

## **SECTION 02235 POLYVINYL CHLORIDE (PVC) PIPE**

### **PART I: GENERAL**

#### **1.1 GENERAL REQUIREMENTS**

- A. Polyvinyl chloride pressure pipe for water distribution, in nominal diameters four inches (4 In) through twenty inches (20 In).
- B. Polyvinyl chloride sewer pipe for gravity sewers in nominal diameters four inches (4 In) through forty-eight inches (48 In).
- C. Polyvinyl chloride pressure pipe for gravity sewers and force mains in nominal diameters four inches (4 In) through twenty inches (20 In).

#### **1.2 MEASUREMENT AND PAYMENT**

- A. Unit Prices:
  - 1. No separate payment will be made for PVC pipe under this Section. Include unit prices for work included as specified in the following sections:
    - a. Section 02400 – Water Lines.
    - b. Section 02500 – Gravity Sanitary Sewers.
    - c. Section 02510 – Sanitary Sewer Force Mains.
    - d. Section 02600 – Storm Sewers.
  - 2. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
  - 1. If Contract is Stipulated Price Contract, payment for work in this Section is included in Total Stipulated Price.

#### **1.3 REFERENCES**

- A. ANSI – American National Standards Institute.
  - 1. ANSI A21.16 (AWWA C116) – Protective Fusion Bonded Epoxy Coating for the Interior and Exterior Surfaces of Ductile Iron and Grey Iron Fittings for Water Supply Service.
- B. ASTM – American Society for Testing and Materials.
  - 1. ASTM D1248 – Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.
  - 2. ASTM D1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
  - 3. ASTM D2241 – Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
  - 4. ASTM D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
  - 5. ASTM D2444 – Standard Test Method for Determination of the

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- Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight).
6. ASTM D2680 – Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.
  7. ASTM D3034 – Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
  8. ASTM D3139 – Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
  9. ASTM D3212 – Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
  10. ASTM F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
  11. ASTM F679 – Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
  12. ASTM F794 – Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
  13. ASTM F949 – Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with Smooth Interior and Fittings.
- C. AWWA – American Water Works Association.
1. AWWA C110 – American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 Inches Through 48 Inches for Water.
  2. AWWA C111 – American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
  3. AWWA C900 – Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inches Through 12 Inches for Water Distribution.
  4. AWWA C905 – Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In., for Water Transmission and Distribution.
  5. AWWA C909 – Standard for Molecularly-Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 Inches through 12 Inches (100mm through 300 mm), for Water Distribution.
- D. CTFS – City of Friendswood Technical Specification.
- E. PPI – Plastic Pipe Institute.
1. PPI TR3 – Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials.
- F. UNI – Uni-Bell Standard.
1. UNI-B-13 – Recommended Standard Performance Specification for Joint Restraint Devices for Use with Polyvinyl Chloride Pipe.

#### 1.4 SUBMITTALS

- A. Conform to requirements of Section 01330 – Submittal Procedures.
- B. Submit shop drawings showing design of new pipe and fittings indicating alignment and grade, laying dimensions, fabrication, fittings, flanges and special details.

1.5 QUALITY CONTROL

- A. Submit manufacturer's certifications that PVC pipe and fittings meet requirements of this Section and AWWA C900, AWWA C909 and AWWA C905 for pressure pipe applications or appropriate ASTM standard specified for gravity sewer pipe.
- B. Submit manufacturer's certification that PVC pressure pipe for water lines and force mains has been hydrostatically tested at factory in accordance with AWWA C900, AWWA C909 and AWWA C905 and this Section.
- C. When foreign manufactured material is proposed for use, have material tested for conformance to applicable ASTM requirements by certified independent testing laboratory located in United States. Certification from other source is not acceptable. Furnish copies of test reports to the Project Manager for review. Cost of testing paid by the Contractor.

