

## SECTION 02730 - SANITARY SEWERS AND ACCESSORIES

## PART 1 - GENERAL

## 1.1 SCOPE

- A. This Section describes products to be incorporated into force mains, sewers, reuse and accessories, and requirements for the installation and use of these items. Furnish all products and perform all labor necessary to fulfill the requirements of these Specifications.
- B. All construction shall comply with the Department of Labor, Occupational Safety and Health Administration, 29 CFR Part 1926, Sub-part P, latest edition.

## 1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Specification Sections, apply to this Section.
- B. Supply all products and perform all work in accordance with the latest provisions of applicable American Society for Testing and Material (ASTM).
- C. Supply all products and perform all work in accordance with the latest provisions of applicable American Water Works Association (AWWA).
- D. Supply all products and perform all work in accordance with the latest provisions of applicable American National Standards Institute (ANSI).

## 1.3 QUALIFICATIONS

- A. As requested by the Engineer, submit evidence that manufacturers have consistently produced products of satisfactory quality and performance for a period of at least two years.

## 1.4 SUBMITTALS

- A. Complete drawings and engineering data, including shop drawings, shall be submitted to the Engineer.

## 1.5 TRANSPORTATION AND HANDLING

- A. Unloading: Furnish equipment and facilities for unloading, handling, distributing and storing pipe, fittings, valves and accessories. Do not drop or dump materials. Any materials dropped will be subject to rejection without additional justification.

- B. Handling: Handle pipe, fittings, valves and accessories carefully to prevent shock or damage in accordance with the manufacturer's written instructions and requirements. Do not use material damaged in handling.

#### 1.6 STORAGE AND PROTECTION

- A. Store all pipes which cannot be distributed along the route. Make arrangements for the use of suitable storage areas.
- B. Stored materials shall be kept safe from damage. The interior of all pipes, fittings and other appurtenances shall be kept free from dirt or foreign matter at all times. Valves shall be drained and stored in a manner that will protect them from damage by freezing.
- C. Pipe shall not be stacked higher than the limits recommended by the manufacturer. The bottom tier shall be kept off the ground on timbers, rails or concrete. Pipe in tiers shall be alternated: bell, plain end, bell, plain end. At least two rows of timbers shall be placed between tiers and chocks, affixed to each other in order to prevent movement. The timbers shall be large enough to prevent contact between the pipe in adjacent tiers.
- D. Store joint gaskets in a cool location, out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.

#### 1.7 QUALITY ASSURANCE

- A. Product manufacturers shall provide the Engineer with written certification that all products furnished comply with all applicable provisions of these Specifications.
- B. If ordered by the Engineer, each pipe manufacturer shall furnish the services of a competent factory representative to supervise and/or inspect the installation of pipe. This service will be furnished for a minimum of five days during initial pipe installation.

### PART 2 - PRODUCTS

#### 2.1 PIPING MATERIALS

- A. Ductile Iron Pipe and Fittings: The Contractor shall furnish pipe and fittings for exterior and interior installation for drain lines, sewer lines and force mains. Pipe and fittings shall be in accordance with the applicable ASTM and/or ANSI/AWWA Specifications, as amended to date, and the requirements specified herein and as detailed on the Drawings.

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
  - 1) American Cast Iron Pipe Company.
  - 2) U.S. Pipe.
  - 3) Union Foundry.
  - 4) Sigma.

- 5) Star Pipe.
  - 6) Approved Equal.
2. Ductile Iron Pipe: Ductile iron pipe shall be furnished in normal lengths of 18 or 20 feet and shall conform to AWWA C 151 and shall be Pressure Class 250. Flanged pipe shall be minimum Class 53.
  3. Fittings: Unless indicated otherwise, fittings shall be cast from ductile iron and shall conform to ANSI Specifications A 21.10 (AWWA C 110) or ANSI Specification A21.53 (AWWA C153). Fittings shall have standard mechanical or flanged joints as called for or shown on the Drawings. Mechanical joint fittings for size 3-inch through 24-inch shall be Class 350 for Ductile Iron. Mechanical joint fittings for size 30-inch through 48-inch shall be Class 250 for Ductile Iron.
  4. Lining, Coating and Painting:
    - a. Cement Lining and Coating: Lining for force mains shall be cement lined, except as specified herein and as indicated on the Drawings. Pipe and fittings shall be cement lined in accordance with AWWA C104 and have an interior seal coat. Pipe and fittings shall be furnished with a bituminous outside coating. Fittings may be furnished with minimum 6-mil nominal thickness fusion bonded epoxy coating conforming to ANSI/AWWA C550 and C116/A21.16 in lieu of bituminous coating.
    - b. Fusion Bonded Lining and Coating: Lining for DIP gravity sewers shall be fusion bonded epoxy and polyurethane. Lining for DIP force mains shall be fusion bonded epoxy and polyurethane for a distance of 100 feet upstream and downstream of air and vacuum relief stations and all manholes, and at locations specifically detailed on the Construction Drawings. Pipe and fittings shall be lined with a composite lining utilizing a primer coating containing fusion bonded epoxy (FBE) and a surface coating containing fusion bonded polyurethane (FBP). The lining shall be Polybond Plus as supplied by American Cast Iron Pipe Company, or equal. Pipe and fittings shall be furnished with a bituminous outside coating. Fittings may be furnished with minimum 6-mil nominal thickness fusion bonded epoxy coating conforming to ANSI/AWWA C550 and C116/A21.16 in lieu of bituminous coating.
    - c. As an acceptable alternate, the owner will accept a Protecto 401 Ceramic Epoxy Lining System as utilized by U.S. Pipe, or equal. The Protecto 401 Ceramic Epoxy Lining System shall be furnished in accordance with ASTM B 117, ASTM G 95, and ASTM D 714. All pipe and fittings shall be holiday tested at 2,500 volts (minimum) and shall be tested to insure a lining thickness of 40 mils (nominal DFT) minimum.
    - d. Painting: Buried Force mains shall have a 12-inch green stripe painted in the top quarter of the pipe. Exposed pipe and fittings to be painted shall not be coated on the exterior but shall be thoroughly cleaned of all dirt, rust, scale, etc., by sandblasting. Submit primer data sheets with shop drawings.
  5. Weights and Marking: Weights of pipe and fittings shall conform strictly to the requirements of ANSI Specifications. The class designations for the various classes of pipe and fittings shall be cast onto fittings in raised numerals, and cast or stamped on the

- outside of each joint of pipe. Weights shall be plainly and conspicuously painted in white on the outside of each joint of pipe and each fitting after the exterior coating has hardened.
6. Jointing: Pipe and fittings shall be furnished with flange, mechanical or bell-and-spigot joints as indicated on the Drawings. Yard piping shall be furnished with mechanical or push-on joints and mechanical joint fittings, as shown on the Drawings. Interior piping shall be furnished with mechanical joints or flange connections, as shown on the Drawings. Flanges for pipe and fittings shall be ANSI Class 125 flanges, unless otherwise shown on the Drawings or specified, and shall be in accordance with ANSI A 21.10 (AWWA C 110) or ANSI Specification A21.53 (AWWA C153), drilled and faced in accordance with American Standard B17.1. Flanges for ductile iron pipe and fittings shall be ductile iron. Gaskets shall be 1/8-inch thick rubber, unless otherwise specified, may be either ring or full face in sizes 12-inch and smaller, and ring for sizes 14-inch and larger. Mechanical and bell-and-spigot joints for pipe and fittings shall be in accordance with applicable ANSI/AWWA specifications. Push-on joints for pipe shall be manufacturer's standard. Gaskets for mechanical and push-on joints shall conform to ANSI A 21.11 (AWWA C 111). Mechanical joint sleeves shall be furnished as needed.
  7. Restrained Joints: Where shown on the Drawings and or specified, joints shall be restrained.
    - a. Slip Joint: Restrained joint pipe shall be "Flex Ring" by American Cast Iron Pipe Company, "TR. Flex" by US Pipe, or approved equal.
    - b. Mechanical Joint: The mechanical joint restraint device shall have a working pressure of at least 250 psi with a minimum safety factor of 2:1 and shall be EBAA Iron, Inc., MEGALUG or equal.
  8. Concrete Blocking: Concrete blocking shall have a compressive strength of 4000 psi and be installed according to details and locations shown on the Contract Drawings.
  9. Weights of Pipe: The American Water Works Specifications regarding minimum and maximum weights for specials shall apply. For pipe 16" and smaller in diameter, pipe will not be accepted in which the weight is less than the standard weight by more than five percent (5%). For pipe that is more than 16" in diameter, pipe will not be accepted in which the weight is less than the standard weight by more than 4%.
  10. Certification: The manufacturer of iron pipe and fittings shall furnish both the Engineer and the Owner with certified reports stating that inspection and specified tests have been made and that the results thereof comply with the applicable ANSI/AWWA Specifications for each.
- B. Polyvinyl Chloride (PVC) Gravity Sewer Pipe:
1. Acceptability of PVC pipe for gravity sewers is indicated in the following:
    2. Standard Minimum Thickness as specified in ASTM D 1784: ASTM D 3034, SDR 26 12454B.
  3. Wall Type: Solid Wall.

