SECTION 02601

PRECAST CONCRETE MANHOLES

PART 1 G E N E R A L

1.1 SECTION INCLUDES

A. Precast concrete sanitary sewer manholes.

B. Precast concrete sanitary sewer manholes with spray-in liner where corrosion-resistant manholes are specifically indicated in the Drawings.

1.2 UNIT PRICES

A. Measurement and payment for normal depth manholes, up to 8 feet deep, is on a unit price basis for each manhole installed. Depth is measured from top of cover to sewer invert.

B. Measurement and payment for shallow depth manholes is on a unit price basis for each manhole installed. Shallow manholes have a depth of 4 feet or less measured from the top of cover to sewer invert.

C. Measurement and payment for extra depth manholes is on a unit price basis per vertical foot for each foot of depth greater than 8 feet. Depth is measured from top of cover to sewer invert.

D. Measurement and payment for normal depth corrosion resistant manholes, up to 8 feet deep, is on a unit price basis for each manhole installed. Depth is measured from top of cover to sewer invert.

E. Measurement and payment for extra depth corrosion resistant manholes is on a unit price basis per vertical foot for each foot of depth greater than 8 feet. Depth is measured from top of cover to sewer invert.

F. Measurement and payment for normal depth standard manhole drops up to 3 feet deep is on a unit price basis for each drop installed. Depth is measured from the invert of the T- fitting to the sewer invert. Standard manhole drops include both internal and external drops.

G. Measurement and payment for extra depth manhole drops is on a unit price basis per vertical foot for each foot of depth greater than 3 feet. Depth is measured from the invert of the T-fitting to the sewer invert. Standard manhole drops include both internal and external drops.

1.3 SUBMITTALS

A. Conform to requirements of all sections and provisions of these specifications.

B. Submit manufacturer's data and details of following items for approval:

1. Shop drawings of manhole sections and base units and construction details, including reinforcement, jointing methods, materials and dimensions.

2. Certification from manufacturer that precast manhole design is in full accordance with ASTM C 478 and design criteria as established in paragraph 2.01 E of this specification.

3. Frames, grates, rings, and covers.

4. Materials to be used in fabricating drop connections.

5. Materials to be used for pipe connections at manhole walls.

6. Materials to be used for stubs and stub plugs, if required.

7. Materials and procedures for corrosion-resistant liner and coatings, if required.

8. Plugs to be used for sanitary sewer hydrostatic testing.

9. Manufacturer's data for pre-mix (bag) concrete, if used for channel inverts and benches.

PART 2 P R O D U C T S

2.1 PRECAST CONCRETE MANHOLES

A. Use manhole sections and base sections conforming to ASTM C 478. Use base riser section with integral floors, unless shown otherwise. Provide adjustment rings which are standard components of the manufacturer of the manhole sections meeting material requirements of ASTM C 478. Mark date of manufacture and name or trademark of manufacturer on inside of barrel.

B. Construct barrels for precast manholes from 48-inch diameter standard reinforced concrete manhole sections unless otherwise indicated on Drawings. Use various lengths of manhole sections in combination to provide the correct height with the fewest joints. Wall sections shall be designed for depth as shown and loading conditions as described in paragraph 2.01E, but shall not be less than 5 inches thick. Base section shall have a minimum thickness of 12 inches under the invert.

C. Provide cone tops to receive cast iron frames and covers, unless indicated otherwise. Use tops designed to support an H-20 loading.

D. Where the Drawings indicate that manholes larger than 48-inch diameter are required, precast base sections of the required diameter shall be provided with flat slab top precast sections used to transition to 48-inch diameter manhole access riser sections. Transition can be concentric or eccentric. The transition shall be located to provide a minimum of 7-foot head clearance from the top of bench to underside of transition.

E. Design Loading Criteria: The manhole walls, transition slabs, cone tops, and manhole base slab shall be designed by the manufacturer to the requirements of ASTM C 478 for the depth as shown on Drawings and the following design criteria:

1. AASHTO H-20 loading applied to the manhole cover and transmitted down to the transition and base slabs.

2. Unit soil weight of 120 pcf located above all portions of the manhole, including base slab projections.

3. Lateral soil pressure based on saturated soil conditions producing an at-rest equivalent fluid pressure of 100 pcf, with soil pressure acting on empty manhole.

