Analysis of Proposed Change G68-06/07 to the 2006 Edition of the International Building Code

by Farid Alfawakhiri, Ph.D., American Iron and Steel Institute
January 5, 2007

The proposed change G68-06/07 to the 2006 Edition of the International Building Code suggests a new item 403.15 and a new Table 403.15 that specify new minimum bond strength requirements for Sprayed Fire Resistive Materials (SFRM) in high-rise buildings. The proposal suggests a minimum SFRM bond strength of 430 psf for buildings over 75 feet in height (above the lowest level of fire department vehicle access), and a minimum SFRM bond strength of 1000 psf for buildings over 420 feet in height. The text of the proposal (see Attachment 1) lists the following reasons for the change:

- The collapse of World Trade Center (WTC) was caused by the action of building contents fire on light steel members in the absence of SFRM, which had been dislodged. Recommendation 6 of NIST WTC report calls for the improvement of in-place performance of SFRM.
- Events such as elevator movement, building sway or maintenance activities have been known to dislodge SFRM.
- Currently specified minimum SFRM bond strength of 150 psf is not sufficient for higher buildings with higher risks.
- Something needs to be done now to improve the in-place durability of SFRM, although more research is needed to establish appropriate bond strength for different levels of risk.
- The proposal will increase the cost of construction only marginally.

During the 2006 Public Hearing held in Lake Buena Vista, FL, the General Code Development Committee approved the proposal with minor editorial modifications. The 2006 Report of Public Hearing lists the following committee reasons (see Attachment 2):

- The proposal goes along with the NIST recommendations and should provide for better safety in high-rise buildings, although no technical data was provided to support the proposal.
- Greater bond strength will increase the probability that the protection will stay in place and will reduce the likelihood of SFRM being dislodged. This should provide for a longer time of safety.
- Taller buildings are at a higher risk; vibration of tall buildings will affect the long-term performance.
- The cost impact was considered as being relatively small, based on provided testimony.

This technical note analyses the proposal change G68-06/07 for its safety benefits and cost impact, and examines whether the relevant listed reasons above were adequate.

SFRM Bond Strength

The bond strength values for standard-density (13-18 psf), medium-density (22-30 psf) and high-density (40 psf and over) SFRM products are listed in Tables 1, 2 and 3, respectively. All products with current noticeable U.S. market presence are listed.

Most of the SFRM products listed in Tables 1-3 are so-called "wet-mix" products (often referred to as "cementitious fireproofing") – i.e. these dry factory-premixed products are mixed with water on site to form slurries that are pumped and sprayed on the steel substrate. Wet-mix SFRM products are proprietary formulations of gypsum or Portland cement binders and lightweight mineral or synthetic aggregates.

Two SFRM products, marked with asterisks in Tables 1 and 2, are the so-called "dry-mix" products that consist of proprietary factory-premixed formulations of Portland cement and inorganic binders combined with mineral wool (therefore, dry-mix products are often referred to as "fiber fireproofing"). These products are pneumatically pumped in dry state on-site and mixed with water at the spray nozzle immediately before the application of the resulting slurry on the steel substrate.

The bond strength values in the Tables 1-3 represent average laboratory test results reported by SFRM product manufacturers. These values were compiled from respective datasheets posted on manufacturers' websites (see relevant excerpts in Attachment 5). It should be noted here that these average laboratory values are only indicative of the level of the bond strength of the SFRM product on unprimed steel – i.e. these values could be compared with the minimum bond strength requirements of 430 psf and 1000 psf in actual construction (as in proposed change G68-06/07) only with an adequate "safety" margin in mind, assuming that reduced bond strength could be expected in field conditions and primed/painted surfaces (when compared to lab conditions and unprimed steel results). It should also be noted here that the proposal G68 is not specific whether the required minimum bond strength is the average bond strength (of several measurements) or the individual measurement bond strength – i.e. the tolerances for this requirement are not clear, which is likely to be interpreted stringently as the minimum individual measurement bond strength requirement.

Comparison of bond strength values in Table 1 with the proposed requirement of minimum bond strength of 430 psf in building over 75 feet suggests that the proposed change is specifically "calibrated" to ban all standard-density SFRM products in buildings over 75 feet in height (above the lowest level of fire department vehicle access). In other words the proposed minimum limit of 430 psf does not appear to address any measurable risk or safety concerns, but it is chosen just above the range of bond strength common for standard-density products, so it is essentially targeting to change the market place by erecting an artificial regulatory barrier for standard-density SFRM products.

Table 1. Properties of Standard-Density SFRM Products

SFRM Product (Manufacturer)	Density (pcf)	Bond Strength (psf)
Cafco Blaze-Shield II (Isolatek International)*	16	360
Cafco 300 (Isolatek International)	17.5	390
Cafco 300 SB (Isolatek International)	17.8	390
Monokote MK-6 and MK-6/HT (W R Grace)	> 15	> 200
A/D Type 5 GP (Carboline Company)	15	> 200
Pyrolite 15 (Carboline Company)	16	515
Pyrolite 15 High Yield (Carboline Company)	15	314

* Dry-Mix SFRM (mixed with water at the spray nozzle)

Table 2. Properties of Medium-Density SFRM Products

SFRM Product (Manufacturer)	Density (pcf)	Bond Strength (psf)
Cafco Blaze-Shield HP (Isolatek International)*	26.2	1421
Cafco 400 (Isolatek International)	25	2850
Monokote Z106 and Z106/HY (W R Grace)	22	> 2000
Monokote Z106/G (W R Grace)	22	797
A/D Type 7 GP (Carboline Company)	22	> 2000
A/D Type 5 MD (Carboline Company)	22 - 26	> 400
Pyrolite 22 (Carboline Company)	22	653
Pyrocrete 239 (Carboline Company)	28	550

* Dry-Mix SFRM (mixed with water at the spray nozzle)

Table 3. Properties of High-Density SFRM Products

SFRM Product (Manufacturer)	Density (pcf)	Bond Strength (psf)
Fendolite M-II (Isolatek International)	45.7	11870
Monokote Z146 (W R Grace)	40	12765
A/D Type 7HD (Carboline Company)	40	> 6000
Pyrocrete 40 (Carboline Company)	40	1317
Pyrocrete 240 High Yield (Carboline Company)	47	2097
Pyrocrete 241 (Carboline Company)	55	> 1146

Comparison of bond strength values in Table 2 with proposed minimum bond strength requirements indicates that most (if not all) medium-density SFRM products in most cases will satisfy the new requirement of minimum bond strength 430 psf for buildings over 75 feet in height. Furthermore, it appears that the most commonly used medium-density products (such as Blaze-Shield HP and Monokote Z106) would easily pass the newly proposed requirement of 1000 psf for buildings over 420 feet in height.

All high-density SFRM products in Table 3 appear to have bond strength well exceeding the proposed minimum bond strength requirements for both building height thresholds of 75 ft and 420 ft.

SFRM Dislodgement

The Steel Solutions Center (SSC) of the American Institute of Steel Construction (AISC) conducted a recent (November 2006) survey of building architects to evaluate their use of SFRM and their experiences with it. The general comments were consistent among the architects surveyed. The common comments were that SFRM use and application were issue-free most of the time, with one exception that is discussed in the next paragraph. The applied thickness was not seen as an issue, being at or above the required thickness on all the projects. The architects felt that the specified protection was provided on the proper members, and that once the construction was finished they had no issues with the SFRM to report. This includes renovation projects where SFRM-protected steel was unenclosed long after the construction was completed.

The sole concern expressed by the architects was that trades working subsequent to the application of fire protection sometimes removed SFRM. In theses cases, the material was intentionally removed in order to attach items to the protected steel. In the case of standard-density dry-mix SFRM ("lightweight fiber fireproofing"), there tended to be more material removed during construction, including a small amount that was removed accidentally (not intentionally) by trades. The architects commented that they understood that the removed material needed to be replaced as part of the specification. They agreed that if the specifications were followed and the attachments to the steel were in place before the application of the SFRM, no material (or less material) would have been removed. Further, if the material removed by other trades were replaced as specified, there would be no concern over the fire protection.

Similar comments on SFRM dislodgement were expressed by SFRM contractors and experts surveyed by the American Iron and Steel Institute (AISI) – i.e. the single most common reason for SFRM dislodgement is intentional or accidental removal of material by workers of other trades during construction. In well-run construction projects, the work is sequenced adequately to minimize intentional or accidental SFRM dislodgement, and final inspections and patching of removed SFRM are planned and performed before permanently concealing the protected steel. In other words, the avoidance SFRM dislodgement problem is mainly linked to good coordination of construction sequences, enforcement of specifications and final inspections and/or patching to ensure the SFRM

is in place. Higher SFRM densities and higher SFRM bond strength would tend to reduce accidental removal of material (compared to standard-density SFRM), but they do not reduce the intentional removal of material by trades - i.e. higher SFRM densities are no guarantee for the material to be in place without adequate inspections and coordination of trades.

It should be noted here that building maintenance trade activities (after the construction is complete) could also result in intentional or accidental removal of SFRM in spaces where the protected steel is left unconcealed. Today, it is a common practice to specify medium or high density SFRM protection to reduce accidental removal of protection from unconcealed steel that is expected to be in close proximity to regular maintenance activities or other traffic. Such unconcealed SFRM-protected steel members are common in elevator shafts, mechanical rooms, and other utility or storage spaces.

AISC and AISI surveys did not reveal any real cases of SFRM dislodgement directly attributed to building sway, whether anecdotal or documented.

Recommendation 6 of NIST WTC report

The extensive investigation of WTC maintenance and renovation records by NIST clearly established the fact that the standard-density SFRM products used in the towers did not exhibit any serious or widespread problems with regard to SFRM dislodgement over the life of the towers (over 30 years) prior to 9/11. The Final Report (NIST NCSTAR 1, September 2005) states on page 149 that "NIST concluded:"

- "In the absence of structural and insulation damage, a conventional fire substantially similar to or less intense than the fires encountered on September 11, 2001, likely would not have led to the collapse of a WTC tower."
- "The condition of the insulation prior to aircraft impact, which was found to be mostly intact…did not play a governing role in initiating collapse of the towers".
- "The towers likely would not have collapsed…if the thermal insulation had not been widely dislodged or had been only minimally dislodged by aircraft impact".

In the second bullet point above, NIST clearly states that the condition of the SFRM prior to 9/11 "was found to be mostly intact". This finding is especially significant given that "the SFRM products used in the WTC towers were applied to steel components coated with primer paint" (see page 210 of the NIST Final Report), which was shown by NIST to reduce SFRM bond strength to about a third to half of the respective adhesive strength on unprimed steel. It should also be noted here that today SFRM products are rarely applied to primed or painted steel, and strict UL regulations (*Fire*, 2006) prohibit the use of primers and paints that reduce the average SFRM bond strength (to unprimed steel) by more than 20%, unless the primed/painted sample was directly tested in the ASTM E119 fire test.

The only notable SFRM dislodgement in WTC towers prior to 9/11 was mentioned by NIST on page 73 of the Final Report. "Inspection of the columns within the elevator shaft

spaces in 1993 indicated some loss of SFRM coverage." As a result, protection on several columns within the elevator shaft space was replaced with new medium-density SFRM (Monokote Z106), which is consistent with general SFRM industry practices for elevator shafts (as noted in the previous section of this technical note).

Although NIST did not find any evidence of any significant dislodgement or poor performance of SFRM over the life of WTC towers prior to aircraft impacts on September 11, 2001, Recommendation 6 of the NIST Final Report suggests "the development of criteria, test methods, and standards" for the "in-service performance" of SFRM, and "to ensure that these materials, as installed, conform to conditions in tests used to establish fire resistance". The text of Recommendation 6 (see Attachment 3) suggests that these developments should include:

- Improved criteria and test methodology for the performance and durability of SFRM under unusual in-service conditions such as temperature cycles, humidity, vibration, impact, with and without primer paint on steel.
- SFRM inspection procedures in building codes to ensure SFRM is in-place after all mechanical and electrical works have been completed, and in fire codes to ensure SFRM is inspected over the life of the building.
- Criteria for determining the effective uniform SFRM thickness.
- Methods for predicting the effectiveness of SFRM insulation as a function of its properties under various fire exposures.
- Methods for predicting service life performance of SFRM under in-service conditions.

There is nothing in NIST WTC Report or specifically in Recommendation 6 to justify, suggest, or recommend the arbitrary changes proposed in G68-06/07. Furthermore, the proposed change actually conflicts with NIST Recommendation 6, because the latter suggests "standards should be adopted in model buildings codes by mandatory reference to, or incorporation of, the latest edition of the standard". However, the proposed changes in G68 are not based on any accepted standard or industry practice.

Cost Impact

The informal recent survey of SFRM contractors and industry experts by AISC and AISI suggested that the substitution of standard-density SFRM products by medium-density products increases the installed cost of SFRM by 50 to 100 %. Substitution of standard-density SFRM by high-density products increases the installed cost of SFRM by about 200% or more. To confirm these suggestions, the AISC SSC commissioned formal estimates of in-place SFRM costs for a specific building frame from Larry Schilling, Carboline Fireproofing Technical Sales Manger, a well-known SFRM expert with over 30 years of experience in the industry. The standard-density, medium-density and high-density SFRM in-place costs were estimated for typical 9-story steel framed building with an overall building area of 276,120 square feet (see Attachment 4). The estimates indicated that:

- The cost of medium-density SFRM exceeded the cost of standard-density SFRM by 58%. For the considered relatively small building, the associated cost increase amounted to $ 125,658.00 ($ 0.46 / ft^2).
- The cost of high-density SFRM exceeded the cost of standard-density SFRM by 236%. For the considered relatively small building, the associated cost increase amounted to $ 520,155.00 ($ 1.89 / ft^2).

It should be noted here, that standard-density SFRM products currently occupy about 90% of the overall SFRM market. Medium- and high-density products are used only where increased durability requirements exist for the effects of impact, abrasion, increased humidity, exposed weather conditions, etc. The changes proposed in G68-06/07, if adopted would constitute a major shift in the SFRM market with tremendous cost impacts.

