

ALLRISK ENGINEERING

Fireproofing

Structural Steel Supports

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ABSTRACT

Structural steel supports are subject to rapid heating and failure during fires. The installation of fireproofing coatings on these supports retards heat transfer which delays the failure of the steel supports allowing time for emergency measures to be taken. The intention of this paper is to educate a reader on the standards used to select and rate fireproofing coating options available for structural steel supports.

INTRODUCTION

WHAT IS FIREPROOFING?

Fireproofing is a type of coating, board, or wrap that can be applied to materials or objects requiring protection from a fire. Fireproofing does not prevent or limit fires. The purpose of fireproofing is to reduce heat transfer from a fire such that the material or object being protected will function properly during a fire. For the purposes of this paper, the materials/objects in question are the load bearing structural steel supports used to build hydrocarbon processing facilities. The fireproofing materials being evaluated are coatings applied directly to the surface of the steel.

TYPES OF FIREPROOFING

There are three types of fireproofing coatings typically used to protect structural steel supports: concrete, lightweight cementitious systems, and intumescent coatings.

Concrete is the most common and oldest type of fireproofing. Light weight cementitious systems are similar to concrete in many aspects; however, they are usually applied to the steel in a different manner and are by definition of a lighter weight than concrete. Intumescent coatings are applied in a paint-like manner. These coatings weigh much less than the other two methods and are the latest technology for fireproofing steel supports.

FIREPROOFING STANDARDS

Fireproofing standards can be separated into two basic Groups: Cellulosic and Hydrocarbon. Cellulosic fire proofing standards apply to the fire hazards associated with building construction materials. Hydrocarbon fire proofing standards apply to the fire hazards associated with flammable liquids. A subset of the Hydrocarbon Group is the “jet fire”. Jet fires arise from releases of gaseous, flashing liquid (two phase) and pure liquid inventories of hydrocarbons through an orifice that ignite. Jet fires represent a significant element of the risk associated with major accidents on offshore installations. Direct flame impingement by a jet fire results in extraordinarily high levels of heat transfer in a much focused manner. Different standards are issued by organizations, private and public, in different countries.

USA

STANDARDS ORGANIZATIONS

ASTM International, American Society for Testing and Materials, is an organization established to set standards to be recognized as testing methods for anything concerning industrial materials or product.

Underwriter Laboratories (UL) is an independent organization that develops standards and test procedures for products, materials, components, assemblies, tools, and equipment.

ANSI, American National Standards Institute, is a private non-profit organization that oversees the development of voluntary consensus standards for products, services processes, systems, and personnel in the United States.

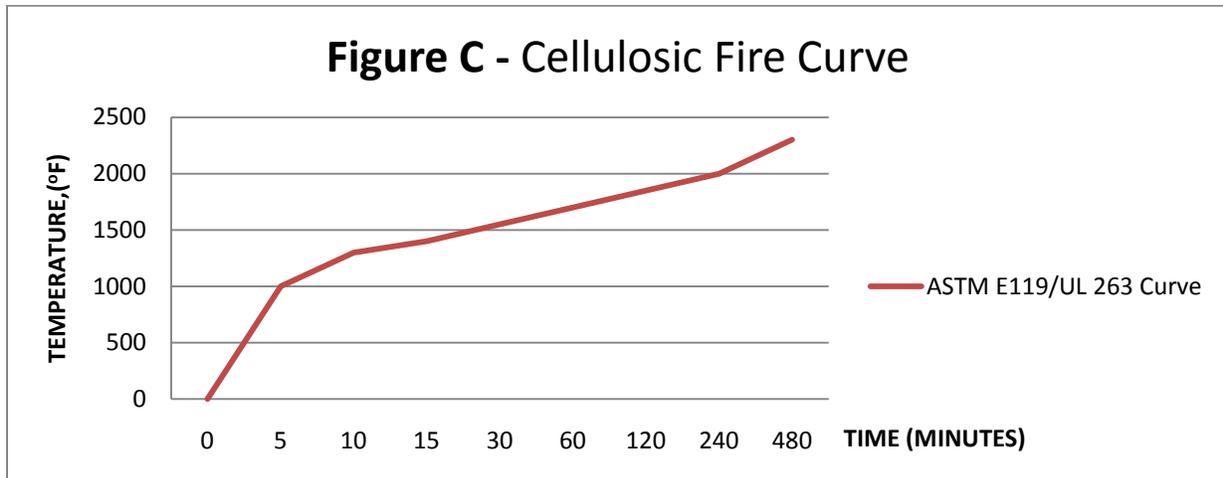
NFPA, National Fire Protection Association, is a US organization charged with creating, and maintaining minimum standards and requirements for fire prevention and suppression activities, training, and equipment, as well as other life-safety codes and standards.

