

SECTION 02731

GRAVITY WASTEWATER SEWER

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Wastewater Sewer Gravity Pipelines
- B. Service Connection Piping
- C. Pipeline Testing

1.02 RELATED SECTIONS

- A. Trenching Backfilling and Compacting: Section 02221.
- B. Cast-In-Place Concrete: Section 03300.
- C. Grout: Section 03600.

1.03 QUALITY ASSURANCE

- A. Source Quality Control:
 - 1. Shop Tests and Inspection:
 - a. All material furnished by the Contractor shall be certified by the supplier for compliance with the pertinent specifications. Shop inspections and testing may be required. The cost of shop testing shall be borne by the supplier or the Contractor.
- B. Disposition of Defective Material: All material found during the progress of the work, either before or after installation, to have cracks, flaws or other defects will be rejected by the Owner's Representative. All defective materials furnished by the Contractor shall be promptly removed by him from the site at his own expense.

1.04 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI A 21.4 – Cement-Mortar Lining for Cast Iron and Ductile-Iron Pipe and Fittings for Water.
 - 2. ANSI A 21.10 – Gray-Iron and Ductile-Iron Fittings, 2 through 48 inches, for Water and Other Liquids.
 - 3. ANSI A 21.11 – Rubber Gasket Joints for Cast Iron and Ductile Pressure Pipe and Fittings.
 - 4. ANSI A 21.50 – Thickness Design of Ductile-Iron Pipe.
 - 5. ANSI A 21.51 – Ductile-Iron Pipe, Centrifugally Cast, in Metal Molds or Sand-Lined Molds for Water or Other Liquids.

- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM A48 – Gray Iron Castings.
 - 2. ASTM C361 – Reinforced Concrete Low-Head Pressure Pipe, Spec. for.
 - 2. ASTM C923 – Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes.
 - 3. ASTM D2321 – Underground Installation of Flexible Thermoplastic Sewer Pipe, Rec. Practice for.
 - 4. ASTM D3034 – Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings, Spec.
 - 5. ASTM D3212 – Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals, Spec. for.
 - 6. ASTM F477 – Elastomeric Seals (Gaskets) for Joining Plastic Pipe, Spec. for.
 - 7. ASTM F679 – Polyvinyl Chloride (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

- C. American Water Works Association (AWWA):
 - 1. AWWA C 100 – Cast-Iron Pressure Fittings.
 - 2. AWWA C 104 – Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water.
 - 3. AWWA C 600 – Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances.

1.05 SUBMITTALS

- A. Shop Drawings and Product Data: Furnish completely dimensioned shop drawings, catalog cut or other data as required to provide a complete description of piping and piping specialties.

- B. Certificates:
 - 1. Certified records or reports of results of shop tests, such records or reports to contain a sworn statement that shop tests have been made as specified.
 - 2. Manufacturer's sworn certification that pipe will be manufactured in accordance with specified reference standards for each pipe type.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Transport, handle and store pipe materials and other Products specified herein in a manner recommended by the respective manufacturers to prevent damage and defects.

1.07 SITE CONDITIONS

- A. Environmental Requirements:
 - 1. Keep trenches dewatered until pipe joints have been made and concrete cradle or encasement, if any, have cured.
 - 2. Under no circumstances lay pipe in water or on bedding containing frost.
 - 3. Do not lay pipe when weather conditions are unsuitable, as determined by the Owner's Representative, for pipe laying work.

