**Monokote® Z-146T**

Severe Environment and Tunnel Grade Fireproofing – High Density

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 aggregate slurry 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 (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_): Structural Steel

B. Section (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_): Cleaning of surfaces to be fireproofed

C. Section (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_): Concrete encasement of structural steel

D. Section (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_): Plaster fireproofing

1.03 REFERENCES

1. 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
   12. ASTM D2240 Standard Test Method for Rubber Property – Durometer Hardness
2. Netherlands Ministry of Transport – Directorate General of Public Works and Water Management
   1. Rijkswaterstaat (RWS) fire curve
3. Health and Safety Executive / Health and Safety Laboratory
   1. OTI 95 634 - Jet-Fire Resistance Test of Passive Fire Protection Materials
4. Bureau of Building Inspection: City of San Francisco
   1. Abrasion Resistance Test Method
   2. Impact Penetration Test Method
5. Underwriters Laboratories Inc. (UL) Fire Resistance Directory (Latest Edition)
   1. UL/ANSI 1709 Rapid Rise Fire Tests of Protection Materials for Structural Steel
   2. UL/ANSI 263 Fire Tests of Building Construction Materials
6. 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
7. Association of the Wall and Ceiling Industry (AWCI)
   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
8. International Building Code (IBC)

1.04 DEFINITIONS

A. Aggregate Slurry as defined by Underwriters Laboratories Inc. (CHPX) 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 aggregate slurry fireproofing.

1. Fire Testing:
   1. Submit evidence that the aggregate slurry fireproofing has been subjected to full-scale UL 263/ASTM E119 fire testing at Underwriters Laboratories Inc. by the manufacturer.
   2. Submit evidence that the aggregate slurry fireproofing has been subjected to full-scale standard ANSI/UL 1709 (Rapid Rise Fire Tests of Protection Materials for Structural Steel) fire testing at Underwriters Laboratories Inc. by the manufacturer.

C. Thickness Schedule: Provide schedule indicating material to be used, structural 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 (as modified for high density high performance products)
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
13. Hardness per ASTM D2240

1.06 QUALITY ASSURANCE

A. Fireproofing work shall be performed by a firm acceptable to the aggregate slurry 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

1. 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 72 hours after application of the spray applied fireproofing. Provide enclosures with heat to maintain temperature.
2. Material shall be prevented from drying out (damp cured) for a minimum of 7 days

1.09 SEQUENCING AND SCHEDULING

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

PART 2 — PRODUCTS

2.01 ACCEPTABLE MANUFACTURER

A. Fireproofing shall be aggregate slurry mixture as manufactured by GCP Advanced Technologies Construction Products, GCP Advanced Technologies Korea Inc, or a licensee of GCP Advanced Technologies-Conn., or its processing distributors.

2.02 MATERIALS

A. Materials shall be Monokote® Z-146Tfactory-blended Portland cement based aggregate slurry fireproofing formulated with an integral corrosion inhibitor added by the manufacturer during the manufacturing process.

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, or as listed in the UL Fire Resistance Directory for each rating indicated, or as required by the authority having jurisdiction, or a minimum average 640 kg/m3 (40pcf), 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 as modified for high density high performance products, shall have a minimum average bond strength of 478 kN/m2 (10,000 psf) and a minimum individual bond strength of 383 kN/m2 (8,000 psf).
5. Air Erosion: Maximum allowable total weight loss of the fireproofing material shall be 0.00 g/m2 (0.00 g/ft2) 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 3,723 kPa (540 psi) when tested in accordance with ASTM E761.
8. Corrosion Resistance: Fireproofing applied to steel shall include an integral corrosion inhibitor and shall be tested in accordance with ASTM E937 and shall not promote corrosion of steel.
9. Abrasion Resistance: No more that 15 cm3 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 cm3 when subjected to impact penetration tests in accordance with the test methods developed by the City of San Francisco, Bureau of Building Inspection.
11. Surface Burning Characteristics: Material shall exhibit the following surface burning characteristics when tested in accordance with ASTM E84:   
    Flame Spread 0   
    Smoke Development 0
12. Resistance to Mold: The fireproofing material shall be formulated at the time of manufacturing with a mold inhibitor. Fireproofing material shall be tested in accordance with ASTM G21 and shall show resistance to mold growth for a period of 28 days for general use.
13. Combustibility: Material shall have a maximum total heat release of 20 MJ/m2 and a maximum 125 kw/m2 peak rate of heat release 600 seconds after insertion when tested in accordance with ASTM E1354 at a radiant heat flux of 75 kw/m2 with the use of electric spark ignition. The sample shall be tested in the horizontal orientation.

NOTE TO SPECIFIER: In-Place Performance Standards: Laboratory fire tests (UL 263/UL 1709) do not measure in-place durability during the design life of the structure. For example, the work of other trades or air movement in return air plenums can affect the ability of the fireproofing to remain intact on the steel. The physical performance criteria recommended above establish minimum levels of acceptable in-place performance for structural steel fire protection. Performance criteria include resistance to damage, bond strength, air erosion and mold resistance protection. Monokote Z-146T meets or exceeds these recognized performance standards for long term fire protection of steel structures.

C. Fire Resistance Classification: The spray applied fireproofing material shall have been tested and reported by Underwriters Laboratories Inc. in accordance with the procedures of ANSI/ASTM E119 and ANSI/UL 1709 and shall be listed in the Underwriters Laboratories Fire Resistance Directory. For tunnel applications, the spray applied fireproofing material shall have been tested and reported by Efectus Nederland in accordance with the TNO/RWS test procedure for tunnel fireproofing.

D. Mixing water shall be clean, fresh, and suitable for domestic consumption and free from such amounts of mineral or organic substances as would affect the set of the fireproofing material. Provide water with sufficient pressure and volume to meet the fireproofing application schedule.

2.03 ACCESSORIES

A. Provide accessories to comply with manufacturer’s recommendations and to meet fire resistance design and code requirements. Such accessories include, but are not limited to, any required or optional items such as bonding agents, mechanical attachments; application aids such as metal lath, scrim, or netting.

2.04 SOURCE QUALITY CONTROL

A. Submit evidence that the aggregate slurry fireproofing has been tested per ANSI/UL 263 and ANSI/UL 1709 by Underwriters Laboratories Inc. or per the TNO/RWS test procedure for tunnel fireproofing by Efectus Nederland. Include evidence that the fire testing was sponsored by the manufacturer under the supervision of test laboratory personnel.

PART 3 — EXECUTION

3.01 EXAMINATION

A. All surfaces to receive spray applied fireproofing shall be provided free of oil, grease, loose mill scale, dirt or other foreign substances which may impair proper adhesion of the fireproofing to the substrate. Where necessary, cleaning or other corrections of surfaces to receive fireproofing shall be the responsibility of the supplier of the incompatible surface.

NOTE TO SPECIFIER: Primed/painted Substrates

Exterior Use(including tunnels where surfaces may be exposed to condensation, mist and/or splash from vehicular traffic or other sources of water): Z-146T neither causes nor prevents the corrosion of structural steel surfaces. All steel substrates should be considered as exposed to the environment. While Z-146T contains an integral corrosion inhibitor this system should be considered as a back up to the full and appropriate corrosion protection system appropriate for the expected environment. All protective coatings must be compatible with alkali conditions created by portland cement based products. The use of alkali resistant immersion grade epoxy is strongly recommended. The use of paint or primer coatings with fireproofing is detailed in the UL Fire Resistance Directory and may require the use of bonding agents or mechanical attachment on beams, columns, tube and pipe steel to maintain the fire-resistive rating The coating supplier should also certify the compatibility of the primer with portland cement based fireproofing. An on-site mock-up and bond test shall be performed on all unknown or un-tested coatings prior to application of fireproofing to determine compatibility.

Interior Use: For interior use conditions, fireproofing obtains its maximum bond strength when applied to bare, unprimed structural steel. Priming of interior structural steel is generally unnecessary, adds to the cost of the structure and may adversely affect the fire resistance rating and the bond of the fireproofing to the substrate. We recommend the following be added to the structural steel specification: “Interior structural steel to receive application of spray applied fireproofing shall be free of primer and paint coatings.”

Where members are to be exposed to a corrosive environment, exterior or wet applications, a corrosion resistant coating must be applied prior to the fireproofing to protect the underlying structural steel.

B. Application of the fireproofing shall not begin until the contractor, applicator and fireproofing testing laboratory (inspector) have examined surfaces to receive fireproofing and determined that the surfaces are acceptable to receive the fireproofing material.

3.02 PREPARATION

1. The placement of mechanically fastened corrosion resistant mesh to all concrete surfaces is required prior to application of Z-146T. Mesh shall be nominal 1.5” x 1.5” x 16 gauge vinyl coated galvanized twisted wire or welded wire fabric.
2. Mesh is required on all surfaces (concrete and/or steel) located directly above active roadways.
3. Prior to application of the fireproofing material, a bonding agent, approved by the fireproofing material manufacturer, shall be applied to all concrete substrates to receive fireproofing.
4. In advance of application of Z-146T, all structural steel that will be exposed to water or high moisture conditions must be protected from corrosion with an appropriate alkali resistant coating.
5. Other trades shall install clips, hangers, support sleeves and other attachments required to penetrate the fireproofing, prior to application of the fireproofing materials.
6. Other trades shall not install ducts, piping, equipment or other suspended items until the fireproofing is complete.
7. Complete placing of concrete on all decking prior to application of the fireproofing to the underside of steel deck and supporting beams and joists.
8. Protection of permanently exposed walls or floors, or special surfaces:

(Please indicate special protection requirements by location in a finish schedule on the plans or herein. Eliminate subparagraph G if not applicable).

