

## 3. Construction Standards

### 3.1 General Requirements

#### 3.1.1 General

- A. Regardless of when early grading and land disturbing activities are permitted, construction on any utility Project shall not commence until all criteria of the design review and approval process have been completed, including a certificate to construct from DEQ, if required and the Department's receipt of a stamped-as-approved set of plans from the County Planning Department.
- B. The Department shall conduct a preconstruction meeting with the Applicant prior to the commencement of work. The Applicant shall provide at least two County working days' advance notice to the Department's Inspection Section to schedule a preconstruction meeting. If all requirements are met, a Department Certificate of Construction ("COC") will be issued at the completion of the meeting. The COC shall be posted on the job site for compliance.
- C. Cut sheets are required on all gravity and force main wastewater Projects. Cut sheets are required on water line Projects where the sub grade has not been installed, in areas where final grades for future roads and paved areas cannot be determined, and on Projects where water lines are installed in easements. Three copies of construction cut-sheets shall be submitted to the Department prior to the commencement of construction. Cut sheets shall be prepared by a qualified engineer or surveyor. Cut sheets shall include station, offset, existing grade, proposed grade, utility location, size, and material as a minimum, plus temporary bench marks at each manhole on sanitary sewer Projects, and at no more than 500 foot intervals on any other Project. Cut sheets shall be provided for gravity sewer Projects at every manhole. For water main or force main Projects, cut sheets shall be provided for every valve, fitting, or pipe feature, excluding services, and at intervals not to exceed 150 feet.
- D. Prior to the installation of water mains, unless waived by the Director, an Engineer or surveyor must certify in writing that:
  - a. All pavement and shoulder areas within the right-of-way are graded to within six inches (6") of sub grade.
  - b. All ditches and slopes to 1 foot outside the right-of-way have been graded to final grade.
- E. The Contractor shall comply with erosion and sediment control requirements of the County and the requirements of the Projects land disturbance permit, if one is required, before beginning clearing or construction.
- F. The Contractor shall comply with the requirements of permits issued by the County, VDOT, and all other regulating agencies.

- G. It shall be the responsibility of the Applicant to acquire all easements necessary for water or sewer installation. Easements shall be obtained, recorded, and the instrument number noted on the as-built plans. Deeds for easements shall be in a form acceptable to the County. The Applicant shall adhere to any special agreements negotiated with the landowner regarding restoration of the easement in addition to the usual and customary requirements of the Department.
- H. The Contractor shall notify all adjoining property owners at least two (2) weeks in advance of the start of any work in an off-site easement. The County may require such notification to be in writing; if so, a copy of each letter shall be presented to the County at the preconstruction conference.
- I. The Contractor shall make all reasonable efforts to keep construction noise at a minimum. The Contractor shall comply with the County's Noise Ordinance at all times.

### 3.1.2 Laws and Regulations

The Contractor shall abide by all Federal, State, and local regulations, rules, laws, and ordinances, which may in any manner affect those employed or engaged in the work, or in any way affecting the conduct of the work.

### 3.1.3 Materials and Workmanship

It is the intent of the County's specifications to describe in general and broad terms the character of materials and workmanship required with regard to all ordinary features, and to require first-class work and materials in all particulars. For any unexpected features arising during the progress of the work and not fully covered in the specifications, the County shall require first-class work to be performed and first class materials to be used by the Contractor.

The County reserves the right to employ an independent testing laboratory to conduct tests, in addition to those to be completed by the Applicant or Contractor, of materials, soils, workmanship, facilities, or other items as the County deems necessary, in its sole discretion, to assure complete compliance with the requirements of this DSM. The Applicant and Contractor shall offer full cooperation with the County in making these tests. If any such test completed by the County shows that the work performed or materials provided are substandard, the Applicant shall be charged the County's cost for completing these tests. The Department will not issue a letter of "Final Acceptance" for any part of the water or sewer system serving the Project until all such charges have been paid.

### 3.1.4 No Deviation by the Contractor from Approved Plans and Specifications

The Contractor shall not deviate from the plans, profiles, cross-sections, and specifications without the written approval of the Director. The Contractor shall obtain approval from DEQ or VHD as required. If deviation occurs on the part of the Contractor, he shall correct the error at his expense in a manner satisfactory to the County.

### 3.1.5 Use of Water

No water shall be drawn from the County's facilities for the testing, flushing, or other purposes of newly installed or repaired lines until suitable arrangements have been made with the Inspector. All other incidental water uses will be covered under the Department fees.

### 3.1.6 Clean Up and Restoration

Upon completion of the Project, before the final inspection of the work and acceptance by the County, the Contractor shall remove any debris and sediment from any installed piping. The worksite, including all rights-of-way, shall be cleared of all trash and debris, all machinery, tools, surplus material, temporary buildings, and any other construction-related structures from the site of the work. The worksite shall be restored to a condition equal to or better than condition in which it was prior to the construction. Areas not stabilized otherwise shall be seeded or mulched.

## 3.2 Trenching, Backfilling and Compaction

### 3.2.1 General

#### 3.2.1.1 Quality Assurance

All work shall conform to County requirements and, where construction is within a State right-of-way, the applicable requirements of VDOT.

#### 3.2.1.2 Safety

The Contractor is responsible for job site safety. The Contractor shall comply with all applicable safety rules and regulations of OSHA, VOSH, and other agencies having jurisdiction over the work, including but not limited to the Virginia Work Area Protection Manual and the "Virginia Overhead High Voltage Line Safety Act." The Contractor shall strictly adhere to and enforce all safety measures related to, but not necessarily limited to, trenching, confined space, traffic control, and other applicable safety measures.

#### 3.2.1.3 Job Conditions

- A. Protection of Existing Utilities: The Contractor shall be responsible for conducting the work in such a manner as to avoid damage to or interference with, any existing utility services. This shall include taking preventive measures, such as plugging or otherwise securing all openings, to exclude the introduction of dirt, stone, construction materials, or any other debris into the existing pipe or service connection. If such damage, interference, or interruption of service occurs as a result of its work, it shall be the Contractor's responsibility to promptly notify the County and utility owner of the occurrence and to repair the damage immediately, at Contractor's expense, to the satisfaction of the County and the utility owner. Further, the Contractor shall be responsible for uncovering and exposing the location of all service connections to avoid

damage or interruption of service. If damage occurs, the Contractor shall make the necessary repairs in accordance with the above requirements. The Contractor shall also be responsible for determining in advance of construction the exact location of all utilities and the effect such utilities will have on the work by contacting "Miss Utility" 48 hours prior to starting work, telephone 1-800-552-7001 for assistance.

- B. Protection of Persons and Property:
  - a. The Contractor shall put up barricades for open excavations or work areas. All such barricades shall be in accordance with the requirements of the authorities or agencies having jurisdiction.
  - b. The Contractor shall protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by work or other operations in the area.
- C. The equipment used for the work shall meet all local, State, and Federal safety standards governing the work. All power machinery shall have adequate mufflers to keep noise to a minimum. The Contractor is responsible for complying with the requirements of the County's noise ordinance.

## 3.2.2 Products

### 3.2.2.1 Soil Materials

#### Definitions:

- A. Unsuitable Soil Materials: Soil that is too wet to permit proper compaction as determined by the Inspector or not appropriate for the use intended as defined in these specifications.
- B. Soil Backfill and Fill Materials:
  - a. Approved excavated or imported soil materials must be free of rock or gravel larger than two inches (2") in any dimension, debris, waste, frozen materials, organic, and other deleterious matter.
  - b. Approved materials must be at a moisture condition suitable for compaction at required density.
- C. Aggregate Materials (Sand, Stone, and others):
- D. Aggregate materials will be defined using the latest edition of the Virginia Department of Transportation Road and Bridge Specifications, "2." Approved materials must be at a moisture condition suitable for compaction at required density.

### 3.2.3 Execution

#### 3.2.3.1 Inspection

The Inspector shall examine the areas and conditions under which excavating, filling, and grading are to be performed and notify the Contractor of any conditions that may be detrimental to the proper and timely completion of the work. The Contractor shall not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the County.

#### 3.2.3.2 Excavation

- A. Excavation consists of removal and disposal of material encountered when establishing required trench elevations. Unauthorized excavation consists of removal of materials beyond indicated elevations or dimensions without specific direction from the County.
- B. The Contractor shall remove unsuitable soil to a depth determined by the Inspector and replace it with No. 57 stone, or other material approved by the Inspector, which shall be uniformly and thoroughly compacted.
- C. Sheeting, Shoring, and Bracing: Provide sheeting, shoring, and bracing as necessary to prevent cave-in of excavation or damage to existing structures on or adjoining the site.
  - a. Establish requirements for trench shoring and bracing to comply with codes and authorities having jurisdiction. The Contractor's attention is called to Rules and Regulations Governing the Safety and Health of Employees Engaged in Construction as adopted by the Safety and Health Codes Commission of the Commonwealth of Virginia and all latest revisions thereto and issued by the Department of Labor and Industry.

The Contractor shall perform all construction operations in accordance with the U.S. "Occupational Safety and Health Act of 1970", the Standards of the U.S. Department of Labor, OSHA, and the latest amendments thereto.
  - b. Sheeting, shoring, and bracing may be left in place with the approval of the utility owner and VDOT if within a State right-of-way, but must be cut off to a depth of not less than two (2) feet below the surface.
- D. Dewatering: Prevent surface water and subsurface or groundwater from flowing into excavations and from flooding Project site and surrounding area.
  - a. Dewatering shall not be done by draining into existing sanitary sewer
  - b. Do not allow water to accumulate in excavation. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations. Dewatering shall continue until backfilling has been completed.

- c. Convey groundwater and surface water removed from excavations to collection or run-off areas approved by the County. Trenches shall not be used as temporary drainage ditches.
  - d. All dewatering shall comply with the requirements of the latest edition of the Virginia Erosion and Sediment Control Handbook.
- E. Stability of Excavations:
- a. Slope sides of excavations to comply with local, State, and Federal codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or because of the instability of the material being excavated.
  - b. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.
- F. Material Storage:
- a. Stockpile approved excavated materials where approved by the County, until required for backfill or fill.
  - b. Place, grade, and shape stockpiles for proper drainage.
  - c. Locate and retain soil materials away from edge of excavations.
  - d. Dispose of excess soil material and waste materials as hereinafter specified.
  - e. Stabilize soil stockpiles with temporary seeding as required.
- G. Excavation for Trenches and Structures:
- a. Trenches shall be opened only so far in advance of pipe laying as the County will permit and in no case will this distance exceed 300 feet. The width of the trench at and below the top of the pipe shall not exceed the outside diameter of the pipe plus twenty-four inches (24"). The trench walls above the top of the pipe may be sloped or the trench above the top of the pipe may be widened as necessary for bracing, sheeting, and shoring. Where these trench widths are exceeded, the Contractor shall be required to mechanically tamp an approved backfill material from the bottom of the trench to six (6") inches above the top of the pipe as directed by the County and the trench re-excavated to the proper dimension.
  - b. Excavate trenches to the depth indicated or required. Carry the depth of trenches for piping to the indicated flow lines and invert elevations.
  - c. Grade bottom of trenches as indicated. Notch under pipe bells to provide solid bearing for the entire body of the pipe.
  - d. The trench shall be in accordance with the DSM Details.
  - e. Cold Weather Protection: Protect excavation bottoms against freezing.

- f. Excavation for structures shall conform to the lines and grades as shown, established, or as necessary. Where the bottom of the excavation is in unsuitable material, such material shall be excavated to a depth of one foot below the bottom of the structure or to a depth required by the County and replaced with No. 57 stone, coarse sand, or other material approved by the County. Bottoms shall be planked or covered with appropriate fabric if necessary to prevent the mixture of native in-place materials with the backfill material. All sheeting, bracing, and shoring required for safety shall be installed in conformity with applicable rules and ordinances.

### 3.2.3.3 Hardpan Excavation

Hardpan is classified as clay, shale, sand indurate, or hardened with a cementitious material, which requires loosening with an air spade or blasting before it can be removed from the trench. The same clearances shall be made between the pipe or structure and hardpan material as is described hereinafter for rock excavation.

### 3.2.3.4 Rock Excavation

- A. Rock excavation is solid rock in the original bed or well defined ledges comprised of solid rock which can only be removed by blasting and/or drilling or by the use of jack hammers, and shall include all boulders or detached pieces of rock one-half cubic yard or more in content.
- B. Pipe Trench: Rock shall be excavated a minimum of six inches (6") below the bottom of all pipes. The pipes shall be laid on a cushion of approved material, of sufficient depth to provide the proper grade. A minimum clearance of six inches (6") shall be provided between the vertical walls of the trench and the bell of the pipe.
- C. Structures: Rock excavation for structures shall extend a minimum of eight inches (8") below the bottom or base of structure and suitable bedding shall be provided. A minimum clearance of two feet (2') shall be provided between the rock and the exterior face of the structure.

### 3.2.3.5 Blasting

- A. Blasting operations shall be in strict accordance with Rules and Regulations Governing Manufacture, Storage, Handling, Use, and Sale of Explosives issued by the Department of Labor and Industry of Virginia and any County ordinances. All blasting shall be done at the sole risk of the Contractor and shall be done only by experienced licensed personnel. Occupants of nearby structures shall be notified prior to beginning blasting operations. The blasting operation and notification schedule shall be coordinated with the County Fire Marshall.
- B. When blasting is required; the Contractor shall conform to the following requirements:
  - a. Blasting shall not be permitted before 9:00 A.M. or after 4:00 P.M. Monday through Friday.

- b. Blasting on Saturdays, Sundays, or holidays shall not be permitted.
- c. The Contractor shall, each day when necessary to blast, set up an approximate schedule of blasting operations and provide 24 hours' notice to the County and property owners with occupied buildings within 1000 feet of blasting.
- d. The Contractor shall use mats to minimize noise and control flying debris.
- e. The Contractor shall obtain all required permits.

### 3.2.3.6 Backfill for Trenches

- A. After the installation of the pipe has been field inspected and approved, the trenches shall be backfilled as specified and shown in the Spotsylvania County Standard Details or VDOT Standard details (specifically the latest version of the LUP-OCPR detail), and all related VDOT standards, specifications, and regulations if in the right of way.
- B. Pipe shall have minimum bedding as shown on the Spotsylvania County Standard Details. Pipe bedding shall be VDOT #5 or #57 stone.
- C. Trenches shall be constructed in accordance with Spotsylvania County Standard Details or VDOT requirement, whichever is more stringent. The initial backfill shall be carefully compacted by hand or pneumatic tamping methods under the pipe, on both sides of the pipe, and above the pipe. Materials shall conform to the following:
  - a. Controlled Fill
    - 1. Roadbed fill shall consist of suitable imported on-site materials per VDOT's LUP- OCPR detail and approved by VDOT for use in the roadway prism.
    - 2. Materials placed in a trench excavated in the roadway: Borrow materials for backfill operations must have a minimum CBR of 15. Suitable materials for fill (minimum CBR of 15) shall consist of any approved material imported or excavated from the cut areas, shall contain no rocks or gravels greater than two inches (2") in size, and shall contain at least 40 percent of material smaller than one-fourth inch (1/4") in size. No material of a perishable, spongy, or otherwise improper nature shall be used as fill. Materials classified as SM or SC in accordance with ASTM D2487 shall be used.
  - b. Select Backfill
    - 1. Imported materials placed under pavement: VDOT 21A
    - 2. All other areas in right-of-way to be maintained by VDOT: Materials classified as SM or SC in accordance with ASTM D2487, free of rock or gravel larger than two inches (2") in any dimension, debris, waste, frozen materials, organic material, and other deleterious matter. The plasticity index shall be less than twenty (20).

c. Bedding

Where directed by County, Owner, or VDOT Inspector, bedding stone shall be wrapped in geosynthetic filter fabric.

