

## University of Houston Master Specification

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<Insert Issue Date>

### SECTION 33 4000 – DRAINAGE

Maintain Section format, including the UH master spec designation and version date in bold in the center columns of the header and footer. Complete the header and footer with Project information

Edit and finalize this Section, where prompted by Editor's notes, to suit Project specific requirements. Make selections for the Project at text identified in bold.

This Section uses the term "Architect." Change this term to match that used to identify the design professional as defined in the General and Supplementary Conditions.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

Delete hidden text after this Section has been edited for the Project.

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The Contractor's attention is specifically directed, but not limited, to the following documents for additional requirements:
  - 1. The current version of the *Uniform General Conditions for Construction Contracts*, State of Texas, available on the web site of the Texas Facilities Commission.
  - 2. The University of Houston's *Supplemental General Conditions and Special Conditions for Construction*.

#### 1.2 SUMMARY

- A. This Section specifies the requirements for furnishing and placing drainage pipe, laterals, stubs, and appurtenances. The pipe shall be of the size, type and location, and to the lines, grades and elevations shown on the Drawings and shall be constructed in accordance with these Specifications.

#### 1.3 APPLICABLE PUBLICATIONS

- A. The following publications of the latest issues listed below, but referred to thereafter by basic designation only, form a part of this Specification to the extent indicated by the references thereto.
  - 1. American Society for Testing and Materials Standards (ASTM).
    - a. ASTM A 48 – Specification for Gray Iron Castings.

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- b. ASTM A 615 – Specification for Deformed and Plain Carbon -Steel Bars for Concrete Reinforcement.
  - c. ASTM C 32 – Specification for Sewer and Manhole Brick (Made from Clay or Shale)
  - d. ASTM C 76 Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.
  - e. ASTM C 443 – Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
  - f. ASTM C 476 – Specification for Grout for Masonry
  - g. ASTM C 478 – Specification for Precast Reinforced Manhole Sections.
  - h. ASTM D 3034 – Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
  - i. ASTM D 3212 – Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
  - j. ASTM F 679 – Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
  - k. ASTM F 758 – Specification for Smooth-Wall Poly (Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport and Similar Drainage.
  - l. ASTM A 746 – Specification for Ductile Iron Gravity Sewer Pipe.
  - m. ASTM F 2306 - Specification for 12- to 60-inch Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications
  - n. ASTM F 2510 – Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures and Corrugated Dual- and Triple-Wall Polyethylene and Polypropylene Pipes
2. Texas Department of Transportation Standard Specifications for Construction of Highways, Streets and Bridges (TxDOT).
    - a. Item 460 – Corrugated Metal Pipe.
    - b. Item 462 – Concrete Box Culverts and Sewers.
    - c. Item 465 – Manholes and Inlets.
    - d. Item 466 – Headwalls and Wingwalls.
    - e. Item 467 – Safety End Treatment.
    - f. Item 476 – Jacking, Boring or Tunneling Pipe or Box.
    - g. Item 479 – Adjusting Manholes and Inlets.
  3. American Water Works Association (AWWA).
    - a. C 110 – AWWA Standard for Ductile-Iron and Gray-Iron Fittings.

### 1.4 PROJECT CONDITIONS

- A. When working with storm manholes new or existing, Contractor must keep requirements for confined space entries. In all activities, Contractor shall work in a safe manner as required by OSHA and other governing criteria.

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- B. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
  - 1. Follow the University of Houston's Plant Operations Planned and Emergency Utility Outage Guidelines. See "COORDINATION" Article in this Section.
- C. If work requires interference with any public drainage systems within or outside of Public Rights of Way or Easements, Contractor must obtain prior written approval and coordinate with Owner and local municipality before commencing work.

### 1.5 ACTION SUBMITTALS

- A. Product Data: For the following as used on the Project:
  - 1. Pipe material.
  - 2. Special pipe fittings, special fittings between dissimilar pipe materials, pressure type fittings, etc.
  - 3. Backwater valves.
  - 4. Drains.
  - 5. Channel drainage systems.
  - 6. Storage and leaching chambers.
- B. Shop Drawings: For the following:
  - 1. Stormwater Detention Structures: Include plans, elevations, sections, details, frames and covers, design calculations, and concrete design-mix report.
- C. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.
- D. Profile Drawings (if not already shown in the Drawings): Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, and materials.
- E. Field quality-control test reports.