The ABS (American Bureau of Shipping) is an organization established to promote the safety and well being of offshore facilities. If a product is ABS acknowledged it can be assumed the product can withstand marine conditions.

CELLULOSIC FIREPROOFING TESTING

ASTM E119 & UL 263 are very similar tests.

They are the primary test used for evaluating building construction materials. In these tests, the test furnace temperature reaches 1000°F within 5 minutes and reaches 2000°F in 4 hours (Shown on Figure C). This fire scenario resembles a slow rising temperature fire typically found in a cellulosic fire. Structural steel vertical columns and restrained beams are tested in loaded and unloaded conditions. The temperature of the steel beams and columns are measured at multiple points. The steel members “fail” when their average temperature exceeds 1000° F or they reach a temperature of 1200°F at any given point. At these temperatures steel loses approximately 50% of its strength.



NFPA 251, “Standard Methods of Tests of Fire Resistance of Building Construction & Materials”, is another widely used test. It requires the use of a hose stream test per ASTM E2226, “Standard Practice for Application of Hose Streams.” This test uses an ASTM E119/UL 263 fire curve exposure and introduces a post-fire test for hose stream impingement to test the integrity of the exposed fireproofing material. A hose impingement test serves as additional testing under other ASTM and UL standards as well.

HYDROCARBON POOL FIRE TESTING

ASTM E1529 is the original standard test method for determining effects of large hydrocarbon pool fires on structural members and wall assemblies. This test method is intended to provide a basis for evaluating a time period during which a beam, girder, column, or non bearing walls will continue to perform its intended function when subjected to a hydrocarbon pool fire exposure.

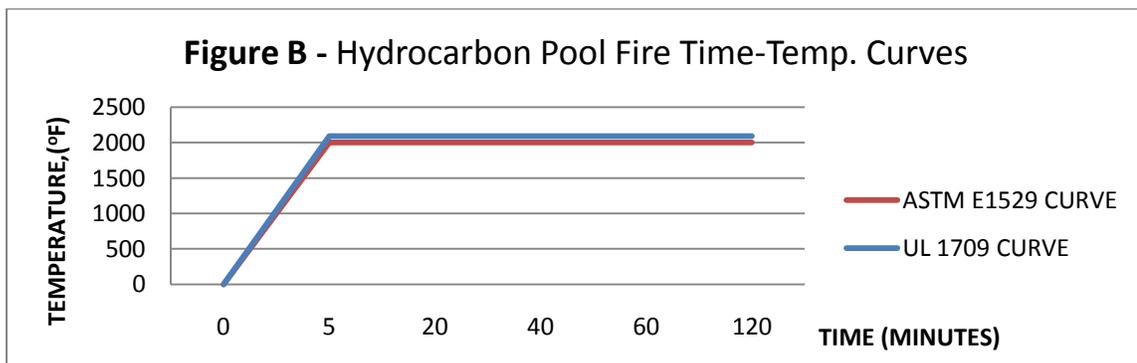
The fire test for structural members consists of a fire reaching 2000°F within 5 minutes with a high heat flux (50,000 Btu/ft²-hr) as shown on Figure B. Steel columns and horizontal steel beams subjected to these test conditions for both loaded and unloaded conditions. A minimum of 4 thermocouples are used on a steel specimen to measure temperature rise. The fire is exposed to all sides of the steel specimen. The steel member temperature must not exceed an average of 1000°F or reach 1200°F at any point for the fireproofing to achieve a rating for a set period of time. This time is generally measured in 1, 2, 3 or 4 hour periods.

UL 1709, “Rapid Rise Fire Tests of Protection Materials for Structural Steel” is the hydrocarbon fireproofing testing standard usually referenced and recognized in North America. The UL 1709 test fire reaches a temperature of 2089°F in approximately 5 minutes and remains this temperature the rest of the testing period. This demonstrates a ‘rapid’ rising temperature curve as shown in Figure B.

The UL 1709 fire test is similar to the ASTM E1529 fire test. UL 1709 has a higher heat flux (65,000 Btu/ft²-hr). This translates into a 30% higher heat load on the tested assemblies. UL 1709 also has a higher maximum temperature. During testing steel columns and horizontal beams, both loaded and unloaded, are exposed to this heat flux. The limiting temperature of steel is set in (Table A).

