02510 - WATER DISTRIBUTION

(Last revised 4/27/16)

SELECTED LINKS TO SECTIONS WITHIN THIS SPECIFICATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the General Requirements and Supplementary Conditions apply to this specification.

B. 02275 – TRENCHING, BACKFILLING AND COMPACTION OF UTILITIES.

1.2 SUMMARY

This section includes all equipment, labor, material, and services required for complete installation of water distribution piping and specialties for municipal water and fire-service mains and services.

1.3 DEFINITIONS

For the purposes of this specification, the following definitions refer to water distribution systems that come under the authority of Town as specified within this and other sections of this manual.

A. **Fire Service**: Exterior fire fighting/suppression water piping.

B. **Town's Engineer**: The Project Engineer or his or her authorized representative.

C. **Water Main**: Exterior water systems for both domestic water and fire suppression needs.

D. **Water Service**: Exterior water piping used to provide water for domestic purposes.

The following are industry abbreviation for various pipe materials:

A. **AC**: Asbestos Cement Pipe
B. **CI**: Cast Iron Pipe
C. **DIP**: Ductile Iron Pipe
D. **RCP**: Reinforced Concrete Pipe

1.4 SUBMITTALS

A. Submit product data for the following:

1) Pipe and Fittings
2) Valves and accessories.
3) Water meters and accessories.
4) Detector Check Valves
5) Backflow preventers and assemblies.
6) Fire Hydrants.
7) Fire Department Connections.
8) Castings
9) All appurtenances proposed for use on a project that may not be listed here.

B. Submit shop drawings:

1) For precast concrete vaults including frames and covers, drains, access hatches, wall sleeves, valve support stands, prefabricated above ground vaults, and backflow prevention devices.

2) Upon request, valve manufacturers shall furnish certified copies of test reports.

3) For any product submitted as an *"or approved equal"* that is not specifically specified in this specification.

1.5 QUALITY ASSURANCE

A. Materials and operations shall comply with the latest revision of all applicable Codes and Standards.

B. Piping materials shall be marked clearly and legibly.

1) Ductile Iron Pipe shall show identification marks on or near bell as follows:
   a. Weight,
   b. Class or nominal thickness,
   c. The letters "DI" or "Ductile,"
   d. Manufacturer's identifying mark,
   e. Year in which pipe was made,
   f. Casting period.

2) Steel pipe shall be marked as follows. Each length of pipe and each special section shall be legibly marked by paint stenciling, die stamping, or hot-roll marking to show the following:
   a. Manufacturer's name or mark,
   b. Size and weight of the pipe or special section,
   c. The type of steel from which the pipe or special section was made.

3) PVC Pipe shall show proper marking of pipe as required in the applicable product specification and shall remain legible during normal handling, storage, and installation. The manufacture date of the pipe must be within 1 year of the proposed date of installation. Marking of PVC pipe commonly includes:
   a. Manufacturer's Name,
   b. Nominal Pipe Size and Size Base,
   c. PVC Cell Classification or Material Code,
   d. Dimension Ratio or Standard Dimension Ratio,
   e. Product Type, Pressure Class or Pressure Rating,
   f. Standard Specification Designation,
   g. Production Record Code.

C. Comply with Factory Mutual's *"Approval Guide*" and Underwriters Laboratories, Inc. "*Fire Protection Equipment Directory*" for fire-service main products.

D. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, and flushing and valve and hydrant supervision for fire mains.

E. Comply with NSF 61 for materials for water service piping and specialties for domestic water.

F. Comply with all applicable AWWA and ANSI standards.

1.6 QUALITY STANDARDS

A. Materials and operations shall comply with the latest revision of the Codes and Standards listed below. The use of ASTM standard specification references without a year designation implies the most current applicable specification.

AASHTO	American Association of State Highway Transportation Officials.
ANSI	American National Standards Institute
AREA	American Railway Engineers Association
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
FM	Factory Mutual System
FS	Federal Specifications

MSDS	Material Safety Data Sheets
NSF	National Sanitation Federation International
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration
UL	Underwriters Laboratories, Inc.
NCDENR	North Carolina Department of Environment and Natural Resources
NCDOT	North Carolina Department of Transportation

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

Materials used for the construction of water mains and appurtenances in the Town's water distribution system shall be new, free of defects, and meet the highest standards set forth. An authorized Town representative must inspect, review, and approve all materials to be used for water lines and appurtenances prior to installation. At the option of the Town, any material installed without inspection will have to be sufficiently removed for inspection and review. Any additions, deletions, or changes from the Town approved plan set must be submitted to Town Engineer for approval, prior to making changes in the field.

A. **Pipe Conditions/Pipe Examination**:

1) **New pipe inspection upon arrival**: Inspect each truckload of materials thoroughly upon arrival at the site. Examine material for damage and to ensure that the right pipe has been delivered to the site. Pipe shall be protected during handling against impact shocks and free fall. Care shall be taken when unloading pipe to avoid damaging the pipe lining. Pipe that has been damaged either in transit or during unloading shall be plainly marked and shall not be used in the construction of the utility. Pipe shall be kept clean at all times, and no pipe shall be used in the work that does not conform to the appropriate ASTM specifications.

2) **Prior to laying pipe**: Prior to being installed, each section of the pipe shall be carefully examined for damage and conformity with theses specifications. All pipe in which spigots and bells cannot be made to fit properly, or pipe, which has chipped bells or spigots, will be rejected. All pipe damaged or deemed not to conform to these specifications, shall be plainly marked and shall not be used in the construction of the utility. The faces of all spigot ends and all shoulders on the bells must be true, without lumps or rough edges, and be brought in fair contact. Examine bell and spigot for uniformity and smoothness of liner and barrel.

B. Inspect fittings and structures thoroughly upon arrival for damage. Remove damaged or rejected materials from site.

C. Observe manufacturer's directions for handling, delivery, and storage of materials and accessories.

D. Protect pipe coating during handling using methods recommended by the manufacturer. Use of bare cables, chains, hooks, metal bars or narrow skids in contact with coated pipe is not permitted.

E. Protect stored piping from entry of water or dirt into pipe. Store pipe on shoulders and not in ditch lines. String out no more pipe than can be installed in a day. Also, protect bells and flanges of special fittings from entry of moisture and dirt. If pipe is provided with end protectors, do not remove protectors until ready for installation or for inspection. Once inspected, replace protectors.

F. Support pipe to prevent sagging or bending.

G. Use slings to handle valves and fire hydrants if size requires handling by crane or other type of lift. Do not use handwheels or stems to lift or for rigging points.

H. Store fire hydrants and valves in such a way as to prevent entry of water and dirt into openings. Support on skids or pallets off the ground or pavement. If fire hydrants or valves are provided with end protectors, do not remove protectors until ready for installation or for inspection. Once inspected, replace protectors. Protect valves against damage to threaded ends or flanges.

1.8 PRODUCT SUBSTITUTIONS

The Town Engineer will approve materials not specified but deemed equal, on a case-by-case basis. Submit documentation and samples of materials. New materials approved for the water distribution system will be incorporated into these specifications after approval.

1.9 PROJECT CONDITIONS

1.9.1 Separation of water and sanitary and/or combined sewers.

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

B. **Parallel Installations**:

1) **Preferred/Normal Condition** – Water lines shall be constructed at least 10 feet horizontally from a sewer or sewer manhole whenever possible. The distance shall be measured edge-to-edge.