**PART II: PRODUCTS**

2.1 MATERIAL

- A. Use PVC compounds in manufacture of pipe that contain no ingredient in amount that has been demonstrated to migrate into water in quantities considered to be toxic.
- B. Furnish PVC pressure pipe manufactured from Class 12454-A or Class 12454-B virgin PVC compounds as defined in ASTM D1784. Use compounds qualifying for rating of four thousand pounds per square inch (4000 psi) for water at seventy-three and four tenths degrees Fahrenheit (73.4° F) per requirements of PPI TR3. Provide pipe which is homogeneous throughout, free of voids, cracks, inclusions and other defects, uniform as commercially practical in color, density and other physical properties. Deliver pipe with surfaces free from nicks and scratches with joining surfaces of spigots and joints free from gouges and imperfections which could cause leakage.
- C. PVC Restrained Pipe: Must be listed on the City's current Product Approval List.
  - 1. Pipe Material:
    - a. DR 18: For restrained joints where shown on Drawings.
    - b. DR 14: For alternate to offset pipe sections shown on the Drawings. Do not use PVC for offset sections with depth of cover greater than twenty feet (20 Ft) or less than four feet (4 Ft). Do not use PVC in potentially petroleum contaminated areas.
- D. Water Service
  - 1. Provide self-extinguishing PVC pipe that bears Underwriters' Laboratories mark of approval and is acceptable without penalty to Texas State Fire Insurance Committee for use in fire protection lines.

2. Bear National Sanitation Foundation Seal of Approval (NSF-PW).
- E. Gaskets:
  1. Gaskets shall meet requirements of ASTM F477. Use elastomeric factory-installed gaskets to make joints flexible and watertight.
  2. Flat Face Mating Flange: Full faces one-eighth inch (1/8 In) thick ethylene propylene (EPR) rubber.
  3. Raised Face Mating Flange: Flat ring one-eighth inch (1/8 In) ethylene propylene (EDR) rubber, with filler gasket between OD of raised face and flange OD to protect flange from bolting moment.
- F. Lubricant for rubber-gasketed joints: Water soluble, non-toxic, non-objectionable in taste and odor imparted to fluid, non-supporting of bacteria growth, having no deteriorating effect on PVC or rubber gaskets.
- G. Do not use PVC in potentially or known contaminated areas.
- H. Do not use PVC in areas exposed to direct sunlight.

## 2.2 WATER SERVICE PIPE

- A. Pipe four inch (4 In) through twelve inch (12 In): AWWA C900, AWWA C909, Class 150, DR 18; AWWA C900, Class 200, DR 14 as alternate to offset pipe sections; nominal twenty foot (20 Ft) lengths; cast-iron equivalent outside diameters.
- B. Pipe fourteen inch (14 In) through twenty inch (20 In): AWWA C905; Class 235; DR 18; nominal twenty foot (20 Ft) lengths; cast-iron equivalent outside diameter.
- C. Provide Polyvinyl Chloride Pipe from approved manufacturers.
- D. Make curves and bends by deflecting joints. Do not exceed maximum deflection recommended by pipe manufacturer. Submit details of other methods of providing curves and bends for review by the Project Manager.
- E. Hydrostatic Test: AWWA C900, AWWA C905, AWWA C909, ANSI A21.10 (AWWA C110); at point of manufacture; submit manufacturer's written certification.

## 2.3 GRAVITY SEWER PIPE

- A. PVC gravity sanitary sewer pipe and storm sewer pipe shall be as specified in TABLE 4.1 – PVC PIPE DESIGNATION in the Section.
- B. When solid wall PVC pipe eighteen inches (18 In) to twenty-seven inches (27 In) in diameter is required in SDR 26, provide pipe conforming to ASTM F679, except provide wall thickness as required for SDR 26 and pipe strength of one hundred fifteen pounds per square inch (115 psi).
- C. For sewers up to twelve inch (12 In) diameter crossing over water lines or crossing under water lines with less than two feet (2 Ft) separation, provide minimum one hundred fifty pounds per square inch (150 psi) pressure-rated pipe conforming to ASTM D2241 with suitable PVC

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adapter couplings.