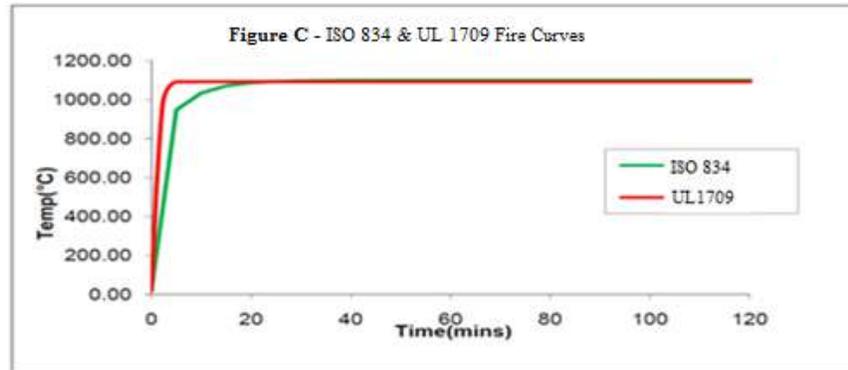
Table A - Critical Temperatures for Various Types of Steel	
Steel	Temperature (°F)
Columns	1000
Beams	1100
Open Web Steel Joists	1100
Reinforcing Steel	1100
Prestressing Steel	800

When steel reaches these critical temperatures the testing is stopped. The time is then recorded. The fireproofing systems covered under UL 1709 are also subjected to environmental tests, which include accelerated aging, high humidity, salt spray exposure, the cycling effects of water/freezing temperatures/dryness, and to exposure to air containing carbon dioxide and sulfur dioxide. Post fire loading and unloading testing is also done as well as pre-fire testing of the coatings bonding strength per ASTM E736 “Standard test method for cohesion/adhesion of spray fire resistive materials applied to structural members.”



INTERNATIONAL

The European community recognizes ISO 834 as a standard. This test is considered to test for hydrocarbon fire exposure (shown on Figure C). ISO 834 has many common features with UL 1709 including the requirement for post fire exposure testing. ISO 834, in contrast to UL 1709 is done using round O-profile structures instead of I-profile structures. When choosing fireproof coatings, ISO 834 would be recognized as more suitable for use on rounded structural columns.



UK

The UK has a set fire protection standards known as BS 476. BS 476 consists of many sections which each section containing several parts. Hydrocarbon based fire hazards are covered in BS 476 - Parts 20 and 21.

Lloyd's Register of Shipping is another standard used within the UK. This is a standard for coatings on marine vessel bulkheads. Products will be labeled as approved by Lloyd's Register of Shipping. This rating is similar to the ABS rating.

GERMANY

German fireproofing standards are found within DIN 4102. DIN 4102 is a very large standard with many Sections and subsections. DIN 4102 has approved several fire proofing paints. They are listed as F30, F60 and F90 (30 minute, 60 minute, 90 minute). They are widely used in and around Germany. The F60 and F90 paints are for use inside of buildings only. F30 Paints are commonly used in Germany on all types of structural steel supports.

NORWAY

NORSOK M-501 gives the requirements for the selection of coating materials, surface preparation, application procedures and inspection for protective coatings to be applied during the construction and installation of offshore installations. NORSOK specifications also require the testing of materials and structure in a manner similar to UL 1709.

DNV is a public corporation that sets standards for fireproofing materials for both onshore and offshore facilities

CONCRETE

DESCRIPTION

Concrete is a construction material composed of cement (commonly Portland cement) and other cementitious materials such as fly ash and slag cement, aggregate such as gravel or crushed rocks like limestone or granite, plus a fine aggregate such as sand, water, and chemical mixtures. Concrete solidifies and hardens after mixing with water due to chemical process known as hydration and eventually forms a stone like material. Concrete has a specific weight of 140 to 150 lb/ft³. Concrete absorbs the heat of a fire when chemically bound water is released from a crystalline structure and is reduced to lime. Concrete is applied to required thicknesses using steel reinforcement material. The corrosive effects of chlorides on the steel surface, dictates the use of protective primers for the steel.

SPECIFICATIONS

Per ASTM E119, steel beams coated should not allow the steel to reach an average temperature of 800° F (for cold drawn steel or 1100°F for reinforcing steel at any point on a steel beam.

Please note that UL 1709 requires steel temperatures to remain lower than critical temperatures as shown on Table A.

ACI, American Concrete Institute, has standards for different common aggregates for concrete using an ASTM E 119 fire test curve (shown on Table B).

Table B - Fire resistance of singular layer concrete walls, floors, and roofs					
Aggregate Type	Minimum equivalent thickness for fire resistance rating. (inches)				
	1 HR	1 1/2 HR	2 HR	3 HR	4 HR
Siliceous	3.5	4.3	5.0	6.2	7.0
Carbonate	3.2	4.0	4.6	5.7	6.6
Semi-Lightweight	2.7	3.3	3.8	4.6	5.4
Lightweight	2.5	3.1	3.6	4.4	5.1

A good “Rule of Thumb” for concrete fire proofing is that 2.5 to 3 inches of concrete will provide 1 hour of fire resistance. To convert this table for use with UL 1709 another “Rule of Thumb” is to add another ½ inch of concrete to the ASTM E-119 required thickness.

