

SECTION 608 – PROTECTIVE MANHOLE COATING (TYPE B)

1. GENERAL

This specification shall govern all work, materials, and equipment required to obtain a structural, monolithic liner eliminating infiltration, providing corrosion protection, repair of voids, and restoration of the structural integrity of the substrate as a result of spray applying a fiber-reinforced calcium aluminate cementitious liner to the wall and bench surfaces of brick, concrete or other masonry construction materials.

Described are the procedures for cleaning, substrate preparation, application and testing. The Contractor approved and trained by the manufacturer shall furnish all labor, equipment and materials for applying a corrosive resistant cementitious mix to form a structural monolithic liner of a minimum 1/2 inch thickness with machinery specially designed for the application. All aspects of the installation shall be in accordance with the manufacturer's recommendation and per the following specifications which includes the removal of any loose and unsound substrate; cleaning of the area to be sprayed with high pressure water; the repair and filling of voids; the repair and sealing of the invert and benches; the elimination of active infiltration prior to making the application; and the spray application of an acid resistant cementitious material to form a structural/structurally enhanced monolithic liner.

2. MATERIALS

A. Patching Material. A quick setting, corrosion resistant cementitious material, shall be used as patching material and is to be mixed and applied according to manufacturer's recommendations. The patch material shall meet the following minimum requirements:

Compressive Strength	ASTM C109	>800 psi, 1 hours
Bond	ASTM C321	>1800 psi, 24 days
		>1600 psi, 28 days
Cement		sulfate resistant
Applied Density		105 pcf ± 5 pounds
Shrinkage	ASTM C596	0% at 90% R. H.

B. Infiltration Control Material. A rapid setting cementitious product specifically formulated for leak control shall be used to stop minor water infiltration and shall be mixed and applied according to manufacturer's recommendations and shall have the following minimum requirements:

Compressive Strength	ASTM C109	>1000 psi, 1 hour
		72500 psi, 24 hours
Freeze/Thaw	ASTM C666 "method A"	100 cycles
Sulfate Resistance	ASTM C267	No weight loss after 15 cycles at 2000 ppm
Pull out strength	ASTM C234	14,000 pounds
Placement time		<60 seconds

C. Grouting Material. Cementitious grout shall be used for stopping very active infiltration and filling voids and shall be mixed and applied according to manufacturer's recommendations. The cement grout shall be volume stable. Chemical grouts may be used for stopping very active infiltration and shall be mixed per manufacturer's recommendations.

D. Liner Material. An acid resistant calcium aluminate cementitious liner product shall be used to form a structural/structurally enhanced monolithic liner covering all interior substrate surfaces and shall have the following minimum requirements at 28 days:

Compressive Strength	ASTM C495	>9000 psi
Tensile Strength	ASTM C496	> 800 psi
Flexural Strength	ASTM C293	>1200 psi
Shrinkage @ 95% R.H.	ASTM C596	0%
Bond (28 days)	ASTM C882	>2000 psi
Applied Density		145 ± 5 lbs/ft ³
Freeze/Thaw	ASTM C666	100 cycles, no visible damage
Sulfate Resistance	ASTM C267	no damage

This product shall be made with a blend of 100% pure fused aluminate clinker with a minimum aluminate content of 46% calcium aluminate cement and calcium aluminate aggregates and shall be used according to manufacturer's recommendations for use where harsh hydrogen sulfide conditions exist within the sanitary sewer system.

E. Water. Water used to mix product shall be clean and potable. Questionable water shall be tested by a laboratory in accordance with ASTM C-94 procedure. Potable water need not be tested.

3. EQUIPMENT

Specially designed machines capable of producing a minimum of 250 psi pumping pressure, mixer with twin ribbon paddles with end discharge or continuous mixer, and an air system for low velocity spray application of product shall be used for applying manhole seal coating.

