

SECTION 80

MANHOLES

PART 1 - GENERAL

1.01 SCOPE

Work covered by this item consists of constructing either brick or precast concrete standard and drop manholes and concrete junction chambers at the locations shown on the plans. Brick manholes can only be built with permission by the Engineer as shown on the plans.

1.02 DESIGN CRITERIA

A. Description

Manholes and junction chambers shall be constructed of specified material to the sizes, shapes and dimensions, and at the locations shown on the plans or as otherwise directed by the Engineer. The height or depth of the manhole will vary with the location, but unless shown otherwise on the plans, shall be such that the top of the manhole frames will be at the finished grade of the pavement or ground surface and the invert will be at the designed elevations. Wall thickness of brick or precast concrete manholes shall be as shown on the drawings.

B. Drop Manholes

Where the different in the invert elevation of a sewer 18 inches in diameter or smaller and any other sewer intersecting in one manhole is 2 feet or more, a drop manhole shall be constructed as shown on the plans. They shall be similar in construction to the standard manhole except than a drop connection of pipe and fittings of the proper size and material shall be constructed outside the manhole and supported by Class A concrete.

C. Distances between manholes

1. Distances between manholes shall not exceed 400 feet for sewer pipe 15 inches in diameter or less.
2. Distance between manholes shall not exceed 500 feet for sewer pipe between 18 inches to 30 inches in diameter.

3. Distance up to 600 feet may be approved in cases where adequate modern cleaning equipment for such spacing is provided.

1.03 QUALITY ASSURANCE

Prior to delivery all basic materials specified herein shall be tested and inspected by an approved independent commercial testing laboratory or, if approved by the Engineer, certified copies of test reports prepared by the manufacturer's testing laboratory will be acceptable. All materials which fail to conform to these specifications shall be rejected. After delivery to the site, any materials which have been damaged in transit or are otherwise unsuitable for use in the work shall be rejected and removed from the site.

1.04 SHOP DRAWINGS AND SPECIFICATIONS

Detailed shop drawings of precast manhole sections, manhole frames, covers and steps shall be submitted for approval of the Engineer in accordance with provisions set forth in these specifications.

1.05 GUARANTEE

The contractor shall provide a guarantee against defective equipment and workmanship in accordance with the requirements of the section entitled "Guarantees and Warranties" of these Specifications.

PART 2 - PRODUCTS

2.01 CONCRETE AND REINFORCEMENT

Concrete, cement, sand and water used in manhole construction shall conform to the applicable requirements of Section 30 of these specifications. All concrete shall be Class A. Steel reinforcement shall conform to the applicable requirements of Section 40 of these specifications.

2.02 BRICK

Brick used in manhole construction shall be either solid or cored, medium hard or better, Grade MA brick conforming to requirements of latest ASTM Standard Specifications, Serial Designation C 32 for sewer brick. Brick manholes shall be constructed upon a concrete base with a minimum of 8 inches of Class A concrete. Precast manholes may be set upon a base of crushed stone or Class A concrete. If crushed stone is used, it shall be at least 8 inches thick. In unstable soil only concrete shall be used with a minimum of 8 inches. More may be required by the Engineer if soil is very unstable.

2.03 MORTAR

Mortar for brick manholes construction shall be sand-cement mortar composed of one part portland cement to two parts clean sand conforming to ASTM C 144. Twenty pounds of hydrated lime per sack of cement may be added. No retempered mortar shall be used.

2.04 PRECAST CONCRETE MANHOLES

- A. Precast concrete manholes shall consist of precast reinforced concrete sections, an eccentric cone or flat slab top section, or a conical cone only if directed by Engineer, and a base section conforming with the typical manhole details as shown on the contract drawings.
- B. Precast manhole sections shall be manufactured, tested, and marked in accordance with the latest provisions of ASTM Standard Specifications, Serial Designation C 478.
- C. The minimum compressive strength of the concrete for all sections shall be 4,000 psi.
- D. The maximum allowable absorption of the concrete shall not exceed 8 percent of the dry weight.
- E. The circumferential reinforcement in the riser sections, conical top sections and base wall sections shall consist of one line of steel and shall be not less than 0.17 square inches per lineal foot.
- F. The ends of each reinforcement in the riser section and the bottom end of the manhole top section shall be so formed that when the manhole risers and the top are assembled, they will make a continuous and uniform manhole.
- G. Joints of the manhole sections shall be preferably of the O-ring joint type. Tongue-and-groove joint types may be used if approved by the Engineer. Sections shall be joined appropriately with either rubber O-rings or a buytl joint sealant. A cement mortar using 1 part Portland Cement to 2 parts clean sand, meeting ASTM Standard Specifications, Serial Designation C 144, latest revision, shall be used to wipe all joints as directed by the Engineer.
- H. Each section of the precast manhole shall have not more than two holes for the purpose of handling and laying. These holes shall be tapered and shall be plugged with rubber stoppers or mortar after installation.
- I. Type of manhole steps shall be selected by the Engineer and shall be installed in each section of the manhole in accordance with the details shown on the contract drawings.

