SECTION 330131.19 - RESTORATION OF MANHOLES

1. GENERAL
	* + 1. RELATED WORK SPECIFIED ELSEWHERE
				1. Earthwork: Section 310000.
				2. Sanitary Sewerage Piping: Section 333100.
			2. DESCRIPTION
				1. This Section prescribes the minimum standards for the safe and efficient restoration of manholes which are structurally stable, yet would benefit from sealing and reinforcing to extend their useful life.
			3. SUBMITTALS
				1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
				2. Manufacturer’s installation instructions shall be provided along with product data.
				3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
				4. Product Data: Catalog sheets, specifications, and application instructions for each material specified.
				5. Quality Control Submittals:

Test Reports: Furnish certified test data issued by an independent testing laboratory, demonstrating that the products submitted comply with the required physical properties.

Workers’ Qualifications Data:

Submit the names and addresses of 3 previous cementitious repair projects. Briefly describe nature of each project.

Submit a letter certifying the supervisor or foreman and the workers applying the repair materials have at least 2 years experience in the application of these materials.

* + - 1. QUALITY ASSURANCE
				1. Qualifications:

Manufacturer’s Qualifications: The manufacturer shall have qualified technical representatives with the technical expertise to advise the Contractor of application procedures required for repair materials under the particular job conditions.

Applicator’s Qualifications: The person supervising the Work of this Section and the workers applying the cementitious repair mortars shall have had 2 years experience and shall have worked on 3 cementitious repair projects of comparable scope and complexity to the work of this project.

* + - 1. DELIVERY, STORAGE, AND HANDLING
				1. Storage and Protection: Comply with the manufacturer’s printed instructions for material storage requirements.
				2. Deliver materials to the job site in original sealed containers clearly marked with manufacturer’s name, brand, and material description.
			2. PROJECT CONDITIONS
				1. Do not apply repair mortar until required restoration of substrate has been completed.
				2. Environmental Requirements:

Do not apply materials to surfaces that contain free water or frost.

Do not apply materials when the temperature is below 40 degrees F or will fall below that temperature within 24 hours.

* + - * 1. Safety Requirements:

Conduct all operations in strict accordance with applicable federal, state and local safety codes and regulations, including OSHA requirements.

Be familiar with Safe Working Requirements in confined spaces.

Perform gas-free testing prior to entering each manhole, and periodically throughout the workday.

1. PRODUCTS
	* + 1. MATERIALS
				1. Cleaning Material: Suitable industrial grade detergent and degreasing compound capable of removing bond-limiting surface contaminants.

Recommended by manufacturer for cleaning concrete, brick and masonry surfaces to allow proper bond of epoxy crack repair material, hydraulic cement, polyurethane grout, and cement-base structural repair mortars and coatings.

* + - * 1. Epoxy Surface Crack Sealer for repair of non-leaking cracks:

Epoxy-Resin-Base Bonding System: ASTM C 881, Type I or IV, Grade 3, Class A or B.

Bond Strength: 2300 psi (15.9 MPa), ASTM C 882.

Bond to Damp Concrete: 100 percent concrete failure, AASHTO T-237.

Tensile Strength: 4500 psi (31.0 MPa).

Acceptable Products: Concresive paste SPL by Master Builders, Inc., 23700 Chagrin Blvd., Cleveland, OH 44122, Telephone: (216) 831-6910; EVA-POX Epoxy Paste No. 22 by Epoxy Industries, Inc., 460 So. Pearl St., Albany, NY 1202, Telephone: (518) 465-7802, or approved equivalent.

* + - * 1. Pressure Injected Urethane Grout to stop flow of water:

One part hydrophilic urethane grout.

Cured grout to produce a stable, non-biodegradable flexible gel.

Acceptable Product: Concresive 1230 or Concresive 1250 by Master Builders, Inc., or approved equivalent.

* + - * 1. Hydraulic Cement to stop flow of water and active leaks:

Compressive Strength (ASTM C 109): 1000 psi (7.0 MPa) at 20-minute test age; 2800 psi (19.0 MPa) at 24-hour test age.

Expansion (ASTM C 157): 0.08 percent at 3-day test age.

Acceptable Product: EMACO 503 by Master Builders, Inc.