1. For general exterior use, lath may be required. The manufacturer’s recommendations related to the lath specification, application and attachment of metal lath shall be followed.

NOTE TO SPECIFIER: Surface protection application of spray applied fireproofing results in overspray onto surfaces in the immediate spray area. Where concrete, masonry or other surfaces subject to overspray need protection, detail that these specific surfaces shall be protected with masking, drop cloths or other satisfactory covering.

3.03 APPLICATION

1. Equipment and application procedures shall conform to the material manufacturer’s application instructions.
2. Post appropriate cautionary “Slippery When Wet” signs in all areas in contact with wet fireproofing material. Erect appropriate barriers to prevent entry by non-fireproofing workers into the fireproofing spray and mixing areas and other areas exposed to wet fireproofing material.
3. Monokote Z-146T can be hand trowelled from pumped slurry.
4. The nominal maximum thickness of Monokote Z-146T that should be applied in any one pass is to be no more than 20 mm (3/4”).

3.04 FIELD QUALITY CONTROL

A. The architect will select, and the owner will pay an independent testing laboratory to randomly sample and verify the thickness and the density of the fireproofing in accordance with provisions of ASTM E605, or the “Inspection Procedure for Field-Applied Sprayed Fire Protection Materials” as published by the Association of Wall and Ceiling Contractors International, or the Uniform Building Code Standard No. 7-6. Where density samples are of irregular shape, a displacement method approved by Underwriters Laboratories Inc. shall be used to determine in-place fireproofing density.

B. The architect will select, and the owner will pay an independent testing laboratory to randomly sample and verify the bond strength of the fireproofing in accordance with provisions of ASTM E736, as modified for high density high performance products.

1. The results of the above tests shall be made available to all parties at the completion of pre-designated areas which shall have been determined during the pre-job conference.

NOTE TO SPECIFIER: There is no ASTM field bond strength test procedure specifically applicable to sprayed fireproofing materials with bond strengths greater than 4,882 kg/m2 (1,000psf) such as Monokote Z-146T. Where bond strength specifications exceed 4,882 kg/m2 (1,000psf) it is recommended that independent laboratory test data based upon a modified version of ASTM E736 be used to verify specification compliance. Copies of the modified version of ASTM E736 are available from GCP Advanced Technologies & Co. – Conn upon request.

3.05 CLEANING

A. After the completion of fireproofing work, application equipment shall be removed.

B. Except as detailed in Section 3.02F, floors shall be left in a scraped condition.

3.06 PATCHING

* + - 1. All patching and repairing of spray applied fireproofing, due to damage by other trades, shall be performed with same materials under this section, and paid for by the trade(s) responsible for the damage.

B. Procedure for repair and patching prior to patching all loose or damaged materials shall be removed and discarded. Where cracking has occurred, cracks shall be widened sufficiently to receive new material to a depth of not less than 12 mm (½”). A bonding agent recommended by the manufacturer shall be applied to the damaged/cracked area and continued to a distance of not less than 150 mm (6”) beyond the area to be repaired. After the bonding agent has dried additional material can be applied as required. Patching material shall have a minimum thickness of 12 mm (½”) and shall be moist cured for a minimum of 7 days.

3.07 FIRE RATING SCHEDULE

Elements

Fire-Resistance Rating (time in hours) schedule shall be as follows:

Structural Hourly Rating Design Restrained\* Unrestrained\*  
Component Requirement Reference (Check one)

Columns \_\_\_\_\_\_\_\_\_\_\_\_ hr. \_\_\_\_\_\_\_\_\_\_\_\_ (N/A) (N/A)  
Roof Supports \_\_\_\_\_\_\_\_\_\_\_\_ hr. \_\_\_\_\_\_\_\_\_\_\_\_ ( ) ( )  
Misc. Shapes and Other \_\_\_\_\_\_\_\_\_\_\_\_ hr. \_\_\_\_\_\_\_\_\_\_\_\_ ( ) ( )  
Tunnel Lining \_\_\_\_\_\_\_\_\_\_\_\_ hr. \_\_\_\_\_\_\_\_\_\_\_\_ (N/A) (N/A)  
  
\*Qualified structural engineer, in compliance with all applicable codes and regulations, shall determine whether restrained or unrestrained criteria applies to the conditions of support of all structural components.