Summary

It follows from the above discussion that the ICC General Code Committee's recommendation of Approval as Modified for proposal G68-06/07 was based on flawed justification and misleading testimony. The proposed change should be rejected by the ICC membership because:

- Nothing in NIST Recommendation 6 or any other part of NIST WTC investigation recommends or justifies the proposed changes for increased SFRM bond strength or SFRM density. NIST clearly points to aircraft impacts as the primary cause of tower collapse – the SFRM bond strength or density did not play any significant role in the tragic events, and nothing suggests that medium- or high-density SFRM would have changed the sequence of events on that day. The NIST report specifically confirms the "mostly intact" condition of SFRM in WTC towers prior to aircraft impacts, although the SFRM was applied to primed/painted steel in WTC, and priming/paint are known to reduce bond strength of SFRM.
- Standard-density SFRM products have reliably served their purpose in high-rises over many decades, and there is nothing to suggest that the currently specified minimum bond strength of 150 psf is inadequate for higher buildings. Increased fire resistance and other stringent regulations already address higher risks associated with taller buildings, and there has been no evidence submitted to suggest that SFRM bond strength or density played any significant role in any high-rise building fire incident in the U.S. The proposal G68 creates an artificial technical barrier specifically calibrated and targeted to ban standard-density SFRM products from the high-rise market – it does not address any measurable risks or safety concerns tied to meaningful bond strength values.
- The single most common reason for SFRM dislodgement during construction is the intentional removal of SFRM by electrical, mechanical and other trades for the purpose of attaching certain installations to the steel frame. This issue can only be addressed by adequate inspections and required replacement of SFRM

dislodged during construction. Arbitrarily Increasing density or bond strength does not resolve the issue of intentional removal of SFRM.

- There has been no evidence submitted to document the claim that building sway dislodges SFRM. Maintenance activities in certain building spaces, such as elevator shafts, mechanical rooms, and other utility and storage spaces are known to dislodge SFRM from unconcealed steel members in close proximity to human or machinery traffic – these concerns are already addressed by the SFRM industry practices. Medium- and high-density SFRM products are recommended for protection of unconcealed steel members subject to traffic impact and abrasion, whether in high-rise or low-rise buildings. If these industry practices need to be codified, then a more focused proposal should be considered that addresses these specific areas of concern. However, the overwhelming majority of SFRM in buildings is concealed or beyond the reach for the effects of human or machinery traffic – there is absolutely no reason to apply blanket increased bond strength or density requirements for the entire building.
- Misleading testimony was offered with regard to the cost impact of proposal G68. In fact, credible estimates for real projects suggest very significant cost increase for installed SFRM if the proposed changes are adopted. Based on AISI's study, for buildings over 75', G68 will increase the installed SFRM cost by at least 50%. In cases where G68 would effectively result in the use of high-density SFRM instead of standard-density products, the installed SFRM cost would increase by at least 200%. These increases cannot be characterized as "marginal" or "relatively small" and the economic impact needs to be fully considered. G68 will result in millions of wasted dollars that could be spent in a smarter way. There is absolutely nothing to suggest that this proposed change, if adopted, would save a single life or a single dollar in fire losses over the foreseeable future.

AISI supports cost effective code changes that will improve the real world performance of SFRM. We share the desire to take action that will respond to the events of 9/11. Unfortunately, we believe that G68 promises more than it can deliver and it has economic implications that are not cost effective. AISI is willing to work with proponents to produce code requirements that effectively allocate societies fire protection resources in meaningful ways. We urge the membership to deny G68-06/07.

References

NIST NCSTAR 1, *Federal Building and Fire Safety Investigation of the World Trade Center Disaster: Final Report on the Collapse of the World Trade Center Towers*, National Institute of Standards and Technology, Gaithersburg, MD, September 2005.

Fire Resistance Directory, Volume 1, With Hourly Ratings for Beams, Floors, Roofs, Columns, Walls and Partitions, Underwriters Laboratories Inc, 2006

Attachment 1

Proposed Change G68-06/07

Cost Impact: The code change proposal will increase the cost of construction.

Analysis: The action on the proposed change to Section 708.1 and Table 1017.1 is dependent on the decision of the General Committee to Section 403.15 of the proposal, therefore, for consistency, the General Committee will make the determination for this entire proposal instead of being split with the MOE and FS Committees.

Public Hearing: Committee: AS AM D
Assembly: ASF AMF DF

G68–06/07
403.15 (New), Table 403.15 (New)

Proponent: William M. Connolly, State of New Jersey, Dept. of Community Affairs, Division of Codes and Standards, representing the International Code Council Ad Hoc Committee on Terrorism Resistant Buildings

THIS PROPOSAL IS ON THE AGENDA OF THE IBC FIRE SAFETY CODE DEVELOPMENT COMMITTEE. SEE THE TENTATIVE HEARING ORDER FOR THAT COMMITTEE.

Add new text as follows:

403.15 Spray-Applied Fire Resistive Materials (SFRM). The bond strength of the SFRM shall be in accordance with Table 403.15.

TABLE 403.15
MINIMUM BOND STRENGTH

HEIGHT OF BUILDING	SFRM MINIMUM BOND STRENGTH
More than 75 feet[a] and up to 420 feet	430 psf
More than 420 feet	1,000 psf

a. Above the lowest level of fire department vehicle access

Reason: This code change proposal is one of fourteen proposals being submitted by the International Code Council Ad Hoc Committee on Terrorism Resistant Buildings.

The purpose of this proposal is to increase the required adhesions of Spray Applied Fire Resistant Materials (SFRM).

The National Institute of Standards and Technology's (NIST) investigation into the World Trade Center (WTC) tragedy documented that the proximate cause of the actual collapse was the action of a building contents fire on light steel members in the absence of spray applied fire resistant material, which had been dislodged. Events far less dramatic than an airplane attack have been known to dislodge SFRM. The initiating events can be as simple as elevator movement, building sway or maintenance activities.

Recommendation 6 of the NIST WTC Report calls for improvement of the in-place performance of SFRM. This proposal is one of three that seeks to achieve that objective. The other two are a proposal for a new Section 714.8 dealing with the application of SFRM and a strengthened Section 1704.10 dealing with special inspections of SRFM installations.

The current code specifies a SFRM bond strength of 150 psf when tested in accordance with ASTM E736, no matter how large the building or how high the risk. This proposal requires the use of higher bond strength material for buildings over 75 feet in height and yet again higher strength for those that exceed 420 feet. These higher standards are warranted by the higher risk associated with taller buildings. Products that meet this standard are available in the marketplace.

Bond strength is not the only material characteristic that affects in-place durability. Density does as well. This proposal does not establish a separate density standard because density and bond strength are linked to one another. High bond strength entails high density.

Some might argue that more research is needed to establish appropriate bond strengths for different levels of risk. The proponents agree but believe something needs to be done now to improve the in-place durability of SFRM. This code provision will have that result. It should be recognized as a beginning, not an end.

Bibliography: National Institute of Standards and Technology. Final Report of the National Construction Safety Team on the Collapses of the World Trade Center Towers. United States Government Printing Office: Washington, D.C. September 2005.

Cost Impact: The code change proposal will increase the cost of construction but only marginally so. Many tall buildings already utilize these higher strength materials.

Public Hearing: Committee: AS AM D
Assembly: ASF AMF DF

G69–06/07
403.15 (New), 403.2 (New)

Proponent: William M. Connolly, State of New Jersey, Dept. of Community Affairs, Division of Codes and Standards, representing the International Code Council Ad Hoc Committee on Terrorism Resistant Buildings

Add new text as follows:

403.15 Structural performance. Buildings that are more than 420 feet (128 m) in height shall be designed to survive a building contents fire to burnout without more than local failure of the structural frame. The building contents fire shall be analyzed in accordance with the *International Performance Code for Buildings and Facilities* and shall be

Attachment 2

General Code Development Committee
Action on Proposed Change G68-06/07

G67-06/07

Committee Action: **Disapproved**

Committee Reason: This was disapproved to be consistent with the action on G66-06/07.

Assembly Action: **None**

G68-06/07

Committee Action: **Approved as Modified**

Modify the proposal as follows:

403.15 ~~Spray-Applied~~ Sprayed Fire Resistive Materials (SFRM). The bond strength of the SFRM shall be in accordance with Table 403.15.

TABLE 403.15
MINIMUM BOND STRENGTH

HEIGHT OF BUILDING [a]	SFRM MINIMUM BOND STRENGTH
More than 75 feet~~a~~ and up to 420 feet	430 psf
More than 420 feet	1,000 psf

a. Above the lowest level of fire department vehicle access

Committee Reason: Although the data which provides technical support was not provided within the proposal, this does go along with the NIST recommendations and should provide better safety in high-rise buildings. Using the greater bond strengths will increase the probability that the protection will stay in place and will reduce the likelihood of being dislodged. These factors should provide for a longer time of safety. Placing the requirements in the high-rise provisions of Chapter 4 instead of within Chapter 7 makes sense because they are only applicable to high-rises and will be more likely to be found within that section. The committee did agree with the different bond strength requirements based upon the thought the taller buildings are at a higher risk and that items such as the vibration of tall buildings will affect the long term performance. Based on testimony which was provided, the cost impact of this requirement was considered as being relatively small. The higher density products which are currently available will generally meet these requirements. The modifications included a revision of the terminology "spray applied" to "sprayed" to be consistent with the action of FS156-06/07 and to create a more global point of reference for building height by moving footnote a to the main title of the first column.

Analysis: Note Section 403.3.1 item 1 states "420 feet (128 m) in height," relating to building height as defined in Section 502.

Assembly Action: **None**

G69-06/07

Committee Action: **Disapproved**

Committee Reason: This proposal which was intended to better understand the affect of a building contents fire on the structural integrity of a highrise was disapproved. Part of the concerns stemmed from a partial reference to the ICC Performance Code within the IBC. The committee felt it needed to be a broader reference or not referenced at all. There was also concern with the design fire specified and how it would be approved by the authority having jurisdiction.

Assembly Action: **None**

G70-06/07

Committee Action: **Disapproved**

Committee Reason: The committee did not feel that the proposal accomplished what was desired to create the "robust" stair enclosure that was discussed in the NIST report. This proposal does not establish the force levels that the enclosure is required to withstand and the hose stream test is not a reasonable comparison to the forces anticipated in a terror-resistant building. As written the proposal is not clear whether the hose stream test is conducted at the end of the completed fire test or if it is conducted on the duplicate sample which is tested at the end of one-half of the desired fire-resistance rating. Currently published test reports do not specify when the hose stream test was conducted, they simply indicate that the assembly passed the test. Therefore this proposal would require retesting of assemblies if the original test data is not available. The proposal was also viewed as limiting to certain materials.

Assembly Action: **None**

G71-06/07

Committee Action: **Disapproved**

Committee Reason: The committee felt that review of the NIST report was not yet complete, therefore this proposal was premature. Modeling should be done to show the extent that an additional stair would improve exiting. The logistics of closing off a stairway for fire department staging during an emergency evacuation must be investigated. The calculation method for exit stairway width was confusing, and did not clearly indicate the width required for the extra stairway. The location of the extra stairway in relation to the other exit stairways was not indicated. In a high rise, fire fighters will typically be using the elevator to get near the fire floor and then move to the stairway. A question would be if this stairway should be located near the elevators.

Assembly Action: **None**

G72-06/07

Committee Action: **Disapproved**

Committee Reason: The committee felt that review of the NIST report was not yet complete, therefore this proposal was premature. The term 'structural bay' was not defined. The standard 'structural bay' is not used in high rise construction. Justification was not provided for the significant change for the additional separation of exits, especially if the additional stairway in G71 is also required. The ½ of the diagonal dimension, in a standard plan with 3 or more stairways, would force the stairway enclosure out of the building footprint. An analysis of the architectural and engineering impact of this change must be performed.

Assembly Action: **None**

G73-06/07

Committee Action: **Disapproved**

Committee Reason: Based upon considerable testimony in opposition, indicating that there are many problems with the proposal that need resolution. There is no explanation given that justifies the

Attachment 3

Recommendation 6 of the NIST WTC Report
(NIST NCSTAR 1, September 2005)

- realistic ratings for structural assemblies made with materials that have improved elevated temperature properties (strength, modulus, creep behavior).

b. Improved procedures and guidance to analyze and evaluate existing data from fire resistance tests of building components and assemblies for use in qualifying an untested building element.

c. Relationships between prescriptive ratings and performance of the assembly in real fires.

Affected National and International Standards[31]: ASTM E 119, NFPA 251, UL 263, and ISO 834. *Model Building Codes:* The standards should be adopted in model building codes by mandatory reference to, or incorporation of, the latest edition of the standard.

Recommendation 6. NIST recommends the development of criteria, test methods, and standards: (1) for the in-service performance of sprayed fire-resistive materials (SFRM, also commonly referred to as fireproofing or insulation) used to protect structural components; and (2) to ensure that these materials, as-installed, conform to conditions in tests used to establish the fire resistance rating of components, assemblies, and systems. This should include:

- Improved criteria and testing methodology for the performance and durability of SFRM (e.g., adhesion, cohesion, abrasion and impact resistance) under in-service exposure conditions (e.g., temperature, humidity, vibration, impact, with/without primer paint on steel[32]) for use in acceptance and quality control. The current test method to measure the bond strength, for example, does not distinguish the cohesive strength from the tensile and shear adhesive strengths. Nor does it consider the effect of primer paint on the steel surface. Test requirements that explicitly consider the effects of abrasion, vibration, shock, and impact under normal service conditions are limited or do not exist. Also, the effects of elevated temperatures on thermal properties and bond strength are not considered in evaluating the performance and durability of SFRM.

- Inspection procedures, including measurement techniques and practical conformance criteria, for SFRM in both the building codes and fire codes for use after installation, renovation, or modification of all mechanical and electrical systems and by fire inspectors over the life of the building. Existing standards of practice (AIA MasterSpec and AWCI Standard 12), often required by codes for some buildings need to be broadly applied to both new and existing buildings. These standards may require improvements to address the issues identified in this recommendation.

- Criteria for determining the effective uniform SFRM thickness—thermally equivalent to the variable thickness of the product as it actually is applied—that can be used to ensure that the product in the field conforms to the near uniform thickness conditions in the tests used to establish the fire resistance rating of the component, assembly, or system. Such criteria are needed to ensure that the as-installed SFRM will provide the intended performance.