4. Internal liquid pressure based on a unit weight of 63 pcf, with manhole filled with liquid from invert to cover, with no balancing external soil pressure.

5. Dead load of manhole sections fully supported by the transition and base slabs.

6. Design additional reinforcing steel to transfer stresses at openings.

7. The minimum clear distance between any two wall penetrations shall be 12 inches or half the diameter of the smaller penetration, whichever is greater.

F. Form joints between sections with O-ring gaskets conforming to ASTM C 443.

G. Do not incorporate manhole steps in manhole sections.

H. Do not use brick masonry in construction of sanitary sewer manholes.

2.2 CONCRETE

A. Conform to requirements of Section 03305 - Concrete for Utility Construction.

B. Channel Inverts: Concrete for inverts not integrally formed with manhole base shall be either 5 sack premix (bag) concrete or Class A concrete, with a minimum compressive strength of 4000 psi.

C. Cement Stabilized Sand Foundation: Provide cement stabilized sand foundation under base section in lieu of foundation slab, where allowed, conforming to requirements of Section 02252 - Cement Stabilized Sand.

D. Concrete Foundation: Use Class A concrete with minimum compressive strength of 4000 psi for concrete foundation slab under manhole base section where indicated on Drawings.

2.3 REINFORCING STEEL

A. Reinforcing steel shall conform to requirements of Section 03305 - Concrete for Utility Construction.

2.4 MORTAR

A. Conform to requirements of ASTM C 270, Type S using Portland cement.

2.5 MISCELLANEOUS METALS

A. Provide cast-iron frames, rings, and covers conforming to requirements of Section 02603 - Frames, Grates, Rings and Covers.

2.6 DROP CONNECTIONS AND STUBS

A. Drop connections and stubs shall conform to the same pipe material requirements used in the main pipe, unless otherwise indicated on the Drawings.

2.7 PIPE CONNECTIONS FOR SANITARY SEWERS

A. Use resilient connectors conforming to requirements of ASTM C 923. Metallic mechanical devices as defined in ASTM C 923 shall be made of the following materials:

1. External clamps: Type 304 stainless steel

2. Internal, expandable clamps on standard manholes: Type 304 stainless steel, 11 gage minimum.

3. Internal, expandable clamps on corrosion-resistant manholes:

a. Type 316 stainless steel, 11 gage minimum, or

b. Type 304 stainless steel, 11 gauge minimum, coated with minimum 16 mil fusion-bonded epoxy conforming to AWWA C 213.

B. Where rigid joints between pipe and a cast-in-place manhole base are specified or shown on the Drawings, use polyethylene-isoprene waterstop meeting the physical property requirements of ASTM C 923, Press-Seal WS Series, or equal.

2.8 SEALANT MATERIALS

A. Sealing materials between precast concrete adjustment ring and manhole cover frame shall be Adeka Ultraseal P201, or approved equal.

2.9 CORROSION RESISTANT MANHOLE MATERIALS

A. Spray application shall be applied by an applicator trained by manufacturer and certified for the application of the specified product with documented exceptional reference and experience of at least 5 years in manhole spray applications.

B. Sanitary sewer acceptance testing Section 02732 shall be completed prior to applying coating application for manholes.

C. Acceptable products include the following (alternates must be approved by the City):

1. Sprayroq protective liner system (SprayWall**)**

2. Carboline Plasite 4500

3. Spectra Shield

D. The Contractor shall make provisions in their unit price bid for each structure to maintain dry conditions for the corrosion resistant liner application and subsequent curing as per manufacturer's recommendations.

2.10 BACKFILL MATERIALS

A. Backfill materials shall conform to the requirements of Section 02227 - Excavation and Backfill for Utilities.

2.11 NON-SHRINK GROUT

A. For non-shrink grout, use prepackaged, inorganic, flowable, non-gas-liberating, non-metallic, cement-based grout requiring only the addition of water. It shall meet the requirements of ASTM C 1107 and shall have a minimum 28-day compressive strength of 7000 psi.