INSTALLATION ISSUES

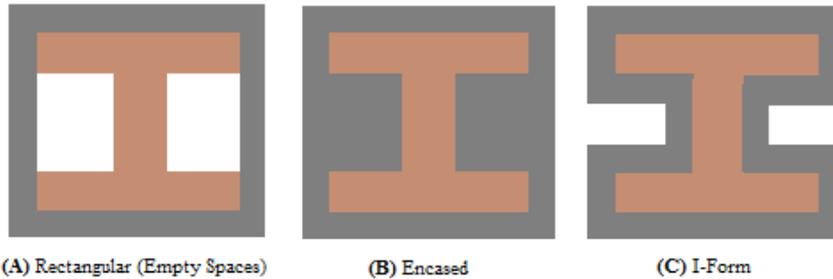
For concrete to be installed properly experienced contactors are needed. Scaffolding, platforms, and forms are needed. Time must be set aside to allow the concrete to dry and cure which may take several days.

Concrete is usually toweled into place using a premade form onto a steel beam. Concrete is held together by steel meshing and steel rebar pending thickness desired. Concrete forms are normally built in three ways around steel beams. One form is a rectangular shaped form around a beam leaving a

INSTALLATION ISSUES - continued

uniform thickness wall of concrete around the beam (Concrete Form A). The second form is an encasement of the beam with concrete where all spaces are filled (Concrete Form B). The last design is an 'I-form' shape (Concrete Form C). This is similar to concrete encased beams but a uniform thickness is achieved. The I-form uses less concrete and material such as steel meshing and/or rebar in contrasted to fully encased beams. The I-form weighs less than a fully encased design.

CONCRETE BEAM DESIGNS



The type A concrete form presents formidable problems. Due to the porous nature of concrete the water can seep through and reach the space where the exposed concrete will begin to rust reaching failure over time. The empty spaces left using this form expose thin areas where machine related impact to the concrete can crack this area and make a hole. This would leave the area exposed to environmental conditions.

The type B concrete form can aid in the strength of the steel supports and will maintain its integrity for years with minimal maintenance. The concrete will add significant weight to the structure itself and should be carefully reviewed when it is applied to multi-level structures.

PROS & CONS

PROS

- Hard finish, can withstand thermal shock and direct hose streams
- Can withstand flame impingement up to 2000⁰F
- Most general contractors can install concrete fire proofing satisfactorily.
- Steel beam can fire proofed (up to 70%) before construction assembly begins.

CONS

- Relatively high weight – in certain circumstances the strength of the supports for equipment, piping, or vessels has to be upgraded just to support the added weight of concrete
- High costs for installation and time involved in forming in-place, especially when applied to existing facilities
- Very Expensive to ship (very heavy weight)
- Primer coating may be needed.
- Need for steel reinforcement.

LIGHTWEIGHT CEMENTITIOUS

DESCRIPTION

Lightweight cementitious products employ lightweight aggregates such as vermiculite, perlite, and diatomite in place of usual sand, stone, and gravel as in concrete. These cementitious products are a form of concrete. They are much lighter in weight due to their aggregate make up. Dry densities range from 35 to 80 lb/ft³ (concrete is ~150 lb/ft³). Most applications for lightweight cementitious products are for steel beams, LPG tanks, and pressure vessels. Due to its fragile characteristics, lightweight cementitious products tend to fracture and break.

Lightweight cementitious products are porous. They absorb moisture. This moisture creates a corrosive condition at the surface of the protected steel and destroys the fire resistance of the coating. Top coating of the fireproofing is critical and should be applied regularly.

Major Brands & Vendors

Brands	Vendor/Company
Pyrocrete 241	CARBOLINE
Pyrocrete 240 HY	
Pyrocrete 40	
CAFCO FENDOLITE M-II	ISOLATEK
1XR	SOUTHWEST FIREPROOFING
Z-146	GRACE
Z-156	