4. Acceptable for sewers greater than or equal to 6" and less than or equal to 18".
5. PVC gravity sewer pipe shall be supplied in lengths not longer than 13 feet.
6. Fittings: Fittings 15 inches in diameter and less shall be manufactured in accordance with ASTM D 3034. PVC compound shall be 12454B or 12454C as specified in ASTM D 1784.
  - a. For sizes 8-inches and less in diameter, fittings shall be molded in one-piece with solvent welded joints. Minimum socket depths shall be specified in ASTM D 3034, Table 2.
  - b. For sizes 10-inches and larger in diameter, fittings shall be fabricated from pipe conforming to ASTM D 3034 using solvent welding. No field fabrication of fittings will be allowed. All such fabrication shall be performed at the factory and the fittings shall be delivered ready for use.
7. Joints: Joints for pipe and fittings shall be of the integral bell and spigot type with a confined elastomeric gasket having the capability of absorbing expansion and contraction without leakage when tested in accordance with ASTM D 3212. Gaskets shall meet the requirements of ASTM F 477. The joint system shall be subject to the approval of the Engineer and shall be identical for pipe and fittings.
8. Manhole Connections - Solid Wall and Closed Profile Wall Pipe: The sewer shall be connected to manholes utilizing standard pipe sections.
9. Acceptance: Acceptance will be on the basis of the Engineer's inspection and the manufacturer's written certification that the pipe and fittings were manufactured and tested in accordance with the applicable standards.

- C. Retainer Glands: Retainer glands shall be supplied by the ductile iron pipe supplier at the locations specifically indicated on the Drawings or specified. Retainer glands shall be the manufacturer's standard design and shall be designed for a minimum working pressure of 250 psi.

## 2.2 BEDDING MATERIAL

- A. Bedding materials shall be #57 stone, unless shown or specified otherwise.
  1. Crushed stone bedding material shall meet the requirements of Georgia Department of Transportation Specification 800.01 for No. 57 stone, Group II.

## 2.3 MANHOLES AND PRECAST CONCRETE PRODUCTS

- A. Precast Concrete Sections:
  1. Precast concrete sections shall meet the requirements of ASTM C 478. The minimum compressive strength of the concrete in precast sections shall be 4,000 psi.

2. The minimum wall thickness shall be one twelfth of the inside diameter of the base, riser or the largest cone diameter. Additionally, the wall thickness shall be sufficient for the proper installation of the rubber boots.
  3. Transition sections, which convert bases that are larger than four feet in diameter to four-feet in diameter for risers, shall be designed by the manhole manufacturer to carry the live and dead loads exerted on the section.
  4. Seal joints between precast sections by means of rubber O-ring gaskets or flexible butyl rubber sealant. Butyl rubber sealants shall meet the requirements of AASHTO M-198. Sealant shall be pre-formed type with a minimum nominal diameter of 1-inch. Butyl rubber sealant shall be equal to Kent Seal No. 2 or Concrete Sealants DS202. All manholes shall be coated on the exterior with two coats of 4 mil each of coal tar epoxy.
- B. Brick and Mortar: Brick shall be whole and hard burned, conforming to ASTM C 32 Grade MS. Mortar shall be made of one part Portland cement and two parts clean sharp sand. Cement shall conform to ASTM C 150. Sand shall meet ASTM C 33.
- C. Iron Castings:
1. Cast iron manhole frames and covers shall meet the requirements of ASTM A 48 for Class 30 gray iron and all applicable local standards. All castings shall be tough, close grained, smooth and free from blowholes, blisters, shrinkage, strains, cracks, cold shots and other imperfections. No casting will be accepted which weighs less than 95% of the design weight. Shop drawings must indicate the design weight and provide sufficient dimensions to permit checking. All castings shall be thoroughly cleaned in the shop and given two coats of an approved bituminous paint before rusting begins.
  2. Manhole frames and covers shall be standard and have the words "HALL COUNTY SANITARY SEWER" cast in the tops.
  3. All frames and covers shall have machined horizontal bearing surfaces.
  4. All manholes shall have standard frames and covers except where specifically shown otherwise on the Drawings. MH frame and cover clear openings shall be 32" for sanitary sewers 18" and larger.
  5. Watertight covers shall be bolt-down type and shall be equipped with four 1/2-inch stainless steel bolts and a 1/8-inch red rubber or rubber O-ring gasket. Covers shall be rotatable and interchangeable. Bolt holes shall be bored through so that debris entering the bolt hole will fall in to the manhole. Bolt holes shall have the full 360 degree circle within the cover's radius when bored through the cover.
- D. Rubber Boots: Provide preformed rubber boots and fasteners equal to those manufactured by Kor-N-Seal or Press Seal Gasket Corporation.

- E. Shop Drawings: Shop drawings for manholes shall include details of all manhole components specified herein. Cut sheets for each manhole shall be provided as part of the shop drawing submittal. Cut sheets shall include plan, profile and layout information for each manhole.

## 2.4 CONCRETE

- A. For sewers and accessories concrete shall have a compressive strength of not less than 4000 psi, and not less than 5.5 bags of cement per cubic yard and at a slump between 3 and 5-inches. For job mixed concrete, submit the concrete mix design for approval by the Engineer. Ready-mixed concrete shall be mixed and transported in accordance with ASTM C 94. Reinforcing steel shall conform to the requirements of ASTM A 615, Grade 60.