- J. Standard precast manhole bases, Cast-In-Place manhole bases and inverts shall be constructed of Class A concrete in accordance with details on contract drawings and inverts shall have the same cross section as the invert of the sewers which they connect. The manhole base and invert shall be carefully formed to the required size and grade by gradual and even changes in sections, care being exercised to form the incoming and outgoing sewer pipes into the wall of the manhole at the required elevations. Changes in direction of flow through the sewer shall be made to a true curve with as large a radius as the size of the manhole will permit.
- K. Pipe openings in manholes
1. All openings into manholes shall have rubber boots installed at factory and after pipe has been installed shall be filled with a non-shrinking grout.
 2. All sewer pipe installed in an existing manhole shall have a rubber waterstop (concrete manhole adapter), i.e. Fernco, or approved equal by C.U. It shall be installed and embedded in the cement mortar patch. The invert shall be properly formed as directed by the Engineer.

2.05 FRAMES, COVERS AND STEPS

- A. Manhole rims, toe pockets and covers shall be cast iron conforming to the minimum requirements of Federal Specifications WW-1-652 or to the latest ASTM Standard Specifications, Serial Designation A 48, for Class 30 Gray Iron Castings. All castings shall be made accurately to the required dimensions, fully interchangeable, sound, smooth, clean and free from blisters and/or other defects. Defective castings which have been plugged or otherwise treated shall not be used. All casting shall be thoroughly cleaned and painted or coated with a bituminous paint. Each casting shall have its actual weight in pounds stenciled or painted on it in white paint.
- B. Reinforced plastic manhole steps shall conform to the minimum requirements of ASTM 2146-68 under Type II, Grade 16906 and ASTM C-478, paragraph 11. The reinforcing bar shall be a grade 60, deformed 1/2-inch reinforcing bar conforming to all the requirements of ASTM A-615.
- C. Manhole frames and covers shall be of the size shown on the construction detail drawings and shall have a minimum 24" clear opening, a total weight of not less than 360 pounds for a frame height of 8 inches and 305 pounds for a frame height of 4 inches respectively, and shall be equal to Vulcan Foundry (V-1380) for a frame height of 8 inches and Vulcan Foundry (V-1180) for a frame height of 4 inches. Approved equal frames and covers will be considered but must be approved by the Engineer.

- D. The contact surfaces of all manhole covers and the corresponding supporting rings in the rims shall be machined to provide full perimeter contact.
- E. All sanitary sewer manhole covers shall have the work "SEWER" cast on the top in letters 2 inches high.
- F. Watertight manhole frames and covers shall be furnished with a rubber gasket, stainless steel tightening bolt, machined bearing surfaces, channel iron locking bar, and concealed watertight pickhole, and shall be equal to the frames and covers described in Section 2.05C of these specifications.

PART 3 - EXECUTION

3.01 CONSTRUCTION OF BRICK MANHOLES

- A. Brickwork shall be constructed using 1 part portland cement to 2 parts clean sand, meeting ASTM Specifications, Serial Designation C 144, thoroughly mixed to a workable plastic mixture. Twenty pounds of hydrated lime per sack of cement may be added. No retempered mortar shall be used. Brick shall be laid radially with mortar joints not more than 3/8-inch horizontally and not less than 3/8-inch wide vertically at the inside face of the manhole. Each 6th brick course shall be a "Stretcher" course. Inside joints shall be trowel struck flush joints to provide smooth, clean surfaces. Joints shall be broken in successive layers.
- B. Outside and inside walls of all manholes shall be covered with cement mortar plaster where shown on the drawings. Manholes shall be completely waterproof.
- C. After the foundation has been prepared and has been approved by the Engineer, the bottom shall be constructed to the required line and grade. After the bottom has been allowed to set for a period of not less than 24 hours, the manhole shall be constructed thereon, care being exercised to form the incoming and outgoing sewer pipes into the wall of the manhole at the required elevations.
- D. The polypropylene plastic or equal steps shall be inserted into the wall of the manhole at the proper locations and elevations as the work progresses and shall be securely embedded in the masonry.
- E. The cast iron frame for the manhole cover shall be set at the required elevation and properly anchored to the masonry. Where manholes are constructed in paved areas, the top surface of the frame and cover shall be tilted to conform to the exact slope, crown and cradle of the existing adjacent pavement.
- F. Manhole inverts shall be constructed of Class A concrete and shall have the same cross section as the invert of the sewers which they connect. The manhole invert shall be carefully formed to the required size and grade by gradual and