- D. Joints: Spigot and integral wall section bell with solid cross section elastomeric or rubber ring gasket conforming to requirements of ASTM D3212 and ASTM F477 or ASTM D3139 and ASTM F477. Gaskets shall be factory-assembled and securely bonded in place to prevent displacement. Manufacturer shall test sample from each batch conforming to requirements ASTM D2444.
- E. Fittings: Provide PVC gravity sewer sanitary bends, tee or wye fittings for new sanitary sewer construction. PVC pipe fittings shall be full-bodied, either injection molded or factory fabricated. Saddle-type tee or wye fittings shall not be acceptable.
- F. Conditioning: Conditioning of samples prior to and during tests is subject to approval by the Project Manager. When referee tests are required, condition specimens in accordance with Procedure A in ASTM D618 at seventy-three and four-tenths degrees Fahrenheit (73.4° F) plus or minus three and six-tenths degrees Fahrenheit ( $\pm 3.6^\circ$  F) and fifty percent (50%) relative humidity plus or minus five percent (5%) relative humidity for not less than forty hours (40 Hrs) prior to test. Conduct tests under same conditions of temperature and humidity unless otherwise specified.
- G. Pipe Stiffness: Determine pipe stiffness at five percent (5%) deflection in accordance with Test Method D 2412. Minimum pipe stiffness shall be forty-six pounds per square inch (46 psi). For diameters four inches (4 In) through eighteen inches (18 In), test three (3) specimens, each a minimum of six inches (6 In) in length. For diameters twenty-one inch (21 In) through thirty-six inch (36 In), test three (3) specimens, each a minimum of twelve inch (12 In) in length.
- H. Flattening: Flatten three (3) specimens of pipe, prepared in accordance with Paragraph 2.3.F, in suitable press until internal diameter has been reduced to sixty percent (60%) of original inside diameter of pipe. Rate of loading shall be uniform. Test specimens, when examined under normal light and with unaided eye, shall show no evidence of splitting, cracking, breaking or separation of pipe walls or bracing profiles. Perform the flattening test in conjunction with pipe stiffness test.
- I. Joint Tightness: Test for joint tightness in accordance with ASTM D3212, except that joint shall remain watertight at minimum deflection of five percent (5%). Manufacturer shall be required to provide independent third (3rd) party certification for joint testing each diameter of storm sewer pipe.
- J. Purpose of Tests: Flattening and pipe stiffness tests are intended to be routine quality control tests. Joint tightness test is intended to qualify pipe to specified level of performance.

#### 2.4 SANITARY SEWER FORCE MAIN PIPE

- A. Provide approved PVC pressure pipe conforming to requirements for water service pipe and conforming to minimum working pressure rating specified in Section 02510 – Sanitary Sewer Force Mains.

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- B. Acceptable pipe joints are integral bell-and-spigot, containing a bonded-in elastomeric sealing ring meeting requirements of ASTM F477. In designated areas requiring restrained joint pipe and fittings, use approved joint restraint device conforming to UNI-B-13, for PVC pipe twelve inch (12 In) diameter and less.
- C. Fittings: Provide approved ductile iron fittings as per Section 02215 – Ductile Iron Pipe (DIP) and Fittings, Paragraph 2.4, except furnish fittings with one (1) of following approved internal linings:
  - 1. Nominal forty (40) mils [thirty-five (35) mils minimum] virgin polyethylene complying with ASTM D1248, heat fused to interior surface of fitting.
  - 2. Nominal forty (40) mils [thirty-five (35) mils minimum] polyurethane.
  - 3. Nominal forty (40) mils [thirty-five (35) mils minimum] ceramic epoxy.
  - 4. Nominal forty (40) mils [thirty-five (35) mils minimum] fusion bonded epoxy.
- D. Exterior Protection: Provide polyethylene wrapping of ductile-iron fittings as required by Section 02260 – Polyethylene Wrap.
- E. Hydrostatic Tests: Hydrostatically test pressure rated pipe in accordance with Paragraph 2.2.E.

