

Finish Standards for Intumescent Cellulosic Fire Protection

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ABSTRACT

There are various resinous materials used in the formulation of intumescent coatings (acrylics, various epoxies, etc). The paper would examine the uses and features of these materials and also compare their starting point for appearance. It would then examine the means and methods and effort required to change (improve) that appearance to align with an expectation. It would do this in the context of comparing to other specified standards (Drywall finishing standards, AISC AESS Standards) and propose the development of an industry standard methodology for specifying finishes.

Key words: Intumescent, IFRM, Cellulosic, Fire Protection, Finish, Smooth, Textured, Architecturally Expressed Steel, AESS, Standard, Epoxy, Water Based

INTRODUCTION

When choosing a Fire-Protection material to meet building code requirements to insulate steel for a prescribed period to facilitate safe evacuations and emergency response from commercial buildings in the event of a fire, there are many factors that influence the selection of an Intumescent Fire Resistive Material (IFRM) over a Spray Applied Fire Resistive Material (SFRM). It could be a concern of the weight of the system; Portland Cement based SFRM's are typically much heavier and bulkier than IFRM's. Another factor could be durability, based on either corrosion resistance or the ability to withstand considerable physical or environmental damage. Cleanliness is yet another reason why IFRM's are chosen over SFRM's. But the primary reason for the choice of an IFRM over an SFRM is usually the enhanced appearance of the finish product.

If finish is such a critical factor in the selection of a fire-proofing material, especially one of a decorative nature, it would be a natural assumption that we would have a mechanism to accurately convey what the expectation of that finish would be. Furthermore, when we do, how do we align that with the limitations of the materials and the design of the structure?

The Relationship of the Substrate, Material Selection, and Finish Type

Architecturally expressed structural steel can be a remarkable feature in architectural design. Not only can it create an aesthetic that is completely unique, but it is a complimentary feature to many modern, post-modern, and neo-futurist designs. Sought after and lauded building designers such as Norman Foster, Renzo Piano, Richard Rogers, and Santiago Calatrava have embraced the use of Architecturally Exposed Structural Steel in some of their signature structures and advances in IFRM materials have benefitted from these designs. Furthermore, it can remove the cost and spatial constraints associated with including things such as bulky column covers and drop ceilings which are used to conceal unsightly SFRM's, reducing the impact financially and environmentally by eliminating the need for or use of these materials.

In the interest of continuing to grow this market and generate more appeal with designers here in the US, the American Institute of Steel Construction developed the AESS (Architecturally Exposed Structural Steel) Category System. This system created 6 categories of Expressed or Exposed Structural Steel:¹

1. SSS- Standard Structural Steel
2. AESS 1- Basic Elements
3. AESS 2- Feature Elements, Not in Close View
4. AESS 3- Feature Elements, In Close View
5. AESS 4- Showcase Elements
6. AESS C- Customer Elements

There are many interesting factors that were taken into account when creating this category system and standard selection including, member visibility, viewing distance, location, lighting, coatings, style and adjacency, but also importantly, cost. The cost increases as the required effort to meet the requirements of each category are realized and care must be taken to identify the purpose of the member prior to the application of the category to ensure a responsible standard is established.²

While viewing distance is identified as a factor in the selection of the standard, its specific reference is limited to identifying 20 ft as the observer distance between AESS 2 and AESS 3, which are the only 2 items classified by observer distance (as "not in close view" and "in close view" specifically). The use of showcase elements tends to be more utilized if the protective coating system or lighting systems used in conjunction with the item, combined with viewing distance would make defect more pronounced. Lastly, the type of steel design may influence the AESS category even in close view. More tectonic designs, which feature the bolted or riveted connections, are typically satisfied by a lesser degree of finish than plastic designs, which are typically welded smooth and formed from more rounded shapes.³ The AISC Code of Standard Practice goes on to further define the criteria for selection in Reference Section 10: Architecturally Exposed Structural Steel. This is further supplemented with the AESS Cost Matrix which was published by the Structural Engineers Association of Colorado and Rocky Mountain Steel Construction Authority (SEAC/RMSCA).^{4,5}

With the exceptional amount of care that goes into the creation and expression of exposed structural steel, it would be expected that similar expectation is assigned to coatings and fire protection, but minimal reference is made to such finishes in AESS. The only comment found in the AESS documents pertaining to IFRM finishes refers to them generally as smooth. However, that is not entirely the case as we examine the different finish standards currently available and specified and the various material types.

Current IFRM Finish Standards used and Limitations

Overall, the Fire Protection Industry is generally more concerned with code and performance than with finish. The NFPA (National Fire Protection Association) is responsible for developing codes and standards for a wide variety of building environments with a focus on active and passive systems and their interplay in building safety. The same would apply for many other code and safety related organizations, such as UL (United Laboratories), ATSM (American Society for Testing and Materials), and ICC (International Code Council).

In the absence of guidance from the Fire Protection Industry, architects and designers had previously relied on standards from the American Wall and Ceiling Institute (AWCI) in the United States. For example, AWCI Tech Manual 12B has widely been accepted as the standard for Inspection for Fire Protection (both SFRM and IFRM) for determining satisfactory thickness of applied systems.⁶ This is due in large part to the fact that older, more common low density SFRM materials were gypsum or vermiculite based and there was some organizational alignment with AWCI in construction. In 1990, AWCI and the Gypsum Association collaborated on the GA-214 Standard for Drywall finishes. These are specifically described in levels ranging from 0-5 with 0 having no additional finishing performed and 5 being perfectly smooth.⁷ This quickly became an extremely popular way to establish quality of finish for drywall finishing (including coatings) in Division 9 specifications where finish appearance was critical, and bidding needed alignment with expectations.

However, in the absence of other available standards, GA-214 also began to quickly proliferate in Division 7 Specifications as a means of establishing quality and finish expectations for IFRM Fire Protection as well. When managed in the field, the arguments are usually constructed as the following: tape is generally compared to reinforcing mesh, knife and trowel marks equated to similar application tool related defects (spray, trowel, brush, or roller), and skim coating is discussed as a means of remediation for both applications. However, this is an extremely poor choice of standard given that not only are the materials, tools, and defects described not like for like in the application of fire protection, but more importantly, that the applied substrate is entirely different. IFRM Fire Resistant Materials are commonly applied to Structural Steel Substrates and therefore are subject to a completely different host of appearance related concerns. An effective standard would align with the aforementioned AESS standards to ensure the substrate finish was mirrored by the subsequent IFRM application.

In Europe, where the use of IFRM's has grossly eclipsed the use of SFRM for Cellulosic fire protection applications, there is a bit more "Fire Protection" specific guidance. In 2010, the Association for Specialist Fire Protection (ASFP) published Technical Guidance Document 16, Structural Fire Design: Off-Site Applied Thin Film Intumescent, to promote the application of intumescent coatings off site. In section 4.3 (Application), Paragraph R470, this document outlines finish standard criteria as follows:⁸

(i) Basic Finish:

The Coating System achieves the required fire performance and corrosion protection performance, but is not required to achieve any requirement for standard of finish

(ii) Decorative Finish:

In addition to the requirements for (i) above, a good standard of cosmetic finish is generally required, when viewed from a distance of 5m. Minor Orange peel or other texture resulting from application or localized repair is acceptable.

(iii) Bespoke Finish:

In addition to the requirements for (1) above, the coating finish is required to have a standard of evenness, smoothness and gloss agreed between the Specifier and the Contractor.