Wet-Mix & Dry-Mix
Spray-Applied Fire Resistive Materials (SFRMs)

Fireproofing Structural Steel
Why do we fireproof steel?

During a fire, steel will weaken as the temperature rises...

Critical failure typically occurs when the steel reaches 1,000°F. At this point bare, unprotected steel reaches 60% of its original strength. It’s ability to carry load is greatly reduced.

Passive fire protection products ensure that the steel’s temperature does not reach these critical stages.
**Passive Fire Protection Technology & Solutions**

**Time-Temperature Curves**

- **Cellulosic** - office buildings, hospitals, schools
  - At 5-minutes, the temperature reaches 1000 °F
  - Temperature gradually increases during duration of test
  - At 4-hours, the temperature within the furnace reaches 2000 °F

- **Hydrocarbon** - oil refineries, petrochemical plants
  - At 5-minutes, the temperature reaches 2000 °F
  - Maintains this temperature for the duration of the test
  - More severe fires than those seen in commercial construction

---

**Graph Details**

- **UL263** - “Fire Tests of Building Construction and Materials”
- **UL1709** - “Rapid Rise Fire Tests”

---

*Images and data provided by ISOLATEK International*
Unexposed Surface Temperatures

Single Point +325°F

or

Avg. +250°F

Gas jets on the floor, which supply the necessary temperatures specified in the fire test standards.
Limiting Temperatures of Steel*

- **Beams**
  - Average Temp. - 1100° F
  - Individual Temp. - 1300° F

- **Columns**
  - Average Temp. - 1000° F
  - Individual Temp. - 1200° F

- **Decking**
  - Average Temp. - 1100° F

* Once either of these temperatures are reached (average or individual), the fire test is terminated and complete.
UL Fire Resistance Directory

Volume 1 - Hourly Ratings for:

- **Floors**: D, G & J Series
- **Roofs**: P - Series
- **Beams/Joists**: N & S Series
- **Columns**: X, Y & XR Series
- **Walls**: U Series
UL Fire Resistance Directory

Volume 1 - Hourly Ratings for:

- 300 Series - Rigid Board Fire Protection
- 600 Series - Intumescent Coatings
- 700 Series - SFRMs
- 800 Series - SFRMs
- 900 Series - All
Thermal Massivity

Thicknes of SFRM is dependant on the W/D Ratio of Steel

<table>
<thead>
<tr>
<th>W8x28</th>
<th>W14x22</th>
</tr>
</thead>
<tbody>
<tr>
<td>W/D = 0.68</td>
<td>W/D = 0.47</td>
</tr>
</tbody>
</table>

\[
W/D = \frac{\text{Lbs./In. ft.}}{4a + 2b - 2c}
\]

W/D = Weight of steel member in pounds per linear foot / Heated Perimeter of the member in inches
Three types of fireproofing based on “Exposure” Needs

<table>
<thead>
<tr>
<th>TYPE</th>
<th>APPLICATION</th>
<th>DENSITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial</td>
<td>Concealed</td>
<td>15 - 19pcf</td>
</tr>
<tr>
<td>Medium</td>
<td>Indirect-Exposed</td>
<td>22 - 25pcf</td>
</tr>
<tr>
<td>High</td>
<td>Exterior-Exposed</td>
<td>39 - 50pcf</td>
</tr>
</tbody>
</table>