4. RECONSTRUCTION PROCEDURE

A. Preparation. Place covers over invert to prevent extraneous material from entering the sewer lines. All foreign material shall be removed from the manhole wall and bench using a high pressure water spray (minimum 3000 psi). Loose and protruding brick, mortar and concrete shall be removed using a mason's hammer and chisel and/or scraper. Fill any large voids with quick setting patching material. Active leaks shall be stopped using quick setting, specially formulated mixes according to manufacturer's recommendations. Some leaks may require weep holes to localize the infiltration during the application. After application, the weep holes shall be plugged with the quick setting mix prior to application of the final coat. When severe infiltration exists, drilling may be required to pressure grout using grouting procedures. Manufacturer's recommendations shall be followed when pressure grouting is required.

B. Invert Repair. After preparations have been completed, remove all loose material and wash wall again. Any bench or invert repair or service line repairs shall be made at this time using quick setting patching material and shall be used per manufacturer's recommendations. Invert repair shall be performed on all inverts with visible damage or where infiltration is present. After blocking flow through the manhole and thoroughly cleaning the invert, the quick setting patch material shall be applied to the invert in an expeditious manner. The material shall be troweled uniformly onto the invert at a minimum thickness of 1/2 inch, extending out onto the bench sufficiently to tie into the monolithic liner to be spray applied. The finished invert shall be smooth and free of ridges. The flow may be re-established in the manhole within 30 minutes after placement of the material.

C. Wall Repair. Should the reconstruction process require application thickness greater than 1/2 inch, a base coat shall be used to build the substrate to within 1/2 inch of the finished dimension. For each bag of product, use the amount of water required per manufacturer's recommendation following mixing procedures as noted on product bag and using the approved equipment for mixing and application. The base coat material is to be applied in multiple passes. Each application thickness shall not exceed 1/2 inch and each application is to be rough troweled. The base coat is to be built out to within 1/2 inch of required finished dimension. The final coat shall be a minimum thickness of 1/2 inch. For each bag of product, use the amount of water or water settings required per manufacturer's recommendations following mixing procedures noted on product bag and using the approved equipment for mixing and application. Prepared mix shall continue to occur in such a manner as to allow spraying continuously without interruption until each application is complete.

D. Base Coat Applications. The surface, prior to spraying base coat applications, shall be clean and free of all foreign material and shall be damp without noticeable free water droplets or running water, but totally saturated, just prior to application of each coat. Materials shall be spray applied from the bottom of the wall to the top, to within 1/2 inch of the original substrate dimension using as many passes as necessary but each application shall not exceed 1/2 inch. The surface is to be rough troweled after each pass. The light troweling is performed to assure that material penetrates the voids and sets the bond.

E. Final Application. A final application, mixed per specifications is applied after the base coat applications have begun to take an initial set (disappearance of surface sheen). The final application shall be a minimum thickness of 1/2 inch. Again, application shall be from the bottom up. The surface is then troweled to a relatively smooth finish being careful not to over trowel so as to bring additional water to the surface and weaken it. A brush finish is then applied to the troweled finish or top coat surface. Manufacturer's recommendations shall be followed whenever more than 24 hours have elapsed between applications.

F. Bench Application. The invert covers shall be removed at this time and the bench sprayed with materials mixed per specifications and spray applied in such a manner that a gradual slope is produced from the walls to the invert with the thickness at the edge of the invert to be no less than 1/2 inch. The wall/bench intersection shall be rounded to a uniform radius the full circumference of the intersection.

5. CURING

Caution should be taken to minimize exposure of applied product to quick surface drying and air movement. If time between application of additional coats is to be longer than 15 minutes, the structure shall be covered. At no time should the finished product be exposed to sunlight or air movement for longer than 15 minutes before covering or closing access. On extremely hot or arid climates, manhole should be shaded while reconstruction is in process. In environments where humidity level is below 70%, it shall be necessary to keep finished product damp for the first 72 hours. The final application shall have a minimum of eight (8) hours cure time before being subject to active flow or surcharge. Traffic shall be withheld for 12 hours after application is complete.

6. WEATHER

No application shall be made to frozen surfaces or if freezing is expected to occur within the substrate within 24 hours after application. Precautions shall be taken to keep the mix temperature at time of application below 90 degrees F. Water temperature shall not exceed 80 degrees F.