1. a. Water mains: When stone is required by the County or VDOT, VDOT #5 OR #57 shall be used.
2. Sanitary Sewer: VDOT #5 or #57 stone.

d. Unsuitable Material

Any material that contains more than five percent (5%) by weight organic matter, or that having unstable bearing capacity, excessive moisture content, roots, mulch, debris, waste, or frozen materials.

- D. After the initial backfill has been placed, the remainder of the backfilling may be done by hand or with mechanical equipment in lifts no greater than eight inches (8") loose or six inches (6") compacted.
- E. Where settlement occurs, the trench shall be refilled, contoured, and compacted by an approved method to conform to the surface of the ground.
- F. In general, sheeting and bracing shall be removed as the backfilling progresses, and in such a manner as to avoid caving of the trench. Voids left by the withdrawal of the sheeting or shoring shall be carefully filled and rammed. Where, in the opinion of the County, damage is liable to result from the withdrawal of the sheeting, it shall be left in place.
- G. No rocks larger than two inches (2") in any dimension should come in contact with pipe.
- H. Backfill shall be completed in six inch (6") layers with the following percentage of maximum density at optimum moisture content as determined by AASHTO T-99. See [Section 3.2.3.8.2](#)
- a. Ninety-five percent (95%) within ten feet (10') of and under pavement, road shoulders, roadside ditches, driveways and other structures.
  - b. Eighty-five percent (85%) for pipelines installed outside of the roadway prism.
- I. Under Existing Roadways and Pavement: Backfill for trenches under roadways and other paved areas shall be in accordance with the requirements specified above or, if more stringent, the requirements of VDOT.
- J. Clay dams: Clay dams shall be utilized in the trench where the possibility exists that ground or surface water will follow the sewer trench, causing damage or undermining of pipe bedding. Clay dams shall be installed in the trench as directed by the Inspector to prevent groundwater from flowing down the trench and damaging the sub grade. Native soil for use in clay dams shall be Class CL, MI, CH, SC, or have a verified imperviousness of 0.001 cm/sec as per ASTM 05084. The Inspector shall approve clay

material prior to use.

- K. **Backfill Placement:** Backfill shall be placed so that it cannot infiltrate existing or newly laid pipes, manholes, valve boxes, or any other related structures.

### 3.2.3.7 Backfill for Structures

Around and adjacent to structures, backfill shall be of material of suitable stability and permeability. Backfill shall be placed in six inch (6") lifts, with each lift compacted by an approved method. No backfill shall be placed against a structural wall until all connecting structural members are in place. It shall be the Contractor's responsibility to provide compaction to ninety-five percent (95%) per ASTM D-698. The Contractor shall provide adequate protection to all structures during backfilling and use every precaution to avoid damaging or defacing them.

### 3.2.3.8 Compaction

The Contractor is responsible for the correct bedding of utility lines, backfill of pipe trenches, and compaction of backfill for all pipe installations except for parallel installations under the pavement as approved by VDOT. If in the Inspector's opinion, excavated material is not suitable for backfill, imported backfill must be used.

The Contractor shall have density and compaction tests performed by a certified independent laboratory verifying that the trench backfill has been compacted as required. Any material not compacted as required shall be removed and replaced, re-compacted, and re-tested. The work shall be performed by a qualified testing consultant. Upon completion of each layer of fill in a designated area, the Contractor shall allow adequate time for the testing consultant to inspect the tests. Verbal results of tests shall be given to the Contractor and Inspector immediately. Copies of all test results shall be submitted to the County within five (5) business days of the conclusion of the test.

Prior to first acceptance of the Project by the county, the Contractor shall supply to the County the certification by a P.E. showing that the construction adhered to the approved plan and complied with the compaction testing specifications.

#### 3.2.3.8.1 COMPACTION AND INSPECTION FOR PUBLIC UTILITIES UNDER PAVEMENT IN VDOT MAINTAINED RIGHT-OF-WAY – NEW CONSTRUCTION

The County or its consultant shall provide testing services for parallel installation of waterlines, sanitary sewers, and appurtenances to be located under pavements in right-of-way to be maintained by VDOT. The Owner shall be responsible for reimbursing the County for all costs associated with reporting, inspection, compaction, and laboratory services related to this installation.

The Reimbursement Agreement in [Appendix I](#) of this DSM shall be executed by the Owner prior to construction. The Reimbursement Agreement outlines requirements and conditions that need to be met for the County to be reimbursed by the Owner for the County's expenditures related to geotechnical testing and inspection for water and sanitary sewer utility trenches under the roadway. The Reimbursement Agreement in [Appendix I](#) is a draft document. The County and the

Owner and agree upon items specific to a Project before construction of public utilities under the roadway can commence. The Reimbursement Agreement shall be reviewed by the County Attorney's office before the County can provide final approval.

Following completion of construction of each site plan, infrastructure plan or section of a subdivision construction plan, as evidenced by the County's First Acceptance Letter, the County shall submit one copy of all reports to:

Area Land Use Engineer (North)  
VDOT Fredericksburg District  
86 Deacon Road  
Fredericksburg, VA 22405

### 3.2.3.8.2 COMPACTION AND INSPECTION – TESTING AND REPORTING METHOD

Any installation of public utilities outside of the VDOT maintained right-of-way shall adhere to Spotsylvania County Utility Standard Details for compaction and backfill.

Any parallel installation of public utilities under pavement in the right-of-way shall follow the requirements below as well as the VDOT Land Development Inspection Documentation Best Practices Manual and all pertinent VDOT specifications.

- A. Test Methods – The following test methods must be used:
  - a. VTM-1: Laboratory Determination of Theoretical Maximum Density Optimum Moisture Content of Soils, Granular Subbase and Base Materials
  - b. VTM-10: Determining Percent Moisture and Density of Soils Under Asphalt (Nuclear Method)
  - c. VTM-12: Use of One-Point Proctor Density
  - d. AASHTO-T191: Standard Method of Test for Density of Soil In-Place by Sand Cone Method
- B. Testing Frequency – Tests shall be performed in accordance with VDOT Materials Division Manual of Instruction Section 309, Project Sampling Testing and Inspection Section 309.01 Density Control, Section (d), Frequency of Field Density Test as modified below:
  - a. Backfill for pipes. A minimum of one (1) test shall be performed for each six inch (6") lift on alternating sides of the structure for each 100 linear feet or portion thereof in structure length. This test pattern shall begin after the first six inch (6") compacted layer above the structure's bedding and shall continue to one (1) foot above the top of the structure.
  - b. Backfill for Manholes: Manholes shall have a minimum of one (1) test performed around the perimeter of the structure every fourth (4<sup>th</sup>) compacted

layer to five feet (5') below the top of the structure; in the top five feet (5'), one (1) test every other lift around the perimeter of the structure shall be performed. The test pattern shall begin after the first four-inch (4") compacted layer above the bedding and shall continue to the top of the structure.

- C. Qualifications of Technicians – Each field technician shall hold a certification as a VDOT Soils Compaction Technician.
- D. Reporting Forms – The Contractor shall report all test results on forms in accordance with VDOT Materials TL (Test Log) Forms as shown below:
  - a. TL-55 Report of Nuclear Test Section
  - b. TL-124 Report of Nuclear Embankment Densities
  - c. TL-125 Report of Field Density of Soil
  - d. TL-12A Worksheet for One-Point Proctor
- E. Report Submissions – The Contractor shall submit the above reports, sealed by a Professional Engineer licensed in the Commonwealth of Virginia, to the Department on a weekly basis. Reports shall certify that the construction conforms to the Approved Plans.

Following completion of construction of each site plan, infrastructure plan or section of a subdivision construction plan, as evidenced by the County's First Acceptance Letter, the Contractor shall submit one copy of all reports to:

Area Land Use Engineer (North)  
VDOT Fredericksburg District  
86 Deacon Road  
Fredericksburg, VA 22405

### 3.2.3.9 Construction in Public Streets, Roads and Alleys

- A. All requirements of the VDOT permit shall be followed, unless specified otherwise by VDOT. The Contractor's operations in public streets, roads, or alleys, shall be confined to as small a space as is practicable, so as not to cause undue inconvenience to the public or abutting properties, and shall be subject at all times to the approval of the County. Unless otherwise directed by an agency controlling the public street, road, or alley being worked in, the Contractor shall perform proposed construction within public streets, roads, and alleys as follows:
- B. Water and sewer lines shall cross roadways at right angles or parallel to roadways. Uncased utility lines shall be designed to have sufficient strength to withstand dead loads and superimposed live loads. All restoration materials and workmanship shall conform to the latest edition of the Virginia Department of Transportation Road and Bridge Specifications in addition to permit requirements. The Contractor shall obtain all highway

permits and forward a copy of each to the County. Method of construction (trenching, boring, tunneling, jacking, or otherwise) shall be shown on the permit and plans. The Contractor shall identify, locate, and, as necessary, adjust, or relocate, existing utilities, structures, and survey markers (including coordinating all work to be performed).

- C. Nothing contained herein is intended, nor should be construed, to relieve the Contractor in any manner whatsoever of the responsibility to maintain trenches, pavement structure, shoulders, and the work site in general in a manner acceptable to the County. The Contractor shall notify the Department and the agency having jurisdiction over the road forty-eight (48) hours prior to the actual open cut, to schedule a meeting with the agency representative and the Inspector.
- D. Wherever pavement is permitted to be cut, not over one-half (1/2) of the road width shall be disturbed at one time, unless the agency having jurisdiction over the road reviews and approves the method of detouring traffic. The first opening shall be in travelable condition before the second half can be opened.
- E. Where the Contractor is granted approval to open cut an existing road, it shall comply with the following requirements:
  - a. The Contractor shall notify VDOT 48 hours prior to any open cut work being performed.
  - b. Work within the roadway shall be done between the hours of 9 A.M. and 4 P.M. or as otherwise required by VDOT.
  - c. The Contractor shall utilize proper sign layout and channelization devices (i.e., cones, plastic barrels, pavement marking, etc.) during construction, according to VDOT's Virginia Work Area Protection Manual.
  - d. The Contractor shall restore the area of the open cut in accordance with the Spotsylvania County Standard Details G-4 or the VDOT LUP-OCPR detail, whichever is more stringent. Any deviations to its details shall be approved by the Department or VDOT.
- F. Where the Contractor is granted approval to open cut the road for parallel installation within the pavement and service crossings, pavement replacement shall be in accordance with the details reflected in this DSM, the Approved Plans, or the VDOT Land Use Permit Special Provisions, whichever is the most stringent.
- G. Placement of all plant mix courses shall be rolled where possible with a unit having a manufacturer's rating of ten (10) tons, and rolled until the aggregate is keyed into the bitumen. Where rolling is not possible, a mechanical tamp shall be used. The stone shall be placed in the trench daily up to 1,500 feet, at which time the pavement shall be covered with a temporary or permanent asphalt patch. If the application of the bituminous layer is delayed for adverse weather conditions, the Contractor shall provide

and maintain a base course that is acceptable to VDOT and the Department until such time as the appropriate pavement patch can be applied and accepted.

- H. Upon completion of the installation of water and sewer lines (not necessarily all testing completed), the Contractor shall restore pavement in the manner prescribed on the VDOT permit within ten (10) days. All trenches and repaving shall be maintained in accordance with the highway permit. All structures (valves, manholes, or other utility items) in the roadway shall be adjusted to the proper height to be flush with the pavement.
- I. Site Maintenance and Restoration: Road connections and private entrances shall be kept in a satisfactory condition. Entrances shall not be blocked and sufficient provisions made for safe travel to adjacent property at all times. When entrances are disturbed, they shall be restored to original condition or to a condition satisfactory to VDOT, the Department, and the property owner. Road drainage shall not be blocked. The pavement, shoulders, ditches, general roadside, and drainage facilities shall be left in as good condition as found (consistent with adjoining sections of the highway), with positive drainage maintained in the ditches. All loose material shall be swept from hard surfaces immediately after backfilling. Calcium chloride or an approved alternate shall be used to settle dust before sweeping whenever necessary. Concrete walks and curbs shall be replaced in entire sections. During rainy periods all trenches shall be watched closely for settlement. If an emergency situation arises under any circumstances, repairs shall be made at no expense to the County. Additionally, after paving is complete per VDOT standards, the repairs for any settlement of trenches requiring additional fill, pavement, or other corrective measures shall be made in accordance with VDOT standards and regulations, this includes future State or private roads currently owned by the Applicant, and shall be provided at no expense to the County.
- J. Work Zone Protection: The Contractor shall immediately correct any situation which may arise as a result of construction that the Department deems hazardous to the traveling public. The Contractor shall comply with the requirements of the agency that issued a permit for the construction.
- K. Traffic shall not be blocked, rerouted, or otherwise impeded without written permission from the appropriate agency. Placement and type of traffic control, warning devices, and personnel shall be in accordance with VDOT's Work Area Protection Manual. Where one-way traffic is permitted, Contractor shall perform proper flagging for the duration of the Project. The Contractor will notify the proper agency at least forty-eight (48) hours before starting work. If traffic is impeded in any way, the same notice shall be given to Fire Department, Rescue Squad, VDOT, Police Department, Sheriff, and School Board. All open trenches, pits, and other hazards shall be secured with barricades and any other equipment necessary to protect the public. Neither the County nor the State of Virginia shall be liable for any damage resulting from construction.

### 3.2.3.10 Tracing Wire for all Water and Sewer Mains

- A. Tracing Wire shall be provided for all water and sewer mains and appurtenances, water and wastewater, regardless of material. Wire shall be #10, Solid type THHN, thermoplastic insulated and nylon jacketed. Wire shall be color coded blue for water and green for sewer.
- B. Tracing wire shall be extended along all water service and into every meter barrel.
- C. Tracing wire shall be extended along all sewer lateral services.
- D. All water and sewer mains must have a location to connect to the tracer wire every 400 feet. Acceptable connection points are meter barrels, fire hydrants, test stations, vaults and manholes.
- E. Wire Connectors
  - a. Direct bury waterproof connection
    - 1. Lug; Tin plated with conductivity aluminum, screws; zinc plated steel, housing; high impact polypropylene, sealant; non-hardening viscous dielectric silicone.
    - 2. Manufacturer: Dryconn Waterproof Connectors or equivalent
  - b. Test Station Box: Plastic box for corrosion protection. Plastic shaft a minimum of three inches (3") long with cast iron lid and collar. Collar shall be a minimum of two inches (2") deep. Lid shall be bolted to collar with brass bolts. Lid shall be imprinted with the wording "TEST." Lid shall be color coded blue for water and green for sewer.
- F. Tracing Wire must be tested for continuity.