## 2.5 ECCENTRIC PLUG VALVES

- A. Scope: The Contractor shall furnish and install eccentric plug valves on all sewage, sludge, and gas lines, as specified and as shown on the Drawings. Eccentric plug valves shall be furnished complete with operators and accessories or both at locations shown on the Drawings or where specified. Valves shall be manufactured by DeZurik, Clow, Pratt or equal. Plug valve manufacturer shall submit shop primer data sheets.
- B. General: Valves shall be of the 90 degree turn, non-lubricated eccentric type with resilient faced plugs and shall be furnished with end connections as shown on the drawings. Flanged valves shall be faced and drilled to the ANSI 125/150 lb. standard. Mechanical Joint ends shall be AWWA Standard C111-64, grooved ends per AWWA C-606-87. Screwed ends shall be to the NPT standard. Experience in the manufacture of similar size and type valves shall be required and verifiable documentation shall be provided. The manufacturer of the plug valves shall submit valid documentation that they have successfully manufactured valve installations of the specified size, port type and eccentric design which have been successful in operation for at least five (5) years.
- C. Valve Body: Valve bodies shall be of ASTM A126 Class B cast iron. Bodies in 4" and larger valves shall be furnished with a 1/8" welded overlay seat of not less than 90% pure nickel, machined to mate with the resilient faced plug. Valves that do not provide positive mating of the resilient faced plug with the nickel seat shall not be acceptable. Seat area shall be raised, with raised surface completely covered with weld to insure that the plug face contacts only nickel. Screwed-in seats shall not be acceptable. True eccentric action shall be required. Design of the valve shall provide for a rectangular port that allows contact between the welded nickel seat and the plug to occur only in the final 3 degrees of the plug movement. Round ported valves as well as other non-eccentric action valves shall not be acceptable. If requested, the manufacturer shall provide a complete site visit to the manufacturing facility for the Owner, Engineer and Contractor to witness the eccentric action of partially assembled valves and to verify the size and shape of the port area as well as the welded nickel seat.
- D. Plugs: Plugs shall be of ASTM A126 Class B cast iron. The plug shall have a cylindrical seating surface eccentrically offset from the center of the plug shaft. The interference between the plug face and the body seat, with the plug in the closed position, shall be externally

adjustable in the field with the valve in line under pressure. The plug shall be completely coated with a hycar compound suitable for use with sewage. The hycar shall be applied at the factory to insure that the plug is completely coated and then heat-treated to insure a positive bond. Following this process, bare cast iron shall not be visible or exposed in the flow area to insure that the plug is abrasion resistant and suitable for service in raw sewage.

- E. Bearings: Bearings shall be sleeve type metal bearings and shall be of sintered, oil impregnated, permanently lubricated type 316 ASTM A743 Grade CF-8M in ½" to 36" sizes. In valves larger than 36", the upper and lower plug journals shall be fitted with ASTM A-240 type 316 stainless sleeves with bearings of ASTM B30, Alloy C95400 aluminum bronze. Non-metallic bearings shall not be acceptable.
- F. Shaft Seals: Valves shaft seals shall be of the multiple V-ring type and shall be externally adjustable and re-packable without removing the bonnet or actuator from the valve under pressure. Valves utilizing O-ring seals or non-adjustable packing shall not be acceptable.
- G. Testing: Valve working pressure rating shall be 250 psi. If required for this working pressure, valve parts specified herein as cast iron may be provided as either ductile iron or stainless steel components as required. Each valve shall be given a hydrostatic and seat test at the factory with the results being certified in accordance with ANSI B16.1.
- H. Actuators: Valve actuators for manual valves shall have nut, lever or gear actuators and tee wrenches, extension stems, floor stand, extension bonnet, etc. as indicated on the plans. All extension bonnets must have gear located at the operator stem extensions. Hand wheel operators on geared actuators are acceptable in a non-buried environment where the valve is installed less than six feet above the floor. When the valve is installed more than six feet above the floor level, a chainwheel operator on the geared actuator shall be installed. All valves 6" and larger shall be equipped with gear actuators. All gearing shall be enclosed in a semi-steel housing and be suitable for running in a lubricant with seals provided on all shafts to prevent entry of dirt and water into the actuator. The actuator shaft and the quadrant shall be supported on permanently lubricated bronze bearings. Actuators shall clearly indicate valve position and an adjustable stop shall be provided to set closing torque and to provide seat adjustment to compensate for change in pressure differential or flow direction change. All exposed nuts, bolts and washers shall be zinc plated. All buried valves 4" and larger shall have gear operators. Valve and gear actuators for buried or submerged service shall have seals on all shafts and gaskets on the valve and actuator covers to prevent the entry of water. Actuator mounting brackets for buried or submerged service shall be totally enclosed and shall have gasket seals. All exposed nuts, bolts and washers shall be stainless steel. All valves and actuators shall be fully manufactured in the USA. Foreign and/or imported components, castings and assembly shall not be acceptable. Documentation of this specification section shall be provided upon request or during the required site visits to the manufacturing facility.

## 2.6 RESILIENT SEATED GATE VAVES

- A. General: The Contractor shall furnish resilient seated gate valves as indicated on the Drawings, and specified herein. Resilient seated gate valves size 2-inch through 12-inch shall conform, in general, with AWWA C 509 as amended to date, shall be equipped with O-ring packing, and shall be as specified herein and as detailed on the Drawings.

- B. Construction: Resilient seated gate valves shall embody the best class of workmanship and finish, and shall open and close freely and easily. With the valve open, an unobstructed waterway shall be afforded, the diameter of which shall not be less than the full nominal diameter of the valve. If guides or guide lugs are used, the design shall be such that corrosion in the guide area does not affect sealing. Resilient seats may be applied to the body or gate and shall seat against a corrosion resistant surface. The surface may be either metallic or nonmetallic. Resilient seats shall be bonded or mechanically attached to either the gate or valve body. The mating surface of the resilient seat shall be machined to a smooth even finish. All stems shall be forged bronze stems.
- C. Working Pressure: Water working pressure for valves shall be 250 psi.
- D. Operation: All valves shall open left. Valves shall be operated by nut. Operating nuts shall conform to the present standard of the Owner, and shall have an arrow cast on them, indicating the direction for opening the valve.
- E. Marking: Each valve shall be plainly marked with the manufacturer's name or particular mark, the year of manufacture, the size of the valve, and designation indicating working pressure, all cast on the bonnet or body.
- F. Testing: All gate valves shall be tested in accordance with American Water Works Association Standards.
- G. Jointing: All gate valves shall be furnished with mechanical joints, and necessary bolts, glands and gaskets unless otherwise shown on the Drawings or specified.
- H. Manufacture: Valves shall be furnished as manufactured by ARI, D-025 L.

## 2.7 AIR VALVES

- A. The Sewage Air Release & Vacuum Valve shall consist of a tubular all stainless steel fabricated body, hollow direct acting float and solid large orifice float in H.D.P.E., stainless steel nozzle and woven dirt inhibitor screen, nitrile rubber seals and natural rubber seat.
- B. The conical body shape shall be designed to maintain the maximum distance between the liquid and the sealing the mechanism and still obtain minimum body length.
- C. Independent spring-guided linkage between the lower float/rod assembly and the upper float sealing mechanism to allow free movement of the float and rod. Vibrations and the movement of the lower float due to turbulence will not unseal the upper float sealing mechanism.
- D. The Rolling Seal Mechanism shall be less sensitive to pressure differentials than a direct float seal. It accomplishes this by having a comparably large orifice for a wide pressure range (up to 250 psi).

- E. Funnel-shaped lower body shall be designed to ensure that residue wastewater matter will fall back into the system and be carried away by the main pipe.
- F. All inner metal parts made of stainless steel. Float made of composite materials.
- G. 1 ½ “ threaded discharge outlet enables connection of a vent pipe.
- H. Dynamic design allows for high capacity air discharge while preventing premature closure.
- I. The ball valve can be opened to release trapped pressure and drain the valve body prior to maintenance and for back-flushing during maintenance.
- J. Valves shall have a minimum pressure rating of 250 psi.
- K. Valves shall be ARI, Series D-025L for sewage application.

## 2.8 FLANGE ADAPTER

- A. The flange adapter shall permit the connection of unthreaded, ungrooved, open-ended ductile iron pipe to ANSI/ASME B16.1, Class 125 flanges. The flange adapter shall meet the test requirements of ANSI/ASME B16.1 for Class 125 flanges. The adapter shall be ductile iron casting incorporating gripping wedges and gasket. The gasket shall provide a compression seal between the adapter, the pipe and the adjacent flange. Flange adapters are to be used only in locations specifically shown on the Drawings and shall be installed in accordance with the manufacturer's recommendations. The flange adapter shall be EBAA Iron Megaflange-Flange Adapter Series 2100.

