

SECTION 02401 - SANITARY SEWER PIPE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The WORK under this Section includes providing all labor, materials, tools and equipment necessary for furnishing and installing sanitary sewer pipe, in accordance with these Specifications and in reasonably close conformity with the lines and grades shown on the Drawings or established by the ENGINEER.
- B. This WORK includes furnishings and installing connecting bands, branch connections, elbows or other fittings, and all appurtenances required to complete the sanitary sewer.

1.2 SUBMITTALS

- A. Sanitary Sewer Pipe: Material certifications stating conformance with the requirements of this Section.

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE (GRAVITY AND PRESSURE SEWER)

- A. Ductile Iron Pipe shall conform to ANSI A21.51. Pipe and fittings shall be cement mortar lined in conformance with ANSI A21.4 and shall have an exterior bituminous coating conforming to the requirements of ANSI A21.10. Pipe joints shall conform to ANSI A2.11 and shall be push-on type as manufactured by United States Pipe and Foundry Company for Tyton pipe, or equal.
- B. Prior to the use of any pipe, the CONTRACTOR shall furnish a certification from the pipe manufacturer that all required tests have been made and that the pipe fully complies with the requirements of ANSI A21.51.
- C. Nominal pipe diameter is shown on the Drawings. No change in pipe diameter shall be made unless approved by the ENGINEER. The minimum pipe strength shall be thickness Class 50. The pipe size and thickness class shall be clearly marked on each pipe.
- D. Where special fittings are required, they shall be fabricated from steel pipe manufactured in accordance with AWWA Standard C200. The steel fitting shall be fabricated with spigot ends suitable for connection to the ductile iron pipe, with cast iron transition couplings as manufactured by Smith-Blair, Inc., or equal. Steel fittings shall be lined and coated with fusion epoxy system as supplied by Water Works Supply Company, Union City, California, or with hot applied coal tar in accordance with AWWA C203.
- E. Connections between ductile iron pipe and PVC pipe shall be made with 'ROMAC' Stainless Steel Sleeve, or approved equal.

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2.2 PVC SEWER PIPE

- A. PVC Sewer Pipe, four inch through 15 inch in diameter, inclusive, shall have a standard dimension ratio (SDR) of 35, and conform to ASTM D 3034. Before any PVC pipe is used on this Project, the CONTRACTOR shall supply certifications, signed by an authorized agent of the seller or manufacturer, stating that the material has been sampled, tested, and inspected in accordance with ASTM D 3034.
- B. PVC Sewer Pipe greater than 15 inch in diameter shall conform to ASTM F 679. Before any PVC pipe is used, the CONTRACTOR shall supply certifications, signed by an authorized agent of the seller or manufacturer, stating that the material has been sampled, tested, and inspected in accordance with ASTM F 679.
- C. The pipe shall have integral wall bell and spigot joints conforming to ASTM D 3212. The bell shall consist of an integral wall section with a solid cross-section elastomeric ring, factory assembled, securely locked in place to prevent displacement.
- D. Flexible water-tight connections, approved by the ENGINEER, shall be used at PVC pipe connections to manholes and other rigid structures.

2.3 PVC PRESSURE PIPE

- A. PVC pressure pipe shall conform to the applicable requirements of ANSI/AWWA C900 and subject to additional requirements specified herein.
- B. The pipe shall be pressure class 100, and shall be furnished complete with rubber gaskets.
- C. Fittings for PVC pressure pipe shall be cement mortar lined ductile iron in conformance with ANSI A21.4 and shall have an exterior bituminous coating conforming to the requirements of ANSI A21.10.
- D. All joints for the buried PVC pipe shall be either an integral bell manufactured on the pipe or a separate coupling both employing a rubber ring joint. The bell and coupling shall be the same thickness as of the pipe barrel, or greater thickness. The sealing ring groove in the coupling shall be of the same design as the groove in cast iron fittings and valves available from local water works supply distributors.
- E. Flexible water-tight connections, approved by the ENGINEER, shall be used at PVC connections to manholes and other rigid structures.
- F. Connections between PVC Sewer Pipe and PVC Pressure Pipe (PVC (HP)), shall be made with "ROMAC" Stainless Steel Sleeve, or approved equal.