PART 2 – PRODUCTS

2.01 SEWER PIPE AND FITTINGS

- A. For pipe joints, use rubber gaskets suitable for conveying domestic sewage.
- B. Ductile Iron (DIP):
 - 1. Pipe (3"-54"): ANSI A21.50 and ANSI A 21.51.
 - 2. Wall Thickness Class (Buried): Class 51.
 - 3. Cement Mortar Lining: Conforming to ANSI Specification A21.4 or AWWA C104, Latest Edition, except the thickness of linings should not be less than the following:
 - a. 3" through 12" 1/8"
 - b. 14" through 24" 3/16"
 - 4. Fittings: Gray iron or ductile iron ANSI A21.10. Fittings larger than 48 in. AWWA C100 Class B (Up to 60").
 - 5. Joints:
 - a. Rubber-Gasket Joints (Buried): ANSI A 21.11.
 - (1) For buried pipe installation, provide either push-on or mechanical joints except where other types of joints are indicated on the Detail Drawings or required by the Specifications.
 - 6. Pipe and Fittings Coating: Factory coated inside and out with bituminous material; minimum 1 mil dry thickness. Bituminous material and finished coat conforming to seal coat requirements in ANSI A 21.4.
- C. Polyvinyl Chloride Pipe (PVC):
 - 1. Pipe: Type PSM SDR-35, ASTM D3034 (ASTM F679 for over 15-inch diameter).
 - 2. Fittings: Conforming to same applicable ASTM Specification requirements for pipe.
 - 3. Joints: Push-on with elastomeric gasket, ASTM D3212; and ASTM F477 for gasket specifications.
- D. Pipe Opening Seals (for reconnection to existing manhole): Gasket type polyisoprene compound, ASTM C923, with stainless steel take up clamps.
 - 1. Acceptable Manufacturer:
 - a. Press Seal Gasket Corporation; PSX Series.
 - b. Or Equal.
- E. Flexible Pipe Coupling: Clamped design with virgin PVC coupling with two adjustable 300 stainless steel bands, and stainless steel shear band.
 - 1. Acceptable Manufacturer:
 - a. The General Engineering Company (GENCO); FERNCO Flexible Couplings.
 - b. Or Equal.

2.02 SERVICE CONNECTION PIPE AND FITTINGS

- A. Polyvinyl Chloride Pipe (PVC):
 - 1. Pipe: Type PSM SDR-35, ASTM D3034.
 - 2. Fittings: Conforming to same applicable ASTM Specification requirements for pipe.
 - 3. Joints: Push-on with elastomeric gasket, ASTM D3212; and ASTM F477 for gasket specifications.

- B. Saddles (Cast Iron): Correctly contoured for outside diameter of pipe and incorporating a gasket and band assembly.
 - 1. Saddle Body: Cast iron, ASTM A48, Class 35, coated inside and out with heavy coat of black asphaltum type paint.
 - 2. Gasket: Compound rubber (neoprene) tubular O-ring design, ASTM C361.
 - 3. Band: Type C 304 stainless steel band assembled with two 3/4-inch Type C 304 stainless steel T-bolts, washers and hex nuts.
 - 4. Provide spigot or bell inlet and proper adapter or coupling suitable for connection of the type and size of service connection pipe.
 - 5. Acceptable Manufacturer: The General Engineering Company; Sealtite, or equal.
- C. Pipe Plugs: Designed for permanent installation and removable. Obtain plugs for various types of pipe used from the respective pipe manufacturer.
- D. Cleanout covers for paved areas shall be Part No. CC4 as manufactured by GENECO, or equal.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Earthwork: Perform earthwork for sewer installation as specified in Trenching, Backfilling, and Compacting: Section 02221.
- B. Inspect each section of pipe and each pipe fitting before laying in conformance with the inspection requirements of the appropriate referenced standard.
- C. Remove rejected pipe from the Project.

3.02 PIPE LAYING

- A. General: All pipe shall be laid to a uniform line and grade between manholes, socket ends upgrade, with a firm and even bearing along the barrel of the pipe, close joints and smooth invert. The spigot end of the pipe is to be centered in, shoved tight and secured against the bell or socket of the previously laid pipe. The interior of each pipe shall be cleaned of all excess joint and foreign material before the next pipe is laid. The pipe shall be laid in the bedding materials as specified in Section 02221. Pipe-laying shall commence at the lowest point and proceed upgrade. At the close of each day's work, and at such other times when pipe is not being laid, the open end of the pipe shall be protected with a close fitting stopper.
 - 1. Excavate trenches in rock at least 25 feet in advance of pipe laying.
 - 2. New extensions shall be isolated from the existing system with a watertight plug in the first manhole upstream from the existing system. Plug shall not be removed until the extension is completed and accepted by the Owner for transmission of wastewater.
- B. Laying Specified Types of Plastic Pipe: Installation and joint assembly according to ASTM D2321 for Class I bedding material.
- C. Laying Ductile Iron Pipe: Installation and joint assembly according to AWWA C 600, and as follows:
 - 1. Where necessary to field cut pipe use approved pipe cutter, milling cutter or abrasive wheel saw.