---

[31] While the WTC recommendations are focused mainly on U.S. national standards, each U.S. standard has counterpart international standards. In a recent report (ISO/TMB AGS N 46), the International Organization for Standardization (ISO), through its Advisory Group for Security (AGS), has recommended that since many of the ISO standards for the design of buildings date to the 1980s, they should be reviewed and updated to make use of the studies done by NIST on the World Trade Center disaster, the applicability of new technology for rescue from high buildings, natural disasters, etc. ISO's Technical Advisory Group 8 coordinates standards work for buildings.

[32] NIST tests showed that the adhesive strength of SFRM on steel coated with primer paint was a third to half of the adhesive strength on steel that had not been coated with primer paint. The SFRM products used in the WTC towers were applied to steel components coated with primer paint.

- Methods for predicting the effectiveness of SFRM insulation as a function of its properties, the application characteristics, and the duration and intensity of the fire.

- Methods for predicting service life performance of SFRM under in-service conditions.

Affected Standards: AIA MasterSpec and AWCI Standard 12 for field inspection and conformance criteria; ASTM standards for SFRM performance criteria and test methods. *Model Building Codes:* The standards should be adopted in model building codes by mandatory reference to, or incorporation of, the latest edition of the standard. (See Recommendation 10 for more on this issue.)

Recommendation 7. NIST recommends the adoption and use of the "structural frame" approach to fire resistance ratings. This approach requires that structural members—such as girders, beams, trusses and spandrels having direct connection to the columns, and bracing members designed to carry gravity loads—be fire protected to the same fire resistance rating as columns. This approach is currently required by the International Building Code (IBC), one of the model codes, and is in the process of adoption by NFPA 5000, the other model code. This requirement ensures consistency in the fire protection provided to all of the structural elements that contribute to overall structural stability.[33] State and local jurisdictions should adopt and enforce this requirement.

9.2.3 Group 3. New Methods for Fire Resistant Design of Structures

The procedures and practices used in the fire resistant design of structures should be enhanced by requiring an objective that uncontrolled fires result in burnout without partial or global (total) collapse. Performance-based methods are an alternative to prescriptive design methods. This effort should include the development and evaluation of new fire-resistive coating materials and technologies and evaluation of the fire performance of conventional and high-performance structural materials.

Recommendation 8. NIST recommends that the fire resistance of structures be enhanced by requiring a performance objective that uncontrolled building fires result in burnout without partial or global (total) collapse. Such a provision should recognize that sprinklers could be compromised, nonoperational, or nonexistent. Current methods for determining the fire resistance rating of structural assemblies do not explicitly specify a performance objective. The rating resulting from current test methods indicates that the assembly (component or subsystem) continued to support its superimposed load (simulating a maximum load condition) during the test exposure without collapse. *Model Building Codes:* This recommendation should be included into the national model codes as an objective and adopted as an integral part of fire resistance design for structures. The issue of non-operational sprinklers could be addressed using the existing concept of Design Scenario 8 of NFPA 5000, where such compromise is assumed and the result is required to be acceptable to the Authority Having Jurisdiction. *Affected Standards:* ASCE-7, AISC Specifications, ACI 318, and ASCE/SFPE 29.

Recommendation 9. NIST recommends the development of: (1) performance-based standards and code provisions, as an alternative to current prescriptive design methods, to enable the design and retrofit of structures to resist real building fire conditions, including their ability to achieve the performance objective of burnout without structural or local floor collapse: and (2) the tools, guidelines, and test methods necessary to evaluate the fire performance of the

---

[33] Had this requirement been adopted by the 1968 New York City building code, the WTC floor system, including its connections, would have had the 3 hour rating required for the columns since the floors braced the columns.

Attachment 4

In-Place SFRM Cost Estimates for a Typical Steel Framed Building

Carboline Company
Representative Office
Suite 137-253, 931 W. 75th Street
Naperville, IL 60565
630/718-9485 · FAX 630/718-9486
Cellular: 630/240-3246

The following cost estimates for low, medium, and high density cementitious spray-applied fire resistive material were prepared at the request of the AISC Steel Solutions Center. The cost estimates represent in-place costs including union labor based on a typical major metropolitan area in the United States. Specific exclusions are listed on the detailed estimates. The estimates are presented in cost per typical floor and total buildings costs.

The steel-framed building provided by the Solutions Center is described with a typical floor plan (Figure 1), typical column schedule (Figure 2), and a typical braced frame elevation (Figure 3). The cost of the roof framing fire protection is assumed to be similar to the typical floor and is not calculated separately. The building is roughly 260 feet by 118 feet with 9 elevated levels with a 14'-6" floor-to-floor height. The building is to be Type IA per IBC 2003.

PROJECT: AISC SAMPLE FLOOR (1) FRAMING
LOCATION: MAJOR METROPOLITAN AREA - USA
BUILDING TYPE: 1A-IBC
DATE: 11/29/2006

APPLIED FIREPROOFING	$ AMOUNT INSTALLED	AREA-S.F.	$/S.F.
LOW DENSITY	$ 24,688.00	30,680	$ 0.80
MEDIUM DENSITY	$ 38,650.00	30,680	$ 1.26
HIGH DENSITY	$ 82,493.00	30,680	$ 2.69
TOTAL BUILDING - 9 STORIES			
LOW DENSITY	$ 222,192.00	276,120	$ 0.80
MEDIUM DENSITY	$ 347,850.00	276,120	$ 1.26
HIGH DENSITY	$ 742,347.00	276,120	$ 2.69

MEMBER	RATING (HOURS)	UL DESIGNATION
STRUCTURAL FRAME (columns & connecting beams/bracing)	3	Y725/N791/X771
FLOOR CONSTRUCTION (beams connected to beams) (unprotected deck: 3-1/4" LWC)	2	D916/N791

NOTES

LATH REQUIREMENTS FOR PRIMED/PAINTED STEEL EXCLUDED
UNION LABOR WAGE RATES IN U.S. METROPOLITAN AREAS

PREPARED BY:
LARRY SCHILLING
CARBOLINE COMPANY

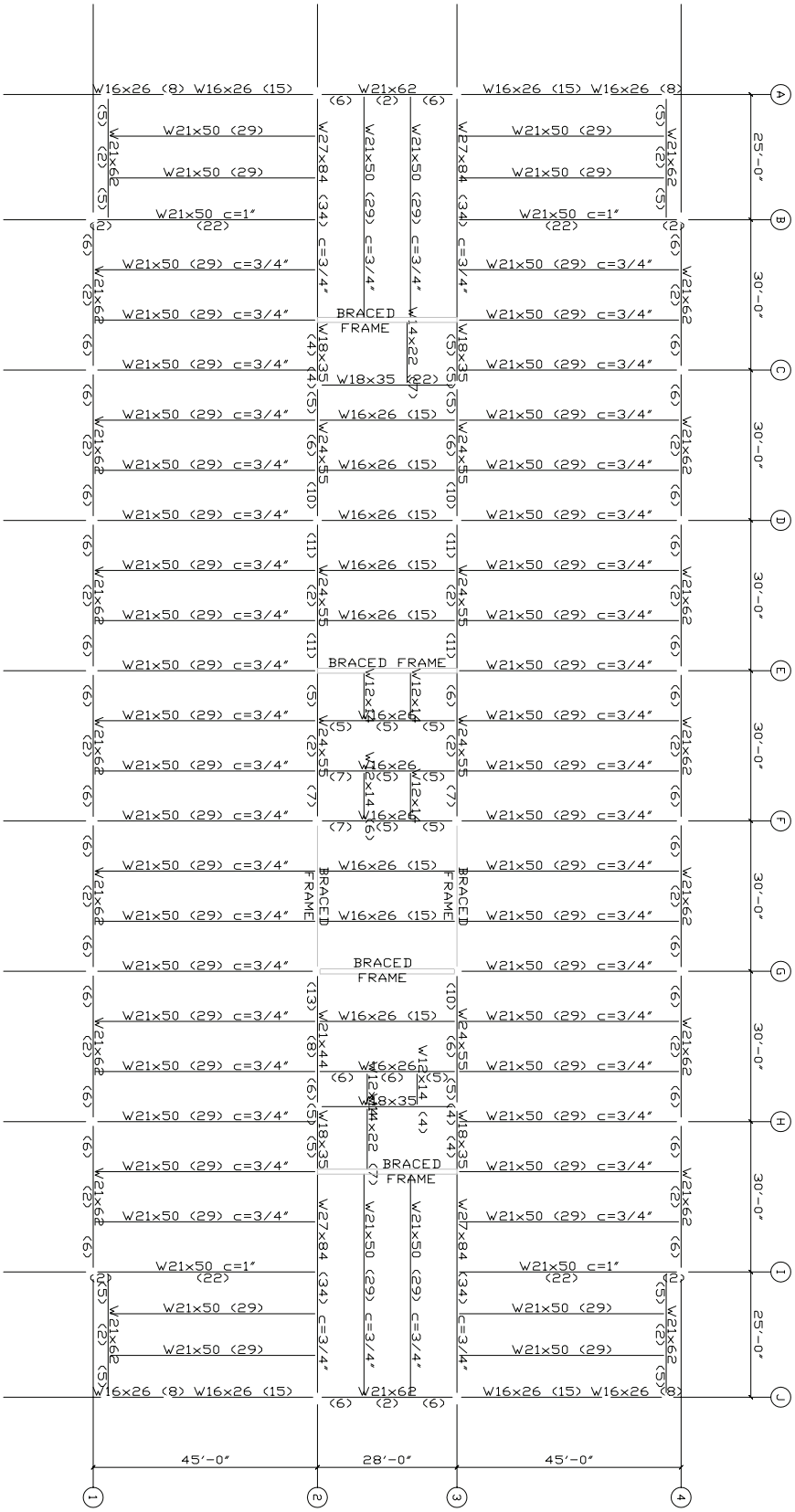
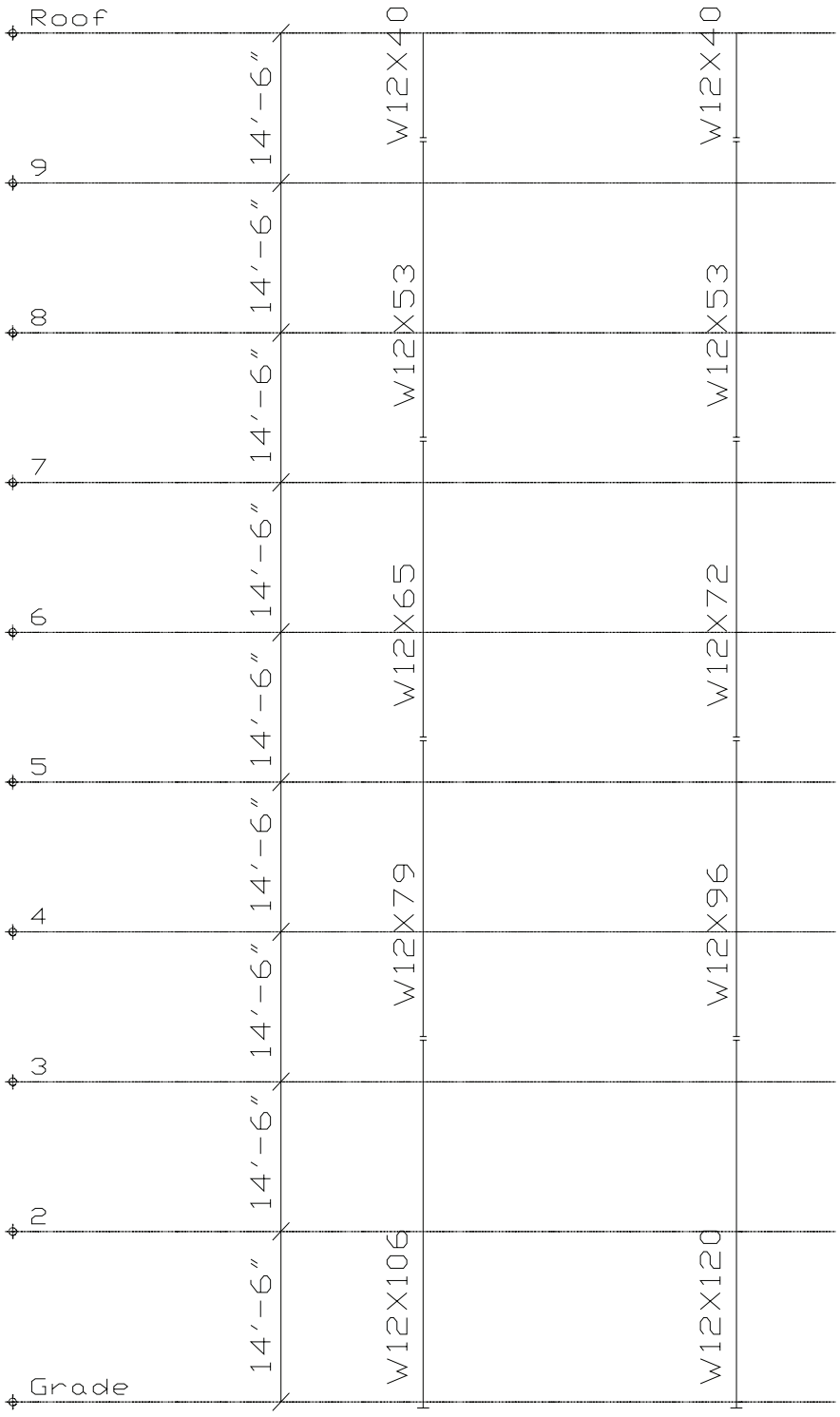