2.12 PROHIBITED MATERIALS

A. Do not use brick masonry for construction of sanitary sewer manholes, including adjustment of manholes to grade. Use only specified materials listed above.

PART 3 E X E C U T I O N

3.1 EXAMINATION

A. Verify lines and grades are correct.

B. Determine if the subgrade, when scarified and recompacted, can be compacted to 95 percent of maximum Standard Proctor Density according to ASTM D 698 prior to placement of foundation material and base section. If it cannot be compacted to that density, the subgrade shall be moisture conditioned until that density can be reached or shall be treated as an unstable subgrade.

Do not build sanitary sewer manholes in ditches, swales, or drainage paths unless directed by the Owner Representative.

3.2 PLACEMENT

A. Install precast manholes to conform to locations and dimensions shown on Drawings.

B. Place manholes at points of change of alignment, grade, size, pipe intersections, and end of sewer.

3.3 MANHOLE BASE SECTIONS AND FOUNDATIONS

A. Place precast base on 12-inch-thick (minimum) foundation of cement stabilized sand or a concrete foundation slab. Compact cement-sand in accordance with requirements of Section 02252 - Cement Stabilized Sand.

B. Unstable Subgrade Treatment: When unstable subgrade is encountered, the subgrade will be examined by the Owner Representative to determine if the subgrade has heaved upwards after being excavated. If heaving has not occurred, the subgrade shall be over-excavated to allow for a 24-inch thick layer of crushed stone wrapped in filter fabric as the foundation material under the manhole base. If there is evidence of heaving, a pile-supported concrete foundation, as detailed on the Drawings, shall be provided under the manhole base, when indicated by the Owner Representative.

3.4 PRECAST MANHOLE SECTIONS

A. Install sections, joints, and gaskets in accordance with manufacturer's printed recommendations.

B. Install precast adjustment rings above tops of cones or flattop sections as required to adjust the finished elevation and to support manhole frame.

C. Seal any lifting holes with non-shrink grout.

D. Where corrosion resistant lining is required, seal joints between sections in accordance with manufacturers recommendations.

3.5 PIPE CONNECTIONS AT MANHOLES

A. Install approved resilient connectors at each pipe entering and exiting sanitary sewer manholes in accordance with manufacturer's instructions.

B. Ensure that no concrete, cement stabilized sand, fill, or other rigid material is allowed to enter the space between the pipe and the edge of the wall opening at and around the resilient connector on either the interior or exterior of the manhole. If necessary, fill the space with a compressible material to guarantee the full flexibility provided by the resilient connector.

C. Test connection for watertight seal before backfilling.

3.6 INVERTS FOR SANITARY SEWERS

A. Construct invert channels to provide a smooth flow transition waterway with no disruption of flow at pipe-manhole connections. Conform to following criteria:

1. Slope of invert bench: 1 inch per foot minimum; 1-1/2 inch per foot maximum

2. Depth of bench to invert:

a. Pipes smaller than 15-inches: one-half largest pipe diameter

b. Pipes 15 to 24-inches: three-fourths the largest pipe diameter.

c. Pipes larger than 24-inches: equal to the largest pipe diameter

3. Invert slope through manhole: 0.10-foot drop across manhole with smooth transition of invert through manhole, unless otherwise indicated on Drawings.

B. Form invert channels with concrete if not integral with manhole base section. For direction changes of mains, construct channels tangent to mains with maximum possible radius of curvature. Provide curves for side inlets and smooth invert fillets for flow transition between pipe inverts.

3.7 DROP CONNECTIONS FOR SANITARY SEWERS

A. Backfill drop assembly with cement stabilized sand or Class A concrete to form a solid mass. Extend cement stabilized sand or concrete encasement a minimum of 4 inches outside of bells.

B. Install a drop connection when a sewer line enters a manhole higher than 30-inches above the invert of a manhole.

3.8 STUBS FOR FUTURE CONNECTIONS

A. In manholes, where future connections are indicated on the Drawings, install resilient connectors and pipe stubs with approved watertight plugs.