2) **Unusual Conditions** – When local conditions prevent a horizontal separation of at least 10 feet, the water line may be laid closer to a sewer provided that:

a. The water main shall be placed in a separate trench, with elevation of the bottom of the water line at least 18 inches above the top of the sewer; or

b. The water main shall be placed in the same trench as the sewer, and located to one side, on a bench of undisturbed earth, and the elevation of the bottom of the water main shall be at least 18 inches above the top of the sewer; or

c. If it is impossible to obtain proper horizontal and vertical separation as described above or anytime the sewer is above the water main, both the water main and sewer must be constructed of DIP complying with public water supply design standards and must be pressure tested to 150-psi to assure watertightness before backfilling. The sewer manhole shall be of watertight construction and tested in place.

C. **Water Mains Crossing <u>Above</u> Sewers**:

1) **Preferred/Normal Condition** – Water lines shall be constructed to cross over sewers whenever possible and shall be laid to provide a vertical separation of at least 18 inches between the bottom elevation of the water line and the top of the sewer.

2) **Unusual Conditions** – When local conditions prevent an 18 inch vertical separation as described in *Crossing,* Preferred/*Normal Conditions* (paragraph above), one of the following construction methods shall be used:

a. Both the water main and sewer shall be constructed of ferrous materials and with joints that are equivalent to water main standards for a distance of 10 feet on each side of the point of crossing. Both the water main and sewer shall be pressure tested at 150-psi to assure watertightness before backfilling.

or

b. Either the water main or the sewer main may be encased in a watertight encasement pipe which extends 10 feet on both sides of the crossing, measured perpendicular to the water main. The encasement pipe shall be of materials approved by NCDENR for use in water main construction (e.g. DIP, steel). If the sewer main is encased, the DIP sewer carrier pipe shall be DIP continuous from manhole to manhole. If the water main carrier pipe is encased, the water shall be constructed of DIP meeting these specifications.

D. **Water Mains Crossing <u>Below</u> Sewers**:

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

a. Whenever it is necessary for a water main to cross under a sewer, both the water main and the sewer shall be constructed of ferrous materials and with joints equivalent to water main standards for a distance of 10 feet on each side of the point of crossing. A section of water main pipe shall be centered at the point of crossing. Both the water main and sewer shall be pressure tested at 150-psi to assure watertightness before backfilling.

b. Provide adequate structural support for the sewers to prevent excessive deflection of the joints, which can result in settling on and/or the breaking the water line.

E. **Water Mains and Other Utilities**

1) **Horizontal Separation; Preferred/Normal Condition** – Water lines shall be constructed to provide at least 3 feet of horizontal separation from other utilities whenever possible. The distance shall be measured edge-to-edge. For Asbestos Cement lines, provide a minimum of 5 feet of clear horizontal separation.

2) **Vertical Separation – Preferred/Normal Condition**: Whenever it is necessary for another utility to cross a water main, a 18-inch vertical separation shall be maintained between the lines. When local conditions prevent a 18-inch vertical separation, the following construction shall apply:

a. Waterline shall be of a ferrous material.

F. **Sanitary Sewer Manholes** – No water mains shall pass through or come in contact with any part of a sewer manhole. A minimum of 3 feet of horizontal separation shall be maintained between water mains and sanitary or combined sewer manholes provided that the applicable provisions of paragraph B, *Parallel Installations, Unusual Conditions*, above, are also met.

G. **Sanitary Sewer And Water Services**: Unless stated otherwise below, the separation requirements for water and sewer services, beyond the water meter, fall under the requirements the *NC State Building Code: Plumbing Code (IPC with North Carolina Amendments),* section 603.2 *Separation of Water Service and Building Sewer*, latest revision. Those provisions are generally as follows:

a. Water service pipe and the building sewer shall be horizontally separated by 5 feet of undisturbed or compacted earth. However, in accordance with *Water & Sewer Design*, paragraph 1.2.1.R *Water Distribution*, the horizontal separation between a water and sewer service within a public right of way or utility easement shall be no less than 3 feet. See **Standard Detail C07.03**).

b. A minimum 12-inch vertical separation with bottom of water above top of sewer and pipe material meets the provisions of this specification.

c. Water can be located in same trench with sewer if pipe material meets the provisions of this specification.

d. Separation is not required if water is sleeved to a point 5 feet either side of the sewer centerline with pipe material meeting Table 605.3, Table 702.2 or Table 702.3 of the *NC State Building Code: Plumbing Code*, latest revision.

H. **New Utilities and Existing Water Mains** – When installing a new utility adjacent to or in close proximity to an *existing* water main, the new utility line shall be installed to provide the minimum horizontal and vertical clearances specified in paragraph 1.9 E, *Water Mains and other Utilities*.

1.10 CROSS-CONNECTION CONTROL

Refer to Town Cross-Connection/Backflow Protection Ordinance (Chapter 53) latest adoption as applicable. See paragraph 2.2.2 for Backflow Preventers device specifications.

1.11 SERVICE INTERRUPTION

Contact the Town of Clayton to coordinate interruption of service, operation of valves, line cut-ins, or placement of a tapping sleeve and valve. If interruption is necessary, the interruption shall be arranged to occur at such a time to cause the least disruption and minimize loss of service. At the direction of Town Engineer, temporary service may be required to be provided. Provide a minimum of 48 hours notice of the proposed utility interruption or necessary operation of valves.

1.12 COORDINATION

A. Coordinate tie-in to municipal water mains with the Town Engineer. Except as needed for fire suppression purposes, the Town of Clayton will be the sole operator of all valves and hydrants on the Town's water distribution system. Adequate notifications to water customers will be given by the Contractor prior to any interruption of service. Service is to be continuously maintained to customers in the project areas except for the minimum amount of time required to make connections with the existing system. Only in the case of an emergency may a valve be closed by a Contractor. Records shall be kept of any valves closed during an emergency and the Town Engineer shall be notified of the specific valves closed at the earliest reasonable time following such valve closure.

   Before shutting off any main, residents are to be notified by the Town of Clayton's representative in writing at least 48 hours in advance of cut off. The Contractor shall provide assistance to the Town in notification distribution. The Town shall be notified at least 1 week in advance of request for operation of valves and making either a wet tap or cut-in.

B. Contact ***"NC One Call"*** at 811 before digging.

   811 Know what's below. Call before you dig.

C. When traffic signals, loops, or their appurtenances are likely to be damaged or interfere as a result of the construction, coordinate temporary operation with the applicable agency having jurisdiction of the signals. Provide a minimum of 48 hours notice prior to anticipated disturbance or interruption. At the discretion of the Town Engineer, the notice may be required to be published in the newspaper.

D. Repair of pavement markings: When cuts are made through any paved surface and the cuts extend through the pavement markings, the replaced pavement shall be marked to match the existing.

E. Water Service Shut-off

   The Town of Clayton requires adherence to the following procedures prior to shutting off water service on any existing Town line:

1) The Contractor must receive approval for shut-off from the Town Engineer. Generally, shut-offs must occur from 9:00 AM to 11:00 AM and 2:00 PM to 4:00 PM on weekdays.

2) After receiving approval, Contractor shall notify affected residents in writing 48 hours in advance of beginning operation.

PART 2 – PRODUCTS

2.1 PIPE AND FITTINGS

2.1.1 COPPER TUBE SERVICE PIPE

Copper pipe shall meet ASTM B88 *Standard Specification for Seamless Copper Water Tube*, Type K, water tube annealed temper soft drawn for use with compression type (brass) fittings for ¾-inch through 2-inch below ground services.