## 2.9 CHECK VALVES

- A. General: The Contractor shall furnish check valves at locations shown on the Drawings or specified.
- B. PVC Ball Check Valves: PVC check valves shall be of the ball type with union body, Viton seat, and NPT threaded ends. Unless otherwise shown or required, all PVC valves shall be Schedule 80, Type I, Grade 1 PVC.
- C. Solenoid Valves: Solenoid valves shall be ASCO Red Hat or equal.

## 2.10 VALVE OPERATOR AND ACCESSORIES

- A. General: Valves shall be furnished with operators and accessories as shown and/or required for the intended service and in accordance with the following:
  - 1. Gear Operator Locations: All valves 6-inches and larger, and all 4-inch and larger underground valves and valves submerged in sewage shall be gear operated. Below floor/grating valves operated from floor above shall have bushed extension stem with valve stand or floor box. Valves that are more than six feet above operating levels shall be geared for chain wheel operation for 6-inch or larger and chain-lever operated for 4-inch and smaller. Chain shall be zinc plated.

2. Gear Actuators: Gear actuators shall be submersible, and have a seal provided on all shafts which will prevent entry of water into the actuator, enclosed gearing shall run in oil or grease. Packing shall be adjustable without disassembling the actuator. Actuator shall clearly indicate valve position. Closing torque shall be set by an adjustable stop.
3. Handwheel Operators: Handwheel operators shall be provided as shown on the Drawings. Valve shall be designed for open LEFT operation. Valve operators shall be pre-tested at rated operating pressure using the specified valve operator to perform the opening and closing cycle; a certificate attesting to operation and leak tests shall be furnished with the valves upon shipment. All valves coated with a shop primer shall submit shop primer data sheet with shop drawings.
4. Chainwheel Operators: All valve operators located 6 feet or greater above the finished floor shall have chainwheel operators. The Chain drop shall be within 3 feet of the finished floor.

## 2.11 VALVE OPERATOR AND ACCESSORIES

- A. All reclaimed water valves and outlets should be tagged or embossed to warn the public and the employees that the water is not intended for drinking.
- B. All piping and pipelines must be color-coded using Pantone Purple 522 using sunlight stable pigment.
- C. All valves and outlets must be tagged and color-coded purple to differentiate potable water lines from reclaimed water.
- D. All reclaimed water valves and outlets must be tagged or labeled "DO NOT DRINK" in addition to the equivalent standard international symbol to warn the public and the employees that the water is not intended for drinking.
- E. Where hose bibs are present on reclaimed water lines, different sizes from those on potable water lines must be established to preclude interchange of hoses.
- F. Cam Lock connection assemblies in small sizes (9 1/2 to 3/4 inch) with lockable meter boxes will be required on all hose connections designated for reclaimed water.
- G. All distribution and application facilities must be color-coded using Pantone Purple 5622.

## PART 3 - EXECUTION 3.1 EXISTING UTILITIES AND OBSTRUCTIONS

- A. General: The Drawings indicate utilities or obstructions that are known to exist according to the best information available to the Owner. The Contractor shall call the Utilities Protection Center (UPC) (325-5000 or 1-800-282-7411) as required by Georgia law (Code Section 25-9-1 through 25-9-13) and all utilities, agencies or departments that own and/or operate utilities in the vicinity of the construction work site, at least 72 hours (three business days) prior to construction, to verify the location of the existing utilities.

B. Existing Utility Location: The following steps shall be exercised to avoid interruption of existing utility service.

1. Provide the required notice to the utility owners and allow them to locate their facilities according to Georgia law. Field utility locations are valid for only ten days after original notice. The Contractor shall ensure, at the time of any excavation, that a valid utility location exists at the point of excavation.
2. Expose the facility to verify its true location and grade for a distance of at least 200 feet in advance of pipeline construction. Repair, or have repaired, any damage to utilities resulting from locating or exposing their true location.
3. Avoid utility damage and interruption by protecting it with means or methods recommended by the utility owner.
4. Maintain a log identifying when phone calls were made, who was called, area for which utility relocation was requested, and work order number issued, if any. The Contractor shall provide the Engineer an updated copy of the log bi-weekly, or more frequently if required.

C. Conflict with Existing Utilities:

1. Horizontal Conflict: Horizontal conflict shall be defined as when the actual horizontal separation between a utility, main, or service and the proposed water main does not permit safe installation of the sewer by the use of sheeting, shoring, teeing-back, supporting, or temporarily suspending service of the parallel or crossing facility. The Contractor may change the proposed alignment of the sewer to avoid horizontal conflicts if the new alignment remains within the available right-of-way or easement and complies with regulatory agency requirements after a written request to and subsequent approval by the Engineer. Where such relocation of the sewer is not approved by the Engineer, the Contractor shall arrange to have the utility, main, or service relocated.
2. Vertical Conflict: Vertical conflict shall be defined as when the actual vertical separation between the utility, main, or service and the proposed sewer does not permit the crossing without immediate or potential future damage to the utility, main, service, or the sewer. The Contractor may change the proposed grade of the sewer to avoid vertical conflicts if the changed grade provides minimum required capacity maintains adequate cover and complies with regulatory agencies requirements, after written request to and subsequent approval by the Engineer. Where such relocation of the sewer is not approved by the Engineer, the Contractor shall arrange to have the utility, main, or service relocated.

D. Electronic Locator: Have available at all times an electronic pipe locator and a magnetic locator, in good working order, to aid in locating existing pipe lines or other obstructions.

E. Potable Water, Sewer and Reuse Separation:

1. Sanitary sewer lines should maintain a minimum 10-foot edge-to-edge separation from potable water mains. Minimum horizontal separation of three feet (outside of pipe to outside of pipe) must be maintained between reclaimed water lines and the potable water or the sewer lines. Where the sewer, or reclaimed water, crosses a potable water main, an

18-inch vertical separation from the bottom of the potable water to the top of the sewer or reclaimed water main shall be maintained. Where possible, a full joint of sewer pipe shall be centered over the water main. Any deviation shall be requested in writing to the Engineer.

2. Where a sewer, or reclaimed water line, crosses over a potable water main, the potable water main shall be encased in concrete to the first joint in each direction.
3. No water main shall be permitted to pass through or come in contact with any part of a manhole.

### 3.2 SOILS

- A. All unsuitable excavated material must be properly disposed of in a manner acceptable to the County Public Works and Utilities Department and in a manner that will not adversely impact the environment.

### 3.3 CONSTRUCTION ALONG HIGHWAYS, STREETS AND ROADWAYS

- A. General: Install pipe lines and appurtenances along highways, streets and roadways in accordance with the applicable regulations of, and permits issued by, the Georgia Department of Transportation and the U.S. Army Corps of Engineers with reference to construction operations, safety, traffic control, road maintenance and repair.

- B. Street Closing: The Contractor shall obtain the approval of the following agencies at least 24 hours in advance before closing any streets:

- 1) Hall County Public Works and Utilities
- 2) Georgia Department of Transportation

- C. Traffic Control:

1. The Contractor shall provide, erect and maintain all necessary barricades; suitable and sufficient lights and other traffic control devices; provide qualified flagmen where necessary to direct the traffic; take all necessary precautions for the protection of the work and the safety of the public. Flagmen shall be certified by a Georgia DOT approved flagman training program.
2. Construction traffic control devices and their installation shall be in accordance with the current Manual On Uniform Traffic Control Devices for Streets and Highways.
3. Placement and removal of construction traffic control devices shall be coordinated with the appropriate agencies and the Construction Manager a minimum of 48 hours in advance of the activity.
4. Placement of construction traffic control devices shall be scheduled ahead of associated construction activities. Construction time in street right-of-way shall be conducted to minimize the length of time traffic is disrupted. Construction traffic control devices shall be removed immediately following their useful purpose. Traffic control devices used intermittently, such as "Flagmen Ahead", shall be removed and replaced when needed.