FIGURE 1: Typical Floor Framing



COLUMN	Exterior	Interior

FIGURE 2: Column Schedule

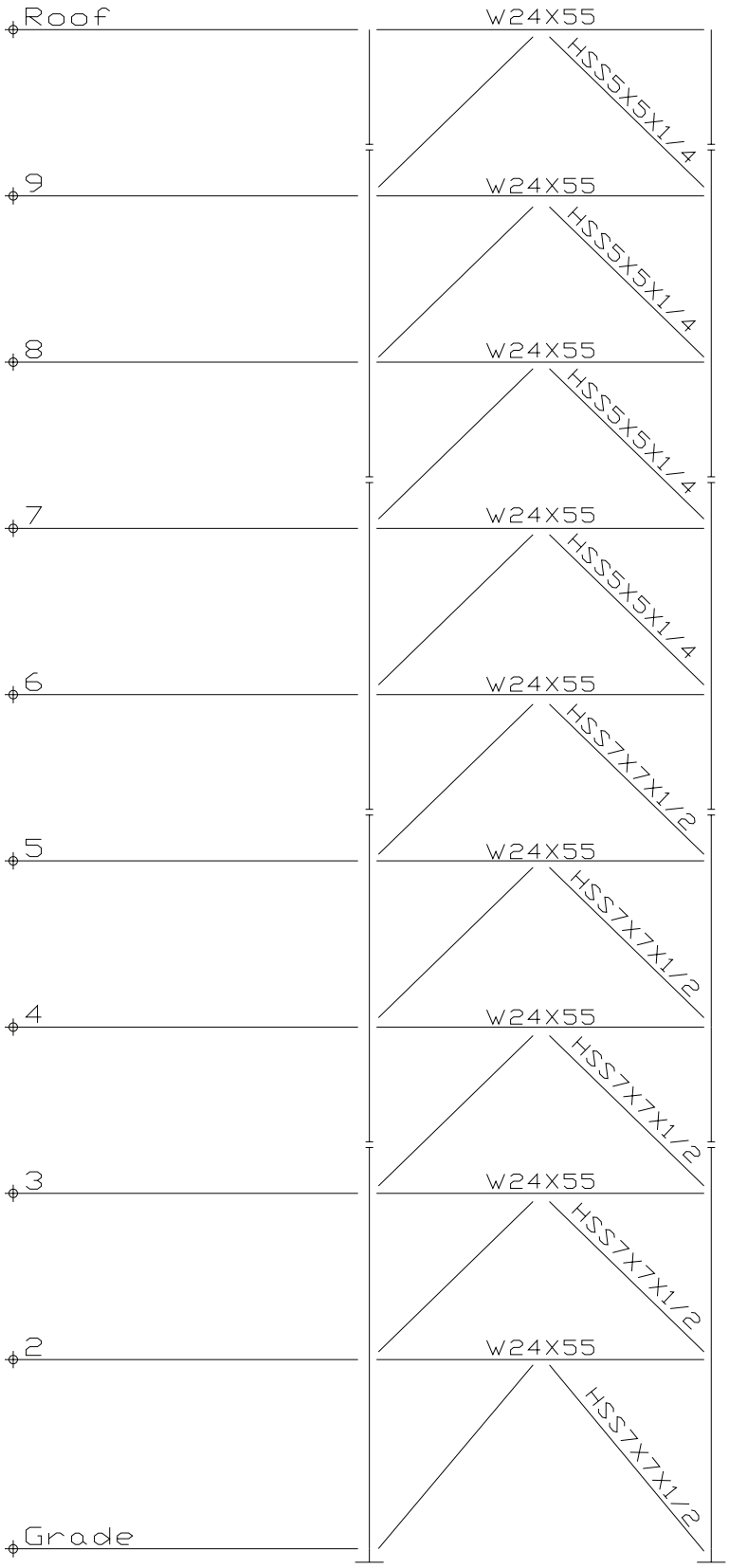


FIGURE 3: Typical Braced Frame

Attachment 5

Excerpts from SFRM Manufacturers Data Sheets with Reported Bond Strength

BLAZE-SHIELD® II

Spray-Applied Fire Resistive Material

CAFCO® BLAZE-SHIELD® II is a portland cement based spray-applied fire resistive material (SFRM) designed to provide fire resistive ratings for structural steel and concrete in commercial construction.

Applied directly to deck, steel beams, columns or concrete surfaces, the outstanding value and proven fire resistive performance of BLAZE-SHIELD II make it an excellent choice for concealed commercial environments.

BLAZE-SHIELD II is applied exclusively by CAFCO licensed and trained contractors. Our technical staff works closely with building team members to meet all fire protection needs.

Code Compliances

CAFCO BLAZE-SHIELD II satisfies the requirements of the following:

- IBC—International Building Code
- SBCCI—Southern Building Code Congress International (Report No. 9423E)
- ICBO—International Conference of Building Officials (Report No. 1244)
- BOCA—Building Officials and Code Administrators International
- New York City—MEA
- NBC—National Building Code of Canada, Sections 2.5, 3.1.5, and 3.1.7

Major Specifications

BLAZE-SHIELD II complies with the requirements of the following specifications:

- General Services Administration (GSA): AIA/SC/GSA: 07811
- Department of the Navy NAVFACENGCOM Guide Specification NFGS 07810, Sprayed-On Fireproofing
- Veterans Administration (VA): H-08-1
- U.S. ARMY Corps of Engineers. CEGS-07811
- U.S. Environmental Protection Agency (EPA): Regulation 40
- Construction Specification Canada (CSC) TEK-AID

Fire Test Performance

CAFCO BLAZE-SHIELD II has been extensively tested for fire endurance by Underwriters Laboratories, Inc. (UL) and Underwriters Laboratories of Canada (ULC) in accordance with ASTM E119 (UL 263, CAN/ULC-S101).

These tests have resulted in ratings of up to 4 hours for:

- Floor Assemblies
- Beams
- Joists
- Columns
- Roof Assemblies
- Walls and Partitions

BLAZE-SHIELD II has also been tested in accordance with ASTM E84 and CAN/ULC-S102 and has the following Surface Burning Characteristics:

Flame Spread.....0
Smoke Developed 0

Thermal Properties

The unique formulation of CAFCO® BLAZE-SHIELD® II makes it a very effective thermal insulator. This benefit is important in reducing heat loss, particularly when applied to the underside of a roof deck. The R-value added by BLAZE-SHIELD II may allow a reduction in roof insulation.

Product	Conductivity (k)*	Resistance (R/inch)
BLAZE-SHIELD II	0.30 BTU in/hr ft² °F @ 75°F (0.043 W/mK @ 24°C)	3.33

*When tested in accordance with ASTM C518

Acoustical Properties

As an efficient sound-absorbing material, BLAZE-SHIELD II adds value to the fire protection application in areas where high-noise levels are anticipated. Typical acoustical performance is as follows:

Product	Thickness	Base	NRC Rating*
BLAZE-SHIELD II	1/2 inch (13 mm)	Deck & Beam	0.75
BLAZE-SHIELD II	1 inch (25 mm)	Solid	0.75

*When tested in accordance with ASTM C423

Physical Performance

Characteristic	ASTM Method	Standard Performance*	Tested Performance**
Density	E605	15 pcf (240 kg/m³)	16 pcf (256 kg/m³)
Combustibility	E136	Noncombustible	Noncombustible
Cohesion/Adhesion	E736	150 psf (7.2 kPa)	360 psf (17.2 kPa)
Deflection	E759	No Cracks or Delaminations	No Cracks or Delaminations
Bond Impact	E760	No Cracks or Delaminations	No Cracks or Delaminations
Compressive Strength	E761	750 psf (35.9 kPa)	2,380 psf (114 kPa)
Air Erosion Resistance	E859	Less than 0.025 g/ft² (0.27 g/m²)	0.000 g/ft² (0.000 g/m²)
Corrosion Resistance	E937, Mil. Std. 810	Does Not Promote Corrosion of Steel	Does Not Promote Corrosion of Steel
Sound Absorption	C423		0.75 NRC, 1/2" (13mm) onto deck and beam

.* Standard performance based on General Services Administration AIA/SC/GSA/07811 except for density, which is based on UL. Refer to UL design for density requirement.

** Values represent independent laboratory tests under controlled conditions

CAFCO® 300

Category: Spray - Applied Fire Resistive Materials(SFRMs) **Sub-Category:** Wet Mix

Properties	ASTM Method	Standard Value	Tested Value
Flame Spread	E84 CAN/ULC-S102	N/A	0
Smoke Developed	E84 CAN/ULC-S102	N/A	0
Density	E605	15 pcf (240 kg/m^3)	17.5 pcf (280 kg/m^3)
Cohesion/Adhesion	E736	150 psf (7.2 kPa)	390 psf (18.8 kPa)
Deflection	E759	No Cracks or Delaminations	No Cracks or Delaminations
Bond Impact	E760	No Cracks or Delaminations	No Cracks or Delaminations
Compressive Strength	E761	750 psf (35.9 kPa)	2,510 psf (120.7 kPa)
Air Erosion Resistance	E859	Less than 0.025 g/ft^2 (0.027 g/m^2)	0.000 g/ft^2 (0.000 g/m^2)
Corrosion Resistance	E937 Mil. Std. 810	Does Not Promote Corrosion of Steel	Does Not Promote Corrosion of Steel
Sound Absorption	C423	N/A	0.50 NRC 1" onto deck & beam
Thermal Conductivity(R value)	C518	NA	1.85
Combustibility	E1354	No Flaming No Heat Release	No Flaming No Heat Release

Standard performance based on General Services Administration AIA/SC/GSA/07811 except for density, which is based on UL. Refer to UL design for density requirement.
Tested values represent independent laboratory tests under controlled conditions.

Performance

- Floor Assemblies
- Beams
- Joists
- Columns
- Roof Assemblies

CAFCO 300 has been extensively tested for fire endurance by Underwriters Laboratories (UL) and Underwriters Laboratories of Canada (ULC) in accordance with ASTM E119 (UL 263, CAN/ULC-S101). These tests have resulted in rating of up to 4 hours for the above.

Spray-Applied Fire Resistive Material

CAFCO® 300SB

Specially Designed For The RETROFIT Construction Market

PRODUCT

CAFCO® 300SB is a durable Spray-Applied Fire Resistive Material (SFRM) specifically designed to provide fire protection in retrofit commercial construction projects. With its light green color and superior overall fire protection performance, CAFCO 300SB is an easily identified, cost effective solution for spray-back fire protection to various floor and roof assemblies, steel beams, columns, and joists.

FIRE TEST PERFORMANCE

CAFCO® 300SB has the best overall fire performance per unit thickness of any commercial density spray-applied fire resistive material. It has been tested for fire endurance by Underwriters Laboratories, Inc. in accordance with ASTM E119 (UL 263, CAN/ULC-S101).

Fire resistance ratings up to 4 hours are available for:

- Floor Assemblies
- Columns
- Beams
- Roof Assemblies
- Joists

CAFCO® 300SB has also been tested in accordance with ASTM E84 (UL 723, CAN/ULC-S102) and has been classified to provide the following Surface Burning Characteristics:

Flame Spread.....0

Smoke Developed.....0

PRODUCT AVAILABILITY

CAFCO Spray-Applied Fire Resistive Materials are available to trained, licensed contractors around the world from strategically located production and distribution points in the U.S., Canada, Mexico, Latin America, Europe and the Pacific Basin.

Table of Physical Properties

Characteristic	ASTM Method	Standard Performance*	Tested Performance**
Cohesion/Adhesion	E736	150 psf (7.2 kPa)	390 psf (18.6 kPa)
Deflection	E759	No Cracks or Delaminations	No Cracks or Delaminations
Bond Impact	E760	No Cracks or Delaminations	No Cracks or Delaminations
Compressive Strength	E761	750 psf (35.9 kPa)	2,510 psf (120.2 kPa)
Air Erosion Resistance	E859	Less Than 0.025 g/ft^2 (0.27 g/m^2)	0.000 g/ft^2 (0.000 g/m^2)
Density	E605	15 pcf (240 kg/m^3)	17.8 pcf (285 kg/m^3)
Corrosion Resistance	E937 Mil Std. 810	Does Not Promote Corrosion of Steel	Does Not Promote Corrosion of Steel

*Standard Performance based on General Services Administration: AIA/SC/GSA: 07811 except for density which is based on UL. Refer to UL design for density requirement.

**Values represent independent laboratory tests under controlled conditions.

ISOLATEK INTERNATIONAL

TECHNICAL GUIDE SPECIFICATION

Monokote® MK-6®s

MK-6/HY® and MK-6s

PART 1 GENERAL

1.01 SUMMARY

A. Work under this section consists of the furnishing of all labor, materials, equipment, and services necessary for, and incidental to, the complete and proper installation of all cementitious fireproofing and related work as shown on the drawings or specified herein, and in accordance with all applicable requirements of the contract documents.

B. Conform to all applicable building code requirements of all authorities having jurisdiction.

1.02 RELATED SECTIONS

A. Section (_____): Concrete

B. Section (_____): Structural Steel

C. Section (_____): Metal Deck

D. Section (_____): Roof Insulation

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM E84 Surface Burning Characteristics
2. ASTM E119 Standard Methods of Fire Tests of Building Construction and Materials
3. ASTM E605 Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Material Applied to Structural Members
4. ASTM E736 Cohesion/Adhesion of Sprayed Fire-Resistive Material Applied to Structural Members
5. ASTM E759 Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members
6. ASTM E760 Effect of Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members
7. ASTM E761 Compressive Strength of Sprayed Fire-Resistive Material Applied to Structural Members
8. ASTM E859 Air Erosion of Sprayed Fire-Resistive Material Applied to Structural Members
9. ASTM E937 Corrosion of Steel by Sprayed Fire-Resistive Material Applied to Structural Members
10. ASTM E1354 Cone Calorimeter
11. ASTM G21 Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

B. Bureau of Building Inspection: City of San Francisco

1. Abrasion Resistance Test Method
2. Impact Penetration Test Method

C. Underwriters Laboratories Inc. (UL) Fire Resistance Directory (Latest Edition)

D. Uniform Building Code (UBC)

1. UBC Standard No. 7-6 – Thickness and Density Determination for Spray Applied Fireproofing
2. UBC Standard No. 7-7 – Methods for Calculating Fire Resistance of Steel, Concrete and Wood Construction

E. 1. AWCI Technical Manual 12-A: Standard Practice for the Testing and Inspection of Spray Applied Fire-Resistive Materials

2. AWCI Technical Manual 12: Design Selection Utilizing Spray Applied Fire-Resistive Materials

1.04 DEFINITIONS

A. Cementitious Fireproofing as defined by Underwriters Laboratories Inc. (CALV) in the latest edition of the UL Fire Resistance Directory.

1.05 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's instructions for proper application of cementitious fireproofing.

B. Fire Testing: Submit evidence that the cementitious fireproofing has been subjected to full-scale ASTM E119 fire testing at Underwriters Laboratories Inc. by the manufacturer.

C. Thickness Schedule: Provide schedule indicating material to be used, building elements to be protected with spray applied fireproofing, hourly rating and material thickness provided and appropriate references.