even changes in sections. Changes in direction of flow through the sewer shall be made to a true curve with as large a radius as the size of the manhole will permit.

- G. Masonry work shall be allowed to set for a period of not less than 24 hours. Outside forms, if any, then shall be removed and the manhole backfilled and compacted in the manner provided in Item 1 of these specifications. All loose or waste material shall be removed from the interior of the manhole. The manhole cover then shall be placed and the surface in the vicinity of the work cleaned off and left in a neat and orderly condition.
- H. After backfilling has been completed, the excavated area, if located in a street, alley or sidewalk, shall be provided with a temporary surface.

3.02 CONSTRUCTION OF CAST-IN-PLACE CONCRETE MANHOLES

- A. Cast-in-place manholes, excluding curved manhole bases, shall be constructed in place with the base, barrel, and conical section all monolithically cast using removable forms of a material and design approved by the Engineer.
- B. The vertical forms, vertical and horizontal wall spacers, steps and placing cone must be carefully positioned and firmly clamped in place before any placement is made. The wall spacers must be located 90 degrees from each other. The forms shall be firmly supported with bottom of forms at the proper elevation to permit the base to be deposited through the vertical forms.
- C. The manhole base shall be deposited down through the wall forms onto undisturbed earth or rock bearing. It shall be evenly distributed around the walls and vibrated both inside and outside the forms until there is a minimum slope of 60 degrees from the bottom of the forms to the bearing surface both inside and outside of the manhole. When this is complete and before additional concrete is added, the concrete must be carefully vibrated on each side of each sewer pipe.
- D. The base shall be concentric with the manhole and have a minimum diameter of 16 inches greater than the outside diameter of the manhole, and 10-inch minimum thickness under the lowest pipe. Minimum wall thickness shall be 6 inches.
- E. Additional concrete must be deposited in evenly distributed layers of approximately 18 inches with each layer vibrated to bond it to the preceding layer. The wall spacers must be raised as the placements are made. The concrete in the area from which the spacer is withdrawn shall be carefully vibrated. Excessive vibration shall be avoided.

- F. Adjustment rings shall be provided between the conical section and the manhole frame. The rings shall be cast-in-place using building felt between pours to create a weakened joint or as directed by the Engineer. If adjustment of the lid elevation is called for, concrete "donut" sections or brick shall be used.
- G. The invert and flow channel shall be constructed in accordance with the applicable requirements of Part 3.01 of this section and shall be formed during or immediately after the placing of the concrete and brush-finished as soon as the concrete has sufficiently set.
- H. Form marks and offsets shall not exceed one inch on the outside surface of the manhole. Form marks and offsets shall not exceed 1/2 inch inside of the manhole. All offsets on the inside surface of the manhole shall be smoothed and rubbed so there is no projection or irregularity capable of scratching a worker or catching and holding water or solid materials. Honeycombed areas shall be completely removed immediately upon removal of the forms and replaced with Class A concrete as directed by the Engineer.
- I. Should circumstances make a cold joint necessary, a formed groove or reinforcing dowels shall be required in the top of the first placement for shear protection. Immediately before the second placement is made, the surface of the cold joint shall be thoroughly cleaned and wetted with a layer of mortar being deposited on the surface.
- J. Concrete setting time, backfilling, brick work setting frame and cover, temporary paving, etc., shall be in accordance with the applicable requirement of Part 3.01 of this Section.

3.03 CONSTRUCTION OF PRECAST CONCRETE MANHOLES

- A. The base and invert shall be constructed in accordance with the applicable requirements of Part 3.01 of this Section.
- B. After the base section has been allowed to set for a period of not less than 24 hours, the precast manhole sections shall be placed thereon, care being exercised to form the incoming and outgoing sewer pipes into the wall of the manhole at the required elevations.
- C. Brickwork required to complete the precast concrete manhole shall be done in accordance with the provisions of Part 3.01 of this Section.
- D. Concrete setting time, backfilling, brickwork, setting frame and cover, temporary paving, etc., shall be in accordance with the applicable requirements of Part 3.01 of this Section.