2.1.2 DUCTILE IRON PIPE

Ductile iron pipe shall be manufactured in accordance with all applicable requirements of AWWA C151/ ANSI A21.51 *Ductile-Iron Pipe, Centrifugally Cast, for Water* for 4-inch and larger diameter pipe, pressure class rated, 350 minimum (rated working pressure plus 100 psi allowance for surge) (See Design Section) for 4-inch and larger diameter pipe, pressure class rated, and shall be in 18 or 20-foot lengths. The thickness of Ductile Iron Pipe shall be determined by considering trench load and internal pressure *(the pressure zone and variances in which the pipe will be used)* separately in accordance with AWWA C150/ANSI A21.50 *American National Standard for Thickness Design of Ductile-Iron Pipe*.

The ductile iron pipe shall be cement mortar lined with a seal coat in accordance with AWWA C104/ANSI 21.4 *Standard for Cement–Mortar Lining for Ductile-Iron Pipe and Fittings*. Outside coat shall be a minimum of 1-mil bituminous paint according to AWWA C151/ANSI A21.51 Section 51-8.1. Pipe shall be stamped as required by AWWA C151.

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

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

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

Pipe shall be furnished complete with accessories per AWWA C111/ANSI A21.11 *Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings*.

A. **Ductile Iron Joints**

Pipe joints may be either mechanical joint or push-on pipe sizes 4 inches through 48 inches. Acceptable types of pipe joints are as follows:

1) **Push-on Joint, Ductile Iron Pipe** shall conform to AWWA C151/ANSI A21.51 *Ductile-Iron Pipe, Centrifugally Cast, for Water* (such as "Fastite," "Tyton," or "Bell-Tite."). The dimensions of the bell, socket, and plain end shall be in accordance with the manufacturer's standard design dimensions and tolerances. The gasket shall be of such size and shape to provide an adequate compressive force against the plain end and socket after assembly to affect a positive seal. Gaskets shall be vulcanized natural or vulcanized synthetic rubber, and comply with AWWA C111/ANSI A21.11 *Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings*.

2) **Mechanical Joint, Ductile Iron Pipe** shall be used only at the specific locations indicated on the drawings or as approved by Town's Engineer.

a. The mechanical joint shall consist of:

i. A bell cast integrally with the pipe or fitting and provided with an exterior flange having cored or drilled bolt holes and interior annular recesses for the sealing gasket and the spigot of the pipe or fitting;

ii. A pipe or fitting spigot;

iii. Mechanical Joint Gaskets to be plain rubber (Styrene Butadiene [SBR]) per AWWA C111/ANSI A21.11;

iv. Separate ductile iron follower gland having cored or drilled bolt holes; and

v. Alloy steel Tee Head bolts and hexagon nuts. All threads are Coarse-Thread Series Class 2A, External and Class 2B, Internal, per ANSI B1.1. Nuts to be furnished in accordance with ASTM A563, *Standard Specification for Carbon and Alloy Steel Nuts*.

b. The joint shall be designed to permit normal expansion, contraction, and deflection of the pipe or fitting while maintaining a leak proof joint connection. The mechanical joint shall conform to the requirements of Federal Specification WW-P-421, AWWA C111/ANSI A21.11, and ASTM A 53 Standard Specification of Ductile Iron Castings.

c. Mechanical Joint Bolt Torque:

See section 3.1.1 below, paragraph B, item b, *Installing Mechanical Joint Pipe*.

3) **Mechanical Joint Restraint**: Acceptable types of joint restraints shall be:

a. Restrained Joints shall consist of the use of a mechanical joint restraint system. Bolt heads are to be "auto-torque" twist off. See Paragraph 2.1.2, B, 3), below for approved manufacturers and models.

b. Restrained Joint Pipe shall be TR Flex or Lok Tyte as manufactured by United States Pipe and Foundry Company, Lok-Fast or Lok-Ring as manufactured by American Cast Iron Pipe Company, Snap-lok as manufactured by Griffin Pipe Products Company.

4) **Flanged Joints** shall be firmly bolted with machine bolts; however, where valves or special fittings are attached to a flange pipe, stud or tap bolts may be used, providing the number used and diameter for each joint is the same for each respective size of pipe or special, or valve, as recommended by the latest AWWA Standard for flanged drilling. Bolts are specified in ANSI B18.2.1 and nuts are specified in ANSI B18.2.2. Bolts and nuts are to be cold worked 304 stainless steel meeting ASTM F593 *Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs* for sizes up to 1.5 inches. Stainless steel bolts and nuts shall have a minimum yield strength of 50,000 psi. For high strength applications, use 304L stainless steel bolts. Bolts shall be of sufficient length to pass through two flanges and the nut threads shall be accurately cut, close fitting, and the prevailing standard. Bolt heads shall be cut square and nuts hexagon in shape, both the heads and nuts being chamfered. Gaskets to be of 1/8-inch thick plain rubber (Styrene Butadiene [SBR]) per AWWA C111/ANSI A21.11 or equal as approved by Town's Engineer.

B. **Ductile Iron Fittings**

Fittings shall be ductile iron, grade 70-50-05, and shall conform to AWWA C110/ANSI A21.10 or AWWA C153/ANSI 21.53 for compact fittings, pipe sizes 4 inches through 48 inches with the exception of manufacturer's proprietary design dimensions and thicknesses for iron, in accordance with AWWA C110/ANSI A21.10. All ductile iron fittings shall have a minimum working pressure rating of 350 psi and shall be cement mortar lined and bituminous coated (minimum 1-millimeter), in accordance with AWWA C104/ANSI A 21.4. The fittings shall be tested and the manufacturer shall provide certified test results when requested by Town. This testing shall include hydrostatic proof testing of fittings. Glands, gaskets, and bolts shall conform to AWWA C111/ANSI A 21.11. The use of push on fittings is not permitted. Acceptable manufacturers are: American Cast Iron Pipe Company, Griffin Pipe Company, Harco, or U. S. Pipe & Foundry Company. Acceptable types of fittings are:

1) **Full Body Mechanical Joint Fittings:** Full body ductile iron mechanical joint fittings shall be minimum class to be 250 and shall conform to AWWA C110/ANSI A21.10. Glands, Gaskets and Bolts shall conform to AWWA C111/ANSI A21.11.

2) **Mechanical Joint Fittings – Compact:** Compact fittings shall be minimum class 350 and shall comply with AWWA C 153/ANSI A21.53, pipe sizes 4 inches through 48 inches. Glands, Gaskets and Bolts shall conform to AWWA C111/ANSI A21.11.

3) **Mechanical Joint Restraint Systems:** (3-inch through 48-inch)**:** Mechanical joint restraint systems shall consist of multiple gripping wedges incorporated

into a follower gland meeting the applicable requirements of ANSI/AWA C110/A21.10. Mechanical joint restraint systems (gland body, wedges and wedge actuating components) shall be constructed of grade 65-45-12 ductile iron material in accordance with ASTM 536. For applications requiring restraint 30 inches and greater, an alternate grade of iron meeting the material requirements of ASTM A536 is acceptable provided the device meets all the end product performance requirements. An identification number consisting of the year, day, plant and shift, shall be cast into each gland body. Sizes 3-inch through 16-inch shall be rated at 350-psi minimum working pressure and sizes 18 inches and larger rated at 250-psi minimum working pressure. Ratings are for water pressure and must include a minimum safety factor of 2 to 1 in all sizes. Bolt heads are to be "auto-torque" twist off. Mechanical joint restraint systems shall accommodate all classes of ductile iron pipe (pressure class 350 through pressure class 150 and class 56 through 50) and appurtenances such as valves and hydrants without damage to the fitting, pipe or cement linings. Consult with manufacturer when use is intended for grey iron pipe. All components shall be manufactured and assembled in the United States. See **Standard Detail 512.02**, sheet 2 for figure. Acceptable manufacturers and models are:

Manufacturer	Model
EBAA Iron Sales, Inc.	**Mega-Lug series 1100**
Star Pipe Products	**Star Grip**
Ford Meter Box Co.	**Wedge Action Uniflange Series 1400**

2.1.3 PVC PIPE – C900 (6" THROUGH 12" MAINS)

PVC pressure pipe, 6-inch through 12-inch, with bell end with gasket and spigot end shall comply with AWWA C900, Pressure Class 150, DR 18 and shall bear the seal of the National Sanitation Foundation for potable water pipe. Pipe OD shall be equivalent to ductile iron pipe of the same nominal size. Pipe joints shall include elastomeric gaskets and shall be integral bell type coupling. Lubricant and gaskets are to be supplied with the pipe by the manufacturer of the pipe. C900 pipe shall be used with ductile iron fittings (restrained joint).