2.4 HDPE PRESSURE PIPE

- A. High-Density Polyethylene (HDPE) pipe shall conform to ASTM D 3550 designation PE 3407 or PE 3408. The pipe shall have a minimum pressure rating of 100 pounds per square inch and a maximum Standard Dimension Ratio (SDR) of 17.0. All HDPE shall have a standard iron pipe size (IPS) outside diameter.

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- B. The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions or other injurious defects. It shall be uniform in color, opacity, density, and other physical properties.
- C. HDPE pipe shall have an ASTM D-3350 material Cell Classification of no less than 335434C.
- D. The pipe shall be marked at five foot intervals with a coded number which identifies the manufacturer, SDR size, PPI rating, manufacturing standard reference and production code from which data and place of manufacturer can be determined.
- E. When HDPE pipe is connected to ductile iron pipe, a flange adapter shall be used. A flange-coupling adapter shall be used on the ductile iron pipe. HDPE flange adapters shall be manufactured by the same manufacturer as the pipe using the same resin as the pipe. Each flange adapter shall be furnished with a ductile iron convoluted back-up ring drilled to match the standard ANSI bolt pattern for the nominal diameter of pipe used.
- F. Connection of the pipe and fittings shall be performed by the thermal butt fusion system. HDPE pipe lengths, fittings, and flange adapter connections to be fused shall be of the same type, grade and class of polyethylene compound and supplied by the same raw material supplier.

2.5 PVC PRESSURE PIPE WITH RESTRAINED JOINTS

- A. Piping for PVC Pressure Pipe with Restrained Joints shall be PVC Pressure Pipe as specified above.
- B. Pipe joints shall be restrained using Uniflange Series 1350 joint restraints or approved equal.

2.6 POLYETHYLENE PIPE

- A. Polyethylene Pipe shall conform to the requirements of ASTM F 714, with SDR of 32.5.
- B. Pipe shall be listed by the National Sanitation Foundation.
- C. Joints shall be made by butt-fusion, with connections to dissimilar materials by stub ends and backing flanges or steel/HDPE transition couplings.

2.7 ACRYLONITRILE-BUTADIENE-STYRENE (ABS) PIPE

- A. Acrylonitrile-Butadiene-Styrene (ABS) Pipe four inches in diameter shall conform to the requirements of ASTM D 2751. ABS Pipe six inches through 15 inches in diameter shall conform to the requirements of AASHTO M 264 (ASTM D 2680).
- B. Joints shall be solvent welded using a primer and cement in accordance with the manufacturer's specifications. All joints shall be wiped clean and dry before applying the primer. All fittings shall be installed in accordance with the manufacturer's specifications.

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- C. Handling, storage, and installation of pipe shall conform to the recommendations of the manufacturer.
- D. Truss pipe shall be used only with Fiberglass Reinforced Plastic (FRP) manholes using molded truss pipe connectors bonded to the barrel.

2.8 UNDERGROUND MARKING TAPE

- A. Underground marking tape shall be green, at least four (4) inches wide, four mil thick, polyethylene tape, with a metallic backing capable of being traced with locators. The tape shall have black letters with the following wording: "Caution: Sewer Line Buried Below." The marking tape shall be installed 12 inches above the top of all sewer mains and services.

PART 3 - EXECUTION

3.1 CONSTRUCTION

- A. Excavation, bedding, and backfill shall conform to the requirements of Section 02203 - Trenching. Underground marking tape shall be installed as shown on CBJ Standard Detail 125 - Pavement Resurfacing and Trench Detail.
- B. Sheeting and bracing required for trenches shall be removed to the elevation of the conduit, but no sheeting will be allowed to be pulled, removed, or disturbed below the conduit. Sheeting and bracing shall meet OSHA requirements.
- C. Before lowering into the trench, the pipe shall be inspected for defects. All cracked, chipped, or broken pipe shall be discarded. The ends and interior of the pipe shall be clean. Belled ends shall be laid upgrade. Handling of the pipe shall be accomplished in a manner that will not damage the pipe. The joint shall be made in the manner recommended by the manufacturer. Care shall be taken not to buckle or disturb previously laid pipe.
- D. Pipe shall be laid accurately to the staked line and grade. All service connections shall be installed as indicated on the Drawings. Where existing service sewers are to be connected, suitable fittings and adapters shall be provided by the CONTRACTOR.
- E. Pipe shall be cleaned of all foreign matter, and water shall be kept out of trenches until joints have been completed. When WORK is not in progress, open ends of pipe and fittings shall be securely closed to keep foreign matter and animals from entering.
- F. Each joint shall be inspected to ensure that it is properly made before backfilling is done. Care shall be taken to prevent any dirt or foreign matter from entering the open end of the pipe. Where it is necessary to cut pipe, such cuts shall be neatly made in an approved manner. The laid pipe shall be true to line and grade and, when completed, the sewer shall have a smooth and uniform invert. No section of gravity sewer, including service connections shall have an adverse grade which would pond water in the invert of the sewer.