### 3.2.3.11 Marking Tape for all Water and Sewer mains

Provide Marking Tape for all pressure mains, water and wastewater, regardless of material. Tape shall be polyethylene tape with a metallic core, two inches (2") in width, with appropriate continuous printed message. Tape shall be Style 85513 for Sewer Lines and 85515 for Water lines as manufactured by the Seton Corp. or approved equivalent.

### 3.2.3.12 Disposal of Waste Materials

- A. Removal from Project Site: Remove waste materials, including unacceptable excavated material, trash, and debris and dispose of it legally off the Project site.
- B. Dust Control: Water, calcium chloride, or approved alternate shall be periodically applied to alleviate problems associated with dust.
- C. Disposal of asbestos cement pipe shall be done in accordance with AWWA Manual 16, Work Practices for Asbestos Cement Pipe.

## 3.3 Sanitary Sewer Systems

### 3.3.1 General

#### 3.3.1.1 Requirements of Regulatory Agencies

Construction as shown on the Approved Plans or stated herein shall be performed in accordance with current and applicable requirements as established by the County, VDH, DEQ, or any other agency having jurisdiction. Where conflicts arise between the Contract Documents and other requirements, the more restrictive, as determined by the Department in its sole discretion, shall apply. If such requirements require a change in the work as stated herein or shown on the plans, the Contractor shall stop work and notify the County for further direction.

### 3.3.2 Products

#### 3.3.2.1 Sewer Pipe and Fittings

- A. Only the following materials may be used unless otherwise approved by the Department.
- B. Polyvinyl chloride (PVC) non-pressure pipe (6"-15") and fittings shall meet requirements of ASTM D3034, Type PSM-SDR-35 with elastomeric gasket joints meeting requirements of ASTM D3212.
- C. Polyvinyl Chloride (PVC) non-pressure pipe (18" - 48") and fittings shall meet requirements of ASTM F679, Table I Type SDR-35 for large diameter solid wall PVC pipe with elastomeric gasket joints meeting requirements of ASTM D3212. Bedding shall be as required by the County for plastic pipes as shown in the DSM. Cell Classification for Sewer Pipe shall be 12454-B or 12364-C.
- D. Polyvinyl Chloride (PVC) non-pressure pipe (21" and larger) shall meet requirements of ASTM F794, and fittings shall meet the requirements of ASTM 3034-35. PVC sewer pipe with elastomeric gasket joints shall meet requirements of ASTM D3212.
- E. Molecularly Oriented Polyvinyl Chloride (PVCO) pressure pipe, (4" – 12") will be allowed as an alternate to zinc coated ductile iron pipe for sanitary force mains only. PVCO pipe shall meet the requirements of AWWA C909 with elastomeric gasket joints meeting the requirements of ASTM D3139. Joint restraint systems shall meet the requirements of UNI-B-13.
- F. Zinc Coated Ductile iron pipe with V-Bio Polywrap shall meet requirements of AWWA C151 and AWWA C105. Pipe shall be Class 52 minimum or higher based on the requirements of the soil load, pressure, impact load, corrosion protection, or other needs identified by standard or by the Engineer. Pipe shall have lining and coating specifically designed for sanitary sewer service.
  - a. Mechanical joints and jointing materials shall meet requirements of AWWA/ANSI C111/A21.11.

- b. Push-on joint and rubber gasket shall meet requirements of AWWA C111.
- c. Exterior, bituminous coating for cast iron fittings and zinc coated ductile iron pipe shall meet requirements of AWWA/ANSI C106/A21.6 or AWWA/ANSI C151/A21.51 as applicable.

### 3.3.2.2 Sanitary Sewer Manholes:

- A. Manholes shall be constructed of precast reinforced concrete manhole sections in accordance with requirements of ASTM C478 and as shown in the DSM Standard Details. Thermoplastic manholes will not be accepted unless specifically approved in writing by the Director. All manholes shall be coated on the outside with a bitumen material, Koppers Bistumastic No 300-M, applied 2 coats min. 16 dry mils.
- B. A maximum of two (2) lift holes per manhole section may be provided.
- C. Provide tongue and groove joints in manhole sections with a preformed groove in the tongue for placement of an O-ring type round, rubber gasket or approved alternate.

Gasket shall comply with requirements of ASTM C361.

Gasket shall provide the sole element in sealing the joint from either internal or external hydrostatic pressure.

- D. Provide flexible pipe connections to manholes for pipes twenty-four inches (24") in diameter and smaller in size. Materials shall consist of EPDM and elastomers designed to be resistant to water, sewage, acids, ozone, weathering, and aging. Use neoprene conforming to ASTM C443 and ASTM C923 and 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 break-away torque wrench available from the precast manhole supplier, and set for 60 - 70 inch/lbs.

Cast or core drill openings in manholes to receive connectors. Connectors shall be suitable for field repair or replacements. Connectors not suitable for field replacement are unacceptable.

The assembled connectors shall allow at least an eleven degree (11°) angular deflection of the pipe and at least one inch (1") of lateral misalignment in any direction and be suitable for a normal variation in diameter or roundness for the pipe material used.

- E. As a general rule steps shall not be installed unless specified. If steps are deemed necessary, they shall be corrosion-resistant and shall be one-half inch (1/2") grade 60-steel reinforcing rod encapsulated in a copolymer polypropylene. The steps shall conform with ASTM C478, paragraph 11 and to the dimensions shown in the DSM Standard Details.
- F. Manhole frames and covers shall be molded of gray cast iron conforming to ASTM A48, Class 35. All castings shall be dipped twice in a preparation of asphalt or coal tar and oil and applied at a temperature of not less than 290° F nor more than 310° F and in such a

manner as to form a firm and tenacious coating. Seating surfaces between frame and cover shall be machined. The dimensions and weights shall conform to the requirements shown in the DSM Standard Details. The word "SEWER" shall be cast into the cover.

- G. Sealant for manhole frames shall be a one-component polyurethane sealant similar to Sika "Sikaflex" type 430. Sealant for flexible pipe connections shall be a two-component polysulfide sealant similar to Sika "Sikaflex" type 412 with primer type 419.
- H. Manhole frames shall be bolted to the manhole and secured with Heat Shrink Seal, Rapid Seal, or equivalent.
- I. Manholes shall have rain inserts installed in accordance with the DSM Standard Detail.

### 3.3.2.3 Sewage Air/Vacuum Valves

- A. The sewage air/vacuum valve shall be designed to automatically exhaust large quantities of air during filling of a system. It shall also allow air to enter the pipe system when the line is being emptied. All this shall be accomplished through the functioning of a compound lever system in conjunction with a large and small orifice in one integral body casting.
- B. This device shall have only orifices and no mechanical leverage, other than the weight of a stainless steel float ball.
- C. It shall automatically provide for the escape of the air to the atmosphere without the loss of water when the float ball moves away from the orifice seal.
- D. The body of the valve shall be cast iron and shall be coated with fusion-bonded epoxy, Teflon, or other approved coating to withstand moist, abrasive, and corrosive conditions.
- E. Float with Buna-N seal shall be provided for positive seating.
- F. Rigid stainless steel valve plug shall be provided to seal off the outlet orifice.
- G. Wherever possible, valves shall have elongated bodies to minimize the problem of clogging by permitting the use of a long float stem. However, where height restrictions do not permit the use of the standard height valve, a short body valve can be applied.
- H. Sizes one inch (1") through three inches (3") shall have N.P.T. inlets and outlets. Larger sizes shall have flanged inlets conforming to ANSI class 125 or 250 and shall have N.P.T. outlet as standard. Flanged outlet or protective hood shall be optional. It shall have a minimum of 3/32" outlet orifice for an operating pressure of 0-150 psi and 1/8" outlet orifice for an operating pressure range of 0-300 psi. All fittings shall be brass.
- I. Valve shall be suitable for 300 psi working pressure at a minimum.
- J. All flushing attachments shall be provided with each valve.

### 3.3.2.4 Sewage Combination Air Release Valves

- A. Combination valves shall be designed to have the operating features of both air and vacuum valves and air release valves. It shall purge air from the system at start-up, vent small pockets of air while the system is pressurized and running, and prevent critical vacuum conditions during draining. They shall be installed at all the high points in the pipe line where air would naturally tend to rise during filling and collect during operation or where vacuum would tend to form when the system is drained.
- B. The device shall have only orifices and no mechanical leverage, other than the weight of a stainless steel float ball.
- C. The body of the valve shall be of a material and coating to withstand moist, abrasive, and corrosive conditions.
- D. Float with Buna-N seal shall be provided for positive seating.
- E. Rigid stainless steel valve plug shall be provided to seal off the outlet orifice.
- F. The combination valve shall be an integral unit manufactured and sold as a combination valve.
- G. Sizes up to three inches (3") shall have N.P.T. inlets and outlets. Larger sizes shall have flanged inlets conforming to ANSI class 125 or 250 and shall have N.P.T. outlet as standard. It shall have a minimum of 3/32" outlet orifice for an operating pressure of 0-150 psi and 1/8" or 1/16" outlet orifice for an operating pressure range of 151-300 psi.
- H. Valve shall be suitable for 300 psi working pressure.
- I. All flushing attachments shall be provided with each valve.
- J. Odor control devices shall be required.

### 3.3.2.5 Sewage Air Release Valves

- A. The sewage air release valve shall be designed to automatically exhaust small amounts of air accumulated at a system's high point. This shall be accomplished while the system is in service and under pressure. They shall be installed at high points in the system where air naturally tends to collect.
- B. The device shall have only orifices and no mechanical leverage, other than the weight of a stainless steel float ball.
- C. The body of the valve shall be of a material and coating to withstand moist, abrasive, and corrosive conditions.
- D. Stainless steel float with Buna-N seal shall be provided for positive seating.
- E. Sizes up to three inches (3") shall have NPT inlets and outlets as per ANSI B2.1. Larger sizes shall have flanged inlet conforming to ANSI B16.1 class 125 as standard. It shall have

a minimum of 3/16" orifice for an operating pressure of 0-150 psi and 1/8" outlet orifice for an operating pressure range of 151-300 psi. All fittings shall be brass.

- F. Valve shall be suitable for a working pressure of 300 psi.
- G. Odor Control devices shall be required.

### 3.3.2.6 Sewage Plug Valves

- A. All sewage plug valves shall be of the non-lubricated, eccentric type with resilient faced plug and round ports of no less than ninety percent (90%), or rectangular ports of no less than eighty percent (80%), of the connecting pipe area, except valves of twenty-four inches (24") or larger size shall have port areas of no less than seventy percent (70%) of the connecting pipe area.
- B. Valves shall be for buried underground service as well as plant service and shall be rated for 175 psi up to twelve inches (12") and 150 psi for sizes fourteen inches (14") and larger. Drop-tight shut-off shall be provided at full rated working pressure in the standard flow direction and 50 psi in the reverse direction, except when full-rated sealing is required in both directions.
- C. Valves six inches (6") and larger shall be equipped with geared actuators with a two inch (2") square operating nut. Hand wheel and power actuated valves shall also include a two inch (2") square operating nut for emergency operation.
- D. All gearing shall be enclosed in a semi-steel housing and be suitable for running in a lubricant with seals provided on all shafts to prevent entry of dirt and water into the actuator. The actuator shaft and the quadrant shall be supported on permanently lubricated bronze bearings. Actuators shall clearly indicate valve position and an adjustable stop shall be provided to set closing torque and to provide seat adjustment to compensate for change in pressure differential or flow direction change. All exposed nuts, bolts, and washers shall be zinc plated.
- E. Valves and gear actuators for buried or submerged service shall have seals on all shafts and gaskets on the valve and actuator covers to prevent the entry of water. Actuator mounting brackets for buried or submerged service shall be totally enclosed and shall have gasket seals. All exposed nuts, bolts, springs, and washers shall be stainless steel.
- F. Valves shall open left (counterclockwise) and shall have mechanical joint end connections for buried service and flanged or Victaulic ends for non-buried service.
- G. Valve bodies and all other cast iron parts shall conform in all respects to the American Society for Testing Materials' Standard Specifications of Gray Iron Castings, "ASTM Specification Designation A-126-Class B." The castings shall be clean and perfect without blow or sand holes or defects of any kind. No plugging or stopping of holes will be allowed.
- H. Body ends shall be flanged with facing and drilling in accordance with ANSI B16.1, Class 125 or mechanical joint in accordance with AWWA Standard C-111 or ANSI A21.11. All

mechanical joint end valves shall be furnished complete with joint accessories (bolts, nuts, gaskets, and glands).

- I. Valve bodies shall be furnished with a raised seat surface completely covered with ninety percent (90%) pure nickel to ensure that the resilient plug face contacts only nickel, or a one-piece 304 stainless steel seat ring threaded to the body. The nickel seat must be welded to the valve body or the body seat ring to produce a metallurgical bond with interpenetration to the base metal with a bond strength equal to or greater than the valve body or seat ring material. The nickel or stainless steel seat must be machined to a finish of not more than sixteen (16) micro-inches to achieve minimal friction and wear to the resilient plug face during valve operation. Whether welded or screwed, the valve seat shall be designed to provide uniform contact with the resilient plug face and to prevent the plug face from contacting any cast iron surface. Resilient seats or seats attached to the body by screws or any other method not specified herein are not acceptable. Plated or sprayed nickel seats or epoxy seats are not acceptable.
- J. Valve bodies shall be furnished with an adjustable closed position stop. The seat end and standard flow direction shall be cast onto the valve body.
- K. Resilient faced plug/operating shaft shall be of a one-piece design of ASTM A126 Class B cast iron with a seating surface eccentrically offset from the center of the plug shaft, and shall have a precision molded resilient facing of chloroprene (Neoprene), Buna-N (nitrile), or nitrile-butadiene (Hycar). With the valve in the open position, all surfaces of the plug/shaft shall be substantially out of the fluid flow path.
- L. Valve shaft journal bearings shall be sleeve type, sintered, oil impregnated, permanently lubricated, type 316 ASTM A743 grade CF-8M or AISI type 317 L stainless steel, or phenolic-backed Teflon. Thrust bearings shall be located in the upper and lower journal areas and shall consist of stainless steel, Teflon, or a combination of those materials. Grit seals shall be provided in the upper and lower journals to prevent abrasive material from entering the bearing and seal areas.
- M. Valve shaft seals shall conform to AWWA Standard C504-87, Section 3.7 and shall be of the bronze cartridge type utilizing O-rings, or the adjustable multiple V-ring type and shall be replaceable without disassembling the valve, while the valve is under system pressure.
- N. Valve interiors and exteriors shall be coated according to AWWA Standard C550-90 with a two-component high build epoxy suitable for potable water service, with interior surfaces receiving 8 - 10 mils (dry film thickness) and exterior surfaces receiving 3 - 5 mils (dft) or 8 - 10 mils (dft) hand-applied epoxy coating. For buried or submerged service, 8 - 10 mils (dft) of asphalt varnish may be substituted for the exterior coating.
- O. Valve testing shall be conducted per AWWA C504-87 Section 5 covering rubber seated butterfly valves. Each valve shall be performance tested per paragraph 5.2 assuring valve operation.

- P. Body seat and shell leakage testing is to be conducted on each valve as per AWWA C504-87 paragraphs 5.3 and 5.4.
- Q. Proof of design testing shall be conducted per AWWA C504-87 paragraph 5.5 and witnessed by a third party inspection agency. Certified copies of this report shall be available upon request.

