

GRACE

(206) 833-2555 / 852-5725

MEMO TO: Bob Locke
FROM: W. V. Culver
CC: T. P. Feit

DATE: April 21, 1987
RE: Cafco

Dear Bob,

Attached is a copy of a paper that was used as the basis for a talk given on Fireproofing in Anchorage on April 17th. Al Peyser is the Sales Representative for Cafco in this market. I am not exactly sure of what their relationship is. Al has been the one who in the past, and as you can see currently, is spearheading the effort to scare people regarding the asbestos issue. Larry heard Al's talk in Anchorage and said he went even beyond the written paper in attempting to scare people into the writing of "asbestos free" specifications.

The bulk of Al's derogatory comments are on pages 10, 11, 17, 18 & 21 and in the suggested specifications.

This is not un-typical of the efforts we have been combating in the past.

If there is anything in this paper which was handed out to the 54 attendee's at the meeting that even approaches libel, I think we ought to pursue the issue.

Bill

WVC/kjn

Attachment

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**A Designers Guide
To
Spray Applied Fireproofing**

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I. Introduction

Only a small percentage of new structures require spray applied fireproofing, so it is difficult for a designer to gain the experience necessary to be an "expert" in this field. It is still important that the spray applied fireproofing products used be carefully selected and the specification be skillfully prepared - if for no other reason than it is an area of significant cost, and potential liability.

A. No General Texts are Available

Most technical literature in the area of spray applied fireproofing is full of technical jargon and deal with very narrow, and highly technical topics.

Unless the size of the project is very large, most designers find it difficult to justify taking the time required to learn this subject, regardless of its importance, as there are many other areas that demand attention also.

B. Few Qualified Consultants

Consultants would normally fill this specialty gap, but there are not many qualified consultants in the United States, and they often lack a practical knowledge in the economics of spray-applied fireproofing.

C. The purpose of this paper

The following paper will give the designer a reasonable background in the area of spray applied fireproofing, its purpose, limitations and characteristics.

This field is complex and subject to conflicting opinions, but there is no reason that you cannot learn a great deal from this paper. Certainly enough to be an expert, in comparison with the average designer.

D. A non-proprietary analysis

The author of this paper is a manufacturer's representative for a number of companies marketing high performance coatings. He is also a Registered Professional Engineer in the State of Washington.

Unlike many other product lines, spray-applied fireproofing demands a high degree of professionalism from the representative, and that the information supplied to designers be as free of proprietary bias as possible. That will be the effort in this paper.

The author considers that all products on the market today have their advantages, and that if the limitations of each of these products are understood, the designer can proceed with confidence.

I will simply try to give the designer the background to make the correct decisions, regarding spray applied fireproofing, and it is hoped that when you are done reading this paper, you will be unable to tell what products the author represents.

II. General Background

A. Fire, the enemy of all structures.

Fire is the enemy of any structure. Whether wood, reinforced concrete or steel. Given time, fire will destroy a structure made of any of these materials - the question at hand is how long it will take, and how long do we have to get out.

B. Spray applied fireproofing buys time

Spray applied fireproofing is basically an insulator, isolating structural components from the effect of fire, therefore buying time. Time for the fire to be put out or time for the occupants to vacate the structure. We are buying time - not absolute protection.

Surprising to many, the most sensitive of the three most common heavy structural elements (steel, concrete and wood timbers) is steel. This is generally because its high cost and homogeneous nature allows it be fully utilized (stressed), and hold its cost to a minimum.

Although some spray applied fireproofing is used to "insulate" concrete and wood from fire damage, by far the most is used to protect steel.

III. Setting the Standard For Fire Protection

Time units of protection are typically in hours. Every designer hears the terms 1, 2, 3 or 4 hours of protection.

What is being implied here is that the structural component is "safe" for the indicated hours, given a specific type of fire. So to understand what 2 hours of protection means we must specify the fire conditions (the time vs temperature curve) and what defines a failure.

A. Defining the fire and the test standards

As indicated above, we must first establish a "standard fire". Certainly it would be much easier to provide 1 hour of protection for a structural member from a candle than from the "fiery furnace" referred to in the Bible.

In addition, given the identical fire, it would be easier to protect a large heavy steel member, than a piano wire, simply because the wire will heat up faster (has less heat sink).

This problem was taken on many years ago by ASTM, The American Society for Testing and Materials. They proposed the criteria which is now known as ASTM E-119.

This test outlines in detail the characteristics of a fire with a time/temperature relationship of a "typical commercial" fire. It also specifies how a test is to be performed and what constitutes a 1, 2, 3 or 4 hour test passage for a protected structural member.

This test has been questioned, and certainly has some limitations, but it has been adapted by all the codes in the United States, and by some other countries - but not by any means all countries of the world. Germany and France for example, have their own test standards - and quite different from the E-119 test procedure.

B. Adapting a test standard

It should be clearly understood that ASTM E-119 is a test method, and has nothing to do with building requirements until it is adapted by a building authority, insurance carrier or the owner of a structure. Only when a proposed standard is adapted by legislation, does it become a building requirement.

This is emphasized, as it is the legislative adoption that establishes the requirement. This is not a trivial point - but one that must be understood. We will explain the importance of this statement when we discuss the function of U.L. and ICBO.

C. Testing materials against the adapted standard

Once the proposed code, such as the Uniform Building Code, has adapted a standard fire (ASTM E-119) and the code has been adapted by legislation, it is now the time for products to be tested and approved - so the designer can make use of them. The testing of various materials is typically done by independent laboratories that have set up furnaces which comply with the adapted standard (ASTM E-119). The best known of these is Underwriters Laboratories (U.L.I.), but there are others too.

D. Reporting the results of the test

A laboratory such as U.L. tests a product in accordance with a standard requested by a manufacturer. A report is generated, that goes to the manufacturer paying for the test. Whether or not that test is made public is up to the manufacturer. The statement "Tested by U.L." in itself means little - as a matter of fact the product may have failed the test. In addition, many times you must review the actual test very carefully, as the test run by U.L. may be unique, resulting from special requests made by the manufacturer.

U.L. themselves state in their Fire Resistance Directory:

"U.L. does not require that there be a published Standard in order to examine and test a product to determine that the design has adequately reduced the risks expected in connection with its use."

In the area we are discussing, it can be said that U.L. tests and reports - but they never really approve a product for use in the sense a designer needs. Such approval is reserved to an agency such as ICBO, providing they are under the authority of legislation for a particular community.

