

## 02530 – SANITARY SEWER

(Last revised 7/24/06)

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## **PART 1 – GENERAL**

### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this specification.
- B. [Section 02275 – TRENCHING, BACKFILLING AND COMPACTION OF UTILITIES.](#)

### **1.2 SUMMARY**

- A. This section includes sanitary sewer piping and specialties for municipal sewer and services outside of building structures.

### **1.3 DEFINITIONS**

#### **A. GENERAL:**

For the purposes of this specification, the following definitions refer to sanitary sewer collection and pressure systems that come under the authority of the City of Jacksonville as specified within this section and other sections of this manual.

- 1) **Cleanouts:** A riser pipe off of a service line that provides access to the line for the purpose of line cleaning.
- 2) **Easement:** An instrument that depicts/describes and conveys rights and privileges to the City of Jacksonville for the placement, access to and maintenance of a utility line across and/or on the property of a second party. Ownership of the land remains with the second party.

- 3) **Public Services Director:** The Public Services Director or his or her authorized representative.
- 4) **Sanitary Sewer:** Exterior gravity or pressure public sanitary sewer systems.
- 5) **Force Main:** Pressure sanitary sewer systems.
- 6) **Lift/Pump Station:** A combination wetwell/pump station and appurtenances.
- 7) **Sewer Service:** Exterior domestic sewer piping which connects to the public sewer system.

B. The following are industry abbreviation for various pipe materials:

- 1) **DIP:** Ductile Iron Pipe
- 2) **CI:** Cast Iron Pipe
- 3) **AC:** Asbestos Cement Pipe
- 4) **RCP:** Reinforced Concrete Pipe

#### 1.4 PERFORMANCE

- A. Gravity Flow, Nonpressure Piping Pressure Ratings: At least equal to the system test pressure.
- B. Force Main Pressure Ratings: At least equal to the system operating pressure plus 50 psi, but no less than 150 psi.

#### 1.5 SUBMITTALS

- A. Submit product data for the following. For third party projects, the developer/project Engineer shall perform all product review and make a submittal at the end of the project to the City.
  - 1) Piping Specialties
  - 2) Air & vacuum release valves and accessories
  - 3) Autodialers
  - 4) Sewage Pumps and appurtenances, operating manuals.
  - 5) Auxiliary Generators
  - 6) Alarm Devices
  - 7) Precast Concrete Manhole Castings
  - 8) Piping Paint
- B. Submit shop drawings for the following.
  - 1) Precast Concrete Vaults and wetwells, including frames and covers, ladders, drains, access hatches, wall sleeves, valve support stands, pumps, and motors.
- C. **Coordination Drawings:** Show manholes and other structures in vicinity, pipe sizes and elevations, elevations of lift station elements such as influent lines, floats, etc.

**D. Computations:**

- 1) Buoyancy calculations for wetwells, manholes, interceptor/outfalls, and mains with shallow cover.
- 2) Provide structural calculations for any elevated main and pier system where span of the main exceeds the joint length. Provide calculations for all aerial mains, and their supporting structures that are subject to hydrodynamic forces.

E. **Bypass Pumping:** Bypass pumping operations must be approved by the City before starting. Provide a detailed written plan of how the bypass pumping operation shall be performed two weeks prior to the operation. See paragraph 3.5 of this specification.

F. **Project Closeout:** Submit three copies of manufacturer's maintenance and operation manuals on all sewage pumps and/or package lift stations and appurtenant devices.

**1.6 QUALITY ASSURANCE**

- A. Materials and operations shall comply with the latest revision of the Codes and Standards listed in paragraph 1.7, below.
- B. Piping materials shall be marked clearly and legibly.
  - 1) Ductile Iron Pipe shall show on or near bell:
    - a. Weight,
    - b. Class or nominal thickness,
    - c. The letters "DI" or "Ductile,"
    - d. Manufacturer's identifying mark,
    - e. Year in which pipe was made, and
    - f. Casting period.
  - 2) Steel pipe shall be marked as follows. Each length of pipe and each special section shall be legibly marked by paint stenciling, die stamping or hot-roll marking to show the following:
    - a. Manufacturer's name or mark,
    - b. Size and weight of the pipe or special section,
    - c. The type of steel from which the pipe or special section was made.
- C. *"Gravity Sanitary Sewer Design and Construction,"* ASCE Manuals and Reports on Engineering Practice – NO. 60, WPCF Manual of Practice NO. FD-5.
- D. AWWA C600: Installation of Ductile Iron Water Mains and Appurtenances.
- E. NC Department of Environment and Natural Resources, Division of Water Quality, NCAC Title 15A 2H .0200 *Waste not Discharged to Surface Waters*, latest revision.

## 1.7 QUALITY STANDARDS

- A. Materials and operations shall comply with the latest revision of the Codes and Standards listed below:

<b>AASHTO</b>	American Association of State Highway Transportation Officials.
<b>ACI</b>	American Concrete Institute
<b>ACPA</b>	American Concrete Pipe Association
<b>ANSI</b>	American National Standards Institute
<b>AREA</b>	American Railway Engineers Association
<b>ASCE</b>	American Society of Civil Engineers
<b>ASSE</b>	American Society of Sanitary Engineers
<b>ASTM</b>	American Society for Testing and Materials
<b>AWWA</b>	American Water Works Association
<b>CISPI</b>	Cast Iron Soil Pipe Institute
<b>CRSI</b>	Concrete Reinforcing Steel Institute
<b>FS</b>	Federal Specifications
<b>MSDS</b>	Material Safety Data Sheets
<b>NCDENR</b>	NC Department of Environment and Natural Resources
<b>NCDOT</b>	North Carolina Department of Transportation
<b>NCMA</b>	National Concrete Masonry Association
<b>NCPI</b>	National Clay Pipe Institute
<b>NSF</b>	National Sanitation Federation International
<b>UL</b>	Underwriters Laboratories, Inc.
<b>WEF</b>	Water Environment Federation

## 1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

Materials used for the construction of gravity sewer, pressure mains and appurtenances in the City sewer collection system shall be new, free of defects, and meet the highest standards set forth. An authorized City representative must inspect, review, and approve all materials to be used for sewer main and appurtenances prior to installation. At the option of the City, any material installed without inspection will have to be sufficiently removed for inspection and review. Any additions, deletions, or changes

from the City of Jacksonville approved plan set must be submitted to the Public Services Director for approval, prior to making changes in the field.

**A. Pipe Condition/Pipe Examination:**

- 1) **New Pipe Inspection:** Inspect materials thoroughly, including the interior, upon arrival. Examine materials for damage and to ensure that the right pipe has been delivered to the site. Remove damaged or rejected materials from site. Pipe shall be protected during handling against impact shocks and free fall. Pipe shall be kept clean at all times, and no pipe shall be used in the work that does not conform to the appropriate ASTM Specifications.
  - 2) **Pre-Installation Inspection:** Prior to installation, each section of the pipe shall be carefully examined for damage and conformity with these specifications. All pipes damaged or deemed not to conform to these specifications shall be rejected and removed from site. All pipes in which the spigots and bells cannot be made to fit properly, or pipe, which has chipped bells or spigots, will be rejected. The faces of all spigots ends and of all shoulders on the bells must be true. Examine bell and spigot for uniformity and smoothness of liner and barrel.
- B. Protect pipe coating during handling using methods recommended by the manufacturer. Use of bare cables, chains, hooks, metal bars, or narrow skids in contact with coated pipe is not permitted.
- C. Prevent damage to pipe during transit. Repair abrasions, scars, and blemishes to the satisfaction of the City. If repair of satisfactory quality cannot be achieved, replace damaged material immediately.
- D. Observe manufacturer's directions for delivery and storage of materials and accessories.
- E. Protect stored piping from entry of water or dirt into pipe. Protect bells and flanges of special fittings from entry of moisture and dirt.
- F. Support pipe to prevent sagging or bending. Do not store plastic pipe, structures, and fittings in direct sunlight for more than one week.
- G. Handle precast concrete manholes and other structures according to manufacturers written rigging instructions.
- H. Construct piping to accurate lines and grades and support as shown in drawings or prescribed in specifications. When temporary supports are used, insure that sufficient rigidity is provided to prevent shifting or distortion of pipe.

## **1.9 PRODUCT SUBSTITUTIONS**

The Public Services Director will approve materials not specified but deemed equal, on a case-by-case basis. Submit documentation and samples of materials. New materials approved for the sewer collection system will be incorporated into these specifications after approval.

## 1.10 PROJECT CONDITIONS

### 1.10.1 Separation of water and sanitary and/or combined sewers

A. Follow the NCDENR standards for separation of water mains and sanitary sewers lines.

B. **Parallel Installations:**

- 1) **Normal Conditions** – Sewer mains or sewer manholes shall be constructed at least 10 feet horizontally from water lines whenever possible. The distance shall be measured edge-to-edge.
- 2) **Unusual Conditions** – When local conditions prevent a horizontal separation of at least 10 feet, the sewer main or sanitary sewer manhole may be laid closer to a water line provided that:
  - a. The sewer line shall be placed in a separate trench, with elevation of the top of the sewer line at least 18 inches below the bottom of the water line; or
  - b. The sewer line shall be placed in the same trench as the water, and located to one side, on a bench of undisturbed earth, and the elevation of the top of the sewer line at least 18 inches below the bottom of the water main; or
  - c. Where this vertical separation cannot be obtained, the sewer shall be constructed of AWWA approved Ductile Iron Pipe pressure-tested in place to 50 psi without leakage prior to backfilling. The sewer manhole shall be of watertight construction and tested in place.

C. **Sewer Mains Crossing Below Water Mains:**

- 1) **Preferred/Normal Condition** – sewer lines shall be constructed to cross below water lines whenever possible and shall be laid to provide a vertical separation of at least 18 inches between the bottom elevation of the water line and the top of the sewer.
- 2) **Unusual Conditions** – when local conditions prevent an 18 inch vertical separation as described in *Crossing, Preferred/Normal Conditions* (paragraph above), the following construction shall be used:
  - a. Both the sewer crossing above water line and the water line itself shall be constructed of AWWA approved Ductile Iron Pipe with joints that are equivalent to water main standards for a distance of 10 feet on each side of the point of crossing.

D. **Sewer Mains Crossing Above Water Mains:**

- 1) **Unusual Conditions** – when local conditions prevent an 18 inch vertical separation, as described in paragraph C, *Sewer Mains Crossing Below Water Mains, Preferred/Normal Conditions*, above, the following construction shall apply:

- a. That a section of DIP sewer pipe, with water main type pipe joints, is centered at the point of the water crossing so that the joints are equidistant and as far as possible from the water main such that, for a 90 degree crossing, the water main type joints are a minimum of 10 feet on each side of the point of crossing.
- b. Provide adequate structural support for the sewers to prevent excessive deflection of the joints, which can result in settling on and/or the breaking the water line.

#### E. Sewer Mains and Other Utilities

- 1) **Horizontal Separation; Preferred/Normal Condition** – sewer lines shall be constructed to provide at least 10 feet from water mains and 3 feet horizontally from other utilities whenever possible. The distance shall be measured edge-to-edge.
  - 2) **Vertical Separation – Preferred/Normal Condition:** whenever it is necessary for another utility to cross a sewer main, an 18-inch vertical separation shall be maintained between the lines. When local conditions prevent a 18-inch vertical separation, the following construction shall apply:
    - a. Provide adequate structural support for the utility to prevent excessive deflection of the joints, which can result in settling on and/or breaking the sewer line.
- F. **Sanitary Sewer Manholes** – no water main shall be allowed to pass through or come in contact with any part of a sewer manhole. A minimum separation of 3 feet of horizontal separation shall be maintained between water mains and sanitary sewer manholes provided that the applicable provisions of paragraph B, *Parallel Installations, Unusual Conditions*, above, are also met.
- G. **Storm Drainage System:** No water mains or services, gravity sewer or sewer lateral shall pass through a storm drain pipe or manhole system.
- H. **New Utilities and Existing Sewer Mains** – when installing a new utility adjacent to or in close proximity to an *existing* sewer main, the new utility line shall be installed to provide the minimum horizontal and vertical clearances specified in [paragraph 1.10 E, Sewer Mains and other Utilities](#).
- I. **Protection of Wells** – No gravity sewer, force main, or manhole structure shall pass or be placed within 50 ft of a private well or 100 feet of a public water supply well, source or structure or the well must be abandoned. This offset distance assumes that ferrous sewer pipe with joints equivalent to water main standards are used.

### 1.11 LOCATING SERVICES

- A. Contact City of Jacksonville Public Services Department to coordinate interruption of services. If interruption is necessary, the interruption shall be arranged to occur at such a time to cause the least disruption and minimize loss of service. At the direction of the Public Services Director, temporary service may be required to be provided. Provide a minimum of 1 week's notice of the proposed utility interruption.

- B. Coordinate tie-in to municipal sewer mains and manholes with the Public Services Director.