2. Make joints as specified previously.
- D. Construction Control: The Contractor shall provide at least three grade boards in advance of pipe laying at all times at intervals not exceeding fifty (50) feet and stretch a line parallel with the grade line. From this line, the trench and every pipe laid shall be tested as to grade and alignment. Base lines and controlling elevations established for the construction of the work shall be preserved and kept uncovered so that they can be examined at any time.
1. The use of laser equipment shall be permitted. Grade boards as specified will not be required if a laser is used.
 2. Regardless of control used, the Contractor shall provide alternative verification of grade as work progresses. Pipe not laid to proper line and grade will be removed and reconstructed at the Contractor's expense.
- E. Variations: The Owner's Representative reserves the right to vary the line and/or grade from that shown on the drawings for pipe lines and manholes when such changes may be necessary or advantageous.
- F. Handling of Sewer Line Materials into Trench: Proper implements, tools and facilities satisfactory to the Owner's Representative shall be provided and used by the Contractor for the safe and convenient prosecution of the work. All pipe, fittings, jointing materials, etc. shall be carefully lowered into the trench piece-by-piece by means of a derrick, ropes, or other suitable tools or equipment, in such a manner as to prevent damage to sewer line materials and/or workmen. Under no circumstances shall such materials be dropped or dumped into the trench.
- G. Pipe Clearance in Rocks: Ledge rock, boulders and large stones shall be removed to provide a clearance of at least 6 inches below and on each side of all pipe and fittings for pipes 24 inches in diameter or less, and 9 inches for pipes larger than 24 inches in diameter.
1. The specified minimum clearances are the minimum clear distances which will be permitted between any part of the pipe and/or fitting being laid and any part, projection or point of such rock, boulder or stone.
- H. Connections to Existing Manholes or Structures: Cut required opening or openings by core drilling so as to prevent cracking and spalling concrete. Make openings of sufficient size to accommodate pipe with clamp retained gasket installed. Make connection watertight.
1. Form a new invert channel in the existing manhole base to properly conduct the flow through the existing manhole.
 2. Use non-shrink, non-metallic grout to form new channel after area has been scarified and cleaned where channel is to be formed. Pea gravel may be added to grout in accordance with manufacturer's recommendations.
 - a. Grout as specified in Section 03600.
 3. Do not permit ground water, surface water or debris to enter the existing facilities through the new connection.
- I. Drop Connections: Make drop connections where drop in invert is two feet or more or as required by the Owner's Representative. Use same pipe material used to construct the main from which the drop connection is made. Construct drop connection in accordance with design shown on the Standard Detail Drawings.
- J. Concrete Cradle and Encasement:
1. Preparation: Prior to the formation of cradle or encasement, if any, temporary supports consisting of timber wedges and solid concrete bricks or cap blocks shall be used to support the pipe in place. Temporary supports shall have minimum dimensions and shall

- support the pipe at not more than two locations, one at the bottom of the barrel of the pipe adjacent to the shoulder of the socket and the other near the spigot end.
2. **Placing:** After jointing of the pipe has been completed, concrete shall be uniformly poured beneath and on both sides of the pipe. Placement shall be done by the use of suitable equipment. The concrete shall be wet enough during placement to permit its flow, without excessive prodding, to all required points around the pipe surface. The width of cradle shall be such as to fill completely the trench width. In case of extremely wide trenches, concrete encasement may be confined above the top of the pipe to a narrower width but in no case shall it be less than the width of trench required for the size of pipe being used. Before depositing concrete, the space within the limits of the pour shall have been cleared of all debris and water. Water shall not be allowed to rise adjacent to, or flow over, concrete deposited for less than 24 hours. Concrete shall be protected from the direct rays of the sun and kept moist, by a method acceptable to the Owner's Representative, for a period of seven days or until backfilling is begun. In no case shall backfilling begin within 24 hours of the time of placing and the Owner's Representative shall have strict control of the rate of backfilling.
 3. **Concrete:** 3000 psi per requirements of Section 03300.