E. Approving and accepting the test

After a fire test is "Reported", or put on paper by the test laboratory, the manufacturer may submit it to the approval agency (ICBO). It is then up to the approval agency to accept the test. In the case of ICBO, such an approval often does not come in the form of the direct approval of a specific test, but in an Evaluation Report. This Evaluation Report might not even mention the U.L. Test, it simply extracts out the information ICBO feels is appropriate.

It is in this philosophy that ICBO has chosen to make its own interpretation of Restrained vs Unrestrained thicknesses.

F. Restrained vs Unrestrained

The technical aspects of this are generally of little interest to most designers - it is only important to understand that ICBO requires that all structural members be fireproofed as unrestrained members, unless specifically shown as thermally restrained by a structural engineer. Since few structural engineers are willing to take this stand, we are almost always dealing with unrestrained members.

This is an example of how, to some degree, ICBO elected use some, but not all the test data from U.L.

G. A critically important summary

Just keep ever in your mind that U.L. "Tests and Reports", ICBO approves. Thinking of U.L. as the approval authority, can be a major mistake for a designer, as he may find out that after his design is complete, the local building authority, the legislated authority, will not approve the design, because it is not ICBO approved.

IV. Making sure your structure can be fireproofed

Many times I have been called in, at the time of construction, and told that the local building authority has disallowed the method selected for fireproofing structural components. I am asked to "solve the problem".

A. Words don't solve the problem

A paragraph in the specification stating "...to comply with all local code requirements" cannot solve the problem for the designer, if the structure simply cannot be fireproofed in accordance with ICBO requirements.

Although the local building authorities sometimes authorize an exception - they might be unwilling to do so. Even if they do - this might not eliminate liability in the event of a fire, as court cases appear to indicate that approval of plans by a local building department, does not transfer full responsibility from the designer.

B. Some examples

An example of has been large trusses. Technically, no large truss (over 2 or so feet in height) has been tested in an E-119 test furnace, simply because the furnace is too small for such a member.

It has been traditional that each member in the truss be treated as either a beam or column. In the past the designer was dependant that the local building authority would accept this approach - ICBO did not approve this extrapolation.

Fortunately, we are now free of this problem, as ICBO has approved such an approach on a product by product basis in the new Evaluation Reports for each individual product. They may be willing to approve this approach on all products, but you had best check with ICBO first.

Roof systems are a definite problem here. Often the designer is very clever in optimizing the roof system to be light weight and highly insulated - but watch out! Many of these unique systems, for all their advantages, are not even close to existing roof tests.

C. Not all steel structures can be protected

Spray applied fireproofing performs the same basic function as gypsum wall board, but unlike gypsum wallboard, the rating is related to the steel it is applied to. In other words, if a product has a fire rating of 1 hour, with 1 inch of material on a W10x49 member, it does not mean that the same 1 inch of material will give a 1 hour rating on another size member.

EXAMPLE: (1 hour rating for CAFCO Blaze-Shield)

Member Description	Inches in Thickness
22 gauge steel deck with 2.5 inches min concrete cover.	1/2
W14x228 Column	3/8
W12x106 Column	5/8
W10x49 Column	3/4
4" Circular Pipe	1
Steel Joist with 2-1/2" normal wt concrete over flutes	1
Steel Joist with 2-1/2" Lt-wt concrete over flutes	1-1/4
Steel Joist under IRMA roof system	2-1/4

The point here is that the thickness of fireproofing depends greatly on the heat sink of the structural member. The smaller the member or the less heat sink, the thicker the fireproofing. In addition, it should be clear that one test cannot do the job - it takes many tests to establish the requirements for components in a building.

The designer then must be very cautious in not assuming that simply because a product has approval for one size beam, he can use it for another.

This is clear in the U.L. Fire Resistance Directory - if you can understand this complex manual. The trouble is that this has not been made clear to the every day designer, or for that matter to the typical building inspector.

Again and again I am asked "how many inches of fireproofing is required for 1 hour of protection". As you can see from the above chart, there is no quick answer to this one, but the new ICBO Evaluation Reports help a lot.

D. ICBO moves to solve a problem

ICBO has recognized that there is potential confusion in this area and has made significant revisions in their new Reports. Working with manufacturers, ICBO has

developed a new report format to provide designers with easy to read thickness charts and guidelines for the application of spray applied fireproofing on various structural members throughout a building.

Although it may not cover unique structural members or some new approach by a structural engineer, it greatly expands previous reports, and goes a long way toward making the designer's life easier.

The designer should check his structure during initial design phases to make sure that the structural components he has selected are covered in this new report. If they are not - be careful! You should check with your local building officials before you commit significant resources in design. In turn, building officials should call ICBO and discuss the exceptions to a Report, as they too are typically required by legislation, to follow ICBO (Uniform Building Code) guidelines.

E. Where does U.L. fit in?

In reality, the designer might be better off putting his U.L. Fire Resistance Directory away behind glass - to be accessed "in emergencies only".

The real danger to the designer is in selecting a design from the U.L. manual and finding that ICBO doesn't recognize it or even disagrees with the design he selected.

In the past, the ICBO Reports were limited in the structural components they covered, so we were forced to turn to the U.L. Fire Resistance Directory to find a design that fit our requirements - but now this is seldom the case.

Now if the designer refers to U.L. in his specification, and if his references are in conflict with ICBO requirements, there is no question, the designer has a problem. The question is that if this mistake cost money in the field, who pays? I think we all know the answer to that.

Conclusion - be very careful about referring to U.L., or making such statements as "U.L. Approved". First because U.L. never approves (it reports), and secondly because ICBO is the legally constituted approval agency. Offhand, I would recommend that designers consider removing all references to U.L. from their specifications, unless they are trying to select physical characteristics for the product they want to use. I personally would try to get ICBO to approve any unusual approach I would like to take, or I would consider a new design. Certainly I would make sure that the local building authority has been made clearly aware of the problem. Assuming that if the plans are approved, you have no problems, is risky business.

V. Getting Approval for an Untested Structural Component

If the designer or his structural engineer propose to use structural components that are not specifically covered in an ICBO Evaluation Report, the local building authorities should be consulted, to make sure the design can be fire protected in an acceptable manner. In this case, it is anticipated that the local agency will call ICBO and discuss the situation with them and take into account ICBO's recommendations.

Using this approach, I have seen approval given for the application of spray applied fireproofing on wood, but I really doubt that ICBO approved this one, even though it was a very conservative approach using metal lath and a thickness of fireproofing that held the temperature to around 350F.

A. ICBO is the final authority

It should be ICBO that approves the use of a specific U.L. test. In fact, it is my opinion that this is the only approach that would stand up in court, in the event of litigation.