Baltimore Convention Center
### SFRM Physical Performance Requirements

<table>
<thead>
<tr>
<th>Physical Property</th>
<th>ASTM Standard</th>
<th>AIA Masterspec/GSA Commerical Density Performance Requirements</th>
<th>AIA Masterspec/GSA Medium Density Performance Requirements</th>
<th>AIA Masterspec/GSA High Density Performance Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Burning Characteristics</td>
<td>ASTM E 84</td>
<td>Flame Spread: 10 or less Smoke Developed: 0</td>
<td>Flame Spread: 0 Smoke Developed: 0</td>
<td>Flame Spread: 10 or less Smoke Developed: 0</td>
</tr>
<tr>
<td>Density</td>
<td>ASTM E 605</td>
<td>Min. 15 pcf average</td>
<td>Min. 22 pcf average</td>
<td>Min. 39 pcf average</td>
</tr>
<tr>
<td>Cohesion/Adhesion (Bond Strength)</td>
<td>ASTM E 736</td>
<td>150 psf min.</td>
<td>434 psf min.</td>
<td>1,000 psf min.</td>
</tr>
<tr>
<td>Deflection</td>
<td>ASTM E 759</td>
<td>No cracking, spalling or delamination</td>
<td>No cracking, spalling or delamination</td>
<td>No cracking, spalling or delamination</td>
</tr>
<tr>
<td>Bond Impact</td>
<td>ASTM E 760</td>
<td>No cracking, spalling or delamination</td>
<td>No cracking, spalling or delamination</td>
<td>No cracking, spalling or delamination</td>
</tr>
<tr>
<td>Compressive Strength</td>
<td>ASTM E 761</td>
<td>750 psf min.</td>
<td>7344 psf min.</td>
<td>43,200 psf min.</td>
</tr>
<tr>
<td>Air Erosion</td>
<td>ASTM E 859</td>
<td>Max. 0.025 g/ft.^2</td>
<td>Max. 0.025 g/ft.^2</td>
<td>Max. 0.025 g/ft.^2</td>
</tr>
<tr>
<td>Corrosion</td>
<td>ASTM E 937</td>
<td>Does not contribute</td>
<td>Does not contribute</td>
<td>Does not contribute</td>
</tr>
</tbody>
</table>

*These values represent those set forth in AIA MASTERSPEC Section 07810*
Dry-Mix Cement Based Material Application*

- Cement - Based Binder
- Recycled Slag Rock / Mineral Wool Matrix
- 100% Inorganic
- 50% - 75% Recycled Content (LEED Credits)
- Conveyed Dry & Water Mixed at the Nozzle
- Utilizes 15% - 40% Less Water
- Single Pass Application
- Designed to Withstand Exterior Weather Conditions Throughout the Construction Cycle

* UL Classified “Investigated for Exterior Use”
Wet-Mix Plaster Based Material Application

- Mechanically Conveyed as a Wet Slurry & Dispersed with Air at the Nozzle
- Gypsum-Based Binder
- Applied in Multiple Passes to Build-Up Thickness
- Gypsum-Based System Set-Times Can Be Accelerated to Allow Fast-Track Applications
- Extended-Set Options Can Eliminate Daily Clean-out
Commercial Density SFRMs (15-19pcf)

* • CAFCO® BLAZE-SHIELD® II, Isolatek International
  • CAFCO® 300™, Isolatek International
  • Monokote MK-6HY, W.R. Grace
  • Monokote MK-6s, W.R. Grace
  • Pyrolite 15, Carboline
  • Type 5, Southwest Vermiculite

* UL Classified “Investigated for Exterior Use”
Medium Density SFRMs (22-25pcf)

• Gypsum and/or Cement-Based Binder
• Excellent Physical Property Performance
• Ideal for Indirect/Semi-Exposed Applications
• Can Be Trowel Finished
• Designed to Withstand Exterior Weather Conditions Throughout the Construction Cycle (BLAZE-SHIELD HP Only)

Newport Office Center #7 in Jersey City, NJ
Medium Density SFRMs (22-25pcf)

* • CAFCO® BLAZE-SHIELD® HP - Isolatek International
* • CAFCO® 400 - Isolatek International
* • Monokote Z-106G - W.R. Grace
* • Monokote Z-106 & Z-106HY - W.R. Grace
* • Pyrolite 22 - Carboline
* • Type 5MD & Type 7GP - Southwest Vermiculite

* UL Classified “Investigated for Exterior Use”

Torre Mayor in Mexico
High/Exposed Density SFRMs (39-50pcf)

- Cement-Based Binder *
- Superior Physical Property Performance
- Ideal for Exterior Applications
- Can Be Trowel Applied & Finished
- Suitable for Hydrocarbon Fire Conditions (See “XR” Series UL Design Listings)

* UL Classified “Investigated for Exterior Use”
High/Exposed Density SFRMs (39-50pcf)

* • CAFCO® FENDOLITE® M-II, Isolatek International
  * • Monokote Z146, W.R. Grace
  * • Pyrocrete 240HY, 241, Carboline
  * • Type 1XR, Southwest Vermiculite

* UL Classified “Investigated for Exterior Use”
**Pneumatic Blowing Machines**

**Contractors Consulting Services, BOSS Power Packs 5, 7 or 10**
- Typical application averages 125+ bags of SFRM per day
- Up to 30 bags per hour
- Typically pump of choice
- Used on all sized projects (1 - 10,000+ bags)
- Requires 230VAC Single Phase, 40-50 Amp
Price $22,000-$28,000/unit