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- G. Connections to pipe stubs of a different pipe material shall be made with DFW/HPI non-shear-type connector, as shown in CBJ Standard Detail 218 - Coupling for Dissimilar Sanitary Sewer Pipes. Connectors must be approved by the ENGINEER prior to installation.
- H. Connections to pipe stubs of a different pipe material, if made beyond the back of sidewalk or other concrete or paved surface, shall be made with a suitable connector. Connectors must be approved by the ENGINEER prior to installation. Connection of all piping, other than bell and spigot connections, within the roadway, street and sidewalk areas, shall be made per CBJ Standard Detail 218 - Coupling for Dissimilar Sanitary Sewer Pipes.
- I. Connections to existing sewer mains, service connections, and manholes shall be made in such a manner so as to not damage the existing facility. Such connections shall be made so that no projections or rough surfaces occur within the pipe.
- J. Locations of the sewer laterals are approximate and may be changed by the ENGINEER. Relocating of the sewer lateral will not add extra cost to the OWNER, unless either of the following conditions result:
 - 1. The relocation results in a significant increase in the length of the lateral; or,
 - 2. There are significant differences in the surface characteristics at the new lateral location which would result in substantial and foreseeable changes in construction methods and materials.
- K. If the CONTRACTOR believes that the WORK at the new location(s) will result in a substantive change, the CONTRACTOR shall notify the ENGINEER prior to beginning the changed WORK. The ENGINEER will evaluate the request and if the relocation is warranted, the change in WORK shall be authorized.
- L. Lateral connections to existing sewer mains shall not obstruct flow and shall be one of the following:
 - 1. Approved remote tapping system
 - 2. Polyethylene saddle strapped to line with two stainless steel bands and neoprene gaskets.
 - 3. Sidewall fused to line as recommended by pipe manufacturer.
 - 4. Manufactured saddle per CBJ Standard Detail 210 - Sanitary Sewer Saddle Tee.
- M. Cleanouts shall be provided with a cast iron ring and cover which shall be locking-type Olympic Foundry No. M-1025, or approved equal. The cover shall be clearly marked with the word "SEWER" case into it.
- N. Lateral connections to new sewer mains shall be made with a manufactured sanitary wye of the same material as the mainline pipe.
- O. Locate Sewer Services shall require that the CONTRACTOR determine the location of the existing sewer services prior to installation of the mainline pipe in such a way that the

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service wyes can be installed in the proper location as the mainline pipe is being installed. No service saddles will be permitted, unless approved by the ENGINEER.

- P. Where gravity flow sanitary sewers cross above or less than 18 inches below waterlines, or approximately parallel water lines within ten feet horizontally, the sewer pipe shall meet the requirements of ductile iron pipe or PVC pressure pipe, as described in Part 2 of this Section.
- Q. HDPE to HDPE connections shall be made by thermal butt fusion, in accordance with ASTM D2657. Fusion jointing shall utilize a pipe manufacturer approved fusion machine operated by experienced and qualified personnel. The CONTRACTOR shall provide three copies of a "Heat Fusion Qualification Guide," published by the HDPE manufacturer, that provides criteria for inspection of thermal fusion joints. The guide shall include criteria for operator training requirements and experience; visual inspection criteria (including photographs) for both intact thermal fusion joints and sample strips cut for thermal fusion joints. The thermal fusion machine operator shall perform a minimum of three test joints in the presence of the ENGINEER. The test joints will be examined from both exterior appearances and from appearance of the joint cross section once the samples have been cut into strips.
- R. Bolted HDPE to HDPE connections shall include a polyethylene flange adapter (stub end) butt fused to the pipe, a backup flange ring, bolts, nuts and a gasket. Flange rings shall be Standard Steel ring Flanges, Class D, in accordance with AWWA C207. High strength bolts, nuts, washers and gaskets shall be in conformance with AWWA C207, Appendix A. Flange rings, bolts, nuts and washers shall be hot dip galvanized after fabrication per ASTM A153 and A386. Gasket dimensions and bolt lengths shall be per pipe manufacturer's recommendations.