## 1.12 COORDINATION

Contact **“NC One Call”** 1-800-632.4949 before digging. Call the City of Jacksonville Public Services Department at 910-938-5249 for water/sewer location services.

## **PART 2** – PRODUCTS

### 2.1 PIPE & FITTINGS

The following references provide the minimum standards as they apply to the specific item listed. In all cases, the latest revision shall apply:

#### 2.1.1 DUCTILE IRON PIPE

Ductile iron pipe shall be manufactured in accordance with all applicable requirements of AWWA C151/ANSI A21.51 and ASTM A746, Standard Specification for Ductile Iron Gravity Sewer Pipe for 4-inch and larger diameter pipe, pressure class rated, class 200 minimum. The thickness of Ductile Iron Pipe shall be determined by considering trench load in accordance with ANSI/AWWA C150/A21.50 (Public Sewers shall be no less than 8-inch diameter).

All pipe and fittings shall be lined with SewperCoat as manufactured by Lafarge Calcium Aluminates or approved equal. SewperCoat is a calcium aluminate mortar made of fused calcium aluminate cement and fused calcium aluminate aggregates.” The thickness of the lining shall be the thickness identified on AWWA C104, Sec. 4.7, paragraph 4.7.1, latest revision but no less than 0.125 inch for 6-inch through 12-inch and 0.1875 inch for 14-inch through 24-inch pipe. The lining thickness may taper to less than the specified at the ends of the pipe. Cracks, other than closed hairline cracks and/or fine crazing shall not be acceptable. Loose areas of cement lining are not allowable. A seal coat shall be applied to the lining as identified on AWWA C104, Sec. 4.11.

Epoxy (Protecto 401) is an acceptable alternative to SewperCoat calcium aluminate mortar lining when pipe is to be used for sewer only.

Outside coat shall be a minimum of 1 mil bituminous paint according to ANSI/AWWA C151/A21.21 Section 51-8.1.

Each joint of ductile iron pipe shall be hydrostatically tested before the outside coating and inside lining are applied at the point of manufacturer to 500 psi. Testing may be performed prior to machining bell and spigot. Failure of ductile iron pipe shall be defined as any rupture or leakage of the pipe wall.

All materials used in production of the pipe are to be tested in accordance with AWWA C151 for their adequacy within the design of the pipe, and certified test results are to be provided to the City of Jacksonville upon request. All certified tests, hydrostatic and material are to be performed by an independent testing laboratory at the expense of the pipe manufacturer.



Push-on and mechanical joint pipe shall be as manufactured by the American Cast Iron Pipe Company, Atlantic States Cast Iron Pipe Company, United States Pipe and Foundry Company, or Griffin Pipe Products Company.

#### A. DUCTILE IRON JOINTS

Pipe joints may be either push-on or mechanical joint pipe sizes 4 inches through 48 inches in diameter. Rubber Gasket Joints and Mechanical Joints shall comply with AWWA C111/ANSI A21.11, ASTM A536 *Standard Specification for Ductile Iron Castings*. Acceptable pipe joints are as follows:

- 1) **Push-on Joint** Ductile Iron Pipe shall conform to AWWA C151/ANSI A21.51 (such as "*Fastite*," "*Tyton*," or "*Bell-Tite*."). The dimensions of the bell, socket, and plain end shall be in accordance with the manufacturer's standard design dimensions and tolerances. The gasket shall be of such size and shape to provide an adequate compressive force against the plain end and socket after assembly to affect a positive seal. Gaskets shall be vulcanized natural or vulcanized synthetic rubber, and comply with AWWAC111/ANSI A21.11.
- 2) **Mechanical Joint, Ductile Iron Pipe** shall be used only at the specific locations indicated on the drawings or as approved by the Public Services Director.
  - a. The mechanical joint shall consist of:
    - i) A bell cast integrally with the pipe or fitting and provided with an exterior flange having cored or drilled bolt holes and interior annular recesses for the sealing gasket and the spigot of the pipe or fitting;
    - ii) A pipe or fitting spigot;
    - iii) A sealing gasket;
    - iv) Separate ductile iron follower gland having cored or drilled bolt holes; and
    - v) Ductile iron tee head bolts and hexagon nuts.
  - b. The joint shall be designed to permit normal expansion, contraction, and deflection of the pipe or fitting while maintaining a leak proof joint connection. The mechanical joint shall conform to the requirements of Federal Specification WW-P-421, AWWA C111/ANSI A21.11, and ASTM A536 Standard Specification of Ductile Iron Castings.

#### B. DUCTILE IRON FITTINGS

Fittings shall be ductile iron at least class 54 thickness and shall conform to AWWA C110/ANSI A21.10 or AWWA C153/ANSI 21.53 for compact fittings. All ductile iron fittings shall have a minimum working pressure rating of 250 psi and minimum iron strength of 25,000 psi. All fittings shall be high alumina cement mortar lined in accordance with ANSI/AWWA C-104/A21.4 and the outside shall be bituminous coated. The fittings shall be tested and the manufacturer shall

provide certified test results when requested by the City. This testing shall include hydrostatic proof testing of fittings. Acceptable types of fittings include Push-On Joint and Mechanical Joint.

- 1) **Mechanical Joint Fittings** - Restraint shall be Megalug series 1100 mechanical joint restraint by EBAA Iron Sales, Inc., Ford wedge action restrainer gland UFR Series 1400, or approved equal. Ductile Iron fittings shall conform to AWWA C110/ANSI A21.10 or AWWA C153/ANSI A21.53 (compact). Glands, Gaskets and Bolts shall conform to AWWA C111/ANSI A21.11.

## 2.1.2 PVC PIPE

### A. PVC SOLID WALL PIPE AND FITTINGS

- 1) **PVC Solid Wall Pipe:** PVC Solid Wall Sewer Gravity Pipe and Fittings, Bell and Spigot Joints shall comply with ASTM D3034, Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings, SDR 35 minimum (6 inches - 15 inches). For 18 inch diameter PVC, comply with the requirements of ASTM F679, Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings, or latest revision, type PSM. Pipe shall be made of PVC plastic having a cell classification of 12454 B or 12454 C or 12364 C or 13364 B, with a minimum tensile modulus of 500,000 psi as defined in ASTM D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds, and shall be appropriately marked. Laying lengths shall be a minimum of 12.5 feet for pipes 15 inches or less and 11 feet for the pipes greater than 15 inches. **SDR 35 shall not be installed at depths greater than 15'.**

PVC pipe strength shall be capable of withstanding stiffness, flattening, and impact test as scheduled or referenced in ASTM D3034 or ASTM F949. Smooth wall pipe shall have a Standard Dimension Ratio (SDR) of 35 or less. All PVC pipe shall have a minimum pipe stiffness of 46 psi when measured at 5 percent vertical ring deflection and tested in accordance with ASTM F477, *Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe*.

- 2) **PVC PIPE JOINTS:** Joints for Solid Wall PVC Sewer Gravity Pipe & Fittings and Elastomeric flexible seals (Gaskets) shall be compatible with pipe and shall meet the requirements of ASTM D3212 *Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals*. Rubber Gaskets shall be used which conform to the requirements of ASTM F477, *Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe*.

### B. PVC COMPOSITE PIPE (PVC TRUSS) - 8-inch and 10-inch only

- 1) PVC truss pipe shall be made of PVC plastic having a cell classification of 12454 B or 12454 C or 12364 C or 13364 B, with a minimum tensile modulus of 500,000 psi as defined in ASTM D1784, *Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds*, and shall be appropriately marked. Minimum pipe stiffness 200 psi (ASTM D2412). PVC truss pipe shall be manufactured in

accordance with ASTM D2680 *Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping* installed in accordance with ASTM D2680, Appendix XI, and shall be imprinted with the ASTM designation. The manufacturer shall provide written certification that each bell joint has been tested for strength and imperviousness.

- 2) Pipe shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions and other injurious defects.
- 3) The other component for the pipe shall be Portland cement, Mearlcrete concrete or other inert filler material that essentially fill the truss annulus to form a composite pipe.
- 4) Bell and spigot push-on joints with elastomeric seal shall be used. No leakage when gasketed pipe joints are tested in accordance with ASTM D2680, Section 10.4.2 and ASTM D3212. Elastomeric seals (gaskets) shall meet the requirements of ASTM F477.
- 5) PVC cell classification shall be clearly marked on pipe at intervals not to exceed 5 feet.
- 6) PVC truss pipe shall be Armco Truss Pipe or approved equal.

**C. PVC PIPE FOR GRAVITY SEWER AND SEWER FORCE MAINS (4-inch through 18-inch)**

- 1) C900 PVC pressure pipe, 4-inch through 18-inch, with bell end with gasket and spigot end shall comply with AWWA C900, Pressure Class 150, DR 18. C-900 pipe shall be used with ductile iron fittings (restrained joint).
- 2) C900 PVC gravity pipe, 4-inch through 18-inch, with bell end with gasket and spigot end shall comply with AWWA C900, Pressure Class 150, DR 18. Pipe shall have a bell with an integral wall section with a factory installed, solid cross section elastomeric ring in accordance with ASTM F477, *Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe*.
- 3) The minimum pipe stiffness shall be 364 psi.
- 4) In accordance with ASTM D1599, *Standard Test Method for Resistance to Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings*, a minimum pipe burst of 755 psi shall be withstood without failure.
- 5) The pipe must be able to withstand an impact of 100 foot-pounds without visible evidence of shattering or splitting as specified in ASTM D2444, *Standard Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)*.

**D. PVC PIPE FOR SMALL SEWER FORCE MAINS ( 2-inch)**

2-inch PVC pressure pipe, bell end with gasket and spigot end shall comply with ASTM D2241, SDR 21, Class 200.

## E. PVC PIPE FOR SERVICE CONNECTIONS

Pipe for 4-inch and 6-inch service connections shall be schedule 40 solid wall PVC pipe with solvent cement weld joints. In-line wyes shall be used for all service connections to new lines. Connections to existing mains shall be made by the use of an approved saddle with stainless steel band. Use of saddles for service connections shall be approved by the Public Services Director on a case-by-case basis.

### 2.1.3 STEEL PIPE – for Sewer Mains, Aerial Creek Crossings, Encasement, Boring Applications, and Vent Pipes (Use of steel pipe - approved on a case-by-case basis):

#### 1) General:

Pipe shall be unwrapped high strength steel, spiral welded or smooth-wall seamless manufactured in accordance with ASTM A139 *Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)* and ASTM A283/A283M *Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates*, Grade “B” steel with a minimum yield strength of 35,000 psi or ASTM A252 *Standard Specification for Welded and Seamless Steel Pipe Piles*, Grade 2 steel with a minimum yield strength of 35,000 psi. All encasement pipes shall meet the applicable NCDOT, Municipal, or AREA specifications but shall be no less than 6 inches larger than the outside diameter of the carrier pipe bell. The steel pipe shall be capable of withstanding the design load. No interior lining and exterior coating shall be required except that all exposed metal is to be coated with epoxy or asphaltic material. The pipe shall have welded joints and be in at least 18-foot lengths.

- a. **Spiders for Encasement Pipes:** Spiders shall be placed at the bell of each carrier pipe within a steel encasement. Steel Spiders/Skids shall be as manufactured by ITT Grinnell, Charlotte, NC; Spider Manufacturing, Durham, NC; Advanced Products & Systems (APS) model SSI with EPDM skids, Lafayette, LA, or approved equal. See [standard detail C07.01](#). For bolted connections, bolts shall be either galvanized or stainless steel.
- b. **Steel Casing End Seals:** Casing end seals shall be 1/8” thick synthetic rubber seamless pull-on end seals with T-304 stainless steel banding with 100% non-magnetic worm gear mechanism. End seals shall permit pipe movement while maintaining a seal. Acceptable manufacturers are: Advance Products & Systems, Inc., Lafayette, LA, or equal.

### 2.1.4 TUNNEL LINERS

- A. Carrier pipe shall be mechanical joint or restrained joint ductile iron pipe pressure class 350 psi.
- B. Grout mix for filling voids in between carrier pipe and tunnel shall consist of the following materials properly mixed in proportions by weight.

