

## 33 30 00 – SANITARY SEWER DISTRIBUTION

### 1. INTRODUCTION

- A. Duke University owns and operates the sewer distribution throughout campus boundary. Duke does not own City of Durham mains that provide service to non-Duke facilities.
- B. Campus sewer distribution systems will be designed in accordance with master plans developed by the Duke Utilities and Engineering Services (DUES) department.
- C. Planning for utility requirements to support projects must start in the programming stages to insure the work is coordinated with ongoing projects and there is adequate capacity to support the project.
- D. All proposed sewer system modifications and extensions shall be coordinated with the Duke Utilities and Engineering Services (DUES) department.

### 2. REFERENCES

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

<b>AASHTO</b>	American Association of State Highway and Transportation Officials
<b>ACI</b>	American Concrete Institute
<b>ACPA</b>	American Concrete Pipe Association
<b>ASTM</b>	American Society for Testing and Materials
<b>AWWA</b>	American Water Works Association
<b>BIA</b>	Brick Institute of America
<b>CRSI</b>	Concrete Reinforcing Steel Institute
<b>FS</b>	Federal Specifications
<b>NCMA</b>	National Concrete Masonry Association
<b>NCPI</b>	National Clay Pipe Institute
<b>ANSI</b>	American National Standards Institute
<b>SDS</b>	Material Safety Data Sheets
<b>UL</b>	Underwriter's Laboratories
<b>COD</b>	Water and Sewer Construction Specifications
<b>COD</b>	Reference Guide for Development

### 3. PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Inspect materials thoroughly upon arrival. Examine materials for damage. Remove damaged or rejected materials from site.
- B. Observe manufacturer's directions for delivery and storage of materials and accessories.
- C. 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.

- D. Prevent damages to pipe during transit. Repair abrasions, scars and blemishes. If repair of satisfactory quality cannot be achieved, replace damaged material immediately.
- E. Construct piping to accurate lines and grades and support as required on drawings or described in specifications. When temporary supports are used, insure that sufficient rigidity is provided to prevent shifting or distortion of pipe. Install expansion devices as necessary to allow expansions and contraction movements.
- F. Check bells and spigots closely for smoothness, roundness, and honeycombing (concrete pipe), which may be a source of infiltration. Check for cracks, chips, etc. on both ends. Reject any pipe that will not provide watertight seal or otherwise is structurally deficient.

#### 4. DUCTILE IRON SANITARY SEWER PIPE AND FITTINGS

- A. Ductile iron pipe shall be Grade 60-42-10 and 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 8-inch and larger diameter pipe, pressure class rated, 350 psi minimum. The thickness of Ductile Iron Pipe shall be determined by considering trench load in accordance with ANSI C150 and AWWA A21.50. (Public Sewers shall be no less than 8-inch diameter).
  - 1. Interior Lining
    - a. The ductile iron pipe shall be cement mortar lined with a seal coat in accordance with ANSI/AWWA C-104/21.4. Outside coat shall be a minimum of 1 mil bituminous paint according to ANSI/AWWA C151/A21.21 Section 51-8.1. **Duke University does not require ceramic epoxy lining on private sewer distribution; however if the sanitary line is owned by the City of Durham, then piping specification should be consistent with Section 33.31.13 of the City of Durham specification.**
- B. 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.
- C. 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 upon request. All certified tests, hydrostatic and material, are to be performed by an independent testing laboratory at the expense of the pipe manufacturer.
- D. Joints:
  - 1. Pipe joints may be either push-on or mechanical joint pipe sizes 8 inches through 48 inches in diameter. Rubber Gasket Joints and Mechanical Joints shall comply with AWWA C111/ANSI A21.11. Acceptable pipe joints are as follows:
    - a. Push-On Joints: Push-on Joint, Ductile Iron Pipe shall conform to AWWA C151/ANSI A21.51 Ductile-Iron Pipe, Centrifugally Cast, for Water("Fastite,"or"Tyton,"). 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 to be American Amarillo Fast-Grip Gaskets (yellow) with high-strength stainless steel (for use with Fastite or Flex-Ring sockets); pipe sizes 6 inches through 30 inches and shall comply with AWWAC111/ANSI A21.11 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings. The yellow color is to be inherent within the rubber; not attained by a surface coating.