D. Test Data: Independent laboratory test results for fireproofing shall be submitted for the following performance criteria:

1. Bond Strength per ASTM E736
2. Compressive Strength per ASTM E761
3. Deflection per ASTM E759
4. Bond Impact per ASTM E760

5. Air Erosion per ASTM E859
6. Corrosion Resistance per ASTM E937
7. Abrasion Resistance (Test Method developed by City of San Francisco, Bureau of Building Inspection)
8. Impact Penetration (Test Method developed by City of San Francisco, Bureau of Building Inspection)
9. High Speed Air Erosion per ASTM E859
10. Surface Burning Characteristics per ASTM E84
11. Combustibility per ASTM E1354 Cone Calorimeter
12. Mold Resistance per ASTM G21

1.06 QUALITY ASSURANCE

A. Fireproofing work shall be performed by a firm acceptable to the cementitious fireproofing material manufacturer.
B. Products, execution, and fireproofing thicknesses shall conform to the applicable code requirements for the required fire-resistance ratings.
C. Contractor, fireproofing subcontractor and independent testing laboratory shall attend a pre-installation conference to review the substrates for acceptability, method of application, applied thicknesses, inspection procedures and other issues.

1.07 DELIVERY, STORAGE AND HANDLING

A. Material shall be delivered in original unopened packages, fully identified as to manufacturer, brand or other identifying data and bearing the proper Underwriters Laboratories Inc. labels for Surface Burning Characteristic and Fire Resistance Classification.
B. Material shall be stored off the ground, under cover, and in a dry location until ready for use. All bags that have been exposed to water before use shall be found unsuitable and discarded. Stock of material is to be rotated and used prior to its expiration date.

1.08 PROJECT/SITE CONDITIONS

A. A minimum air and substrate temperature of 4.4°C (40°F) shall be present before application of spray applied fireproofing. A minimum air and substrate temperature of 4.4°C (40°F) must be maintained during and for 24 hours after application of the spray applied fireproofing. Provide enclosures with heat to maintain temperature.
B. Provide ventilation in poorly ventilated areas to achieve a minimum total air exchange rate of 4 times per hour until the material is substantially dry.

1.09 SEQUENCING AND SCHEDULING

A. Sequence and coordinate application of cementitious fireproofing with work in other sections which would interfere with efficient fireproofing application.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURER

A. Fireproofing shall be cementitious mixture as manufactured by Grace Construction Products, W. R. Grace & Co.-Conn., or its processing distributors.

2.02 MATERIALS

A. Materials shall be Monokote® MK-6® factory-blended cementitious fireproofing.

NOTE TO SPECIFIER: Product Selection
Monokote MK-6/HY® and MK-6s afford the same level of fire protection at identical protection thicknesses. Both MK-6/HY and MK-6s meet or exceed all performance criteria listed in this specification. By simply specifying "Monokote MK-6," the fireproofing subcontractor can select the product that will provide the most efficient fire protection for the specific project conditions. Both MK-6/HY and MK-6s can be used on flat plate cellular decking. Where cellular decking is present, include a requirement in Section 2.03 (Accessories) for Spatterkote® SK-3.

B. Physical Performance Characteristics: Fireproofing material shall meet the following physical performance standards:
1. Dry Density: The field density shall be measured in accordance with ASTM Standard E605. Minimum average density shall be that required by the manufacturer, listed in the UL Fire Resistance Directory for each rating indicated, ICBO Evaluation Report, as required by the authority having jurisdiction, or minimum average 240 kg/m^3 (15 pcf), whichever is greater.
2. Deflection: Material shall not crack or delaminate from the surface to which it is applied when tested in accordance with ASTM E759.
3. Bond Impact: Material subject to impact tests in accordance with ASTM E760 shall not crack or delaminate from the surface to which it is applied.
4. Bond Strength: Fireproofing, when tested in accordance with ASTM E736, shall have a minimum average bond strength of 9.6 KPa (200 psf) and a minimum individual bond strength of 7.2 KPa (150 psf).
5. Air Erosion: Maximum allowable total weight loss of the fireproofing material shall be .05 g/m^2 (.005 g/ft^2) when tested in accordance with ASTM E859. Sample surface shall be "as applied" (not pre-purged) and the total reported weight loss shall be the total weight loss over a 24 hour period from the beginning of the test.
6. High Speed Air Erosion: Materials to be used in plenums or ducts shall exhibit no continued erosion after 4 hours at an air speed of 12.7 m/s (47 km/h) [2500 ft/min (29 mph)] when tested per ASTM E859.
7. Compressive Strength: The fireproofing shall not deform more than 10% when subjected to compressive forces of 57 KPa (1200 psf) when tested in accordance with ASTM E761.
8. Corrosion Resistance: Fireproofing applied to steel shall be tested in accordance with ASTM E937 and shall not promote corrosion of steel.
9. Abrasion Resistance: No more that 15 cm^3 shall be abraded or removed from the fireproofing substrate when tested in accordance with the test methods developed by the City of San Francisco, Bureau of Building Inspection.
10. Impact Penetration: The fireproofing material shall not show a loss of more than 6 cm^3 when subjected to impact penetration tests in accordance with the test methods developed by the City of San Francisco, Bureau of Building Inspection.

product data

carboline®

Southwest™ Fireproofing Type 5 GP™

fireproofing systems

Selection & Specification Data

Generic Type

Type 5GP is a non-combustible blend of gypsum and vermiculite. Factory blended, Type 5GP requires only the addition of water at the job site. Available also in MD (medium density).

Description

Type 5GP is a spray applied, single component, factory blended cementitious fireproofing. It is intended for application to structural steel columns and beams, steel decking and concrete surfaces. It is tested and certified for fire resistance ratings up to 4 hours.

Features

Applicator friendly – no alum required for increased coverage and easy clean-up.
Asbestos-free – complies with EPA and OSHA regulations.
Mineral Wool free – no airborne fibers.
Quality Manufactured – under strict Carboline quality standards and UL inspection.

Primers

Type 5GP neither promotes nor prevents corrosion. Fireproofing should not be considered part of the corrosion protection system. Primers are not required or recommended. For contour applications where steel is primed, bond strength must meet minimum UL criteria. Please contact the Fireproofing Division for further information.

Topcoats

Generally not required. In severely corrosive atmospheres, consult Carboline Technical Service for selection of coating most suitable for the operating environment.

Thickness

Recommended thickness depends on desired rating and assembly to be fireproofed. **Caution:** When applying Type 5GP to flexible roof systems it is required that Type DK adhesive is used. Also be sure that all roof work is completed and water tight before commencing installation of fire protection. Roof traffic shall be limited to maintenance only after fire protection is applied and cured.

Selection & Specification Data (cont.)

Limitations

Type 5GP is not intended for direct exposure to weather or excessive physical abuse. Contact your Carboline representative for alternate product recommendations.

Physical Data (Typical Values)

Type 5GP Color	Tan
Density, ASTM E-605	15 pcf (215 to 272 kg/m³)
Combustibility, ASTM E-136	Passed, noncombustible
Compressive Strength, ASTM E-761	16.25 lbf/in.² (112 kPa)
Cohesion / Adhesion, ASTM E-736	>200 lbf/ ft.²
Impact, ASTM E-760	Passed
Deflection, ASTM E-759	Passed
Corrosion of Steel, ASTM E-937	Passed
Air Erosion, ASTM E-859	0.00 g/ft. ² (0.00 g/m²)
Surface Burning, ASTM E-84	Flame Spread: 0, Smoke: 0
Fungi Resistance ASTM G-21	Passed, no growth
DOD Classification, ASTM-1024	Type I, NCR 50, class (a) category A

NOTE: These are laboratory results and not intended for specification purposes.

Acoustics, ASTM C-384 (applied to gypsum board)					
Min. Thickness, in. (mm)	Octave band αP values				NRC
	250	500	1000	2000	
0.3 in. (7.6)	0.21	0.29	0.30	0.84	0.37
0.45 in. (11.4)	0.29	0.37	0.53	0.70	0.51

NOTE: These are laboratory results and not intended for specification purposes

January 2006 replaces August 2005

product data

carboline®

PYROLITE® 15

fireproofing systems

Selection & Specification Data

Generic Type

Cementitious inorganic fireproofing formulation supplied as a single powder component that is mixed with clean, potable water prior to application.

Description

A single package powder component mixed with clean, potable water before application. PYROLITE 15 is designed to fireproof interior structural beams, joists, walls, roofs, decks, girders, columns, electrified floors and pre-cast concrete units.

Features

- Cementitious – Durable, remains in place during construction and beyond.
- Excellent film build – On all surfaces including columns, beams and decks.
- Applicator friendly – High film build, no alum required for increased coverage and easy clean-up.
- Asbestos-free – Complies with EPA and OSHA regulations.
- Mineral –Wool free – No airborne fibers.
- Alum and Chloride free – No special priming required.
- Styrene free – No toxic decomposition gasses.
- Economical – Maintains project on budget.
- Multiple U.L. Designs – Provides for design flexibility with over 40 U.L. designs.
- Quality Manufactured – Under strict Carboline quality standards.
- U.L. inspection service, consistent quality in every bag.
- Ready to Use – No site additives required.
- RETRO-LITE 15 (blue) is available for special order for asbestos abatement .

Finish

PYROLITE 15 is normally left as a sprayed finish. Material can be tamped down after spray application.

Primers

PYROLITE 15 is alum-free and neither promotes nor prevents corrosion. Fireproofing should not be considered part of the corrosion protection system. Primers are not required or recommended. For contour applications where steel is primed, bond strength must meet minimum U.L. criteria. Please contact the Fireproofing Division for further information.

Selection & Specification Data (cont.)

Topcoats

Generally not required. In severely corrosive atmospheres, consult Carboline Technical Service for selection of the coating most suitable for the operating environment.

Dry Film Thickness

Recommended thickness depends on desired rating and assembly to be fireproofed. See attached design details.

Temperature Resistance

Not recommended for use as a refractory cement or where operating temperatures exceed 200°F (93°C).

Physical Data (Typical Values)

Property	Method	Result/Value
Color	Normal	Non-Uniform Tan
Density(1) (Average)	ASTM E605(1)	18 lbs/ft^3 (0.25 g/cm^3)
Compressive Strength	ASTM E761	6019 PSF
Fungi Resistance	ASTM G21 ASTM D3273	Passes
Air Erosion	ASTM E859 ASTM E1042	<0.005 (g/ft^2)@ 24 hrs 0.000 (g/ft^2)@ 48 hrs
Bond Strength Unprimed Steel	ASTM E736	515 psf
Impact Resistance	ASTM E760	Pass
Deflection Resistance	ASTM E759	Pass
Flame Spread	ASTM E84	10
Smoke Development	ASTM E84	0
Corrosion	ASTM E937	0.00 gm/mm^2
Insulation "K" Factor	ASTM C177	0.73 (BTU in/hr ft^2-°F at 75°F)
Specific Heat		0.37 BTU/lb°F
Shrinkage		<0.5%
Coverage 45 lb. bag (2)		35 BFM
Shelf Life		1year

(1) Air dry at ambient conditions until constant weight. Do not force cure. Use ASTM E605 Positive Bead Displacement.

(2) Material losses during mixing and application will vary and must be taken into consideration when estimating job requirements.

Test reports and additional data available upon written request.

January 2005 replaces September 2004

0149

product data

carboline®

PYROLITE® 15 HIGH YIELD

fireproofing systems

Selection & Specification Data

Generic Type

Cementitious, inorganic fireproofing formulation supplied as a single powder component.

Description

A single package powder component mixed with clean, potable water before application. PYROLITE 15 HIGH YIELD is designed to fireproof interior structural beams, joists, walls, roofs, decks, electrified floors and pre-cast concrete units.

Features

- Cementitious – Durable, remains in place during construction and beyond.
- Excellent film build – On all surfaces including columns, beams and decks.
- Applicator friendly – High film build, no alum required for increased coverage and easy clean-up.
- Asbestos-free – Complies with EPA and OSHA regulations.
- Mineral Wool free – No airborne fibers.
- Alum and Chloride free – No special priming required.
- Styrene free – No toxic decomposition gasses.
- Economical – Maintains project on budget.
- Multiple U.L. Designs – Provides for design flexibility with over 40 U.L. designs.
- Quality Manufactured – Under strict Carboline quality standards with U.L. inspection service.

Finish

PYROLITE 15 HIGH YIELD is normally left as a sprayed finish. Material can be tamped down after spray application.

Primers

PYROLITE 15 HIGH YIELD is alum-free and neither promotes nor prevents corrosion. Fireproofing should not be considered part of the corrosion protection system. Primers are not normally recommended. For contour applications where steel is primed, bond strength must meet minimum U.L. criteria.

Note: For application to galvanized metal decks, it may be necessary to use mechanical attachments or apply Type DK-1 before the PYROLITE 15 HIGH YIELD. Consult the relevant UL Design for details or contact Carboline Technical Service for further information.

Selection & Specification Data (cont.)

Topcoats

Generally not required. In severely corrosive atmospheres, consult Carboline Technical Service for selection of the coating most suitable for the operating environment.

Dry Film Thickness

Recommended thickness depends on desired fire rating and type of assembly to be fireproofed.

Temperature Resistance

Not recommended for use as a refractory cement or where operating temperatures exceed 200°F (93°C) continuously.

Physical Data (Typical Values)

Property	Method	Result/Value
Color	Normal	Non-Uniform Tan
Density(1) (Min-Average)	ASTM E605(1)	15 lbs/ft^3 (.24 g/cm^3)
Compressive Strength	ASTM E761	2232 PSF
Fungi Resistance	ASTM G21 ASTM D3273	Passes
Bond Strength Unprimed Steel	ASTM E736	314 psf
Impact Resistance	ASTM E760	Pass
Deflection	ASTM E759	Pass
Flame Spread	ASTM E84	10
Smoke Development	ASTM E84	0
Corrosion	ASTM E937	0.00 gm/mm^2
Insulation "K" Factor	ASTM C177	0.73 (BTU in/hr ft^2-°F at 75°F)
Specific Heat		0.37 BTU/lb°F
Shrinkage		<0.5%
Coverage 45 lb. bag (2)		40 BFM
Shelf Life		18 months

(1) Air dry at ambient conditions until constant weight. Do not force cure. Use ASTM E605 Positive Bead displacement.

(2) Material losses during mixing and application will vary and must be taken into consideration when estimating job requirements.

Test reports and additional data available upon written request.