Fusible C900 pipe, used for directional drilling, shall only be used with written approval from the Town Engineer.

2.1.4 POLYETHYLENE WATER PIPE

A. All polyethylene pipe, tubing, and fittings shall conform to all applicable provisions and requirements of the latest revision of AWWA C901, AWWA C906, or CSA B137.1 and, by inclusion, all appropriate standard references therein. Polyethylene compounds utilized in the manufacture of products furnished under this specification shall have a grade of PE24 with a minimum cell classification of PE 234363(C, D, or E) for PE2406/2606 materials, or a grade of PE34 with a minimum cell classification of PE 345464(C or E) for PE3408/PE3608 materials, as defined in ASTM D3350. In conformance with AWWA C901, AWWA C906, or CSA B137.1, they shall have a PPI recommended Hydrostatic Design Basis (HDB) of 1250 psi (PE2406/2606) or 1600 psi (PE3408/PE3608) at a temperature of 73.4°F (23°C).

All materials which come in contact with water, including lubricants, shall be evaluated, tested, and certified for conformance with ANSI/NSF Standard 6.1.

Clean re-work material of the same type grade, and cell classification generated from the manufacturer's own pipe and fitting production may be used by the same manufacturer as long as the pipe, tubing, and fittings produced meet the requirements of AWWA C901, AWWA C906, or CSA B137.1.

B. **Reference standards**

AWWA C901: Polyethylene (PE) Pressure Pipe and Tubing, 1/2-inch through 3-inch for Water Service.

AWWA C906: Polyethylene (PE) Pressure Pipe and Tubing, 4-inch through 63-inch for Water Service.

ASTM D2657: Standard Practice for Heat Joining Polyolefin Pipe and Fittings.

ASTM D2683: Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.

ASTM D2837: Standard Test Method for Obtaining Hydrostatic Design Basis of Thermoplastic Pipe Materials.

ASTM D3261: Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.

ASTM D3350: Standard Specification for Polyethylene Plastic Pipe and Fittings Materials.

ASTM F714: Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

ASTM F1055: Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.

PPI TR-3: Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials.

PPI TR-4: Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Pipe and Fitting Compounds.

ANSI/NSF: Standard Number 61 for Drinking Water Systems Components – Health Effects.

NSF Standard #14: Plastic Piping Components and Related Materials.

CSA B137.1: Polyethylene Pipe, Tubing, and Fittings for Cold Water Pressure Services.

C. **Qualification of Manufactures**

The manufacturer shall have manufacturing and quality control facilities capable of producing and assuring the quality of the pipe and fittings required by these

specifications. Given reasonable notice, the manufacturer's production facilities shall be open for inspection by Town or their representative. Qualified manufacturers shall be approved by the Project Engineer. Approved manufacturers include Plexco Performance Pipe Division-Chevron Chemical Company.

D. **Manufacturer's Quality Control**

The manufacturer of the Polyethylene pipe and fittings shall have an established quality control program responsible for inspecting incoming and outgoing materials. Incoming polyethylene materials shall be inspected for density, melt flow rate, and contamination. The cell classification properties of the material shall be certified by the supplier. Incoming materials shall be approved by Quality Control before processing into finished goods. Outgoing products shall be tested as required in AWWA C901 or AWWA C906, as applicable.

E. **Pipe and Tubing**

Pipe and tubing furnished under this specification shall be manufactured using compounds complying with the requirements of paragraph A above. Dimensional performance characteristics shall conform to the requirements of AWWA C901, C906, or CSA B137.1. The pipe's DR (Dimension Ratio) and Working Pressure (WPR) shall be as specified or shown on the drawings.

F. **Fittings**

Polyethylene fittings furnished under this specification shall be manufactured using compounds complying with the requirements of paragraph A above and all appropriate requirements of AWWA C901, C906, or CSA B137.1 Socket type fittings shall comply with ASTM D2683. Butt fusion fittings shall comply with ASTM D3261. Electrofusion fittings shall comply with ASTM F1055. Mechanical fittings produced from material not listed in paragraph A above, shall be approved only after submission of appropriate test data and service histories indicating their acceptability for the intended service. In all cases, the specifications and requirements of the fittings supplied shall comply with the appropriate section of AWWA C901, C906, or CSA B137.1.

G. **Pressure Class**

The Pressure Class of the Polyethylene pipe and fittings shall be specified on the basis of the Working Pressure Rating of the water system as defined in AWWA C906. Recurring positive pressure surges of up to one half of the pipe's nominal pressure class and occasional pressure surges of up to 100% of the pipe's nominal pressure class may be ignored due to the fatigue endurance of the polyethylene materials. Non-polyethylene fittings shall be specified and used in accordance with the surge tolerance of the particular appurtenance in use.

H. **Marking**

Pipe and tubing shall be marked in accordance with either of AWWA C901, AWWA C906, or CSA B137.1, whichever applies. Marking shall be legible and shall remain legible under normal handling and installation practices. Indent marking may be utilized provided; 1) the marking does not reduce the wall thickness to less than the minimum value for the pipe or tubing, 2) it has been

demonstrated that these marks have no effect on the long term strength of the pipe or tubing and, 3) the marks do not provide leakage channels when elastomeric gasket compression fittings are used to make the joints.

Fittings shall be marked on the body or hub. Marking shall be in accordance with either ASTM D2683, ASTM D3261, AWWA C906, or ASTM F1055, depending on fitting type and the standard that applies. Mechanical fittings shall be marked with size, body material designation code, pressure rating and manufacturer's name or trademark.

I. **Workmanship**

Pipe, tubing, and fittings shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, blisters, dents, or other injurious defects. The pipe, tubing, and fittings shall be as uniform as commercially practicable in color, opacity, density, and other physical prosperities.

2.1.5 STEEL CASING PIPE

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

B. **Spiders/Skids for Encasement Pipes**: Steel Spiders/Skids shall be as manufactured by ITT Grinnell, Charlotte, NC; Spider Manufacturing, Durham, NC; Advanced Products & Systems (APS) model SSI with EPDM skids, Lafayette, LA, or approved equal. See paragraph 3.1.2.A and **Standard Detail C07.01**. For bolted connections, bolts shall be either galvanized or stainless steel.

C. **Steel Casing End Seals**: Casing end seals shall be 1/8" thick synthetic rubber seamless pull-on end seals with T-304 stainless steel banding with 100% non-magnetic worm gear mechanism. End seals shall permit pipe movement while maintaining a seal. Acceptable manufacturers are: Advance Products & Systems, Inc., Lafayette, LA, or equal.