B. ICBO Evaluation Reports can be out of date

Just remember, Evaluation Reports are only published about every other year, so many systems are already approved by ICBO and are simply waiting for the next Evaluation Report to be published.

C. Using the Services of Manufacturers

Manufacturers can be of great assistance to the designer, his structural engineer and the municipality. Manufacturers are on the leading edge of testing, and have a feel for what is happening throughout the United States. Even ICBO relies heavily on information given to them by the manufacturers. They are major players in this field, and for the most part very professional.

This is particularly true of firms like United States Mineral Products Company and W. R. Grace. These two firms, in combination, sell about 95% of all the commercial fireproofing in the United States, and since the chances are that your job will be done with a product from one of these companies, they certainly are candidates when you need to find out what ICBO might accept.

D. Note of Caution on Using Manufacturers

Professional as they are, the purpose of a manufacturer is to sell product.

While there may be good reason to eliminate products, it is seldom in the best interest of the owner to hinder competition. In this area you must be very careful to check out the "facts" presented to you. I feel it is fair to ask the representative to explain in detail any areas of his recommendation that would eliminate or make a competitive product less viable when bid. If he is not straight with you, avoid his recommendations in the future - and let him know that is how you operate.

Remember, most products have been on the market for many years and in reality there are few field problems with any of them, that are not the result of incorrect application.

It is unfortunate, but probably to be expected, that a firm that has a particularly hard product will place great stress on the importance of this - even attempting to put fear into the designers thought about the disasters that can occur, if the designer does not require a hardness at least as great as his product.

Probably one of the most abused areas is bond strength. Perhaps this is because in this complex field, it appears easy to understand and most of us might conclude that the greater the bond, the better the product.

There are flaws to this thought. First, if a product has very high bond, and is a rigid cement, it will not "flex" with the steel, and its hardness is its own destruction as it tends to "shear" off the surface. This is why many hard industrial products, with very high bond, must be applied over metal lath. Not only would they delaminate in a fire when the steel expands, but also and tend to delaminate on roof systems where the thickness is greater and the members tend to flex more.

Yes, high bond is great, but more than is required to do the job is never needed. In the same way hardness, light weight, appearance etc, are all at first glance great, but be sure that you really need and want it - and are willing to pay for it. More logical, find out if the suggested problem is really a problem in the field - I think that you will find the "problems" disappear and typically boil down to salesmanship.

VI. Selecting the Product

Once the designer has made sure that his structure can be fireproofed, he now needs to select which products are proper for his particular job application.

Specific product selection is necessary because some products are not qualified for particular applications and also because there are times when qualified products do not have the physical characteristics desired, or are too costly.

It may also be desired by the designer to select a product based on its appearance, or special features that have nothing to do with fireproofing, such as:

- o Auxiliary thermal insulation
- o Accoustical absorption (either NRC or STC)
- o Decorative value
- o Impact resistance
- o Weathering capability
- o Freedom from toxic fumes during a fire
- o Freedom from asbestos |

If any of these added features are desirable, you need to be able to select the appropriate products with a relatively high degree of sophistication due to the following real world factors:

- o Applied costs of various products range from \$0.50 to \$14.00 per square foot for 1 hour of protection.
- o Some products cannot be used for interior applications, due to the generation of toxic fumes during a fire.
- o Salesmen sometimes give somewhat distorted information to a designer, stressing the advantages of certain physical characteristics of his product, primarily because they are unique to his product in his price range.

Later we will discuss some specifics in this area that should be of help in sorting all this out.

There may be as many as 15 manufacturers in the United States that market spray applied fireproofing. Some of these firms have several products. In all, there are easily 30 or so different products that could be evaluated.

VII. Review of Available Products

The best way to select your qualified fireproofing is to know the products and their individual characteristics.

Following I have listed individual products from 5 different manufacturers of spray applied fireproofing. These firms were selected because they dominate this market. Products from the other firms are used in this area, but not very often. This is not to say they are not good, only that the free market has for one reason or another eliminated them.

In any event, the products below (arranged alphabetically by manufacturer), represent a strong cross section of the types of products available:

NOTICE: All comments below are personal evaluations, using information that is available to me. It could easily be that my remarks are not correct, or that the manufacturer of the product might disagree with my analysis. I can only state that these are my impressions, based on 12 years of field experience, and are correct to the best of my knowledge.

A. Avco

1.) Chartek 59

This is an intumescent and ablative organic epoxy. It could be described as a thick epoxy paint that puffs up during a fire and creates an insulation of very tough ash. Prior to a fire, it is not an insulator, it is a protective coating.

Can come in various colors and is very tough, resisting both impact and solvents. Properly applied it can be very attractive and weather resistant.

Typically it is used outside for industrial applications such as oil drilling rigs and at refineries. It is questionable if it should be used inside as there is a high potential for toxic fumes during a fire.

The manufacturer recommends that the steel be sand blasted before application. This is a costly fireproofing and can run as high as \$16.00/square foot applied, even on a large job.

B. Carboline

1. Pyrocrete L/D

A magnesium oxychloride cement with a dry density of 40 to 44 pounds per cubic foot.

It is hard and durable, but because of the chloride content it is somewhat corrosive, if water is present.

It has a limited number of U.L. tests, mostly on columns and as far as I can tell does not have a current ICBO Report Evaluation.

Application cost is generally between \$4.00 to \$6.00/square foot because of the required metal lath

2. Pyrocrete 104

A magnesium oxychloride cement with a dry density of 55 to 60 pounds per cubic foot.

It is hard and durable, but because of the chloride content it is somewhat corrosive, if water is present.

It has a limited number of U.L. tests, mostly on columns and as far as I can tell does not have a current ICBO Report Evaluation.

Application cost is generally between \$5.00 to \$7.00/square foot because of the required metal lath

3. Pyrocrete 201

A magnesium oxychloride cement with a dry density of 55 to 60 pounds per cubic foot.

It is hard and durable, but because of the chloride content it is somewhat corrosive, if water is present.

It has a limited number of U.L. tests, but they include both beams and columns. As far as I can tell does not have a current ICBO Report Evaluation.

Application cost is generally between \$5.00 to \$7.00/square foot because of the required metal lath

4. Pyrocrete 240 and 241

Single component cementitious fireproofing. Basically they are similar light weight and I believe portland cement products and would look like a wood floated concrete finish..

They have a limited number of U.L. tests, but they include both beams and columns. As far as I can tell, they do not have a current ICBO Report Evaluation.