- b. Mechanical Joints: Mechanical joint pipe Ductile Iron Pipe shall be used only at specific location identified on the drawings or as approved by the City and shall meet AWWA C111/ANSI A21/11. The mechanical joint shall consist of:
    - 1) 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;
    - 2) A pipe or fitting spigot;
    - 3) Mechanical Joint Gaskets to be plain rubber (Styrene Butadiene [SBR]) per AWWA C111/ANSI A21.11;
    - 4) Separate ductile iron follower gland having cored or drilled bolt holes; and
    - 5) Alloy steel Tee Head bolts and hexagon nuts. All threads are Coarse-Thread Series Class 2A, External and Class 2B, Internal, per ANSI B1.1. Nuts to be furnished in accordance with ASTM A563, Standard Specification for Carbon and Alloy Steel Nuts.
    - 6) The joint shall be designed to permit normal expansion, contraction, and deflection of the pipe or fitting while maintaining a leak proof joint connection.
    - 7) Bolts are to be torqued in accordance with the requirements of AWWA C600.
- E. Fittings:
1. AWWA C153 (compact) or AWWA C110, ductile iron full body fittings, Class 350 for 6" through 24" and Class 250 psi for pipe greater than 24" and less than 48" in diameter.

## 5. PVC SOLID WALL PIPE AND FITTINGS

- A. ASTM D3034, Type PSM, Poly (Vinyl Chloride) (PVC) material, SDR 35 minimum; bell and spigot style rubber ring sealed gasket joint.
- B. PVC Solid Wall Sewer Pipe (8 inches through 15 inches): 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 (8 inches -15 inches). 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.

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. With the exception of services, PVC Fittings shall not be used with pipes 8 inches and larger in diameter.

- C. PVC Gravity Pipe Joints: Joints for solid wall PVC sewer gravity pipe and 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.
- D. PVC Solid Wall Service Pipe (4-inch to 6-inch diameter): ASTM D1785, Minimum Schedule 40, Poly (Vinyl Chloride) (PVC) material; bell and spigot style solvent sealed joint ends.
  - 1. Fittings: ASTM D2466, PVC.
  - 2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

**6. C900 PVC PIPE FOR GRAVITY SEWER AND FORCE MAINS (4-INCH THROUGH 12INCH):**

- A. C900 PVC gravity and pressure pipe, 4-inch through 12-inch, with bell end with gasket and spigot end shall comply with AWWA C900, Pressure Class 150, DR 18. Pipe shall also meet ASTM D2122, *Standard Method of Determining Dimensions of Thermoplastic Pipe and Fittings*, and ASTM D3139, *Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals*. 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.
- B. The pipe shall be extruded from Class 12454-A or 12454-B PVC compound as defined in ASTM D1784. Stress due to working pressure cannot exceed the HDBa (4000 psi) ÷ 2.5 safety factor (HDS = 1,600 psi). The pipe outside diameters shall conform to dimensions of Ductile Iron Pipe. All pipe furnished shall be in conformance with AWWA C900, latest revision.
- C. The minimum pipe stiffness shall be 364 psi.
- D. 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.
- E. 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).
- F. Pipe shall be homogenous throughout. It shall be free from voids, cracks, inclusion, and other defects. It shall be as uniform as commercially practical in color, density, and other physical properties. Pipe surfaces shall be free from nicks and scratches. Joining surfaces of spigots and joints shall be free from gouges and imperfections that could cause leakage.

G. Each length of pipe furnished shall bear identification marking that will remain legible after normal handling, storage, and installation. Markings shall be applied in a manner that will not weaken or damage the pipe. Markings shall be applied at intervals of not more than 5 feet on the pipe. The minimum required markings are given in the list below. Marking requirements shall be in conformance with AWWA C900.

1. Nominal Size and OD Base (e.g. 12CI)
2. PVC
3. Dimension Ratio (e.g., DR 18)
4. AWWA pressure rating (e.g. PR 150)
5. AWWA designation number (AWWA C900)
6. Manufacturer's name or trademark
7. Manufacturer's production code, including day, month, year, shift, plant, and extruder of manufacture.