### 3.3.3 Execution

#### 3.3.3.1 Installation of Sanitary Sewer Systems

- A. Excavating and Backfilling and Bedding:
  - a. The Contractor shall remove any and all materials encountered in the course of excavating for all underground utility systems. After the pipe is in place, the Contractor shall backfill with suitable material, free from frozen earth, rocks, organic materials, or other unsuitable materials.
    - 1. The Contractor shall provide all necessary shoring required for the protection of excavations, existing utilities, and workmen and do all necessary pumping required to keep excavation and pipe free from water from any source at all times.
    - 2. The Contractor shall provide sufficient barricades, etc., adjacent to excavations to safeguard against injury to workmen and the public.
    - 3. The Contractor shall carefully protect the roots of live trees where they are encountered in excavations.
    - 4. The Contractor shall exercise special care in backfilling trenches to guard against disturbing the joints.
    - 5. The Contractor shall remove and dispose of any material not used for backfill: Removal of subsurface obstructions, which are uncovered during excavation for installation of the sanitary sewer systems, shall be at the Contractor's expense. This shall include removal of existing concrete or brick from existing building foundations, footings, abandoned utility piping, wires, structures, rock, boulders, etc., which may not be visible from surface investigations before construction but will interfere with new installations. If such obstructions are encountered, they shall be removed two feet (2') from around the area of new work and the excavation backfilled with a suitable material as specified.
  - b. Bedding
    - 1. Pipes up to and including twenty-four inches (24") in diameter, shall be bedded in compacted granular material. Pipe shall be placed on compacted granular bedding having a minimum thickness of one-fourth (0.25) of the

pipe's outside diameter (four inches (4") minimum), and the granular bedding shall extend to the spring line of the pipe. Pipe bedding shall conform to the requirements of Table II-3 of the VDOT Road and Bridge Specifications; Size 8, 8P, or 9, having a maximum half inch ( $\frac{1}{2}$ ") particle size. Bedding for pipe larger than 24 inches (24") and zinc coated ductile iron pipe shall be designed on an individual basis and approved by the Director.

2. Only Class A, B, or C bedding (latest edition of the ASCE Manuals and Reports on Engineering Practice, WEF Manual of Practice) and AWWA class shall be permitted. The design engineer may require a different class of bedding in order to provide the strength necessary for the soil and load conditions encountered.

B. Pipe Handling:

- a. The Contractor shall take all precautions to ensure that pipe and related items are not damaged in unloading, handling, and placing in trench. Examine each piece of material just prior to installation to determine that no damage has occurred. Remove any damaged material from the site and replace with undamaged material.
- b. The Contractor shall keep pipe clean. Exercise care to keep foreign material and dirt from entering pipe during storage, handling, and placing in trench. Flushing of new sanitary sewer lines shall be the responsibility of the Contractor prior to CCTV inspection by the County.
- c. The Contractor shall survey Line and Grade:
  1. The Contractor shall maintain line and grade and provide the County with cut-sheets unless the County waives this requirement.
  2. The Contractor shall have level or transit in good working order on the job set up at all times to periodically check line and grade of pipe.

C. Sewer Pipe Laying:

- a. Laying of sewer pipe shall be accomplished to line and grade as indicated on the Approved Plans and in the trench only after it has been dewatered and the foundation or bedding has been prepared. Mud, silt, gravel, and other foreign material shall be kept out of the pipe and off the jointing surfaces.
- b. All pipe laid shall be retained in position so as to maintain alignment and joint closure until sufficient backfill has been completed to adequately hold the pipe in place. All pipes shall be laid to conform to the prescribed line and grade shown on the Approved Plans. After completion, the pipe shall exhibit a full circle of light at one manhole when viewed from the next.

- c. The sewer pipe shall be laid upgrade from point of connection to the existing sewer or from a designated starting point. If the starting point is at an existing stub, it shall be removed and a full length of pipe installed. The sewer pipe shall be installed with the bell end forward or upgrade. When pipe laying is not in progress, the forward end of the pipe shall be kept tightly closed with a water-tight plug or cap. When the upstream end of a sewer does not terminate at a manhole, it shall be plugged and its location marked in a manner approved by the Inspector.
  - d. The pipe shall be fitted and matched so that when installed it will form a smooth uniform invert.
  - e. Prior to joining the pipe, all surfaces of the pipe to be joined and the surfaces of factory made jointing materials shall be clean and dry. Lubricants, primers, adhesives, etc., shall be applied and the pipes joined as recommended by the manufacturer's specifications. Sufficient pressure shall be applied in making the joint to assure that the pipe is "home". The interior of the pipe shall be cleaned of all foreign material as the work progresses. At the end of the work day, the last pipe laid shall be blocked to prevent joint separation and closed with a water tight plug or cap.
  - f. Joining Pipe:
    - 1. Zinc coated ductile iron pipe is to be joined in accordance with the requirements of AWWA Standard C600 and the manufacturer's recommendations.
    - 2. Polyvinyl chloride (PVC) pipe shall be joined in accordance with ASTM Standard D-2321 and the manufacturer's recommendations.
    - 3. Other type pipe shall be joined in accordance with the manufacturer's recommendations and the requirements of the Approved Plans.
  - g. All visible leaks shall be corrected prior to testing.
- D. Manhole Installation:
- a. The Contactor shall take all necessary precautions to keep any debris from being introduced into the manhole during installation.
  - b. Manholes shall be constructed to the elevations indicated on the Approved Plans in accordance with the DSM Standard Details.
    - 1. Set manhole base section on bed of #57 stone with a minimum depth of eight inches (8"). Stone shall be thoroughly compacted and carefully leveled to the excavated earth wall.
    - 2. Join all manhole risers, cone top sections, and any other sections by the use of rubber gaskets.

3. Install pipe stubs in manholes where called for on the Approved Plans. All stubs shall extend beyond the manhole as reflected on the Approved Plans and shall be sealed with a watertight plug or cap.
  4. Install flexible manhole connections for all pipes sizes six inches (6") to twenty-four inches (24"), inclusive, and apply sealant to completely fill joint between manhole barrel and flexible connection for the full thickness of the manhole barrel.
  5. Plug lift holes from the outside with non-shrink grout and repair any defects in manhole.
  6. Set adjusting rings and manhole frames in one quarter inch (1/4") bed of Ram Nek Pioneer 301 Mastic, or approved joint sealer and secured with Heat Shrink Seal, Rapid Seal or equivalent.
  7. In paved roadways or walkways, adjusting rings shall permit upward or downward adjustment of manhole frame. Maximum height of rings shall not exceed twelve inches (12").
  8. Construct bench of concrete.
    - i. Elevation of bench at the channel shall be at the spring line of the lowest incoming pipe and the outgoing pipe.
    - ii. Bench shall slope from the wall to the channel such that the bench at the channel is three inches (3") lower than at the manhole wall.
    - iii. Where stubs are provided for future pipe connections, bench and invert shall be so formed.
    - iv. Use sulfide resistant cement for concrete or mortar on all acid-resistant manholes.
    - v. Where sealant is used, bench shall not be in contact with pipe or flexible pipe connection.
    - vi. All inverts shall be formed and allow for smooth deflections. Where multiple inlets exist, form multiple inverts consistent with the diameter and position of each inlet. Smoothly transition the invert through the manhole to accommodate varying pipe sizes.
    - vii. In drop manholes, bench to the invert of the drop pipe and transition the flow smoothly into the channel invert.
    - viii. All visible and known leaks shall be corrected prior to testing.
- E. Service Connections: The Contractor shall take all necessary precaution to keep any debris from being introduced into the service connection during installation. Place a tee-wye SDR 26 or SCH 40 fitting with four inch (4") outlet in the sewer where service connection

is to be constructed. Lay four inch (4") SDR 26 or SCH 40 PVC or zinc coated ductile iron pipe from the connection to the property line or easement boundary on a grade of not less than one quarter inch (1/4") per foot unless otherwise shown on Approved Plans. Pipe shall be bedded in stone four inches (4") under pipe and to the spring line. Terminate service connection at the property line or easement boundary with an approved glue-on cap, and mark the end with 4" x 4" CCS pressure treated board installed plumb from bottom of four inch (4") cap to four feet (4') above ground. Service connection shall be of same type of pipe as sewer unless otherwise approved by County. When making a service connection to an existing sewer, the Contractor shall use a mechanical hole-cutter and approved saddle or other approved fitting.

- F. Existing Manhole Tie-In: The Contractor shall take all necessary precautions to prevent any debris from being introduced into the manhole or line during tie-in. Core drilling and a flexible pipe-to-manhole connector shall be used in the connection of the sewer pipe to precast manholes, where stubs do not exist.

The connector shall be Kor-N-Seal assembly or approved equivalent.

The connector shall be installed in the manhole wall by activating the expanding mechanism in strict accordance with the recommendation of the connector manufacturer.

The connector shall be of a size specifically designed for the pipe material and size being utilized on the Project. All materials must conform to the approved products reflected in these standards.

### 3.3.3.2 Testing of New Sanitary Sewer System (Non-Pressure)

- A. Sanitary sewer lines forty-two inches (42") in diameter and smaller shall be tested after backfill using a low-pressure air test in accordance with ASTM F1417, latest edition. Sewer lines larger than forty-two inches (42") in diameter shall be tested by infiltration/exfiltration test. All manholes shall be vacuum tested. All testing shall be conducted in the presence of the Inspector. The Contractor shall provide all labor, materials, tools, and equipment necessary to make the tests. All equipment and methods used shall be acceptable to the Department All monitoring gauges shall be subject to calibration, if deemed necessary.
- B. Low-Pressure Air Test (Sewer Pipe forty-two inches (42") and Smaller Diameter):
  - a. Summary of Method: Plug the section of the sewer line to be tested. Introduce low-pressure air into the plugged line. Use the quantity and rate of air loss to determine the acceptability of the section being tested.
  - b. Preparation of the Sewer Line: If required by County, flush and clean the sewer line prior to testing. Give special attention to laterals. Test will be conducted with laterals installed from the main to plugs for future connection. Plug all pipe outlets using approved pneumatic plugs with a sealing length equal to or greater than the

diameter of the line to be tested. Prior to use, the pneumatic plugs must be tested by plugging both ends of a single joint of pipe. The plugs shall be pressurized to twenty-five (25) psig (or other pressure defined by the pneumatic plug manufacturer and accepted by the County prior to testing), then the pipe pressurized to five (5) psig. The plugs must not move and bracing is not allowed.

- c. Ground Water Determination: If a line is located below the water table, the elevation of the water table must be determined prior to testing. To determine the elevation of the water table, the following procedure shall be utilized unless another procedure is approved by the Inspector. Install a half inch (½”) capped galvanized pipe nipple, approximately twelve inches (12”) long, through the manhole on top of the lowest sewer line in the manhole. Immediately prior to the line acceptance test, the ground water elevation shall be determined by removing the pipe cap and blowing air through the pipe nipple into the ground so as to clear it, and then connecting a clear plastic hose to the pipe nipple. The hose shall be held vertically and a measurement of the height in feet of water over the invert of the pipe shall be taken thirty (30) seconds after the water has reached a steady level in the plastic hose.
- d. Procedures: Determine the duration for the section under test by computation from the applicable formulas shown in ASTM F1417, latest edition. The pressure-holding time is based on an average holding pressure of three (3) psi gage (a drop from 3.5 psi to 2.5 psi gage). The allowable leakage rate Q is 0.0015 cubic feet per minute per square foot of pipe area being tested.

Air Test: Minimum Time for one (1) psig Drop:

Pipe Diameter Inches	Minimum Time up to Length Shown Min:sec	Length for Minimum Time Feet	Minimum Time for Longer Length Seconds
4	3:46	597	0.380 L
6	5:40	397	0.854 L
8	7:34	298	1.520 L
10	9:26	239	2.374 L
12	11:20	199	3.418 L
15	14:10	159	5.342 L
18	17:00	133	7.692 L
21	19:50	114	10.470 L
24	22:40	99	13.674 L

27	25:30	88	17.306 L
30	28:20	80	21.366 L
33	31:10	72	25.852 L

The above values are extracted from Table 1, ASTM F1417 and are based on the equation:

$$T = 0.085 DK/Q$$

Where:        T = minimum time require for 1 psig pressure drop, seconds  
                   D = measured pipe diameter, inches  
                   Q = allowable leakage (0.0015 cfm/sf of internal surface)  
                   K = 0.000419 DL (NOT LESS THAN 1)  
                   L = length of tested section of pipe, feet

Lateral service lines are included in this test, and their effects shall be considered only if the tested section does not achieve the required minimum time. In that case, minimum time may be calculated by:

$$T = [0.085 K (D_1^2L_1 + D_2^2L_2 + \dots D_n^2L_n)] / [(Q (D_1L_1 + D_2L_2 + \dots D_nL_n))]$$

Where variables are as above except:

                  D<sub>n</sub> = nominal diameter of each pipe size being tested, inches  
                   L<sub>n</sub> = length of pipe in each diameter being tested, feet  
                   K = 0.000419 (D<sub>1</sub>L<sub>1</sub> + D<sub>2</sub>L<sub>2</sub> + ... D<sub>n</sub>L<sub>n</sub>) not less than 1

If the tested section meets the revised minimum time as calculated above, it shall be accepted.

Where the required minimum time exceeds 60 minutes, a pressure drop of 0.5 psig may be used as an alternate. The required minimum time for a 0.5 psig drop shall be half of the time required for the 1.0 psig drop as presented or as calculated above.

Determine the required test pressure. The test pressure shall be 3.5 psig unless the pipe to be tested is below the water table. If the pipe to be tested is submerged below the water table, the test pressure shall be increased by 1.0 psi for every 2.31 feet the ground water level is above the lowest invert of the tested section of the sewer.

Add air until the internal air pressure of the sewer line is raised to approximately 0.5 psi gage above the test pressure. After this internal pressure is obtained, allow time for the air pressure to stabilize. The pressure will normally show some drop until the temperature of the air in the test section stabilizes.

When the pressure has stabilized, and is at or above the starting test pressure of 3.5 psi as adjusted for water table elevation, commence the test. Before starting the test, the pressure may be allowed to drop to the starting gage pressure. Record the drop in pressure for the test period. If the pressure drops more than 1.0 psi gage during the test period, the line fails. The test may be discontinued when the prescribed test time has been completed even though the 1.0 psi gage drop has not occurred.

The test procedure may be performed prior to completing backfilling at the Contractor's option solely to identify leakage prior to backfilling, but must be performed after completion of backfilling. Acceptance shall be based only on testing completed after backfilling of the excavation.

- e. Safety: The air test may be dangerous if, because of lack of understanding or carelessness, a line is improperly prepared.

As a safety precaution, pressurized equipment shall include a regulator or relief valve set at no more than ten (10) psi to avoid over-pressurizing and damaging an otherwise acceptable line. No one shall be allowed in the manholes during testing.

- C. All manholes will be tested using the negative air pressure test (vacuum) in accordance with ASTM C1244, latest edition, for water tightness. Manholes will be visually inspected after backfilling. Contractor may backfill before testing with the understanding that any repairs will be made from the exterior of the manhole.