3.04 CONSTRUCTION OF PRECAST CONCRETE "TEE" MANHOLE BASE

- A. Precast concrete tee manhole base and elbows shall conform to the requirements of Section 30 of these specifications. Class of pipe used shall be the same as that used in the line adjacent to the manhole and elbow. The tee section shall be carefully formed to the required size. The inside of the base shall be left smooth with no rough projections where the tee is connected to the pipe. Tee manhole bases are allowed only on sewer lines greater than 48 inches in diameter.
- B. Elbows where required shall be fabricated to a true angle as shown on the drawings. Elbows shall be made smooth by hand troweling and the finish surface shall be equal to that in the rest of the pipe.
- C. All fabrication work on the manhole base and elbows shall be done by the manhole or pipe manufacturer at the plant. No field fabrication will be permitted without specific authorization of the Engineer.
- D. After the base section has been installed, the precast manhole sections shall be placed thereon and the outside painted with a bistumatic material specified by the Engineer.
- E. Brickwork required to complete the precast concrete manhole shall be done in accordance with the provisions in Part 3.01 of this Section.
- F. The cast iron frame for the manhole cover shall be set at the required elevation and properly anchored to the masonry. Where manholes are constructed in paved areas, the top surface of the frame and cover shall be tilted to conform to the exact slope, crown and grade of the existing adjacent pavement.
- G. Masonry work shall be allowed to set for a period of not less than 24 hours. Outside forms, if any, then shall be removed and the manhole backfilled and compacted in the manner provided in Item 1 of these specifications. All loose or waste material shall be removed from the interior of the manhole. The manhole cover then shall be placed and the surface in the vicinity of the work cleaned off and left in a neat and orderly condition.
- H. After backfilling has been completed, the excavated area, if located in a street, alley or sidewalk, shall be provided with a temporary surface as provided for under Item 1 of these specifications.

3.05 CONSTRUCTION OF JUNCTION CHAMBERS

- A. All concrete shall be Class A for the construction of the junction chamber and shall conform to the applicable requirements of Section 30 of these

specifications. Steel reinforcement shall conform to the applicable requirements of Section 40 of these specifications.

- B. Junction chamber toe pockets shall conform to the applicable requirements of Part 2 of these specifications and shall be placed as shown on the plans.
- C. The concrete shall be constructed in strict accordance with the plans and specifications and all lines inside the chamber shall be finished smooth with no protrusions to obstruct flow, all subject to the approval of the Engineer.
- D. During construction of the junction chambers the existing sewage flow shall be maintained in a manner acceptable to the Engineer. Bypassing of sewage into streams or storm water drainage facilities will not be permitted. If the junction chamber is to be built on an existing sewer, the section of sewer within the junction chamber shall be removed before the base of the junction chamber is poured unless shown otherwise on the plans.
- E. All ground areas that are disturbed during construction of the junction chamber shall be prepared for grass as called for in Section 110 "Seeding" of the specifications and shall be grassed.

3.06 PLACEMENT OF PRECAST MANHOLE ON EXISTING SANITARY SEWER LINE

Where a manhole is to be placed on an existing sanitary sewer line the contractor shall install a precast manhole base with flexible rubber boots on the line. The area where the base is to be placed shall be leveled with graded stone, No. 7. The existing sewer line shall be cut and base properly placed. In most conditions PVC pipe will be used to connect the existing pipe to the manhole boots. The appropriate flexible couplings will be used to connect the existing and new sewer pipe together. The contractor shall be sure to tighten all clamps securely to avoid leaks. All new and existing sewer pipe exposed shall be properly bedded with No. 7 stone. After final installation of the manhole has been completed and before backfilling around manhole, Cleveland Utilities must approve the installation.

3.07 TESTING

Manholes, including frame and cover permanently secured to the cone, installed in this contract shall be tested prior to backfilling for compliance with the infiltration limits specified for pipe. The method used shall be a vacuum test in which manholes are plugged, pumped to 5 psi vacuum or 10 inches of mercury vacuum, and held for a minimum of 1 minute. The manhole shall be approved when it loses less than 1 psi vacuum or 2 inches of mercury vacuum during the 1 minute test period.

**** END OF SECTION ****