

# National Fireproofing Contractors Association Handbook of Accepted Fireproofing Knowledge

© 2007 (Slides), 2015-2020 (Book)

## Appendix 1:

### PATCHING SFRM 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 Spray-Applied Fire-Resistant Materials (SFRM), 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.<sup>1</sup>

Where SFRM 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 building 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), FM Approvals and Intertek provide detailed designs, that must be followed. Following the designs helps the installation comply with the designs that were tested to ASTM E119, *Standard Test Methods for Fire*



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



*SFRM 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*

*Tests of Building Construction and Materials, UL 263, Fire Tests of Building Construction and Materials or ULC CAN S101, Standard Methods of Fire Endurance Tests of Building Construction and Materials* requirements stated in the building and fire codes. The listed fire-resistance designs published by those agencies within these directories online 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.

### **Patching SFRM**

During construction, patching SFRM is a relatively straightforward process as the applicator of the SFRM might still be on-site and can patch the assemblies with the same material specified. This is because records are close at hand and the material can be identified. The specifications are available, and the SFRM fireproofing contractor has the manufacturers' installation instructions and the listings and patching requirements at his or her fingertips.

Over time, the information may be lost for a variety of reasons. Or maybe the building owner or General Contractor may not wish to re-engage the original SFRM fireproofing applicator to do the patching work, preferring to do this themselves or even hiring another fireproofing contractor.

### **SFRM 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. Since there are only a few manufacturers of SFRM fireproofing, it is not that difficult to identify the manufacturers to send the product to.

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 fireproofing that was installed.

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

SFRM 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 manufacturers installation instructions, it's very difficult to verify that the material used for patching will perform under fire conditions.

For instance, if a gypsum-based SFRM product was used to provide the original fire-resistance rating, a patch of a cement-based product may not be compatible, or vice-versa.

### **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.

Of the manufacturers contacted while researching for this appendix, several indicated that they have data indicating that the areas of SFRM fireproofing that are patched with dissimilar materials might delaminate, or pop-off the structural element or steel in the event of a fire condition. This is even though the patching 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.

Another concern is environmental exposure of the patched area during a renovation where temperatures might change, heat or cold. Most SFRM application is 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 and, ultimately, loss of bond to the substrate.

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 SFRM 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 SFRM 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 gypsum, cementitious, mineral wool based SFRM 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 SFRM 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 photographic evidence and information about the age of the installation. They can also attempt to identify the products from sample extractions or visits.

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.

There is a patented, trowel applied fire resistive material designed and tested as a patch for repairing damaged SFRM. According to the manufacturer, it is tested for compatibility against all known types of SFRM including plaster and cementitious products. The patching product has a robust density, superior adhesion/cohesion, and a 2-hour fire-resistance rating when used in accordance with UL listing design number Y737 and Intertek VEL/CF 120-01. The use of the product is limited to those listed designs, however. As with all fire-resistance products, there are limitations to the product usage. The UL Listing design number Y737 is a continuous encasement listing where the steel column is a minimum, W10x49

and cementitious fireproofing is 1-3/16" thick, for a 2-hour fire-resistance rating. Larger columns can also be protected using the material as listed.

The Intertek listing VEL/CF 120-01 seems to be meant for patching existing column assemblies with fire-resistance ratings up to 2-hour with cementitious fireproofing. The listing states that the product can be used with cementitious fireproofing. It can also be applied to structural steel members including column, beam, joist, girt or corrugated steel decking, where fireproofing is already applied to the deck. The limitations are that a maximum area of 3 square feet of material can be used, with a minimum of 12" of original SFRM material between each patch.

### **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 and or statements from manufacturers regarding compatibility. The manufacturer also should describe the method to apply the materials as a patch. The manufacturer should also provide 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 product repair or patch instructions from the manufacturers of fireproofing materials. 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.