

## **ITEM VIII – MANHOLE REHABILITATION**

### **8.01 Description**

- (a) The work included in this section consists of providing all labor, materials and equipment necessary for rehabilitating existing manholes (by methods other than complete replacement) including:
  - (1) Manhole Sealing, Plugging, and Patching
  - (2) Manhole Invert Construction
  - (3) Manhole Lining and Structural Enhancement using a Spray Applied Cementitious Liner
  - (4) Manhole Inside Drop System
- (b) Manholes requiring rehabilitation or replacement are indicated on the plans.
- (c) Manholes that are indicated to be completely replaced shall be built in accordance with MSD's standard details and Section VI-II, 2.11 of the Technical Specifications.

### **8.02 Quality Assurance**

- (a) Manhole rehabilitation involving cementitious liners shall be performed using a qualified manufacturer's product. The installer must be approved by the manufacturer. Both the installer and the manufacturer shall show evidence of at least 3 years of successful experience in the specific type of manhole rehabilitation.
- (b) Storage, mixing, handling, and use of all materials and compounds shall be in strict accordance with manufacturer's instructions and specifications.
- (c) Standards: NASSCO Specification Guidelines for Sewer Collection System Maintenance and Rehabilitation, Current Edition.

### **8.03 Submittals**

- (a) Shop Drawings shall be submitted in accordance with the General Conditions of these specifications. In addition, the following shall be submitted to the ENGINEER for approval prior to construction:
  - (1) A detailed description of equipment, materials, and operational procedures to accomplish the manhole sealing and lining including, but not limited to, sealant mixture design, patching material mixture design, coatings, liner materials, application patching/lining procedures, samples and test data.

- (2) A detailed description of equipment, materials, and operational procedures to accomplish manhole invert construction including, but not limited to, concrete or grout mixture design, prefabricated inverts, samples and test data.
- (3) A detailed description of equipment, materials, and operational procedures to construct manhole inside drop systems including, but not limited to, drop bowl and piping drawings with dimensions and specifications, installation procedures, samples and test data.
- (4) A detailed time schedule.

#### **8.04 General**

The materials used shall be designed, manufactured, and intended for sewer manhole rehabilitation and the specific application in which they are used. The materials shall have a proven history of performance in sewer manhole rehabilitation. The materials shall be delivered to the job site in original unopened packages and clearly labeled with the manufacturer's identification and printed instructions. All material shall be stored and handled in accordance with recommendations of the manufacturer.

#### **8.05 Sealing, Plugging, and Patching Materials**

Materials used for specific applications shall be as follows:

- (a) Plugging holes and stopping active hydrostatic infiltration at points in concrete and masonry manholes:
  - (1) A premixed fast-setting volume stable waterproof cement plug consisting of hydraulic cement, graded silica aggregates, special plasticizing and accelerating agents. It shall not contain chlorides, gypsums, plasters, iron particles, aluminum powder, or gas-forming agents, or promote the corrosion of steel that it may come in contact with. Set time shall be approximately 60 seconds or less. Ten-minute compressive strength shall be a minimum of 500 psi.
  - (2) Chemical grouts may be used for stopping very active infiltration, and shall be mixed per the manufacturer's recommendations.
  - (3) After surface preparation and prior to the application of coatings, infiltration shall be stopped by plugging as previously described herein.
- (b) Patching, repointing, filling and repairing non-infiltrating holes, cracks, and breaks in concrete and masonry manholes:
  - (1) A premixed nonshrink cement-based patching material consisting of portland cement, graded silica aggregates, special plasticizing and accelerating agents,

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which has been formulated for vertical or overhead use. It shall not contain chlorides, gypsums, plasters, iron particles, aluminum powder, or gas-forming agents or promote the corrosion of steel it may come in contact with. Set time shall be less than 30 minutes. One-hour compressive strength shall be a minimum of 200 psi, and the ultimate compressive strength shall be a minimum of 5,000 psi.

- (2) Loose material shall be removed from the area to be patched or re-pointed exposing a sound sub-base. Holes or voids around steps, joints or pipes, spalled areas, and cavities caused by missing or broken brick shall be patched and missing mortar re-pointed using a non-shrink patching mortar conforming to the requirements of this section. Cracks not subject to movement and greater than 1/16 inch in width shall be routed out to a minimum width and depth of 1/2 inch and patched with non-shrink patching mortar as indicated above.