Application cost is generally between \$5.00 to \$7.00/square foot because of the required metal lath

C. Stan Chem

1. Albi Clad 89S and 890

These are both intumescent vinyl based single component mastics. Slightly gray in color, they are best described as very tough.

Highly resistant to impact, either of the products are excellent for high impact industrial applications. They can also be used in architectural situations, but do generate some toxic fumes as they puff up to create their insulation.

There U.L. tests are quite limited, so check out your requirements carefully. The maximum test is for 2 hours, except for a very expensive composite application using both Albi-Crete and Albi-Clad.

One advantage of Albi-Clad is that it can be applied at temperatures below freezing - making it unique among spray applied fireproofing systems.

If properly applied, they can be very attractive - especially 89S, but you cannot count on attractive appearance, unless you require it in your specifications. The 890 product was developed more for exterior use, and tends to be a bit harder to work with.

These are semi-popular products in specifications, where high impact and a thin product is desired, but tend to be eliminated at the job site due to their high applied cost - which runs about \$7.00 to \$8.00 per square foot.

Both products require special primers, but designers often do not call these out on the steel - this is a field problem that is one factor in their non-use.

2. DuraSpray

An unusual product, this can best be described as a foamed, magnesium oxychloride. It looks like plaster of paris but weighs only 30 pounds per cubic foot.

It is very hard despite its light weight and has a number of excellent features, but like all products with a high chloride content, tends to be corrosive in a moist atmosphere.

Cost of application runs around \$4.50 to \$6.50/square foot/hour, and requires both a specialized pumper and a unique foam generator.

D. U. S. Mineral

1. Blaze-Shield

This is a portland cement based product, with rock wool fillers and binders. It is applied much like gunite using specialized equipment.

Field density runs from 13 to 18 pounds per cubic foot, and is presently supplied in either gray or off-white. It has a surface appearance ranging from rough and undulating to that of an acoustical plaster (similar to the old tamped asbestos ceilings) - depending on the application method.

Without any surface hardeners, or surface coatings, it is not recommended by the manufacturer in situations subject to abrasion. However, without any surface treatment, it easily passes all requirements for normal commercial high-rise fireproofing, and is used throughout the world in this area.

Unusually flexible in application and appearance, it has been used as an acoustical ceiling and thermal insulation material for many buildings.

Applied cost runs about \$0.55/square foot. It has an extensive ICBO Evaluation Report, which covers nearly every situation.

Almost free from freeze damage, it is not recommended by the manufacturer that it be applied below 40F, but there are less problems that with most products in this area.

The principal problem with this product is its appearance. Since it can be applied to look good enough for acoustical ceilings, the designer must make it clear in his specifications that certain appearance standards must be met if this is critical to him. Discuss this with the manufacturer.

2. Deck-Shield

In many ways similar to Blaze-Shield, this product tends to be higher in density and whiter in color, due to added gypsum. It is covered under the same ICBO Evaluation Report as Blaze-Shield.

It finds less usage than Blaze-Shield, but has a place in certain unique tests, such as for IRMA roof systems, and fire walls for metal buildings.

Applied cost runs around \$0.65 to \$0.90/square foot.

3. 460

Similar in nature to Deck-Shield, this product has been formulated to spray at a density of approximately 25 pounds/cubic foot. It is off-white in color and can be "tamped" to a relatively hard, smooth surface.

Typically this is used in locations where medium impact is required. It can be topcoated with various coatings and used in many industrial situations.

Applied cost is around \$1.50/square foot, and therefore is not competitive for normal commercial fireproofing - but very competitive if a light industrial product is required. In this area it has been used in nuclear power plants.

4. 560

This is a light gray, cementitious material with a density of about 30 pounds/cubic foot. It is relatively hard and damage resistant, but will not take high impact, without a topcoat. Cost is around \$2.75/square foot.

Typical of its use is in nuclear power plants and in light industrial facilities.

It has limited ICBO approval for both beams and columns.

5. 800

With a density of 44 to 50 pounds/cubic foot, it is a very hard industrial fireproofing. Light gray in color it has limited ICBO approval for columns. It has been tested for high-rise petrochemical fires and is approved for use at refineries.

Applied cost is around \$4.50/square foot, and although a topcoat is recommended for exterior applications, it has passed exterior weathering tests without a topcoat.

E. W. R. Grace**1. MK4 and MK5**

These two products are a vermiculite based cementitious fireproofing. Applied density ranges between 14 and 18 pounds/cubic foot.

Light tan in color it normally has a relatively fine grain surface. If properly applied, can have an attractive appearance, but this cannot be assumed. If finish is important, it is recommended that the designer make this clear in his specification.

These two products are known as Monokote, and is a sales leader in the United States.

2. MK6

This is a new cementitious product, just being introduced into the market by W. R. Grace. For that reason there is little or no published published data on the product.

It appears that it will be white in color and is formulated with polystyrene beads and cellulose fiber as its "aggregate". Anticipated density is about 15 pounds/cubic foot.

It may be the "new" Monokote, formulated to eliminate the use of the vermiculite used in MK-4 and MK-5. Vermiculite is a light weight aggregate that can carry minute quantities of tremolite, an asbestiform mineral.

VIII. Simple Selection Chart

On the following page is a chart that summarizes the characteristics of the products described above. Note the wide range of applied costs and the general categories of "Normal Commercial", "Heavy Duty Commercial", "Light Industrial" and "Heavy Industrial". All the chart headings are explained in the paragraph immediately following the chart:

Spray Applied Fireproofing - Selection Chart

Manufacturer	Product	Asbestos Free Cert	Thermal Insulation	Acoustical On Solid	Normal Commercial	Heavy Duty Commercial	Light Industrial	Heavy Industrial	\$/Hr Applied	\$ To Mobilize	Notes
Avco	Chartec	Probable	none	none	No	No	Y-ExOnly	Y-ExOnly	12.00-16.00	500	
Carboline	1/8 201 240 & 241	Probable Probable Probable	none none none	none none none	Ok Ok Ok	Ok Ok Ok	Yes Yes Yes	Yes/Coat Yes/Coat Yes/Coat	4.00-6.00 5.00-7.00 5.00-7.00	1000 1000 1000	
Stan-Chem	Albi-Clad Dura-Spray	Yes Yes	none unit	none none	Ok Ok	Ok Yes	Yes Yes	Yes Yes/Coat	7.00-9.00 7.00-9.00	500 500	
U.S. Mineral	Blaze-Shield Deck-Shield 500 800	Yes Yes Yes Yes	R-3.45 R-3.25 unit unit	MCR .65 MCR .60 unit none	Yes Yes Ok Ok	Yes/Coat Yes/Coat Yes Ok	NR Y/C Yes Yes	NR Yes/Coat NR Yes	51-.58 1.50-1.70 2.00-3.00	1000 1000 1000 1000	
W. R. Grace	MK-5, MK-6	Doubtful ?	unit unit	unit unit	Yes Yes	Yes/Coat Yes/Coat	NR NR	NR NR	51-.58 51-.58	1000 1000	

Yes - Is the ideal place for this product
 Yes/Coat - Yes with some form of protective coating
 Y-ExOnly - Yes but exterior only due to toxic fumes
 No - Should not be used, probably due to toxic fumes
 None - Does not have this feature
 Unit - Author was unable to find out
 Ok - Could be used but an economic "Over-Kill"

1/2

IX. Explanation of the chart

The preceeding chart has many weaknesses, but it will serve you well in most situations. First let us explain some of the categories.