3.9 MANHOLE FRAME AND ADJUSTMENT RINGS

A. Combine precast concrete adjustment rings so that the elevation of the installed casting cover is 3/8 inch below the pavement surface. Seal between adjustment ring and the precast top section with non-shrink grout; do not use mortar between adjustment rings. Apply a latex-based bonding agent to precast concrete surfaces to be joined with non-shrink grout. Set the cast iron frame on the adjustment ring in a bed of approved sealant. The sealant bed shall consist of two beads of sealant, each bead having minimum dimensions of 1/2-inch and 3/4-inch wide.

B. For manholes in unpaved areas, top of frame shall be set a minimum of 6 inches above existing ground line unless otherwise indicated on Drawings. In unpaved areas, encase the manhole frame in mortar or non-shrink grout placed flush with the face of the manhole ring and the top edge of the frame. Provide a rounded corner around the perimeter.

3.10 BACKFILL

A. Place and compact backfill materials in the area of excavation surrounding manholes in accordance with requirements of Section 02227 - Excavation and Backfill for Utilities. Use embedment zone backfill material, as specified for the adjacent utilities, from manhole foundation up to an elevation 12 inches over each pipe connected to the manhole. Provide trench zone backfill, as specified for the adjacent utilities, above the embedment zone backfill.

B. Where rigid joints are used for connecting existing sewers to the manhole, backfill under the existing sewer up to the springline of the pipe with Class B concrete or flowable fill.

C. In unpaved areas, provide positive drainage away from manhole frame to natural grade. Provide a minimum of 4 inches of topsoil conforming to requirements of Section 02920 - Topsoil. Seed in accordance with Section 02932 - Hydromulch Seeding. If shown on Drawings, sod disturbed areas in accordance with Section 02935 - Sodding.

3.11 ACCEPTANCE TESTING OF WASTEWATER MANHOLES

Manholes shall be tested separately and independently of the wastewater lines.

B. Test by the Vacuum Method
Vacuum Test shall be performed per ASTM C1244-05 “Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill”. Manholes will be tested after installation with all connections in place. The structural soundness of the manhole for the vacuum testing shall be certified and sealed in writing by

the Engineer of Record and manufacturer to the City Engineer in advance of the testing. Successful Vacuum Testing (approved by Engineer of Record or the City) after backfill and compaction are complete will be the basis for acceptance of the manhole.

Equipment:

a) The manhole vacuum tester shall be a device approved for use by the Engineer or designated representative.

b) Pipe sealing plugs shall have a load resisting capacity equal to or greater than that required for the size of the connected pipe to be sealed.

Procedures:

a) Manhole section interiors shall be carefully inspected; units found to have through-wall lift holes, or any penetration of the interior surface by inserts provided to facilitate handling, will not be accepted. Coating shall be applied after the testing unless it is applied at the factory. All lift holes and exterior joints shall be plugged with an acceptable non-shrink grout. No grout shall be placed in horizontal joints.

b) After cleaning the interior surfaces of the manhole, the Contractor shall place and inflate pneumatic plugs in all of the connecting pipes to isolate the manhole; sealing pressure within the plugs shall be as recommended by the plug manufacturer. Plugs and the ends of pipes connected by flexible boots-shall be blocked to prevent their movement during the vacuum test.

c). The vacuum test head shall be placed on the top of the cone section or, inside of the top of the manhole cone section, and the compression seal band inflated to the pressure recommended by its manufacturer. The vacuum pump shall be connected to the outlet port with the valve open. When a vacuum of 10 inches of mercury [(-5 psig) has been attained, the valve shall be closed and the time noted. Tampering with the test equipment will not be allowed.

d) The manhole shall have passed the test if the vacuum does not drop below 9 inches of mercury [(-4.5 psig) within three (3) minutes of the time the valve was closed. The actual vacuum shall be recorded at the end of the three (3) minutes during which the valve was closed.

e) When the standard vacuum test cannot be performed because of design or material constraints (examples: T-Type manholes, T-Lock Liners, or other reasons acceptable to the Engineer or designated representative), testing of individual joints shall be performed as directed by the Engineer or designated representative.

B. Test by the Exfiltration Method

At the discretion of the Engineer or designated representative, the Contractor may substitute the Exfiltration Method of testing for the Vacuum test described in Section A above. This method may only be used when ground water is not present. If ground water is present a Vacuum Test shall be used unless otherwise directed by the Engineer or designated representative. All backfilling and compaction shall be completed prior to the commencement of testing.

