOPCOAT APPLICATION					
Ref No.	**Activity**	**Auth.**	**Process**	**Complete/Received**	**Notes**
5.1	Pre-checks		Air Temperature		
			Steel Temperature		
			Relative Humidity		
			Dew Point		
5.2	Application		Stripe coat (if required)		
			Wet film		
5.3	Post-checks		Dry film measurements		
			Visual appearance		

6. REMEDIATION
Remediation:

7. FINAL CHECK
Final Check: