

National Fireproofing Contractors Association Handbook of Accepted Fireproofing Knowledge

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Appendix 2:

PATCHING IFRM INSTALLATIONS

In new construction and existing buildings where the structure requires fire-resistance - the unexpected can happen. Plumbing, electrical, mechanical and cabling contractor employees hang piping, conduit, cables, etc., from protected structural elements and horizontal assemblies within buildings.

To provide proper attachment or weld to attach the piping, cables or other elements, they need to first remove the fireproofing material, either Spray-Applied Fire-Resistant Materials (SFRM) or Intumescent Fire-Resistant Materials (IFRM), to get to bare substrate – either metal or concrete. When that happens, repairs are needed since the continuity of fire-resistance protection is now compromised.

Studies have indicated that the fire-resistance of protected steel is significantly diminished if only a small portion of the fire-resistance material is removed. The reduction in the rating is dependent upon the extent of the removal and the size of the steel, but it can be as high as a 40% reduction in the time to failure for a 2-hour rated W10X49 column with only a 4% loss of fire protection material.¹

Where IFRM fireproofing is used to protect the structural element or assembly, there are procedures that need to be followed to patch the fireproofing and provide continuous fire-resistance.

Why Patch Fireproofing?

The need for repair of fireproofing materials applied to structural steel or other building elements or assemblies raises the question, “Is it acceptable to use one material to patch or repair another already installed material that might be dissimilar, or from two different manufacturers?” Too often the answer is “Well, they looked the same, so we thought that it would be okay to use what we had available....”.

Most of the commonly used codes, such as the International Building Code (IBC), National Building Code of Canada (NBC), International Fire Code (IFC), NFPA 5000, Building Construction and Safety Code and NFPA 101, the Life Safety Code, detail the steps needed to provide a fire-resistance rating to structural steel or other building elements or assemblies.

The fire-resistance directories of testing agencies such as Underwriters Laboratories (UL) and Intertek detail the steps (via designs) necessary to meet the ASTM E119, *Standard Test Methods for Fire Tests of Building Construction and Materials*, UL 263, *Fire Tests of Building Construction and Materials* or ULC



SFRM or IFRM can be damaged during construction, then repairs are needed. GCP Applied Technologies Photo



SFRM or IFRM can be damaged when new services are added to existing buildings and need repair and documentation of the repair to comply. GCP Applied Technologies Photo

CAN S101, *Standard Methods of Fire Endurance Tests of Building Construction and Materials* requirements stated in the building and fire codes.

All the listed fire-resistance designs published by those agencies within these directories detail the use of specific fireproofing products on the steel element or assembly at any one time for single source responsibility and for other various life-safety reasons.

IFRM Product Identification

In an existing building, what if the fireproofing contractor, building owner, or other contractor cannot identify the installed fireproofing product? What if there are no records to identify which manufacturer's product it is? Is it acceptable to use a dissimilar product – something comprised of chemically different properties from the originally installed product – for patching?

NFCA's position is that it is not as simple as just getting the same type of material and just patching it without researching the original manufacturer. We are unaware of a listed design by any IAS-accredited testing agency that shows different products used on the same piece of steel simultaneously.

How does the fireproofing product get identified? What research is needed?

The manufacturer(s) should be invited to visually inspect the fireproofing at the site. If the manufacturers allow, the fireproofing contractor, building owner or others can send samples of the product, of size specified by the manufacturer. The samples are then analyzed in the laboratory to understand the chemical makeup of the product – and possibly identify if it is their product or not. There are several manufacturers of IFRM fireproofing, making it difficult to identify the manufacturer. This is much different than the process of identifying SFRM materials where only a few companies produce the products.

In addition to the manufacturer, there are accredited material testing laboratories that can test the samples and possibly identify the product manufacturer.

At the very least, the sampling and testing will identify the ingredients in the material and provide the 'TYPE' of IFRM fireproofing that was installed.