A. Asbestos free certification

This is not a dead issue. The problem is that standards for minimum asbestos content are still waiting for a decisive agency. It is a highly political issue, with many dollars at stake. Presently OSHA allows what many would consider a very high percentage of asbestos, and discussion continues over downward revision of the allowable percent of asbestos.

Perhaps the banks and owners are taking the lead in this area, generally demanding zero asbestos.

A number of products are admitted by the manufacturer as have "traces" of asbestos. These "trace" quantities are defined on a percent by weight basis and are very small indeed.. The problem is that asbestos is very light, so percent by volume may be more realistic, but even at trace levels we are still talking about 500,000 to 2,000,000 individual fibers per bag. With many jobs requiring 10,000 bags, this may not be insignificant to an owner.

One must always keep in mind that allowable content of asbestos has changed in the past and is likely to change in the future, and there are no "grandfathers clauses" in this area.

Under this column I have indicated the manufacturers willing to certify that they have no asbestos. In some cases I was unable to get a clear answer from the manufacturer.

I did indicate "Probable", if I knew the material and felt that there was a high degree of probability that there was no asbestos in the product. If I felt that there may indeed be asbestos, but was unable to get a definitive answer, I put a "Doubtfull". Finally I placed a "?" where I had no idea.

B. Thermal Insulation

A few products, have significant added thermal insulation characteristics. This is very useful on roofs and sidewalls.

Many roof systems require as much as 2 inches of spray applied fireproofing. In some cases this can give the owner an "extra" R-7.0, at no extra cost, perhaps lowering the amount of insulation on the roof.

C. Acoustical on Solid base

Again this may be useful on some jobs. Few products have this characteristic, but some do. This is of no significance unless you desire it - but it does tend to drop the "flanking" noises from one room to another in a highrise.

D. Normal Commercial Environment

This is the bulk of the normal commercial fireproofing. It includes all the areas behind drop ceilings, and in most cases the decks in parking garages. Products in this area can be relatively soft, but must have resistance to air erosion so as not to cause filter problems when air plenums are used as returns.

This is the most economical application area, and represents about 90 percent of the square footage of fireproofing applied in the United States.

Almost all fireproofing products are qualified for this area, but some would be an Over-Kill (indicated by "ok").

E. Heavy Duty Commercial

Elevator shafts, equipment rooms and areas subject to light abrasion. In most cases, this would be the application for the lower flanges of beams in parking garages, but that is a judgement call, perhaps you might look at Light Industrial.

F. Light Industrial

Areas not subject to heavy impact but might receive some light impact. It is a judgment category as it is still subject to damage, but not nearly as much as is even the Heavy Duty Commercial fireproofing. Damage would be limited and relatively easy to repair.

G. Heavy Industrial

Heavy duty fireproofing. Used in refineries, nuclear power plants, oil platforms, columns in warehouses, and in some cases prisons.

H. \$/Hour to Apply

This is an estimate of the cost per square foot to apply 1 hour of fire protection to a W10x49 column, if you have a large number of them to do. In other words, mobilization is not a factor.

These costs are based on 12 years of experience and assume an experienced applicator, in the state of Washington, with an office near the project. Alaska, in the Anchorage area might be 30% higher.

I. \$ To Mobilize

This is the cost to get ready to spray and at the end of the job, to clean up. It must be added to the \$/Hour to Apply cost.

In addition, if the job is of such a nature that the applicator must mobilize several times, each mobilization must be added. Finally location, difficulty of the job, unusual weather and other unique factors must be taken into account - but it is a start.

X. A Note on Appearance

All spray applied fireproofing can be put on to have a very attractive appearance, and there is not one of them that cannot be put on to look like World War III just took place.

Selecting a specific product in order to obtain an attractive appearance, is subject to disappointments.

If you want an attractive appearance, make sure you are willing to pay the price and then make this clear in your specification.

Spray applied fireproofing in Area 3-A is intended as a decorative finish and must be applied in a smooth uniform manner, not deviating more than 3 / 4 inch in 2 feet. Applicator must apply selected product to an area no less than 100 square feet in size and obtain architects written approval, before proceeding. Approved area shall serve as the appearance standard for the remaining application. Applied fireproofing that fails to meet approved standard shall be removed and replaced, at the request of the architect.

XI. Slecting Qualified Products

A. Step 1 - Eliminate all unqualified products

Many products have very limited ratings. Some only have 1 or 2 hour ratings. Some have no beam rating, or cannot be applied to joists or decks. The restrictions go on and on.

If you are only protecting W10x49 columns for 1 hour, you may have nearly all the products to select from. On the other hand, if you are doing a special joist, with a specific roof system, perhaps only 1 or 2 products have ICBO approval.

Do not make any assumptions. Demand very clear approvals from the manufacturers. Many unqualified products get specified and applied.

B. Step 2 - Eliminate all products that are too costly

This step is related to the next step but I have selected it as more important simply because spray applied fireproofing can be very costly and a designer needs to be sure he is willing to pay the price, in the event he selects one of the more costly products.

If he selects a product that costs \$7.00 per square foot to apply, every lineal foot of a column could cost in excess of \$21.00 to fireproof, as many columns have several square feet of surface per lineal foot. That can be significant. After the job is bid, experience indicates that a general contractor is seldom willing to give back all this money, in the event the designer is forced to select a less expensive product - because of cost overruns.

Select your product with care and then you will not be faced with a client wondering why you made this selection in the first place.