**Unisul Poly-Spray C-500**
- Typical Application averages 150+ bags of SFRM per day
- Up to 35 bags per hour
- Used on all sized projects (1 - 10,000+ bags)
- Two Models C540 (10 hp blower) and C570 (15 hp blower)
Price $29,000-$35,000/unit

**Contractors Consulting Services, BOSS Patch Pump**
- Small project patch pump
- Ideal for small areas
- 1 bag feed rate
Price $7,500 – 8,900/unit
Wet-Mix Pumps (examples)

**Putzmeister S5EV - Electric Rotor Stator Pump**
- Rotor-Stator Pump
- Typical Application ranges from 120 to 180 bags of SFRM per day
- 2L6 Rotor Stator
- Hose lengths are limited to 200’
- Used on small to medium sized projects (1-3,500 bags)
- Stators usually require replacing every 1000 bags of material
- Comes in electric or gas

Price $19,000 - $22,000/unit

**Putzmeister A3 Series “Tommy Gun”**
- Mechanical Piston Pump
- Typical Application ranges from 180-250 bags of SFRM per day
- Mechanical Piston
- Used on medium to large sized projects (3,500-30,000+ bags)
- Mixer are usually part of the tag along unit
- Comes in electric, gas or diesel.

Price $30,000 - $45,000/unit

**Putzmeister “Big Blue”**
- Hydraulic Piston Pump
- Typical Application averages 250+ bags of SFRM per day
- Up to 60 bags per hour
- Typically pump of choice for high-rise applications
- Hydraulic piston
- Used on large sized projects (10,000+ bags)
- Mixer are usually part of the tag along unit
- Comes in electric, gas.

Price $59,000 – $78,000/unit
– **Blast Overpressure:** The highest pressure above atmospheric that is experienced at a specified distance from an explosion

Simulates a vapor cloud explosion by fuel or petrochemical source

- 1.0 bar: Complete structural damage to buildings
- 1.7 bar: Estimated Blast Overpressure at the World Trade Center
- 2.0 bar: Highest measured industrial explosion (*Piper Alpha* off-shore rig, 1988)
- 3.0 bar: Equivalent of 1,000 lbs TNT

– *Followed by fire test to evaluate fire performance!*
Blast Overpressure Testing

- Investigate resistance of Passive Fire Protection Products to blast overpressure
- High Profile Structures: i.e. High-Rise Structures, Government Buildings, Airports, etc.
- Intumescent Coatings are the most lightweight, durable yet flexible blast overpressure resistive fire protection currently available
Building Codes

Chapter 5 of the International Building Code (IBC) explains:

- allowable height and area limitations
- building types
- occupancy classifications

Chapter 6 of the International Building Code (IBC) explains:

- Required fire resistance ratings for various building types
- Required fire resistance ratings for different structural elements
- Exceptions
New 2009 IBC Requirements for High-Rise Buildings

403.2.4 Sprayed fire-resistant materials (SFRM). The bond strength of the SFRM installed throughout the building shall be in accordance with Table 403.2.4.

<table>
<thead>
<tr>
<th>HEIGHT OF BUILDING&lt;sup&gt;a&lt;/sup&gt;</th>
<th>SFRM MINIMUM BOND STRENGTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 420 feet</td>
<td>430 psf</td>
</tr>
<tr>
<td>Greater than 420 feet</td>
<td>1,000 psf</td>
</tr>
</tbody>
</table>

Bond Strength Provisions:

For building heights from ground to 75’, a minimum bond strength of 150 psf is required (commercial density).

• For building heights from 75’ to 420’, a minimum bond strength of 430 psf is required (medium density).

• For building heights of 420’ or greater, a minimum bond strength of 1,000 psf is required (high density).

For SI: 1 foot = 304.8 mm, 1 pound per square foot (psf) = 0.0479 kW/m².

<sup>a</sup> Above the lowest level of fire department vehicle access.
UL Qualified Contractor Program

- Pass a UL Qualified Contractor Test
- UL Approved Quality Assurance Standards
- UL will Audit Contractor’s Operation Annually to Insure Program Compliance
- Supported by the National Fireproofing Contractors Association (NFCA)

www.nfca-online.org