3.2 TESTING

- A. Prior to testing all manholes, all sections of pipe shall be cleaned using an inflatable rubber ball of a size that will inflate to fit snugly into the pipe. The ball may, at the option of the CONTRACTOR, be used without a tag line; or a rope or cord may be fastened to the ball to enable the CONTRACTOR to know and control its position at all times. The ball shall be placed in the last clean out or manhole on the pipe to be cleaned, and water shall be introduced behind it. The ball shall pass through the pipe with only the force of the water impelling it. All debris flushed out ahead of the ball shall be removed at the first manhole where its presence is noted. In the event cemented or wedged debris, or a damaged pipe, stops the ball, the CONTRACTOR shall remove the obstruction and make any necessary repairs in a manner that is acceptable to the ENGINEER. Any alternate methods of cleaning sewers shall be submitted to the ENGINEER for approval, and shall not be used unless approved.
- B. Prior to testing, the sewer shall be complete with laterals, and trenches shall be fully backfilled and compacted to finish grade, or, if the sewer is under pavement, finish pavement subgrade.
- C. For WORK involving placement of new sanitary sewer collection systems, all sections of pipe shall be tested for leakage using the Exfiltration Test for either air or water as specified hereafter; or, at the sole direction of the ENGINEER, when the normal water

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table is above the sewer throughout the section under test, the ENGINEER may permit use of the Infiltration Test procedure specified hereafter. Where leakage is in excess of the specified rate, the sewer shall be repaired by the CONTRACTOR as required to comply with the leakage test requirements. The ENGINEER may require the CONTRACTOR to repair obvious leaks even though the total length of the test section falls within the maximum allowable leakage for the test used.

- D. For WORK involving replacement of existing, active sanitary sewer collection systems, and the new system is not put into service during the same work shift, no Exfiltration/ or Infiltration Tests will be required. TV inspection of the new pipes by the ENGINEER shall be used to determine system acceptance.
- E. Defective pipe joints shall be repaired in a manner that the repaired pipe joint will have some flexibility and the effectiveness of the repair will not be affected by differential movement of the adjoining pipes. A "CSSI" or DFW/HPI non-shear coupling, as per CBJ Standard Detail 218 - Coupling for Dissimilar Sanitary Sewer Pipes, or approved equal, will be acceptable in making such repairs.
- F. The ENGINEER will make one complete TV inspection after all sewers have passed the specified watertightness test. All defects regarding sewer alignment and grade, damaged pipe, and visible leaks observed during this inspection, shall be corrected by the CONTRACTOR. The CONTRACTOR shall de-water the sewers as required for the performance of the TV inspection work by the ENGINEER. The CONTRACTOR shall be responsible for all costs associated with any TV inspection required following the initial TV inspection, if any defects were observed during this or any subsequent TV inspections.
- G. The hydrostatic test procedure for HDPE Pipe shall consist of two (2) steps: the initial expansion phase and the test period. In order to accommodate the initial expansion of the pipe under test, sufficient make-up water shall be added to the system at hourly intervals for three hours to return to the test pressure. The test period begins after the final addition of make-up water in the expansion phase of the test procedure. The test period is three (3) hours. After this test period, a measured amount of make-up water shall be added to return to test pressure. The amount of make-up water shall not exceed the allowable expansion in U.S. gallons shown in the following table:

THREE HOUR TEST

| Nominal Pipe Size (Inches) | Allowance for Expansion (U.S. Gal. Per 100 feet of pipe) |
|---------------------------------------|---|
| 8 | 1.5 |
| 10 | 2.1 |
| 12 | 3.4 |
| 16 | 5.0 |
| 18 | 6.5 |

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Under no circumstances shall the total test procedure exceed eight hours at 1.5 times the pipe pressure rating. If the test is not completed within eight hours, the test section shall not be re-tested for eight more hours. Repair and re-testing shall continue until a passing test is obtained.