- 1) 1.0 Part Cement
  - 2) 3.0 Parts Fine Sand, 100 Percent Shall Pass No. 16 Sieve
  - 3) 0.5 to 0.6 Part Water
- C. Tunnel lining construction shall comply with the “*Specification for Steel Tunnel Liner Plates*” in the AREA Manual for Railway Engineering. The design and shape of the liner plates shall be such that erection and assembly of the liner plate structure can be completely and readily effected from inside the tunnel. Plates shall be accurately curved to suit the tunnel cross section, and all dimensions shall be of the size and accuracy that plates of similar curvature shall be interchangeable. All plates shall be connected by bolts on both longitudinal and circumferential joints.
- D. The steel lining shall consist of plates 16, 18, or 24 inches wide. Each circumferential ring shall be composed of the number and length plates necessary to complete the required shape shown on the drawings. The nominal tunnel diameter shall be of sufficient size to install the carrier pipe.
- E. Plates shall be one-piece steel meeting the requirements of ASTM A 569, ASTM A 570, or ASTM A 611. Plates shall have an ultimate tensile strength of at least 42,000 psi and yield strength of 28,000 psi. Gage thickness shall be a minimum of 8 gage. The liner plate and bolts shall be galvanized in accordance with ASTM A153. In addition, the liner plates shall be asphalt coated to meet AREA 1-14-13. For two flange plates, the minimum thickness shall be 0.135 inches. Plates shall be manufactured by Armco Steel Corporation, Commercial Shearing, Incorporated, Republic Steel Corporation, or equal.
- F. Grout holes 1½ inches or 2 inches (or larger) in diameter shall be provided in each ring to permit grouting as the erection of the tunnel liner plates progresses. Grout hole screw plugs shall be provided in plates.
- G. Steel bolts shall meet requirements of ASTM A449 for plate thickness equal to or greater than 0.209 inch and ASTM A 307 for plate thickness less than 0.209 inch. The nut shall meet requirements of ASTM A 307, Grade A.

### **2.1.5 CARRIER PIPE FOR CASINGS AND TUNNELS**

Carrier pipe shall be mechanical joint ductile iron pipe of the class indicated on the drawings.

## **2.2 MISCELLANEOUS APPURTENANCES AND MATERIAL**

### **2.2.1 AIR AND VACUUM RELEASE VALVES:**

Combination air and vacuum release valves are to be used to bleed air during filling of force mains and to automatically vent air that collects in the force mains. The valve shall be a NPT threaded cast iron body with a stainless steel float assembly and stainless steel trim. The valve outlet is to be protected from debris entering the outlet of the valve. Plumbing valves shall be all brass. The air and vacuum release valves shall be furnished with a back flushing hose with quick disconnect and brass valve assembly. Valves shall be designed for a maximum cold water pressure of 300 psig. Combination air and vacuum release

valves shall be located as shown on the drawings or as otherwise directed by the Public Services Director. The valve shall be housed in a precast concrete eccentric manhole and shall be installed in accordance with [standard detail 534.03](#). Acceptable manufacturers are Crispin as manufactured by Multiplex Manufacturing Co., Berwick, PA and Empire Specialty Co., Inc., Mars, PA., Val-Matic, Elmhurst, IL.

### 2.2.2 BEDDING

Bedding material, shall be clean coarse aggregate No. 67 or smaller, and shall meet the requirements of Section 1005 of the NCDOT Standard Specifications for Roads and Structures.

- 1) **Minimum Bedding Allowed:** The bedding depth shall be 6 inches under the pipe (any depth over 6 inches is considered foundation stone). Pipe shall be bedded to the spring line of the pipe. See [standard detail 531.01](#).

### 2.2.3 SOLID BRICK (for modifications to manholes)

Sold brick shall be hard clay, grade SM, ASTM C 32, *Standard Specification for Sewer and Manhole Brick (Made From Clay or Shale)* and AASHTO M91.

### 2.2.4 CONCRETE

Concrete classes (NCDOT) to Design compressive Strength at 28 days (f'c):

Class	28-day Compressive Strength (f'c)
AA	4500 psi
A	3000 psi
B	2500 psi

Ready mixed concrete shall comply with ASTM C94, *Standard Specification for Ready-Mixed Concrete*. All exposed concrete shall be air entrained. Concrete strength shall be as specified on the standard details and drawings. Unless otherwise specified, all concrete shall be minimum class A.

### 2.2.5 CONCRETE BLOCK (for manholes)

Concrete block shall conform to the requirements of ASTM C139, *Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes*.

### 2.2.6 MORTAR FOR CONCRETE BLOCK & CLAY BRICK

Mortar shall be type M, ASTM C 270, *Standard Specification for Mortar for Unit Masonry* and ASTM C-144, *Standard Specification for Aggregate for Masonry Mortar*. Mortar shall be prepared from cement in perfect condition and shall be prepared in boxes for that purpose. No mortar that has stood beyond forty-five minutes shall be used. Proportion by volume for the different types of application shall be as follows:

Brick masonry = 1 part cement to 2 parts sand

Pointing = 1 part cement to 1 part sand

### 2.2.7 IRON CASTINGS: MANHOLE FRAMES AND COVERS

- A. **General:** Manhole frames and covers shall be manufactured from Class 35B gray iron, meeting the requirements of ASTM A48, *Standard Specification for Gray Iron Castings* as noted in section 3.1 of AASHTO M306. Standard manhole frames and covers shall be built to the dimensions and configurations shown on [standard detail C06.01](#) and shall be manufactured in the USA. Minimum inside diameter of the opening shall be 22 ¼ inches. Manholes castings are to be uncoated. The bearing surface of the frames and covers shall be machined and the cover shall seat firmly into the frame without rocking. Covers are to be embossed along the perimeter with the name “City of Jacksonville” and with the words “Sanitary Sewer.”

**Watertight Frames and Covers:** Watertight bolt-down frames and covers shall have 4 stainless steel bolts at 90 degrees and one polyvinyl gasket between cover and frame seat. Frame is to have four 1-inch diameter holes in flange at 90 degrees. Bolt down frames and covers are to be utilized whenever a manhole top is set lower than 1-foot above the 100-year base flood elevation.

- B. Approved castings are:

Manufacturer	East Jordan Iron Works	US Foundry	Capitol Foundry
Standard Model	-	USF-700 KL	-
Watertight Model (Bolt-Down)	Bolt-down V-2384	669-KL-BWT	MH-2001-WT
Cover Weight	135	125	120
Frame Weight	180	190	190

- C. **Bolting Down Frames to Manhole:** For watertight frames and covers only, precast concrete cones or flat tops shall be drilled and the frames bolted into cone sections with a minimum of 4 bolts. Bolts shall be stainless steel expansion bolts by manufactures such as Hilti, Rawl or Liebig. See [standard details C06.01 and C06.02](#).
- D. For flat top manholes, East Jordan Iron Works V-2484-3 bolt-down frames and covers shall be used and cast into the top (See [standard details C06.01, sheet 2 of 2](#)).
- E. Frame weights shall not vary more than 5%+/- from that shown on the standard details.

### 2.2.8 IRON CASTINGS: SEWER CLEANOUT BOX (in paved areas only)

**General:** Sewer cleanout frames and covers shall be manufactured from Class 35B gray iron, meeting the requirements of ASTM A48, *Standard Specification for Gray Iron Castings*. Standard sewer cleanout frame and covers shall be built to the dimensions and configurations shown on [standard detail 533.03](#). Approved casting is Capitol Foundry model VB-FCWA #3435.

## 2.2.9 PORTLAND CEMENT

Type I, CSA normal, ASTM C150 *Standard Specification for Portland Cement*.

## 2.2.10 PRECAST REINFORCED CONCRETE STRUCTURES

- A. Manholes of precast reinforced concrete shall be designed and manufactured in accordance with ASTM C478, *Standard Specification for Precast Reinforced Concrete Manhole Sections*, or latest revision. Manhole diameters shall be 4-ft. minimum. The wall shall be a minimum of 5 inches thick and have a minimum 6-inch thick base. Either an “O” ring or “ram neck” joint seal shall be used. The “O” ring joint shall conform to the requirements of ASTM C443, *Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets* or latest revision. The gasketed joint shall conform to ASTM C990, *Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants* (or AASHTO M-199) or latest revision. Preformed plastic rope gaskets shall be installed per the manufacturer’s recommendations. Rubber boot and stainless steel clamps, meeting the requirements of ASTM C923, *Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals*, shall be supplied with the manhole bases to tie the pipe to the base section of the manhole. Concrete used in the construction of the manholes shall have a minimum 28-day strength of 4000-psi air entrained (with 4 to 6 percent air) conforming to ASTM C33, *Standard Specification for Concrete Aggregates* and ASTM C94/C94M, *Standard Specification for Ready-Mixed Concrete*. Manhole units shall consist of standard modular precast riser sections, modular riser sections, grade ring, doghouse, and a monolithic base. Where conditions do not favorably accommodate the use of an eccentric cone, eccentric precast reinforced concrete flat tops are to be used. In areas of high H<sub>2</sub>S concentration, provide protection of manhole by providing linings or coatings on the interior of the manhole such as Polyethylene, PVC, Reinforced Thermosetting Resin (RTR), “Strong-Seal,” or coal tar epoxy.

Manholes shall be of the form and internal dimensions as shown on **standard details 532.01, 532.02, 532.03, 532.04 and 532.06**. All cone and grade rings sections shall have a minimum outside diameter of 36 inches.

**Extended Bases:** Precast manholes shall have extended bases with appropriate reinforcing. Manholes which do not have extended bases shall be placed on a formed 8-inch thick 3000 psi cast-in-place reinforced concrete base with #4 reinforcing bars spaced at a minimum of 12 inches on center both ways. The cast-in-place base shall be placed on a minimum of 8 inches of #67 stone

**Drop Manholes:** New drop manholes shall be a minimum of 5 feet in diameter and shall be constructed in accordance with **standard detail 532.06**.

Unless otherwise allowed by the Public Services Director, manholes will be precast reinforced concrete. Brick or block manholes are not permitted.

- B. **Flexible Pipe-to-Manhole Connector:** A flexible Pipe-to-Manhole connector shall be employed in the connection of the sanitary sewer to precast manholes. The connector shall be *KOR-N-SEAL*, as manufactured by NPC, Inc., Milford, New Hampshire, *PSX*, or equal.



The connector shall be the sole element relied on to assure a flexible watertight seal of the pipe to the manhole. No adhesives or lubricants shall be employed in the installation of the connector into the manhole. The rubber for the connector shall comply with ASTM C923 *Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals*, and consist of EPDM and elastomers designed to be resistant to ozone, weather elements, chemicals, including acids, alkalis, animal and vegetable fats, oils and petroleum products from spills.

All stainless steel elements of the connector shall be totally non-magnetic Series 304 Stainless, excluding the worm screw for tightening the steel band around the pipe, which shall be Series 305 Stainless. The worm screw for tightening the steel band shall be torqued by a breakaway torque wrench available from the precast manhole supplier, and set for 60-70 inch/lbs.

Flexible sleeve boots shall not be used with concrete pipe or on pipe larger than 18 inches in diameter. Boots shall have either a serrated flange of the boot cast into the manhole wall or an expanding stainless steel interlocking sleeve to compress the boot against a cast or core hole (PSX, KOR-N-SEAL or equal) may be used. Mechanical expansion of the interlocking ring shall be done in accordance with the manufacturer's recommendations.

The connector shall be of a size specifically designed for the pipe material and size being utilized on the project.

Refer to the sheet 2 of [standard detail 532.01](#) for boot to pipe connection detail.

### C. Joints at Existing Manholes (Clay Brick and Concrete Brick)

For 12 inch and smaller pipe, a virgin PVC waterstop concrete manhole adapter (Fernco Joint Sealer Company - CMA series or equal), sized for the respective pipe, shall be placed over the pipe, centered horizontally within the manhole wall and the space between the pipe and manhole completely filled with non-shrink grout (water plug or approved equal).

For 15-inch and larger sewers, the annular space shall be complete filled with nonshrink grout. Standard brick and mortar shall then be place completely around the pipe outside the manhole, supported on the extended base and entirely coated with at least 3/4 inch of mortar. Particular care shall be exercised in placing the bedding in order to achieve adequate and uniform support of the manhole and the pipe through the first joint outside the manhole.

## 2.2.11 SERVICES

PVC pipe for sewer services and fittings shall be minimum schedule 40 solvent cement. The service shall include the in-line wye, bends, long sweep elbow, and clean-out stack provided with a brass clean-out plug. See [standard detail 533.03](#).

**Service Saddles:** Sewer pipe saddles shall be Romac Industries, Inc. CB-4.80 (6-inch through 12-inch) or CB-4.80LS (14-inch through 24-inch), Geneco U 40 or E40 gasketed bell to accept schedule 40 or approved equal. See [standard details 533.01 and 533.02](#).

### 2.2.12 TRANSITION COUPLINGS

Where it is necessary to join different types of pipe (e.g. DIP to SDR 35 PVC, and approved by the Public Services Director, rigid couplings encased in stone shall be used. Fernco couplings are not permitted.

