

SECTION 02520
POLYVINYL CHLORIDE PIPE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Polyvinyl Chloride (PVC) pipe, fittings, and appurtenances.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 01 - General Requirements.
 - 3. *{Section XXXXX - Trenching, Backfilling and Compaction for Utilities. Define frequency and location of backfill compaction testing by an independent testing firm}*.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American National Standards Institute (ANSI):
 - a. B40.100, Pressure Gauges and Gauge Attachments.
 - 2. ASTM International (ASTM):
 - a. PVC (polyvinyl chloride) materials:
 - 1) D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
 - 2) D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
 - 3) D2241, Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
 - 4) D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 - 5) D2564, Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
 - 6) D3034, Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - 7) D3139, Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
 - 8) D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipe using Flexible Elastomeric Seals.
 - 9) F477, Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
 - 10) F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - 11) F679, Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
 - 12) F794, Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
 - 13) F949, Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings.
 - 14) F1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
 - b. Installation:
 - 1) D2321, Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 - 3. American Water Works Association (AWWA):
 - a. PVC (Polyvinyl Chloride) materials:

- 1) C605, Standard for Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
 - 2) C900, Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 IN through 60 IN, for Water Transmission and Distribution.
 - b. Polyethylene (PE) materials:
 - 1) C901, Standard for Polyethylene (PE) Pressure Pipe and Tubing, 1/2 IN through 3 IN, for Water Service.
 - c. Ductile Iron materials:
 - 1) C600, Standard for Installation of Ductile Iron Water Mains and Their Appurtenances.
 4. American National Standards Institute/American Water Works Association (ANSI/AWWA):
 - a. C104/A21.4, Standard for Cement-Mortar Lining for Ductile Iron Pipe and Fittings.
 - b. C110/A21.10, Standard for Ductile-Iron and Gray-Iron Fittings for Water.
 - c. C153/A21.53, Standard for Ductile-Iron Compact Fittings for Water Service.
 5. National Sanitation Foundation International (NSF).
- B. Manufacturer's and Installer's Qualifications:
1. Manufacturer shall have experience in manufacturing polyvinyl chloride (PVC) pipe of similar size and type to that specified herein. For a manufacturer to be determined as acceptable for providing PVC pipe, they must show evidence of manufacturing a minimum of 10,000 linear feet of PVC piping and ten years' experience in the design and manufacturing of PVC pipe of similar size, type, and application (water/wastewater) as specified herein.
 2. Pipe and fittings shall not have been used in any previous application.

1.3 SUBMITTALS

- A. Shop Drawings:
1. Refer to Specification "Section 01340 – Submittals" for requirements for the mechanics and administration of the submittal process.
 2. Product technical data for gaskets, pipe, fittings, and appurtenances including:
 - a. Acknowledgement that products submitted meet the requirements of standards referenced.
 - 1) Acknowledgement shall be in the form of a letter or company-standard form containing all required data and signed by an officer of the manufacturing, fabricating, or supplying company and at a minimum include:
 - a) Name and location of the Work.
 - b) Name and address of the Contractor.
 - c) Name of the manufacturing or fabricating company.
 - d) Design calculations.
 - b. Certificates: Provide affidavit of compliance per AWWA C110 or AWWA C153 for fittings.
 - c. Test reports: Summarizing results of the final field pressure leakage test.
 - d. Copies of manufacturer's written directions regarding material handling, delivery, storage, and installation for each type of pipe.
 3. Details of temporary restraints for testing.
- B. Field quality control documents:
1. Test reports.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall use all means necessary to protect pipe materials, fittings, and appurtenances before, during, and after installation.
- B. Contractor shall use straps and not chains, cables, or unpadded forks to handle pipe.
1. Handle only from the outside of the pipe and fittings.