D. **Carrier Pipe for Casings and Tunnels:** Carrier pipe shall be ductile iron pipe of the class indicated on the drawings.

2.1.6 TUNNEL LINERS AND APPURTENANCES

A. Grout mix for filling voids in between carrier pipe and tunnel shall consist of the following materials properly mixed in proportions by weight.

1) 1.0 Part Cement.

2) 3.0 Parts Fine Sand, 100 Percent Shall Pass No. 16 Sieve.

3) 0.5 to 0.6 Part Water – water should be sufficient to provide a consistency of thick cream when well mixed.

4) 2% approved additive (Bentonite, Septamine Seaex, Hydrocide liquid, etc.)

B. Tunnel lining construction shall comply with the "Specification for Steel Tunnel Liner Plates" in the American Railway Engineering Association Manual for Railway Engineering. The design and shape of the liner plates shall be such that erection and assembly of the liner plate structure can be completely and readily effected from inside the tunnel. Plates shall be accurately curved to suit the tunnel cross section, and all dimensions shall be of the size and accuracy that plates of similar curvature shall be interchangeable. All plates shall be connected by bolts on both longitudinal and circumferential joints.

C. The steel lining shall consist of plates 16, 18, or 24 inches wide. Each circumferential ring shall be composed of the number and length plates necessary to complete the required shape shown on the drawings. The nominal tunnel diameter shall be of sufficient size to install the carrier pipe.

D. Plates shall be one-piece steel meeting the requirements of ASTM A1011 *Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength*, or ASTM A1008 *Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable*. Plates shall have an ultimate tensile strength of at least 42,000 psi and yield strength of 28,000 psi. Nominal plate dimensions shall provide the sectional properties shown in Article 1.13.9 (or latest update) of the AASHTO Standard Specifications for Highway Bridges. Thickness tolerances shall conform to Paragraph 14 of AASHTO M167 *Standard Specification for Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches*. Gage thickness shall be a minimum of 8 gage. The liner plate and bolts shall be galvanized in accordance with ASTM A153 *Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware*. In addition, the liner plates shall be asphalt coated to meet AREA Article 1.14.13 (or latest update). For two flange plates, the minimum thickness shall be 0.135 inches. Plates shall be manufactured by Armco Steel Corporation, Commercial Shearing, Incorporated, Republic Steel Corporation, or equal.

E. Grout holes 1½ inches or 2 inches (or larger) in diameter shall be provided in each ring to permit grouting as the erection of the tunnel liner plates progresses. Grout hole screw plugs shall be provided in plates.

The minimum provision for grouting openings shall be one opening in a top plate of the tunnel at locations not to exceed 54" apart. Additional plates with grouting openings are to be installed at the top quarter points on each side between the top openings. The opening shall be staggered, but shall not exceed 54" in any

one line. Grout vent pipes will be required at a minimum of one per monolithic pour.

F. Steel bolts shall meet requirements of ASTM A449 *Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use* for plate thickness equal to or greater than 0.209 inch and ASTM A307 *Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength* for plate thickness less than 0.209 inch. The nut shall meet requirements of ASTM A307, Grade A.

G. Steel casing pipe for boring through soil shall be grade B, meet requirements of ASTM A139 *Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)*, and have wall thickness to meet AREA Specifications. No interior lining and exterior coating shall be required.

2.1.7 CARRIER PIPE FOR CASINGS AND TUNNELS

Carrier pipe shall be mechanical joint pipe with restraint gland ductile of the class indicated on the drawings but no less than pressure class 350 psi (minimum thickness class 50). See paragraph 2.1.2, Ductile Iron Pipe.

2.2 VALVES AND FIRE HYDRANTS

2.2.1 AIR RELEASE VALVE

Air release valves shall be 2-inch Crispin, G. A. Industries, or approved equal Pressure Air Release Valves with cast iron bodies, type 302 stainless steel floats, bronze trim and buna-n seats. Air release valves shall also meet ASTM C512. Size and location shall be as indicated on the drawings. Valves shall be rated for working and corresponding test pressure as indicated on the drawings. These valves shall be suitable for a minimum 200 psi working pressure but shall be no less than the working pressure indicated on the drawings. The valves are to be designed to allow air to escape automatically while the main is in service and under pressure. The valves are to relieve large volumes of air as the lines are filled and also release small quantities of entrained air under pressure. Acceptable manufacturers and models are:

Size	Manufacturer	Model
2-inch	Crispin	Type “N” PL20
2-inch	G. A. Industries	Fig. 920

Manhole units shall consist of standard modular precast riser sections, modular riser sections, and a doghouse base. Where conditions do not favorably accommodate the use of an eccentric cone, eccentric precast reinforced concrete flat tops are to be used. See **Standard Detail 516.01**.

2.2.2 BACKFLOW PREVENTERS:

A. **Detector Check Valves:** Heavy Duty Detector check valves shall conform to the requirements of these specifications, working pressure 175-psi minimum. Heavy Duty Detector check valves shall be listed by Underwriters Laboratories, Inc. and approved by Associated Factory Mutual. Detector check valves shall be installed in the horizontal position with an arrow pointing in the direction of flow. The by-

pass meter may be trimmed either right or left. A meter trim package shall be furnished containing all nipples, bushings, elbows and related fittings needed to construct by-pass line. A meter shall be installed meeting these specifications.

Detector check valves shall have flanged ends having the exterior either factory finished with red paint or hot dipped galvanized. Flanged ends shall comply with the dimensional requirements of ANSI B16.1.

The clapper is to be rubber-faced with nylon pivot bushings.

The valve body is to have an external arrow cast into the body indicating the direction of flow during system operation.

Provide bolted cover with air-bleed device for access to internal parts. Include threaded bypass taps in inlet and outlet for bypass meter connection.

Set valve to allow minimal water flow though bypass meter when major flow is required.

Approved detector check valves are the Mueller A-2130-6 (red painted) or A2131-6 (Galvanized).

B. **RPZ (Reduced Pressure Principle) Backflow Preventers**

1) 3/4" to 2" RPZ Backflow Preventers:

RPZ Backflow preventers are to be unique patent design of air-in/water-out principle high capacity relief valve discharge during the emergency conditions of combined backsiphonage and backpressure with both checks fouled meeting.

The reduced pressure backflow preventer shall consist of two independently operating, spring loaded, "Y" pattern check valves, and one hydraulically dependent differential relief valve. In a nonflow condition, check valves are closed with pressure between the checks, called the zone, being maintained at least 5 PSI lower than the inlet pressure and the relief valve is maintained closed. If the differential between the zone and the upstream pressure drops to 2 PSI, the differential relief valve will open, maintaining proper zone differential.

Valve body and caps including relief valve body and cover shall be bronze. Check valve moving members shall be center stem guided. All hydraulic sensing passages shall be internally located within the mainline and relief valve bodies and relive valve cover. Diaphragm to seat area ratio shall be 10:1 minimum. Relief valve shall have a removable seat ring. Check valve and relief valve components shall be constructed so they may be serviced without removing the valve body form the line. All seat discs shall be reversible. Shut-off and testcocks shall be full ported ball valves.

The assembly shall be rated to 175 PSI water working pressure and water temperature range from 32°F to 140°F.

The assembly shall meet the requirements of ASSE Standard 1013; AWWA Standard Code C511.89; CSA Standard B64.4; and approved by the

Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California, UL Listed and FM approved.

2) **2 ½" to 10" RPZ Backflow Preventers:**

RPZ Backflow preventers are to be unique patented design of air-in/water-out principle high capacity relief valve discharge during the emergency conditions of combined backsiphonage and backpressure with both checks fouled meeting.