INSTALLATION ISSUES

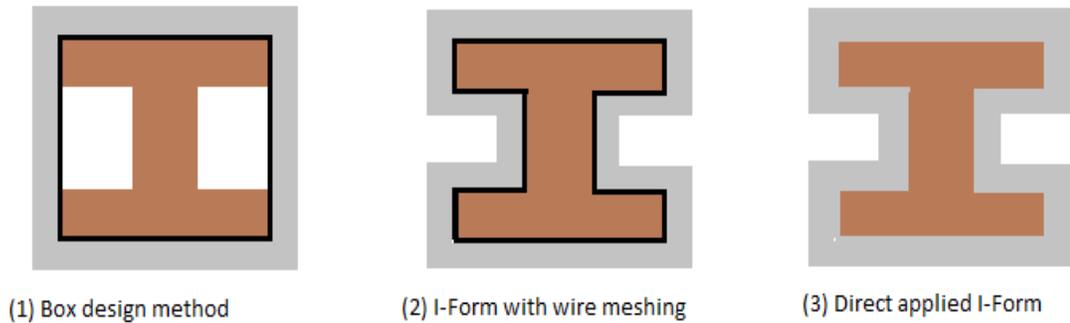
To begin installing lightweight cementitious products a certified applicator must be contracted. Using uncertified contractors will void a products warranty. Equipment and scaffolding must be rented. Lightweight cementitious coatings can take days fully cure. Until fully cured, touch ups can then be done to assure a smooth finish. At this point a proper topcoat should be applied.

Most lightweight cementitious products require a primer and topcoat to protect the steel substrates. Primers are intended to maintain the alkali balance to prevent steel from rusting. Primers must be compatible to product specifications in order to meet guidelines for bonding and adhesion.

Lightweight cementitious materials can be applied two ways: by troweling or by pneumatic spraying. The trowel method is for pour-in-place applications. The pneumatic require the use of plural spray equipment that pneumatically sprays the product. This equipment applies the product by simultaneously mixing and spraying the water and the cementitious blend. Most pneumatically applied fire proofing is about 20% heavier than poured-in-place lightweight cementitious materials and requires more reinforcing to support it on the steel.

Various designs can be configured to the application of lightweight cementitious products. One method is to use a box design method (1) which presents a case where a box form is made up around a beam. Wire meshing is either stapled onto the beam or tied onto the beam to form a box around it leaving two spaces where the beam concaves. The I-form structure is another way to apply lightweight cementitious coatings. Using the 'I-form' structure, coatings can be applied by using wire meshing attached directly to the beam (2). On top of the I-form a uniform lightweight cementitious coating is then applied on top. In some instances various companies have products that will directly bond to the steel. Using a direct uniform application another type of 'I-form' application can be constructed (3).

INSTALLATION ISSUES - continued



COLOR KEY:
BROWN: BEAM
BLACK: WIRE MESHING
GREY: LIGHTWEIGHT CEMENTITIOUS COATING

Porous nature of lightweight cementitious coatings allows water to seep onto the steel and cause corrosion which eventually leads to structural failure. The box form application allows a larger gap in a beam where water can pool. For this reason primers are required for application. Topcoats are highly recommended for use as waterproofing and to aid in chemical resistance.

Lightweight cementitious coatings are brittle. Strong vibrations in the work place can cause the coatings to crack or fracture. In addition, mechanical impact can fracture coatings leaving steel exposed to environmental conditions.

PROS & CONS

PROS

- Capable of withstanding direct flame impingement up to 2000°F
- Capable of withstanding thermal shock and high-pressure hose streams
- Lighter than concrete
- Can be applied via specialty spray system on site
- Less expensive application process than concrete

CONS

- Porous makeup, which can allow penetration by water.
- Moisture absorption can lead to cracking and spalling in freezing climates
- Repeated maintenance required to maintain a top coating to prevent moisture or hydrocarbons from penetrating (additional timely costs to man hours)
- Expensive to ship (moderately heavy weight)
- Primers required
- Susceptible to mechanical damage

INTUMESCENT

DESCRIPTION

An intumescent coating is a paint-like substance that chemically reacts in a fire to form a 'char'. This char expands and helps to remove energy from a fire hazard. It prolongs the time structural failure will occur in a fire. Intumescent coatings are typically manufactured as an epoxy. Epoxies consist of a base and a hardener, or a two part system. Epoxies harden to make a suitable coating for better impact resistance, chemical resistance, and water resistance (dense make up). Epoxies are resistant to vibration wear, abrasive wear, and reduce spalling. Intumescent coatings are lighter in weight than lightweight cementitious coatings.

Major Brands & Vendors

Brands	Vendor/Company
THERMO-LAG 3000	CARBOLINE
THERMO-LAG 2000	
THERMO-LAG 440	
ALBI CLAD 800	ALBI
CHARTEK 7	INTERNATIONAL
CHARTEK 8	
CHARTEK 1709	
M90	LEIGH'S PAINTS
M93	
PITT-CHAR	PPG

INSTALLATION ISSUES

Installing intumescent coatings requires certified applicators. Application by uncertified contractors will void product warrantee. Intumescent coatings are mainly applied by pneumatic spray systems. Some intumescent products require pleural pneumatic spray equipment for epoxies. This system mixes the two parts of an epoxy as it simultaneously applies it by spray.