All visible leaks must be plugged prior to application of the cementitious liner. Quick setting, non-shrink hydraulic cement mortars of the same or greater strength than the Liner Mix and/or chemical grouts may be used. If water pressures are severe, relief holes may be drilled at the bottom of the manhole wall to concentrate the leaks before plugging.

* + - * 1. Liner Mix:

Densely compacted micro-silica-enhanced Portland cement mortar applied uniformly at a minimum thickness of 1/2 inch to interior surfaces of 48 inch diameter manholes up to 14 feet deep, as conditions require.

|  |  |  |
| --- | --- | --- |
| **PHYSICAL PROPERTIES** | **24 HOURS (Minimum)** | **28 DAYS (Average)** |
| Compressive Strength (ASTM C 109) | 3,000 psi | 10,000 psi |
| Flexural Strength (ASTM C 293) | 650 psi | 800 psi |
| Modulus of Elasticity (ASTM C 469) | 180,000 psi | 1,150,000 psi |

Increase the thickness for depths greater than 14 feet, as shown in the Liner Thickness Design Charts at the end of this Section. Liner mixes producing less than 3,000 psi compressive strength in the first 24 hours shall be applied at 1.5 times the prescribed minimum thickness.

Deliver the Liner mix in factory prepared packaging suitable for mixing with only the addition of clean water, at the prescribed rate. No additives shall be used at the Site without manufacturer’s approval.

Acceptable Liner Mix: Permacast MS-10,000 by Action Products Marketing Corp., P. O. Box 555, Johnston, IA 50131, Telephone: (515) 276-9610, or approved equivalent.

* + - * 1. External Manhole Chimney Seal:

Nominal 9-inch wide rubber sleeve conforming to ASTM C 923; minimum 3/16-inch thickness.

Physical Properties:

Tensile Strength: 1500 psi.

Hardness (Durometer): 48 + 5.

Elongation at break: 350 percent minimum.

Compression set: 18 percent maximum decrease.

Ozone resistance rating: zero.

Tear resistance: 200 lb f/in.

Corrugated shape allowing movement within the confines of the surrounding backfill, and 2-inch vertical movement without stretching the material.

Top and bottom compression bands: 16 gage stainless steel; ASTM A 240, Type 304.

Acceptable Manhole Chimney Seal: CRETEX Manhole Seal by Cretex Specialty Products, P. O. Box 26, Waukesha, WI 53187, Telephone: (414) 542-8153, or approved equivalent.

1. EXECUTION
	* + 1. PREPARATION
				1. Protect existing construction not required to be treated.
				2. Surface Preparation:

Place a covering over the manhole floor to collect debris and prevent solids from entering the sewer piping.

Pressure wash the interior of the manhole at 3500 psi or at a level sufficient to etch and thoroughly clean surfaces.

Remove all loose and defective material.

* + - 1. MIXING
				1. Adhere strictly to manufacturer’s published specifications and directions for proportioning and mixing by a certified applicator.
			2. EQUIPMENT
				1. Use equipment recommended by the manufacturer to ensure proper mixing and pumping.

Equipment shall be in good working order.

Engage trained workers to operate the equipment and perform the process.

Use a high speed centrifugal spraying device with a controllable retrieval method to produce a uniform dense application without the need to trowel.

* + - 1. APPLICATION
				1. Following preparation work on the interior surfaces of the manhole, commence application according to the manufacturer’s recommended procedures.

Apply a single coating at the prescribed thickness (see Liner Thickness Design Charts) without interruption so as to produce a uniform and monolithic liner of prescribed minimum thickness.

Multiple layers with time between applications that allow drying will not be acceptable.

* + - * 1. Upon completion of the lining process, cover the manhole to prevent air drying and evaporation.

In arid conditions or high temperatures, commercial curing compounds may be applied.

To prevent surface cracks, exercise particular care when the mix water content is at the lower end of the prescribed range.

* + - 1. TESTING AND VERIFICATION
				1. Verify thicknesses, with a wet gage, in the presence of the Director’s Representative.

Any area found to be less than the prescribed minimum thickness shall immediately receive the additional material needed.

* + - * 1. Cast 2 test cubes from each day’s mix and test for strength verification under the direction of the Director’s Representative.
			1. LINER THICKNESS DESIGN CHARTS
				1. Design parameters are based upon the following assumptions pertaining to the mortar material:

Minimum 3,000 psi compressive strength in first 24 hours.