H. C900 pressure pipe for force mains shall be used with ductile iron fittings (restrained joint).

#### **7. PVC SOLID WALL PIPE AND FITTINGS**

A. 2-inch and 3-inch PVC pressure pipe, with integral bell end with reinforced gasket and spigot end shall comply with ASTM D2241, Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series), SDR 21, Class 200 minimum, PVC 1120 Cell Classification 12454 as identified in ASTM D1784. Materials shall meet ASTM D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

Joints for solid wall PVC sewer gravity pipe and 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.

#### **8. STEEL PIPE FOR ENCASEMENT, AERIAL CREEK CROSSINGS, BORING APPLICATIONS, AND VENT PIPES:**

A. 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 A283/283M 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. Unless otherwise shown on the approved drawings, 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.

1. Steel Encasement Pipe for Boring Applications: Encasement pipe shall meet applicable NCDOT and AREA specifications. Casing pipe shall include pipe carriers (spiders) to support carrier pipe (interior of pipe to be uncoated).
    - a. Casing Wall Thickness: Refer to City of Durham Standard Detail C07.01 for standard wall thickness based on diameter and location (i.e. highway, rail).
    - b. Steel Casing End Seals: Casing end seals shall be 8-inch thick brick masonry with a 1inch diameter weep hole constructed as shown on City of Durham Standard Detail C07.01.
    - c. Spiders/Skids for Encasement Pipes: See City of Durham Pre-Approved Product List for acceptable spider/skid manufacturers and models.
      - 1) Band and Risers:
      - 2) Band: 14 gauge T-304 Stainless Steel; 8 or 12 inches. Interior surface of circular stainless steel band.
      - 3) Riser: 10-gauge T-304 Stainless Steel. All risers shall be welded to band by MIG welding. All welds shall be passivated.
      - 4) Band width requirements to be determined by weight, pipe and fluid and spacing.
      - 5) Band Spacing, unless otherwise noted on plans: 1 to 2 feet from each end of bell joint and one placed every 7 to 9 feet thereafter; 3 per pipe 18-foot pipe joint.
      - 6) Liner – Elastomeric PVC per ASTM D149 or extruded EPDM
      - 7) Skids/Runners: Abrasion resistant runners attached to band. Glass reinforced nylon or Ultra High Molecular weight (UHMW) polyethylene per ASTM D638. Ends of Skids/runners to be beveled to facilitate installation over rough weld beads or welded ends of misaligned or deformed casing pipe.
      - 8) Fasteners: Type 304 stainless steel per ASTM A193.
      - 9) See City of Durham Standard Detail C07.01 for spacing/location of spiders.
  2. Steel Pipe for Aerial Creek Crossings (without encasement and carrier pipe): The outside of the pipe shall have one coat of zinc chromate primer conforming to Federal Specification TT-P-1757 and afterwards painted with coal-tar enamel.
  3. Rail Applications: Encasement for rail applications, encasement pipe to be coal tar coated, lined, and wrapped except, if permitted by Rail agency, the interior shall be left unlined to permit ease of carrier pipe/spider installation.
  4. Steel Vent Pipes for Sanitary Sewer Manholes: The vent pipe shall be made from Schedule
  5. 40 Stainless Steel. See City of Durham Standard Detail 732.10.
- B. Carrier pipe shall be mechanical joint or restrained joint ductile iron pipe of the class indicated on the drawings but no less than pressure class 250 psi.

## **9. SEWER MAIN WYES, SADDLES AND COUPLING CONNECTION**

- A. In-line wye with Schedule 40 connection (gasketed main or glued service) with GPK Repair Coupling PVC SDR 35, GXG; as manufactured by GPK Products, Inc. or an approved equal.
- B. Saddle: 45 degree SDR 35 Type PSM PVC Saddle wye meeting ASTM D3034 and ASTM F1336, as manufactured by GPK Products, Inc. or an approved equal.
- C. Poured concrete collars are not permitted.
- D. Flexible couplings are not permitted.