The various manufacturers of IFRM fireproofing state that the original product (or an approved equal – the same type) must be used to repair the IFRM that, together with the structural element or assembly, provide the assembly with its fire-resistance rating.

IFRM fireproofing have very complex chemistries unique to each manufacturer's formulation. Should a material be used that is not of the same family, or even manufacturer, there can be chemical incompatibilities at the junction point of the patch and the existing material, thus resulting in delamination under fire conditions.

This means that without a specific fire test using the same structural element or assembly and the material installed to a listed design and manufacturer's installation instructions, it's very difficult to verify that the material used for patching will perform under fire conditions.

Patching & Manufacturers Recommendations

Can an IFRM intumescent material be used to patch cementitious materials?

The IFRM can be used only if there exists a valid tested and listed design within the exact listing number that details that such a construction will not damage the fire-resistance rating and is chemically compatible. In researching the UL Product iQ Online Directory, it seems no such design currently exists.

Patching materials with 'similar', but different chemical base materials might bond to the steel or the original fireproofing material at the time of the patch or repair installation. Adhesion at application is different than adhesion during fire conditions. Under fire conditions, without testing to prove suitability, there could be failure.

Another concern is environmental exposure of the patched area during a renovation where temperatures might change, heat or cold. Most IFRM applications are performed while a building is in a semi-exposed, general purpose condition. This condition exposes fireproofing materials to fluctuating temperatures, humidity and exposure to the elements. Much of the patching work is carried out during this same time frame, with the original material.

Exposure long after the building is occupied, where a patch occurs, would subject a patch of dissimilar materials to expansion and contraction during rising and falling temperatures. A single material will expand and contract at the same rate, while dissimilar materials will tend to expand and contract at different rates, which can cause stress-cracking at a cold joint seam.

For contractors and building owners and managers, who accepts liability for the 'tie in' from one manufacturer's products to the other's products?" These are all issues that exist when working in new construction and existing buildings.

Several manufacturers state that regarding patching their existing material, that their material will be the only one used to patch, period.

From the UL Product iQ BXRH Guide Info section on Fire-Resistance Ratings, Jan. 2020, the following is stated under "Design Modifications":

Careful consideration needs to be given to alterations or modifications of the fire-resistance assemblies.

When field issues arise, it is recommended the first contact for assistance be the technical service staff provided by the product manufacturer noted for the design. Users of fire-resistance assemblies are advised to consult the general Guide Information for each product category and each group of assemblies. The Guide Information includes specifics concerning alternate materials and alternate methods of construction.

Based on this information, it can be assumed that UL does not permit dissimilar materials to be used to repair fireproofing.

The National Fireproofing Contractors Association (NFCA) recognizes the complexity of material chemistries – both SFRMs and IFRMs – and recommends that patching fireproofing should be accomplished with the same material as is already in place, or with a patching material specifically listed by the SFRM manufacturer and/or IFRM used throughout the building for use with the material and design listing that is in place. NFCA advocates for testing to be the proof of performance of a

product in a specific application. If the material cannot be identified by manufacturer, the next few paragraphs answer more questions.

Patching by Type of fireproofing

What happens when the original IFRM product is not known and there is a need to repair the fireproofing? Is there a way to determine what the product is, and what products may be used to repair it?

The material type is referring to latex, solvent or epoxy based IFRM and other material types. Patching recommendations likely would have similar type materials specified for the patching at a thickness as recommended by the manufacturer, based on a listed design that makes sense, and of course, approved by the AHJ.

The technical service departments of the IFRM fireproofing suppliers all have indicated that they can provide some guidance as to the chemical type, or make-up of the original material, based upon sampling and laboratory testing.

If every possible means was used and the individual material manufacturer cannot be identified, another manufacturers' products of the *same type* might be used. It is recommended that the type is a specific recommendation from the manufacturer of the patch material. The manufacturer also needs to follow the guidelines from a major testing laboratory, such as UL – and – of course, follow the thicknesses of the patching material to achieve the rating that was in the listed design, if known.