Operation: In a nonflow condition, check valves on the by-pass and mainline units are closed with pressure between the checks, called the zone, being maintained at least 5 PSI lower than the inlet pressure and the relief valve is maintained closed. If the differential between the zone and the upstream pressure drops to 2 PSI, the differential relief valve will open, maintaining proper zone differential. The by-pass reduced pressure backflow preventer will operate identically to the mainline assembly.

By-Pass: The by-pass opens to detect initial flow and the mainline opens for all other flows.

Mainline RPZ is to be flanged, ANSI B 16.1, Class 125, heavy valve bodies manufactured of ductile iron ASTM A536, Grade 65-45-12 with bronze seats, internal and external fusion epoxy coating, epoxy coated cast iron relief valve with stainless steel trim and with bronze body ball valve test cocks in parallel with a reduced pressure by-pass assembly. RPZ's are to be furnished with OS&Y gate valve shutoffs. RPZ backflow preventers shall be furnished and shall conform to the requirements of these specifications suitable for supply pressures of 175-psi and water temperatures of 110°F.

All low flow demands up to a minimum of 3 GPM are to pass only through the by-pass meter and meter-size reduced pressure assembly and be accurately recorded. All flows above that of 3 GPM will pass through both the line-size reduced pressure assembly and by-pass with out accurate registration by or damage to the meter. Shut off valves and testcocks shall be resilient seats with full flow characteristics and are to be considered integral to the assembly. The mainline shut-offs are to OS&Y, UL/FM for fireline service.

Reduced pressure detector assemblies are to be factory assembled and tested to assure proper mainline/by-pass balance and cross over performance.

RPZ's are to be approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California, UL Listed and FM approved.

RPZ's shall be installed in the horizontal position with an arrow pointing in the direction of flow. The by-pass meter may be trimmed either right or left. A meter trim package shall be furnished containing all nipples, bushings, elbows and related fittings needed to construct by-pass line. A meter shall be installed meeting Town of Clayton specifications as noted elsewhere in these specifications.

RPZ's shall have flanged ends having the exterior either factory finished with red paint or hot dipped galvanized. Flanged ends shall comply with the dimensional requirements of ANSI B16.1, Class 125.

Provide bolted cover with air-bleed device for access to internal parts. Include threaded bypass taps in inlet and outlet for bypass meter connection.

The assembly shall meet the requirements of ASSE Standard 1013; AWWA Standard Code C511.89; CSA Standard B64.4; and approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California, UL Listed and FM approved

2.2.3 BALL VALVES: ¼ TURN STAINLESS STEEL BALL VALVES

One-quarater turn stainless steel ball valves (used for air relief valves) with NPT threaded ends shall have a full port 316 stainless steel body, stems and balls with PTFE seals, seats and stem thrust bearing. Handles shall also be stainless steel. Valve shall be non-shock cold water rated for no less than 200-psi. Acceptable stainless steel gate valves are those manufactured by Apollo and Watts (Watts Series S-FBV-1), or approved equal. See **Standard Detail 516.01**.

2.2.4 BUTTERFLY VALVES (16 inches and larger):

Butterfly valves, for valve applications 16 inches and larger, shall meet AWWA C504, *AWWA Standard for rubber-seated butterfly valves*. Valves shall be short body and rated at no less than 150-psi. The Town may require installation of horizontal gate valves with a by pass assembly.

Butterfly valves shall be mechanical joint in accordance with AWWA C111. Accessories (bolts, glands, and gaskets) shall be supplied by the valve manufacturer.

All bolts shall be stainless steel.

Valve operators shall meet the requirements of AWWA C504 and shall be of the traveling-nut type, sealed, gasketed, and lubricated for direct-bury underground service. Valve operators shall be sized for the pressure indicated on the drawings. Operator shall be capable of withstanding an input torque of 450 ft-lbs at full open or closed position, without damage to the valve or valve operators.

Valves shall be factory tested in accordance with Section 5 of AWWA C504 specification. Upon request the manufacturer shall furnish certified copies of test reports.

Valves shall open counter-clockwise (left) and shall be equipped with a 2-inch square AWWA operating nut.

Valves shall be coated interior with fusion bonded thermosetting plastic, rubber, or epoxy. The exterior of buried valves shall also be bituminous or asphalt coated.

Acceptable butterfly valve manufacturers and models are:

Manufacturer	Model
Clow (M&H)	**4500-01 (200-psi)**
Mueller	**Linseal III B3211-20 (200-psi)**
DeZurik	**M-Series**

All resilient seat gate valves furnished for a project shall be from the same manufacturer.

Butterfly valves shall be placed in a precast concrete manhole. See **Standard Detail 513.09**, sheet 1.

2.2.5 CHECK VALVES

All swing check valves used for pressure zone separation shall be iron body; with a disc of extra heavy cast iron, ASTM A126 *Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings* construction, bronze mounted with either mechanical joint or flanged ends as noted on the drawings. Standard mechanical joint ends shall be furnished with bolts, glands, and rubber gaskets. Flanged ends shall be provided with bolts and gaskets. The shaft shall be 304 stainless steel and the seat ring shall be of bronze with an easily replaceable resilient disc seat. The valve shall be tight seating.

Check valves shall be non-slamming (shock absorber) type. Check valves shall be equipped with an outside lever and weight with an external bronze cushion chamber, air operated, unless otherwise noted on the drawings. Valves 16" to 24" shall have a minimum non-shock cold-water pressure rating of 250 psi.

Flanged check valves shall meet the dimensional requirement of ANSI B16.1 and meet or exceed the requirements of ANSI/AWWA C-508.

When more positive control is needed a lever-and-spring may be specified.

When check valves are used in vault applications, a ball drip valve is to be provided.

All check valves shall be furnished with an arrow cast into the body indicating the direction of flow during system operation.

Acceptable manufacturers and models are:

Manufacturer	Model
Mueller	**A-2606-6-01**

2.2.6 GATE VALVES

A. **Gate Valves, Resilient Wedge (3 inches through 12 inches)**: All gate valves shall be iron body of the resilient wedge type complying with AWWA C509 and shall be UL listed and FM approved for a working pressure of 200 psi. All internal parts shall be accessible without removing the body from the line. The wedge shall be of cast iron completely encapsulated with resilient material. The resilient sealing material shall be permanently bonded to the cast iron wedge

with a rubber tearing bond to meet ASTM D429 Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates and AWWA C550.

Non-Rising Stems (NRS) shall be cast bronze with internal collars in compliance with AWWA. OS&Y stems shall be bronze. The NRS stuffing box shall have two "O"-Ring seals above the thrust collar. These rings shall be field replaceable without removing the valve from service.

Each valve shall be hydrostatically tested at 400-psi to the requirements of both AWWA and UL/FM.

All gate valves 4 through 12 inches shall be of the mechanical joint type. 2-inch gate valves shall be iron pipe threads.

All bolts and nuts shall be stainless steel.

Valves shall open counter-clockwise (left) and shall be equipped with a 2-inch square AWWA operating nut.

The valve body and bonnet shall be coated interior and exterior with fusion bonded thermosetting plastic or epoxy.

Acceptable manufacturers and gate valve models, sizes 4-inch through 12 inches, are:

Manufacturer	Model
American Flow Control	**Series 2500SS**
Clow (M&H)	**F-6100**
Kennedy	**Kenseal II**
Mueller	**A-2360-20**

All resilient seat gate valves furnished for a project shall be from the same manufacturer.