## 2.5 BENDS AND FITTINGS FOR PVC PRESSURE PIPE

- A. Bends and Fittings: ANSI A 21.10 or ANSI A 21.53, ductile iron; ANSI A 21.11 single rubber gasket push-on type joint; minimum two hundred pounds per square inch (150) psi pressure rating. Approved restrained joints, two hundred pounds per square inch (200 psi) and two hundred fifty pounds per square inch (250 psi), may be provided for up to twelve (12) inches in diameter (water or sanitary).
- B. Provide approved restrained joint fittings: Integral restrained joint fittings and pipe shall not require secondary restraint.

## PART III: EXECUTION

### 3.1 PROTECTION

- A. Store pipe under cover out of direct sunlight and protect from excessive heat or harmful chemicals in accordance with manufacturer's recommendations.

### 3.2 INSTALLATION

- A. Conform to requirements of Section 02400 – Water Lines, Section 02500 – Gravity Sanitary Sewers and Section 02510 – Sanitary Sewer Force Mains, as applicable.
- B. Install PVC pipe in accordance with Section 02125 – Excavation and Backfill for Utilities, ASTM D2321 for Sewer Pipe and manufacturer's

recommendations.

- C. Install PVC water service pipe to clear utility lines and have minimum depth of cover below property line grade of street, unless otherwise required by Drawings:
  - 1. Water service pipe twelve (12) inches in diameter and smaller four feet (4 Ft) of cover.
  - 2. Water service pipe sixteen (16) inches in diameter and larger five (5) feet of cover.
- D. Avoid imposing strains that shall overstress or buckle pipe when lowering pipe into trench. Do not drop pipe more than two feet (2 Ft).
- E. Hand shovel pipe bedding under pipe haunches and along sides of pipe barrel and compact to eliminate voids and ensure side support.
- F. Store PVC pipe under cover out of direct sunlight. Protect pipe from excessive heat or harmful chemicals. Prevent damage by crushing or piercing.
- G. Allow PVC pipe to cool to ground temperature before backfilling when assembled out of trench to prevent pullout due to thermal contraction.

### 3.3 PVC RESTRAINED MECHANISM

- A. Do not apply lubricant to spline or pipe or coupling spline grooves.
- B. Do not use excessive force while inserting the spline through coupling.
- C. Insert spline until it is fully seated around circumference of pipe.
- D. Field Cutting of Pipe Ends:
  - 1. Perform by workers certified by manufacturer.
  - 2. Use a PVC pipe cutter and provide square ends.
  - 3. Use manufacturer approved power routing and grooving tool to field fabricate required pipe groove.

**PART IV: TABLES**

**4.1 – PVC PIPE DESIGNATION**

| <b>WALL CONSTRUCTION</b> | <b>MANUFACTURER</b> | <b>ASTM DESIGNATION</b> | <b>SDR (MAX.)/<br/>STIFFNESS<br/>(MIN.)</b> | <b>DIAMETER<br/>SIZE RANGE</b> |
|--------------------------|---------------------|-------------------------|---|--------------------------------|
| Solid                    | J-M Pipe            | D3034                   | SDR 26 / PS 115                             | 6" TO 10"                      |
|                          |                     | D3034                   | SDR 35 / PS 46                              | 12" & 15"                      |
|                          | CertainTeed         | F679                    | SDR 35 / PS 46                              | 18" to 27"                     |
|                          | Diamond             | AWWA C900               | DR 18 / N/A                                 | 4" to 12"                      |
|                          | Uponor ETI          | AWWA C909               | DR 18 / N/A                                 | 4" to 12"                      |
|                          | North American      | AWWA C905               | DR 18 / N/A                                 | 14" to 16"                     |
| Truss (Gasketed)         | Contech             | D2680                   | N/A / 200 psi                               | 8" to 15"                      |
| Profile                  | Contech A-2000      | F949                    | N/A / 46 psi                                | 12" to 16"                     |
|                          | Contech A-2026      | F949                    | N/A / 115 psi                               | 8" to 10"                      |
|                          | ETI, Ultra-Rib      | F794                    | N/A / 46 psi                                | 8" to 30"                      |
|                          | ETI, Ultra-Corr     | F794                    | N/A / 46 psi                                | 24" to 36"                     |

**END OF SECTION**