- C. Prevent damage to the pipe, fittings, and appurtenances during handling and transit by using methods recommended by the manufacturer and approved by the Engineer.
 - 1. Repair abrasions, scars, and blemishes.
 - a. If repair of satisfactory quality cannot be achieved, replace damaged material in its entirety immediately.
 - 2. All damaged pipe, fittings, and appurtenances shall be removed from the site by the Contractor and when directed to do so by the Owner.
- D. Pipe shall be stored to assure the preservation of quality and fitness for the Work.
 - 1. Store pipe in a manner to keep pipe interior free from dirt and foreign matter.
 - 2. Storage on stones or other hard material that can damage the pipe exterior is not permitted.
 - 3. Storage of pipe on top of pipe is not permitted.
 - 4. Protect pipe stored outside from sunlight.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Restraint System for PVC Bell and Spigot Joints:
 - a. EBAA Iron, Inc., Series 1600/2800.
 - b. Ford Meter Box Company, Inc., Series 1390.
 - c. Sigma Corporation, PV-LOK Series.
 - d. Smith-Blair Camlok
 - e. Or approved equal.
 - 2. Restraint System for PVC to Mechanical Joint Fittings:
 - a. EBAA Iron, Inc., Series 2000 PV.
 - b. Ford Meter Box Company, Inc., Series 1500.
 - c. Sigma Corporation ONE-LOK Series.
 - d. Or approved equal.
- B. Submit request for substitution in accordance with Specification Section *{Insert applicable section}*.

2.2 MATERIALS

- A. PVC Force Main Piping:
 - 1. Furnish materials in full compliance with the following requirements:
 - a. PVC Pipe:
 - 1) 4 IN through 60 IN, AWWA C900.
 - 2) Laying lengths shall be 13 FT or 20 FT.
 - 3) Restrained joint where shown on the Contract Drawings.
 - 4) Unplasticized polyvinyl chloride plastic pressure pipe with integral wall bell and spigot joints and shall bear the seal of approval by the National Sanitation Foundation (NSF).
 - b. Joints:
 - 1) Push-on joints:
 - a) O-ring gaskets, ASTM F477.
 - b) Flexible factory assembled elastomeric ring in the integral bell-end, ASTM D3139.
 - 2) Joint material including gaskets and lubricants:
 - a) AWWA C900 and ASTM D3139.
 - b) At no time shall gaskets be cut that will be used in the installation of pipeline

- c. Fittings:
 - 1) ANSI/AWWA C110/A21.10 ductile iron or C15/A21.53
 - a) Refer to Specification “Section 02510 – Ductile Iron Pipe and Fittings”.
 - d. Polyethylene encasement:
 - 1) All ductile iron fittings shall be wrapped *{Engineer to decide if single/double wrapping and to coordinate with HRSD Project Manager if newly introduced biowrap is acceptable or preferable}* with polyethylene encasement conforming to the requirements of ANSI/AWWA C105/A21.5 unless otherwise shown on the plans or specified herein. *{Engineer to decide if required}*.
 - 2) Polyethylene encasement shall have minimum thickness of 8 mil per layer.
 - e. Tracer Wire:
 - 1) Copper tracer wire shall be 10-gauge, solid wire with plastic coating.
 - f. Utility Marking Tape:
 - 1) Subsurface utility marking tape shall be of a durable, metalized, plastic film, bright green in color, imprinted with the legend “CAUTION: SEWER BELOW”.
 - a) The utility marking tape shall be manufactured by Griffolyn Company or approved equal.
 - b) Tape shall be placed no less than 6 IN and no greater than 12 IN below the proposed finished grade.
- B. PVC Gravity Sewer Piping:
- 1. Furnish materials in full compliance with the following requirements:
 - a. PVC Pipe, Joints, and Fittings:
 - 1) Pipe sizes 6 IN through 15 IN DIA, ASTM D3034 SDR 26.
 - 2) Pipe sizes 18 IN through 60 IN DIA, ASTM F679.
 - 3) Manufactured from approved PVC compound, ASTM D1784.
 - 4) Laying lengths shall be 13 FT or 20 FT.
 - 5) Integral bell with gasketed joints, except where specified otherwise on the Drawings.
 - 6) Joints:
 - a) ASTM D3034, Section 6.
 - b) Performance requirements of ASTM D3212.
 - 7) Rubber gaskets shall meet physical requirements in ASTM F477 and ASTM D3212
 - 8) At no time shall gaskets be cut that will be used in the installation of pipeline
- C. Utility Marking Tape:
- 1. Subsurface utility marking tape shall be of a durable, metalized, plastic film, bright green in color, imprinted with the legend “CAUTION: SEWER BELOW”.
 - a. The utility marking tape shall be manufactured by Griffolyn Company or approved equal.
- D. Saddles for Air Vents:
- 1. Service saddles shall have 2-inch threaded outlets (Mueller CC threads).
 - 2. Smith Blair Models
 - a. Style 366 for pipe 18-inch diameter and larger.
 - b. Style 313 for pipe less than 18-inch diameter
 - 3. JCM Industries
 - a. Style 418 for pipe 24-inch and larger
 - b. Style 404 for pipe less than 24-inch diameter