Minimum 750,000 psi modulus of elasticity.

Extremely dense to prevent water migration (levels less than 1,000 coulombs).

* + - * 1. When a measurable thickness of the original wall has been lost, the new liner shall be increased in thickness an equal amount.
				2. Relined manholes are most adversely affected by traffic loads passing over or near the structure and hydrostatic loads from external ground water pressures. Since these factors are the most critical factors, design calculations, which overcome each factor, are more than sufficient to overcome all other factors. Vehicular loading moments affect the top 2 feet (600 mm) only and can be categorized as light or heavy. Ground water pressure increases with depth, requiring increase in liner thickness also with depth.

# LIGHT TRAFFIC LOADS

 Age = 12 Hours Age = 24 Hours Age = 7 Days

| **Diameter** | **Depth** | **Thickness** | **Diameter** | **Depth** | **Thickness** | **Diameter** | **Depth** | **Thickness** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **(In.)** | **(Ft.)** | **(In.)** | **(In.)** | **(Ft.)** | **(In.)** | **(In.)** | **(Ft.)** | **(In.)** |
| 24 | 1 | 1 | 24 | 1 | 1 | 24 | 1 | 0.75 |
| 24 | 2 | 0.5 | 24 | 2 | 0.5 | 24 | 2 | 0.5 |
| 24 | 3 | 0.5 | 24 | 3 | 0.5 | 24 | 3 | 0.5 |
| 24 | 4 | 0.5 | 24 | 4 | 0.5 | 24 | 4 | 0.5 |
| 36 | 1 | 1.25 | 36 | 1 | 1 | 36 | 1 | 1 |
| 36 | 2 | 0.5 | 36 | 2 | 0.5 | 36 | 2 | 0.5 |
| 36 | 3 | 0.5 | 36 | 3 | 0.5 | 36 | 3 | 0.5 |
| 36 | 4 | 0.5 | 36 | 4 | 0.5 | 36 | 4 | 0.5 |
| 48 | 1 | 1.5 | 48 | 1 | 1.25 | 48 | 1 | 1 |
| 48 | 2 | 0.5 | 48 | 2 | 0.5 | 48 | 2 | 0.5 |
| 48 | 3 | 0.5 | 48 | 3 | 0.5 | 48 | 3 | 0.5 |
| 48 | 4 | 0.5 | 48 | 4 | 0.5 | 48 | 4 | 0.5 |

**LEGAL LIMIT TRAFFIC LOADS**

 Age = 12 Hours Age = 24 Hours Age = 7 Days

| **Diameter** | **Depth** | **Thickness** | **Diameter** | **Depth** | **Thickness** | **Diameter** | **Depth** | **Thickness** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **(In.)** | **(Ft.)** | **(In.)** | **(In.)** | **(Ft.)** | **(In.)** | **(In.)** | **(Ft.)** | **(In.)** |
| 24 | 1 | 1.75 | 24 | 1 | 1.25 | 24 | 1 | 1.25 |
| 24 | 2 | 0.5 | 24 | 2 | 0.5 | 24 | 2 | 0.5 |
| 24 | 3 | 0.5 | 24 | 3 | 0.5 | 24 | 3 | 0.5 |
| 24 | 4 | 0.5 | 24 | 4 | 0.5 | 24 | 4 | 0.5 |
| 36 | 1 | 2 | 36 | 1 | 1.75 | 36 | 1 | 1.5 |
| 36 | 2 | 0.5 | 36 | 2 | 0.5 | 36 | 2 | 0.5 |
| 36 | 3 | 0.5 | 36 | 3 | 0.5 | 36 | 3 | 0.5 |
| 36 | 4 | 0.5 | 36 | 4 | 0.5 | 36 | 4 | 0.5 |
| 48 | 1 | 2.25 | 48 | 1 | 1.75 | 48 | 1 | 1.75 |
| 48 | 2 | 0.5 | 48 | 2 | 0.5 | 48 | 2 | 0.5 |
| 48 | 3 | 0.5 | 48 | 3 | 0.5 | 48 | 3 | 0.5 |
| 48 | 4 | 0.5 | 48 | 4 | 0.5 | 48 | 4 | 0.5 |