July 2004 replaces June 2002

0152

Spray-Applied Fire Resistive Material

BLAZE-SHIELD® HP

PRODUCT

CAFCO® BLAZE-SHIELD® HP is a portland cement based, medium density Spray-Applied Fire Resistive Material (SFRM) designed to provide protection for the structural steel frame in commercial high-rise construction. BLAZE-SHIELD HP's durable surface and cement based formula enable it to withstand indirect weather exposure conditions and limited physical abuse, thus allowing for application in parking garages, mechanical rooms and elevator shafts. BLAZE-SHIELD HP has been tested and is classified as "investigated for exterior use" by Underwriters Laboratories, Inc. With a simple one-step application process, BLAZE-SHIELD HP is able to provide complete passive fire protection for most construction conditions at reduced costs and in less time.

FIRE TEST PERFORMANCE

CAFCO BLAZE-SHIELD HP has been tested for fire endurance by Underwriters Laboratories, Inc. (UL) and Underwriters Laboratories of Canada (ULC) in accordance with ASTM E119 (UL 263, CAN/ULC-S101).

These tests have resulted in ratings of up to 4 hours for:

- Floor Assemblies
- Beams
- Joists
- Columns
- Roof Assemblies
- Walls and Partitions

BLAZE-SHIELD HP has also been tested in accordance with ASTM E84 (UL 723, CAN/ULC-S102) and has the following Surface Burning Characteristics:

- Flame Spread 0
- Smoke Developed 0

MAJOR SPECIFICATIONS

BLAZE-SHIELD HP complies with the requirements of the following specifications:

- General Services Administration (GSA): AIA/SC/GSA: 07811
- Department of the Navy NAVFACENGCOM Guide Specification NFGS 07810, Sprayed-On Fireproofing
- Veterans Administration (VA): H-08-1
- U.S. ARMY Corps of Engineers. CEGS-07811
- U.S. Environmental Protection Agency (EPA): Regulation 40
- Construction Specification Canada (CSC) TEK-AID

Table of Physical Properties

Characteristic	ASTM Method	Standard Performance*	Tested Performance**
Cohesion/Adhesion	E736	434 psf (20.8 kPa)	1,421 psf (68 kPa)
Deflection	E759	No Cracks or Delaminations	No Cracks or Delaminations
Bond Impact	E760	No Cracks or Delaminations	No Cracks or Delaminations
Compressive Strength	E761	7,344 psf (351 kPa)	7,980 psf (382 kPa)
Air Erosion Resistance	E859	Less Than 0.025 g/ft^2 (0.27 g/m^2)	0.000 g/ft^2 (0.000 g/m^2)
Density	E605	22 pcf (352 kg/m^3)	26.2 pcf (420 kg/m^3)
Combustibility	E136 (CAN4-S114)	Noncombustible	Noncombustible
Corrosion Resistance	E937	Does Not Promote Corrosion of Steel	Does Not Promote Corrosion of Steel

** Standard Performance based on General Services Administration: AIA/SC/GSA: 07811 except for density which is based on UL. Refer to UL design for density requirement.*

***Values represent independent laboratory tests under controlled conditions.*

ISOLATEK INTERNATIONAL

CAFCO® 400

Spray-Applied Fire Resistive Material

CAFCO® 400 is a portland cement based, Spray-Applied Fire Resistive Material (SFRM). It is a medium density wet mix product, designed to provide fire protection for structural steel in commercial and high-rise construction. The durable surface and portland cement based formulation of the product makes it well suited for application in areas which may be subjected to higher levels of abuse and elevated humidity levels. CAFCO 400 offers the best fire resistance performance per unit thickness of any commercial SFRM. This means less material is needed to achieve required fire ratings. With virtually no waste during installation, CAFCO 400 is cost-effective, clean and neat in appearance. CAFCO 400 has been tested for fire endurance by Underwriters Laboratories, Inc. (UL) and Underwriters Laboratories of Canada (ULC) in accordance with ASTM E119 (UL 263, CAN/ULC-S101).

Code Compliances

CAFCO 400 satisfies the requirements of the following building code organizations:

- **IBC - International Building Code**
- **SBCCI - Southern Building Code Congress International**
- **ICBO - International Conference of Building Officials**
- **BOCA - Building Officials and Code Administrators International, Inc.**
- **New York City - MEA**

Major Specifications

CAFCO 400 complies with the requirements of the following specifications:

- **General Services Administration (GSA): AIA/SC/GSA:07811**
- **Department of the Navy NAVFACENGCOM Guide Specification NFGS 07810, Sprayed-on Fireproofing**
- **Veterans Administration (VA): H-08-1**
- **U.S. ARMY Corps of Engineers. CEGS-07811**

Physical Performance

Characteristic	ASTM Method	Standard Performance*	Tested Performance**
Surface Burning	E84		Flame: 0 Smoke: 0
Density	E605	22 pcf(352 kg/m^3)	25 pcf (400 kg/m^3)
Cohesion/Adhesion	E736	434 psf(20.8 kPa)	2,850 psf (136.4 kPa)
Deflection	E759	No Cracks or Delaminations	No Cracks or Delaminations
Bond Impact	E760	No Cracks or Delaminations	No Cracks or Delaminations
Compressive Strength	E761	7,344 psf(351 kPa)	12,740 psf (610 kPa)
Air Erosion Resistance	E859	Less than 0.025 g/ft^2 (0.27 g/m^2)	0.000 g/ft^2 (0.000 g/m^2)
Corrosion Resistance	E937	Does Not Promote Corrosion of Steel	Does Not Promote Corrosion of Steel
Sound Absorption	C423		0.60 NRC 1/2" (13 mm) on deck and beam
Combustibility	E1354	No Flaming or Heat Release	No Flaming or Heat Release

* Standard performance based on General Services Administration AIA/SC/GSA/07811 except for density, which is based on UL. Refer to UL design for density requirement.

** Values represent independent laboratory tests under controlled conditions.

ISOLATEK INTERNATIONAL

Monokote® Z-106 and Z-106/HY®

DATA SUBMITTAL

Portland Cement Based, Medium Density, Cementitious Fireproofing

Product Information/ Description

Monokote® Z-106 and Z-106/HY® are portland cement based cementitious fireproofing designed to meet specific commercial and industrial fire protection requirements on structural steel members, floor/ceiling and roof/ceiling assemblies.

Monokote Z-106 and Z-106/HY are hard, moisture resistant and suitable for interior areas where resistance to moisture and abrasion is needed. Formulated for use with Grace's patented Injection System, Monokote Z-106/HY offers high-yield and improved application characteristics while providing resistance to repeated physical contact and/or high humidity.

Note: Monokote Z-106 and Z-106/HY afford the same level of fire protection and physical performance. Specifying both Monokote Z-106 and Z-106/HY allows alternatives to provide the most cost effective installation while assuring the specifier of the same high in-place performance characteristics.

Applications

Monokote Z-106 and Z-106/HY can be used for interior, exposed applications where abrasion, high humidity and damage resistance are desired such as:

- Special use areas in commercial buildings
- Transportation Terminals
- Convention Centers
- Stairwells
- Parking Garages
- Elevator Shafts
- Light Manufacturing Areas and Facilities
- Mechanical Rooms
- Gymnasiums and Pool Areas
- Correctional Facilities

Benefits

Monokote Z-106 and Z-106/HY offer the following advantages to the architect, owner, applicator and building occupant.

- Durability – 100% portland cement binder provides increased durability in interior environments where high-traffic resistance to physical abuse is required.
- Moisture Resistant – Provides excellent resistance to high-humidity and condensation.
- Quick Set – HY formulation allows use with Grace patented Injection System for high-yield and quick set.
- Applicator Friendly – Low pumping pressures allow use of small diameter hoses for increased maneuverability and greater pumping distances.
- Non-Toxic – The factory-mixed blend of common portland cement and inert materials require only the addition of water for mixing and application.

Delivery and Storage

a. All material to be used for fireproofing shall be delivered in original unopened packages bearing the name of the manufacturer, the brand and proper Underwriters' Laboratories Inc. labels for fire hazard and fire resistance classifications.

b. The material shall be kept dry until ready for use. Packages of material shall be kept off the ground, under cover and away from sweating walls and other damp surfaces. All bags that have been exposed to water before use shall be discarded. Stock of material is to be rotated and used before its expiration date.

Recommended Specifications — Medium Density Products

Physical Properties	Z-106	Z-106/HY	Test Method	Laboratory Test* Value
Minimum Density	350 kg/m^3 (22 pcf)	350 kg/m^3 (22 pcf)	ASTM E 605	See Note Below**
Minimum Bond Strength	94.5 kN/m^2 (2,000 psf)	94.5 kN/m^2 (2,000 psf)	ASTM E 736	Greater than 94.5 kN/m^2 (2,000 psf)
Minimum Compressive Strength @ 10% Deformation	680 kPa (100 psi)	680 kPa (100 psi)	ASTM E 761	Greater than 680 kPa (100 psi)
Deflection & Bond Impact	No Cracking No Delamination	No Cracking No Delamination	ASTM E 759 ASTM E 760	Pass Pass
Air Erosion	0.000 gr/m^2 (0.000 gr/sf)	0.000 gr/m^2 (0.000 gr/sf)	ASTM E 859	0.000 gr/m^2 (0.000 gr/sf)
Mold Inhibitor	Yes	Yes	ASTM G 21	Pass/No Growth
Standard Color	Gray	Gray		NA

* Actual laboratory tested values meet or exceed Grace's recommended value. Test reports are available on request from your Grace Sales Representative.

** ASTM test methods modified where required, for high density, high performance products

GRACE Construction Products

Monokote® Z-106/G

DATA SUBMITTAL

Gypsum Based, Medium Density Cementitious Fireproofing

Product Information/ Description

Monokote® Z-106/G is a gypsum based cementitious fireproofing designed to meet commercial and industrial fire protection requirements on structural steel members, floor/ceiling and roof/ceiling, and wall assemblies.

Z-106/G is designed to meet interior exposed product requirements where the superior durability and water resistance of portland cement based products is not required.

Applications

Z-106/G can be used for interior, exposed applications where light abrasion, and damage resistance are desired:

- Elevator Shafts
- High Bay Light Manufacturing Areas
- High Bay Mechanical Rooms

Benefits

Monokote Z-106/G offers the following advantages to the architect, owner, applicator and building occupant.

- Low Cost – Z-106/G is a low cost, medium density product for interior, dry environments subject to intermittent traffic and physical contact.
- Durability – Higher gypsum binder content improves damage resistance and helps maintain the fire resistance for the design life of the building.
- Quick Set – May be used with our patented Injection System for quick set and fast double on multiple pass applications.
- Applicator Friendly – Low pumping pressures allow use of small diameter hoses for increased maneuverability and greater pumping distances.
- Aesthetics – Can be spray applied to a fine texture finish.
- Non-Toxic – The factory-mixed blend of common gypsum, portland cement and inert materials requires only the addition of water for mixing and application.

Delivery and Storage

a. All material to be used for fireproofing shall be delivered in original unopened packages bearing the name of the manufacturer, the brand and proper Underwriters' Laboratories Inc. labels for fire hazard and fire resistance classifications.

b. The material shall be kept dry until ready for use. Packages of material shall be kept off the ground, under cover and away from sweating walls and other damp surfaces. All bags that have been exposed to water before use shall be discarded. Stock of material is to be rotated and used before its expiration date.

Steel and Concrete Surfaces

a. Prior to the application of Monokote Z-106/G Fireproofing, an inspection shall be made to determine that all steel and concrete surfaces are acceptable to receive fireproofing. The steel to be fireproofed shall be free of oil, grease, excess rolling compounds or lubricants, loose mill scale, excess rust,

Performance Characteristics

Physical Properties	Recommended Specifications	Test Methods/ Notes	Laboratory Tested* Value
Dry Density	min. 350 kg/m^3 (22 pcf)	ASTM E605	See Note Below**
Bond Strength	min. 23.6 kN/m^2 (500 psf)	ASTM E736	37.6 kN/m^2 (797 psf)
Compressive Strength @ 10% Deformation	min. 340 kPa (50 psi)	ASTM E761	413.6 kPa (60.8 psi)
Deflection & Bond Impact	No Cracking or Delamination	ASTM E759 ASTM E760	Pass Pass
Air Erosion	0.000 gr/m^2 (0.000 gr/sf)	ASTM E859	0.000 gr/m^2 (0.000 gr/sf)
Resistance to Mold Growth	No mold growth after 28 days	ASTM G21	Pass/No Growth

* Independent laboratory tested value. Report available on request.

** All in-place performance tests should be conducted at or below the minimum recommended specified density. Tests reported here were conducted at 350 kg/m^3 (22 pcf) or below.

GRACE Construction Products

product data

carboline®

fireproofing systems

Southwest™ Fireproofing Type 7 GP™

Selection & Specification Data

Generic Type

TYPE 7GP is a noncombustible blend of high quality Portland cement and asbestos-free vermiculite. TYPE 7GP requires only the addition of water at the job site.

Description

TYPE 7GP is a UL listed, spray applied single component, and factory blended cementitious fireproofing specifically formulated for interior high humidity areas. TYPE 7GP is resistant to damage and moisture and is an excellent choice for use in high traffic areas, mechanical rooms, swimming pool areas elevator shafts and parking garages.

Features

Damage Resistant and Permanent: TYPE 7GP is a medium density fireproofing. It is harder, stronger and more durable than general fireproofing. It is ideal for protection of structural steel under conditions too severe for general fireproofing where the potential for damage exists.

Moisture Resistant: TYPE 7GP is Portland cement based which provides it the ability to withstand the effects of high humidity that may cause other fireproofing products to deteriorate.

Durable: TYPE 7GP is medium density fireproofing. It is hard and durable. It will resist damage and abuse from conditions too severe for general fireproofing.

Economical: TYPE 7GP offers the lowest installed cost when compared to products with similar performance characteristics.

Primers

Type 7GP neither promotes nor prevents corrosion. Fireproofing should not be considered part of the corrosion protection system. Primers are not required or recommended. For contour applications where steel is primed, bond strength must meet minimum UL criteria. Please contact the Fireproofing Division for further information.

Selection & Specification Data (cont.)

Topcoats

Generally not required. In severely corrosive atmospheres, consult Carboline Technical Service for selection of coating most suitable for the operating environment.

Thickness

Recommended thickness depends on desired rating and assembly to be fireproofed. **Caution:** When applying Type 7GP to flexible roof systems it is required that Type DK adhesive is used. Also be sure that all roof work is completed and water tight before commencing installation of fire protection. Roof traffic shall be limited to maintenance only after the fire protection has completely cured.