5. Existing traffic control devices within the construction work zone shall be protected from damage. Traffic control devices requiring temporary relocation shall be located as near as possible to their original vertical and horizontal locations. Original locations shall be measured from reference points and recorded in a log prior to relocation. Temporary device locations shall provide the same visibility to affected traffic as the original device location. Relocated traffic control devices shall be reinstalled in their original locations as soon as practical following construction.
6. Construction traffic control devices shall be maintained in good repair, and shall be clean and visible to affected traffic for daytime and nighttime operation. Traffic control devices affected by the construction work zone shall be inspected daily.
7. Construction warning signs shall be black legend on an orange background. Regulatory signs shall be black legend on a white background. Construction sign panels shall meet the minimum reflective requirements of the Department of Transportation and Hall County. Sign panels shall be of durable materials capable of maintaining their color, reflective characters and legibility during the period of construction.
8. Channelization devices shall be positioned preceding an obstruction at a tapered length as required by the current Manual On Uniform Traffic Control Devices for Streets and Highways, as appropriate for the speed limit at that location. Channelization devices shall be patrolled to insure that they are maintained in the proper position throughout their period of use.

D. Construction Operations:

1. Perform all work along highways, streets and roadways to minimize interference with traffic.
2. Stripping: Where the pipe line is laid along road right-of-way, strip and stockpile all sod, topsoil and other material suitable for right of-way restoration.
3. Trenching, Laying and Backfilling: Do not open the trench any further ahead of pipe laying operations than is necessary. Backfill and remove excess material immediately behind laying operations. Complete excavation and backfill for any portion of the trench in the same day.
4. Shaping: Reshape damaged slopes, side ditches, and ditch lines immediately after completing backfilling operations. Replace topsoil, sod and any other materials removed from shoulders.

E. Excavated Materials: Do not place excavated material along highways, streets and roadways in a manner that obstructs traffic. Sweep all scattered excavated material off the pavement in a timely manner.

F. Drainage Structures: Keep all side ditches, culverts, cross drains, and other drainage structures clear of excavated material. Care shall be taken to provide positive drainage to avoid ponding or concentration of runoff.

- G. Landscaping Features: Landscaping features shall include, but are not necessarily limited to: fences; property corners; cultivated trees and shrubbery; manmade improvements; subdivision and other signs within the right-of-way and easement. The Contractor shall take extreme care in moving landscape features and promptly re-establishing these features.
- H. Maintaining Highways, Streets, Roadways and Driveways:
  - 1. Maintain streets, highways, roadways and driveways in suitable condition for movement of traffic until completion and final acceptance of the work.
  - 2. During the time period between pavement removal and completing permanent pavement replacement, maintain highways, streets and roadways by the use of steel running plates. The edges of running plates shall have asphalt placed around their periphery to minimize vehicular impact. The backfill above the pipe shall be compacted, as specified elsewhere up to the existing pavement surface to provide support for the steel running plates.
  - 3. Furnish a road grader or front-end loader for maintaining highways, streets, and roadways. Make the grader or front-end loader available at all times.
  - 4. Immediately repair all driveways that are cut or damaged. Maintain them in a suitable condition for use until completion and final acceptance of the work.

### 3.4 PIPE DISTRIBUTION

- A. Pipe shall be distributed and placed in such a manner that will not interfere with traffic.
- B. No pipe shall be strung further along the route than 1,000 feet beyond the area in which the Contractor is actually working without written permission from the Owner. The Owner reserves the right to reduce this distance to maximum distance of 200 feet in residential and commercial areas based on the effects of the distribution to the adjacent property owners.
- C. No street or roadway may be closed for unloading of pipe without first obtaining permission from the proper authorities. The Contractor shall furnish and maintain proper warning signs and obstruction lights for the protection of traffic along highways, streets and roadways upon which pipe is distributed.
- D. No distributed pipe shall be placed inside drainage ditches.
- E. Distributed pipe shall be placed as far as possible from the roadway pavement and no closer than five feet from the roadway pavement, as measured edge-to-edge.

### 3.5 LOCATION AND GRADE

- A. General: The Drawings show the alignment and grade of the gravity sewer, force main and the position of manholes and other appurtenances. The slope shown on the profile and/or called for in the Specifications is the slope of the invert of the pipes.

- B. Surveys: From the information on the Drawings and the survey points found on the Project site, the Contractor shall perform all surveys necessary for the establishment of the horizontal and vertical alignment of the sewer.
- C. Reference Points:
1. The Contractor shall take all precautions necessary, which includes, but is not necessarily limited to, installing reference points, in order to protect and preserve the centerline or baseline established by the Engineer.
  2. Reference points shall be placed at or no more than three feet from the outside of the construction easement or right-of-way. The location of the reference points shall be recorded in a log with a copy provided to the Engineer for use prior to his verifying reference point locations. Distances between reference points and the manhole centerlines shall be accurately measured to the nearest 0.01 foot.
  3. The Contractor shall give the Engineer reasonable notice that reference points are set. The reference point locations must be verified by the Engineer, prior to commencing clearing and grubbing operations.
  4. After the Engineer approves the manhole centerlines or baselines of the sewer, the Contractor shall perform clearing and grubbing.
- D. Cut Sheets:
1. Cut sheets shall be utilized for basis of payment and confirming that the profile is as shown on the Drawings.
  2. Prior to beginning installation of any section of the gravity sewer, prepare cut sheets from field run ground elevations and submit them to the Engineer for approval.
  3. The survey, from which cut sheets are prepared, may be performed prior to or after clearing and grubbing operations. The surveyor shall obtain an elevation on each benchmark shown on the Drawings and provide this information to the Engineer.
  4. No installation of the sewer shall commence prior to approval of the cut sheets.
  5. Submittal of cut sheets shall be in accordance with these Specifications.
  6. Cut sheets shall provide the station (to the nearest 1 foot) and the elevation (to the nearest 0.1 foot) at maximum 100 foot intervals, plus at each change in slope of the ground and at each manhole centerline. The cut sheet shall also show the invert elevation of the sewer at the corresponding sewer station. From a straight line interpolation of the data, the Contractor shall calculate and record the station of each point where there is change in the cut brackets indicated on the Bid form. The Contractor shall calculate and record the length of the sewer between each change in cut bracket. The Contractor shall also indicate the pipe material and class as well as the type of bedding. The slope of the sewer shall also be indicated between manholes. At least one offset hub or temporary benchmark shall be provided at each manhole. Its elevation and the resulting cut from the hub to the manhole invert shall also be shown on the cut sheets.

7. Construction shall begin at the low end of the sewer and proceed upstream without interruption. Multiple construction sites shall not be permitted without written authorization from the Engineer for each site. At a minimum, cut sheets between construction sites shall be submitted and approved before multiple construction sites will be permitted.
- E. Damage: The Contractor shall be responsible for any damage done to reference points, base lines, center lines and temporary bench marks, and shall be responsible for the cost of re-establishment of reference points, base lines, center lines and temporary bench marks as a result of the operations.

### 3.6 LAYING AND JOINTING PIPE AND ACCESSORIES

- A. General: Lay all pipe and fittings to accurately conform to the lines and grades established by the Engineer.
- B. Pipe Installation:
  1. Proper implements, tools, and facilities shall be provided for the safe performance of the work. All pipe, fittings and valves shall be lowered carefully into the trench by means of slings, ropes or other suitable tools or equipment in such a manner as to prevent damage to sewer materials and protective coatings and linings. Under no circumstances shall sewer materials be transported with forks of a lifting device into the pipe or dropped or dumped into the trench.
  2. All pipe, fittings, valves and other appurtenances shall be examined carefully for damage and other defects immediately before installation. Defective materials shall be marked and held for inspection by the Engineer, who may prescribe corrective repairs or reject the materials.
  3. All lumps, blisters and excess coating shall be removed from the socket and plain ends of each pipe. The outside of the plain end and the inside of the bell shall be wiped clean and dry and free from dirt, sand, grit or any foreign materials before the pipe is laid. No pipe which contains dirt shall be laid.
  4. Foreign material shall be prevented from entering the pipe while it is being placed in the trench. No debris, tools, clothing or other materials shall be placed in the pipe at any time.
  5. As each length of pipe is placed in the trench, the joint shall be assembled and the pipe brought to correct line and grade. The pipe shall be secured in place with approved backfill material.
  6. It is common practice to lay pipe with the bells facing the direction in which work is progressing however, it is not mandatory.
  7. Applying pressure to the top of the pipe, such as with a backhoe bucket, to lower the pipe to the proper elevation or grade shall not be permitted.