3.03 SERVICE CONNECTIONS

- A. Fittings and service pipe shall be provided in strict accordance with these specifications. All practices and precautions required for the sewer main are applicable to the service connections from the sewer to the right-of-way line, or to a location designated by the Owner's Representative.
 1. The Contractor shall place a 2" x 4" wooden marker at the end of each sewer lateral.
 2. The marker shall be one piece and may not be constructed from two or more smaller pieces.
 3. The marker shall extend from the lateral invert to 12" above grade.
- B. If rock is encountered during the installation of the lateral, the Contractor shall extend the lateral to the required distance as specified elsewhere in these specifications, and shall provide a minimum "rock-free" distance of one foot beyond the end of the lateral. No lateral shall be "butted" against rock.
- C. **Reconnection of Existing Service Connections:** Use PVC wye or tee fittings or cast iron tee saddles for connection to the sewer main. Use pipe, if required, as specified previously. Make connection to existing piping with flexible pipe couplings.
 1. **Saddles (Cast Iron):** Make connections to sewers, which incorporate a saddle connection, by machine cutting a hole in the sewer of proper size to accommodate the saddle. Use a machine specifically designed for the purpose; no other means of making the hole permitted.
 - a. Install saddle in accordance with manufacturer's installation instructions.
 - b. After saddle is satisfactorily installed, concrete cradle sewer pipe and saddle to the centerline of the saddle branch and extend cradle along the sewer pipe to undisturbed bedding.
- D. **Pipe Outlet:** Connect service connection piping to outlet in manner specified for joining pipe.
- E. **Plugs:** Close free ends of branches and service connections with a carefully fitted plug. Type of plug used and method of installation to Owner's Representative's approval. Installed plugs shall successfully pass Line Acceptance Tests.

3.04 TESTS

- A. General Requirements: Conduct tests specified herein so that each pipeline installed in the Project is tested to the Owner's Representative satisfaction.
1. Provide tools, materials (including water), apparatus and instruments necessary for pipeline testing.
 2. Conduct tests in the presence of and to the satisfaction of the Owner's Representative.
- B. Testing Equipment:
1. Use air compressing apparatus equipped with a control panel with necessary piping, control valves and gauges to control air flow rate to piping test section; and to monitor air pressure within piping test section and air pressure within piping test section, provide air-compressing apparatus with an approved pressure relief device set to relieve at 10 psi. Test gauge shall be calibrated in 0.5 psi increments. Provide written certification as to gauge's accuracy. Calibration no greater than six months prior to test. Test equipment must be commercially manufactured specifically for low pressure air testing.
 2. Provide an extra pressure gauge of known accuracy to frequently check test equipment and apparatus.
 3. Air testing equipment and associated testing apparatus subject to Owner's Representative's approval.
 4. Provide GO, NO-GO, mandrel and incidental equipment for deflection test. Mandrel to conform to following requirements:
 - a. Cylindrical in shape with not less than nine arms spaced evenly around the mandrel.
 - b. Minimum contact length of mandrel arms with pipe wall not less than the nominal diameter of the pipe being tested.
 - c. Mandrel diameter 95 percent of inside pipe diameter.
- C. Cleaning Prior to Tests: Before tests are conducted, clean piping using high pressure flushing equipment including sewers, branches, and service connections until free of dirt or silt or construction debris. Contractor is responsible for removal of all water, dirt, silt and debris and their disposal.
- D. Alignment: After the mains have been laid, backfilled, and cleaned, a light will be flashed between manholes or manhole locations to determine whether the alignment of the sewer is true and whether any pipe has been displaced, broken or otherwise damaged subsequent to laying. This test will again be conducted before final acceptance of the sewer. Each section (manhole to manhole) of sewer shall show a good light circle throughout its length and any and all defects shall be corrected by the Contractor, to the satisfaction of the Owner's Representative, before the work shall proceed and before acceptance of and/or payment therefore shall be made.
- E. Leakage Tests:
1. Air Testing: The Contractor shall test each section of sewer between manholes and all laterals to the limit of this contract using low pressure air. Testing shall not be performed, until all backfilling, cleaning and lamping has been completed. The Contractor may, at his option, test the section of sewer for his own purposes, prior to completion of backfilling; however, the requirements of this subsection shall not be deemed to be completed until the lines have been tested after the backfilling has been completed and trench settlement has been minimized.
 2. A minimum of two minutes shall be provided to allow equilibrium of the air temperature with pipe wall before test readings shall commence. The rate of air loss shall be determined by measuring the time interval required for the average internal pressure to decrease by 1.0 psig.