Limitations

Not intended for permanent exterior exposure. Contact Carboline for alternate product recommendations.

Physical Data (Typical Values)

Type 7 GP Color	Gray
Density, ASTM E605	22 pcf (350 kg/m^3) nominal
Combustibility, ASTM E136	Passed, noncombustible
Compressive strength, ASTM E761	17136 psf (820 kPa)
Cohesion / Adhesion, ASTM E736	>2000 psf (>47.9 kPa)
Air erosion, ASTM E859	0.004 g/ft^2 after 24 hours at high speed (2000 ft/min)
Deflection, ASTM E759	Passed, no spalling or delaminating
Shore D Hardness, ASTM D2240	20.1
Impact, ASTM E760	Passed, no spalling or delaminating
Corrosion of Steel, ASTM E937	Passed
Surface burning characteristics, ASTM E84	FSI = 0, SD = 0
Fungi Resistance, ASTM G21	No growth

NOTE: These are laboratory results and not intended for specification purposes

January 2006 replaces August 2005

product data

carboline®

fireproofing systems

Southwest™ Fireproofing Type 5 MD™

Selection & Specification Data

Generic Type

Type 5MD is a non-combustible blend of gypsum and vermiculite. Factory blended, Type 5MD requires only the addition of water at the job site. Available also in GP (general purpose).

Description

Type 5MD is a spray applied, single component, factory blended cementitious fireproofing. It is intended for application to structural steel columns and beams, steel decking and concrete surfaces. It is tested and certified for fire resistance ratings up to 4 hours.

Features

Applicator friendly – no alum required for increased coverage and easy clean-up.
Asbestos-free – complies with EPA and OSHA regulations.
Mineral Wool free – no airborne fibers.
Quality Manufactured – under strict Carboline quality standards and UL inspection.
Ready To Use – No site additives required.

Primers

Type 5MD neither promotes nor prevents corrosion. Fireproofing should not be considered part of the corrosion protection system. Primers are not required or recommended. For contour applications where steel is primed, bond strength must meet minimum UL criteria. Please contact the Fireproofing Division for further information.

Topcoats

Generally not required. In severely corrosive atmospheres, consult Carboline Technical Service for selection of coating most suitable for the operating environment.

Selection & Specification Data (cont.)

Thickness

Recommended thickness depends on desired rating and assembly to be fireproofed. **Caution:** When applying Type 5MD to flexible roof systems it is required that Type DK adhesive is used. Also be sure that all roof work is completed and water tight before commencing installation of fire protection. Roof traffic shall be limited to maintenance only after fire protection is applied and cured.

Limitations

Not intended for direct exposure to weather. Contact Carboline for alternate product recommendations.

Physical Data (Typical Values)

Type 5MD Color	Gray
Density, ASTM E-605	22 to 26 pcf (352 to 417 kg/m³)
Combustibility, ASTM E-136	Passed, noncombustible
Compressive Strength, ASTM E-761	118 lbf/in.² (813 kPa)
Cohesion / Adhesion, ASTM E-736	>400 lbf/ft.²
Impact, ASTM E-760	Passed
Deflection, ASTM E-759	Passed
Corrosion of Steel, ASTM E-937	Passed
Air Erosion, ASTM E-859	0.00 g/ft. ² (0.00 g/m²)
Surface Burning, ASTM E-84	Flame Spread: 0, Smoke:0
Fungi Resistance ASTM G-21	Passed, no growth
DOD Classification, ASTM-1024	Type I, NCR 50, class (a) category A

NOTE: These are laboratory results and not intended for specification purposes.

Acoustics, ASTM C-384 (applied to gypsum board)					
Min. Thickness, in. (mm)	Octave band αP values				NRC
	250	500	1000	2000	
0.3 in. (7.6)	0.21	0.29	0.30	0.84	0.37
0.45 in. (11.4)	0.29	0.37	0.53	0.70	0.51

NOTE: These are laboratory results and not intended for specification purposes.

January 2006 replaces August 2005

product data

carboline®

PYROLITE® 22

fireproofing systems

Selection & Specification Data

Generic Type

Cementitious inorganic fireproofing formulation supplied as a single powder component that is mixed with clean, potable water prior to application.

Description

A single package powder component mixed with clean, potable water before application. Pyrolite 22 is designed to fireproof interior structural beams, joists, walls, roofs, decks, girders, columns, electrified floors and pre-cast concrete units.

Features

- Cementitious – Durable, remains in place during construction and beyond.
- Excellent film build – On all surfaces including columns, beams and decks.
- Applicator friendly – High film build, no alum required for increased coverage and easy clean-up.
- Asbestos-free – Complies with EPA and OSHA regulations.
- Mineral –Wool free – No airborne fibers.
- Alum and Chloride free – No special priming required.
- Styrene free – No toxic decomposition gasses.
- Economical – Maintains project on budget.
- Multiple U.L. Designs – Provides for design flexibility with over 40 U.L. designs.
- Quality Manufactured – Under strict Carboline quality standards.
- U.L. inspection service, consistent quality in every bag.
- Ready to Use – No site additives required.
- RETRO-LITE 22 (blue) is available for special order for asbestos abatement .

Finish

PYROLITE 22 is normally left as a sprayed finish. Material can be tamped down after spray application.

Primers

PYROLITE 22 is alum-free and neither promotes nor prevents corrosion. Fireproofing should not be considered part of the corrosion protection system. Primers are not required or recommended. For contour applications where steel is primed, bond strength must meet minimum U.L. criteria. Please contact the Fireproofing Division for further information.

Selection & Specification Data (cont.)

Topcoats

Generally not required. In severely corrosive atmospheres, consult Carboline Technical Service for selection of the coating most suitable for the operating environment.

Dry Film Thickness

Recommended thickness depends on desired rating and assembly to be fireproofed. See attached design details.

Temperature Resistance

Not recommended for use as a refractory cement or where operating temperatures exceed 200°F (93°C).

Physical Data (Typical Values)

Property	Method	Result/Value
Color	Normal	Non-Uniform Tan
Density(1) (Average)	ASTM E605(1)	22 lbs/ft^3 (.35 g/cm^3)
Compressive Strength	ASTM E761	6019 PSF
Air Erosion	ASTM E859 ASTM E1042	<0.025 (g/ft^2)@ 24 hrs 0.003 (g/ft^2)@ 48 hrs
Fungi Resistance	ASTM G21 ASTM D3273	Passes
Bond Strength Unprimed Steel	ASTM E736	653 psf
Impact Resistance	ASTM E760	Pass
Deflection Resistance	ASTM E759	Pass
Flame Spread	ASTM E84	10
Smoke Development	ASTM E84	0
Corrosion	ASTM E937	0.00 gm/mm^2
Insulation "K" Factor	ASTM C177	0.76 (BTU in/hr ft^2-°F at 75°F)
Specific Heat		0.37 BTU/lb°F
Shrinkage		<0.5%
Coverage 43 lb. bag (2)		28.6 BFM
Shelf Life		1year

(1) Air dry at ambient conditions until constant weight. Do not force cure. Use ASTM E605 Positive Bead Displacement.

(2) Material losses during mixing and application will vary and must be taken into consideration when estimating job requirements.

Test reports and additional data available upon written request.

January 2006 replaces September 2004

0147

product data

carboline®

PYROCRETE® 239

fireproofing systems

Selection & Specification Data

Generic Type

Cementitious inorganic fireproofing formulation.

Description

Single powder component mixed with clean, potable water before it is used in application. Excellent for fireproofing and acoustic combinations. Recommended uses for the fire protection of structural steel, wood, bulkheads, and upgrading the fire resistance of any existing concrete. Recommended areas of application are pharmaceutical facilities, pulp and paper mills, nuclear and conventional power plants, factories, warehouses, institutional, stadiums, acoustical, and convention buildings.

Features

- Easily applied by spray or trowel
- Excellent acoustic and fireproofing in one application.
- Excellent physical properties – hard, durable
- Nonflammable – during or after application
- Asbestos free – complies with EPA and OSHA regulations
- Chloride free – no special priming required
- Non-friable – high impact strength
- Single package – mixed with clean, potable water at the job site
- Investigated for exterior use by Underwriters Laboratories, Inc.
- Quality Manufactured – under strict Carboline quality standards.
- U.L. factory inspection service

Finish

If a smooth finish is required this may be done by trowel, roller or brush typically within 1 to 2 hours after final application of PYROCRETE 239.

Primers

PYROCRETE 239 neither promotes nor prevents corrosion. The fireproofing should not be considered as part of the corrosion protection system. For applications where primers are required, use an appropriate alkaline resistant primer. For contour applications where primers are recommended, PYROCRETE 239 must meet minimum U.L. bond strength criteria.

Selection & Specification Data (cont.)

Topcoats

Generally not required. In severely corrosive atmospheres, consult Carboline Technical Service for selection of the coating most suitable for the operating environment.

Dry Film Thickness

Recommended thickness depends on desired rating and assembly to be fireproofed. See attached design details.

Temperature Resistance

Not recommended for use a refractory cement where operating temperatures exceed 200°F (93°C).

Physical Data (Typical Values)

Property	Method	Result/Value
Color	Non-Uniform	Speckled Gray
Density (Average)	ASTM E605(1)	28 lbs./ft^3
Durometer Hardness(Shore D)	ASTM D2240	15
Compressive Strength	ASTM E761	105 psi
Acoustical	ASTM C423 ASTM E795	See Acoustic Table
Air Erosion	ASTM E859	0.0215 g/ft^2 @ 24 hrs
Fungi Resistance	ASTM G21 ASTM D3273	Passes
Bond Strength Unprimed Steel	ASTM E736	550 psf
Bond Impact	ASTM E760	Pass
Impact Resistance	ASTM D2794	Indents at 20 foot pounds
Deflection	ASTM E759	Pass
Ave. Flexural Strength	ASTM D790	190.5 psi
Flame Spread	ASTM E84	2
Smoke Development	ASTM E84	2.5
Maximum Strain	ASTM D790	0.00225 (in/in)
Corrosion	ASTM E937	0.00 gm/mm^2
Insulation “K” Factor	ASTM C177	0.56 (BTU in/hr ft^2°F @ 75°F)
Specific Heat		0.36 BTU/lb°F
Shrinkage		<0.5%
Coverage 50 lb. bag(2)		29.6 Bd.Ft.
Shelf Life		Two years
1) Air dry at ambient conditions until constant weight. Do not force dry. Use ASTM E605 Positive Bead Displacement.		
2) Material losses during mixing and application will vary and must be taken into consideration when estimating the job requirements.		

Test reports and additional data available upon written request.

January 2006 replaces July 2004

0145

FENDOLITE® M-II

Spray-Applied Fire Resistive Material

CAFCO® FENDOLITE® M-II is a single package, factory controlled Spray-Applied Fire Resistive Material (SFRM) based on vermiculite and portland cement. It is specifically developed for spray-application to structural columns and beams in exterior environments and interior situations where higher levels of abrasion resistance and hardness are necessary. FENDOLITE TG has been developed for application by trowel, in areas where spraying is impractical or not permitted. Although FENDOLITE is 1/3 the density of concrete, thus significantly reducing dead load, it is also highly durable and resistant to cracking or spalling under mechanical impact. FENDOLITE may be used in either boxed or contour designs and the finish may be spray-textured or troweled smooth. FENDOLITE M-II and TG are classified by Underwriters Laboratories for up to 4 hours protection.

Major Specifications

CAFCO FENDOLITE M-II complies with the requirements of the following specifications:

- General Services Administration (GSA): AIA/SC/GSA:07811
- Department of the Navy NAVFACENGCOM Guide Specification NFGS 07810, Sprayed-on Fireproofing
- Veterans Administration (VA): H-08-1
- U.S. ARMY Corps of Engineers. CEGS-07811

Physical Properties

CHARACTERISTIC	ASTM Method	Standard Performance*	Tested Performance**
Surface Burning	E84 (UL723,CAN/ULC-S102)		Flame Spread 0 Smoke Developed 0
Density	E605	35-44 pcf(560-704 kg/m^3)	45.7 pcf (732 kg/m^3)
Cohesion/Adhesion	E736	1,000 psf(47.9 kPa)	11,870 psf (568 kPa)
Deflection	E759	No cracks or delaminations	No cracks or delaminations
Bond Impact	E760	No cracks or delaminations	No cracks or delaminations
Compressive Strength	E761	43,200 psf(2,068 kPa)	78,912 psf (3,778 kPa)
Air Erosion Resistance	E859	Less than 0.025g/ft^2 (0.27 g/m^2)	0.000g/ft^2 (0.000 g/m^2)
Corrosion Resistance	E937	Does Not Promote Corrosion	Does Not Promote Corrosion
Thermal Conductivity	C177		1.32 BTU in/hr ft^2 °F @ 75°F (0.19 w/mK @ 24°C)
Combustibility	E136 (CAN4-S114)	Noncombustible	Noncombustible

*Standard performance based on General Services Administration AIA/SC/GSA/07811 except for density, which is based on UL. Refer to UL design for density requirement.

** Values represent independent laboratory tests under controlled conditions.

ISOLATEK INTERNATIONAL

Monokote® Z-146

DATA SUBMITTAL

High Density, Cementitious Fireproofing

Product Information/ Description

Monokote® Z-146 High Density Cementitious Fireproofing has been developed by Grace Construction Products to meet specialty, commercial and industrial fireproofing requirements. Z-146 is a portland cement-based, factory-mixed material requiring only the addition of water on the job for application. It is spray applied directly to structural steel (beams and columns), providing up to 4 hours of fire resistance. Its physical characteristics are excellent for areas exposed to environmental or climatic conditions. Z-146 may be used in areas where high durability is required such as parking garages. This product is ideal for use in clean room environments where issues such as particle emissions and off gassing are critical to the interior environment within the building.

Features

Z-146 offers the following advantages to architects, engineers, and applicators:

- Factory Pre-Mixed – Ready to use. No job site proportioning required. Simply add water in a standard paddle-type plaster mixer and apply with conventional plastering equipment.
- Non-Toxic – The factory-mixed blend of common portland cement and other inert materials requires only the addition of water for mixing and application.
- Attractive Finishes – Z-146 may be sprayed and/or trowelled to various textures.
- Versatility – Z-146 has been applied using equipment ranging from rotor-stator pumps to large hydraulic pumps. Please refer to your local Grace sales representative for details.
- Moisture Resistant – The portland cement base affords excellent fire protection characteristics in areas subjected to high humidity.
- Durable – Hardness and durability help resist accidental physical damage.
- Weatherable – Able to withstand freeze/thaw, wind, rain and other climatic conditions.