D. Alignment and Gradient:

Lay pipe straight in alignment and gradient and follow true curves, where shown on the Drawings, as nearly as practicable. Do not deflect any joint more than the maximum deflection recommended by the manufacturer or as detailed on the drawings.

1. Maintain a transit, level and accessories on the job to lay out angles and ensure that deflection allowances are not exceeded.
2. The Contractor shall check the invert elevation of the gravity sewer at each manhole and the pipe invert elevation at least three times daily: start, mid-day and end of day. Elevations shall be checked more frequently if more than 100 feet of pipe is installed in a day or if the pipe is being constructed at minimum slope.
3. The Contractor shall check the horizontal alignment of the sewer at the same schedule as for invert elevations.
4. Do not install force main or reuse main such as to generate a high point except where shown on the Drawings. Prior to backfilling the trench, the Contractor shall survey the elevation of force main top of pipe barrel at minimum 100-foot intervals, at all bends, at all air valves, and where elevations are shown on the Drawings. The location description and elevation of each benchmark used for this survey shall be recorded and all this information submitted to the Engineer. Vertical deflections required to avoid existing underground obstructions shall not result in a high point in the force main unless approved by the Engineer.
5. Any section of force main or reuse main which is determined to have been installed such that a high point is generated at a location other than that shown on the Drawings shall be removed and reinstalled to the correct elevation, unless the variation in elevation was approved in writing by the Engineer.
6. Proper alignment of the pipelines shall be maintained by laser.
7. Any pipe that has its alignment, grade or joints disturbed after installation shall be taken up and reinstalled at no cost to the Owner.

D. Expediting of Work: Excavate, lay the pipe and backfill as closely together as possible. Do not leave unjointed pipe in the trench overnight. Backfill and compact the trench as soon as possible after laying and jointing is completed. Cover the exposed end of this installed pipe each day at the close of work and at all other times when work is not in progress. If necessary to backfill over the end of an uncompleted pipe or accessory, close the end with a suitable plug, either push-on, mechanical joint, restrained joint, or as approved by the Engineer.

E. Joint Assembly: Push-on, mechanical and flange type joints shall be assembled in accordance with the manufacturer's recommendations.

F. Cutting Pipe:

1. Cut PVC or ductile iron pipe using a suitable saw.
2. Remove all burrs and smooth the end before jointing.

3. The Contractor shall cut the pipe and bevel the end, as necessary, to provide the correct length of pipe necessary for installing the fittings, valves, accessories and closure pieces in the correct location.
- G. Pipe which has been laid, but during the course of work has had its alignment, grade or joints disturbed after it was installed, shall be taken up and re-laid.
- H. Valve and Fitting Installation:
1. Prior to installation, valves shall be inspected for direction of opening, number of turns to open, freedom of operation, tightness of pressure-containing bolting and test plugs, cleanliness of valve ports and especially seating surfaces and handling damage and cracks. Defective valves shall be corrected or held for inspection by the engineer. Valves shall be closed before being installed.
  2. Valves, fittings, plugs and caps shall be set and joined to the pipe in the manner specified in this Section for cleaning, laying and joining pipe, except that 12-inch and larger valves shall be provided with special support, such as treated timbers, crushed stone, concrete pads or a sufficiently tamped trench bottom so that the pipe will not be required to support the weight of the valve.
- I. Air Release Valve Manholes:
1. Construct the vault or manhole as detailed on the Drawings.
  2. The frame and cover shall be cast into the top slab or cone.
  3. Where vent pipes are not shown on the Drawings, the frame and cover or floor door shall be provided with 1-inch holes to provide the equivalent opening as in air valve. The minimum number of holes shall be two. The quantity for each valve size is as follows: 2-inch, 4; 3-inch, 9; 4-inch, 16; 6-inch, 36; 8-inch 64.
  4. Air release valves shall be installed at the high points of the pipeline as shown on the Drawings. The actual location of the high points are to be confirmed utilizing a surveyors level and the elevation submitted as specified in 3.05, C.5. No other high points are allowed.

#### J. PIPE BEDDING AND BACKFILL

1. Flexible Pipe: Shall be in accordance with ASTM D 2321 for Class I, II and III bedding materials.
2. Rigid Pipe: Shall be in accordance with ASTM C12 for Class A, B, and C bedding materials.
3. Trench backfill shall be compacted to a minimum of 95% modified Proctor density as determined in accordance with ASTM D 1557 in improved streets or streets that are planned to be paved.

3.7 MANHOLE AND PRECAST CONCRETE PRODUCT CONSTRUCTION

- A. General: Construct manholes as shown on the Drawings.
- B. Precast Concrete: Handle sections carefully to prevent cracking or chipping. Provide uniform bedding of the bottom section to prevent uneven loading. Install gaskets and joint sealants in accordance with manufacturer's recommendations to produce a watertight structure.
- C. Pipe Connections: All pipes shall be connected to precast concrete manholes by a rubber boot provided in a cored or precast hole of the proper diameter.
- D. Inverts: Form channels as shown on the Drawings, rounded, and troweled smooth. Maintain consistent grade through the invert.
- E. Top Elevations: Build manholes outside of paved areas to 18-inches above finished grade unless otherwise shown on the Drawings or directed by the Engineer. Build manholes in paved areas to existing grades.
- F. Drop Connections: Manholes requiring drop connections are shown or indicated on the Drawings. Construct drop connections of the same materials as the upstream sewer and in accordance with the details shown on the Drawings. Drop manhole connections are required for incoming sewer pipes that are more than 2 feet above the manhole invert.
- G. Frames and Covers: Unless frame and cover is at grade, the frame shall be cast into the cone section.
- H. Sealing: Seal all manhole joints and lift holes, both inside and out, with grout. Between precast sections, this is in addition to joint sealant.
- I. Invert Elevations: The invert elevations shown on the Drawings shall be for the invert at the centerline of the precast concrete manhole. Prior to setting the laser or other vertical alignment control system for the sewer upstream of the manhole, the Contractor shall verify the elevation of the sewer installed at the manhole. Should the elevation differ from that shown on the Drawings, the Contractor shall take the following corrective action:
  - 1. If the sewer is laid at negative grade or to a grade less than the grade shown on the EPD-approved drawings (i.e., bid drawings), the Contractor shall remove and reinstall the sewer at the correct grade at no additional cost to the Owner.
  - 2. If the sewer is laid at a grade less than that shown on the Drawings, thus reducing the sewer's capacity, the Owner may require the sewer to be removed and re-laid at the correct grade at no additional cost to Owner. As a minimum, the grade to the next upstream manhole shall be adjusted such that the next upstream manhole shall be set at the correct elevation.
  - 3. If the sewer is laid at a grade greater than that shown on the Drawings, and the Contractor can show that there are no conflicts with upstream existing utilities or obstructions, the Contractor shall adjust the grade of the next upstream manhole such that the next upstream manhole shall be set at the correct elevation. If such an adjustment, in the Engineer's opinion, is substantial, the grade adjustment shall be spread over multiple

sections of the sewer. If such an adjustment, in the Owner's opinion, significantly reduces the sewer's capacity, the Owner may require the Contractor to remove and relay that portion of the sewer laid at the improper grade.

