Section 2435. Sanitary and Storm Sewer Structures

2435.01 DESCRIPTION.

This section was developed in conjunction with Sections 6010 and 6030 of the SUDAS Standard Specifications, with modifications to suit the needs of the Department.

A. Construct sanitary and storm sewer manholes to provide access to sewer systems for maintenance and cleaning purposes.

B. Construct storm sewer intakes for collection of surface water and conveyance to the storm sewer system.

C. Modify existing manholes and intakes as necessitated by other improvements adjacent to the manholes or intakes.

D. Clean and inspect sanitary and storm sewer manholes, intakes, and other utility structures. Test sanitary sewer manholes.

2435.02 MATERIALS.

Apply Article 4149.04.

2435.03 CONSTRUCTION.

A. General Requirements for Installation of Manholes and Intakes.

1. Excavation.
Excavate according to Section 2552.

2. Subgrade Preparation.
- **a. Cut Sections (Undisturbed Soil):** Prepare subgrade to accurate elevation required to place structure base or subbase.
- **b. Fill Sections:** Compact to 95% of maximum Standard Proctor Density and hand grade to accurate elevation required to place structure base or subbase, or install stabilization material as directed by the Engineer.
- **c. Unstable Soil:** Install stabilization material as directed by the Engineer.

3. Subbase.
- **a. Cast-in-place Structures:** No subbase material is required.
- **b. Precast Structures:** If precast structure is provided, install 8 inch (200 mm) thick pad of Class I bedding material a minimum of 12 inches (300 mm) outside the footprint of the structure.

4. Installation of Manhole or Intake Structure.
Adjust wall height and depth of base, when necessary, to provide a minimum of 48 inches (1200 mm) between form grade elevation and top of base.
- **a. Cast-in-place:** Apply Article 2435.03, B.
- **b. Precast:** Apply Article 2435.03, C.

5. Pipes.
Install and bed pipes and connect to manhole or intake. Install pipe flush with inside wall of structure. Place bedding and pipe embedment material according to Section 2552.
- **a. Cast-in-place Structures.**
  - **1) Storm:** Form structure walls around pipe.
  - **2) Sanitary:** Form or core circular opening and install flexible watertight gasket according to Article 4149.04, G. Keep void between pipe and manhole section free of debris and concrete.
- **b. Precast Storm Sewer Manholes or Intakes.**
  Fill space between pipe and structure with non-shrink grout.
- **c. Precast Sanitary Sewer Manholes.**
  Connect to structure with flexible watertight gasket according to Article 4149.04, G. Keep void between pipe and manhole section free of debris and concrete.

d. Sanitary Sewer Manholes on Existing Pipe.
Install waterstop according to Article 4149.04, G.

6. Joint Sealant.

a. Sanitary Sewer Manholes.

1) Install rubber O-ring or profile gasket (precast structures).

2) Apply bituminous jointing material or butyl sealant wrap to exterior of all sanitary sewer manhole joints.

b. Storm Sewer Manholes and Intakes.

1) Apply bituminous jointing material or install rubber rope gasket.

2) If indicated in the contract documents, apply engineering fabric wrap to joints.

7. Invert.

a. Construct manhole invert up to one half of pipe diameter to produce a smooth half pipe shape between pipe inverts.

b. Shape invert to provide a smooth transition between pipe inverts.

c. Slope invert top toward pipe 1/2 inch per foot (40 mm per meter) perpendicular to flow line.

d. For sanitary sewer, keep void between pipe and structure wall free of debris and concrete.

e. For precast inverts, remove projections and repair voids to provide a hydraulically smooth channel between ends of pipes.

8. Top Sections.
Install manhole eccentric cone or flat top section or install intake top.

9. Adjustment Ring(s).
Bed each concrete ring with bituminous jointing material in trowelable or rope form. Bed each polyethylene ring with the manufacturer's approved product. Do not install more than a total ring stack height of 12 inches (300 mm). For greater adjustment, modify lower riser section(s).

