REHABILITATION OF EXISTING MANHOLES

PART 1 - GENERAL

1.01 SECTION INCLUDES

Rehabilitation of existing manholes.

1.02 DESCRIPTION OF WORK

Rehabilitate existing manholes to waterproof and to prevent inflow and infiltration, to prevent corrosion, or to reestablish the structural integrity of the manhole. Includes construction of structural liners, protective liners, and infiltration barriers.

1.03 SUBMITTALS

Comply with Division 1 - General Provisions and Covenants, as well as the following:

A. Concrete mix design, if required by the Engineer.

B. Catalog cuts of all mortar mixes, sealants, and liners.

1.04 SUBSTITUTIONS

Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING

Comply with Division 1 - General Provisions and Covenants.

1.06 SCHEDULING AND CONFLICTS

Comply with Division 1 - General Provisions and Covenants.

1.07 SPECIAL REQUIREMENTS

None.

1.08 MEASUREMENT AND PAYMENT

A. Infiltration Barriers:

1. **Rubber Chimney Seal:**
   a. **Measurement:** Each rubber chimney seal installed on an existing manhole will be counted.
   b. **Payment:** Payment will be made at the unit price for each chimney seal.
   c. **Includes:** Unit price includes, but is not limited to, all necessary compression or expansion bands and extension sleeves as necessary to complete chimney seal.

2. **Molded Shield:**
   a. **Measurement:** Each molded shield installed on an existing manhole will be counted.
   b. **Payment:** Payment will be made at the unit price for each molded shield.
   c. **Includes:** Unit price includes, but is not limited to, sealant.

3. **Urethane Chimney Seal:**
   a. **Measurement:** Each urethane chimney seal installed on an existing manhole will be counted.
   b. **Payment:** Payment will be at the unit price for each urethane chimney seal.
   c. **Includes:** Unit price includes, but is not limited to, preparing the surface of the manhole and furnishing and applying primer and urethane chimney seal according to the manufacturer's requirements.

1.08 MEASUREMENT AND PAYMENT (Continued)

B. In-Situ Manhole Replacement, Cast-in-place Concrete:

1. **Measurement:** The vertical dimension of in-situ manhole replacement will be measured in feet from the lowest flowline to the top of the rim.

2. **Payment:** Payment will be at the unit price per vertical foot.

3. **Includes:** Unit price includes, but is not limited to, handling of sewer flows as required to properly complete the installation, invert overlay as recommended by the manufacturer, replacement of existing casting with a new casting, and testing the manhole upon completion.

C. In-Situ Manhole Replacement, Cast-in-place Concrete with Plastic Liner:

1. **Measurement:** The vertical dimension of in-situ manhole replacement with plastic liner will be measured in feet from the lowest flowline to the top of the rim.

2. **Payment:** Payment will be at the unit price per vertical foot.

3. **Includes:** Unit price includes, but is not limited to, handling of sewer flows as required to properly complete the installation, invert overlay as recommended by the manufacturer, replacement of existing casting with a new casting, sealing at the frame and cover, sealing pipe penetrations as recommended by the manufacturer, and testing the manhole upon completion.

D. Manhole Lining with Centrifugally Cast Cementitious Mortar Liner with Epoxy Seal:

1. **Measurement:** The vertical dimension of manhole lining will be measured for depth in feet from the bottom of the lining to the top of the lining for each liner thickness specified.

2. **Payment:** Payment will be at the unit price per vertical foot for each liner thickness.

3. **Includes:** Unit price includes, but is not limited to, the handling of sewer flows during lining operations as required to properly complete the installation, and salvaging and reusing existing casting.

E. Multi-Layer Polyurea/Polyurethane Lining System:

1. **Measurement:** The vertical dimension of the lined structure with multi-layer polyurea/polymer protective liner will be measured in feet from the lowest flowline to the top of the rim.

2. **Payment:** Payment will be at the unit price per vertical foot for each structure size.