Manholes shall be vacuum tested and shall have ten inches (10") of mercury applied to the manhole and the time measured for the vacuum to drop from ten inches (10") to nine inches (9") of mercury. Minimum allowable test times for manhole acceptance at the specified vacuum drop.

<u>Depth of Manhole (feet)</u>	<u>Minimum Test Times (seconds) by Manhole Size (inches)</u>		
	<u>48"</u>	<u>60"</u>	<u>72"</u>
10 or less	60	75	90
Greater than 10 but less than 15	75	90	105
Greater than 15 but less than 25	90	105	120
Over 25	Time shown plus 2 seconds per foot of depth greater than 25 feet		

Test times for structures other than manholes will be based on the times for manholes of the nearest equivalent volume or as directed by the Inspector.

- D. Test for leakage of gravity sewers (greater than forty-two inches (42") diameter) using either the infiltration or exfiltration test:
  - a. Ground Water Determination: Use same procedure as "low pressure air test" above.

- b. Use infiltration test when ground water is four feet (4') or higher above pipe crown along entire length of line to be tested. Plug the pipe at the upstream manhole. Install suitable measuring device at the downstream manhole. Measure the amount of water flowing through the outlet after flow has stabilized for a period of one (1) hour minimum. Test period shall be at least fifteen (15) minutes and not more than one (1) hour. The flow measuring device must be accurate within the flow rate expected for the test duration. Allowable leakage shall be fifty (50) gallons per inch of pipe diameter per mile per twenty-four (24) hours.
- c. Exfiltration test shall be accomplished by plugging the sewer at the downstream end and filling the upstream manhole with water to the top of the manhole. Test period shall be a minimum of two (2) hours. Allowable leakage shall be fifty (50) gallons per inch of pipe diameter per mile per twenty-four (24) hours.

### 3.3.3.3 Video Inspection of Sanitary Sewer Lines

All CCTV video inspection of sanitary sewer lines shall be performed prior to first acceptance.

Contractor requirements prior to CCTV inspection are:

- A. Work Order request submitted to County
- B. All sanitary sewer lines are to be flushed by Contractor per [Section 3.3.3.1](#)
- C. Site must be backfilled to subgrade (stone)
- D. For third party CCTV inspections; Inspector shall meet with the third party vendor before inspections begin.

Procedures for sanitary sewer line CCTV inspections:

- A. Closed Circuit Television Color (CCTV) Inspection by a National Association of Sewer Service Companies (NASSCO) certified entity is required for all new sewer mains and laterals. Laterals shall be installed and inspected by the Contractor who installs the sewer main from the main to either the cleanout at the served structure if service is provided concurrently with construction of the new main, or to the cleanout at the property line or easement boundary if service will be provided at a later date.
- B. Laterals must be separately CCTV inspected if they are not connected for service concurrently with the installation of the sewer main. Lateral CCTV inspections shall be completed from the service cleanout near the served structure to the sewer main, including passing through the cleanout at the property line or easement boundary. Lateral CCTV inspections shall be conducted by the Contractor who installs the lateral from the property line to the structure.
- C. Video recordings of inspections must be turned over to and reviewed by the Inspector prior to acceptance. Inspectors must be notified when CCTV inspections are being conducted and may require their attendance.

- D. CCTV inspection will be done one manhole section at a time. Flow in the section being inspected should normally be limited to the allowable leakage in the new main. Any flow will be suitably controlled.
- E. The television camera used for the inspection shall be one specifically designed and constructed for such inspection. Lighting for the camera shall be suitable to allow a clear color picture of the entire periphery of the pipe. The camera shall be operative in 100% humidity conditions. The camera, television monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of the Inspector;
- F. The camera shall be moved through the line in either direction at a moderate rate not exceeding 30 feet per minute, stopping when necessary to permit proper documentation of the sewer's condition. Manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line.
- G. When manually operated winches are used to pull the television camera through the line, telephones or other suitable means of communication shall be set up between the two manholes of the section being inspected to ensure good communications between members of the crew.
- H. The importance of accurate distance measurements is emphasized. Measurement for location of defects shall be above ground by means of a meter device. Marking on the cable, or the like, which would require interpolation for depth of manhole, will not be allowed. Accuracy of the distance meter shall be checked by use of a walking meter, roll-a-tape, or other suitable device and the accuracy shall be satisfactory to the County's Representative.
- I. Documentation of the television results shall include:
  - a. Television Inspection Logs: Printed location records shall be kept by the Contractor and will clearly show the location in relation to an adjacent manhole of each infiltration point observed during inspection. In addition, other points of significance such as locations of lateral sewers, unusual conditions, and other discernible features will be recorded and a copy of such records will be supplied to the County.

Video Recordings: The purpose of video recording shall be to supply a visual and audio record of problem areas of the lines that may be replayed. Video recording playback shall be at the same speed that it was recorded. Slow motion or stop-motion playback features may be supplied at the option of the Contractor. The Contractor shall have all video recordings and necessary playback equipment readily accessible for review by the County during the project. All initial recordings and any re-inspections shall be supplied to and will become the property of the County on acceptance of the sewer main. Video recordings must be in a standard digital format (MP4 with H.264 Compression) approved

by the Department of Utilities. The Contractor may maintain a separate copy for his records.

#### 3.3.3.4 Pressure Testing Requirements for Sewer Force Mains

Force main pressure testing shall conform to the requirements as established for water systems. See [Section 3.4.3.2](#) of this DSM.

#### 3.3.3.5 Tracing Wire and Locating Tape for Sewer Force Mains and Gravity Mains

All sewer laterals, gravity mains and force mains shall have tracing wire and locating tape installed. A continuity test for tracing wires must be performed prior to acceptance.

The tracing wire shall be accessible for test hook-up at all test stations. The tracing wire must be completely insulated from ground. The tracing wire will be attached to the top of the pipe using duct tape at an interval no greater than 16 feet. Tracing wire within test stations shall be stripped three quarters of an inch ( $\frac{3}{4}$ " ) from the end and capped with a wire nut to minimize electrical ground contact. All connections at the main line must be electrically sound and physically secure with approved connections as per [Section 3.2.3.10](#). All connections must be taped with electrical tape and sealed with an electrical coating sealant. Test stations shall be installed at intervals on no greater than 500 feet along force mains. Tracing wire shall be color coded green.

Locating tape shall be installed in the trench approximately twelve inches (12") above the installed pipe. Tape shall be polyethylene with metallic core, two inches (2") in width, with continuous printed message "Caution - Force Main Buried Below". Tape shall be Catalog No. 2 WAT as manufactured by the Seton Name Plate Corp. or approved equivalent.

#### 3.3.3.6 Clean-Up

Upon the completion of the installation of the sanitary sewer system and prior to the County acceptance, sediment and debris shall be removed from the system. The work area shall be restored to a condition equal to or better than its condition prior to construction and pavement replaced to the satisfaction of VDOT and the County. All trash and debris shall be removed and disposed of properly. Areas not otherwise stabilized shall be seeded and mulched and a good stand of grass established.

## 3.4 Water Distribution System

### 3.4.1 General

#### 3.4.1.1 Requirements of Regulatory Agencies

Construction as shown on the plans or stated herein shall be performed in accordance with current and applicable requirements as established by the County and the VDH or any other agencies having jurisdiction. Where conflicts arise between the construction documents and previously mentioned requirements, the more restrictive shall apply. If such requirements require a change in the work as stated herein or shown on the Approved Plans, the Contractor shall stop work and notify the County immediately for further direction.

### 3.4.2 Products

#### 3.4.2.1 General

All materials shall be new, virgin material. All brass, copper, and water meter materials must comply with the ANSI/NSF 61 Standard. Shop drawings, as defined in the General Section, and operation manuals are required on Projects where there are special structures.

#### 3.4.2.2 Water Pipe

- A. Zinc coated ductile iron pipe shall meet the requirements of AWWA C150 and AWWA C151. Pipes 12" or less shall be, at a minimum, pressure class 350. Pipes greater than 12" shall be, at a minimum, class 52. Pipe shall have cement-mortar lining and a bituminous seal coat conforming to the requirement of AWWA C104. A minimum of five percent (5%) of the pipe furnished shall be gauged for roundness full length and so marked. Pressure class of pipe shall be increased if the specific installation warrants it.

The Ductile Iron Pipe Research Association (DIPRA) Design Decision Model will be used to determine the corrosivity of all soil conditions. **All ductile iron pipe shall be zinc coated and encased in V-Bio Polywrap** for conditions that are determined to be in categories 2 – 5 in the DIPRA Design Decision Model. It is the responsibility of the Engineer to show that zinc coating and V-Bio Polywrap are not needed based on a soil corrosivity analysis. If the corrosivity is determined to be category 1 according to the DIPRA Design Decision Model, then zinc coating and V-Bio Polywrap encasement are not required.

Pipe fittings shall meet the requirements of AWWA C110 or AWWA C153, pressure class 250. Fittings shall have a cement-mortar lining and a bituminous seal coating. All fittings shall be encased in V-Bio Polywrap for conditions that are determined to be in Categories 2 – 5 in the DIPRA Design Decision Model. It is the responsibility of the Engineer to show that zinc coating and V-Bio Polywrap are not needed based on a soil corrosivity analysis. If the corrosivity is determined to be category 1 according to the DIPRA Design Decision Model, then zinc coating and V-Bio Polywrap encasement are not required.

All buried pipe and fittings shall conform to the requirements of AWWA C111. Bolts for mechanical joint fittings shall be high strength ductile iron having an ultimate tensile strength of 75,000 psi and a minimum yield point of 45,000 psi. All bolts and nuts shall be coated with FluoroKote #1 process or be equivalent shall be installed.

Exposed (non-buried) pipe and fittings shall have flanged joints conforming to the requirements of AWWA C115. Bolts shall be 304 stainless steel.

- B. No other pipe material is accepted for water main installations twelve inches (12") diameter and greater unless specifically approved in writing by the Director.

### 3.4.2.3 Gate Valves and Tapping Valves

A. Resilient Seat Gate Valves (4" – 12"):

- a. All resilient seat gate valves four inches (4") to twelve inches (12") in size shall comply with AWWA C-509, latest revision.
- b. All valves shall be manually operated non-rising stem, equipped with operating nut, for installation in a vertical position, unless otherwise specified, and the valve body shall be ductile iron with reinforced flanges.
- c. All iron surfaces, internal and external, must be coated with a minimum eight (8) mils thickness of hand applied epoxy or three (3) to five (5) mils thickness fusion bonded epoxy.
- d. The valve stem shall have an independent stem nut (not rigidly attached to the gate), which allows the gate to flex without stressing the stem.
- e. All valves shall have either a bronze stem collar bushing with two O-rings above the stem or a stem collar with one O-ring below and one O-ring above the stem collar.
- f. Seating shall use compression closure. The gate shall be of a true bi-directional, mirror image design.
- g. Valves shall have a smooth bottom design.
- h. All valves shall open left (counter-clockwise). Buried valves shall have mechanical joints while exposed valves shall have flanged joints.
- i. The bodies, bonnets, and other ductile iron parts shall conform in all respects to the American Society for Testing Materials' Standard Specifications of Gray Iron Castings, "ASTM Specification Designation A-126, Class B for valve sizes four inches (4") through twelve inches (12"). The castings shall be clean and perfect without blow or sand holes or defects of any kind. No plugging or stopping of holes will be allowed.
- j. Valves four inches (4") through twelve inches (12") must have a 250 psi working and 500 psi test pressure.

- k. If the standard valve provided by a manufacturer does not fully comply with these specifications, but compliance can be attained by providing optional features, then each valve must be permanently marked to indicate the option or options that have been provided. The method of marking valves to indicate that options are included must be approved by the County.
  - l. Stainless steel bolts are required for all valves. Bolts shall be grade eight (8) with grade ten (10) nuts.
- B. Valves shall comply with AWWA Standard C500, latest revision, and the following:
- a. All valves shall be manually operated, inside screw and yoke, equipped with operating nut, for installation in a vertical position, unless otherwise specified. They shall be iron body and bronze mounted with one of the resilient seat designs.
  - b. All valves shall open left (counter clockwise). Buried valves shall have mechanical joints while exposed valves shall have flanged joints. All joint surfaces of mechanical joint end gate valves, which will be in contact with the mechanical joint gasket, shall be fully machined to the dimensions and tolerances set forth in ANSI A21.11.
  - c. The bodies, bonnets and other cast iron parts shall conform in all respects to the American Society for Testing Materials' Standard Specifications for Gray Iron Castings, ASTM Specification Designation A-126, Class B for valve sizes four inches (4") through twenty-four inches (24") and A-126, Class C for valve sizes thirty inches (30") through forty-eight inches (48"). The castings shall be clean and perfect without blow or sand holes or defects of any kind. No plugging or stopping of holes will be allowed.
  - d. All valves shall have either a bronze stem collar bushing with two O-rings above the stem collar or a stem collar with one O-ring below and one O-ring above the stem collar, with the stem collar being completely sealed in a permanent grease reservoir.
  - e. All other materials not specified shall meet AWWA C500, latest edition.
  - f. Valves four inches (4") through twelve inches (12") must have a 200 psi working and 400 psi test pressure. Valves fourteen inches (14") and larger must have 150 psi working and 300 psi test pressure.
  - g. All valves shall be manufactured to allow removal of seal plate under pressure in either an open or closed position.
  - h. If the standard valve provided by a manufacturer does not fully comply with these specifications, but compliance can be attained by providing optional features, then each valve must be permanently marked to indicate the option or options that have been provided. The method of marking valves indicating the options must be approved by the County.

- i. Stainless Steel bolts are required for all valves. Bolts shall be grade eight (8) with grade ten (10) nuts.
- C. Tapping Valves:
- a. Tapping valves shall meet the specifications as referenced in “A.” above except, the body seat rings shall have a clear inside opening sufficient to pass a cutter of full diameter and equal to the nominal size of the valve. The outlet end shall be suitable for use with the type of pipe being utilized.
  - b. Tapping valves will be suitable for use with all approved manufactured tapping sleeves without modification.

#### 3.4.3.4 Butterfly Valves (16” – 72”)

All butterfly valves shall conform to the latest revision of AWWA Standard C-504, Class 250-B unless otherwise indicated and meet the following:

- A. Valve bodies shall be ductile iron per ASTM A-536 grade 65-45-12. Body ends shall be flanged with facing and drilling in accordance with ANSI B16.1, Class 250-B or mechanical joint in accordance with AWWA Standard C-111 or ANSI A21.11. All mechanical joint end valves shall be furnished complete with joint accessories (bolts, nuts, gaskets, and glands), and be for underground use only. All valves shall conform to AWWA C-504, “Table 3, Laying Lengths for Flanged Valves and Minimum Body Shell Thickness for all Body Types.”
- B. Valve disc shall be cast iron, ASTM A-126 Class B or ductile iron ASTM A-536, grade 65-45-12. Valve disc shall be of the offset or symmetrical design providing 360-degree uninterrupted seating, and for sizes thirty inches (30”) and larger shall be of the flow through type, cored, or domed.
- C. The resilient seat shall be natural rubber or BUNA-N located on the disc or the body retained by an epoxy backing ring or 18-8, Type 304 stainless steel retaining ring secured to the disc by 18-8, Type 304 stainless steel screws. The seat shall be capable of mechanical adjustment in the field and field replaceable without the need for special tools on twenty-four inches (24”) and larger valves. Valve body seat shall be 18-8, Type 304 Stainless Steel.
- D. Valve shaft shall be 18-8, Type 304 stainless steel. Valves shall have either one piece (through shaft) or two piece (stub shaft). The shaft should be attached to the disc by means of O-ring sealed taper pins with lock nuts on thirty inches (30”) and larger valves. Taper pins should be either 304S.S or 416S.S heat treated for added strength or shaft is attached with stainless steel shaft journals hex mated to drive shaft.
- E. The valve assembly shall be furnished with a non-adjustable factory set thrust bearing designed to center the valve disc at all times.
- F. Shaft bearing shall be contained in the integral hubs of the valve body and shall be of non-cold flowing phenolic backed, PTFE or corrosion resistant self-lubricated sleeve type.

