

DIVISION 34

FORCE MAIN AND GRAVITY SEWERS

34.01 SCOPE: The Contractor shall furnish all labor, materials, equipment and supplies and shall perform all work necessary for the complete installation of force mains and gravity sewers, including all specified testing. The force mains and sewers shall be constructed to the alignment and inverts shown on the construction plans, and of the size and type shown or specified. All materials provided by the Contractor shall be new and as specified herein.

- A. Pipe to be supplied with special locking or flexible type joints or especially fabricated sections will be specified or detailed on the plans. Reference other sections of these specifications as applicable.
- B. Pipe stronger than that specified herein may be furnished at the Contractor's option and at no additional cost to the City, provided such pipe conforms in all other respects to the applicable provisions of these specifications.
- C. The Manufacturer and Contractor shall use equipment and methods adequate to protect pipe, joint elements, and coatings from damage during hauling, storage and handling. When there is reasonable doubt as to the structural strength or water tightness of damaged sections, those sections will be rejected and replaced at the Contractor's expense.
- D. All Standards referenced shall be the latest edition.
- E. Any proposed deviations from the listed materials must be approved by the Engineer prior to ordering.
- F. Valves on existing mains shall be operated only by authorized representatives of Public Utilities.

34.02 MATERIALS: All materials for sewer pipe shall be new and shall be furnished by the Contractor as specified in the Proposal in accordance with the following requirements:

- A. Gravity Sewer:
 - 1. ABS Composite Pipe: ASTM D 2680 pipe, 8 to 15 inches in diameter, shall be Truss Pipe as manufactured by ARMCO or an approved equal.

Joints for ABS composite sewer pipe shall be type SC solvent-cemented joints conforming to ASTM D2680.

2. PVC Composite Pipe:

Pipe and Fittings: PVC Composite pipe and fittings specified herein are essentially the ABS composite pipe and fittings specified elsewhere except with PVC thermoplastic material instead of ABS. This system shall be directly compatible with ABS composite systems in terms of dimensions, performance, and use. Pipe and fittings shall comply with the specification of ABS Composite Pipe, with applicable portions of ASTM D-2680 and with the following:

a. Thermoplastic Materials: Rigid PVC plastic conforming to ASTM D-1784 for a minimum cell class of 12454B. Solvent cement shall comply with both ASTM D-2564 (PVC or PVC) and ASTM D-3138 (PVC to ASS transition joints).

b. Joints: ASTM D-3212 Elastomeric Gasket Joints.

3. ABS Solid Wall Sewer Pipe: Pipe and fittings shall conform to ASTM D-2751 and shall be used for 4 and 6-inch laterals on ABS composite pipe installations.

a. Design: The minimum wall thickness shall conform to SDR 23.5 for pipe sizes 4 and 6 inch.

b. Joints shall be type SC solvent-cemented joints conforming to ASTM D-2235.

4. PVC Solid Wall Sewer Pipe: Pipe, fittings, couplings and joints shall conform to ASTM D-3034, unless otherwise specified.

a. Design: The minimum wall thickness for PVC pipe shall conform to SDR35 for sizes 8 through 12 inch and for 4 and 6-inch pipe the minimum wall thickness shall conform to SDR23.5

b. Joints: Shall be locked in factory assembled rubber ring-type conforming to ASTM D-1689.

c. Fittings: Fittings defined as "Y" connections suitable for assembly to 4 or 6-inch house or building laterals shall be saddle-type fittings of approved PVC plastic.

5. Ductile Iron Pipe for Gravity Sewers: Shall conform to the same requirements as for ductile iron force main pipe.

B. Force Main:

1. Ductile Iron Pipe, Fittings and Accessories shall conform to the requirements of Division 33.02.A, except no cement lining shall be provided.
2. PVC Pipe: Shall conform to the requirements of Division 33.02.B.

C. Valves:

1. Gate Valves: Double disc type and general shall conform to the requirements of Division 33.02.E., except they shall be left opening (counterclockwise).
2. Air Release Valves: Two (2) inch air release valves shall be installed in accordance with details shown and shall be screwed, wheel operated brass gate valves, non-rising stem wedge disc with screwed bonnet, for 150 psi pressure, Crane (Figure 410) or equal. Distance for centerline of body to top of wheel shall not be more than seven and three-eighths ($7\text{-}\frac{3}{8}$) inches. Two (2) inch corporation stops shall be installed at the tap.