3.3 FILTRATION TEST (USING AIR)

- A. The CONTRACTOR shall furnish all facilities and personnel for conducting the test under the observation of the ENGINEER. The equipment and personnel shall be subject to the approval of the ENGINEER. Joints only may be tested in pipe 36 inches in diameter or larger, at the option of the CONTRACTOR.
- B. Immediately following the pipe cleaning, the pipe installation shall be tested with low pressure air. Air shall be slowly supplied to the plugged pipe installation until the internal air pressure reaches five pounds per square inch greater than the average back pressure of any ground water that may submerge the pipe. At least two minutes shall be allowed for temperature stabilization before proceeding further.
- C. The pipeline shall be considered acceptable when tested at an average pressure of four psi greater than the average pressure of any ground water that may submerge the pipe if the section under test does not lose air at a rate greater than 0.0030 cubic feet per minute per square foot of internal surface.
- D. The requirements of this Specification shall be considered satisfied if the time required for the pressure to decrease from 4.5 psi to 3.5 psi above average ground water pressure is greater than that shown on the following table:

TIME FOR PRESSURE TO DROP FROM 4.5 TO 3.5 PSI ABOVE AVERAGE GROUND WATER PRESSURE

| Pipe Diameter | Minutes | Seconds |
|---------------|---------|---------|
| 8 " | 3 | 57 |
| 10" | 4 | 43 |
| 12" | 5 | 40 |
| 15" | 7 | 5 |
| 18" | 8 | 30 |
| 24" | 11 | 20 |
| 30" | 14 | 10 |

- E. For other sizes, determine test time using the following formula:

$$T = 28.33 D$$

Where T = time in seconds
D = pipe diameter in inches

- F. For pipes 36 inches in diameter, or larger, if individual joints are tested, they shall hold six psi air pressure over the average back pressure of any ground water for a minimum time of 15 seconds.

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- G. Pressure gauges should be incremented in not more than one-half pound increments for accurate tests.
- H. Braces shall be required to hold plugs in place and to prevent the sudden release of the compressed air. Due to the large forces that could be exerted by an escaping plug during the testing of the pipe, no one shall be allowed in the manholes in which plugs have been placed while tests are being conducted. The CONTRACTOR's testing equipment shall have a pressure relief device that will prohibit the pressure in the pipeline from exceeding ten pounds per square inch.

3.4 EXFILTRATION TEST (USING WATER)

- A. Where groundwater is below the pipe to be tested, a minimum of head of eight feet of water above the crown at the upper end of the test section shall be maintained for a period of four hours, during which time it will be presumed that full absorption of the pipe body has taken place, and thereafter for a further period of one hour for the actual test of leakage. During this one hour period, the measured loss shall not exceed the rate given below:

| Type of Pipe | Allowable Exfiltration Rate |
|--------------|-----------------------------|
| PVC | E = 0.0004 DL |
| Ductile Iron | E = 0.00008 DL |

E = Allowable leakage in gallons per hour
D = Nominal inside diameter of pipe in inches
L = Length of pipe being tested in feet

- B. Where groundwater is above any pipe to be tested, the minimum head of the test will be raised to provide an elevation head of eight feet above the groundwater.
- C. The maximum length of sewer in any test section shall be 500 feet.

3.5 INFILTRATION TEST

- A. Infiltration testing may be allowed at the ENGINEER's option when the natural ground water table is above the crown of the higher end of the test section and the external water pressure exerted on the pipe is equivalent to the exfiltration test. The maximum allowable limit for infiltration shall be as determined by the formulas defined in the above section Exfiltration Test (Using Water).

3.6 PRESSURE SEWER TEST

- A. The CONTRACTOR shall, in the presence of the ENGINEER, test all pressure sewer pipe to a test pressure of 100 pounds per square inch and maintain the pressure a minimum of one hour. The CONTRACTOR shall make all necessary arrangements to provide water for testing pipelines.

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- B. Leakage shall not be in excess of five gallons per inch of pipe diameter per one thousand (1,000) feet of pipe per day. Where leakage is in excess of the specified rate, the CONTRACTOR shall make all repairs necessary to reduce the amount of leakage to a quantity within the specified rate. The testing and repair process shall be repeated until the installation is accepted. In addition, the CONTRACTOR shall repair all visible leaks.

END OF SECTION