3. **Includes:** Unit price includes, but is not limited to, the handling of sewer flows during lining operations as required to properly complete the installation, and salvaging and reusing existing casting.

F. Remove and Replace Casting:

1. **Measurement:** Each casting to remove and replace will be counted.

2. **Payment:** Payment will be at the unit price for each casting to be removed and replaced.

3. **Includes:** Unit price includes, but is not limited to, furnishing and installing adjustment rings, installing new infiltration barrier (sanitary sewer manholes only), and salvaging existing casting for the Jurisdiction.

PART 2 - PRODUCTS

2.01 INFILTRATION BARRIER

A. Rubber Chimney Seal: Comply with Section 6010, 2.11 for external and internal rubber chimney seals.

B. Molded Shield: Comply with Section 6010, 2.11 for molded shields.

C. Heat Shrink Sleeve: Comply with Section 6010, 2.11 for heat shrink sleeves.

D. Urethane Chimney Seal: Comply with the following table for the physical properties.

Table 6020.01: Physical Properties

Property	ASTM Test Method	Acceptable Value
Elongation	D 412	800%, minimum
Tensile Strength	D 412	1150 psi, minimum
Adhesive Strength	D 903	175 lb/in, minimum
Pressure Resistance	C 1244	2 minutes

2.02 IN-SITU MANHOLE REPLACEMENT, CAST-IN-PLACE CONCRETE

A. Forming System: Provide an internal forming system capable of forming a new and structurally independent manhole wall within the existing manhole, with the specified thickness and conforming to the general shape of the existing manhole.

B. Concrete: Comply with Section 7010, 2.01, A.

C. Plastic Liner: When specified, provide a PVC or PE plastic liner resistant to degradation by sulfuric acid. Use a liner capable of being attached to the exterior of the forming system during erection of the forms. Use a plastic liner with a ribbed or studded exterior surface suitable for anchoring to the newly formed interior wall.

D. Casting: Provide new casting. Comply with Section 6010, 2.10.

2.03 CENTRIFUGALLY CAST CEMENTITIOUS MORTAR LINER WITH EPOXY SEAL

A. Cementitious Lining:

1. Use a high-strength, high-build, corrosion-resistant mortar, based on Portland cement fortified with micro silica. Mixed mortar is to have a paste-like consistency that may be sprayed, cast, pumped, or gravity-flowed into any area 1/2 inch and larger.

2.03 CENTRIFUGALLY CAST CEMENTITIOUS MORTAR LINER WITH EPOXY SEAL (Continued)

2. Comply with the following table for physical properties.

Table 6020.02: Physical Properties

Property	Value
Unit Weight	102 to 130 pcf
Set Time at 70° F ASTM C 403 Initial Set / Final Set	240 minutes / 480 minutes
Modulus of Elasticity ASTM C 469 24 hours / 28 days	180,000 psi min. / 1,150,000 psi min.
Flexural Strength ASTM C 293 24 hours / 28 days	650 psi min. / 800 psi min.
Compressive Strength ASTM C 109 24 hours / 28 days	3,000 psi / 10,000 psi
Tensile Strength ASTM C 307	600 psi
Shear Bond ASTM C 882	>1,000 psi
Shrinkage ASTM C 157	None
Chloride Permeability ASTM C 1202	<550 Coulombs

3. Use a lining containing a liquid admixture for the prevention of micro-biologically induced corrosion.

B. Corrosion-Resistant Epoxy Lining:

1. Use a two-component 100% solids epoxy formulated for use in sewer systems.

2. Comply with the following table for physical properties.

Table 6020.03: Physical Properties

Property	Value
Dry Time	4-6 hours at 75° F; 50% Relative Humidity
Compressive Strength ASTM D 695	15,000 psi min.
Flexural Strength ASTM D 790	11,000 psi min.
Tensile Strength ASTM D 638	4,500 psi min.
Hardness ASTM D 2240	68 to 90 Shore D
Ultimate Elongation ASTM D 638	3.5 to 5.5 %
Adhesion ASTM D 7234	Substrate Failure