10. Casting.
Install the type of casting specified in the contract documents and adjust to proper grade. Where a manhole or intake is to be in a paved area, adjust the casting to match the slope of the finished surface. When specified in the contract documents, attach a casting frame to the structure with four anchor bolts.

11. Chimney Seal.
For sanitary sewer manholes, install an internal or external rubber chimney seal.

a. Do not use external chimney seal if seal will be permanently exposed to sunlight.

b. Extend seal 3 inches (75 mm) below the lowest adjustment ring.

c. Extend seal to 2 inches (50 mm) above the flange of the casting for a standard two piece casting, or 2 inches (50 mm) above the top of the base section of the casting for an adjustable three piece casting.

d. Use multiple seals, if necessary.

e. Install compression bands (external chimney seal) or expansion bands (internal chimney seal) to lock the rubber sleeve or extension into place and to provide a positive watertight seal. Once tightened, lock bands into place. Use only manufacturer recommended installation tools and sealants.

12. Placing and Compacting Backfill Material.

a. Place suitable backfill material after concrete in structure has reached at least 3000 psi (21 MPa) compressive strength or 550 psi (3850 kPa) flexural strength. If concrete strength is not determined, place backfill material at least 14 calendar days after initial concrete placement.

b. Place backfill material simultaneously on all sides of walls and structures so the fill is kept at approximately the same elevation at all times.

c. Compact the 3 feet (1 m) closest to all walls for wing faces using pneumatic or hand tampers only. Ensure proper and uniform compaction of backfill material around structure.

B. Additional Requirements for Cast-In-Place Concrete Structures.

1. Forms.

a. Apply Article 2403.03, B, 5.

b. Form all cast-in-place manholes and intakes on both the inside and the outside face above the base. Do not form against excavated earthen surface.

2. Reinforcing Steel.

a. Apply Section 2404.

b. Lap bars a minimum of 36 diameters, unless specified otherwise in the contract documents.

c. Provide a minimum of 3 inches (75 mm) of clearance for structure bases and 2 inches (50 mm) of clearance for walls and tops.

3. Concrete Mixing.

a. Apply Article 2403.02, D.

b. When using ready-mixed concrete, comply with ASTM C 94/C 94M.

4. Concrete Placing.

a. Apply Article 2403.03, C.

b. Do not place concrete when the air temperature is less than 40°F (5º C) without the approval of the Engineer. When placement below 40ºF (5ºC) is allowed, apply Article 2403.03, F.

c. Place concrete continuously in each section until complete. Do not allow more than 30 minutes to elapse between depositing adjacent layers of concrete within each section.

d. Apply Article 2403.03, D, for concrete vibration.

e. Form 1 1/2 by 3 inch (38 mm by 75 mm) keyed construction joints at locations shown in the contract documents.

f. Provide a broom finish on portions of structure that are to become part of exposed pavement.

5. Stripping and Cleaning.

a. Remove forms for manhole and intake walls and tops according to Article 2403.03, M. References to culverts include all sanitary and storm structures. When allowed by the Engineer, compressive strengths at six times the stated flexural strengths may be used in determining concrete strength of structure tops.

b. Finish surfaces according to Article 2403.03, P. Give exposed surfaces a Class 2 finish.

6. Curing.

a. Apply Article 2403.03, E.

b. For surfaces visible to the public, use only curing compounds complying with ASTM C 309, Type 1-D or Type 2.

7. Exterior Loading.

a. Restrict exterior loads on concrete according to Article 2403.03, N.

b. When allowed by the Engineer, compressive strengths at six times the stated flexural strengths may be used.

8. Repairs.

After visual inspection of the completed manhole or intake, repair honeycomb areas, visible leaks, tie holes, or other damage areas. Remove concrete webs or protrusions.