**HYDROSTATIC LOADS**

 Age = 12 Hours Age = 24 Hours Age = 7 Days

| **Diameter** | **Depth** | **Thickness** | **Diameter** | **Depth** | **Thickness** | **Diameter** | **Depth** | **Thickness** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **(In.)** | **(Ft.)** | **(In.)** | **(In.)** | **(Ft.)** | **(In.)** | **(In.)** | **(Ft.)** | **(In.)** |
| 24 | 4 | 0.5 | 24 | 4 | 0.5 | 24 | 4 | 0.5 |
| 24 | 6 | 0.5 | 24 | 6 | 0.5 | 24 | 6 | 0.5 |
| 24 | 8 | 0.5 | 24 | 8 | 0.5 | 24 | 8 | 0.5 |
| 24 | 10 | 0.5 | 24 | 10 | 0.5 | 24 | 10 | 0.5 |
| 24 | 12 | 0.5 | 24 | 12 | 0.5 | 24 | 12 | 0.5 |
| 24 | 14 | 0.75 | 24 | 14 | 0.5 | 24 | 14 | 0.5 |
| 24 | 16 | 0.75 | 24 | 16 | 0.5 | 24 | 16 | 0.5 |
| 24 | 18 | 0.75 | 24 | 18 | 0.75 | 24 | 18 | 0.5 |
| 24 | 20 | 0.75 | 24 | 20 | 0.75 | 24 | 20 | 0.5 |
| 24 | 30 | 0.75 | 24 | 30 | 0.75 | 24 | 30 | 0.75 |
| 24 | 40 | 1 | 24 | 40 | 0.75 | 24 | 40 | 0.75 |
| 36 | 4 | 0.5 | 36 | 4 | 0.5 | 36 | 4 | 0.5 |
| 36 | 6 | 0.5 | 36 | 6 | 0.5 | 36 | 6 | 0.5 |
| 36 | 8 | 0.75 | 36 | 8 | 0.5 | 36 | 8 | 0.5 |
| 36 | 10 | 0.75 | 36 | 10 | 0.75 | 36 | 10 | 0.5 |
| 36 | 12 | 0.75 | 36 | 12 | 0.75 | 36 | 12 | 0.5 |
| 36 | 14 | 0.75 | 36 | 14 | 0.75 | 36 | 14 | 0.75 |
| 36 | 16 | 0.75 | 36 | 16 | 0.75 | 36 | 16 | 0.75 |
| 36 | 18 | 0.75 | 36 | 18 | 0.75 | 36 | 18 | 0.75 |
| 36 | 20 | 1 | 36 | 20 | 0.75 | 36 | 20 | 0.75 |
| 36 | 30 | 1 | 36 | 30 | 1 | 36 | 30 | 0.75 |
| 36 | 40 | 1 | 36 | 40 | 1 | 36 | 40 | 1 |
| 48 | 4 | 0.5 | 48 | 4 | 0.5 | 48 | 4 | 0.5 |
| 48 | 6 | 0.75 | 48 | 6 | 0.75 | 48 | 6 | 0.5 |
| 48 | 8 | 0.75 | 48 | 8 | 0.75 | 48 | 8 | 0.5 |
| 48 | 10 | 0.75 | 48 | 10 | 0.75 | 48 | 10 | 0.75 |
| 48 | 12 | 0.75 | 48 | 12 | 0.75 | 48 | 12 | 0.75 |
| 48 | 14 | 1 | 48 | 14 | 0.75 | 48 | 14 | 0.75 |
| 48 | 16 | 1 | 48 | 16 | 1 | 48 | 16 | 0.75 |
| 48 | 18 | 1 | 48 | 18 | 1 | 48 | 18 | 0.75 |
| 48 | 20 | 1 | 48 | 20 | 1 | 48 | 20 | 0.75 |
| 48 | 30 | 1.25 | 48 | 30 | 1 | 48 | 30 | 1 |
| 48 | 40 | 1.25 | 48 | 40 | 1.25 | 48 | 40 | 1 |

* + - 1. CHIMNEY SEAL INSTALLATION
				1. Install external manhole chimney seal in accordance with manufacturer’s printed instructions.

END OF SECTION 330130.91