D. Sleeves and Couplings: Shall conform to the requirements of Division 33.02.C.

E. Taping Sleeves: Shall conform to the requirements of Division 33.02.D.

F. Valve Boxes: Shall conform to the requirements of Division 33.02.G.

34.03 PIPELINE INSTALLATION:

A. Reference Standards: The work shall be performed in accordance with the applicable sections of the following standards and regulations:

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| 1. AWWA C600 | 6. AWWA MANUAL M23 |
| 2. AWWA C105 | 7. SEWERAGE REGULATIONS |
| 3. AWWA C111, APPENDIX A | 8. ASTM D2321 |
| 4. AWWA C115, APPENDIX A | 9. ASTM C828 |
| 5. AWWA C500, APPENDIX A | 10. ASTM D3839 |
| | 11. HANDBOOK OF PVC PIPE |

B. Required Submittals and Construction Record Data:

1. In all cases the Contractor shall submit the following for review and approval by the Engineer:

- a. Material affidavit for all materials furnished. The affidavit shall include all of the following:
 - 1) Name and location of work;
 - 2) Name and address of Contractor;
 - 3) Quantity and date or dates of shipment and/or delivery for each item;
 - 4) Manufacturer, Model No. and/or product description for each item provided;
 - 5) Signature of an Officer of the manufacturing, fabricating or supplying company, on a company standard form certifying that the listed materials were provided.
 - b. Construction Record Drawings and specified data for installed valves. The dimensions and data may be clearly indicated on prints of the Contract Drawings or separate sketches as appropriate.
 - 1) Locations of horizontal bends, vertical offsets, valves, ends of installed lines, and laterals with dimensions referenced to existing mains, property lines, curb lines, or other permanent objects.
 - 2) Data for valves installed: Date set, cover, size, manufacturer, number of turns to open, direction of opening, and joint types.
2. In those cases where the installation or procedure proposed is not detailed on the plans or in the specifications; or a significant modification is required, the Contractor shall submit the following for review and approval by the Engineer:
- a. Procedures and equipment to be used for pressure testing and leakage testing.
 - b. Detailed drawings and method of joint or pipe restraint.
 - c. Method of installing polyethylene tube or sheet material for pipe encasement.
 - d. Detailed drawings of proposed modifications, offsets or special fittings and method of installation.

- C. Line and Grade: All pipe shall be laid true to line and grade as shown on the plans and as specified herein. Refer to Division 33.03.C for additional requirements.
- D. Separation of Water Pipelines and Sanitary Sewers and Laterals: Shall conform to the requirements of Division 33.03.D.
- E. Material Handling:
1. The pipe and fittings shall be handled and protected during loading, transporting and unloading operations in such a manner as to avoid damage. Pipe and fittings shall be unloaded by lifting with hoists or skidding so as to avoid shock, damage, or contamination. Under no circumstances shall the pipe or fittings be dropped nor shall they be permitted to roll against pipe already on the ground. Insofar as practical, each piece of pipe shall be delivered and unloaded near the place where it is to be installed and where it will not interfere with excavation, traffic, or adjacent property owners. All damaged pipe and fittings will be rejected and such rejected pipe and fittings shall be removed from the site as directed by the Engineer. In the event of slight damage to the coating or lining, the Engineer may permit the damage to be repaired On the site. Such repairs shall be made at the contractor's expense.
 2. Cleaning and Inspection of Pipes and Castings: The inside of pipes and castings shall be thoroughly cleaned before laying and shall be kept clean until accepted in the completed work. Whenever the work is interrupted, all open ends of pipe shall be temporarily blocked with plugs. All pipes and special castings shall be carefully examined for defects; defective pipes and castings shall not be installed. If any such pipe or casting is discovered after placement, it shall be removed and replaced with an acceptable pipe or casting by the contractor at his own expense.
- F. Earthwork: Shall conform to the requirements of Division 33.03.F.
- G. All sewer pipe (gravity and force main) shall be installed in full standard lengths. In the event a fitting (we, tee, bend, valve, etc.) does not fall at the end of a full Joint of pipe, the pipe shall be cut in accordance with the requirements noted below, and the fitting installed where shown on the plans. The pipe installed beyond the fitting shall be full standard length.
- H. Sheeting Left in Place: Shall conform to the requirements of Division 33.03.G.
- I. Sub-Surface Utility Warning Tape: All non-ferrous water mains shall be identified by a sub-surface utility warning tape placed at an elevation not less than six (6) inches, nor more than twelve (12) inches below the proposed finished

grade. The utility warning tape shall be manufactured by Griffolyn Co., or approved equal.

The tape shall be of a durable, metalized, plastic film similar to Terra Tape D for identification of water mains; bright green tape imprinted with the legend "Caution - Sewer Below" shall be used.

J. Field Cutting Pipe: Shall conform to the requirements of Division 33.03.I.

K. Joint Assembly:

1. Force Mains Gaskets and joint assembly shall be in accordance with AWWA C111 or the manufacturer's recommended procedures, if more stringent.

Both the gasket and plain end of the pipe shall be thoroughly cleaned to remove all loose rust and foreign material. Just prior to assembly, both the gasket and the plain end shall be brushed with soapy water or approved pipe lubricant.

a. Joint Deflection: At any single joint shall not exceed 80 percent of the manufacturer's allowable deflection for the type of joint to be used.