- J. Walls: Manholes shall be constructed such that their walls are plumb and cast-in steps are properly aligned for safe access.

### 3.8 THRUST RESTRAINT

- A. General: Provide restraint at all points where hydraulic thrust may develop.

- B. Concrete Blocking:

1. Provide concrete blocking for all bends, tees, valves, and other points where thrust may develop in addition to retainer glands, except where other means of thrust restraint are specifically shown on the Drawings.
2. Form and pour concrete blocking at fittings as shown on the Drawings and as directed by the Engineer. Pour blocking against undisturbed earth. Increase dimensions when required by over excavation.

- C. Retainer Glands:

1. Retainer glands shall be ductile iron and shall be manufactured in the United States. All retainer glands on the Project shall be the product of a single manufacturer.
2. Retainer glands shall be provided at all mechanical joints, including fittings, valves and other locations as shown on the Drawings.
3. Retainer glands shall be of a wedge type. Wedge type retainer glands shall be MEGALUG, Series 1100 as manufactured by EBAA Iron, Inc.

- D. Harnessing:

1. Provide harness rods only where specifically shown on the Drawings or directed by the Engineer.
2. Harness rods shall be manufactured in accordance with ASTM A 449 and shall have an allowable tensile stress of no less than 39,600 psi. Harness rods shall be hot dip galvanized or field coated with bitumastic before backfilling.
3. Where possible, harness rods shall be installed through the mechanical joint bolt holes. Where it is not possible, provide 90-degree bend eyebolts.
4. Eyebolts shall be of the same diameter as specified in AWWA C111 for that pipe size. The eye shall be welded closed. Where eyebolts are used in conjunction with harness rods, an appropriate size washer shall be utilized with a nut on each end of the harness rods.

### 3.9 INSPECTION AND TESTING

- A. General: Clean and test lines before requesting final acceptance. Where any obstruction is encountered, clean the sewers by means of rods, swabs, or other instruments. When requested by the Engineer, flush out lines and manholes before final inspection. Notify the Owner and Engineer 48 hours prior to scheduling any tests so their presence can be made for any tests.
- B. Gravity Sewers: Pipelines shall be straight and show a uniform grade between manholes. Correct any discrepancies discovered during inspection.
  - 1. Infiltration Tests: Use only when groundwater is two feet above the top of the pipe.
    - a. Install suitable weirs in manholes selected by the Engineer to determine the leakage of ground water into the sewer. The maximum length of line for each infiltration test shall be 5,000 feet. Measure leakage only when all visible leaks have been repaired and the ground water is two feet above the top of the pipe. If leakage in any section of the sewer line exceeds 25 gpd per inch of diameter per mile, locate and repair leaks. Repair methods must be approved by the Engineer. After repairs are completed, re-test for leakage.
    - b. Furnish, install, and remove the necessary weirs, plugs, and bulkheads required to perform the leakage tests. Where continuous monitoring of flow level is required, the Owner will provide and operate monitoring equipment.
  - 2. Exfiltration Tests: Choose one of the following when groundwater is not two feet above the top of the pipe.
    - a. Hydrostatic Test:
      - 1) Test pipe between manholes with a minimum of 10 feet hydrostatic pressure, measured at the center of the pipe at the upstream manhole.
      - 2) The ends of the pipe in the test section shall be closed with suitable watertight bulkheads. Inserted into the top of each bulkhead shall be a 2-inch pipe nipple with an elbow. At the upper end of the section, a 12-inch riser pipe shall be connected to the 2-inch nipple. The test section of pipe shall be filled through the connection in the lower bulkhead that shall be fitted with a valve until all air is exhausted and until water overflows the riser pipe at the upper end. Water may be introduced into the pipe 24 hours prior to the test period to allow complete saturation. House service lines, if installed, shall also be fitted with suitable bulkheads having provisions for the release of air while the test section is being filled with water.
      - 3) During the test period, which shall extend over a period of two hours, water shall be introduced into the riser pipe from measured containers at such intervals as are necessary to maintain the water level at the top of the riser pipe. The total volume of water added during the test period shall not exceed 25 gpd per inch diameter per mile.
    - b. Low Pressure Air Test:
      - 1) Prior to air testing, the section of sewer between manholes shall be thoroughly cleaned and wetted. Immediately after cleaning or while the pipe is water soaked, the sewer shall be tested with low-pressure air. At the

Contractor's option, sewers may be tested in lengths between manholes or in short sections (25 feet or less) using inflatable balls pulled through the line from manhole to manhole. Air shall be slowly supplied to the plugged sewer section until internal air pressure reaches approximately 4.0 psi. After this pressure is reached and the pressure allowed to stabilize (approximately two to five minutes), the pressure may be reduced to 3.5 psi before starting the test. If a 1.0 psi drop does not occur within the test time, then the line has passed the test. If the pressure drops more than 1.0 psi during the test time, the line is presumed to have failed the test, and the Contractor will be required to locate the failure, make the necessary repairs, and retest the line. The minimum test time for various Ductile iron and PVC pipe sizes shall be in accordance with ASTM F-1417 and as follows:

Nominal Pipe Size, inches	T (Time Min/100) Feet
6	3.8
8	7.6
12	11.3
15	14.2
16	15.1
18	17.0
20	18.9
24	22.8
30	28.3
48	91.2
54	115.4

- 2) Required test equipment, including inflatable balls, braces, air hose, air source, timer, rotameter as applicable, cut-off valves, pressure reducing valve, 0-15 psi pressure gauge, 0-5 psi pressure gauge with gradations in 0.1 psi and accuracy of  $\pm$  two percent, shall be provided by the Contractor. Testing equipment shall be equal to Cherne Air-Loc Testing System.
- 3) The Contractor shall have the Owner and or Engineer present and keep records of all tests made. A copy of such records will be given to the Engineer or the Owner. Such records shall show date, line number and stations, operator, and such other pertinent information as required by the Engineer.
- 4) The Contractor is cautioned to observe proper safety precautions in performance of the air testing. It is imperative that plugs be properly secured and that care be exercised in their removal. Every precaution shall be taken to avoid the possibility of over-pressurizing the sewer line.

3. Deflection Test:

- a. Test PVC gravity sewer for excessive deflection by passing a mandrel through the pipe. Testing shall conform to ASTM D 2122. Deflection of the pipe shall not exceed the following:

Nominal Pipe Diameter	Maximum Allowable Deflection
12-inches	5%
> 12-inches	4%

- b. The mandrel size shall be based upon the maximum possible inside diameter for the type of pipe being tested, taking into account the allowable tolerances of the pipe. The mandrel shall have an odd number of legs, or vanes, with a quantity of such equal to or greater than nine. The legs of the mandrel shall be permanently attached to the mandrel. A mandrel with variable sizes shall not be allowed. The mandrel shall be constructed of steel, aluminum or other material approved by the Engineer, and shall have sufficient rigidity so the legs of the mandrel will not deform when pulling through a pipe. The mandrel dimensions shall be checked by the Engineer before use by the Contractor.
- c. Excavate and reinstall properly any section of pipe not passing this test. Re-test until results are satisfactory.
- d. This test shall be performed within the first 30 days of installation or during final inspection. The test shall not be performed until at least 7 days has passed since final backfill was placed. Deflection shall be limited to the limits specified above. Where excessive deflection is encountered, corrective measures shall be taken to bring deflection to within the allowable tolerance.

4. Digital Inspection Testing: All new gravity sewer lines six inch (6") diameter and above shall be video inspected with closed circuit television by an independent testing firm. The speed shall be sufficient that technicians show each pipe joint and lateral condition. Contractor shall deliver written reports of the inspection as well as digital video to the Owner. Should deficiencies be observed, Contractor shall make corrections and perform subsequent inspections until deficiencies are corrected.