B. **Gate Valves, Resilient Wedge (16 inches and larger)**: Valves shall be iron body of the resilient wedge type complying with AWWA C509 and shall be UL listed and FM approved for a working pressure of 250-psi. Valves shall meet or exceed the requirements of AWWA C515. Valve body, bonnet, wedge, and operating nut shall be constructed of ductile iron. The exterior of the ductile iron wedge shall be fully encapsulated with rubber. The resilient sealing material shall be permanently bonded to the ductile iron wedge with a rubber tearing bond to meet ASTM D429 Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates and AWWA C550. Non-buried valves shall have all internal and external surfaces of the valve body and bonnet shall have a fusion-bonded epoxy coating complying with AWWA C550, applied electrostatically prior to assembly. Buried valves shall be bituminous or asphalt coated.

Non-Rising Stems (NRS) shall be cast bronze with internal collars in compliance with AWWA. Stem and stem nut shall be high-strength bronze. Stem shall be sealed by three O-rings. The NRS stuffing box shall have the top two O-ring seals shall be replaceable with valve fully open and while subject to full rated working pressure. O-rings set in a cartridge shall not be allowed. Valve shall

have thrust washers located with 1 above and 1 below the thrust collar to ensure trouble-free operation of the valve.

Each valve shall be hydrostatically tested at 500-psi to the requirements of both AWWA and UL/FM.

All gate valves shall be of the mechanical joint type.

All bolts and nuts shall be stainless steel.

Valves shall open counter-clockwise (left) and shall be equipped with a 2-inch square AWWA operating nut.

Acceptable manufacturers and gate valve models, sizes 14 inches and larger, are:

Manufacturer	Model
American Flow Control	**Series 2500SS**
Clow (M&H)	**Style 67-01**

All resilient seat gate valves furnished for a project shall be from the same manufacturer.

Gate valves 16 inches and larger shall be placed in a precast concrete manhole. See **Standard Detail 513.09**.

C. **Inserting Valves**: Inserting valves shall meet requirements of gate valves specified above for valve mechanism and AWWA C110/ANSI A21.10 for the sleeve for pressure ratings shown on the drawings.

D. **Gate valves smaller than 2 inches** shall be resilient seat, solid wedge, inside screw, non-rising stem, bolted bonnet, stainless steel bolts, and threaded ends. All valves shall be furnished with a 2-inch operator nut and open left. Acceptable manufacturers and gate valve models are:

Manufacturer	Model
American Flow Control	**2502SS Series**
Clow (M&H)	**F-6103**
Mueller	**H-2360-8**

2.2.7 TAPPING SLEEVES AND VALVES

The tapping sleeve and valve shall be suitable for wet installation without interrupting water service.

Stainless Steel Tapping Sleeve: Sleeve body, flange, bolts, nuts, test plug, and any other structural components shall be constructed of Grade 18-8 Type 304 stainless steel. The sleeve and gasket shall provide full wrap-around (360 degree) pipe coverage. Sleeve to be provided with a full gasket of gridded virgin SBR compounded for water service per ASTM D2000. Outlet gasket to be gridded virgin Buna-N compounded for water service per ASTM D2000. Use of ductile iron tapping sleeves must be approved by the Town Engineer. Acceptable manufacturers are listed below:

Manufacturer	Model
Romac	**SST w/ stainless steel flange**
Mueller	**H-304SS**
Smith-Blair	**665**

See **Standard Detail 513.02**.

Tapping Valves: Resilient seat tapping valves shall be epoxy coated (minimum 10-mil thickness) and otherwise meet the requirements of Part 2- PRODUCTS, *Gate Valves*, paragraph 2.2.6 except that the seat openings shall be larger than nominal size with a raised alignment ring on the flange. Valve ends shall be mechanical joint by flange. Valves shall open counter-clockwise (left) and shall have a 2-inch operator nut. See **Standard Detail 513.02**.

All bolts and nuts are to be stainless steel.

Tapping valves shall be "O" ring type a mechanical joint end conforming to AWWA non-rising stem construction. Inlet flange end shall be Class 125 (ANSI B16.1). Acceptable resilient seat tapping valve manufactures and models are listed below:

Manufacturer	Model
American Flow Control	**2500 TM**
Clow	**F-6114**
Mueller	**T-2360**
Kennedy	**Kenseal II**

2.2.8 FIRE HYDRANTS

See **Standard Details 514.04** and **514.05.** Fire hydrants shall comply with ANSI/AWWA C502 *Dry-Barrel Fire Hydrants*, latest revision, UL 246 and FM1510. Hydrants shall be hub end, triple nozzle, improved AWWA type. Interior coating to be in accordance with AWWA C550. Minimum working pressure shall be 150-psi. Hydrants shall consist of the following:

1) Two 2½-inch fire nozzles and one 4½-inch steamer nozzle, National Standard hose threads.
2) The steamer nozzle shall be provided with an auxiliary straight pattern Storz Fire Department connection. Storz unit to be hard coated aluminum construction Guardian 6600 series Storz Fire Department Connection, Female NPT x Locking Storz Inlet with Storz blind Cap. Storz cap to include securing chain.
3) All nozzles shall be provided with caps and chains.
4) The hydrant foot valve opening shall be 5¼ inches.
5) Hydrant to be dry top with lubrication reservoir.
6) Bronze to bronze threads shall be provided between the hydrant seat or seat ring and the seating attaching assembly. Seat ring to shoe shall be bronze to bronze.
7) All hydrants must include cast or ductile epoxy lined shoe (minimum 4 mils), rubber drain seals and positive protective valve stop device.

8) Hydrants shall open left and shall have a National Standard pentagon-type operating nut (1 ½" point to flat). The operating nut shall be of one-piece bronze construction. A thrust washer shall be supplied between the operating nut and stem lock nut. The valve stem shall have a safety flange and a safety coupling.
9) Hydrants shall have a 6-inch hub-end or mechanical joint elbow.
10) The hydrant barrel shall be of sufficient length to provide a minimum bury of 3 feet.
11) Hydrants shall be of the compression type closing with line pressure and shall be of the traffic model breakaway type.
12) Hydrant cap and stuffing box shall be of unitized, one-piece design creating a watertight cavity without the use of gaskets. The combination of O-Rings to a crimped brass ferrule around the stem shall seal the cavity from contact with water. Hydrant caps shall have a means for providing periodic lubrication of the operating threads.
13) The main valve shall be of synthetic rubber reinforced with steel. The seat shall be of a bronze ring threaded to a bronze insert in the hydrant shoe, with O-Rings to seal the drain way and barrel from leakage of water in the shoe.
14) The hydrant drain hole shall momentarily force flush with each operation.
15) All hydrant extension kits, flange kits, stems, couplings or other repair parts must be of the original hydrant manufacturer. Only one 24-inch extension kit is allowed.
16) Hydrants are to be painted with 2 coats of Sherwin Williams or approved equal paint in accordance with **Standard Detail 514.07**. Barrels are to be painted federal safety red with the caps and bonnet.
17) If line is to be pressurized within 7 days of setting hydrant, then 4000-psi high early strength concrete shall be used.

Approved fire hydrant manufacturers and models are listed below:

Manufacturer	Model
American Darling	**B62B-1**
American Flow Control	**B-84-B**
Clow (M&H)	**F-2545 Medallion**
Kennedy	**Guardian**
Mueller	**A-423 Super Centurion 250**

All hydrants furnished for a project shall be from the same manufacturer.

See paragraph 3.2.5, Fire Hydrants for installation requirements.