C. Casting: Provide new casting. Comply with Section 6010, 2.10.

2.04 MULTI-LAYER POLYUREA/POLYURETHANE LINING SYSTEM

A. Lining System: Comprised of polyurea adhesion coating, polyurethane surface material, and polyurea final layer.

B. Polyurea Adhesion Coating and Final Layers: Fast set, spray applied, two component that is 100% solid, contain no volatile organic compounds, moisture tolerant, elastomeric polyurea providing infiltration and corrosion protection. Ensure material is capable of curing properly given the specific project site conditions and conforms to the following table.

2.04 MULTI-LAYER POLYUREA/POLYURETHANE LINING SYSTEM (Continued)

Table 6020.05: Physical Properties

Property	Specifications	Value
Harness	ASTM D 224	D 48
Tensile Strength	ASTM D 412	3300 psi
Modulus (100%)	ASTM D 412	1650 psi
Modulus (200%)	ASTM D 412	1950 psi
Modulus (300%)	ASTM D 412	2650 psi
Elastomer Tear Strength	ASTM D 624	400 psi
Elongation	ASTM D 412	<395%
Taber Abrasion	CS-17 Wheel	<15mg
Severe Wastewater Analysis Testing	ASTM G 210	Pass

C. Polyurethane Surface Layer: Spray applied, two component that is high closed cell content, contain no volatile organic compounds, be moisture tolerant, elastomeric polyurethane. Ensure material is capable of curing properly given the specific project site conditions and conforms to the following table.

Table 6020.06: Physical Properties

Property	Value
Density ASTM D 1622	6-8 pcf
Compressive Strength ASTM D 1621	130-180 psi
Closed Cell Content	>94%
Water Absorption	<0.03 lbs/sq ft
Maximum Service Temperature	180
Ultimate Elongation ASTM D 638	3.5 to 5.5 %
Adhesion ASTM D 7234	Substrate Failure

PART 3 - EXECUTION

3.01 INFILTRATION BARRIER

A. Rubber Chimney Seal: Comply with Section 6010, 3.01.

B. Molded Shield: Comply with Section 6010, 3.01.

C. Urethane Chimney Seal: Use only when specified in the contract documents.

1. Prepare the surface according to the manufacturer's recommendations, including sandblasting, pressure washing, sealing leaks or gaps, and drying the surface.

2. Apply primer, prepare product, and brush-apply the seal to a minimum thickness of 175 mils, covering 2 inches above the bottom of the frame and the entire adjustment ring area to 3 inches below the bottom adjustment ring.

3.02 IN-SITU MANHOLE REPLACEMENT, CAST-IN-PLACE CONCRETE

A. Preparation: Prepare according to the forming system manufacturer's recommendations, including the following:

1. Clean the existing surface to remove loose material and debris.

2. Remove existing steps that might interfere with the erection of the forms.

3. Control infiltration that may affect placement of concrete.

B. Installation: Install and test according to the forming system manufacturer's recommendations, including the following:

1. Place pipe extensions through the structure to maintain flow during installation.

2. Erect forms inside the manhole. Secure the assembled internal forms to prevent shifting and to provide sufficient stiffness and strength to prevent collapse.

3. Install a plastic liner when specified.

4. Seal the forms at the bottom of the manhole to ensure the concrete does not enter the sewer.

5. Carefully place concrete between the forms and the existing manhole walls. Place concrete from the bottom up to prevent segregation of concrete.

6. Consolidate concrete as required to fill all pockets, seams, and cracks within the existing manhole wall.

7. Remove the forms when the concrete has cured sufficiently.

8. Weld and test joints if a plastic liner is installed.

9. Apply a sealing strip around the circumference of the invert top where it meets the vertical wall and around all pipe penetrations to form a waterstop.