Patching SFRM with IFRM?

There are many issues that arise from attempting to patch an SFRM with an IFRM in existing buildings. Surface preparation carried out correctly, is one question raised about patching. SFRM materials are generally applied over clean bare steel substrates, while IFRMs require even more detailed substrate preparation. IFRMs also require that an approved primer be applied to the steel. The question that arises is about the cold joint between the SFRM and the IFRM preparation. There is a possibility of disbondment at that interface if the preparation is not in accordance with the manufacturer's instructions and a listing.

It is a generally known fact that intumescent materials rely on the bond strength to the primed substrate to stay adhered and perform during a fire. If this is compromised at the interface, a crack can form that will cause the entire patch to intumesce off the steel, leaving bare steel exposed to the fire. This could be especially troublesome on horizontal patches along the bottom of beams and decks. Exposure of steel to fire can cause heating of the structural element and possibly exceed the temperature at which the steel becomes plastic.

After extensive in-house testing and along with UL Guidelines, some manufacturers do not recommend patching SFRMs with any other product other than what has originally been applied. Again, it's back to the manufacturers, if they can be identified.

At the present time, we understand there has been no independently evaluated fire test data developed with both IFRM and SFRM products applied to the same structural member, or to intersections of independent members, where these products lie adjacent to each other.

In the absence of fire test data, UL has advised that the use of multiple products on the same structural member, unless specifically listed in the design, not be allowed. The use of multiple products, each applied to a separate structural member, is allowed provided that each structural member is fireproofed with the specific product as detailed in the applicable designs.

Despite this general opinion by UL disallowing the use of multiple products on the same structural member, we understand UL has issued job specific letters giving guidelines as to how mechanically fastened metal lath can be used to maintain fire-resistance ratings when it is desired to use IFRM and SFRM on the same structural member.

From NFCA's perspective, there needs to be full-scale fire testing to the ASTM E119, UL 263 and ULC-S-101 Test Standards to prove that patches work. Not all structural members are equal under fire conditions. No two products are exactly alike.

NFCA has heard that there might be other methods to marry different materials on the same structural member or building element. The word 'different' in this context means different manufacturers, as well as different types.

NFCA Recommendations

NFCA's recommendations to Contractors working with assemblies where two different types of materials are used is to get test data from manufacturers stating compatibility and describing the method to apply the materials as a patch, as well as request guidance on which listing to use for the fireproofing contractor to present to the AHJ for approval.

Even when the materials are the same from the same manufacturer, NFCA recommends getting instructions from the manufacturers of fireproofing materials for how to repair the products. As time goes on and formulations change for various materials, the compatibility of the manufacturer's own products can change. Anything can change in formulations that might affect how the materials are prepared, applied and finished. That's why fireproofing contractors and others that might perform patching need to understand the manufacturer's patching requirements.

The critical point about patching installed fireproofing, SFRM, IFRM or a combination of the materials is that the objective of fireproofing is to maintain the fire-resistance of the assembly. It's not to patch with whatever material is around on the jobsite. The purpose is fire-resistance and structural safety of the building.

Since fire-resistance needs to be maintained to keep the building safe, guesses cannot be made about the patch integrity. When product manufacturers cannot be identified, the fireproofing material patching manufacturer needs to have testing that proves the material can work – through a fire, based on a listing of some kind - on the same-sized beam, column, tube, joist and/or horizontal assembly, as well as the type of material. Only then will due diligence have been completed to keep buildings safe.

Endnote:

1. Analyses of the Impact of Loss of Spray-Applied Fire Protection on the Fire Resistance of Steel Columns. J. Milke, N. Ryder, S. Wolin. International Association of Fire Safety Science Fire Safety Science Proceedings, seventh international symposium, pp. 1025-1036.