C. Step 3 - Eliminate all products that do not meet your requirements in the area of asbestos.

If you don't want asbestos in your spray applied fireproofing then state your desires clearly. In doing so remember that the material supplier is seldom a party to the owners contract with his general, so you must be very specific:

Spray applied fireproofing must be certified by the material supplier as "absolutely asbestos free". Said certification shall be signed by a corporate officer of the material supplier and delivered to the architect prior to application. Failure to deliver said certification will require removal and replacement at the expense of the general contractor.

Be careful that you do not allow "fuzzy" verbage, such as, "*Product binders shall be asbestos free*". Since the binders may not be the problem, say what you really want.

D. Step 4- Select the physical characteristics required

Spray applied fireproofing is generally formulated to be as inexpensive as possible - since it is costly, and adds little to the functionality of the structure.

This does not mean that physical characteristics should be ignored. Quite the contrary, they should be reviewed carefully. The designer must answer such questions as "how hard" or "how much bond is required", what color etc, etc.

Do not make these decisions lightly. Many dollars can be involved. For example, it may be much less expensive to paint the fireproofing white afterwards, than to insist on a white fireproofing.

Once you have made a careful decision in this area you need to set the standards that must be met. I have listed various ASTM tests below that are traditionally used for this purpose, but I feel personally that they must be called out with a great deal of caution.

Since products are what they are, I feel it is best to simply select the qualified products. But if you use caution, you might get what you want by setting the minimum values for the following tests. The trouble is that the features that a designer is looking for, often are only indirectly approached by the following tests.

These test are described in the following paragraphs and outlined in detail in the appendix.

ASTM E84 - Test for Surface-Burning Characteristics of Building Materials.

ASTM E605 - Thickness and Density of Sprayed Fire Resistive Material Applied to Structural Members.

ASTM E759 - Effect of Deflection of Sprayed Fire Resistive Materials Applied to Structural Members.

ASTM E760 - Impact on Bonding of Sprayed Fire Resistive Materials Applied to Structural Members.

ASTM E761 - Compressive Strength of Sprayed Fire Resistive Materials Applied to Structural Members.

ASTM E859 - Air Erosion of Sprayed Fire Resistive Materials Applied to Structural Members.

ASTM E937 - Corrosion of Steel by Sprayed Fire Resistive Materials to Structural Members.

XII. Selecting the Right Product for Your Job

After you have gone through the above steps, the right products should almost "pop out" at you. In a few cases only one will do the job, in others, several will.

If you are still not sure, then call several of the manufacturers and ask why their product should or should not be used. I would also suggest that you also ask them why they feel a competitive product should or should not be used. In doing so, be sure to tell them that you intend to call the other manufacturers and ask the same question - I feel that this increases your chance for a conservative answer. By talking to several manufacturers using this approach, I am sure you will have enough data to make a decision.

XIII. Specifications

Writing a specification for spray applied fireproofing is no more difficult than for any other product. In all cases it is an art, and subject to problems, if you don't know your subject well.

To help you out I have attached both a long form and a short form specification. I really don't believe much in the long form type specification for the following reasons:

Fireproofing products are what they are. The manufacturer is limited to how much he can modify his product formula due to the tests he has taken at U.L.

If a specifier starts defining densities, bond strength and other physical characteristics of the desired fireproofing, he is at risk of eliminating qualified products. Remember, one of the subtle tricks in this field is to tell the architect that Brand-X is just fine, but "be sure that it is applied at a density equal to ours", or at a "bond strength equal to ours".

This all sounds reasonable at the time but keep in mind that even though all the fireproofing products mentioned above perform the same function (protecting the steel), they are radically different in formulation. Each does its job, each has passed necessary fire tests, and each has its advantages.

Do not allow one unique feature of a product (good or bad) to dominate your thinking enough to be persuaded to eliminate a competitive product, which might have other features that are equally valuable to you.

If you feel that one feature of a product is of major concern, call the manufacturer and discuss it with him.

If for example you elect to use the recommended short form specification, but are concerned about appearance, or want the product to have thermal or acoustic features, select products that are capable of satisfying your needs and then make it clear in your specification that that is what you want. Don't imply your requirements by attempting to utilize unique ASTM tests - unless you really know what you are doing. I have personally seen more problems in this area than any other, and in most cases it is caused by self-serving suggestions by manufacturers.

I feel that the specifications we have given you are not of this variety, but I would suggest that you discuss them with several manufacturers first, and get their input.

A. Short and Long Form Specifications

On the following pages, you will find both a short and a long form specification draft. These represent a good place to start if you are preparing a commercial fireproofing specification.

A fireproofing specification for an industrial job is much more specialized and here I suggest that you contact the manufacturers for assistance.

XIV. Field Inspection

Field inspection is easy. I have enclosed a guideline that should be of use if you are in an ICBO territory.

Generally thickness is the only problem. I have never seen a product that has failed either bond or density tests, but I guess it is possible. Most typically I find that a test lab has problems with the density test itself.

The only problem I have seen in thickness (except that it doesn't meet thickness requirements), is that the thickness tests are taken with the wrong type gauge and are not taken at the locations specified by the ICBO standard.

I will say this however. Before the job starts, I recommend strongly that there be a coordination meeting with all parties in attendance. If the designer has appearance requirements in his specifications, these should be clearly stated again at that meeting. Also the test lab that will make the tests, should agree to come quite often, especially at the beginning of the job, so the applicator has a chance to correct any bad "habits" before he is well along on the job. This really works well as I find that most applicators really want to do a good job, but they must have guidelines.

-2-

A jury in Greenville, S. C., awarded \$8.4 million in damages to the City of Greenville in a trial against GRACE. The city claimed that GRACE was negligent in its sale of MONOKOTE-3, which occurred in 1971-1972. This jury verdict has been reported in The Wall Street Journal, the New York Times and we're sure other newspapers. Since the stories only mention "MONOKOTE" and do not distinguish between MK-3 and MK-4 or MK-5, there may be confusion on the part of our customers.

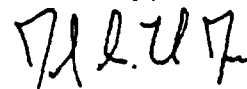
Prior to 1973, W. R. GRACE & CO., like other fireproofing suppliers, produced a fireproofing material, MONOKOTE-3, which did contain commercially-added asbestos. However, MONOKOTE-3 was a "second generation" cementitious fireproofing material designed as an alternative to fibrous, high-asbestos content materials. MONOKOTE-3 should not be confused with those products which were formulated with high asbestos contents (up to 90%) and were air sprayed to form a low density, fluffy, lightly-bound mat. By contrast, MONOKOTE-3 contained approximately 12 - 13% chrysotile asbestos and was combined with water on the job site to produce a dense, cementitious, plaster-type mixture which firmly bonded to the surface to which it was applied. The asbestos fibers were encapsulated in the plaster matrix, and if undamaged, are not subject to release in the environment.