### 2.2.13 WETWELL/VALVE VAULT ACCESS HATCHES

- A. **Non-Traffic Areas:** The aluminum access frames and covers are manufactured with 1/4-inch thick, one-piece aluminum extruded frame, with a continuous concrete anchor as part of the one-piece extrusion. The door panels are 1/4-inch thick aluminum diamond plates, to withstand a live load of 300 lbs. per square foot, with a safety factor of times 1.5. The doors are provided with stainless steel hinges with tamper-proof fasteners. All hardware is stainless steel. The doors open to 90 degrees and lock automatically in that position with a stainless steel positive locking arm and a stainless steel release handle. Doors are provided with a stainless steel lifting handle, stainless steel locking bar, or stainless steel snap-lock with removable key handle. Two key handles shall be provided with each door. The doors will close flush with the top of the frame, resting on a 1/2-inch wide lip around the entire inside of the frame for added support. Provide padlock hasp for doors on wetwells and valve vaults.
- B. **Traffic Areas** (Low Density Traffic H-20 Loading – 12,000 lb. wheel load on an 8 1/2-inch x 20 1/2-inch wheel area): The aluminum access frames and covers are provided with a 1/4-inch thick structural grade aluminum channel frame with the flanges acting as a continuous concrete anchor. The inside of the frame has a continuous door support angle that must have a full bed of Class "A" concrete under both the frame and support angle. Door leaves shall be a minimum of 1/4-inch thick aluminum diamond plate with structural grade aluminum. Door reinforcing shall withstand an H-20 live load designation. The doors also have lifting aids of aluminum tubular construction with compression springs to assist in opening and closing of the doors. The doors are provided with heavy-duty stainless steel hinges with tamper-proof fasteners. All hardware is to be stainless steel. The doors open to 90 degrees and lock automatically in that position with a stainless steel positive locking arm and a stainless steel release handle. Doors are provided with a stainless steel lifting handle, stainless steel snap-lock with removable key handle. Two key handles shall be provided with each door. The door leaves extend to the outside perimeter of the frame for added support. Provide padlock hasp for doors on wetwells and valve vaults.
- C. **Guarantee and Manufacturer:** The aluminum access frames and covers shall carry a 10-year guarantee against defects in materials and workmanship. The frame and cover shall equal or exceed the units manufactured by Halliday Products, Inc. or The Bilco Company.

### 2.2.14 YARD HYDRANTS

Yard hydrants shall equal or exceed the Clayton Mark model 5451 Lever type Frostproof Yard Hydrant or the Woodford W-34 for 3/4-inch and the Woodford Y-1 for 1-inch.

## **PART 3 – EXECUTION**

### **INSTALLATION – PIPE AND FITTINGS**

#### **3.1 PIPE AND FITTINGS**

##### **3.1.1 CONSTRUCTION – ALL PIPE**

- A. **Trench width shall be per [standard detail 531.01](#).**
- B. **Protection of Existing Sewers:** Sewer lines under construction shall be plugged with a mechanical plug (wing nut, rim bolted type, or approved equal) at the first manhole upstream from the point of connection. Plug shall be placed in the outlet connection and secured with a steel cable. Plug shall remain in place until acceptance of lines by the City of Jacksonville. Water, stone, dirt, or any other debris shall not be allowed to enter the City sanitary sewer system during flushing operations or at any other time. Construction taking place in the vicinity of any existing City sewer lines or manholes shall not cause any inflow of surface water or debris to enter the City sanitary sewer system. Existing City manholes located in construction sites are to remain accessible at all times. The Owner and/or Contractor shall be responsible for any damages incurred to the City of Jacksonville sanitary sewer system and any fines imposed by the State of North Carolina Division of Water Quality due to sewer spills or overflows.
- C. **Pipe Laying Direction:** Place piping beginning at low point and progress uphill. Place on grade, with unbroken continuity in invert, horizontally and vertically, and on alignment as indicated on plans. Place bell ends of piping facing upstream. Install gaskets, seals, sleeve, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- D. **Directional changes in gravity lines:** Use manholes for changes in direction and grade of gravity lines.
- E. **Stringing out Pipe:** Only the amount of pipe that will be used in one day may be strung out. When pipe is strung out, it shall be set on high ground and in a position to prevent silt deposits, storm water, or other matter from entering the pipe prior to its placement in the trench.
- F. **Pipe Laying:** The foundation for gravity sewer pipe shall be a firm flat bottom trench with a minimum of 6 inches of stone compacted with bell holes. The pipe and fittings shall be laid in the trench so that its interior surface shall conform to the grade and alignment as shown on the plans. Pipe laying shall be done in such a way as to disturb as little as possible the pipe that has already been laid. The alignment and grade of the sewer main may be field adjusted whenever, in the opinion of the Public Services Director, it is necessary, so long as the adjustments are within that allowed by NCDENR based on regulations in effect at the time of the change and so long as the changes are consistent with the City's policy in effect at the time of the change. **Changes in either grade or alignment may only occur at manholes.**

Before laying, the bell and spigot will be wiped free from any dirt or other foreign matter. All surfaces of the portion of the pipe to be joined, and the factory-made jointing material, shall be clean and dry. Lubricants, primer, adhesives, etc., shall be used as recommended by the pipe or joint manufacturer's specifications. The jointing material or factory-fabricated joints shall then be placed, fitted, and adjusted in such skillful manner as to obtain the degrees of water tightness required.

Trenches shall be kept as dry as possible during bedding, laying and jointing and for as long a period as required until the trench is backfilled. As soon as possible after the joint is made, sufficient bedding material shall be placed along each side of the pipe to offset conditions that might tend to move the pipe off line or grade. The greatest care shall be used to secure water tightness and to prevent damage to or disturbing of the joints during the backfilling process, or at any other time.

All special fittings, such as wyes and other connections, shall be installed at the points indicated on the plans, in accordance with the standard detail drawings. Use appropriate adaptors to tie connection pipe to wyes or saddles. Plug end of connection with appropriate plug.

After the trench foundation has been properly graded to receive the pipe, the pipe shall be carefully lowered into the trench with approved methods. Under no circumstances shall the pipe or accessories be dropped or dumped into the trench. All damaged pipe shall be replaced.

The Contractor shall correct any defects due to settlement.

- G. **Temporary Suspension of Work:** When the trench is left for the night or if pipe laying is suspended, the upper end of the pipe shall be plugged to keep out dirt, water, animals and other foreign matter or substances. This plug shall be kept in the end of the pipeline at all times when laying is not in actual progress.
- H. **Cutting or Fitting Pipe:** Whenever a pipe requires cutting, to fit in the line or to bring it to the required location, the work shall be done in a satisfactory manner with an approved cutting tool or tools which will leave a smooth end at right angles to the axis of the pipe and not otherwise damage the pipe or liner. When the cut end is to be assembled in a *Fastite* bell, an adequately smooth (without sharp edges) bevel should be ground or filed on the cut edge to prevent damage to or dislodgement of the gasket during assembly. The method of cutting pipe shall be in accordance with manufacturer's recommendations. No welding, flame cutting or flame tapping will be allowed. Such cuts shall be made by the Contractor.
- I. **Surface Water Crossings:** Surface water crossings with pipe under streambed shall have the pipe encased in either a concrete or a steel casing. Concrete or steel casing shall extend from top of stream bank to top of stream bank.
- J. **Ravine/Channel Crossings:** Ravine and channel crossings are to be perpendicular to the ravine or channel crossed. Pipe support piers or steel girders, as applicable, shall adequately support surface water crossings with pipe above the water. Kraft paper shall be placed between pipe and all points of contact with concrete and stainless steel straps. Disturbed banks are to be stabilized with rip rap placed over a non-woven fabric.

- K. **Crossing Conflicts:** All drains, gutters, culverts, and sewers for surface drainage are to be kept open or if unavoidably closed, other provisions are to be made for this drainage.

### 3.1.2 DUCTILE IRON PIPE

#### A. Construction

Gravity DIP shall conform to the same foundation and backfill requirements as those prescribed for water mains. Minimum laying length shall be 18 feet except for tie in at a structure. However, bury limitations shall govern as follows:

<b>Bury Limitations on DIP</b>		
<b>Pipe</b>	<b>Maximum Bury to Invert of Pipe*</b>	
	<b>Type 4 Laying Condition - Equivalent to Class C Bedding (See detail 511.01)</b>	<b>Type 5 Laying Condition - Equivalent to Class B Bedding (See detail 511.01)</b>
8-inch DIP, Class 50	34 feet	50 feet
10-inch DIP, Class 50	28 feet	45 feet
12-inch DIP, Class 50	28 feet	44 feet
14-inch DIP, Class 50	28 feet	44 feet
16-inch DIP, Class 50	28 feet	44 feet

\*Laying condition **type 4** is a 4-inch bed of stone with pipe embedded to 1/8 pipe diameter (equivalent to Class C bedding). **Type 5** laying condition is also a 4-inch bed of stone with pipe embedded to the spring line of the pipe (equivalent to a Class B).

#### B. Mechanical Joint Bolt Torque

Where mechanical joint fittings are required, unless otherwise advised by the manufacturer, the minimum bolt torque shall comply with Table 2 of AWWA C600 for mechanical joints, as follows:

<b>Bolt Size (Inches)</b>	<b>Torque (Ft-Lbs)</b>
5/8	45-60
3/4	75-90
1	100-120
1 1/4	120-150

- C. See also [Section 02275 – Trenching, Backfilling, and Compaction of Utilities](#).
- D. Minimum cover shall not be less than 3 feet.

### 3.1.3 PVC PIPE

- A. Installation shall comply with *Underground Installation of Flexible Thermoplastic Sewer Pipe*, ASTM D2321, *Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications*. Installation

of PVC Truss Pipe shall comply with ASTM D2680 *Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping*, Appendix XI, or latest revision.

**B. Bury Limitations:**

<b>Table 253.2</b>		
<b>Bury Limitations on all PVC</b>		
<b>Pipe</b>	<b>Bedding Class</b>	<b>Maximum Bury to top of pipe</b>
SDR 35 PVC	Class B-1 w/ VDOT # 67 stone	15'
PVC Truss	Class B-1 w/ VDOT # 67 stone	Per Uni-Bell Handbook

Minimum cover shall not be less than 3 feet.

**3.1.4 REINFORCED CONCRETE PIPE**

Pipe support for pipe shall provide uniform bearing for the pipe barrel along its entire length.

Minimum pipe bedding class for pipe shall be as stated in Specification Section 02275 – *Trenching, Backfilling, and Compaction of Utilities*.

- A. Pipe with varying wall class must not be mixed between manholes.
- B. **Bury Limitations:** **Tables 253.3 and 253.3a** shall govern as the maximum allowable bury for concrete sewer pipe:

<b>Table 253.3</b>				
<b>Bury Limitations on RCP</b>				
<b>(15 through 60 inches)</b>				
<b>Pipe Class</b>	<b>Maximum Depth of Bury<sup>a</sup></b>			<b>Max Trench Width (feet)</b>
	<b>Class III (feet)</b>	<b>Class IV (feet)</b>	<b>Class V (feet)</b>	
15-inch	9.5	14.5	23	4.0
18-inch	9.5	15.0	32.5	4.0
24-inch	11.5	23.0	50	4.0
30-inch	11.0	19.5	44.5	5.0
36-inch	10.5	18.0	35	6.0
42-inch	11.0	19.0	36.5	6.5
48-inch	11.5	19.5	37.5	7.0
54-inch	12.0	20.0	38.5	7.5
60-inch	12.0	20.5	38.5	8.0

<sup>a</sup> Based on saturated clay weighing 120 pcf, trench width as specified, class C stone bedding, 1350 plf per ft of internal diameter for class III and 2000 plf per ft of internal diameter for class IV, 3000 plf per ft of internal diameter for class V,  $D_{-0.01}$  crack

**3.1.5 STEEL PIPE**

All operations of the Contractor shall be subordinate to the free and unobstructed use of the right of way of the passage of traffic without delay or danger to life, equipment, or property.

**A. Aerial Pipe:**

Where required, steel aerial pipe shall meet the length, thickness, and diameter shown on the plans.

Pipe is to be joined by welding. The pipe shall be beveled and prepared for field welding at the circumferential joints. Joining of steel pipe shall meet the requirements of AWWA C206, *Standards for Field Welding Steel Water Pipe Joints*.

Kraft paper shall be placed between pipe and all points of contact with concrete and stainless steel straps. Upon completion of installation, paint the exterior of the pipe with coal tar enamel. See [section 2.1.4](#) of this specification.

**B. Encasement Pipe:**

**General:** Where required, steel encasement pipe shall meet the length as shown on the plans and the thickness and diameter as shown on **Standard Detail C07.01**. Boring across roads and railways shall be performed by dry boring and jacking a steel encasement pipe under the pavement or rail. The encasement shall be located in an area that is relatively free from material such as rock and stone that may hamper the boring operation. If requested by the Public Services Director, the Contractor shall submit a complete plan and schedule for pipe installation prior to the commencement of such work. The submission shall include complete details of the sheeting, shoring and bracing for the protection of the roadbed and the materials and equipment pertinent to the boring operation. The Contractor shall not proceed with the pipe installation until he has received approval of the plan and schedule from the Public Services Director.

Construction shall be executed in such a manner as to prevent settlement of the ground surface above the pipeline. The installation of the pipeline shall follow the heading or tunneling excavation as closely as possible.