When joint deflections are required the pipe shall be inserted straight into the bell and the pipe deflected after complete insertion.

b. Mechanical Joint: T bolts (or tie bolts) shall be alternately and uniformly tightened to insure that the gland compresses the gasket evenly around its perimeter.

Nuts shall be gradually tightened to the torque ranges as follows:

<u>Pipe Size</u>	<u>Bolt Diameter</u>	<u>Range of Torque</u> (ft. lb.)
4" – 24"	3/4"	75 – 90
30" – 36"	1"	100 – 120
42" – 48"	1 1/4"	120 – 150

Bolts of stainless steel or other corrosion control steel alloys shall be used when specifically called for on the plans or stated herein.

2. Gravity Sewers: Joints shall be made as noted for each type of material. To the maximum extent possible, the Joint shall be watertight.

L. Joint Restraint (for Force Mains): Shall conform to the requirements of Division of 33.03.K.

M. Installing Valves: Valves shall be installed at the locations shown on the plans or as otherwise directed by the Engineer.

Valves will be set with the operating stem truly plumb. The top of the operating nut shall be not more than 4 feet below the top rim of the valve box when said box is properly installed to finished grade. Valve stem extension devices shall not be used. Valves shall be supported by a gravel bed and shall not be supported by the pipeline.

N. Air Relief Assemblies: Air relief assemblies required on the plans or installed by the Contractor, with the approval of the Inspector, to facilitate air removal shall be installed in accordance with Standard Drawing S-3.

O. Polyethylene Encasement: Encasement of the pipeline shall be installed as shown on the plans or as directed. In the event that corrosive soils (as defined by Appendix "A" of ANSI/AWWA C105/A21.5) are encountered during excavation the Engineer may direct that all, or a portion, of the pipeline be encased, whether or not encasement was indicated on the plans.

P. Pressure Tests:

1. Force Mains: Shall conform to the requirements of Division 33.03.P.

2. Gravity Sewers: Any of the following procedures shall be acceptable for testing the rate of infiltration of the gravity sewer line:

a. Infiltration Test will be conducted if the Contractor proves to the satisfaction of the Engineer that the water table is high enough to conform to the requirements noted below.

The level of the groundwater shall be at least 4 ft. above the top of the sewer line along the entire section of pipeline to be tested. Measurements shall be made every hour for three hours to determine the amount of infiltration.

b. Exfiltration Test:

1) Water level in the sewer system shall be at least 4 ft. above the water table, or to the top of the manhole, whichever is lesser.

2) Measurements shall be taken every hour for three hours to determine the amount of exfiltration.

- c. Air Test: Procedures shall conform to ASTM C828, latest revisions, except as noted below:
 - 1) Starting pressure for the test shall be 3.5 psi plus additional pressure equal to the pressure exerted by the groundwater above the pipe.
 - 2) If air test is employed, the manholes shall be tested separately. The manhole shall be filled with water and let stand for 12 hours before testing.

- d. Allowable Leakage:
 - 1) Infiltration / Exfiltration shall not exceed 25 gallons per day, per inch diameter, per mile of sewer.
 - 2) Air Test:
 - a) Pipe: Time for pressure to drop 1 psi from initial pressure shall be determined as follows:
 - $T = .085 DK/Q$ where
 - T = minimum acceptable time for pressure drop (seconds)
 - D = pipe diameter (inches)
 - Q = .0025 cu. ft./min./sq., ft of interval surface
 - K = .000419 DL, but not less than 1
 - L = length of pipe to be tested (.ft.)
 - (b) Manhole leakage shall not exceed 1 gallon in four (4) hours.
 - 3) The above does not relieve the Contractor of making the sewer as water tight as possible. All visible leaks shall be repaired.

Q. Deflection Tests:

- 1. Use: All gravity sewer, 8-inch diameter through 15-inch diameter except ductile iron.
- 2. Procedure: Tests shall be performed no sooner than thirty (30) days after completion of backfill. The Owner, at his option, may require a second proving ring as manufactured by Wortco, Inc., or an approved equal, will be provided by the Contractor. The mandrel shall be manually pulled,

from manhole, through the entire length of mainline pipe. Upon successful completion of the initial test, the mandrel, proving ring and carrying case shall become the property of the City.