10. Overlay the invert top with concrete or high-strength mortar. Vary thickness from 3 inches at the wall to 1/2 inch at the edge of the channel.

3.02 IN-SITU MANHOLE REPLACEMENT, CAST-IN-PLACE CONCRETE (Continued)

11. Apply an epoxy lining to the invert top. Apply clean sand to the epoxy to create a non-slip surface.

12. Seal the plastic liner to the manhole casting and existing pipe stubs as recommended by the manufacturer.

13. Install new casting.

3.03 CENTRIFUGALLY CAST CEMENTITIOUS MORTAR LINER WITH EPOXY SEAL

A. Surface Preparation: Prepare according to the manufacturer's recommendations, including the following:

1. Wash the interior with a high-pressure washer.

2. Plug active leaks with the appropriate sealing material.

B. Mortar Application: Apply according to the manufacturer's recommendations, including the following:

1. Apply with a rotating centrifugal casting applicator, beginning at the bottom of the manhole.

2. Retrieve the applicator head at the manufacturer's recommended speed to achieve the desired thickness.

3. Apply to the full required thickness utilizing multiple passes as necessary. Minimize the time between passes so subsequent passes are cast against fresh mortar.

4. Verify thickness with a wet gauge at several locations to ensure proper depth.

5. Hand-apply high-strength mortar to the invert surface. Vary thickness from 3 inches at the wall to 1/2 inch at the edge of the channel.

C. Epoxy Seal Application: Seal according to the manufacturer's recommendations, including the following:

1. Apply with a rotating centrifugal casting applicator or airless sprayer onto the fresh mortar liner.

2. If the epoxy seal is applied more than 24 hours after application of the mortar liner, or if the mortar liner is contaminated, clean the liner and then apply the epoxy.

D. Finishing: Install a new casting.

3.04 MULTI-LAYER POLYUREA/POLYURETHANE PROTECTIVE LINING SYSTEM

A. Surface Preparation: Prepare according to the manufacturer's recommendations and the following.

1. Provide a surface compatible for installation of the liner system, which may include high pressure water cleaning, hydro blasting, abrasive blasting, grinding, or detergent water cleaning.

2. Produce a cleaned, abraded, and sound surface with no evidence of laitance, loose concrete, brick or mortar, contaminants or debris.

3.04 MULTI-LAYER POLYUREA/POLYURETHANE PROTECTIVE LINING SYSTEM (Continued)

3. After the defects in the structure are identified, repair all leaks with a chemical or hydraulic sealant designed for use in field sealing of ground water. Repair severe cracks with a urethane-based chemical sealant, as approved by Jurisdiction prior to installation. Repair exposed rebar, defective pipe penetrations, or inverts utilizing non- shrink grout or approved alternative method.

B. Lining Material Installation: Apply according to the manufacturer's recommendations and the following.

1. Ensure an adhesion layer minimum thickness of 50 mils.

2. Apply the polyurethane liner system surface layer to a thickness of no less than 400 mils. Also use this material to produce a uniform interior wall surface prior to the installation of the final layer.

3. Ensure final installation is a minimum of 50 mils of the lining.

C. Quality Assurance and Acceptance:

1. The Engineer will conduct a visual inspection of the completed lining system prior to acceptance. Any deficiencies in the finished liner system will be marked. Repair marked deficiencies according to the manufacturer's recommendations.

2. Utilize high voltage holiday detection to inspect for pinholes or breaches in the liner system installation according to ASTM D 4787.

3. When required, verify thickness of the application by point depth checks into the surface layer component and/or physical removal of a small area of the polyurethane material. Repair the test areas immediately following the test at the Contractor's expense.

3.05 CASTING

Install casting per Section 6010, 3.01, J.

3.06 CLEANING, INSPECTION, AND TESTING

Comply with Section 6030 for in-situ manhole replacement and centrifugally cast mortar lined rehabilitation.

END OF SECTION