

EXISTING BUILDINGS & FIREPROOFING - TO PATCH OR NOT TO PATCH

In 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 SFRM and or IFRM Fireproofing are used to protect the 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



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

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 E-119, *Standard Test Methods for Fire Tests of Building Construction and Materials*, ANSI/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. (see sidebar on page 29)

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.

THE QUESTION WAS...

Now, back to the question... Is the fire-resistance-rating maintained when the SFRM or IFRM Fireproofing disappears or has been removed? During construction, this is a relatively straightforward process as the applicator of the SFRM or IFRM might still be on-site and can patch the assemblies with the same material specified. The specifications are available, and the Fireproofing Contractor has the Manufacturers' installation instructions and the listings and patching requirements at his or her fingertips.

However, over time, that 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 or IFRM Fireproofing applicator to do the patching work, preferring to do this themselves or even hiring another Fireproofing Contractor.

The question then arises - what if the Contractor cannot identify the 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?

"The simple answer is no," states GCP Applied Technology's John Dalton. "We are unaware of a design by any IAS-accredited testing agency that shows different products used on the same piece of steel simultaneously".

There are many companies involved in the production and testing of products used to provide a fire-resistance-rating for structural steel and other fire-resistance-rated building elements or assemblies.

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

SFRM and IFRM Fireproofing materials have very complex chemistries unique to each Manufacturer's formulation. "There can be chemical incompatibilities at the junction point of the patch and the existing material, thus resulting in delamination under fire conditions," states GCP's Dalton. This means that without a specific fire test using the same structural element or assembly to verify that the material used for patching will perform under fire conditions, it's a guess if the IFRM or SFRM patch will work when exposed to fire. Isolatek International's Phil Mancuso agrees. Isolatek is a manufacturer of both SFRM and IFRMs.

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. The same principle applies to IFRM made from solvent or water-based, and even water to water-based materials.

PATCHING & MANUFACTURERS RECOMMENDATIONS

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

"Of course, it can, but 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", states Carboline's Sean Younger. No such design currently exists, according to GCP's Dalton.

Of the manufacturers contacted while researching for this article, 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 patching or repair installation.

Younger further states, "Another concern would be for 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. This 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 IFRM, the issue is equally important,” states Isolatek’s Phil Mancuso. “The chemistries are different between Manufacturers. And, 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.

Hilti’s Ernst Toussaint agrees. “Regarding patching our existing material, our material will be the only one used.”

George Guanci of Sherwin Williams states, “We do not permit other materials to be used to patch Firetex, nor do we use Firetex to patch/repair other materials. It is our understanding 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 – 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 Manufacturer of the SFRM 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.

PATCHING BY TYPE OF FIREPROOFING

What happens when the original 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 Technical Service Departments of the Fireproofing Suppliers all indicated that they can provide some guidance as to the 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 cannot be identified, that is where another Manufacturer’s products of the *same type*, but different than the original material Manufacturer, might be used – with a specific recommendation from the Manufacturer of the patch material, which should follow the guidelines from a major testing laboratory, such as UL.

The material type is referring to gypsum, cementitious, mineral wool SFRM, water-based or solvent-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 listing that makes sense, and of course, approved by the AHJ.

There is a patented, trowel applied fire resistive material designed and tested as a patch for repairing damaged SFRM. “Tested for compatibility against all known types of SFRM including plaster/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”, states Universal Fireproofing Patch’s Tim Vellrath, the Vellrath Group, manufacturer of the product.

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 up to 2 hour fire-resistance-rated column assemblies with cementitious fireproofing. The listing states that the product can be used with cementitious fireproofing, be applied to a 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.

The manufacturers interviewed for this article recommend patching first with their own material, to the listed design. If the manufacturer is not known, then patching with the same type of material as mentioned above.

PATCHING SFRM WITH IFRM?

“There are many issues that arise from attempting to patch an SFRM with an IFRM in existing buildings,” states Younger. “How will the surface preparation be carried out correctly,” is one question raised. “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. How should the cold joint between the SFRM and the IFRM be prepared? You would almost certainly get some type of disbondment at that interface.”

According to Younger, intumescent materials rely on the bond strength to the primed substrate to hang on 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.

He continues, "After extensive in-house testing and along with UL Guidelines, Carboline does not recommend patching IFRMs with different intumescent materials or types, as well as patching SFRMs with any other product other than what has originally been applied."

Younger adds, "At the present time, to the best of our knowledge, 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." According to Younger, "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, is not 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," states Younger, "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 intumescent coatings and SFRM on the same structural member."

From NFCA's perspective, there needs to be full-scale fire testing to the ASTM E 119, UL 263 and ULC-S-101 Test Standards to prove that patches work. Not all structural members are equal under fire conditions.

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 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.

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.

REFERENCE

- 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

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SIDEBAR 1

CODE REQUIREMENTS AND LABORATORY GUIDE INFORMATION AND PATCHING FIREPROOFING

The IBC's Chapter 7 states clearly that the SFRMs need to be installed to the Manufacturers' installation instructions and the listings/designs.

704.13.1 Fire-resistance rating.

The application of SFRM shall be consistent with the *fire-resistance rating* and the listing, including, but not limited to, minimum thickness and dry density of the applied SFRM, method of application, substrate surface conditions and the use of bonding adhesives, sealants, reinforcing or other materials.

704.13.2 Manufacturer's installation instructions.

The application of SFRM shall be in accordance with the manufacturer's installation instructions. The instructions shall include, but are not limited to, substrate temperatures and surface conditions and SFRM handling, storage, mixing, conveyance, method of application, curing and ventilation.

With the IBC speaking clearly, the SFRM or IFRM materials need to be installed to the listings and the Manufacturers' installation instructions. They also need to be maintained in the same way to the Manufacturers' instructions, the designer's construction documents and the listing as stated in the International Fire Code's Chapter 7 and NFPA 101's Chapter 8.

In addition, the UL Fire Resistance Directory contains the following language:

"Unless specifically detailed in the individual designs or in the product certification information, the interaction of dissimilar fireproofing materials on the same structural element or at the intersection of structural members, and the adherence of one product to the other, has not been investigated under fire test conditions".

SIDEBAR 2

TWO MORE COMMON SFRM AND IFRM RECENT FIREPROOFING QUESTIONS

SPRAY FOAM OVER FIREPROOFING?

A common question received at the National Fireproofing Contractors Association (NFCA) is about the application of Spray Polyurethane Foam and other insulations over Spray Fire-Resistant Materials and Intumescent Fire-Resistant Materials. A UL Bulletin states that the application has not been tested.

Here's what UL says:

Unless otherwise noted in the individual design or certification published in UL's Online Certifications Directory, the application of sprayed polyurethane foam or other insulation over Sprayed Fire Resistive Materials (SFRM) or Intumescent Fire Resistive Materials (IFRM) coatings has not been investigated.

When UL states it has not been investigated, it likely means that there is no data to prove that the assembly will perform under fire conditions.

DOES 2018 IBC REQUIRE FIREPROOFING ON COLUMNS IF THE ROOF DOESN'T?

Another question relates to Table 601, Note b in the 2018 International Building Code (IBC) and the protection of structural members in roof construction and primary structural frame members.

"...if a primary structural frame member (e.g., beam, girder) was part of the roof construction, the rating could be exempt; however, a rating will still be required for any columns." Excerpt from ICC's Staff Interpretation.

This helps answer the question of whether or not protection is needed in this section. Check out NFCA's website for the complete interpretation.

Need more info? Check out www.NFCA-online.org