All operations of the Contractor shall be subordinate to the free and unobstructed use of the right of way of the passage of traffic without delay or danger to life, equipment, or property. Installation shall be in accordance with of the *NCDOT Standard Specifications for Roads and Bridges, latest revision* or AREA, as applicable.

The pipe shall be plain end, mill beveled for field butt welding, unwrapped steel pipe and prepared for field welding at the circumferential joints. Joining of steel casing pipe shall meet the requirements of AWWA C206, *AWWA Standard for Field Welding of Steel Water Pipe*. Field welded joints shall be performed by AWS D.1.1 certified welders and shall be full penetration single vee groove, butt type welds around the entire circumference of the pipe. The pipe shall be in at least 18-foot lengths. Casing shall be installed by either dry boring and jacking or open cut, as indicated on the drawings.

Encasement ends shall be enclosed as shown on **Standard Detail C07.01**. The steel encasement pipe shall be of leak proof construction. All exposed metal is to be coated with epoxy or asphaltic material.

All carrier piping shall be slip joint ductile iron pipe supported by spiders.

**Manufactured Spiders:** The spiders necessary to support the carrier pipe inside of the steel encasement pipe shall conform to both the shape and dimensions of **standard detail C07.01** and shall be in accordance with paragraph **2.1.3 B, Spiders for Encasement Pipes**. Unless otherwise shown on the drawings, one spider shall be placed at each bell as well as at each end of the encasement pipe (see **standard detail C07.01** for location of spiders).

### 3.2 TUNNELING METHOD

#### A. GENERAL:

All liner plates and ribs used in the tunnel shall be of one type.

All operations of the Contractor shall be subordinate to the free and unobstructed use of the rights of way for passage of traffic without delay or danger to life, equipment, or property. The Contractor shall provide all necessary bracing, bulkheads, and shields to ensure safety to traffic at all times. The Contractor shall provide all traffic control devices as necessary and as shown on the approved traffic control plan.

#### B. TUNNELING (BORING METHOD):

- 1) Commence boring operation from a pit, with the bottom excavated to grade, and sheeted or shored if necessary. A steel pipe shall be jacked in place as a casing pipe. Boring through rock shall be oversized to allow installation of carrier pipe but no casing pipe shall be required unless liner plate is necessary for safety reasons.

#### C. TUNNELING (HAND MINING)

- 1) Commence tunneling operation from a pit, with the bottom excavated to grade, and sheeted or shored if necessary.
- 2) Install the steel liner plates immediately after the excavated material has been removed, and remove the material not more than 24 inches ahead of the installed liner plates.
- 3) Grout all voids between the soil and tunnel liner plates. The maximum grouting pressure shall be 30 PSI. Start grouting at the bottom of the tunnel liner plates and proceed upward progressively and simultaneously on both sides of the tunnel. Install liner plates no more than 6 feet ahead of grout section. Prohibit traffic over ungrouted sections of tunnel unless this section is in solid rock. Thoroughly dry-mix grout ingredients before adding water. After adding water, mix the batch for 3 minutes. Batches shall be of size to allow continuous placement of freshly mixed grout. Grout not used within 30 minutes after mixing shall be discarded. Placing shall be quick and continuous. Placement shall be under pressure with a grout pump. The period between installation of the tunnel liner plate and the placing of grout



shall not exceed 7 hours, without the approval of the Public Services Director. Upon completion of grouting, fill grout plugs with provided grout hole plugs.

- 4) Smoothly pave the bottom of the tunnel with concrete: After installation of the tunnel liner plates, the Contractor shall pour concrete pavement on the bottom quadrant (invert) of the tunnel, the surface of the pavement being parallel to the inner plate, with screed rails embedded in it, on line and grade for the installation of pipe in the tunnel.
- 5) The periphery of the tunnel shall be trimmed smooth to fit the outside of the steel liner plate as nearly as is practical, so that the void outside the plates is a minimum.
- 6) After installation of the tunnel liner, pull the carrier pipe in place a joint at a time. Each joint of the carrier pipe shall be supported by spiders strapped to the carrier pipe.
- 7) Close up tunnel liner ends to protect against entrance or foreign matter. The open ends of the casing pipe or tunnel shall be closed off by an 8-inch grout or masonry block wall prior to backfilling. A steel drain line to a 1 cubic yard French drain or daylight shall be provided.
- 8) If installation is under railway tracks, all permits shall be obtained and Railway Company shall be notified prior to such installation. The same shall apply to contacting the applicable municipality or NCDOT if installation is under a roadway.

### 3.3 MANHOLE CONSTRUCTION

- A. **Precast Manholes:** Manholes shall be constructed in accordance with **standard details 532.01, 532.02 and 532.03** and shall be of the eccentric cone type. The Contractor shall exercise care in the ordering of manholes so that the use of grade rings for leveling and adjustments can be minimized.
  - 1) **Standard Manholes:** Standard manholes shall be those greater than 5 feet in depth measured from the base of the cover frame to the top of the concrete footing.
  - 2) **Shallow manholes:** shallow manholes shall be 5 feet or less in depth measured from the base of the cover frame to the top of the concrete footing and shall be of the flat top construction (eccentric opening) and shall be capable of supporting HS-20 traffic loading.

Non-shrink grout shall be placed around pipe where pipe meets precast invert in manhole to provide for a smooth transition for sewage flow.

Manholes shall be installed plumb.

In the case of either integrally cast or expanding sleeve boots, the pipe exterior and boot interior shall be thoroughly lubricated prior to pipe insertion. The exterior of the boot under the bands shall be thoroughly lubricated with pipe soap. Puckering of boots shall not be allowed.

Flexible sleeve boots shall not be used with concrete pipe or on pipe larger than 18 inches in diameter.

**B. Drop Manholes – 5' diameter:**

Invert elevations for drop connections in manhole shall be as shown on the plans.

Interior drop connections shall consist of schedule PVC pipe and fittings. Interior drop manholes shall be installed per [standard detail 532.06](#). Manholes shall conform to PART 2 - PRODUCTS.

Exterior drops are not permitted.

**C. Flexible Pipe-to-Manhole Connector:** When it is necessary to field core a manhole and install a flexible Pipe-to-Manhole connector in precast concrete sanitary sewer manholes, the connector shall be installed per the manufacturer's recommendations.

**D. Precast Concrete Doghouse Manholes:** When it is necessary to install a manhole over an existing sewer main, a precast concrete doghouse manhole shall be installed over the main. A minimum of an 8-inch thick reinforced concrete base shall be poured over a #67 stone base and the doghouse manhole risers set over the existing sewer. The joint between the precast manhole and the base shall be sealed both inside and out with grout. The annular space of the precast manhole, around the main, shall be filled with grout and a shelf formed to the springline of the existing main. The crown/top of the main shall be removed once the shelf has been formed and has set sufficiently and all upstream lines tested and approved by the City. See [standard detail 532.04](#).

**E. Manhole Inverts:**

Manhole inverts may be formed from brick and/or 3000 psi concrete and shall be constructed as shown on [standard details 532.01, 532.02 and 532.03](#). The depth of the channel shall be 3/4 of the pipe ID with vertical wall from the springline of the pipe up. The bench shall then be sloped to the manhole walls at 1/2 inch per foot. The channel shall be "U" shaped. Curved channels due to changes in pipe alignment shall be constructed in such a way as to provide gentle curves as shown on [standard detail 532.05](#).

The internal cavity between the boot and the manhole wall will be completely filled with non-shrink grout and filleted at the manhole wall. The face where the pipe enters or leaves the manhole shall be struck smooth and the channel shall form a smooth flow line from the pipe entry to pipe exit.

**F. Installation of Manhole frames and Covers** frames and covers shall be installed to manhole in accordance with [standard detail C06.03](#). Frame and covers shall be installed to finished elevation. Adjustments shall be made as necessary to achieve finished elevation. On all manholes, a bituminous base sealant is to be placed between the frame and concrete casting or grade adjustment ring. Watertight frames & covers are to be bolted to the manhole cone.

- G. **Grade Rings/Adjustments:** In street rehabilitation work, the combination of concrete grade rings and/or brick shall not exceed two rings before removal of the cone is necessary to effect adjustment. When making adjustments to manhole frames, place a ½-inch parge coat on interior of manhole from half depth of the iron casting to a depth of 2 inches below the top of the precast cone. See [standard detail C06.03](#).

H. **Replacement/Rehabilitation of Existing Manholes:**

**Replacement of manholes:** The City of Jacksonville reserves the right to require replacement of the existing manhole with a new manhole. When a new manhole is necessary, the old manhole must be completely removed and a new precast manhole constructed in its place.

Any tie-in's performed on sanitary sewer manholes must be machine-core drilled with a neoprene flexible boot and adjustable band, except brick manholes. The core shall be the size specified with a smooth finish. If connecting to existing brick manhole, seal penetration and add "Strong-Seal" on perimeter of manhole. Coordinate with the Public Services Director.

I. **Connection to Existing Manholes**

Connection to existing sewer shall be made at manholes. For connection of encased pipe, the casing shall be flush with the inside wall and shall be encased with at least 8 inches of stone on the outside of the manhole. Existing manholes to which connections are made shall be rehabilitated, as directed by the Public Services Director, to the degree necessary to correct any apparent signs of infiltration or inflow (see [paragraph 3.3.1, Replacement/Rehabilitation of Existing Manholes](#)).

Upon completion of the connection to existing sewers, existing lines no longer needed shall be sealed or plugged and the invert rebuilt to reflect the new flow patterns.

- J. **Testing of New Manholes:** Manholes are to be subjected to a vacuum test. Manholes shall be vacuum tested after installation in accordance with the [manhole vacuum testing procedures](#) outlined in paragraph [3.10 C, subparagraph 9, Manhole Vacuum Test](#). Service connections tied into manholes shall be tested in conjunction with the manhole.

### 3.4 ABANDONING SEWER LINES & MANHOLES

- A. **Sewer lines:** When an existing sewer line is designated to be abandoned in place, the low end of the line is to be plugged and lean concrete grout (flowable fill) pumped into the line until it is completely filled.
- B. **Manholes:** When an existing manhole, either partially or wholly, is designated to be abandoned and the sewer lines, either entering or exiting the manhole, have been abandoned according to the preceding paragraph, the upper portion of the manhole is to be removed to within 36 inches of the proposed finished grade, or as determined by the Public Services Director. Below pavement, backfill with flowable fill concrete. Outside of pavement, backfill with select fill compacted in place.

### 3.5 CONNECTION TO EXISTING SEWERS

Where required or shown on the plans, connection to existing sewer shall be made in a manner that will maintain existing sewage flow on a continuous basis. Where flow cannot be maintained, interruption of service shall be minimized such that no by-pass of sanitary sewage to any natural waterway or storm drain occurs nor shall such interruption create a public health hazard by sewage back up or overflows. Sewage by-pass pumping shall comply with the requirements of [paragraph 3.6, Bypass Pumping](#), below.

Connection of new sewer mains to existing sewer mains shall be made at manholes. [See paragraph 3.3 J, Connection to Existing Manholes](#).

### 3.6 BYPASS PUMPING

- A. The bypass system shall be of sufficient capacity to handle peak flow of the pipe. Provide the necessary labor and supervision to set up and operate the pumping and bypassing system. Contractor shall comply with local sound ordinance. If pumping is required between the hours of 8:00 PM and 6:00 AM, engines shall be equipped as specified in paragraph E, below, in order to keep noise to a minimum. The equipment shall be manned continuously. During bypass pumping operations, the Contractor shall provide the necessary labor to continually monitor the operation and ensure uninterrupted and sufficient pumping at all times.
- B. Contractor shall provide all materials and labor as necessary to maintain flows in the existing sewer interceptor and all collector and lateral lines at all times and under all weather conditions. Interruption of flows will not be permitted. Overflows from bypass operations will not be permitted to enter into any streams or bodies of water. **The Contractor will be solely responsible for any legal actions taken by the state regulatory agencies if such overflows occur during construction.**
- C. Bypass pumping equipment shall include pumps, conduits, engines, and related equipment necessary to divert the flow or sewage around the section in which work is to be performed. In addition, the contractor shall maintain at the same location and in operable condition, duplicate equipment to be used in case there is equipment failure. In this event, the Contractor shall promptly repair or replace the failed equipment to the satisfaction of the Public Services Director.
- D. The new sewer line may be used by the Contractor to carry the sanitary flows after the new pipe has passed inspection and testing. The Public Services Director shall approve any “temporary” connections to the new sewer line.
- E. Engine driven equipment for bypass pumping equipment shall have “critical grade mufflers.” If equipment is operated between the hours of 8:00 PM and 6:00 AM, this equipment shall also be provided with sound attenuation enclosure consisting of a three sided enclosure with roof constructed of 2 x 4 frame with ½-inch plywood sheathing and 2-inch Styrofoam panels attached to the inside of the entire enclosure. The enclosure shall be portable in order to allow the enclosure to be moved when bypass pumping equipment is moved.