C. Additional Requirements for Precast Concrete Structures.

1. Substitutions.

Precast structures may be substituted for designated cast-in-place structures so long as structure is constructed as specified in the contract documents and according to Article 2435.03, B.

2. Cast-in-place Base.

a. Apply Article 2435.03, B, for placement of concrete.

b. Ensure proper vertical and horizontal alignment of base riser section.

3. **Precast Base or Base with Integral Riser Section.**
   Place base or base with integral riser section and ensure proper vertical and horizontal alignment.

4. **Additional Riser Sections.**
   Install additional riser sections as required.

5. **Lift Holes.**
   Install rubber plug in lift holes. Cover plug and hole with non-shrink grout.

D. Adjustment of Existing Manhole or Intake.

1. **Casting Extension Rings.**
   - **a.** Only install casting extension rings when allowed by the contract documents, and only in conjunction with pavement overlays.
   - **b.** Install according to the manufacturer's recommendation and adjust for proper alignment.

2. **Minor Adjustment (Adding or Removing Adjustment Rings).**
   - **a.** Remove casting.
   - **b.** Modify adjustment ring stack height by one of the following methods:
     - **1)** Add adjustment rings as necessary to adjust existing manhole or intake to finished pavement grade or finished topsoil grade, to a maximum ring stack height of 16 inches (400 mm). Bed each concrete ring with bituminous jointing material. Bed each polyethylene ring with manufacturer's approved product.
     - **2)** Remove one or more adjustment rings, as appropriate, to reduce casting elevation.
   - **c.** Install new casting on modified adjustment ring stack. Existing casting may be reinstalled when specified in the contract documents.
   - **d.** Replace chimney seal for sanitary sewer manhole using only new materials.

3. **Major Adjustment (Adding, Removing, or Modifying Riser or Cone Section).**
   When adjustment is greater than can be accomplished through adding or removing adjustment rings, a major adjustment will be required.
   - **a.** Remove casting.
   - **b.** Remove top.
   - **c.** Remove and replace or modify existing riser section and/or top section, as appropriate.
   - **d.** Install new frame and cover or grate. Existing casting may be reinstalled when allowed by the contract documents.
   - **e.** Replace chimney seal for sanitary sewer manhole using only new materials.

E. Connection to Existing Manhole or Intake.

1. **Sanitary Sewer.**
   - **a. General.**
     - **1)** Excavate as required.
     - **2)** Divert flow as necessary. Obtain approval of the diversion plan from the Engineer. Maintain sanitary sewer service at all times unless specified otherwise in the contract documents.
     - **3)** Remove existing invert as necessary to install pipe at required elevation and develop hydraulic channel.
   - **b. Cored Opening.**
     - **1)** Insert flexible watertight connector into new opening.
     - **2)** Install and tighten internal expansion sleeve to hold flexible connector in place.
     - **3)** Insert pipe through flexible connector and tighten external compression ring.
     - **4)** Do not grout opening or pour collar for cored opening with flexible connector.
   - **c. Cut and Chipped Opening (Knockout).**
     - **1)** Saw opening to approximate dimensions with a masonry saw. Saw to depth sufficient to sever reinforcing steel.
     - **2)** Remove concrete and expand opening to a diameter at least 6 inches (150 mm) larger than the outside diameter of the new pipe.
     - **3)** Cut off all reinforcing steel protruding from the structure wall.
     - **4)** Remove existing concrete invert as required to accommodate new pipe.
     - **5)** Insert pipe into structure and trim end flush with inside wall of structure.

