



DENVER

THE MILE HIGH CITY

CITY AND COUNTY OF DENVER
DEPARTMENT OF PUBLIC WORKS | ENGINEERING DIVISION

Storm Drainage and Sanitary Sewer Construction Detail and Technical Specifications

**Approved for Specific Capital Projects Only - Product Must Be
Specifically Noted In the Contract Documents at Time of Bid**

15.2 Spectrashield™ Manhole Liner

15.2.1 General

The work described within this specification details a complete program for manhole rehabilitation. This section details the methods, procedures, materials and equipment as required to produce “A Total System for Manholes”. The complete system will provide a corrosion resistant liner to rehabilitate deteriorated manholes and prevent any further deterioration from hydrogen sulfide and other corrosive gases/acids caused by the wastewater stream. The completed system will also eliminate all ground water infiltration into existing manholes.

15.2.2 Referenced Standards

ASTM 4541 – Adhesion

ASTM D412 – Tensile Strength (PSI)

ASTM D412 – Elongation (%)

ASTM D2240 – Tear Strength (PLI)

ASTM D1737 – Hardness

ASTM D1737 – Flexibility (1/8” mandrel)

ASTM 4060 – Taber Abrasion (mg loss)

CIGMAT Evaluation (UH96-7) of Spectrashield Liner System for Wastewater Concrete and Clay Brick Facilities. University of Houston Department of Civil Engineering: December 1996

15.2.3 Submittals

All materials and procedures required to establish compliance with the specification shall be submitted to the City’s Project Manager for review/approval. Submittals shall include the following as a minimum:

1. A Denver Fire Department permit (Hazardous, Flammable, Hot Work, Confined Space) must be obtained by the contractor prior to beginning any work; with any material.
2. A letter to the City’s Project Manager requesting use of the product/system for a specific Capital Project must be approved in writing prior to product use.
3. Descriptive literature, bulletins and or catalogs of materials.
4. Work procedures including flow diversion plan, method of repair, etc.
5. Material and method for repair of leaks or cracks in manholes.
6. Final installation report on completed manholes

15.2.4 Quality Assurance

1. The manufacturer and/or installer of the total liner system of manholes shall be a company that specializes in the design, manufacture or installation of corrosion protection systems for manholes. Installer shall be completely trained in leak repair, surface preparation and corrosion materials application on manholes. Corrosion materials/products shall be suitable for installation in a severe hydrogen sulfide environment without any deterioration to the liner.
2. To ensure total unit responsibility, all materials and installation thereof shall be furnished and coordinated with/by one supplier/installer who turnkeys the work and assumes full responsibility for the entire operation.

15.2.5 Delivery, Storage and Handling

Handle and Store materials in accordance with manufacturer’s recommendations and MSDS.

15.2.6 Materials

Products shall be Spectrashield™, by CCI Spectrum, Inc.

1. The materials to be utilized in the lining of manholes shall be designed and manufactured to withstand the severe effects of hydrogen sulfide in a wastewater environment and eliminate all ground water infiltration. Manufacturer of corrosion protection products shall have long proven experience in the

production of the lining products utilized and shall have satisfactory installation record.

15.2.7 Equipment

1. 3000 psi hydro blasting equipment shall be suited to remove corroded materials from the existing concrete/brick structure.
2. Equipment for installation of lining materials shall be high quality grade and be as recommended by the manufacturer.
3. The lining system to be utilized for manhole structures shall be a multi-component stress skin panel liner system as described below:

a. Liner

<u>Installation</u>	<u>Liner</u>
Moisture Barrier	Modified Polymer
Surfacer	Polyurethane/Polymeric Blend Foam
Final Corrosion Barrier	Modified Polymer

b. Moisture Barrier - Modified polymer shall be sprayable, solvent free, two-component polymeric, and moisture/chemical barrier specifically developed for a corrosive wastewater environment. Typical chemical analysis is as follows:

<u>"A" Component</u>	
Viscosity, 77° F, cps, ASTM D-1638	300-400
Physical State	Liquid
Color	Clear to amber
Hygroscopicity	Reacts with water

<u>"B" Component</u>	
Viscosity, 160° F, cps, ASTM D-1638	400-600
Physical State	Liquid
Color	Flamingo Pink
Non-Volatile	100%

<u>Reaction Profile (100 grams, 175° F Sample)</u>	
Gel Time, Seconds	1-2
Tack Free Time, seconds	15
Cure Time, seconds	30