- G. Valve shaft seal shall consist of O-rings or Split-V ring. Where the valve shaft Projects through the valve body for the actuator connection, the O-ring or Split-V ring packing seal shall be field replaceable as a part of a removable bronze cartridge, without valve disassembly. Connection to the actuator shall be provided by means of at least two (2) bolts for sixteen inch (16") to twenty-four inch (24") valves and at least four (4) bolts for thirty inch (30") and larger valves.
- H. Valves shall open counter-clockwise.
- I. When required, manual actuators shall be amply sized for line conditions. All manual actuators should be traveling nut or worm gear type. All sixteen inch (16") through twenty-four inch (24") butterfly valve manual actuators shall be capable of withstanding 300-450 foot pounds of input torque against the open or closed stops. All actuators shall have adjustable mechanical stop limits. The closed position stop may or may not be externally adjustable.
- J. All valves shall be coated with AWWA Standard Epoxy Coatings or asphalt varnish equal, in conformance to AWWA Standard C-550 or C-450, latest revision. All interior ferrous surfaces, including disc, shall be coated a nominal ten (10) mils thick for long life and body exterior shall have a minimum eight (8) mils thickness of hand applied epoxy or three (3) to five (5) mils thickness fusion-bonded epoxy coating in order to provide protection in shipment and storage, and to afford a superior base for field-applied finish coats.

### 3.4.2.5 Tapping Sleeves

#### 3.4.2.5.1 DUCTILE IRON TAPPING SLEEVES

- A. The body and glands of the tapping sleeve shall be of ASTM-126, ductile iron. Sleeves shall be furnished complete with all mechanical joint accessories (bolts, nuts, gaskets, and glands), and shall have an epoxy coating.
- B. Valve flange, body gaskets, and clamping hardware (bolts, nuts, and washers) shall be as specified for the fabricated steel tapping sleeve.
- C. Application: Any approved taps on PVC or ductile iron water main, matching size or one nominal size smaller than tapped main.

### 3.4.2.6 Double Check Assembly

Double check assemblies and other fire protection devices are governed by "Article 2 – Fire Regulations" of the Spotsylvania County Design Standards Manual.

### 3.4.2.7 Fire Hydrants

- A. Fire hydrants shall be manufactured in full compliance with this specification and shall also comply with the AWWA Fire Hydrant Specification C-502, latest revision and the following:

- a. Type: Compression - Dry Standpipe: Valve shall open against and close with the pressure. The design shall be such that all internal operating parts can be removed through the standpipe and main valve rod extended without excavating.
- b. Size: Internal valve diameter shall be a minimum of five and one - quarter inches (5 ¼").
- c. Inlet Size and Type: Six inch (6") mechanical joint end with accessories.
- d. Hose Nozzles: Each hydrant shall be equipped with two, two and a half inch (2½") I.D. hose nozzles with National Standard threads, one-quarter (1/4) turn bayonet lock or threaded in with O-ring seal, and suitable locking arrangement.
- e. Steamer Nozzle: Each hydrant shall be equipped with one four and a half inch (4½") Steamer Nozzle having National Standard Threads, one quarter (1/4) turn bayonet lock or threaded in with O-ring seal, and suitable locking arrangement.
- f. Direction of open: Left, counter – clockwise. Standpipe - Ground line Safety Construction: The standpipe sections shall be Direction of Open: Left, counter-clockwise.
- g. Size and Shape of Operating Nut and Cap Nuts: to be one and one half inch (1½") point to flat pentagon. Each hydrant shall be equipped with a weather cap.
- h. Seal Plate: The hydrant shall be so constructed that a moisture-proof lubricant chamber is provided which encloses the operating threads, thereby automatically lubricating the threads each time the hydrant is operated. The lubricant chamber shall be enclosed with at least three O-rings. The two lower O-rings will serve as pressure seals; the third O-ring will serve as a combined dirt and moisture seal to prevent foreign matter from entering the lubricant chamber. The hydrant shall be equipped with either an anti-friction washer or bronze bushing to reduce operating torque. The bonnet will be secured to the hydrant using bolts and nuts.
- i. Bury line safety construction: The standpipe section shall be connected at the ground line by a two part, bolted safety flange or breakable lugs. The main valve rod sections shall be connected at the ground line by a break away coupling. The standpipe and ground line safety construction shall be such that the hydrant nozzles can be rotated to any desired position without disassembling and removing the top operating components and the top section of the standpipe. The minimum inside diameter of the barrel shall be six inches (6").
- j. Main Valve, Stem Assembly: The main valve rod assembly shall be so constructed to allow removal of all operating parts through the barrel regardless of depth of bury, using a removal wrench which does not extend below the ground line of the hydrant. The main valve seat ring shall be bronze and its assembly into the hydrant shall involve bronze-to-bronze thread engagement, and the valve assembly pressure seals shall be obtained without the employment of torque-compressed

gaskets. The design of the main valve rod shall be such that the operating threads at the top of the rod and the valve assembly threads at the bottom of the stem are isolated from contact with water in the standpipe or in the hydrant inlet shoe.

- k. Drain Valve: The operation of the drain mechanism shall be correlated with the operation of the main valve and shall involve a momentary flushing of the drain ports each time the hydrant is opened. The drain ports shall be fully closed when the hydrant valve is more than two and a half (2½) turns open and the drainage channel in the bronze valve seat ring shall connect to two or more outlet drain ports. No springs may be employed in the hydrant valve or drain valve mechanism. The drain valve will be protected with at least one-half (½) yard #57 stone protected with filter cloth.
  - l. Depth of Bury: Normally hydrants shall be suitable for installation in trenches four and a half feet (4-1/2') deep. Required parts and materials to adjust fire hydrants to different depth of bury shall be provided by the manufacturer to meet actual field conditions.
  - m. Painting Instruction: Two prime coats and one Rustoleum Safety Red # 7564 finish coat shall be used, unless otherwise specified. Exposed area of fire hydrant shall receive one field coat of Rustoleum Safety Red # 7564 after installation. The wetted surface of the hydrant shoe shall be epoxy coated to prevent corrosion of the waterway.  
  
A coat of reflective 3M Scotchlite 7210 Silver paint is required around the bonnet.
  - n. Pressure Rating: Test pressure 300 psi, working pressure 150 psi.
- B. If the standard hydrant provided by a manufacturer does not fully comply with these specifications, but compliance can be attained by providing optional features, then each hydrant must be permanently marked to indicate the option or options that have been provided. The method of marking hydrants to indicate that options are included must be approved by the Inspector.

### 3.4.2.8 Check Valves

Check valves shall be of the horizontal swing type, iron body bronze mounted, equipped with weighted lever or spring as specified or shown on the plans.

### 3.4.2.9 Water Service Assembly for 5/8" and 3/4" Water Meters

All water services and plumbing shall conform to the Uniform Statewide Building Code as per "12VAC5-590-1190". When connecting to waterlines that are zinc coated and encased in V-Bio Polywrap the first three feet (3') of the service shall be encased in V-Bio Polywrap. All materials for the installation of water services shall be as follows or approved as equal:

- A. Water meter barrel shall be PVC solid fabricated barrel eighteen inch (18") I.D. by thirty inch (30") height with access notches for piping. For traffic areas reinforced barrels shall be used.
- B. The meter barrel lid shall A32-T Ford or equivalent, a round cast iron, one (1) piece cover designed to fit the corresponding opening on the meter barrel and have a square tread plate surface design. Meter box lids shall have a one and three-quarter inch (1 ¾") diameter hole located in its center. The hole shall either be cast in place at the foundry or, after casting, be retrofitted via a plasma arc torch or hole saw. Holes shall be compatible with the County's touch read meter system.
- C. The meter barrel lid shall have a lift bar will be solid to the bottom of the pocket with a half inch (1/2") top width and a three-sixteenths inch (3/16") bottom width forming a hook ledge for ease of removal with a lifting tool. There shall be a three-eighths inch (3/8") notch on the outer edge directly in line with the lift bar. The cover shall have a guide ring on the underside half inch (1/2") by eleven inch (11") O.D. and have a total weight of less than ten (10) lbs. The cover must be a Carson Plastics Model # HW-00182003 or approved equivalent.
- D. Meter yokes shall be 5/8" x 3/4" AY McDonald Model #14-2, Ford 5020 or Mueller 502 or approved equivalent. Expanders shall be Ford EC23 or approved equivalent with epoxy coating.
- E. Provide corporation stop with corporation cock thread inlet. All brass shall be NSF 61.
- F. Pipe shall be one inch (1") or three-quarter inch (3/4") type "K" copper domestic manufactured pipe.
- G. Service Saddles are not allowed unless pre-approved by Department.

#### 3.4.2.10 Water Service Setter for 1", 1 ½" and 2" Water Meters

All water services and plumbing shall conform to the Uniform Statewide Building Code as per "12VAC5-590-1190". When connecting to waterlines that are zinc coated and encased in V-Bio Polywrap the first three feet (3') of the service shall be encased in V-Bio Polywrap. All materials for the installation of water services shall be as follows or approved equal:

- A. General: All one and one-half inch (1 ½") and two inch (2") meter setters shall be constructed of seamless threaded red brass pipe, standard Type K hard copper tube (per ASTM B-88-62), high quality brass (per AWWA C-800,) and leadless solder and provide horizontal female pipe threads on both front and rear connections. Setters must include a valved bypass for meter maintenance, except for irrigation and residential meters.

Meters are supplied by the County and installed by the Department.

- B. Bypass: Meter setters shall have an appropriately sized bypass line with an inverted key or ball-type stop threaded directly into the inlet bypass tee fitting. This bypass valve shall have a solid tee head and be either lock wing type or provide a bracket or other device to

lock this valve in the "off" position upon installation. If copper tube is used for the bypass line, the compression connection for the copper side of the bypass valve must be as produced by the following manufacturers:

Mueller Co., "110" compression connection for copper pipe; or

Ford Meter Box Co., "Quick Joint - Q" connection for copper pipe; or

A.Y. McDonald, "Q - McQuik" compression connection for copper pipe.

Otherwise, a tee head inverted plug or ball type bypass valve is required with a threaded connection. Both of the bypass tee fittings, (inlet and outlet,) shall have brace pipe eyelets cast within them to stabilize setter upon installation.

- C. Angle Valves: Flanged, inverted key, or ball-type "tee head" angle valves are required on both meter connections, and will include lock wings and meter support bracket to aid in meter installation. Compression connections with check valve are allowed on the vertical riser pipe; these connections must be threaded or soldered copper. Valves shall be double drilled, (two-inch (2") size only) to accommodate both one and one half inch (1 ½") and two inch (2") meters. Angle or ball valves shall provide a stop or check to limit movement of tee head at ninety degrees (90°) Maximum, (from fully open to completely off). Arrows cast within the inlet valve shall indicate direction of flow while in service.
- D. Dimensions: Meter setters shall accommodate the following meter dimensions:

1" male x male pipe thread laying length: 10 ¾" ± 1/16"

1 ½" flanged meter laying length: 13 ¼", includes gasket

2" flanged meter laying length: 17 ¼", includes gasket

The rise or height of meter setter, measured vertically from center line of inlet pipe thread to center line of meter flange bolt, shall be:

1" meter setter, maximum height of 12"

1 ½" meter setter, maximum height of 8 ½"

2" meter setter, maximum height of 9 ½"

The copper used on the bypass and vertical riser pipe, (if so equipped,) shall be Type K and comply with ASTM B-88-62, which states outside diameters as shown here:

¾" nominal pipe size, .875" outside diameter, .065" wall

1" nominal pipe size, 1.13" outside diameter, .065" wall

1 ½" nominal size pipe, 1.63" outside diameter, .072" wall

2" nominal size pipe, 2.13" outside diameter, .083" wall

The bypass assembly shall be sized as follows:

1" meter setter requires minimum ¾"

1 ½" meter setter requires minimum 1" bypass pipe & valve

2" meter setter requires minimum 1" bypass pipe & valve

- E. Meter boxes for one inch (1"), one and one-half inch (1 ½") and two inch (2") meters shall be as shown in the standard details. Five-eighths inch (5/8") to three quarter inch (3/4") meter - - 18"x 30" meter barrel, one inch (1") meter 24" x 30"- - meter barrel, one and one-half inch (1 ½") meter 30"x 30"- - meter barrel, two inch (2") meter - - 36" x 30" meter barrel.
- F. Backflow prevention devices are not to be used at yokes.
- G. Direct tap required on all water mains for water services one inch (1") and less.

#### 3.4.2.11 Valve Boxes

All underground valves shall be installed in approved cast iron valve boxes, having suitable base and shaft sections, and covers to protect the valve and permit easy access and operation. Valve box assemblies shall be adjustable using a slip type system. Install a two foot by two foot by six inch (2' x 2' x 6") concrete collar around all valve boxes not in pavement. Extend valve operator nut to within forty-eight inches (48") of final grade.

#### 3.4.2.12 Air Release Valves

- A. Type 1: Small orifice valves shall be either:
  - a. Kinetic design - This must have only one (1) moving part, a stainless steel float ball.
  - b. Stainless steel float and lever – The valve shall maintain the closed position to prevent the loss of water by positive seating of the float ball against a smoothly ground contact surface of the exhaust orifice.

It shall automatically provide for the escape of air to atmosphere without the loss of water when the float ball moves away from the orifice seat. The body of the valve shall be cast iron and shall be coated to withstand a moist environment.

Air release valves shall have a minimum of a one inch (1") N.P.T. inlet for six inch (6"), eight inch (8"), and twelve inch (12") pipe sizes and a two inch (2") N.P.T. inlet for pipes sixteen inches (16") and larger, and shall have a minimum of a three thirty-seconds of an inch (3/32") outlet orifice for six inch (6"), eight inch (8"), and twelve inch (12") pipe sizes and a three-sixteenth inch (3/16") outlet orifice with sixteen inch (16") and larger pipes.

Air release valves shall be suitable for 150 psi working pressure at a minimum.

Air release valves for sewage force mains shall be specifically designed for sewage applications.

All flushing attachments shall be provided with air release valves.

- B. Type 2: Shall be a combination, dual unit valve, combining one (1) small and one (1) large unit, both employing the kinetic operating principal or of the stainless steel and lever

type. For the Kinetic type, the only moving parts shall be two (2) stainless steel balls (one for each unit) which will remain in the respective throat areas when discharging air without blowing shut or collapsing the float ball(s).

In the closed position, resulting from water filled line, the valve shall prevent leakage.