3. Requirement: All pipe shall allow passage of the test mandrel. The mandrel and proving ring shall be sized at 5% less than the ASTM dimension for the pipe in accordance with the following table:

Nom. Dia	ASTM D3034 SDR 35		ASTM D2680
	L	D	D
8"	8"	7.28"	7.40"
10"	10"	9.09"	9.31"
12"	12"	10.79"	11.22"
15"	15"	13.20"	14.09"

L = Mandrel Contact Length
D = I.D. of Proving Ring

- R. Concrete Work: The Contractor shall furnish and install all thrust blocks shown on the plans. Concrete shall conform to the requirements of Division 33.03.-K.1 and Division 36.
- S. Tie-Ins to Existing City Force Mains:
 1. General:
 - a. All materials shall be installed in accordance with the manufacturer's recommendations including, but not limited to, alignment, torque requirements, tolerances, etc.
 - b. All materials shall be thoroughly cleaned before they are installed.
 - c. No tie-in shall be made except in the presence of the Inspector.
 2. Tapping Existing Mains Under Pressure: Shall conform the requirements of Division 33.03.R.2.
- T. Shut Down For Main Adjustment Or Tie-ins: Shall conform to the requirements of Division 33.03.S.
- U. Abandonment of Existing Pipe in Place: Shall conform to the requirements of Division 33.03.T.
- V. Material Salvage: Shall conform to the requirements of Division 33.03.U.

34.04 MEASUREMENT AND PAYMENT:

A. Bid Item Definition:

1. Gravity sanitary sewer pipe shall include furnishing and installing the pipe, appurtenances, stone bedding, trench excavation, sheeting and bracing, dewatering, testing, trench backfill and compaction, and final surface grading. Gravity sanitary sewer pipe shall not include laterals, manholes, or cleanout assemblies.
2. Gravity sewer lateral shall include furnishing and installing the pipe, appurtenances, stone bedding, trench excavation, sheeting and bracing, dewatering, testing, trench backfill and compaction, and final surface grading. Gravity sewer lateral shall not include cleanout assemblies.
3. The force main pipe shall include furnishing and installing the pipe, appurtenances, restraints, bedding, excavation sheeting and bracing, dewatering, testing, tie-ins, placing in service, backfilling, compaction, and final surface grading. Force main pipes that are 2", 4" 6", 8", 10" or 12" shall include fittings while pipe greater than 12" shall not include fittings.
4. The force main fittings shall De the furnishing and installation of bends, tees, sleeves, reducers, retainer glands, caps and plugs with the associated appurtenant bolts, standard gland, and thrust block.
5. The valves shall include furnishing and installing each valve and valve box assembly with the necessary pipe.
6. The tapping sleeve and valve shall include the tapping sleeve, the tapping valve, valve box, and the tapping operation with the necessary appurtenant items.
7. The air release valve at the high points of the force main piping shall include the tapping of the pipe, the air release piping, the access box, and the necessary appurtenant items.
8. The offset assembly shall include all necessary pipes, fittings, thrust restraint and necessary appurtenant items.

- B. Measurement and Payment: The term "complete in place" as it is used here, shall be taken to mean that the item of work shall be furnished and installed in accordance with the specifications complete with all appurtenances necessary for the item to be used for its intended function. Where appropriate, this means that payment for the item includes, but is not necessarily limited to, testing, cleanup,

and restoration of all disturbed areas to original condition unless specified otherwise.

1. Gravity sanitary sewer pipes, which are installed and satisfactorily tested, shall be measured in place (for each size, class, and pipe material) in the horizontal plane from center to center of structure and shall be paid for by the linear foot according to the average plan depth between structures. The average plan depth is defined as the average of the plan depth (rim to invert) of the upstream and downstream structure on a pipe run. The applicable depth categories are as follows: 0-6', 6-8', 8-10', 10-12', 12-14', 14-16', 16-18', 18-20', and 20' and over. Where the average depth between structures is determined to be exactly equal to the upper and lower limits of 2 categories, depth shall be classified in the category of greater depth.
2. Sewer laterals, which are installed and satisfactorily tested, shall be measured in place (for each size, class, and pipe material), in the horizontal plane from the main sewer line to the cleanout assembly and shall be paid for by the linear foot.
3. Force main pipes, which are installed and satisfactorily tested, shall be measured in place (for each size, class, and type material) in the horizontal plane on the pipe centerline. The measurement for 2", 4", 6", 8", 10", and 12" pipe shall include fittings while the measurement for sizes greater than 12" shall exclude fittings. The force main pipe shall be paid for on a linear foot basis.
4. The force main fittings greater than 12" which are installed and satisfactorily tested shall be counted complete in place (for each size, class, and type of fitting) and shall be paid for on a per fitting basis.
5. The valves, which are installed and satisfactorily tested, shall be counted complete in place (for each size, class, and type of valve) and shall be paid for on a per valve basis.
6. The tapping sleeve and valves, which are installed and satisfactorily tested, shall be counted complete in place (for each size, combination of sleeve and valve) and shall be paid for on a per tapping sleeve/valve basis.
7. The air release valves and offsets, which are installed and satisfactorily tested, shall be counted complete in place and paid for on a per item basis.