Although MK-3 is an asbestos-containing material, its presence in a building poses no unreasonable risk of injury to building occupants. (In the case of Greenville, the city did not plan immediate removal of the MK-3, indicating that they also did not believe there was a risk.) We believe that the verdict is not supported by the law and the facts, and we will appeal.

It is unfortunate that your time and effort must be distracted by marketing scare tactics. GRACE believes that these tactics unnecessarily call attention to non-existent health issues associated with fibrous materials and cementitious fireproofing alike, when the real concerns should be directed towards in-place performance of fireproofing materials.

I trust that the information I've provided addresses your concerns. If you require additional information, please feel free to contact me.

Sincerely,



John S. Hamilton, Jr.
Manager, Technical Services

JSH/acd
Att.

cc: Mr. Ken Brown
Dept. of Public Works
Kenei Peninsula Burrough
P. O. Box 850
Soldotna, AL 99669

W. Culver - CPD/Auburn

**SECTION 07250
SPRAY APPLIED FIREPROOFING**

Part 1 - GENERAL

1.1 Scope

- A. Furnish all material, equipment and labor to apply sprayed-on fireproofing to the substrates listed below to the thickness required by appropriate ICBO Report.

UNRESTRAINED HOURLY RATING

Spandrel Columns_____	Secondary Beams_____
Spandrel Beams_____	Floor System_____
Interior Columns_____	Roof System_____
Primary Beams_____	Other_____

1.2 Contractors Qualification

- A. The contractor must be approved in writing by the manufacturer of the spray applied fireproofing as being qualified for this type of work.

1.3 Submittals

- A. Manufacturer's literature and detailed application instructions
- B. Statement signed by an officer of the manufacturer of the spray applied fireproofing stating "Material furnished for this project complies with all the minimum performance standards set forth in Paragraph 2.2". All payments may be withheld until above signed statement is received by the architect.

1.4 Insulation Credit

- A. If spray applied fireproofing products used has incidental insulation capability when applied to the thickness required for fire protection, said insulation capability may be used in calculating the thermal resistance of roof systems.

PART 2 - PRODUCTS

- 2.1 Acceptable products if certified by manufacturer to comply with Minimum Performance Standards set forth in paragraph 2.2.

2.2 Minimum Performance Standards:

- A. Minimum Dry Density: As required by ICBO Report but not less than 13 pcf.
- B. Cohesion/Adhesion: 100 pcf. ASTM E759
- C. Air Erosion: Less than 0.025 grams per square foot at 4000 fpm, ASTM E859
- D. Absolutely free of asbestos.

PART 3 - EXECUTION

3.1 Preparation

- A. Prior to application of spray applied fireproofing material, an inspection shall be made to see that all steel is acceptable to receive fireproofing. Steel shall be free of oil, grease, loose mill scale, or any other substance that may impair proper adhesion.**
- B. All clips, hangers, supports, sleeves and other attachments to the fireproofing bases are to be placed by others prior to the application of the fireproofing material.**
- C. Ducts, piping, conduit or other suspended equipment that interfere with the uniform application of the fireproofing material shall be positioned after the application of the sprayed fireproofing.**

3.2 APPLICATION

- A. Application of sprayed fireproofing shall be in accordance with the printed instruction of the material manufacturer and shall be installed by experienced craftsmen.**
- B. Fireproofing to the underside of roof assemblies shall be done only after roofing application is complete and roof traffic has ceased.**
- C. No fireproofing shall be applied prior to completion of concrete work on steel decking.**
- D. Temperature and enclosure conditions shall be as required by the fireproofing manufacturer.**
- E. Provide all necessary measures for protection of the general public and for prevention of air pollution as required. Enclose exterior openings to areas where spray application is taking place.**
- F. Spray applied fireproofing in equipment rooms and in parking garages shall be troweled or tamped to a reasonably smooth and flat surface. The lower flange of all beams shall be sealed with a minimum of 1/8 inch of a "hard coat" material approved by the manufacturer.**

3.3 Patching and Repair

- A. All patching and repairing of sprayed fireproofing, due to other trades, shall be performed under this section and paid for by the General Contractor.**

3.4 Cleanup

- A. After completion of the fireproofing work, equipment shall be removed and all exposed wall and floor areas shall be left in a broom-clean condition.**

3.5 Field Tests

- A. The architect may select, and the owner will pay, an independent testing laboratory to sample and verify the thickness and density of the fireproofing in accordance with provisions of Uniform Building Code Standard Number 43-8, "Thickness and Density Determination for Spray-Applied Fireproofing".
- B. The results of the above tests shall be made available to all parties at the completion of each floor.

**SECTION 07250
SPRAY-APPLIED FIREPROOFING**

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Sprayed fireproofing on structural steel and deck members
- B. Schedule of ratings

1.02 RELATED WORK

- A. Section 05120 - Structural Steel.
- B. Section 05300 - Metal Decking.
- C. Section 07200 - Insulation.

1.03 QUALITY ASSURANCES

- A. Comply with code requirements of the City of () Building Department and the Uniform Building Code with Amendments.
- B. Applicator: Approved by the manufacturer of the fireproofing.
- C. The fireproofing material shall have been tested by Underwriters Laboratories, Inc., and approved by ICBO and the jurisdictional code authorities, for the hourly fire resistances specified.
- D. Fireproofing material shall have met the following standards of performance when tested as specified below:

CHARACTERISTICS: ASTM MINIMUM PERFORMANCE

Dry Density	E605	Twenty times the weight of applied fireproofing.
Cohesion/Adhesion	E736	100 psf
Deflection	E759	No Cracks or Delaminations
Bond Impact	E760	No Cracks or Delaminations
Compressive Strength	E761	10% maximum deformation @ 500 psf
Air Erosion	E859	Less than .025 grams/sf @ 1250 fpm
Corrosion Resistance	E937	Steel: No evidence of corrosion
Surface Burning	E84	Flame spread - 10, Smoke Developed - 0

- E. Fireproofing installation is subject to testing and inspection as specified in UBC Standard No.43-8.

- F. Fireproofing material shall be absolutely free of asbestos. Signed certification required from officer of manufacturer.

- G. Fireproofing applicator shall apply a minimum of 100 square feet of each type and special application of fireproofing to be used and receive Architect's written approval for appearance before proceeding with job. Approved section(s) of fireproofing shall remain as a part of the job and shall be used as acceptable job standard for appearance.