The large orifice seat shall be of composition material and replaceable.

The body of the valve shall be cast iron and shall be coated to withstand moist environment.

Air release valve size shall be six inches (6") with a three-eighths inch (3/8") orifice for the small unit and shall be suitable for 150 psi working pressure. The larger orifice shall be sized based on the specific application based on the manufacturer's recommendation.

#### 3.4.2.13 Air release Valve Manholes

Valve manholes shall be concrete meeting the requirements of ASTM C-478. Diameters shall be as shown on plans, but in no case shall they have an inside diameter of less than four feet (4'). Manhole frame and covers should meet the requirements for sanitary manhole frame and covers shall be utilized except that the covers shall have the word "WATER" cast on them.

#### 3.4.2.14 Joint Restraint Systems

Thrust protection as shown on plans in the standard details shall consist of pipe joints, fittings, and appurtenances specially designed for thrust restraint of ductile iron pipe. Thrust blocks are prohibited except where pipe restraint cannot be achieved using restrained pipe joints, fittings, and appurtenances.

All restraint devices must be U.L. listed and F.M. approved.

Mechanical joint restraint shall be incorporated in the design of the follower gland and shall include a restraining mechanism which, when actuated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Flexibility and minimal deflection of the joint shall be maintained after burial. Glands shall be manufactured of ductile iron conforming to ASTM A536-80. Twist-off nuts shall be used to ensure proper actuating of the restraining devices.

Restraining devices shall be of ductile iron, heat-treated to a minimum hardness of 370 BHN. There shall be no dissimilar metals allowed. Dimensions of the gland shall be such that it can be used with all AWWA approved standardized mechanical joint bell and tee-head bolts conforming to ANSI/AWWA A21.11 and ANSI/AWWA C153.53/A21.53 of latest revision. The mechanical joint restraint device shall have a working pressure of at least twice the working pressure of the pipe.

All existing bell and spigot end joints within the length of required restrained joint pipe shall be restrained with a clamping ring and an additional ring designed to fit behind the bell end of the ductile iron pipe. The rings shall be connected with T-head bolts or rods. Rods shall be 304 Stainless Steel or coated with FluoroKote #1 process or be equivalent.

### 3.4.2.15 Cast Couplings

Center Sleeve: Made of ductile iron, Spec ASTM-A536, and coated with an enamel shop coat, sized to accommodate all AWWA pipes of the same nominal size.

End Ring: Made of ductile iron Spec ASTM-A536, and color coded with an enamel shop coat to easily identify its use on various types of pipe.

Gaskets: SBR rubber compound, Grade 30 per Spec ASTM D-2000 for normal water service and an extended shelf life.

Bolts: High strength low alloy steel bolts with heavy hex nuts, per AWWA C-111.

### 3.4.2.16 Casing Spacers

Casing Spacers shall be bolt on style with a shell made in two sections of heavy T-304 stainless steel. Connecting flanges shall be ribbed for extra strength. The shell shall be lined with a PVC liner .090" thick with 85-90 durometer or neoprene rubber. All nuts and bolts are to be 18-8 stainless steel. Runners shall be made of ultra-high molecular weight polymer (UHMW) or glass reinforced plaster. Runners shall be supported by risers made of heavy T-304 stainless steel or ten (10) gauge welded steel. The supports shall be MIG welded to the shell, and all welds shall be passivated or three-eighths inch (3/8") diameter stud welded to band and locked with a locking fastener. The height of the supports and runners combined shall be sufficient to keep the carrier pipe at least three-quarters of an inch (3/4") from the casing pipe wall at all times.

## 3.4.3 Execution

### 3.4.3.1 Installation of New Water Systems

#### A. Excavating and Backfilling:

- a. The Contractor shall take care and provide all necessary precautions during the course of excavating for all underground utility systems. After the pipe is in place, backfill with suitable earth, without rocks and other unacceptable materials. The Contractor shall:
  1. Provide all necessary shoring required for the protection of excavations, existing utilities, and workmen. Do all necessary pumping required to keep excavation and pipe free of water from any source at all times.
  2. Provide sufficient barricades, fencing, or other protective devices adjacent to excavations to safeguard against injury to workmen and the public. Provide and maintain sufficient warning at walks, roadways, and parking areas to provide safety at all times.
  3. Where roots of live trees are encountered in excavations, carefully protect them during construction.

4. Exercise special care in backfilling trenches to guard against disturbing the pipe joints.
  5. Remove and dispose of any excess or unacceptable material.
- b. At his expense, the Contractor shall remove subsurface obstructions uncovered during excavation for installation of the water systems. This shall include removal of existing concrete or brick of existing building foundations, footings, abandoned utility piping, wires, structures, rock, boulders, etc., which may not be visible from surface investigations before construction, but will interfere with new installations. If such obstructions are encountered they shall be removed two feet (2') from around the area of new facility and the trench backfilled with a suitable material as specified.
- B. Pipe Storage
- a. All pipe shall be tightly closed with a mechanical watertight plug or cap if it is contact with or close enough to the ground surface where dirt, debris or any other contaminant can enter the pipe.
  - b. Pipe may be "strung out" along Project site as needed if the conditions above are met.
- C. Pipe Installation:
- a. Take all precautions to ensure that pipe and related items are not damaged in unloading, handling, and placing in trench. Examine each piece of material just prior to installation to determine that no damage has occurred. Remove any damaged material from the site and replace with undamaged materials.
  - b. Keep pipe clean. Exercise care to keep foreign material and dirt from entering pipe during storage, handling, and placing in trench. When pipe laying is not in progress or the pipe is unattended for any period of time, the forward end of the pipe shall be kept tightly closed with a mechanical water tight plug or cap; **plywood or plastic is not acceptable.**
  - c. Do not lay pipe when weather or trench conditions are unsuitable. The Department reserves the right to stop work in unsuitable conditions.
  - d. Water Pipe Laying:
    1. Laying of water pipe shall be accomplished only after the trench has been dewatered and the foundation or bedding has been prepared. Mud, silt, gravel, and other foreign material shall be kept out of the pipe and off the jointing surfaces. The Contractor shall be responsible to visually inspect each section of pipe prior to installation.
    2. All pipe laid shall be retained in position so as to maintain alignment and joint closure until sufficient backfill has been completed to adequately hold the pipe

in place. All pipe shall be laid to conform to the prescribed line and grade shown on the plans and shall include digging out for bell ends.

3. Water pipe runs intended to be laid straight shall be so laid. Deflection from a straight line may be made by deflecting the joints only when permission has been given by the County. Joint deflection in pipe shall not exceed one-half (1/2) that recommended by AWWA Standards or the manufacturer whichever is less. Changes in grade or alignment, which cannot be made by deflecting pipe joints, shall be made by use of proper bends, offsets or special fittings as required.
4. The water pipe, unless otherwise approved by the Inspector, shall be laid up grade from point of connection of the existing water line or from a designated starting point. Water pipe shall be installed with the bell end forward or upgrade. When pipe laying is not in progress or the pipe is unattended for any period of time, the forward end of the pipe shall be kept tightly closed with a water tight plug or cap; **plywood or plastic is not acceptable.**
5. The pipe shall be fitted and matched so that when installed the pipe segments will form a smooth, uniform invert.
6. Prior to joining the pipe, all surfaces of the pipe to be joined and the surfaces of factory-made jointing materials shall be clean and dry. Lubricants, primers, adhesives, etc., shall be applied and the pipes joined as recommended by the manufacturer's specifications. Sufficient pressure shall be applied in making the joint to assure that the pipe is "home". The interior of the pipe shall be cleaned of all foreign material as the work progresses. When pipe laying is not in progress or the pipe is unattended for any period of time, the forward end of the pipe shall be kept tightly closed with a water tight plug or cap; **plywood or plastic is not acceptable.**
7. Joining Pipe:
  - 1) Zinc coated ductile iron pipe to be joined as follows:
    - I. Mechanical joint pipe:
      - i. When installing PVC pipe into M.J. fittings, the beveled end of the pipe must be cut off to allow for maximum insertion depth and sealing area to avoid leaks. Thoroughly clean inside of the bell and eight inches (8") of the outside of the spigot end of the joining pipe to remove oil, grit, excess coating, and other foreign matter from the joint. Paint the bell and spigot with soap solution (one half (1/2) cup granulated soap dissolved in one (1) gallon water). Slip zinc coated ductile iron gland on spigot end with lip extension of gland toward end of pipe. Paint rubber gasket with or dip into the soap solution and place on the spigot end with thick edge toward the

gland.

- ii. Push the spigot end forward to seat in the bell. Then carefully press the gasket into the bell so that it is located evenly around the joint. The gland is moved into position, bolts inserted and nuts turned finger tight. Tighten all nuts to torque listed below:

Bolt Size (inches)	Torque (ft - lbs)
5/8	50 -60
¾	85-90
1	90 – 100
1 - ¼	90 – 120

- iii. Tighten nuts on alternate sides of the gland until pressure on the gland is equally distributed and torque value is reached.
  - iv. Permissible deflection in mechanical joint pipe shall not be greater than one-half (1/2) of that listed in AWWA C600.
- II. Push-on joint zinc coated ductile iron pipe
- i. Thoroughly clean inside of the bell and eight inches (8”) of the outside of the spigot end of the joining pipe to remove oil, grit, excess coating, and other foreign matter. Flex rubber gasket and insert in the gasket recess of the bell socket. Apply a thin film of gasket lubricant, supplied by pipe manufacturer, to the gasket and spigot end of the joining pipe.
  - ii. Start spigot end of pipe into socket with care. The joint shall then be completed by forcing the plain end to the bottom of the socket with a forked tool or jack type device. Field cut pipe shall have the end filed to match the manufactured spigot end.
  - iii. Permissible deflection in push-on joint pipe shall not be greater than one-half (1/2) of that listed in AWWA C600.
8. V-Bio Polywrap shall be applied to all zinc coated ductile iron pipe. Material shall be meet the ANSI/AWWA C105/A21.5 standards for polyethylene encasement. It must be new and have no holes, rips, or tears. Polywrap should be wrapped tightly around pipe to ensure good contact with the pipe surface. In dry trench conditions, the polywrap shall be secured with tape across the folded over edge. In a wet trench condition with groundwater, tape must be applied around the pipe in multiple places and both ends to ensure

any water that intrudes does not travel down the pipe. Any rips or tears in the polywrap must be covered with a piece of polywrap and taped down to be watertight.

9. Tracing wire shall be accessible for test hook-up at all fire hydrants and test stations. The tracing wire must be continuous and completely insulated from ground. The tracing wire will be attached to the top of the pipe using duct tape at an interval no greater than sixteen feet (16'). Tracing wire within test stations and hydrants shall be stripped three quarters of an inch ( $\frac{3}{4}$ " ) from the end and capped with a wire nut to minimize electrical ground contact. Test stations shall be installed at intervals no greater than 500 feet. All connections at the main line must be electrically sound and physically secure with approved waterproof connections. All connections must be sealed with a waterproof coating sealant. Tracing wire for waterlines shall be color coded blue. Tracer wire shall be run to all meter barrels. Continuity will be verified.
10. Place underground warning tape directly above all water mains at two feet (2') above the water line. Tape shall be polyethylene tape with a metallic core, two inches (2") in width, with the continuous printed message "Caution - Waterline Buried Below." Tape shall be Catalog No. 2 WAT as manufactured by the Seton Name Plate Corp. or approved equivalent.

D. Installation of Valves, Fittings, and Hydrants:

- a. General: Valves, fittings, and hydrants shall be set and joined to the piping system as specified for cleaning, laying, and joining pipe.
- b. Valves and Valve Boxes: Cast iron valve boxes shall be firmly supported, centered, and plumb over the operating unit of valve. Box cover shall be set flush with the surface of finished pavement or at such other level as may be directed by the Inspector. Valve rod extension with guide shall be required to maintain a maximum distance of two feet (2') to four feet (4') from operating nut to top of box. All valves shall be properly restrained.
- c. Cross Connections: Drainage branches shall not be connected to any sewer, submerged in any stream, or installed in any manner which, in the opinion of the Inspector, will constitute a contamination or cross-connection hazard.
- d. Hydrants:

Connection to Main: Each hydrant shall be restrained and connected to the main with a minimum six inch (6") diameter branch, controlled by an independent six inch (6") resilient seat gate valve. All hydrant valves shall be restrained to the hydrant tee on the main line.

Setting of Hydrants: When hydrants are set, a drainage pit two feet (2') in diameter and two feet (2') below the bowl of the hydrant shall be excavated. The pit shall

be filled with coarse gravel or #57 clean stone to a level of six inches (6") above the weep hole. No hydrant drainage pit shall be connected to a sewer. The bowls of all hydrants shall be well braced against unexcavated earth, and restrained to the pipe. All hydrants shall be thoroughly cleaned of dirt or foreign matter before setting.

Fire hydrant weep holes are subject to contamination when installed in areas subject to high groundwater, to flooding, to contaminant or pollutant spills, or in areas where surface water ponds. Weep holes should be plugged and seasonally drained in locations where contamination from back siphonage is a possibility. Another alternative is to pipe the drains to daylight. The Contractor shall notify the Department if there is a presence of high ground water.

- e. Anchorage of Fittings: All fittings (i.e., each bend, tee, plug, valve, and cap) shall be prevented from moving by means of mechanical restraints, as shown in the standard details.

E. Installation of Tapping Sleeves:

General: The following testing and conditions apply to all sleeves:

- a. The tapping sleeve shall be tested in place to a minimum of 150 psi, for a minimum of ten (10) minutes with no loss of pressure.
- b. Tapping sleeves sixteen inches (16") and larger shall be supported by a concrete pedestal support to be designed by the Engineer.
- c. Clean pipe surface thoroughly, particularly in the area where the gasket will seal. The Contractor shall wipe the pipe in the area where the tap is to be made with a one percent (1%) chlorine solution prior to installing the sleeve.
- d. Lubricate pipe and gasket with soap and water. Mount body halves on pipe. Contractor shall ensure gasket is secure in gasket groove.
- e. Contractor shall ensure that the tapping nipple is pointing in its final direction so it will not be moved or rotated on the pipe.
- f. Insert bolts and hand tighten nuts, keeping equal gaps between body halves.
- g. Prior to tightening nuts, position outlet as required to suit the installation. Contractor shall ensure test connection is accessible.
- h. Tighten bolts, alternating from one side to the other to equalize the gap between halves. Continue to tighten bolts until sleeve halves conform to the contour of the pipe and all bolts are to a uniform tightness. The required torque for dry threads will be 70-100 ft. lbs. (Lubricated threads 35-50 ft. lbs.) On thin wall or badly corroded pipe care should be taken to prevent crushing or collapsing of the pipe.
- i. A pressure test is required to test the sleeve and valve in place prior to tapping.