6) Install waterstop around new pipe centered within structure wall.
7) Fill opening between structure and pipe with non-shrink grout.
8) Construct concrete collar around pipe and exterior manhole opening.
   a) For new pipes 12 inches (300 mm) or smaller, install two No. 3 steel reinforcing hoops on collar around pipe. Pour concrete collar around pipe/structure junction to a minimum thickness and width of 6 inches (150 mm).
   b) For new pipes larger than 12 inches, install two No. 4 steel reinforcing hoops in collar around pipe. Pour concrete collar around pipe/structure junction to a minimum thickness and width of 9 inches (230 mm).
9) Provide pipe joint, non-shear coupling, or other approved flexible coupling within 2 feet (600 mm) of structure wall to allow for differential settlement between the new sewer and the structure.
10) Reconstruct structure invert to provide a well defined channel between pipes.

2. Storm Sewer.

a. Excavate as required.
b. Cut opening to manhole or intake to 3 to 6 inches (75 to 150 mm) beyond the outside of the pipe. Remove existing invert as necessary to install pipe at required elevation and develop hydraulic channel.
c. Position end of pipe flush with interior wall of manhole.
d. Fill opening between manhole wall and outside of pipe with non-shrink grout. Construct a concrete collar around the pipe.
e. Reconstruct invert according to Article 4149.04, K.
f. Place backfill material according to Section 2533.

F. Cleaning, Inspection, and Testing of Structures.

1. Cleaning.

a. Clean all manholes, intakes, and structures by removing sheeting, bracing, shoring, forms, soil sediment, concrete waste, and other debris.
b. Do not discharge soil sediment or debris to drainage channels, existing storm sewer, or existing sanitary sewer system.

2. Visual Inspection.

a. Examine structure for:
   1) Damage.
   2) Slipped forms.
   3) Indication of displacement of reinforcement.
   4) Porous areas or voids.
   5) Proper placement of seals, gaskets, and embedments.
b. Verify that the structure is set to true line, grade, and plumb.
c. Verify structure dimensions and thicknesses.

3. Repair.

Apply Article 2435.03, B, 8.

4. Sanitary Sewer Manhole Testing.

a. **General.**
   1) Use vacuum testing for new sanitary sewer manholes unless exfiltration testing is specified in the contract documents.
   2) Conduct final test after manhole construction is complete, all repairs and connections have been made, and invert has been installed.
b. **Vacuum Test.**
   1) Applicable only for new manholes isolated from connecting sewer lines.
   2) Use manufactured vacuum test equipment meeting the Engineer's approval. Follow the equipment manufacturer's recommended procedures throughout.
   3) Use extreme care and follow safety precautions during testing operations. Keep personnel clear of manholes during testing.
   4) Seal all openings except manhole top access using pneumatic plugs rated for test pressures. Install plugs according to the test equipment manufacturer's recommendations.
   5) Brace pipe inverts if backfill material has not been placed around connecting pipes.

6) Install the vacuum tester head assembly on the manhole top access, and inflate the seal.
7) Evacuate the manhole to 5 psi (35 kPa). Close the isolation valve and start the test. Record the starting time.
8) Maintain vacuum in the manhole for the time indicated in Table 2435.03-1 below for the diameter and depth of manhole being tested.
9) Test failure is indicated by vacuum loss greater than 0.5 psi (4 kPa) within the minimum test time indicated in Table 2435.03-1 below for the depth and diameter of the manhole being tested.

Table 2435.03-1: Minimum Vacuum Test Times for Various Manhole Diameters

Depth feet (m)	Diameter inches (mm)				
	48 (1200)	54 (1350)	60 (1500)	66 (1650)	72 (1825)
	Time, Seconds				
8 (2.45)	20	23	26	29	33
10 (3.28)	25	29	33	36	41
12 (3.66)	30	35	39	43	49
14 (4.27)	35	41	46	51	57
16 (4.88)	40	46	52	58	67
18 (5.49)	45	52	59	65	73
20 (6.10)	50	53	65	72	81
22 (6.71)	55	64	72	79	89
24 (7.32)	59	64	78	87	97
26 (7.93)	64	75	85	94	105
28 (8.54)	69	81	91	101	113
30 (9.15)	74	87	98	108	121

c. Exfiltration Test.