1.04 REFERENCES

- A. American Society for Testing and Materials, latest editions
1. ASTM E84 - Test for Surface Burning Characteristics of Building Materials.
 2. ASTM E119 - Fire Test of Building Construction and Materials.
 3. ASTM E605 - Thickness and Density of Sprayed Fire Resistive Material Applied to Structural Members.
 4. ASTM E736 - Cohesion/Adhesion of Sprayed Fire Resistive Materials Applied to Structural Members.
 5. ASTM E759 - Effect of Deflection of Sprayed Fire Resistive Materials Applied to Structural Members.
 6. ASTM E760 - Impact on Bonding of Sprayed Fire Resistive Materials Applied to Structural Members.
 7. ASTM E761 - Compressive Strength of Sprayed Fire Resistive Materials Applied to Structural Members.
 8. ASTM E859 - Air Erosion of Sprayed Fire Resistive Materials Applied to Structural Members.
 9. ASTM E937 - Corrosion of Steel by Sprayed Fire Resistive Materials to Structural Members.
- B. Underwriters Laboratories, Inc. (UL) - Fire Resistance Directory, (latest edition)
- C. I.C.B.O. - Verify current report number.

1.05 SUBMITTALS

- A. Submit the following in accordance with Section 01300.
1. Product Data
 2. ICBO Report and/or appropriate U.L. Test Reports showing clearly the thicknesses to be used.
 3. Certifications: Submit certification of compliance with all specified requirements, and a copy of letter of acceptance of fireproofing material by the jurisdictional code authorities.
 4. Copies of reports from reputable independent testing agencies, of products proposed for use, which indicate conformance to ASTM E84 and E119.
 5. Manufacturer's published installation recommendations.

1.06 DELIVERY, STORAGE, AND HANDLING**A. In accordance with Section 01600 and the following:**

1. Deliver material in Manufacturer's original unopened and undamaged packages. Labels are to clearly identify Manufacturer, UL label, brand name, and contents.
2. Acceptance at site: Verify undamaged condition. Damaged packages will be rejected.
3. Protection prior to application.
 - a. Store in original packaging under protective cover. Store in dry place, off the ground, and away from any material subject to sweating or other dampness.
 - b. Rotate stock periodically.
 - c. Use before expiration date.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Maintain minimum air and substrate temperature of 40 degrees F for 24 hours before, and 24 hours after application of fireproofing material.
- B. Provide natural or mechanical ventilation during and 24 hours after application to properly dry the fireproofing, and maintain a non-toxic unpolluted working environment.

1.08 INSULATION CREDIT

- A. If spray-applied fireproofing product used has incidental insulation capability when applied to the thickness required for fire protection, said insulation capability may be used in calculating the thermal resistance of roof and floor systems.

PART 2 PRODUCTS**2.01 FIREPROOFING SYSTEMS**

- A. Blaze-Shield DC/F, Deckshield C/F, Cafco Division, United States Mineral Products Co.
- B. Monokote MK-5, MK-6 Fireproofing, Construction Products Division of W.R. Grace Co.
- C. Spray Overcoat Sealer: Cafco - Bond Seal; Monokote - as recommended by the manufacturer.
- D. Cementitious Hardcoat: Cafco: Mixture of three parts sand, one part portland cement or three parts sand, one part structolite. Add one quart Bondseal per 500 pounds of wet mix. Monokote: Three parts sand, one part gypsum or three parts vermiculite, one part gypsum.
- E. Substitutions: Submit in accordance with Section 01600.

PART 3 EXECUTION**3.01 PREPARATION**

- A. Installer must examine substrates and conditions under which fireproofing work is to be performed, and must notify Contractor, in writing, of unsatisfactory conditions. Do not proceed with fireproofing work until unsatisfactory conditions have been corrected in a manner acceptable to installer.
- B. Clean substrates of substances which might be incompatible with or interfere with bond of fireproofing, including oil, dirt, heavy scale, rust and non-compatible shop primer. Remove ill timed work which might interfere with installation of fireproofing.
- C. Verify that no paint finishes have been specified for surfaces to be fireproofed. If paint or primer has been specified, consult with fireproofing manufacturer for compatibility with fireproofing.
- D. Verify that clips, hangers, supports, sleeves, and other items required to penetrate fireproofing are in place.
- E. Coordinate fireproofing application with the work of other Sections to minimize subsequent damage to fireproofing. Repair of fireproofing damage caused by other trades shall be paid for by trade causing damage.
 - 1. Apply sprayed fireproofing to the underside of the roof only after roof traffic has ceased.
 - 2. Apply fireproofing to floor decks only after concrete work is complete.
- F. Cover other work which might be damaged by fall-out or overspray of fireproofing materials during spraying operations. Provide temporary enclosure as may be required to confine operations, protect the environment, and ensure adequate ambient conditions.
- F. Beginning of installation means acceptance of substrates and installation conditions.

3.02 INSTALLATION

- A. Apply in accordance with the manufacturer's printed installation instructions, and fire test report requirements.
- B. Special Application Requirements
 - 1. At locations below 8' -0" above finish floor not scheduled to receive fireproofing damage protection (i.e. gypboard wrap or column cover), trowel or tamp to a reasonably flat surface; apply 1/8 inch minimum cementitious hardcoat protection over fireproofing material.

2. **Garage Beams** - Locations below 8'-0" above finish floor, trowel all surfaces of Monokote or tamp all surfaces of Cafco to a reasonably flat plane surface.
 - Apply minimum 1/8 inch cementitious hardcoat protection to lower flange.
3. **Equipment Rooms** - Apply spray overcoat sealer to surfaces of fireproofing exposed in mechanical rooms, and in plenums and other areas exposed to air movement greater than 4000 fpm. Apply at the rate of 200 square feet per gallon, unless otherwise recommended by the manufacturer.
4. **View areas** - Fireproofing surface deviation of 1/2" in 2' span tolerance.

3.03 CLEANUP

- A. Patch all damaged areas to maintain the fire rating of the assembly. Patching shall be performed by applicator applying fireproofing only, and at no additional cost to the Owner.
- B. After completion of fireproofing work, remove all equipment and clean all exposed wall, ceiling and floor areas of deposits of sprayed fireproofing materials.

3.04 SCHEDULE

CONSTRUCTION: TYPE [] FR

UNRESTRAINED HOURLY RATING

- A. Columns: [] hour rating
- B. Primary Beams: [] hour rating
- C. Secondary Beams: [] hour rating
- D. Floor assembly: [] hour rating
- E. Roof assembly: [] hour rating

END OF SECTION