- j. Prior to pressure testing, the Inspector shall obtain a reading of line pressure in the system, either from a hydrant or a service. The pressure test should be at two and a half (2 ½) times line pressure or 200 psi, whichever is greater. The duration of this pressure test shall be a minimum of ten (10) minutes. If the sleeve fails the pressure test, it shall be completely removed and apparent problem corrected or returned and a new sleeve used. The tapping sleeve, valve, and tapping machine assembly are to be adequately supported during the tapping operation to prevent movement or rotation of the tapping sleeve.
  - k. Contractor shall complete tapping procedure and perform the necessary checking as required. Contractor shall furnish the Inspector with the tap coupon.
  - l. Check the bolts for tightness and re-torque, if required.
- F. Installation of Services:
- a. Three-quarter Inch (3/4") and One Inch (1") Services:
    - 1. Taps on existing PVC Pipe shall be direct tapped. Taps shall be made on a forty-five degree (45°) angle.
    - 2. Corporation stops shall have "cc" thread inlet and copper compression outlet.
    - 3. Tap shall be made with a tapping machine equipped with a bit designed for the type of pipe being tapped.
    - 4. Distance between taps or from a joint or bell shall be a minimum of eighteen inches (18").
    - 5. Service pipe shall be type "K" soft copper G. Services shall be installed with thirty-six inch (36") minimum cover up to meter yoke where yoke shall be installed so that meter will set between eighteen inches (18") and twenty-two inches (22") below finished grade.
    - 6. Meter yokes shall be from approved materials list.
    - 7. Meter yoke and box shall be set one foot (1') inside right-of-way or easement or as directed by the Inspector. Meters shall be installed on reasonably level ground or conform to the angle of the slope.
    - 8. Backfill shall be hand-tamped up to service pipe at tap to prevent corporation stop from being broken off during backfilling.
    - 9. Set meter box in center of lot unless approved alternate location is provided. Meter boxes are not to be set in the driveway.
  - b. One and One-half inch (1½") and Two Inch (2") Services
    - 1. All taps for one and one-half inch (1½") and two inch (2") services shall be made with four inch (4") tee and valve and then reduced down to size needed. Four inch (4") resilient seat valve and valve boxes are required for all services

one and one-half inch (1 ½") and larger. All services shall be constructed with four (4") ductile iron water line within one foot (1') of the meter barrel

2. Distance between taps or from a joint or bell shall be a minimum of eighteen inches (18").
3. Service pipe shall be type "K" hard copper.
4. Services shall be installed with thirty-six inch (36") minimum cover up to meter yoke where yoke shall be installed so that meter will set between eighteen (18") and twenty-two inches (22") from finished grade.
5. Meter yokes shall be from approved materials list. Meter yoke and box shall be set one foot (1') inside right-of-way or easement or as directed by the Inspector. Meters shall be installed on reasonable level ground or conform to the angle of the slope.
6. Backfill shall be hand tamped up to service pipe at tap to prevent corporation stop from being broken off during backfilling.

G. Filling of Water mains and appurtenances

- a. When installation has been completed, the main shall be filled with water such that the full pipe velocity is no greater than one foot per second (1 ft/sec) (0.3m/sec). Precautions shall be taken to ensure that air pockets are eliminated. As an optional procedure, if required by the Department, water used to fill the new main shall be supplied through a temporary connection that shall include an appropriate cross-connection control device, consistent with the degree of hazard, for backflow protection of the active distribution system. Procedure shall be in accordance with AWWA standard C651.

### 3.4.3.2 Pressure Testing of Water Main

- A. Each section of the piping system including all water services, shall be subjected to a pressure test of 150 psi, or one and one-half (1 ½") times the working pressure, whichever is greater, measured at the high point of the system. Maintain this pressure for a minimum of two (2) hours with an allowable leakage (defined as the amount of water that must be added to maintain the test pressure within 5 psi of the test pressure) of not greater than:

$$L = (S \times D \times \text{Square Root of } \sqrt{P}) / 148,000$$

Where:

L = Allowable Leakage in Gallons per Hour

S = the length of the pipe tested in feet

D = the nominal pipe diameter in inches, and

P = the average test pressure in psi during the leakage test.

Prior to applying pressure to the lines, all mechanical restraints shall have been completed to the satisfaction of the Contractor and the Inspector. As the pipes are being filled, all air shall be expelled from the pipes by providing hydrants at the high points of the system.

Any defects discovered during this test shall be repaired and the test repeated until the results are satisfactory to the Inspector. The Contractor shall provide all equipment, materials, and labor necessary to conduct the test. The Contractor shall provide a suitable test pump and properly calibrated gauge or other means for measuring leakage, and a disinfected potable water tank, which is satisfactory to the Inspector.

- B. Water for Testing: Water from the County's water system shall be used for flushing, sterilization, and testing. A hydrant meter shall be obtained from the Department and Contractors will be billed for water used. Filling of water line may be performed provided permission has been obtained from the Inspector. The Contractor is not permitted to operate valves on existing lines unless otherwise directed by the Inspector.
- C. It is recommended that a copy of all applicable AWWA standards for pressure testing of water mains be kept at the jobsite.

#### 3.4.3.3 Disinfection

- A. Prior to being placed in service, the pipe line and appurtenances shall be disinfected in general accordance with ANSI/AWWA C651, latest edition, AWWA Standard for Disinfecting Water Mains and the supplemental procedures as set forth below.
  - a. "Section 4.7 of AWWA C651" emphasizes nine (9) basic procedures in the disinfection process. These procedures are to:
    - 1. Inspect materials to be used to ensure their integrity;
    - 2. Prevent contaminating materials from entering the water main during storage, construction, or repair and note potential contamination at the construction site;
    - 3. Remove, by flushing or other means, those materials that may have entered the water main or appurtenances;
    - 4. Prevent contamination of existing mains from cross-connection during flushing, pressure testing, and disinfection;
    - 5. Pressure test the water main to ensure the main meets the purchaser's allowable leakage rate. Hydrostatic pressure tests should be conducted with potable water;
    - 6. Chlorinate and adequately document the process used for disinfection;
    - 7. Flush the chlorinated water from the main. Refer to ANSI/AWWA C655 Field Dechlorination for dechlorination procedures, if dechlorination is required;

8. Determine the bacteriological quality of water samples collected from the pipe by laboratory test after disinfection;
9. Final connection of the newly disinfected water main to the active distribution system without sacrificing sanitary practices and conditions.

B. Preliminary Flushing:

The main shall be flushed prior to disinfection at a velocity of not less than three feet per second (3 ft/s) unless the Department determines that conditions will not permit the required flow. Adequate provisions shall be made by the Contractor for disposal and neutralization of flushing water, so that no physical or environmental damage results.

C. Forms of Chlorine for Disinfection:

It is the Contractor's responsibility to be familiar with and have available for his employees the "Safety Data Sheets" of any products used as a source of chlorine and to provide the proper safety instructions and personal protective equipment to the employees mixing and using materials for disinfection of the water facilities.

- a. Acceptable sources of chlorine for disinfection may be obtained from any of the following four sources:
  1. Liquid sodium hypochlorite (household bleach).
  2. Liquid sodium hypochlorite (industrial strength).
  3. Calcium hypochlorite granules.
- b. The direct introduction of chlorine gas (or liquid) from a pressure cylinder into a water line shall not be allowed.
- c. The mixing of a source of chlorine to obtain a suitable disinfecting solution shall be as follows:
  1. Liquid sodium hypochlorite is supplied in strengths from five and one-quarter percent (5.25%) available chlorine (commercially available household bleach) to fifteen percent (15%) available chlorine (industrial strength sodium hypochlorite). A water-sodium hypochlorite solution shall be prepared by adding liquid sodium hypochlorite to water.
  2. A water calcium hypochlorite solution shall be prepared by dissolving calcium hypochlorite granules containing sixty-five percent (65%) available chlorine by weight in a pre-determined volume of water to make the desired water-calcium hypochlorite concentration. Disinfection of new mains by water calcium hypochlorite solution shall not be used unless a suction or in-line strainer is available on the solution pump to prevent any undissolved solids from entering the piping. An alternative method of straining the solution to remove undissolved granules may be approved by the Inspector on a case-by-case basis.

D. Method of Chlorine Application and Testing:

- a. The continuous feed method of applying the disinfecting solution shall be as follows: Water from the existing distribution system or other approved sources of potable water supply shall flow through an approved flushing mechanism at a constant, measured rate into the newly-laid pipeline. The water shall be mixed with a chlorine-water solution as prepared above, also fed at a constant, measured rate. The two rates shall be proportioned so that the chlorine concentration of the water and water/chlorine solution in the pipe is elevated to and maintained at, a minimum of fifty milligrams per liter (50 mg/l) available chlorine.

Since the forms of preparation for a water-sodium hypochlorite or water-calcium hypochlorite concentration are a batch process, a method acceptable to the Inspector shall be available to replenish the concentration being fed and mixed with the water flow, so there is no interruption of the flow of disinfection solution.

To assure that this concentration is maintained, the chlorine residual shall be measured at intervals not exceeding 2,000 feet and at the end of all branch lines or cul-de-sacs in accordance with the procedures outlined herein. During the application of the chlorine-water solution, valves, hydrants, and any other appurtenances shall be operated in order to be thoroughly disinfected. Chlorine-water solution application shall continue until the entire new main is filled with water having a residual of a minimum of ten milligrams per liter (10 mg/l) of free chlorine. The chlorinated water shall be retained in the main for at least twenty-four (24) hours. Procedure shall be in accordance with AWWA standard C651 4.4.3.3.

- b. After the applicable retention period, the heavily chlorinated water shall be flushed from the main until the chlorine residual of the water leaving the main is equal to the chlorine residual of the incoming system water. At that time, the new system shall be valved off to allow the residual to dissipate to two-tenths of a milligram per liter (0.2 mg/l) before taking samples for bacteriological analysis. Additional instructions for disposal of the heavily chlorinated water are covered later in this section.

E. Bacteriological Tests:

- a. Prior to collecting any Bacteriological test, samples shall be collected and tested for acceptable aesthetic quality (e.g., chlorine residual, pH, alkalinity, specific conductance, turbidity). Levels should be as expected or typical for the water system.
- b. After final flushing, and before the water main is placed in service, samples shall be collected and tested for bacteriological quality. Two (2) consecutive negative tests from the same location shall show the absence of coliform organisms. At

least two (2) samples shall be collected by the County at a minimum of sixteen (16) hours apart at intervals determined by the Inspector (not exceeding 1200 feet apart and at the end of all branch lines and cul-de-sacs) and tested by a qualified laboratory selected by the County. The County shall bill the Contractor a standard fee, to be set by the County, for this service, including all retests.

- c. Samples for bacteriological analysis shall be collected in approved sterile bottles or bags treated with sodium thiosulfate. If laboratory results indicate the presence of coliform bacteria, the samples are unsatisfactory and disinfection shall be repeated as prescribed above until the samples are satisfactory. Cleaning, disinfection, and testing shall be under the direction of the Inspector but remains the responsibility of the Contractor. The Contractor shall be responsible for any cost associated with the loading, hauling, discharging, and dechlorination of the heavily chlorinated water.
  - d. The County will provide water at no cost for the first two (2) sets of Bacteriologic samples. Subsequent tests will result in an additional charge for water used, based on the current bulk water rates.
  - e. In the event of a positive test result for total coliform but a negative test result for *E. Coli*, the water main shall be disinfected in accordance with [Section 3.4.3.3](#) and ANSI/AWWA C651 guidelines.
  - f. In the event of a positive test result for *E.Coli* in the first set of samples, the water main shall be disinfected in accordance with [Section 3.4.3.3](#) and ANSI/AWWA C651 guidelines. The Contractor shall collect two (2) sets of Bacteriologic samples seven (7) days apart. In the event of additional positive *E.Coli*, the water main and appurtenances shall be CCTVed. The results from the CCTV inspection shall be reviewed by the Department. The Department reserves the right to determine corrective action up to and including removal of the water main.
- F. It is recommended that a copy of all applicable AWWA standards for the disinfection process of water mains be kept at the jobsite.

#### 3.4.3.4 Supplemental Procedures for Disinfecting, Testing, And Flushing

- A. In order to best assure satisfactory bacteriological results, it is essential that all aforementioned preventive and precautionary measures be taken prior to and during construction to protect the interiors of pipe, fittings, and valves from contamination. Failure to follow the precautionary measures increases the likelihood of unsatisfactory bacteriological tests and increases the construction requirements necessary for final acceptance.
- B. Because of the large volume of water to be flushed from the fire hydrants, the Contractor must inspect the areas of discharge and provide the necessary equipment or materials to prevent any environmental damage or erosion. Sufficient hose length and termination fittings are to be provided so as to discharge the water into stable, heavily vegetated

areas, drainage ponds, storm sewers, paved ditches, or other areas capable of withstanding the inundation without sustaining damage. The Contractor shall be responsible for any damage that may result from flushing.

- C. When flushing heavily chlorinated water from the system, flush through fire or flushing hydrants to remove the disinfecting solution from the new line. For site-specific locations, the Inspector may require the use of a neutralizing chemical and piping arrangement. The expense of a neutralizing station is the responsibility of the Contractor.

Flushing volumes shall be as below:

Main size (Nominal)	Double Check Valve Single Gate Size (Note 1)	<u>INITIAL FLUSH</u> (Note 2) Min. Flow (gpm)	<u>FINAL FLUSH</u> (Note 2) Max. Flow (gpm)
6"	4"	260	88
8"	4"	470	160
12"	6"	1060	350
16"	6"	1880	624
20"	8"	2940	978
24"	10"	4230	1410
30"	Designed by Consultant	6610	2202
36"	Designed by Consultant	9520	3174

### **Flushing Schedule**

Notes:

- a. Approximation of flushing flows can be made by using either a pitot tube or a method of measuring the static discharge pressure from a hydrant used for discharge of the flushing water.
- b. On a case-by-case basis, dependent upon such variables as length of new waterline (<200'), space limitations, or other unforeseeable obstacles, the Inspector may authorize the use of a smaller flushing device if the use of this device will provide for adequate flushing of the new waterline.

#### **3.4.3.5 Testing of Double Check Assembly**

The Inspector will be responsible for ensuring the appropriate test is performed up to the outside isolation valve located on the inlet side of the double check assembly.

The Contractor shall have the double check assembly tested by an approved tester prior to service being authorized to the building. Tests on the double check assembly shall be conducted annually by a certified tester approved by the Department.

#### 3.4.3.6 Abandonment of Water Service

Abandoned water services shall be excavated at the main and the corporation stop exposed. The corporation stop shall be turned off and the service pipe disconnected from the corporation stop. If practical, the corporation stop should be removed and a screw plug installed in the hole. If it is not practical to remove the corporation stop, provide a screw plug for the corporation stop. If the corporation stop is left in place, provide As-Built Plans to show its location. Remove the meter box, yoke, and service line. The Inspector will deliver the meter to the Department.

#### 3.4.3.7 Abandonment of Water Mains

Water mains and hydrants to be abandoned shall be permanently disconnected from the remaining system. If the abandonment takes place at a tee, the tee shall be removed from the main and a straight pipe installed. For other instances involving fittings, the proper fitting shall be installed to eliminate the previous connection.

All open ends on abandoned pipe shall be permanently sealed by plugging with masonry, mortar, or a plug. All valve boxes, fire hydrants, flushing hydrants (blow-offs), or other appurtenances shall be removed. Salvageable items shall be returned to the Department.

#### 3.4.3.8 Clean-Up

Upon the completion of the installation of the water system and prior to County acceptance, all restoration shall be complete. The work area shall be restored to its original condition and pavement replaced to the satisfaction of VDOT and the County. All trash and debris shall be removed and disposed of properly.