Intumescent coatings are required to be sprayed a certain mil (thickness). A dry mil is thinner than a wet mil due to the process of coatings shrinking during the curing process. Coating recommendations are usually made based upon dry mils.

Trowel application is used for touch up and hard to reach areas.

Intumescent coatings can fail if surfaces of steel are improperly prepared before application. Steel surfaces must be clean and subject to coating standards. Intumescent coatings require the use of a primer. Primers must be compatible to intumescent coatings to ensure cohesion/adhesion properties. Topcoats are recommended for better chemical resistance. Topcoats can also be added for decorative purposes, labeling purposes, and UV resistance.

PROS & CONS

PROS

- Can be done onsite fairly efficiently via spray systems
- Beams can be up to 80% - 90% pre-coated in shop before installation
- Faster cure times and dry times than concrete and lightweight cementitious systems
- Not as expensive to ship in comparison to concrete and lightweight cementitious systems

PROS - continued

- Lightest fireproofing available and durable under nonfire conditions
- Excellent bonding and corrosion protection
- Easy repair
- Flexible and tolerates vibration
- Coatings are available that provide an attractive finish appearance

CONS

- Require expertise in application, and may require multiple coats or special equipment that can apply dual components simultaneously.
- Some manufacturers require factory-certified application personnel
- Possibility of damage to a char coating during a fire, if subjected to impingement by fire hose streams
- Lengthy cure times in the process of multiple coats
- Primer required frequently with most products
- Topcoat sometimes required, pending product used and conditions of environment.

APPENDIX

- **LIGHTWEIGHT CEMENTITIOUS COATINGS**

- CARBOLINE

- PYROCRETE 241
 - PYROCRETE 240 HY
 - PYROCRETE 40

- ISOLATEK

- CAFCO FENDOLITE M-II

- SOUTHWEST FIREPROOFING

- 1XR

- GRACE

- Z-146
 - Z-156

- **INTUMESCENT COATINGS**

- CARBOLINE

- THERMO-LAG 3000
 - THERMO-LAG 2000
 - THERMO-LAG 440

- ALBI

- ALBI-CLAD 800

- INTERNATIONAL

- CHARTEK 7
 - CHARTEK 8
 - CHARTEK 1709

- LEIGHS PAINTS

- M90
 - M93

- PPG

- PITT CHAR

- **VENDOR CONTACT INFORMATION**

- CARBOLINE

- ISOLATEK – CAFCO

- SOUTHWEST FIREPROOFING

- GRACE

- ALBI

- INTERNATIONAL

- LEIGHS PAINTS

- PPG

CEMENTITIOUS

PRODUCT:	PYROCRETE 241
COMPANY:	CARBOLINE
TYPE:	Lightweight Cementitious - Single powder component mixed with clean, potable water before application
PRIMER:	Highly Recommended - For corrosion protection of steel
TOPCOAT:	Generally not required - Required in corrosive atmospheres
USES:	Structural Steel, Bulkheads, and Upgrading fire resistance of existing concrete, LPG Vessels
APPLICATION:	Spray - Trowel, Roller, or Brush (optional for smooth finish application)
CERTIFICATIONS:	UL 1709 Exterior Investigated/OHSA/EPA/ASTM E119/UL 263
LIMITATIONS:	Not for use on refractory cement or where operating temperatures exceed 200°F (93 ⁰)

PRODUCT:	PYROCRETE 240 HY
COMPANY:	CARBOLINE
TYPE:	Lightweight Cementitious - Single powder component mixed with clean, potable water before application
PRIMER:	Highly Recommended - For corrosion protection of steel
TOPCOAT:	Generally not required - Required in corrosive atmospheres
USES:	Structural Steel, Bulkheads, Upgrading fire resistance of existing concrete, Fire Walls, Floor & Roof Assembly
APPLICATION:	Spray - Trowel, Roller, or Brush (optional for smooth finish application)
CERTIFICATIONS:	UL 1709 Exterior Investigated/OSHA/EPA/ASTM E119/UL 263/NFPA 251
LIMITATIONS:	Not for use on refractory cement or where operating temperatures exceed 200°F (93 ⁰)

PRODUCT:	PYROCRETE 40
COMPANY:	CARBOLINE
TYPE:	Lightweight Cementitious - Single powder component mixed with clean, potable water before application
PRIMER:	Highly Recommended - For corrosion protection of steel
TOPCOAT:	Generally not required - Required in corrosive atmospheres
USES:	Structural Steel, Bulkheads, Upgrading fire resistance of existing concrete, Fire Walls, Floor & Roof Assembly
APPLICATION:	Spray - Trowel, Roller, or Brush (optional for smooth finish application)
CERTIFICATIONS:	UL 1709 Exterior Investigated/OSHA/EPA/ASTM E119/UL 263
LIMITATIONS:	Not for use on refractory cement or where operating temperatures exceed 200°F (93 ⁰)