#### **8.06 Manhole Inverts**

- (a) Inverts shall be constructed to transition flow between any influent main or service line and the effluent pipe where the difference in elevation between influent and effluent lines are 2 feet 0 inches or less. Inverts shall also be constructed to receive inside drop system pipes.
- (b) Manhole inverts shall be in accordance with Section VI-II, 2.11 (i) of the Technical Specifications and the Standard Details for new construction. Constructed inverts shall match flow lines on lined pipe.
- (c) Invert construction shall start with the demolition of existing brick or concrete to a point which assures the rebuild invert work shall be no less than 2 inches thick. Other demolition shall be required where it is necessary to enhance flow lines through the manhole in order to provide the longest curves possible.
- (d) Manhole invert demolition shall take place prior to lining.
- (e) Invert reconstruction shall not take place until after mainline and manhole walls have been rehabilitated.

#### **8.07 Manhole Lining and Structural Enhancement**

##### Cementitious Liner (spray applied)

- (a) Materials:
  - (1) Specially formulated pre-packaged mixes shall be used. The material shall be fiber reinforced and contain special additives which produce a minimum 24-hour compressive strength of 3,000 psi, and a minimum 28-day compressive strength of 8,000 psi. The material shall form a

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mechanical and chemical bond to the manhole surface and have zero shrinkage.

- (2) The mortar shall include calcium aluminate or other ENGINEER-approved substance to be suited for resistance against corrosion.

(b) Mixing:

- (1) For each bag of product, the Installer shall follow the manufacturer's defined guidelines for mixing.
- (2) Empty the mixed material 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.

(c) Spraying:

- (1) This work consists of spray applying the cementitious-based liner to the inside of the existing manhole. The necessary equipment and application methods to apply to the cementitious-based liner materials shall be approved by the material manufacturer.
- (2) The material shall be pumped for spray application. The material shall only be applied when the manhole is in a damp state, with no visible water dripping or running over the manhole walls.
- (3) Spraying shall be performed by starting at the manhole invert and progressing up the wall to the corbel and chimney areas. The material shall be applied to allow a uniform minimum thickness of 1 inch for the cured liner on all vertical surfaces, such as barrel sections. Minimum thickness on inclined sections, such as brick chimneys and cone sections, shall be one-half inch.
- (4) Troweling of the materials shall begin immediately following the spray application. Initial troweling shall be in an upward motion, to compress the material into voids and solidify the manhole wall. Proper precautions shall be taken not to overtrowel.

(d) Bench Application:

- (1) The material to be sprayed on the bench will form a gradual slope from the walls to the invert with the thickness at the edge of the invert being no less than 1 inch. The material shall be applied to the bench area in such a manner as to provide for proper drainage without ponding. The material shall be a smooth steel trowel finish sloping from wall to invert. The wall bench intersection shall be rounded to a uniform radius the full circumference of the

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manhole. Benches shall not be rehabilitated until after the manhole walls have been completed.

(e) Invert Repair:

- (1) Invert repair shall be performed on all inverts. After blocking the flow through the manhole and thoroughly cleaning the invert, a quick-setting patch mix shall be applied to the invert in an expeditious manner. The mix shall be troweled uniformly onto the invert, extending out onto the bench sufficiently to tie into the liner spray applied to the bench. The finished invert shall be U-shaped uniform with pipe diameter with a minimum depth of 6 inches for 8-inch pipe and full depth for greater sized mains. Finish is to be that accomplished by steel trowel. Pipe crowns are to be built on all pipes. Invert shall be at least 2 inches thick, and be smooth and free of ridges. Invert reconstruction shall not take place until after the manhole wall rehabilitation has been completed.

(f) Curing:

- (1) The material shall be cured according to the manufacturer's instructions and recommendations.
- (2) Caution should be taken to minimize exposure of applied product to sunlight and air movement. At no time should the finished product be exposed to sunlight or air movement for longer than 15 minutes before replacing the manhole cover.

**8.08 Manhole Inside Drop System**

(a) Material:

- (1) The inside drop system shall be a PVC collection device that facilitates the controlled drop of effluent into the main stream flow of a sanitary manhole. The system shall be constructed of PVC pipe and fittings as shown on the drawings. The system shall permit easy inspection and cleaning without the need to enter the structure. Adjustable stainless steel straps shall fully support the drop pipe.
- (2) The inside drop system shall consist of the following components:
  1. SDR 35 PVC Fittings
  2. SDR 35 PVC drop pipe
  3. New grouted invert for drop pipe

(b) Application:

