

**DESCRIPTION**

This work consists of all work, materials and equipment required for manhole rehabilitation for the purpose of eliminating infiltration, providing corrosion protection, repair of voids and restoration of the structural integrity of the manhole by application of a cementitious liner to the wall and bench surfaces of brick, concrete or any other masonry material.

**MATERIALS**

**Patching Mix** - A quick setting cementitious material shall be used as a patching mix and is to be mixed and applied according to the manufacturer's recommendations and have the following minimum requirements:

Compressive strength (ASTM C-579B)      1400 psi  
 Shrinkage (ASTM C-596)      0% at 90% R.H.  
 Bond (ASTM C-321) 145 psi @ 28 days  
 Cement      Sulfate Resistant  
 Density, when applied 105 ± 5 lb/cf

**Infiltration Control Mix** - A rapid setting cementitious product specially formulated for leak control, shall be used to stop minor water infiltration and shall be mixed and applied according to the manufacturer's recommendations and shall have the following minimum requirements:

Compressive strength (ASTM C-579B      600 psi @ 1 hr., 1000 psi @ 24 hrs.  
 Bond (ASTM C-321)      29 psi @ 1 hr., 80 psi @ 24 hrs.

**Grouting Mix** - A 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 cementitious grout shall be volume stable and have a minimum 28 day compressive strength of 250 psi and a 1 day strength of 50 psi.

Chemical grouts may be used for stopping very active infiltration and shall be mixed and applied per manufacturer's recommendations.

**Liner Mix** - A cementitious liner shall be used to form a structurally enhanced monolithic liner covering all interior manhole surfaces and shall have the following minimum requirements at 28 days:

Compressive strength (ASTM C-579B)      3000 psi  
 Tensile strength (ASTM C-496)      300 psi  
 Flexural strength (ASTM C-293)      600 psi  
 Shrinkage (ASTM C-596)      0% at 90% R.H.  
 Bond (ASTM C-321)      130 psi  
 Density, when applied      105 ± 5 lbs/cf

Liner mix shall be made with Type I or Type III Portland cement and shall be used

according to manufacturer's recommendations in applications where there is no or very mild sulfide conditions (pH 3.0 or higher).

Liner mix shall be made with Calcium Aluminate cement and shall be used according to manufacturer's recommendations in applications where there is evidence of severe sulfide conditions (pH less than 3.0).

**Water** - Shall be clean and potable. Questionable water is to be tested by an approved laboratory in accordance with ASTM C-94. Potable water need not be tested.

**Other Materials** - No other materials shall be used with the mixes previously described without prior approval or recommendation from the manufacturer.

### **CONSTRUCTION DETAILS**

Rehabilitation shall consist of the following:

1. The removal of any loose and unsound material.
2. Cleaning the area to be treated using a high pressure water spray.
3. The repair and filling of voids.
4. The repair and sealing of the invert and benches.
5. The elimination of active infiltration prior to application of the surface treatment.
6. Spray application of a cementitious mix to form a structurally enhanced monolithic liner.

**Equipment** - Specially designed machines consisting of an optimized progressive cavity pump capable of producing a minimum of 250 psi pumping pressure, contra-blend mixer with twin ribbon paddle with end discharge, and an air system for spray application of product, shall be used for applying liner products.

Equipment is complete with water storage and metering system. Mixer and pump are hydraulically powered.

### **Application**

**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 1200 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 mix.

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 which the weep holes shall be plugged with the

quick setting mix prior to the final liner application. When severe infiltration is present, drilling may be required in order to pressure grout using a cementitious grout. Manufacturer's recommendations shall be followed when pressure grouting is required.

**Invert Repair** - After all preparation has been completed, remove all loose material and wash wall again.

Any bench, invert, or service line repairs shall be made at this time using the quick setting patching mix and shall be used per manufacturer's recommendations.

Invert repair shall be performed on all inverts with visible damage or infiltration. After blocking flow through the manhole, and thoroughly cleaning invert, the quick setting patch mix shall be applied to the invert in an expeditious manner. The mix shall be troweled uniformly onto the damaged invert extending out onto the base of the manhole sufficiently to tie into the structurally enhanced monolithic liner to be applied. The finished invert surfaces shall be smooth and free of ridges. The flow may be re-established in the manhole within 30 minutes after placement of the mix.

**Mixing** - For each bag of product, use the amount of water specified by the manufacturer and mix using the approved equipment for 30 seconds to 1 minute after all materials have been placed in the mixing hopper.

Place the mix into the holding hopper and prepare another batch with timing such that the nozzleman can spray in a continuous manner without interruption until each application is complete.

### **Spraying**

**1<sup>st</sup> Application** - The surface prior to spraying shall be clean and must be free of all foreign material and shall be damp without noticeable free water droplets or running water, but totally saturated, just prior to application. Materials shall be spray applied from the bottom of the wall to the top, to a minimum uniform thickness to insure that all cracks, crevices, and voids are filled and a relatively smooth surface remains after light troweling. The light troweling is performed to compact the material into voids and to set the bond.

**2<sup>nd</sup> Application** - A second application is applied after the 1<sup>st</sup> application has begun to take an initial set (disappearance of surface sheen which could be 15 minutes to 1 hour depending on ambient conditions) to assure a minimum total finished thickness of 12 millimeters. Again, application shall be from the bottom up. The surface is then troweled to a smooth finish being careful not to over trowel so as to bring additional water to the surface and weaken it. Manufacturer's recommendations shall be followed whenever more than 24 hours have elapsed between applications. A brush finish is accepted and is applicators option.

**Bench Application** - The covers shall be removed at this time and the bench sprayed such that a gradual slope is produced from the walls to the invert with a thickness at the edge of the

invert being no less than 1/2". The wall/bench intersection shall be rounded to a uniform radius the full circumference of the intersection.

**Curing** - Caution should be taken to minimize exposure of applied product to sunlight and air movement. If application of second coat is to be longer than 15 minutes after completion of application of 1<sup>st</sup> coat, the manhole cover shall be set back in place. At no time should the finished product be exposed to sunlight or air movement for longer than 15 minutes before replacing the manhole cover. In extremely hot and arid climates manhole should be shaded while reconstruction is in process.

The final application shall have a minimum of four (4) hours cure time before being subjected to active flow.

Traffic should not be allowed over manholes for 24 hours after reconstruction is complete.

**Weather** - No application shall be made to frozen surfaces or if freezing is expected to occur inside the manhole within 24 hours after application. If ambient temperatures are in excess of 95° F, precautions shall be taken to keep the mix temperature at time of application below 90° F. Mix water temperature shall not exceed 84°F. Chill with ice if necessary.

**Product Testing** - Four 2" cubes shall be cast each day or from every 50 bags of product used, and shall be properly labeled and sent in for testing in accordance with the COUNTY'S or manufacturer's directions, for compression strength testing as described in ASTM C-579B.

**Final Acceptance Testing** - At the direction of the COUNTY or his assignee, the rehabilitated manholes shall be tested as follows:

1. Visually verify the absence of leaks.
2. Perform an exfiltration test using a method approved by the ENGINEER.

**BASIS OF PAYMENT**

Payment shall be based on a vertical foot basis. Depth of manhole shall be measured from the bottom of the invert to the top of the ring seat for manhole cover.

Payment will be made under:

<b><u>Item No.</u></b>	<b><u>Item</u></b>	<b><u>Pay Unit</u></b>
C604.88	Seal Interior of Existing Storm Manholes	LF