PRODUCT:	FENDOLITEM-II
COMPANY:	ISOLATEK - CAFCO
TYPE:	Lightweight Cementitious - Single package, factory controlled spray-applied fire resistive material (SFRM)
PRIMER:	Contact Isolatek for further recommendation
TOPCOAT:	Contact Isolatek for further recommendation
USES:	Structural Columns, Structural Beams
APPLICATION:	Spray or Trowel
CERTIFICATIONS:	UL 1709 Exterior Investigated/ASTM E119/UL263
LIMITATIONS:	Contact Isolatek for further recommendation

PRODUCT:	1XR
COMPANY:	SOUTHWEST FIREPROOFING
TYPE:	Lightweight Cementitious
PRIMER:	Contact Southwest Fireproofing for further recommendation
TOPCOAT:	Contact Southwest Fireproofing for further recommendation
USES:	Contact Southwest Fireproofing for further recommendation
APPLICATION:	Contact Southwest Fireproofing for further recommendation
CERTIFICATIONS:	UL 1709 Exterior Investigated/ASTM E119
LIMITATIONS:	Contact Southwest Fireproofing for further recommendation

CEMENTITIOUS – continued

PRODUCT:	Z-146
COMPANY:	GRACE
TYPE:	High Density Cementitious Fireproofing
PRIMER:	Contact Grace for further recommendation
TOPCOAT:	Contact Grace for further recommendation
USES:	Steel Framed Structures, Concrete Surfaces
APPLICATION:	Job Dependent - Can be applied by plaster type equipment or continuous mixer/pump spray units
CERTIFICATIONS:	UL 1709/ASTM E119/UL 263/BS 476 Part 21:1987
LIMITATIONS:	Must be mixed on site before use - Contact Grace for further recommendation
PRODUCT:	Z-156
COMPANY:	GRACE
TYPE:	High Density Cementitious Fireproofing - Factory Pre-mixed, just add water
PRIMER:	Contact Grace for further recommendation
TOPCOAT:	Contact Grace for further recommendation
USES:	Structural Steel (Beams & Columns), Concrete Surfaces
APPLICATION:	Job Dependent - Can be applied by plaster type equipment or continuous mixer/pump spray units
CERTIFICATIONS:	UL 1709/ASTM E119/UL 263
LIMITATIONS:	Contact Grace for further recommendation

INTUMESCENT

PRODUCT:	THERMO-LAG 3000
COMPANY:	CARBOLINE
TYPE:	Epoxy Based Intumescent
PRIMER:	Compatible Primer Required
TOPCOAT:	Required - Exterior & Interior "general use" ~ Optional - Interior "conditioned" use
USES:	Steel - Beams, Columns, Tubes, Pipes, Vessel Skirts, Bulkheads, Underdecks, and Electrical Raceways
APPLICATION:	Plural Component Spray Equipment
CERTIFICATIONS:	UL 1709 Exterior & Interior/DNV/Lloyd's Register/ABS/ASTM E119/UL 263
LIMITATIONS:	Steelwork subject to long-term service over 150 ⁰ F (65 ⁰ C) in normal use
PRODUCT:	THERMO-LAG 2000
COMPANY:	CARBOLINE
TYPE:	Epoxy Based Intumescent
PRIMER:	Compatible Primer Required
TOPCOAT:	Required - Exterior & Interior "general use" ~ Optional - Interior "conditioned" use
USES:	Steel - Beams, Columns, Tubes, Pipes, Vessel Skirts, Bulkheads, Underdecks, and Electrical Raceways
APPLICATION:	Plural Component Spray Equipment
CERTIFICATIONS:	UL 1709 Exterior & Interior/DNV/Lloyd's Register/ABS/ASTM E119/UL 263
LIMITATIONS:	Steelwork subject to long-term service over 150 ⁰ F (65 ⁰ C) in normal use
PRODUCT:	THERMO-LAG 440
COMPANY:	CARBOLINE
TYPE:	Epoxy Based Intumescent
PRIMER:	Compatible Primer Required
TOPCOAT:	Compatible Topcoat Required
USES:	Pressurized & Nonpressurized Spheres, Tanks, Railcars, and Structural Steel
APPLICATION:	Plural Component Spray Equipment
CERTIFICATIONS:	UL 1709 Exterior & Interior/Lloyd's Register/BAM/Department of Transportation
LIMITATIONS:	Steelwork subject to long-term service over 150 ⁰ F (65 ⁰ C) in normal use