- (1) All existing manhole structures to receive inside drops shall be outfitted with drop bowl system components as specified on the Plans. The drop pipe size shall be determined by incoming pipe size. Provide a 4-inch bowl and 4-inch drop pipe for a 4-inch inlet. Provide a 6-inch bowl and 6-inch drop pipe for a 6-inch inlet. The appropriately sized drop pipe of SDR 35 PVC shall be securely attached to the manhole wall using stainless steel adjustable clamping brackets and stainless steel fasteners. The clamping pipe supports shall be of 304 (11 gage) stainless steel with 3/8 x 18 stainless nuts and bolts. The turn-out at the base end of the drop pipe shall be accomplished with a newly constructed grouted invert to the main stream invert.
  - (2) All services that are to receive a drop bowl shall be located in the barrel section of the manhole. Services entering the cone section or having velocities sufficient to overshoot the bowl shall, at the ENGINEER's discretion, be relocated to either the barrel section of the manhole, removed from the manhole and connected to the mainline or lowered to the invert of the manhole.
- (c) Installation:
- (1) Manhole wall rehabilitation shall take place prior to installing inside drop systems.
  - (2) Select bowl size in accordance with these Specifications.
  - (3) Cut and mount SDR 35 PVC drop pipe of diameter appropriate to drop bowl size and flow using adjustable stainless steel clamping brackets (clamping brackets shall adjust to allow drop pipe to maintain correct stand off from wall).
  - (4) Construct invert to provide smooth transition into channel flow. If pipe crown does not match pipe crown of effluent main from manhole, an invert shall be built according to DISTRICT's Specifications.

#### **8.09 Manhole Frame and Cover Replacement**

- (a) Where indicated on the Plans, the manhole frame and cover shall be replaced with a new frame and cover. The new frame and cover shall be in accordance with DISTRICT's Specifications and the Standard Details.

#### **8.10 Preparation**

- (a) Cleaning: All concrete and masonry surfaces must be clean. Grease, laitance, organic matter, loose bricks, mortar, unsound concrete, and other materials must be completely removed. Water blasting using proper nozzles shall be the primary method of cleaning; however, other methods such as wet or dry sandblasting, acid wash, concrete cleaners, degreasers or mechanical means may be required to properly clean the surfaces. Surfaces on which these other methods are used shall

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be thoroughly rinsed, scrubbed, and neutralized to remove cleaning agents and their reactant products.

- (b) For the rehabilitation processes described herein, active infiltration shall be stopped as described in Section 7.05. All large voids in the manhole wall, corbel or riser sections shall be patched.
- (c) Manhole steps, lifting hook or eyes or other protrusions shall be removed flush with the manhole interior.
- (d) Where the process requires interruption of flow, the CONTRACTOR shall provide all necessary diversion or bypass pumping equipment to handle the flow for the duration of the manhole rehabilitation, including curing times where applicable.
- (e) Where overspray or droppings may affect the benching or flow channels, the manhole base shall be covered with plywood and braced to provide a firm working platform.
- (f) All spoil material resulting from the preparatory cleaning, plugging, and patching operation shall be removed from the manhole and not allowed to enter the collection system. All spoils removed from the manhole shall be disposed of in accordance with local or state regulations.
- (g) The CONTRACTOR shall keep his work areas neat, clean and reasonably free of debris. The CONTRACTOR shall bear the responsibility for and provide immediate cleanup of any spills at or near the site or during transport operations.

#### **8.11 Field Quality Control and Testing**

- (a) Prior to demobilization from the site, the CONTRACTOR shall remove all construction debris, stabilize any spill areas and wash roadway areas affected by the work.
  - (b) Visual inspection of the finished product shall verify a leak free, uniform appearance.
  - (c) The Cementitious lining shall provide a continuous surface with uniform thickness throughout the manhole interior.
- (1) The CONTRACTOR shall work with the ENGINEER to develop an easy method for measuring the liner thickness. This method should be such that the ENGINEER does not have to enter the manhole to measure the thickness. One possible method would be to install a pin (such as plastic adhesive pins) at every two-foot vertical spacing on the manhole wall. This spacing should occur in a random fashion such that no directly adjacent pins are located in the same quadrant of the manhole. The pins should protrude slightly less than an inch

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from the wall. The liner would be installed over the pins, and the ENGINEER could verify the thickness visually without entering the manhole. The CONTRACTOR may develop other methods for verifying the thickness and present them to the ENGINEER for consideration.

- (2) If the thickness of the lining is not uniform or less than specified, it shall be repaired or replaced at no additional cost to the DISTRICT.
- (d) Performance Testing: All rehabilitated manholes shall be vacuum tested in accordance with DISTRICT'S Specification Section VI-II, Paragraph 2.12(b) with one exception. The duration of the test shall be 20 seconds.
- (e) Material Testing: A minimum of four 2 X 2-inch mortar cube test samples shall be taken from the material used each day. The samples shall be properly packaged, labeled, and provided to ENGINEER for subsequent testing as described in ASTM C-109.
- (f) All manhole rehabilitative sealing and/or lining work shall be guaranteed against faulty workmanship and/or materials for a period of 5 years after completion of the work. Inspection by the ENGINEER will be scheduled 1 year, 3 years, and 5 years after the work is complete to verify that there is no visible leakage. Visible leakage, if found, will be corrected by the CONTRACTOR at no additional cost to the DISTRICT.