3. The initial test pressure to be developed in the sewer and laterals shall be determined as follows:
 - a. For depths six (6) feet or less, the internal pressure shall not be less than 6.0 psig.
 - b. For depths greater than six (6) feet, the internal pressure in psig shall be calculated as the sum of 3.5 plus the maximum height in feet divided by 2.3 between the invert of the sewer and the existing ground surface in the section of sewer to be tested. (For example, if the maximum height is determined to be 9.2 feet, the added pressure would be 4.0 psig. The initial test pressure in the sewer would then be 7.5 psig. The allowable drift would be to 6.5 psig within the time indicated elsewhere in this subsection.)
 - c. In no case shall the test pressure in the sewers or laterals be greater than the maximum internal differential joint pressure recommended by the manufacturer of the pipe.
4. The pipe shall be considered acceptable if the air loss rate does not exceed 0.0030 cubic feet per minute per square foot of internal pipe surface when tested at the initial pressure previously defined in this subsection. The time for the air pressure to decrease 1.0 psig shall not be less than the time indicated in the following table:

Pipe Diameter	Minutes	Seconds
6"	2	55
8"	3	57
10"	4	43
12"	5	5
15"	7	5
18"	8	30
21"	9	50
24"	11	20
27"	12	45
30"	14	10
36"	17	00
42"	19	50
48"	22	40

5. If the above rates of leakage are exceeded, the Contractor shall, at no cost to the Owner, determine source of leakage, excavate and make all necessary corrections using methods approved by the Owner's Representative and retest.
 - a. For sections of sewer containing service connections which service existing buildings, perform Line Acceptance Test by testing one joint at a time.
6. The Contractor shall submit to the Owner's Representative, for approval, the detailed test procedure and list of proposed test equipment to be used prior to testing.

F. Infiltration:

1. After the air testing described in the preceding paragraph has been completed by the Contractor, regardless of any indications of the test results made by the Owner's Representative, the Owner reserves the right to perform field investigations, prior to final written acceptance of each sewer run by the Owner and/or during the maintenance period specified elsewhere in these specifications, to establish the leakage of groundwater into the sewer and laterals constructed under this Project. The cost of these investigations shall be borne by the Owner.
2. Should the leakage exceed 100 gallons per day per inch diameter per mile of pipe for any section, the Contractor shall, at the direction of the Owner's Representative, and at no cost to the Owner, perform any additional testing or corrective work required to reduce the infiltration in each manhole run from those lines installed by the Contractor to less than

100 gallons per day per inch diameter per mile of pipe. This leakage applies to each manhole run separately and should not be construed to mean total leakage in the total system. The scope of this corrective work shall include, but not be limited to, cleaning, televising and testing the sewer and laterals to the limits installed by the Contractor, to include testing of joints, excavation and replacement of faulty or damaged portions of the work, and all final restoration.

- G. Deflection Test: In addition to air tests and infiltration test, conduct deflection tests on PVC pipe. Test each PVC pipe sewer main installed.
1. Conduct deflection testing not less than 30 days after section of pipe sewer main and service connection between adjacent manholes is backfilled.
 - a. Pull mandrel through pipe section manually; powered pulling devices not permitted.
 - b. Consider sewer line section which mandrel cannot pass through to have more than maximum allowable deflection of percent.
 2. Lines which fail must be excavated, replaced or repaired to Owner's satisfaction, then retested.
- H. Acceptance: Observation of successful testing of manholes, sewers or force mains by the Owner's Representative does not constitute acceptance of the system or any portion thereof. Upon completion of any determined portion of a total system, and successful testing thereof, the Owner's Representative may recommend final acceptance to the Owner. Only upon final inspection by the Owner or Owner's Representative, and upon written acceptance for same will the system or portion thereof be considered substantially completed. Upon such acceptance, the warranty period as specified for the manholes, sewers or force main will commence.
1. If, during this final inspection, any irregularities are observed, the condition must be corrected at the Contractor's expense prior to acceptance.

END OF SECTION