PART 3 - EXECUTION

3.1 INSPECTION

- A. Items of material furnished under this Section shall be subject to inspection prior to installation.
 - 1. Items found not to be in compliance with this Section shall be removed from the project site and replaced with items that have been approved for installation.

2. Inspections and approvals do not supplement the need to comply with the Contract Documents.

3.2 PIPE INSTALLATION

- A. Trenching:
 1. Excavate trenches by open cut method to depth and width necessary to accommodate Work.
 2. Support existing utility lines traversing trench and stabilize excavation to prevent undermining of existing utility lines.
 3. Open only length of trench required to complete each day's piping installation.
- B. Dewatering:
 1. Install a dewatering system as required to prevent softening and disturbance of subgrade during construction. All dewatering system design is the Contractor's responsibility.
 2. Groundwater shall be maintained at least 2 FT below the bottom of any excavation.
 3. Keep dewatering system in operation until backfill to cover pipe is in place.
 4. Dispose of uncontaminated groundwater to an area which will not impair construction operations or damage existing construction.
 5. Refer to the requirements of "Section 02710 – Contaminated Groundwater Management" if suspected or confirmed presence of hydrocarbon and other defined contaminants in the removed groundwater. *{Engineer to determine applicability of this section}*
 6. Contractor shall adhere to locality noise ordinance for operation of dewatering pumps and generators.
- C. Preparation of Foundation for Pipe Laying:
 1. Subgrade Stabilization:
 - a. If subgrade of pipe trenches is in a frozen, loose, wet, or soft condition before construction is placed thereon, remove frozen, loose, wet, or soft material and replace with approved compacted material as authorized by Engineer in writing.
 - b. Loose, wet, or soft materials, when approved by Engineer in writing, may be stabilized by a compacted working mat of well graded crushed stone.
 - 1) Over-excavate up to a depth of 2 FT below the design final subgrade elevation to remove the unsuitable material.
 - c. Compact stone bedding material thoroughly into subgrade to avoid future migration of fines into the stone voids.
 - d. Unstable trench bottoms caused by the Contractor's failure to dewater or Contractor operations shall be replaced at no additional compensation.
 - e. All trenching and subgrade preparation shall be in accordance with the manufacturer's recommendations.
- D. Laying Pipe in Trench:
 1. Clean each pipe length thoroughly and inspect for compliance to Specifications.
 2. Grade trench bottom and excavate for pipe bell and lay pipe on trench bottom.
 3. Thoroughly clean gasket, bell and spigot before assembling joint.
 4. Lay pipe in only suitable weather with good trench conditions.
 - a. Never lay pipe in water except where approved by Engineer.
 - b. Never use rock, brick, or other materials under the pipe while aligning the pipeline grade that may result in a fracture point for the PVC pipe.
 - c. Never allow debris, angular materials or other unsuitable bedding and backfill materials to be in contact with PVC pipe.
 5. Seal open end of line with watertight plug if pipe laying stopped.
 6. Remove water in trench before removal of plug.
- E. Joining Method - Push-On Joints:
 1. Install in accordance with AWWA C605
 2. Assemble push-on joints in accordance with manufacturer's directions.
 3. Lubricate spigot end of pipe to facilitate assembly without damage to gasket.
 - a. Use lubricant that has no deteriorating effects on the gasket material
 4. Assure the gasket groove is thoroughly clean.