The procedures for the test shall include the following:

a) Manhole section interiors shall be carefully inspected; units found to have through-wall lift holes, or any penetration of the interior surface by inserts provided to facilitate handling, will not be accepted. Coating shall be applied after the testing unless coating is applied before field assembly, or at the factory. All lift holes and exterior joints shall be plugged with an acceptable non-shrink grout. No grout shall be placed in horizontal joints.

b) After cleaning the interior surface of the manhole, the Contractor shall place and inflate pneumatic plugs in all of the connecting pipes to isolate the manhole; sealing pressure within the plugs shall be as recommended by the plug manufacturer.

c) Concrete manholes shall be filled with water or otherwise thoroughly wetted for a period of 24 hours prior to testing.

d) At the start of the test, the manhole shall be filled to the top with water. The test time shall be 1 hour (60 minutes). The Construction Inspector must be present for observation during the entire time of the test. Permissible loss of water in the 1 hour test time is 0.025 gallons per diameter foot, per foot of manhole depth. For example, for a 4 foot diameter manhole, this quantity converts to a maximum permissible drop in the water level (from the top of the manhole cone) of 0.05 inches per foot of manhole depth or 0.5 inches for a 10 foot deep manhole.

C. Holiday Testing

After the coating product(s) have set in accordance with manufacturer instructions, all surfaces shall be inspected for holidays with high-voltage holiday detection equipment. Reference NACE RPO 188-99 for performing holiday detection. All detected holidays shall be marked and repaired by abrading the coating surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional coating can be hand applied to the repair area. All touch-up/repair procedures shall follow the coating manufacturer's recommendations. Documentation on areas tested, results and repairs made shall be provided to Owner by Contractor.

D. Inspection

The Engineer or designated representative shall make a visual inspection of each manhole after it has passed the testing requirements and is considered to be in its final condition. The

inspection shall determine the completeness of the manhole; any defects shall be corrected to the satisfaction of Engineer or designated representative.

Visual inspection will include but no be limited to the following:

1. Observation for identification for leakage into the manhole as well as general workmanship.
2. Verification that there are no infiltration, cracks, or loose material.
3. Observation of the Installed liner system to make sure it is completely free of pinholes and hollow spots/voids and other defects that will reduce the life expectancy of the applied system.
4. Observation of the Liner to ensure it is free of severe wrinkles, areas deficient of resin, delamination of the fabric layers, infiltration, large hollow areas behind the liner and any other defects that will affect the life expectancy.
5. Observation of the Liner to ensure it is free of severe wrinkles, areas deficient of resin, delamination of the fabric layers, infiltration, large hollow areas behind the liner and any other defects that will affect the life expectancy of the Composite Liner.
6. Observation to verify that there are no loose panels, peeling, bubbles, or other areas that may hinder the performance of the liner.
7. Observation to insure bonding, resin saturation, complete cure and a smooth surface free from cracks or hollow spots.

E. Failure to Pass the Test - Records of Tests.

If the manhole fails to pass the initial test method as described in (A) Test by the Vacuum Method and, if allowed, (B) Test by the Exfiltration Method, or if visible groundwater leakage into the manhole is observed, the Contractor shall locate the leak, if necessary by disassembly of the manhole. The Contractor shall check the gaskets and replace them if necessary. The Contractor may re-lubricate the joints and re-assemble the manhole, or the Contractor may install an acceptable exterior joint sealing product on all joints and then retest the manhole. If any manhole fails the vacuum and/or exfiltration test twice, or unable to pass the Holiday test, the Contractor shall consider replacing that manhole. If the Contractor chooses to attempt to repair that manhole, the manhole must be retested until it passes. In no case shall cold applied preformed plastic gaskets be used for repair. Records of all manhole testing shall be made available to the Engineer or designated representative at the close of each working day, or as otherwise directed by the Engineer or designated representative. Any damaged or visually defective products, or any products out of acceptable tolerance shall be removed from the site.

3.12 PROTECTION

A. Protect manholes from damage until work has been finally accepted. Repair damage to manholes at no additional cost to Owner.

END OF SECTION