1) Applicable to new manholes (when specified in the contract documents) or rehabilitated manholes.
2) Testing may be performed in conjunction with sanitary sewer line testing. Apply Section 2504.
3) Do not test by this method if water may potentially freeze during the test.
4) Plug the manhole inlet and outlet.
5) Fill the manhole with water to 2 feet (600 mm) above the outside top of the connecting pipe. If groundwater is present, fill the manhole to no less than 2 feet (600 mm) nor more than 5 feet (1.5 meters) above the groundwater level. Do not fill above the top of the standard barrel sections.
6) Mark the water level.
7) Allow water to stand in the manhole for 1 hour, then refill to the original water level and begin the test.
8) Determine the allowable drop in water level by using the equation given in Article 2504.03, C, 6, i. After 1 hour, measure the drop in water level.
9) Test failure is indicated by water loss greater than maximum allowable calculated exfiltration.

5. Test Failure.

If testing fails, reseal the openings, repair the manhole, and retest. An alternate test method complying with these specifications may be used for a retest if desired.

2435.04 METHOD OF MEASUREMENT.

A. Manhole.

Each type and size of manhole will be counted.

B. Intake.
Each type and size of intake will be counted.

C. Drop Connection.
Each drop connection will be counted.

D. Casting Extension Rings.
Each casting extension ring will be counted.

E. Manhole or Intake Adjustment, Minor.
Each existing manhole or intake adjusted to finished grade by addition or removal of adjustment rings or adjustment of adjustable casting will be counted.

F. Manhole or Intake Adjustment, Major.
Each existing manhole or intake adjusted to grade by addition or removal of riser, cone or flat top sections, or the exchange of existing riser sections with sections having different vertical dimensions will be counted.

G. Connection to Existing Manhole or Intake.
Each connection made to an existing manhole or intake will be counted.

H. Cleaning, Inspection, and Testing.
None.

2435.05 BASIS OF PAYMENT.

A. Manhole.

1. Payment will be at the contract unit price for each type and size of manhole.

2. Payment is full compensation for excavation, placing bedding and backfill material, compaction, base, structural concrete, reinforcing steel, precast units (if used), chimney seals, castings, and adjustment rings.

B. Intake.

1. Payment will be at the contract unit price for each type and size of intake.

2. Payment is full compensation for excavation, placing bedding and backfill material, compaction, base, structural concrete, reinforcing steel, precast units (if used), castings, adjustment rings, and all appurtenances necessary for proper installation.

C. Drop Connection.

1. Payment will be at the contract unit price for each drop connection.

2. Payment is full compensation for the connection to the manhole and all pipe, fittings, concrete encasement, and bedding and backfill material.

D. Casting Extension Rings.
Payment will be at the unit price for each casting extension ring.

E. Manhole or Intake Adjustment, Minor.

1. Payment will be made at the contract unit price for each minor manhole or intake adjustment.

2. Payment is full compensation for:
- Removing existing casting and existing adjustment rings,
- Furnishing and installing adjustment rings,
- Furnishing and installing new casting, and
- Installing new chimney seal (sanitary sewer manholes only).

F. Manhole or Intake Adjustment, Major.

1. Payment will be at the contract unit price for each major adjustment.

2. Payment is full compensation for:
- Removal of existing casting, adjustment rings, top sections and risers,
- Excavation,
- Concrete and reinforcing steel or precast sections,
- Furnishing and installing new casting
- Installing new chimney seal (sanitary sewer manholes only),
- Placing backfill material, and
- Compaction.

G. Connection to Existing Manhole or Intake.

1. Payment will be made at the contract unit price for each sewer connection.

2. Payment is full compensation for coring into the existing manhole or intake, pipe connectors, grout, and waterstop (when required).

H. Cleaning, Inspection, and Testing.
Cleaning, inspection, and testing of structures are incidental to construction of structures and will not be paid for separately.