C. Force Main and Reuse Main Pressure and Leakage Test:

- 1. All sections of pipeline subject to internal pressure shall be pressure tested in accordance with AWWA C600. A section of line will be considered ready for testing after completion of all thrust restraint backfilling. Each segment of pipeline between line valves shall be tested individually. Conduct tests after pipe has been buried and properly backfilled but before any permanent covering is completed such as grass, pavement, etc.
- 2. Contractor may, if field conditions permit and Engineer approves, partially backfill trench and leave joints exposed for inspection and conduct an initial service leakage test. Final test shall not be done until all backfilling is completed as specified above.
- 3. Test Preparation:
  - a. Flush pipeline section thoroughly at flow velocities adequate to remove debris from pipe and valve seats. Partially operate valves and hydrants to clean out seats. Provide correctly sized temporary outlets in number adequate to achieve flushing velocities.
  - b. Provide temporary blocking, bulkheads, flanges and plugs as necessary, to assure all new pipes, valves and appurtenances will be pressure tested.
  - c. Before applying test pressure, air shall be completely expelled from the pipeline and all appurtenances. Unless permanent air vents are in place, insert temporary

corporation stops at highpoints to expel air as line is filled with water.

- d. Fill pipeline with a maximum filling velocity of 0.25 feet per second, calculated based upon the full area of the pipe, with water furnished by the Contractor. Provide a suitable pump with an accurate water meter to pump the line to the specified pressure. Differential pressure at valves and hydrants shall equal the maximum possible, but shall not exceed manufacturer's pressure rating.

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4. Test Pressure: Test the pipeline and thrust restraints at 150 psi measured at the lowest point for two hours. Apply and maintain the test pressure with hydraulic force pump. Valve off the piping system when test pressure is reached.
  5. Leakage: Leakage shall be defined as the quantity of water that must be pumped into the test section: equal to the sum of the water to maintain pressure within 5 psi of the specified test pressure for the test duration plus water required to return line to test pressure at the end of the test. Leakage shall be the total cumulative amount measured on a water meter.
    - 1) The Owner assumes no responsibility for leakage occurring through existing valves.  
  
Test Results: No test section shall be accepted if the leakage exceeds the limits determined under Section 4 of AWWA C600. The leakage test shall be repeated until the test section is accepted and repairs made. All visible leaks shall be repaired regardless of leakage test results.
    - 2) Completion: After a pipeline section has been accepted, relieve test pressure, record the type, size and location of all outlets on record drawings.
- D. Manholes: All manholes shall be tested and shown to be watertight. Prior to testing manholes for water tightness, all lift holes shall be plugged with a non-shrink grout, all joints between precast sections shall be properly sealed and all pipe openings shall be temporarily plugged and properly braced.
1. Exfiltration Test: manholes that have been backfilled, shall be tested for Exfiltration for a test time of one (1) hour by fill the manhole with water to the top of the ring. The maximum allowable Exfiltration rate shall be two (2) gallons per foot of depth per foot of manhole diameter.
  5. Vacuum Test: In lieu of Exfiltration Tests, prior to backfilling each manhole shall pass the vacuum test as defined in ASTM C 1244, "Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test." Vacuum shall be held at 10 inches of mercury for a period of 60 seconds with the vacuum pump shut off. If pressure drops below 9 inches, test has failed and repairs shall be made and retested.

### 3.10 PROTECTION AND RESTORATION OF WORK AREA

- A. General: Return all items and all areas disturbed, directly or indirectly, by work under these Specifications to their original condition or better, as quickly as possible after work is started.
  - 1. The Contractor shall plan, coordinate, and prosecute the work such that disruption to personal property and business is held to a practical minimum.
  - 2. All construction areas abutting lawns and yards of residential or commercial property shall be restored promptly. Backfilling of underground facilities, ditches, and disturbed area shall be accomplished on a daily basis as work is completed. Finishing, dressing, and grassing shall be accomplished immediately thereafter, as a continuous operation within each area being constructed and with emphasis placed on completing each individual yard or business frontage. Care shall be taken to provide positive drainage to avoid ponding or concentration of runoff.
  - 3. Handwork, including raking and smoothing, shall be required to ensure that the removal of roots, sticks, rocks, and other debris is removed in order to provide a neat and pleasing appearance.
  - 4. The Engineer shall be authorized to stop all work by the Contractor when restoration and cleanup are unsatisfactory and to require appropriate remedial measures.
- B. Man-Made Improvements: Protect, or remove and replace with the Engineer's approval, all fences, walkways, mail boxes, pipe lines, and drain culverts, power and telephone lines and cables, property pins and other improvements that may be encountered in the work.
- C. Cultivated Growth: Do not disturb cultivated trees or shrubbery unless approved by the Engineer. Any such trees or shrubbery which must be removed shall be heeled in, and replanted under the direction of an experienced nurseryman.
- D. Cutting of Trees: Do not cut trees for the performance of the work except as absolutely necessary. Protect trees that remain in the vicinity of the work from damage from equipment. Do not store spoil from excavation against the trunks. Remove excavated material stored over the root system of trees within 30 days to allow proper natural watering of the root system. Repair any damaged tree over 3 inches in diameter, not to be removed, under the direction of an experienced nurseryman. All trees and brush that require removal shall be promptly and completely removed from the work area and disposed of by the Contractor. No stumps, wood piles, or trash piles will be permitted on the work site.
- E. Disposal of Rubbish: Dispose of all materials cleared and grubbed during the construction of the project in accordance with the applicable codes and rules of the appropriate County, State and Federal regulatory agencies.
- F. Swamps and Other Wetlands:
  - 1. The Contractor shall not construct permanent roadbeds, berms, drainage structures or any other structures that alter the original topographic features within the easement.

2. All temporary construction or alterations to the original topography will incorporate measures to prevent erosion into the surrounding swamp or wetland. All areas within the easement shall be returned to their original topographic condition as soon as possible after work is completed in the area. All materials of construction and other non-native materials shall be disposed of by the Contractor.
3. The Contractor shall provide temporary culverts or other drainage structures, as necessary, to permit the free migration of water between portions of a swamp, wetland or stream that may be temporarily divided by construction.
4. The Contractor shall not spread, discharge or dump any fuel oil, gasoline, pesticide, or any other pollutant to adjacent swamps or wetlands.

### 3.11 BYPASS PUMPING

- A. Bypass pumping may be allowed or required as indicated on the Drawings for the proper execution of the work. Care shall be taken to ensure that the spillage of raw wastewater onto the ground or into a receiving stream or body of water does not occur. Bypass pumping that allows raw wastewater to come into contact with the ground or into a receiving stream or body of water is prohibited.

### 3.12 IDENTIFICATION AND LOCATOR WIRE

- A. Install continuous underground detectable mylar warning tape during backfilling of trench for underground sewer and reuse piping. Locate below finished grade, directly over piping.
- B. A continuous or properly spliced Number 12 AWG solid plastic coated copper wire (Green) shall be placed along all PVC pipe installations.
- C. The locator wire shall run from the surface clean out and terminate at the sanitary sewer main locator wire. If the locator wire for the main sewer line is missing, the line shall terminate at the sanitary sewer main with a magnesium anode (1 lb. min.). The locator wire shall be attached at each end in a manner, approved by the inspector, to allow direct access to the wire.
- D. All splices shall be made by using copper wire "Split" bolt assemblies or "Butt" connections and then covered with 12 AWG compatible wire heat shrink fully insulated solder terminals or dielectric silicon fill to seal out moisture and corrosion.
- E. Care shall be taken during backfilling to prevent damaging or cutting of the locator wire. All tracer wire damaged during construction shall be repaired as outlined in 3.12.D. above or to the satisfaction of the inspector
- F. Wire shall be wrapped around pipe such that at least four (4) "wraps" are produced per length of pipe.
- G. The tracer wire may be strung along the top of pipe instead of "wrapping" provided it is taped to the pipe every 5 feet to insure proper positioning during backfilling.

END OF SECTION