5. For cold weather installation, warm gasket prior to placement in bell.
 6. Taper of bevel shall be approximately 15 degrees with centerline of pipe and approximately 1/4 IN back.
 7. Lining Up Push-On Joint Piping:
 - a. Pipe deflections shall not exceed 50 percent of the maximum deflection values stated in manufacturer's written literature.
 - b. Install shorter lengths of pipe in such length and number that angular deflection of any joint does not exceed 50 percent of the maximum deflection values stated in manufacturer's written literature.
 - c. Measure and mark on the spigot end of the pipe the proper insertion point into the bell or fitting to prevent stress related damage.
- F. Joining Method - Push-On Mechanical Joints (Restrained):
1. Install in accordance with AWWA C605.
 2. Assemble mechanical joints in accordance with manufacturer's directions.
 3. Lubricate spigot end of pipe to facilitate assembly without damage to gasket.
 - a. Use lubricant that has no deteriorating effects on the gasket material
 4. Assure the gasket groove is thoroughly clean.
 5. For cold weather installation, warm gasket prior to placement in bell.
 6. Do not overstress bolts. The use of a torque wrench is required.
 7. Install restraint system in accordance with manufacturer's directions and as required in the plans.
- G. Installation of Saddles for Air Vents *{Engineer to review this requirement against HRSD Standard Detail}*
1. Approved stainless steel saddle shall be used to install air vent assembly at each high point along pipeline.
 2. Field taps shall be made at each location for air vent assembly.
- H. Polyethylene Encasement:
1. Wrap all ductile iron fittings in polyethylene encasement in full compliance to ANSI/AWWA C105/A21.5 unless otherwise shown on the plans or specified herein.
 - a. Encase underground appurtenances required as part of installation.
 - b. Make sections of tubing 2 FT longer than the fitting to be covered.
 - c. Slip tube over fitting while fitting is suspended immediately before placing in trench.
 - d. After installing in trench, pull tube ends over joint and overlap.
 - e. Fasten securely in-place on each side of each joint with joint tape or strapping.
 - f. Completely cover fittings and connections with film held snugly in-place with joint tape or strapping.
- I. Backfilling Methods:
1. Comply with the following:
 - a. Observe specific pipe manufacturer's recommendations regarding backfilling and compaction.
 - b. Over excavation shall be filled with #57 stone at the contractor's expense.
 - c. Place backfill in lifts not exceeding 8 IN (loose thickness).
 - d. Hand place, shovel slice, and pneumatically tamp all backfill to a depth of 6-IN above top of pipe.
 - e. Compact each lift to specified requirements
 - f. Compaction testing as defined in the Bid Documents for locations and frequency of testing to be performed by an independent testing firm.
 - g. Avoid displacing joints and appurtenances or causing any horizontal or vertical misalignment, separation, or distortion.
 2. Water flushing for consolidation is not permitted.
- J. Tracer Wire:
1. Install tracer wire in accordance with the following:
 - a. Tracer wire shall be installed on all PVC pipe installations.

- b. Tracer wire shall be attached to the top of the pipe with plastic strapping at a minimum spacing of 10 FT.
 - c. Tracer wire access boxes shall be installed at a maximum distance of 400 FT apart.
 - 1) Use of air vents or valve boxes as tracer wire access boxes is not permitted.
 - 2) Combination Tracer Wire/Cathodic Test Station box shall be used for the tracer wire access point.
 - 3) There shall be adequate wire in the tracer wire test station box to pull the wire 2 FT outside of the box.
- K. Utility Marking Tape:
- 1. Install utility marking tape in accordance with the following:
 - a. Tape shall be placed no less than 6 IN and no greater than 12 IN below the proposed finished grade.