INTUMESCENT – continued

PRODUCT:	ALBI-CLAD 800
COMPANY:	ALBI
TYPE:	Intumescent Mastic
PRIMER:	Compatible Primer Required
TOPCOAT:	Not Required - Only use compatible topcoats for color addition, aesthetics, or for additional chemical resistance
USES:	Structural Steel & Concrete, Off-shore/On-shore Oil/Gas Facilities
APPLICATION:	Heavy Duty Pneumatic Spray Equipment
CERTIFICATIONS:	UL 1709/ASTM E119/UL 263
LIMITATIONS:	Contact Albi for further recommendation
PRODUCT:	CHARTEK 7
COMPANY:	INTERNATIONAL
TYPE:	Solvent Free, Reinforced Epoxy Based Intumescent
PRIMER:	Compatible Primer Required
TOPCOAT:	Contact International for further recommendation
USES:	Steel (Structural, Divisional, and Vessels), Aluminum, Bulkheads, Ship Decks, Off-shore/On-Shore Oil/Gas Facilities
APPLICATION:	Heated Plural Spray Equipment, Single Leg Spray System, Trowel, Precast Form
CERTIFICATIONS:	ABS/DNV/Lloyd's Register/NORSOK M501/UL 1709 Exterior Investigated/JET Fire Rated/BS 476: Parts 2&21
LIMITATIONS:	Needs to be Pre-mixed before application, Reinforced - Pending design steel meshing may be required
PRODUCT:	CHARTEK 8
COMPANY:	INTERNATIONAL
TYPE:	Solvent Free, Reinforced Epoxy Based Intumescent
PRIMER:	Compatible Primer Required
TOPCOAT:	Contact International for further recommendation
USES:	Structural Steelwork (Divisions & Bulkheads), Process Equipment (Pipe Work & Vessels), Intended for offshore use
APPLICATION:	Heated Plural Spray Equipment, Single Leg Spray System, Trowel - touch up
CERTIFICATIONS:	NORSOK M501
LIMITATIONS:	Needs to be Pre-mixed before application, Reinforced - Pending design steel meshing may be required
PRODUCT:	CHARTEK 1709
COMPANY:	INTERNATIONAL
TYPE:	Solvent Free, Epoxy Intumescent (May require steel mesh pending design)
PRIMER:	Compatible Primer Required
TOPCOAT:	Contact International for further recommendation
USES:	Steel (Structural, Divisional, and Vessels), Aluminum, Bulkheads, Off-shore/On-Shore Oil/Gas Facilities
APPLICATION:	Plural Spray Equipment, Pneumatic Spray Equipment - alternative, Trowel - touch up or hard to reach areas
CERTIFICATIONS:	UL 1709 Exterior & Interior/ABS/DNV/Lloyd's Register/NORSOK M501/JET Fire Rated/BS 476: Parts 2&21
LIMITATIONS:	Needs to be Pre-mixed before application, May require steel mesh support pending design
PRODUCT:	M90
COMPANY:	LEIGH'S PAINTS
TYPE:	Solvent Free, Epoxy Intumescent
PRIMER:	Compatible Primer Required
TOPCOAT:	Compatible Topcoat Required
USES:	Offshore Structures, LPG Tanks, Steelwork Subject to Hydrocarbon Pool Fire and Jet Fire
APPLICATION:	Plural Twin Component Spray, Trowel - touch up and for smooth finish
CERTIFICATIONS:	UL 1709/BS 476/DNV/Lloyd's Register/BAM/ABS/Head of Netherlands Shipping Inspection/Bureau Veritas
LIMITATIONS:	May require steel mesh support pending design

INTUMESCENT – continued

PRODUCT:	M93
COMPANY:	LEIGH'S PAINTS
TYPE:	Solvent Free, Epoxy Intumescent
PRIMER:	Compatible Primer Required
TOPCOAT:	Compatible Topcoat Required
USES:	Offshore Structures, LPG Tanks, Steelwork Subject to Hydrocarbon Pool Fire and Jet Fire
APPLICATION:	Plural Twin Component Spray, Trowel - touch up and for smooth finish
CERTIFICATIONS:	UL 1709
LIMITATIONS:	May require steel mesh support pending design
PRODUCT:	PITT-CHAR
COMPANY:	PPG
TYPE:	Solvent Free, Epoxy Intumescent
PRIMER:	Compatible Primer Required
TOPCOAT:	Contact PPG for further recommendations
USES:	Offshore - Structural Steel, Bulkheads, Decks / Onshore - pipework, storage tanks, vessels
APPLICATION:	Plural Twin Component Spray Equipment, Trowel - touch up and hard to reach areas
CERTIFICATIONS:	NORSOK M501/DNV/Lloyd's Register/UL 1709/NORSOK M501
LIMITATIONS:	Contact PPG for further recommendations