- F. **Plan Requirements:** The plan should include, but is not necessarily limited to, the following details:
- 1) Staging areas for the pumps.
  - 2) Sewer plug method and type of plugs or gates to be used.
  - 3) Number, size, material, locations, and method of installation of suction piping.
  - 4) Bypass pump sizes, capacity, number of each size to be on site, and power requirements.
  - 5) Calculations of static lift, friction loss, and flow velocity.
  - 6) Stand-by power.
  - 7) Downstream discharge plan.
  - 8) Method of noise control for each pump.
  - 9) Temporary pipe supports and anchoring required.
  - 10) Heavy equipment needed for installation of pumps and piping.
  - 11) Stand-by/back-up pumpset for the bypass application.
  - 12) Detail plan for 24-hour monitoring.
  - 13) Fueling of pumpsets on demand.
- G. **Sewer Overflows – Penalties:** The Contractor shall make every effort to avoid causing sewer overflows. All sewer overflows shall result in the following disciplinary actions:

Incident	Penalty
First Violation	\$2,000
Second Violation	\$5,000
Third Violation	\$10,000
Fourth Violation	Termination of Contract

For all sewer overflows, the Contractor shall be responsible, and shall reimburse the City, for any damages, operational costs, fines, or other effects.

- 1) **Unplanned Service Outages:** The Contractor shall make every effort to avoid causing unplanned service outages. All Contractor caused service outages shall be investigated by the Public Services Director. If the investigation determines that the Contractor could have avoided the service outage, then the outage shall result in disciplinary actions as shown above.

### 3.7 SERVICE CONNECTIONS

- A. **New Services:** Unless otherwise permitted by the Public Services Director, all 4 and 6 inch sewer services shall be class schedule 40 PVC solvent cement joint pipe and fittings. The laying and joining of service connection pipe shall conform to the same requirements as stipulated for main installation. See [standard detail 533.03](#).
- B. **Location of Service:** Unless directed otherwise by the Public Services Director, service connections shall extend to a point within the right-of-way or easement. In streets with curb and gutter, the preferred location is 2 feet behind the curb. Services shall be extended behind the ditch line in ribbon paved or unpaved streets. Service connections shall not be located in driveways unless the clean-out is enclosed in a cast iron box (see [standard detail 533.03](#)). The cleanout is to be set between 2 inches from the top of the box.

- C. **Bored Services:** Where laterals are bored, the face of the bore cut shall be a minimum distance of five feet outside of the edge of the pavement on either side unless the Public Services Director gives approval to the contrary.
- D. **Service Connections:** 4-inch and 6-inch sewer laterals shall be connected to new mains by means of an in-line monolithic wye or, if on an existing line and approved by the Public Services Director on a case-by-case basis, with a tap and saddle installed over a hole cut in the top quadrant of the main at an angle of 45 degrees (see [standard details 533.01 and 533.02](#)), with respect to flow direction. The hole shall be cut with a mechanical circular type saw cutter designed for the particular use and rendering a smooth uniform cut with no damage to the main and is one that retrieves the plug. Saddle service “coupon” shall be given to the City’s Inspector for review and approval. Service saddles shall be fully encased with #67 stone and special attention shall be given to embedment of the service pipe from the saddle through the lateral trench.

Service saddles shall be constructed using Romac Industries, Inc. or Geneco sewer service saddles (see [paragraph 2.2.12](#) ) placed in the top quadrant of the pipe main. Backfill under and around saddle with #67 stone. See [standard details 533.01 and 533.02](#). The cost for such cut-ins shall be included in the cost of the lateral.

A cleanout shall be installed at the terminal end of the service connection as shown on [standard detail 533.03](#). The cleanout shall be installed to surface grade and both the cleanout and the service material shall be capped or plugged to exclude entry of water or earth. Bronze plugs or caps shall be required for all above ground piping. A long sweep 90-degree elbow is to be provided at the cleanout set at the property line. All laterals are to be left exposed until the Inspectors can verify the installation of each service. A sanitary tee shall be placed on the cleanout riser by others when service connection is extended by others.

Service connections shall not be located in driveways unless the cleanout is enclosed in a cast iron box (see [standard detail 533.03](#)) with the word “sewer” on the lid. The cleanout is to be set 2 inches from the top of the box. Cleanouts shall not be relocated outside of a driveway once installed.

- E. **Service Connection to Manholes:** Unless approved otherwise by the Public Services Director, services connections to manholes shall be made at dead end lines only. Service connections must enter the bottom of the manhole when ever possible. If not practical, services may be located above the bottom but may not enter the cone or it’s joint. Service connections in manholes shall also be core bored and booted and shall be separated by a minimum of 2 times the pipe OD (either vertically or horizontally) from other services or mains. When connections are made at deep manholes, a standard drop connection shall be provided. The invert of manhole service connections shall be located such that a pipe half-diameter channel formed through the bench shall be required.
- F. **Deep Sewer Service Connections:** For service connection to deep sewer with confined trenches, the service shall extend from the connection upward at a 45 degree angle to a point near the trench wall, shall bend 45 degrees up to a riser which shall parallel the vertical trench wall to a point no less than 30 inches below finished grade and shall turn using 2 consecutive 45 degree bends to

provide a lateral service to match the grade and slope of the building sewer. For all other service connections, the service shall extend from the connection upward at 45 degrees to a point where it shall bend 45 degrees to match the grade and slope of the building sewer. Vertical stacks or standpipe services are not allowed.

- G. **Cleanout Spacing:** Unless otherwise shown on the plans, cleanout spacing on 4 or 6 inch on long service lines shall not exceed 75 feet on center, or a length as specified by the latest version of the International Uniform Building Code (whichever is shortest) and shall be provided at all horizontal or vertical changes in direction.
- H. **Grade:** Minimum grade for services shall be ¼-inch per foot for 4-inch services. Minimum grade for 6-inch services are to be laid preferably at a 1/8-inch per foot but no less than 0.6%.
- I. During service installation or line rehabilitation on existing mains, the Contractor shall be responsible for the maintenance of all sewer house connections and the proper treatment and/or by-pass of effluent sewer around work areas.
- J. Any services or utilities damaged by the Contractor shall be properly repaired.
- K. Sewer lines shall be **air tested** (low-pressure air test) after the complete installation of all sewer services. Laterals shall be tested with the main line.

### 3.8 CONCRETE ENCASEMENTS

All concrete encasements shown on the plans shall be constructed per the details on the plans.

The earth may be used for side and bottom forms provided such sides can be excavated uniformly smooth and to the size and shape specified. Care must be taken during the pouring operation to ensure that the pipe does not float or move from the buoyant affects of the concrete. Misalignments of the crossings shall be cause for total removal and replacement of the encasement by the Contractor.

Once the concrete is set, measures shall be taken to cure the concrete by covering it with plastic. Water shall not be allowed to run over the concrete for at least 48 hours.

Forms will be required if the subgrade and sides are not firm, or will not hold shape.

Exercise care to avoid spilling concrete into creek.

### 3.9 TESTING

- A. **Preparation for Testing:** Prior to testing of sanitary sewer lines, the lines shall be thoroughly cleaned, using appropriate tools, the line visually inspected for line and grade, apparent obstructions, leaks, deformities or other defects. Any deficiencies noted shall be repaired or replaced at no expense to the City.
- B. The following tests shall apply for the respective pipe materials as required by the following specifications.

<b>Material</b>	<b>Air Test</b>	<b>Vacuum Test</b>	<b>Infiltration</b>	<b>Mandrel Test</b>	<b>TV Inspection</b>
All PVC pipe	X		X	X	a
DIP	X		X		a
RCP	X		X		a
PVC Force Main	X				
Manholes		X			

<sup>a</sup>On a case-by-case basis at the discretion of the Public Services Director

### C. Test and Inspection

Unless otherwise specified (see [paragraph 1.10.1 B2C](#)), all sanitary sewer pipe shall be tested after backfilling has been completed and before final acceptance by the City. Upon completion of entire pipe installation, the Public Services Director shall inspect the work in part or as a whole and make such tests as necessary to verify that the work has been carried out in accordance with the plans and specifications.

All manholes shall be of the specified size, shape, and material, and shall have their tops set to the grade as furnished by the design engineer.

The Contractor shall provide all equipment, material, water, labor, etc. needed to perform any and all tests in accordance with the procedures listed herein. All equipment, materials, etc. used shall be checked and approved by the Public Services Director or his representative prior to its use. It shall be the responsibility of the Contractor to insure pipe to be tested is clean before any tests are made. Frame and covers shall be tested with manhole tests.

Test for leakage of gravity sewers shall be done as directed by the City or as shown on the plans.

- 1) **General Requirements:** Testing and inspection shall promptly follow installation of wastewater pipe including services. Testing shall no be more than 1000 feet behind sewer pipe laying operation.

Furnish all pumps, gauges, instruments, test equipment and personnel required for inspections and testing operations.

**All final testing** and inspections shall be performed in the presence of a City representative.

Flush all sand, dirt and debris from lines prior to inspection. Provide lights and mirrors and inspect lines in presence of the City's representative.

Clean and pretest prior to notifying the Public Services Director and arranging for inspections and tests.



Inspect the system for conformance with line and grade shown on the plans and provide record drawing measurements on Record Drawings.

- 2) **Flushing:** If during any of the inspections sewer lines and manholes are found to contain mud and other debris, the Contractor shall be required to flush or clean this material from the system by whatever means necessary. Mud and other debris shall not be allowed to enter the existing sanitary sewer system. The Contractor shall be responsible for the cost of water used to flush the system.
- 3) **Backfill Testing:** Testing of backfill shall be performed in accordance with the requirements of [Section 02275 – Trenching, Backfilling, and Compaction of Utilities](#).

**Frequency:** Test frequency shall be one test per road crossing and/or per 1000 feet of line except where additional tests are required to determine the extent of unacceptable compaction. These additional tests are the responsibility of the Contractor.

- 4) **Visual Inspection:** Visual inspections may be required by the City on a case-by-case basis. When required, sewer lines shall be visually inspected from every manhole by use of mirrors and television cameras. The lines shall exhibit a fully circular pattern when viewed from one manhole to the next. Lines, which do not exhibit a true line and grade, have obstruction or structural defects, shall be corrected to meet these specifications and the sewer barrel left clean for its entire length.
- 5) **Infiltration Test:** Infiltration shall be measured by the Contractor in the presence of the Public Services Director or his representative and shall not exceed 50 gallons per inch diameter per mile per day for pipe diameter larger than 18 inches. For exposed or aerial piping and pipe diameters 18 inches and smaller, there shall be no visible signs of infiltration. Infiltration and exfiltration testing of the lines in lieu of air testing **shall not be accepted** without written approval of the Public Services Director. For these methods to be considered, the Contractor shall state, **in writing**, the reasons for this consideration. *Also, see [paragraph 3.10 B. 8\) Procedures for Air Testing Concrete](#).*
- 6) **Pipe Deflection Test:** Deflection testing shall be performed for all semi-rigid and flexible pipe 8 inches or larger. Deflection shall not exceed 5% (95% of the ASTM base inside diameter). Testing shall be conducted in the presence of the Public Services Director or his representative and shall utilize a mandrel go/no-go gauge complete with proving ring. Mandrel shall be approved by the Public Services Director for this test. Arm mandrels shall have a minimum of nine arms.

The mandrel device shall be cylindrical in shape and constructed with a minimum of nine evenly spaced arms or prongs. Mandrels with less than nine arms will not be approved for use. The "D" mandrel dimension shall carry a tolerance of plus or minus 0.01 inch. Allowance for piping wall thickness tolerances or ovality (from heat, shipping, poor production, etc.) shall not be deducted from the "D" dimension but shall be counted in as a part of the 5% or lesser deflection allowance.

The mandrel shall be hand pulled through by the Contractor in the presence of the Public Services Director or his representative. Any sections of the sewer not passing the mandrel shall be uncovered and the Contractor shall re-round or replace the sewer to the satisfaction of the Public Services Director. The repaired section shall be retested.

The inspection shall be conducted no earlier than 30 days after reaching final trench backfill grade.

Contact length shall be measured between points of contact of the mandrel arm.

The Inspector shall be responsible for approving the mandrel. Proving rings may be used to assist in this. The Contractor shall furnish drawings of the mandrel with complete dimensions to the Public Services Director for each diameter and specification of pipe.

- 7) **Primary test method – Low Pressure Air Test:** Sewer lines shall be **air tested** after the complete installation of all sewer services. Sewer laterals are to be tested along with main. The Contractor shall be responsible for furnishing all equipment and labor for the low-pressure air test at no additional cost to the City of Jacksonville.