Applications

Z-146 may be used in parking garages, exterior exposure, mechanical rooms and other areas where a highly durable product is required.

Delivery and Storage

a. All material to be used for fireproofing should be delivered in original unopened packages bearing the name of the manufacturer, the brand and proper Underwriters' Laboratories Inc. labels for fire hazard and fire resistance classifications.

Performance Characteristics

Physical Properties	Recommended Specifications	Test Method/Notes**	Laboratory Tested* Value
Dry Density	min. 640 kg/m^3 (40 pcf)	ASTM E605	See note below***
Bond Strength	min. 478 kN/m^2 (10,000 psf)	ASTM E736	609 kN/m^2 (12,765 psf)
Compressive Strength @ 10% Deformation	3.79 MPa (550 psi)	ASTM E761	4.08 MPa (592 psi)
Hardness	40	ASTM D2240	41
Yield	—	Theoretical maximum	1.55 m^2 at 25 mm (16.7 board feet) per bag
Color	—	Natural concrete gray	
Volatile Organic Content (off gassing) at 50°C organic compounds C6-C28	Less than 1 PPMW (part per million by weight)	Dynamic headspace (Thermal desorbtion gas chromatography – mass spectrometry)	Less than 1 PPMW (Below detectable limits)
Leachable Ammonia	Less than 50 PPB (50 parts per billion, 50 nanograms/mg)	Leachable ion by ion chromatography	Less than 50 PPB (Below detectable limits)

* Independent laboratory tested value. Report available upon request.

** ASTM International test methods modified for Bond Strength and Compressive Strength, where required, for high density, high performance products.

*** All in-place performance tests should be conducted at or below the minimum recommended specification density. Tests reported here were conducted at 632 kg/m^3 (39.4 pcf).

GRACE Construction Products

product data

carboline®

Southwest™ Fireproofing Type 7 HD™

fireproofing systems

Selection & Specification Data

Generic Type

TYPE 7HD is a noncombustible blend of high quality Portland cement and vermiculite.

Description

Basic Use: TYPE 7HD is a spray applied factory blended cementitious fireproofing. TYPE 7HD is categorized as high density with excellent hardness and durability to help resist accidental physical damage.

Features

Damage Resistant and Permanent: TYPE 7HD is a higher density, harder and stronger product than general fireproofing. It is ideal for protection of structural steel where the potential for damage from abuse and severe conditions exists.

Moisture Resistant: TYPE 7HD is Portland cement based which provides the ability to withstand the effects of weather exposure such as wind, rain and high humidity that may cause other fireproofing products to deteriorate.

Economical: TYPE 7HD offers the lowest installed cost per unit area when compared to other products with similar density and/or performance characteristics.

Non-Toxic: TYPE 7HD is comprised of common Portland cement and other inert materials requiring only the addition of water.

Versatility: The broad range of fire test designs offers maximum design flexibility to the architect and engineer.

Primers

Type 7HD neither promotes nor prevents corrosion. Fireproofing should not be considered part of the corrosion protection system. Primers are not required or recommended. For contour applications where steel is primed, bond strength must meet minimum UL criteria. Please contact the Fireproofing Division for further information.

Selection & Specification Data (cont.)

Topcoats

Generally not required. In severely corrosive atmospheres, consult Carboline Technical Service for selection of coating most suitable for the operating environment.

Thickness

Recommended thickness depends on desired rating and assembly to be fireproofed.

Physical Data (Typical Values)

Type 7 HD Color	Gray
Density, ASTM E605	40 pcf (636 kg/m^3) nominal
Combustibility, ASTM E136	Passed, noncombustible
Compressive strength, ASTM E761	350 psi (2411 kPa) nominal
Cohesion / Adhesion, ASTM E736	>6000 psf (>287 kPa)
Air erosion, ASTM E859	0.00 g/ft^2
Deflection, ASTM E759	Passed, no spalling or delaminating
Impact, ASTM E760	Passed, no spalling or delaminating
Shore D Hardness, ASTM D2240	40
Corrosion of Steel, ASTM E937	Passed
Surface burning characteristics, ASTM E84	FSI = 0, SD = 10
Fungi Resistance, ASTM G21	No growth

NOTE: These are laboratory results and not intended for specification purposes.

January 2006 replaces August 2005

product data carboline® **Pyrocrete®40**

fireproofing systems

Selection & Specification Data

Generic Type

Cementitious inorganic polymer fireproofing formulation.

Description

Single powder component mixed with clean, potable water before it is used in application. Recommended uses for the fire protection of structural steel, bulkheads, and upgrading the fire resistance of any existing concrete. Recommended areas of application are pharmaceutical facilities, power plants, penthouses, schools & hospitals, abatement spray and air plenums.

Features

- Easily applied by spray or trowel
- Lightweight – 1/3 the weight of concrete for equal fire protection
- Most Economical – Offers a 40 lb/ft^3 density.
- Coverage – outstanding coverage at 18.3 board feet.
- Excellent physical properties – hard, durable
- Nonflammable – during or after application
- Asbestos free – complies with EPA and OSHA regulations
- Chloride free – no special priming required
- Non-friable – high impact strength
- Single package – mixed with clean, potable water at the job site
- UL 1709 Ratings for Hydrocarbon type fires.
- Investigated for exterior use by Underwriters Laboratories, Inc.
- Quality Manufactured – under strict Carboline quality standards.
- U.L. factory inspection service

Finish

If required, may be done by trowel, roller or brush typically within 1 – 2 hours after application of PYROCRETE 40.

Primers

PYROCRETE 40 neither promotes nor prevents corrosion. The fireproofing should not be considered as part of the corrosion protection system. For applications where primers are required, use an appropriate alkaline resistant primer. For contour applications where primers are recommended, PYROCRETE 40 must meet minimum U.L. bond strength criteria.

Selection & Specification Data (cont.)

Topcoats

Generally not required. In severely corrosive atmospheres, consult Carboline Technical Service for selection of the coating most suitable for the operating environment.

Dry Film Thickness

Recommended thickness depends on desired rating and assembly to be fireproofed. See attached design details.

Temperature Resistance

Not recommended for use a refractory cement or where operating temperatures exceed 200°F (93°C).

Physical Data (Typical Values)

Color	Non-Uniform	Speckled Gray
Density (Average)	ASTM E 605(1)	40 lbs./ft^3
Durometer Hardness(Shore D)	ASTM D 2240	40
Compressive Strength	ASTM E 761	594 psi
Coefficient of Thermal Expansion		5.8 X10 ^{6} (inch / inch °F)
Combustibility	ASTM E 136	Non-Combustible
Bond Strength	ASTM E 736	1317 psf
Bond Impact	ASTM E 760	Pass
Impact Resistance	ASTM D2794	Indents at 20 foot pounds
Deflection	ASTM E 759	Pass
Average Flexural	ASTM D 790	136 psi
Maximum Strain	ASTM D 790	0.0094 in/in
Flame Spread	ASTM E 84	0
Smoke Development	ASTM E 84	10
Corrosion	ASTM E 937	0.00 gm/mm^2
Insulation “K” Factor	ASTM C177	1.06(BTU in/hr ft^2-F)
Specific Heat		.36 BTU/LB/°F
Shrinkage		<0.5%
Coverage 50 lb. bag (2)		18.3 Bd.Ft.
Shelf Life		Two years
1) Air dry at ambient conditions until constant weight. Do not force dry. Use ASTM E 605 Positive Bead Displacement.		
2) Material losses during mixing and application will vary and must be taken into consideration when estimating the job requirements.		

Test reports and additional data available upon written request.

July 2004 replaces November 1999

0130

product data

carboline®

Pyrocrete® 240 High Yield

fireproofing systems

Selection & Specification Data

Generic Type

Cementitious inorganic fireproofing formulation.

Description

Single powder component mixed with clean, potable water before it is used in application. Recommended uses for the fire protection of structural steel, bulkheads, and upgrading the fire resistance of any existing concrete. Recommended areas of application are refineries, petrochemical, pharmaceutical facilities, pulp and paper mills, offshore platforms, nuclear and conventional power plants, factories, warehouses, institutional and biomedical facilities.

Features

- Easily applied by spray or trowel
- Lightweight – 1/3 the weight of concrete for equal fire protection
- Excellent physical properties – hard, durable
- Nonflammable – during or after application
- Asbestos free – complies with EPA and OSHA regulations
- Chloride free – no special priming required
- Non-friable – high impact strength
- Single package – mixed with clean, potable water at the job site
- Investigated for exterior use by Underwriters Laboratories, Inc.
- Quality Manufactured – under strict Carboline quality standards
- UL factory inspection service

Finish

If a smooth finish is required this may be done by trowel, roller or brush typically within 1 to 2 hours after final application of Pyrocrete 240 High Yield.

Primers

Pyrocrete 240 High Yield neither promotes nor prevents corrosion. The fireproofing should not be considered as part of the corrosion protection system. For applications where primers are required, use an appropriate alkaline resistant primer. For contour applications where primers are recommended, Pyrocrete 240 High Yield must meet minimum UL bond strength criteria.

Selection & Specification Data (cont.)

Topcoats

Generally not required. In severely corrosive atmospheres, consult Carboline Technical Service for selection of the coating most suitable for the operating environment.

Dry Film Thickness

Recommended thickness depends on desired rating and assembly to be fireproofed. See attached design details.

Temperature Resistance

Not recommended for use as a refractory cement where operating temperatures exceed 200°F (93°C).

Physical Data (Typical Values)

Color	Non-Uniform	Speckled Gray
Density (Average)	ASTM E 605(1)	47 lbs/ft^3
Durometer Hardness (Shore D)	ASTM D2240	55
Compressive Strength	ASTM E761	836 psi
Coefficient of Thermal Expansion		4.5 X10 $^{-6}$ (inch / inch °F)
Bond Strength	ASTM E736	2097 psf
Bond Impact	ASTM E760	Pass
Impact Resistance	ASTM D2794	Indents at 20 foot pounds
Deflection	ASTM E759	Pass
Flame Spread	ASTM E84	0
Smoke Development	ASTM E84	0
Corrosion	ASTM E937	0.00 gm/mm^2
Insulation "K" Factor	ASTM C177	1.09 (BTU in/hr ft^2-F)
Specific Heat		0.36 BTU/lb/°F
Shrinkage		<0.5%
Coverage 50 lb. bag (2)		15.4 Bd.Ft.
Shelf Life		Two years
(1) Air dry at ambient conditions until constant weight. Do not force dry. Use ASTM E605 Positive Bead Displacement.		
(2) Material losses during mixing and application will vary and must be taken into consideration when estimating job requirements.		

Test reports and additional data available upon written request.

March 2003 replaces May 2001

0150

product data

carboline®

Pyrocrete® 241

fireproofing systems

Selection & Specification Data

Generic Type

Cementitious inorganic fireproofing formulation.

Description

Single powder component mixed with clean, potable water before application. Recommended uses for the fire protection of structural steel, bulkheads, and upgrading the fire resistance of existing concrete. Recommended areas of application are refineries, petrochemical, pharmaceutical facilities, pulp and paper mills, offshore platforms, nuclear and conventional power plants, factories, warehouses, institutional and biomedical facilities.

Features

- Easily applied by spray or trowel
- Lightweight – one-third the weight of concrete for equal fire protection
- Excellent physical properties – hard, durable
- Nonflammable – during or after application
- Asbestos-free – complies with EPA and OSHA regulations
- Chloride and sulfide free – no special priming required
- Non-friable – high impact strength
- Single package – mixed with clean, potable water at the job site
- Investigated for exterior use by Underwriters Laboratories, Inc
- Quality Manufactured – under strict Carboline quality standards
- UL factory inspection service
- Unique crack-free formulation

Finish

If a smooth finish is required, this may be done by trowel, roller or brush typically within 1 to 2 hours after final application of Pyrocrete 241.

Primers

Pyrocrete 241 neither promotes nor prevents corrosion. The fireproofing should not be considered as part of the corrosion protection system. For applications where primers are required, use an appropriate alkaline resistant primer. U.L. Primer requirements for contour applications where primers are recommended, Pyrocrete 241 must meet minimum U.L. bond strength criteria. Contact the Carboline Fireproofing Division for other approved primers.

Selection & Specification Data (cont.)

Topcoats

Generally not required. In severely corrosive atmospheres, consult Carboline Technical Service for selection of the coating most suitable for the operating environment.

Dry Film Thickness

Recommended thickness depends on desired rating and assembly to be fireproofed. See attached design details.

Temperature Resistance

Not recommended for use as a refractory cement or where operating temperatures exceed 200°F (93°C).

Physical Data (Typical Values)

Color	Non-Uniform	Speckled Gray
Density (Average)	ASTM E 605(1)	55 lbs/ft^3
Durometer Hardness (Shore D)	ASTM D 2240	55
Compressive Strength	ASTM E 761	817 psi
Coefficient of Thermal Expansion		4.5 X10 $^{-6}$ (inch / inch °F)
Bond Strength Unprimed Steel	ASTM E 736	>1146 psf
Bond Impact	ASTM E 760	Pass
Impact Resistance	ASTM D 2794	Indents at 20 foot pounds
Deflection	ASTM E 759	Pass
Average Flexural Strength	ASTM D 790	502 psi
Flame Spread	ASTM E 84	0
Smoke Development	ASTM E 84	0
Maximum Strain	ASTM D 790	0.0015 in/in
Corrosion	ASTM E 937	0.00 gm/mm^2
Insulation "K" Factor	ASTM C 177	0.87 (BTU in / hr ft^2-°F at 75°F)
Specific Heat		0.36 BTU/lb°F
Shrinkage		<0.5%
Coverage 50 lb. bag (2)		14.3 Bd.Ft.
Shelf Life		Two years

(1) Air dry at ambient conditions until constant weight. Do not force dry. Use ASTM E 605 Positive Bead Displacement.

(2) Material losses during mixing and application will vary and must be taken into consideration when estimating job requirements.

Test reports and additional data available upon written request.

July 2004 replaces March 2003