<u>Processing</u>	
A System/B system, volume ratio	1.00/1.00

<u>Typical Physical Properties</u>	
Tensile Strength, PSI	>1500
Elongation, %	>125
Tear Strength, PSI	350
Shore D Hardness	55-65
100% Modulus, PSI	>1500

c. Surfacers - Polyurethane Rigid Structure Foam, low viscosity two-component, containing flame retardants. Typical chemical analysis is as follows:

<u>"A" Component</u>	
Viscosity, 77° F, cps, ASTM D-1638	200
Physical State	Liquid
Color	Dark Brown
Hygroscopicity	Reacts with water and evolves CO2 gas
<u>"B" Component</u>	
Viscosity, 77° F, cps, ASTM D-1638	600-1000
Physical State	Liquid
Color	Tan
Hygroscopicity	Absorbs water rapidly thus changing ratio
Reaction Profile (100 grams, 77° F sample)	
Cream Time, seconds	1-4
Tack free time, seconds	5-8
Rise Time, seconds	6-10
<u>Processing</u>	
A System/B system, volume ratio	1.00/1.00
Typical Physical Properties	
Density, nominal, core, lbs/ft ³ ASTM D-1622 @ 74° F	4-10
Compression Strength, ASTM D-1621 @ 74° F parallel rise; PSI	90-150
Closed Cell Content, % - ASTM 1940 @ 74 °	Over 90
Shear Strength, PSI – ASTM C-273 @ 74° F	225-250

d. Final Corrosion Barrier - Total thickness of multi-component stress skin panel liner shall be a minimum of 500 mils.

15.2.8 Execution

15.2.8.1 Initial Inspection

1. Prior to conducting any work, perform inspection of structure to determine need for protection against hazardous gases or oxygen depleted atmosphere and the need for flow control or flow diversion.
2. Submit plan for flow control or bypass to owner/engineer for approval prior to conducting the work. Cost of flow control or bypass shall be included in cost of the manhole rehabilitation.

15.2.8.2 Surface Preparation

1. Conduct surface preparation program to include monitoring of atmosphere for hydrogen sulfide, methane, low oxygen or other gases, approved flow control equipment, and hydro blasting equipment.
2. Remove manhole steps by cutting flush with vertical face of manhole wall prior to rehabilitation product application.
3. Hydro blasting equipment shall remove all corrosion from structure. Final product shall be a cleaned, dry surface ready for liner application.
4. After completion of surface preparation, blasting phase, perform the seven point check list, which is the inspection for:
 1. Leaks
 2. Cracks
 3. Holes
 4. Exposed Rebar
 5. Ring and Cover condition
 6. Invert Condition
 7. Inlet and Outlet Pipe Condition
5. After the defects in the structure are identified, repair all leaks with a chemical or hydraulic sealant designed for used in field sealing of ground water. Severe cracks shall be “repaired with a urethane based chemical” sealant. Product to be utilized shall be as approved by owner/engineer prior to installation. Repairs to exposed rebar, defective pipe penetrations or inverts, etc. shall be repaired utilizing non-shrink grout or approved alternative method.
6. Benches, walls and floors shall be repaired or refinished as necessary to comply with Wastewater Management Division Standard Detail Drawings (Drawing No. S-502) using chemical grout, hydraulic cement or Portland type II cement. Bench areas and floors shall be lined with Spectrashield™.

15.2.8.3 Material Installation

1. The limits of the corrosion protection system shall include all exposed concrete/brick surfaces including walls, tap sections, risers, benches etc., unless otherwise directed by the owner/engineer.
2. Application of multi-component system shall be in strict accordance with manufacturer’s recommendation. Final installation shall be a minimum of 500 mils. A permanent identification number and date of work performed shall be affixed to the structure in a readily visible location.

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3. Provide final written report to owner/engineer detailing the location, date of report, and description of repair.

15.2.8.4 Final Inspection

1. Final concrete/brick structure corrosion protection system shall be completely free of pinholes or voids and has completely eliminated all ground water infiltration. Entire exposed concrete/brick surface shall be protected with corrosion protection system. Liner thickness shall be the minimum value as described here.
2. The Contractor, at his expense, shall provide all necessary labor, equipment and materials to re-inspect all rehabilitated manholes at two intervals, once at 18 months after the date of final inspection, and once at 34 months after final inspection. It will be the responsibility of the Construction Project Manager to schedule above inspections.