3.3 CONNECTIONS WITH EXISTING PIPE

- A. Scheduling: Refer to Section “01520 – Maintenance of Pipe and Pumping Operations”.
- B. Locations of existing piping shown on the Contract Drawings shall be considered approximate.
- C. Verify exact location of existing piping prior to laying connection piping which could alter the Work.
 - 1. Re-laying of pipe as a result of an incorrect alignment to an existing pipe shall be corrected.
- D. Use suitable and proper fittings to suit conditions encountered.
- E. Provide suitable equipment to dewater, drain, and dispose of liquid removed from existing pipe during connection.
- F. Where connections necessitate employment of past installation methods not currently part of trade practices, utilize special piping components.

3.4 FIELD QUALITY CONTROL

- A. Backfill Compaction Testing
 - 1. Compaction testing as required and defined in the Bid Documents for locations and frequency to be tested by an independent firm.
- B. Testing of PVC Pressure Pipe:
 - 1. General Procedures for Hydrostatic Pressure Testing:
 - a. Testing shall be in accordance with AWWA C605.
 - b. Provide temporary restraints for exposed joints during test.
 - c. Test buried piping after backfilling.
 - d. Ports for testing shall be at 2-IN taps for proposed air vents or in plugs installed for testing. Under no circumstances shall the contractor tap the proposed force main for testing purposes.
 - e. Test requirements:
 - 1) Test medium: Water.
 - 2) Pressure: 100 psi.
 - 3) Duration: 2 hrs.
 - f. Perform pressure test using calibrated pressure gages and calibrated volumetric measuring equipment to determine leakage rates. *{Note to Engineer: coordinate with HRSD Project Manager as to a preference for Owner provided calibrated gauge verses Contractor provided calibrated gauge for specific hydrostatic test}*
 - 1) Contractor shall furnish and use a gauge that has been calibrated within 12 months of the planned use. Contractor shall provide to Engineer verification certification of stated calibration of the pressure test gauge.
 - 2) Select each gauge so that the specified test pressure falls within the upper half of the gauge's range.

- 3) Notify the Owner's Representative a minimum of 2 business days prior to each test.
- 4) Owner's Representative shall be present during the test.
- g. Completely assemble and test new piping systems prior to connection to existing pipe systems.
- h. PVC Force Main Test Allowance: Testing allowance shall be defined as the quantity of water that must be supplied to the pipe section being tested to maintain a pressure within 5 psi of the specified hydrostatic test pressure. No installation will be accepted if the quantity of makeup water is greater than that determined by the formula:

$$Q = \frac{LD\sqrt{P}}{148,000}$$

Where:

Q = quantity of makeup water (gph)

L = length of pipe section being tested (FT)

D = nominal diameter of the pipe (IN)

P = average test pressure during the hydrostatic test (psig)

- i. The Contractor shall bear the cost of all testing and inspecting, locating and remedying of leaks and any necessary retesting and re-examination.
 - j. Prepare hydrostatic test report and submit to Engineer in accordance with Section "01340 – Submittals".
- C. PVC Gravity Sewer Allowable Leakage Rates:
- 1. Hydrostatic exfiltration and infiltration:
 - a. Leakage outward or inward shall not exceed 100 gallons per inch diameter per mile per day (2,400 GPD/MI maximum) at a minimum of 4 FT of head above the crown of the pipe.
 - b. Groundwater level is below the top of pipe:
 - 1) Leakage rate: 200 gallon per inch diameter per mile per day at average head on test section of 3 FT.
 - a) Average head is defined from groundwater elevation to average pipe crown.
 - 2) Acceptable test head leakage rate for heads greater than 3 FT:
 - a) Acceptable leakage rate (gallons per inch diameter per mile per day) = 115 x (actual test head to the 1/2 power).
 - c. Groundwater level is above the top of pipe:
 - 1) Allowable leakage rate: 200 gallon per inch diameter per mile per day when depth of groundwater over top of pipe is 2 to 6 FT.
 - 2) Leakage rate at heads greater than 6 FT: Allowable leakage rate (gallons per inch diameter per mile per day) = 82 x (actual head to the 1/2 power).
- D. Tracer Wire:
- 1. The tracer wire shall be tested for continuity as part of the project acceptance.
 - 2. Any breaks in the tracer wire shall be excavated and spliced to restore continuity.

END OF SECTION