### 1.6 DEFINITIONS

- A. HDPE: High-density, polyethylene plastic.
- B. PE: Polyethylene plastic.
- C. PP: Polypropylene plastic.
- D. PVC: Polyvinyl chloride plastic.

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### 1.7 COORDINATION

- A. Complete the Outage Planning Form in the University of Houston's Planned and Emergency Utility Outage Guidelines available in Section 00 6000 of these Specifications.

## PART 2 - PRODUCTS

### 2.1 PIPE

- A. Reinforced concrete pipe shall conform to ASTM C-76, wall "B" thickness for, Class III and Class IV as shown on the Drawings or as necessary to meet ASTM cover design requirements.
- B. Corrugated metal pipe shall conform to TxDOT Item 460 specifications.
- C. Polyvinyl Chloride (PVC) pipe 4 inches in diameter shall be DR 18 and conform to AWWA C900. PVC pipe 6 to 10 inches in diameter shall be SDR 26 and conform to ASTM 3034. PVC pipe 12 to 15 inches in diameter shall be SDR35 and conform to ASTM D3034. Polyvinyl chloride pipe 18 to 36 inches in diameter shall be SDR35 and conform to ASTM F679.
- D. Precast box culverts shall conform to ASTM C 1433 and TxDOT Item 462.
- E. Polyvinyl Chloride Perforated pipe and fittings shall conform to ASTM F 758.
- F. Ductile Iron Pipe (DIP) shall be Class 51 and conform to ASTM A 746.
- G. High-Density Polyethylene (HDPE) Pipe shall conform to ASTM F 2306.

### 2.2 JOINTS

- A. Reinforced concrete pipe joints shall conform to ASTM C-443 Rubber Gaskets.
- B. PVC pipe joints shall conform to ASTM D-3212 and ASTM F477 specifications.
- C. DIP pipe joints shall conform to AWWA C110, latest edition.
- D. HDPE pipe joints shall conform to ASTM F 2306 and shall be watertight integral Bell and Spigot. Bell shall overlap a minimum of two corrugations of spigot end when fully engaged.

### 2.3 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318, and the following for manholes and inlets:
  - 1. Cement: ASTM C 150, Type II.
  - 2. Fine Aggregate: ASTM C 33, sand.
  - 3. Coarse Aggregate: ASTM C 33, crushed gravel.

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### 4. Water

- a. Water used for mixing or curing shall be reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable matter or other substances injurious to the finished product.
- b. Water sources other than the local municipal domestic water supply must be approved by the Owner.
- c. If onsite reclaimed water sources are used, tanks and apprentices must be clearly marked with the words "non-potable" water.

B. Portland Cement Design Mix: 4000 psi minimum in 28 days, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcement Bars: ASTM A 615, Grade 60 deformed steel.

C. SAFETY END TREATMENTS

D. Safety End Treatments shall conform to the products and installation requirements listed in TxDOT Item 467.

### 2.4 HEADWALLS AND WINGWALLS

A. Headwalls and Wingwalls shall conform to the products and installation requirements listed in TXDOT Item 466.

## PART 3 - EXECUTION

### 3.1 PIPE SEWERS

A. Open Trench Construction

1. No pipe shall be installed in the trench until excavation has been properly constructed per the Drawings and details to at least two pipe lengths beyond the section of pipe being installed and the bottom of trench has been properly shaped.
2. Batter boards where used shall be placed into position properly. Boards shall be nominal 1 x 4 inch lumber, planed on all four sides to parallel faces. The boards and all location stakes shall be protected from injury or change of location.
3. Pipe shall be so laid that after the sewer is completed the interior surface shall conform accurately to the grades and alignments fixed and given in the Drawings.
4. All sewers shall be laid accurately to line and grade, with tongue or spigot end downstream.
5. Pipes shall be fitted together and matched so that when laid, they form a sewer with a smooth and uniform invert.
6. When trenches exceed five feet in depth the Contractor shall utilize trench safety measures per Section 31 4133 "Trench Safety."