The portion of the line being tested shall be accepted if the portion under the test meets or exceeds the requirements of ASTM F1417 *Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air*. This requirement shall be accomplished by performing the test as follows: the time required in minutes for the pressure to decrease from 3.5 to 2.5 psig greater than the average back pressure of any groundwater that may be over the pipe shall not be less than the time shown for the given diameters in [Table I Line Pressure Air Test Table](#). If the system does not meet the foregoing requirements, the Contractor will be required to locate and repair the leaks at no cost to the City and repeat the tests until the allowable leakage is obtained.

**Procedure:**

It is imperative that proper plugs be installed on the laterals at the cleanout stack. All plugs should be properly installed to withstand the test pressures without requiring external bracing or blocking. Before tests are made, all wyes, tees, or end of side sewer stubs shall be plugged with flexible-joint caps, or acceptable alternate, securely fastened to withstand the internal test pressures. Such plugs or caps shall be readily removable, and their removal shall provide a socket suitable for making a flexible-jointed lateral connection or extension.

Air leakage testing of installed system shall be performed with a continuous monitoring gauge no less than 4 inches in diameter with minimum divisions of 0.10 psi and an accuracy of plus or minus 0.04 psi. All air used shall pass through a single, above ground control panel visible to the City's representative.

All air used shall pass through a single control panel. Individual air hoses shall be used from control panel to pneumatic plugs, from control panel to

sealed line for introducing low-pressure air, and from sealed line to control panel for continually monitoring the air pressure rise in the sealed line. After all pipes are cleaned, air shall be slowly supplied to the plugged pipe installation until the internal air pressure reaches 4.0 psig (greater than average groundwater backpressure that may submerge the pipe). Throttle the air supply to maintain that constant pressure for at least 2 minutes. The air pressure supply shall then be disconnected from the system or shut-off. Do not enter manhole during test. Do not exceed 9.0 psig in the system.

Observe the continuous monitoring gauge while decreasing the pressure to no less than 3.5 psig (greater than groundwater pressure). At a reading of 3.5 (adjusted), or any convenient observed pressure reading between 3.5 and 4.0 psig (adjusted), timing shall commence with a stopwatch or other timing device that is at least 99.8% accurate. Regulate the pressure for at least 2 minutes to permit the air/ground temperature to reach equilibrium before commencing test.

Measure the time interval for pressure to drop 1.0 psig.

If the time, shown in Table I for the designated line size and length, elapses before the air pressure drops 1.0 psig; the section undergoing the test may be discontinued once the prescribed time has elapsed even though the 1.0-psig drop has not occurred. Record all readings.

If the pressure drops 1.0 psig before the appropriate time shown in [Table I](#) has elapsed, the air loss rate shall be considered excessive, and the section of pipe has failed the test. Record all readings.

If service lateral sewers are included in the test section, their lengths may be ignored for computing the required test times. The test will be slightly more severe. In the event a test section, having a total surface area less than 625 square feet, fails to pass the air test when lateral sewers have been ignored, the test time shall be recomputed to include all laterals.

If the sections fail the air test, the Contractor shall determine the source or sources of leakage and shall repair or replace all defective material and workmanship.

No sealant shall be used in the newly installed sewers to correct the leaks.

The extent and type of repair that may be allowed shall be subject to the approval of the Public Services Director.

The repaired pipe installation shall be retested and required to meet the requirements of this test.

**Safety Note:** The air pressure test may be dangerous if, because of ignorance or carelessness, a line is improperly prepared. It is extremely important that the various plugs be installed and braced in such a way as to prevent blowouts. A force of 250 lbs is exerted on an 8-inch plug by an internal pressure of 5 psi. It should therefore be realized that sudden expulsion of a poorly installed plug, or a plug that is partially deflated before the pressure is released, can be dangerous. As a safety precaution, pressurizing equipment should include a pressure regulator set at, for

example, 10 psi to avoid over-pressurizing and damaging an otherwise acceptable line. **No one shall be permitted in the manholes during testing.**

- 8) **Procedure for Air Testing Concrete Pipe:** Conform to the requirements of ASTM C924 *Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method*. The test time required for the pressure to drop from 3.5 psi to 2.5 psi is provided in Tables 1 and 2 below. For test times and air loss for diameters larger than 24 inches, refer to the Appendix of ASTM C924. All test pressures are measured as gauge pressure, which is defined as any pressure greater than atmospheric pressure. Since water produces a pressure of 0.43 psi for every foot of depth, air test pressures must be increased to offset the depth of ground water over the sewer line. If the ground water level is 2 ft or more above the top of the pipe at the upstream end or if the air pressure required for the test is greater than 5-psi gauge, the air test method shall not be used. In that event, the infiltration test, ASTM C969 *Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines*, shall be used.

Use or failure of this air test shall not preclude or prohibit acceptance by appropriate water infiltration or exfiltration testing (ASTM C969), or other means approved by the Public Services Director.

<b>Table 1</b> <b>MINIMUM TEST TIME FOR VARIOUS PIPE SIZES</b> (Excerpted from ASTM C924)	
Nominal Pipe Size, in.	T (time), min/100 feet
21	3.0
24	3.6

<b>Table 2</b> <b>ALLOWABLE AIR LOSS FOR VARIOUS PIPE SIZES</b> (Excerpted from ASTM C924)	
D, Nominal Pipe Size, in	Q ft <sup>3</sup> /min
21	5.5
24	6

**TABLE I**  
**Line Pressure Air Test Using Low-Pressure Air**  
**SPECIFICATION TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP**  
**FOR SIZE AND LENGTH OF PIPE INDICATED FOR Q = 0.0015**  
 (Excerpted from ASTM F 1417)

1 Pipe Diameter (in.)	2 Minimum Time (min:sec)	3 Length For Minimum Time (ft.)	4 Time For Longer Length (sec.)	Specification Time for Length (L) Shown (min:sec)													
				100 ft.	150 ft.	200 ft.	250 ft.	300 ft.	350 ft.	400 ft.	450 ft.						
4	3:46	597	.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:40	5:40	5:40	5:40	5:40	5:40	5:40	5:40
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:34	7:34	7:34	7:34	7:34	7:34	7:34	7:34	7:34	7:34
10	9:26	239	2.374 L	9:26	9:26	9:26	9:26	9:26	9:26	9:26	9:26	9:26	9:26	9:26	9:26	9:26	9:26
12	11:20	199	3.418 L	11:20	11:20	11:20	11:20	11:20	11:20	11:20	11:20	11:20	11:20	11:20	11:20	11:20	11:20
15	14:10	159	5.342 L	14:10	14:10	14:10	14:10	14:10	14:10	14:10	14:10	14:10	14:10	14:10	14:10	14:10	14:10
18	17:00	133	7.692 L	17:00	17:00	17:00	17:00	17:00	17:00	17:00	17:00	17:00	17:00	17:00	17:00	17:00	17:00
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33	113:47	125:00	136:13	147:26	158:39	169:52

## 9) Manhole Vacuum Testing

Manholes shall be vacuum tested as indicated below unless otherwise allowed by the Public Services Director. Vacuum testing shall meet ASTM C1244 *Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test*. Only new manholes are to be vacuum tested. Vacuum testing of existing manholes is not required.

The test shall be made using an inflatable compression band, vacuum pump, vacuum test plate, and appurtenances specifically designed for vacuum testing manholes. Equipment to be manufactured by Peter A Glazier & Associates, Worcester, MA or approved equal. The Contractor shall be responsible for furnishing all equipment and labor for the vacuum test at no additional cost to the City.

Manholes may be tested by vacuum test immediately after assembly of the manhole, frames and connecting pipes and before any backfill is placed around the manholes. However, the final test and acceptance shall be based only upon a test after the manhole is backfilled and the cover frame castings are grouted in place. Testing devices shall be installed on the iron manhole frame.

All lift holes shall be plugged with nonshrink grout and all pipes shall be plugged, taking care to securely brace the plugs and pipe. Stubouts, manhole boots and pipe plugs shall be secured to prevent movement while the vacuum is drawn.

Manholes shall be tested from the top of the casting, including the casting-to-cone joint (adjusting ring).

Installation and operation of vacuum equipment and indicating devices shall be in accordance with manufacturer's recommendations.

After the testing equipment is in place, a measured vacuum of 10 inches of mercury (Hg) shall be established in the manhole. The time for the vacuum to drop to 9 inches of mercury shall be recorded.

Acceptance standards for leakage shall be established from the elapsed time for a negative pressure change from 10 inches to 9 inches of mercury. The maximum allowable leakage rate for a 4-foot diameter manhole shall be in accordance with the following:

<b><u>Manhole Depth</u></b>	<b><u>Minimum Elapsed Time for a Pressure Change of 1-inch of Hg</u></b>
4 feet	60 seconds
5 feet	75 seconds
6 feet	90 seconds

If the manhole fails the test, the Contractor shall locate the leakage, make the proper repairs, and the vacuum test shall be repeated until the manhole passes the test. Repairs shall be made while the vacuum is still being drawn. After the manholes have been backfilled and the cover frame casting sealed in place, and prior to final acceptance of the project, any signs of leaks or

weeping visible from the inside of the manhole shall be repaired and the manhole made watertight and tested. The extent and type of repairs that may be allowed shall be subject to the approval of the Public Services Director. Leaks shall be repaired on the outside of the manhole unless approved otherwise by the Public Services Director.

If a manhole joint mastic material is completely pulled out during the vacuum test, the manhole shall be disassembled and the mastic replaced.

#### 10) Video Inspection of Sanitary Sewers

TV inspections may be required by the City on a case-by-case basis at the discretion of the Public Services Director. A video recording will be made of each inspection. City personnel will perform the video inspection.

#### 11) Force mains Testing

- a. **Order of Operations:** Except for chlorination and tests for purity, the installation of sewer force mains shall be set forth on the plans and shall meet the requirements for water mains and as set forth in these specifications. Fill the system with water at a velocity of approximately 1 foot per second while necessary measures are taken to eliminate all air. Do not leave fill line connected to sewer line unless an RPZ backflow preventer is placed between the potable water supply and the line being filled.
- b. **Pressure Tests & Leakage:** The Contractor shall test completed sections of line, including fittings, with water. This testing, however, does not relieve the Contractor of his responsibility to repair or replace any cracked or defective pipe. All work necessary to secure a tight line shall be done performed by the Contractor. Testing shall be performed in the presence of a City representative and the Contractor. Cost for testing shall be incidental to line construction.

**Pressure Test:** The newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for two hours to a leakage test. Raise the pressure by pump to either 150 psi, 150% of design working pressure, or test pressure as shown on the drawings, whichever is greater. Measure the pressure at the low point on the system compensating for gauge elevation. Maintain this pressure (+ or – 5 psi) for 2 hours. If pressure cannot be maintained using reasonable pumping rate, determine cause, repair, and repeat the test until successful. The allowable leakage shall be no greater than allowances shown in Table 6A - Hydrostatic Testing, Section 5.2, of AWWA C 600-93, *AWWA Standard for Installation of Ductile Iron Water Mains and Their Appurtenances*. A copy of this chart is located at the rear of the Specification Section [02510, Water Distribution](#). The Contractor shall be responsible for all costs, labor, materials, and equipment to perform the testing. All visible leaks, broken or cracked pipe, valves, etc. shall be repaired.

- i) Prerequisite conditions for testing shall be as follows:
  - All pipe has been laid and the trench backfilled.

- Valves shall be properly located, operable and at correct elevation.
- All reaction anchors have had sufficient set of 3 days. High early strength concrete, 4500 psi or greater, may be used to reduce number of days.
- Lines shall be properly vented where entrapped air is a consideration.
- **All construction activities on the project, that requires trenching or excavation within the limits of the line location, shall be completed prior to pressure testing of line.**

### 3.10 PUMP STATIONS AND FORCE MAINS

- A. **Pump Stations:** Pump stations and force mains will be allowed only with the permission of the Public Services Director. Pump stations shall be either self-priming or submersible pumps and designed in accordance with the requirements of the NC Department of Environment and Natural Resources, Division of Water Quality, NCAC Title 15A 2H .0200 *Waste not Discharged to Surface Waters*, latest revision. Typical Pump station site layout shall conform to [standard details 534.01](#) and [534.02](#). Lift stations shall include the following as a minimum:
- 1) Service head, meter base, service connection, disconnect, and area light with switch.
  - 2) Audible and visual high water alarm and alarm silence. High water alarm circuitry. Provide dual high water alarm floats. The first (lowest) high water alarm float is to activate the telemetry only (not the alarm and light) to allow maintenance personnel time to arrive at site and attempt to fix the problem. The second (higher) high water alarm float shall activate the alarm horn and light.
  - 3) Auto-dialer (minimum 8 numbers, 4 channels). The automatic telephone dialer shall be a solid state component capable of dialing up to eight phone numbers, each up to 24 digits in length. The dialer shall have solid state voice message recording and playback, all implemented with permanent nonvolatile solid state circuitry with no mechanical tape mechanism.
  - 4) Automatic air release valves, as applicable.
  - 5) For self-priming pumps, provide air bubbler type control system with hand-off-automatic (H-O-A) switches and an automatic alternator. For submersible pumps, provide mercury float switches for level control.
  - 6) 3-phase voltage monitor, if applicable. Indication of 3-phase power fail.
  - 7) Suction and/or discharge gauges, as applicable.
  - 8) Elapsed time indicators.
  - 9) High pump temperature protection.
  - 10) Pump run lights.
  - 11) Motor overload resetter.
  - 12) Surge suppressor.
  - 13) Duplex service receptacles on GFCI installed external to the NEMA 4X enclosure.
  - 14) Surge relief valve and return piping to wetwell.



- 15) Start-up assistance and certification, including operational/witness/drawdown test. Certified pump curves shall be provided as part of the project closeout documents.
- 16) Dual power supply auto switch-over, etc.
- 17) Non-Freeze Yard Hydrant (Woodford W-34 for ¾ inch and the Woodford Y-1 for 1-inch Clayton Mark model 5451 Lever type frost proof yard hydrant).
- 18) For self-priming pump stations, provide heaters and fluorescent lighting.
- 19) Non-Freeze shower w/ eyewash and concrete pad.
- 20) 10 ft x 10 ft x 8-inch concrete pad for water tank with drain and valve.
- 21) Emergency pump connection w/ blind flange and gate valve.
- 22) The lift station is to include back-up alarm system that operates off a 12-volt battery connection in the event of power failure. The battery system is to include a trickle charger to ensure battery integrity.
- 23) Provide auxiliary propane, natural gas or diesel fired automatically activated stand-by power generator source with automatic reset, placed on site. Pump manufacturer to provide power demand/ratings to Contractor before ordering pump and the power demand appropriately marked on the pump shop drawings. Generator shall have the capacity sufficient to sequentially start and run all pumps in the pump station. The Contractor shall provide a complete engine driven generator set. The generator set shall consist of four-cycle, radiator-cooled, engine direct connected to an alternating current generator, a unit-mounted control panel, all mounted on a common sub-base. The control panel shall be complete with engine controls and instruments, safety controls and panel lights including the following:
  - a. The generation unit shall be capable of powering the pump motors starting current, electrical systems, instrumentation/controls and alarm systems, and other auxiliary equipment as may be necessary to provide for the safe and effective operation of the pump station. The generation unit shall have the appropriate power rating to start and continuously operate under all connected loads.
  - b. The generation unit shall be provided with special sequencing controls to delay lead and lag pump starts unless the generating unit has the capacity to start all pumps simultaneously while the auxiliary equipment is operating.
  - c. The generation unit shall be capable of shutting down and activating the audible and visual alarms and telemetry if a damaging operating condition develops.
  - d. The generation unit shall be protected from damage when restoration of power supply occurs.
  - e. The generator shall be equipped with an automatic transfer switch to start generator and transfer load to emergency in case of utility undervoltage, overvoltage, power loss, phase reversal, or phase loss.
  - f. The control panel shall be complete with run-stop-remote switch; remote start-stop terminals; cranking limit; battery charge rate ammeter, oil pressure gauge, temperature gauge; low oil pressure shutdown; high engine temperature shutdown; over speed shutdown; AC voltmeter; voltage adjustment; frequency meter; and running time meter. The controls must indicate engine run, common engine fail, transfer switch position, low fuel level, and fuel tank leak for remote telemetry purposes. The generator shall be equipped with an automatic transfer switch to start generator and transfer load to emergency in case of utility under voltage, over voltage, power loss, phase reversal, or phase loss.
  - g. Circuit breakers shall be provided with a built in control panel.

- h. The manufacturer of the unit shall completely assemble and test the unit before shipment. He shall be one who is regularly engaged in the production of such equipment, and who has spare parts and service facilities. He must also provide one complete set of filters.
- i. The controls must indicate engine run, common engine fail, transfer switch position, low fuel level, and fuel tank leak for remote telemetry purposes.
- j. The automatic transfer switches must have a disconnect on the utility service main side.
- k. The generator shall comply with the following minimum requirements:
  - i) Engine: Four-cycle, 4 cylinder, radiator cooled, at 1800 RPM. Starting shall be from batteries, with capability to start the unit at 32 degrees temperature.
  - ii) Generator: Rating shall be continuous standby service at 0.8 power factor, at 1800 RPM.
  - iii) Voltage: Three-phase, 208. KW rating to match facility needs.
  - iv) Engine shall be equipped with an isochronous governor as manufactured by Woodall.
  - v) Frequency regulation shall be less than 3-cycles from no-load to full load.
- l. All accessories needed for the proper installation of the system shall be furnished. Included should be batteries, battery cables, exhaust piping, mufflers, vibration mounting, and three bound sets of detailed operation and maintenance manuals with parts list. Batteries should be lead acid.
- m. The generator set shall be enclosed with a factory-installed weather-protective housing (sound abating enclosure to 68db @ 23 ft.) Housing shall provide easy access to the engine-generator and instrument panel. Muffler to be designed so exhaust is not blown or sucked across the set by cooling air.
- n. Included with the generator shall be a complete fuel system consisting of a fuel tank, fuel gauge, fuel lines, fuel pumps, valves and any and all other items incidental to a first-quality installation.
- o. Provide integral sub-base double-walled diesel tank. The tank is to be UL approved closed-top dike type. The tank shall also be fitted with a leak sensor device. The tank must have a capacity to run the generator for a minimum of 48 hours at 100% load.
- p. Fuel tank shall consist of the fuel tank separate and contained within the frame. No generator weight is to be supported by the tank. Provide a drain plug at one end of the rupture basin. Provide vibration isolators between generator set and tank assembly. Provide fuel low-level alarm remote mounted.
- q. Provide manufacturer's recommended anti-freeze and engine block heater, per manufacturer's recommendations, with thermostatic controls to maintain engine coolant at proper temperature to fulfill start-up requirements, adjustable if possible. Provide suitable trickle battery charger. All accessories shall be engine-mounted and within the weatherproof sound attenuated housing.
- r. Provide annunciator panels with visual and audible alarms to monitor and warn of emergency operation conditions affecting line and generator power sources.
- s. Provide stainless steel super critical grade type exhaust silencer mounted inside of the generator enclosure for corrosion protection.

- t. Provide amp meter, voltmeter, and frequency meters with phase switches.
  - u. Provide fuses or circuit breakers for battery charger and engine.
  - v. Provide an automatic battery charger, static type, magnetic amplifier control with DC voltmeter, DC ammeter and potentiometer for voltage adjustment. The charger is to be completely automatic and rated for the type of battery use. The charging rate is to be determined by the state of the battery and reducing to milliamp current on fully charged battery. The charger shall be 120 V., single-phase, 60 cycle, AC input with 6-amp maximum output.
  - w. Operation and Maintenance instructions. The Contractor shall provide a minimum of four continuous hours of operation and maintenance instructions for the Owner's personnel.
  - x. The City must be furnished with one complete set of air, oil and fuel filters.
- B. **Pump Certification:** Contractor to provide a certified shop test of pump from pump manufacturer. Manufacturer's representative shall be present at pump start-up. See *Pump Station Operational/Witness Test/Start-up* requirements, below.
- C. **Wetwell Coating:** Wetwell interiors shall be coated with a two component elastomeric, hydrophobic, corrosion resistant polyurea coating where the primer can be applied to damp or dry surfaces. Primer coat film thickness shall be 1.5 to 3 mils. The topcoat film range shall be from 8 to 12 mils. Shore hardness D shall be minimum 75. Coating shall equal or exceed Duramer K-2002 by Innovative Polymer Solutions, LLC. Contractor to follow all applicable safety measures for handling and application as recommended by the Manufacturer of the coating. Comply with applicable confined space safety requirements.
- D. **Wetwell/Valve Vault Hatches:** Provide access frames and covers meeting paragraph 2.2.14 of this specification with padlocked hasps.
- E. **Force mains:** Force mains shall be ductile iron or PVC C900. PVC Force mains must be approved by the Public Services Director. Pipe joints shall be push on or mechanical joint type. Fittings shall be mechanical joint with appropriate blocking and/or rodding. Force mains shall be constructed in accordance with the plans and in accordance with the requirements applicable to water main construction.
- F. **Manuals/Parts:** The City must be furnished with three copies of the Operation and Maintenance and Parts Manuals for the pumps/motors and/or station, pump controls, the generator unit and the automatic transfer switch. Also, provide a spare impeller, key, nut, washer, and mechanical seal for each pump.
- G. **Safety Placards:** Provide safety placards as required for structure (e.g. confined access entry) and equipment as required by OSHA readily shall be posted and readily visible.
- H. **Pump Station Operational/Witness Test/Start-up**
- 1) **Witnessed Testing:** Witnessed testing shall be performed in the presence of the Public Services Director or his representative and the results of the testing maintained as part of the construction record documentation.

Witnessed testing shall include start-up assistance by a qualified factory representative and certification. Prior to acceptance by the City, an operational test of all pumps, drive, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.

After construction debris and foreign material has been removed from the wet well, the Contractor shall supply an adequate amount of clear water volume to operate station through several pumping cycles. Observe and record operation of pumps, suction (if applicable) and discharge gage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems. Be alert to any undue noise, vibration, or other operational problems.

- 2) **Drawdown test:** The Contractor shall conduct a drawdown test to confirm that the pump is operating at or near the required design operating point and to determine the actual pumping rate of each pump. This test shall be conducted in the presence of the Public Services Director or his representative, the Contractor and a representative of the pump manufacturer. The rate shall be determined by subtracting the starting static surface elevation of the water in the wetwell from the “off” elevation and multiplying the difference by the volume per vertical foot of wetwell. That number shall then be divided by the number of minutes of pump run time to affect the drop measured. This test shall be performed for each pump and the rates recorded for each pump and included as part of the record in the certified pump test.
- 3) **Manufacturers Start-up Services:** The manufacture’s representative shall be present at pump start up. Co-ordinate station start-up with manufacturer’s technical representative. The representative or factory service technician shall inspect the completed installation. He shall calibrate and adjust instrumentation, correct or supervise correction of defects or malfunctions, and instruct operating personnel in proper operation and maintenance procedures.

### 3.11 PIPE DESIGN LIFE

In addition to the above noted specifications, the Contractor shall secure and the manufacturer shall warrant that sanitary sewer pipe is designed for a 50-year life.

### 3.12 CLEANUP AND RESTORATION OF SITE:

After the backfill is completed, the Contractor shall dispose of all surplus material, dirt and rubbish from the site, and shall keep the site free of mud and dust to the satisfaction of the Public Services Director. Prior to completion of project, all dewatering “stingers” shall be removed and the void filled with either flowable fill concrete or #67 rock. The Contractor may be required to flush or sprinkle the street to prevent dust nuisance. It is important that clean up and restoration of the site follows the work closely. The Contractor shall dispose of surplus material and clean the street at the end

of each day for the portion of work completed that day unless additional cleaning is required. After all work is completed, the Contractor shall remove all tools and other equipment, leaving the site free, clean, and in good condition.

<b>TABLE II VACUUM TEST TABLE FOR MANHOLES BASED ON ASTM C1244</b>					
<b>MINIMUM TEST TIMES FOR VARIOUS manhole DIAMETERS FOR PRESSURE DROP FROM 10 INCHES TO 9 INCHES HG.</b>					
<b>DIAMETER (FEET)</b>					
<b>Depth (FT)</b>	<b>4</b>	<b>4.5</b>	<b>5</b>	<b>5.5</b>	<b>6</b>
<b>TIME (SECONDS)</b>					
<b>6</b>	<b>15</b>				
<b>8</b>	<b>20</b>	<b>23</b>	<b>26</b>	<b>29</b>	<b>33</b>
<b>10</b>	<b>25</b>	<b>29</b>	<b>33</b>	<b>36</b>	<b>41</b>
<b>12</b>	<b>30</b>	<b>35</b>	<b>39</b>	<b>43</b>	<b>49</b>
<b>14</b>	<b>35</b>	<b>41</b>	<b>46</b>	<b>51</b>	<b>57</b>
<b>16</b>	<b>40</b>	<b>46</b>	<b>52</b>	<b>58</b>	<b>67</b>
<b>18</b>	<b>45</b>	<b>52</b>	<b>59</b>	<b>65</b>	<b>73</b>
<b>20</b>	<b>50</b>	<b>53</b>	<b>65</b>	<b>72</b>	<b>81</b>
<b>22</b>	<b>55</b>	<b>64</b>	<b>72</b>	<b>79</b>	<b>89</b>
<b>24</b>	<b>59</b>	<b>64</b>	<b>78</b>	<b>87</b>	<b>97</b>
<b>26</b>	<b>64</b>	<b>75</b>	<b>85</b>	<b>94</b>	<b>105</b>
<b>28</b>	<b>69</b>	<b>81</b>	<b>91</b>	<b>101</b>	<b>113</b>
<b>30</b>	<b>74</b>	<b>87</b>	<b>98</b>	<b>108</b>	<b>121</b>

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