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7. Outfall pipes shall be as detailed on the Drawings. Before laying pipes a sufficient bed shall be prepared at the grade indicated on the Drawings. Backfill shall be placed as outlined in Section 31 2333 "Trenching, Backfilling, and Compaction."

### B. Boring, Jacking or Tunneling Construction

1. Suitable pits shall be constructed for the boring, jacking or tunneling operations. Excavations greater than five feet in depth shall be protected as specified in Section 31 4133 "Trench Safety."
2. Construction operations shall be done in such a manner that the operation and structural integrity of the road or other area over the bore is not weakened or damaged in any way nor road operations interfered.
3. Pits shall be filled immediately upon completion of the pipe installation.
4. Jacking operations shall meet the requirements of TxDOT Item 476.3(A and D).
5. Boring operations shall meet the requirements of TxDOT Item 476.3(B and D).
6. When pipe sizes are sufficient for tunneling methods, Contractor may tunnel and jack pipe. When this method is used, special safety precautions shall be used to protect the workers involved. Any over-excavation shall be filled with drilling mud after the pipe is installed. Tunneling operations shall meet the requirements of TxDOT Item 476.3(C).

## 3.2 MANHOLES, JUNCTION BOXES AND INLETS

- A. Manholes, junction boxes and inlets shall be constructed at locations shown on the Drawings and to the depth indicated thereon.
- B. Manholes, junction boxes and inlets shall be constructed of precast concrete sections and in all types shall be constructed to the dimensions shown on the Drawings.
- C. Joints between precast concrete manhole and inlet sections shall be made by uniformly placing "Ram-Nek" flexible plastic gaskets on all faces of the lower part of the joint and lowering the upper ring evenly into place to produce uniform bearing and compression on the sealer. To propose a different gasket, refer to Section 01 2500 "Substitution Procedures."
- D. The construction of manholes, junction boxes and inlets shall be done as soon as practical after the sewer line into or through the manhole, junction box or inlet locations are completed.
- E. All sewers shall be cut neatly at the inside face of the walls of the manhole, junction box or inlet and pointed up with mortar.
- F. After the masonry work has been completed to the proper elevation, the cast iron manhole cover frame shall be set in a full mortar bed and adjusted to the elevation established on the Drawings.
- G. The inverts of the sewer line or several sewer lines entering the manhole or junction box at or near the flow line elevation of the manhole or junction box shall be shaped and routed across the floor of the manhole or junction box using mortar to obtain the proper contour.

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- H. Adjusting manholes and inlets shall conform to specifications in TxDOT Item 479.
- I. All manholes, junction boxes and inlets are to be backfilled per article 3.2.C.1 in Specification Section 31 2333 "Trenching, Backfill and Compaction."

### 3.3 FRAMES, GRATES, RINGS AND COVERS

- A. Castings shall conform to the type shown on the Drawings and shall be clean substantial castings, free from sand or blow holes or other defects.
- B. Surfaces of the castings shall be free from burnt-on sand and shall be reasonably smooth.
- C. Bearing surfaces between manhole rings and covers or grates and frames shall be cast or machined with such precision that uniform bearing shall be provided throughout the perimeter area of contact.
- D. Castings in pavement areas or areas designated to receive traffic loading shall be a heavy duty type capable of H-20 loading.

### 3.4 UNDERDRAIN SYSTEMS

- A. Pipe shall be laid per paragraph 3.1 of this Section and per the details on the Drawings.
- B. Prior to placing granular backfill and bedding, line the trench with drainage fabric according to the details on the Drawings. The drainage fabric shall be Supac 4NP. To propose a different drainage fabric, refer to Section 01 2500 "Substitution Procedures."
- C. Granular bedding shall be prepared to a depth of 2 to 4 inches below the pipe invert. The pipe shall be laid with the perforations facing down. The granular backfill shall then be placed to the depth shown on the details in the Drawings. The filter fabric shall then be wrapped around the granular material with a minimum overlap at the top of 6 inches.
- D. Where vertical pipe risers penetrate the granular backfill to the surface, the drainage fabric shall be cut in an 'X' to accommodate the pipe penetration and then the fabric shall be sealed with a heavy duty tape to the pipe in a manner to insure the integrity of the filter fabric.

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