2.2.9 BLOW OFFS

Blow-Off Assembly for Future Extension: Blow-off assemblies for future extensions shall consist of two standard valve boxes, one for a NRS gate valve and one for a 2-inch brass pipe riser (see **Standard Detail 514.01**), thrust collar, a mechanical joint plug tapped for 2-inches, a 2-inch brass pipe riser with a 2-inch threaded male threaded plug.

Permanent Blow-Off Assembly: Permanent blow-off assemblies shall consist of a standard valve box (see **Standard Detail 513.01**) with a concrete stabilizing pad, a NRS gate valve, a mechanical joint reducer as applicable, thrust collar, a

riser with elbow and blocking, and if applicable, a flange 90 degree elbow placed above grade. See **Standard Detail 514.02.**

2.2.10 CORPORATION STOPS

Compression Fittings: Corporation stops for ¾-inch through 1-inch taps only shall be all bronze CC tapered threaded inlet by compression copper outlet, as manufactured by Ford or Mueller. 2-inch corporation stops are not permitted. See **Standard Details 513.04 and 519.01**. Acceptable manufacturers and models are:

Manufacturer	Model
A. Y. McDonald	**4701T**
Ford Meter Box Co.	**F-1000G**
Mueller	**H-15008**

2.3 MISCELLANEOUS APPURTENANCES

2.3.1 BEDDING

Bedding material, when specified, shall be clean coarse aggregate No. 57 or No. 67 and shall meet the requirements of Table 1005-1, *Aggregate Gradation, Coarse Aggregate* of the *NCDOT Standard Specifications for Roads and Structures*, latest revision.

2.3.2 CAST STRAIGHT AND TRANSITION COUPLINGS (REPAIR COUPLINGS)

Couplings shall be of a gasketed, sleeve type. Each coupling shall consist of a steel middle ring, two steel followers, two rubber compounded wedge section gaskets and sufficient track head stainless steel bolts to properly compress the gaskets. Couplings shall be of the type to match piping on which installed. Approved coupling manufactures and models are listed below:

Manufacturer	Model
Ford	**FC-1 (2" through 12")** **FC-2 (14" through 24")**
Romac	**501**
Smith-Blair	**411**

2.3.3 WARNING TAPE AND LOCATOR WIRE

A. **Metallic underground warning tape**: Metallic detectable underground warning tape shall consist of a solid aluminum foil core, 35 gauge minimum, encased on each side with plastic (minimum overall thickness 5 mils) and be 3 inches wide with black lettering imprinted on a color coded background that conforms to APWA uniform color code specification (BLUE) and silver with black ink letters. Minimum tensile strength shall be 22 lbs/inch. Soil tolerance range to be pH 2.5 to pH 11.0. On one side of the tape, the text shall include the wording "WATER LINE BELOW" repeated along the length of the tape. A detectable warning tape shall be used with all water mains. Underground warning tape is to be placed directly over the pipe 12 to 18 inches below the finished grade. See **Standard Detail 511.01**.

Standard color code for tape and wire.

Blue: Water Systems

B. **Locator Wire**: #12 AWG blue insulated solid copper wire shall be installed above all water mains. Electrical conductivity along the pipe shall be continuous and uninterrupted between valve boxes. A sufficient excess length of wire shall be left in each valve box to provide at least a 6 to 12 inches length of wire above finished grade. See **Standard Details 513.01, 513.02** and **513.03**.

2.3.4 TRACING WIRE STATION – LOCATOR POST

Tracing wire stations are to be high visibility plastic posts with two external terminals. The posts shall be blue and specifically designed for outdoor use with UV stabilizers that keep the colors bright and resist fading. The plastic blend is to be formulated to keep the post from becoming brittle in the winter and from softening in the summer heat. Tracing wire stations shall equal or the Rhino TriView Flex Tracing Wire Station model MB-70429.

2.3.5 DUCTILE IRON TRANSITION COUPLINGS

Transition couplings shall be ANSI/NSF Standard 61 Certified, fusion bonded powder epoxy coating and constructed of ASTM A-536, grade 65-45-12 ductile iron flanges and middle ring. Coupling to be rated at a minimum of 200-psi working pressure per AWWA C219, and -20ºF to 212º F. Gaskets shall be specially compounded new rubber polymer suitable for use on water and sewage. Bolts are to be stainless steel 18-8 Type 304. Transition couplings are to accommodate IPS PVC, C-900 PVC, Ductile Iron Pipe, Cast Iron, and Asbestos Cement Classes 100/150/200.

Approved coupling manufacturers and models are listed below:

Manufacturer	Model
Ford	**FC2W Ultra-Flex Ductile Iron Wide Range Coupling (3" through 12")**
Dresser	**253 Modular Cast Coupling (3-inch through 16-inch)**
Smith-Blair	**441 and 461**

2.3.6 FIRE HYDRANT PAVEMENT MARKERS

A permanent raised bidirectional one color (blue and blue) pavement marker shall be of the glass or plastic face lens with prismatic reflector consisting of a high impact plastic shell which may be filled with a mixture of inert thermosetting compound filler material. Plastic lenses must be scratch resistant. The shell must contain two prismatic reflective lenses. The minimum reflective area of the lens face is 2.0 square inches. All raised pavement marker reflective lenses must be in close conformance with the Federal Standard No. 595 Colors when viewed at night. Use sand or inert granulars embedded in the surface of the inert thermosetting compound and filler material prior to its curing to provide a surface which will readily bond to the adhesive. Use shells made of molded methyl methacrylate conforming to Federal Specification L-P-380C, Type I, Class – 3.

Epoxy must meet the requirements of Section 1081, *Epoxy and Adhesives* of the NCDOT Specification for Roads and Structures. The two types of epoxy adhesives which may be used are Type 6A (Standard Setting), and Type 6C (Rapid Setting). Use Type 6A when the pavement temperature is above 60ºF. Use Type 6C when the pavement temperature is between 50ºF and 60ºF or when a very fast set is desirable. See **Standard Details 514.04 and 514.05** for location on pavement.

2.3.7 MANHOLE FRAME AND COVERS

Manhole frames and covers shall be manufactured from Class 35B gray iron, meeting the requirements of ASTM A48, *Standard Specification for Gray Iron Castings,* as noted in section 3.1 of AASHTO M306. Standard manhole frames and covers shall be built to the dimensions and configurations shown on **Standard Detail C06.01.** Minimum inside diameter of the opening shall be 23 ½ inches. Manholes castings are to be uncoated. The bearing surface of the frames and covers shall be machined and the cover shall seat firmly into the frame without rocking. Covers are to be embossed along the perimeter with the name "TOWN OF CLAYTON." Cover shall read "WATER" in the center and "CONFINED SPACE" around the circumference.

Weights shall not vary more than 5% +/- of the weight shown on **Standard Detail C06.01**.

Acceptable Manufacturers and models are:

Manufacturer	US Foundry	East Jordan Iron Works
Standard Model	700KL	V-1384
Cover Weight	125	135
Frame Weight	190	180

2.3.8 MISCELLANEOUS CONCRETE WORK

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

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

Concrete shall be constructed of a minimum of 3000 psi concrete at 28 days. Ready mixed concrete shall comply with ASTM C94, *Standard Specification for Ready-Mixed Concrete.* This applies to concrete blocking, valve box stabilizing pads, thrust collars, concrete encasement, and Fire Hydrant setting and thrust pads. All exposed concrete shall be air entrained.

2.3.9 PRECAST CONCRETE MANHOLE STRUCTURES

Structures of precast reinforced concrete manholes shall be designed and manufactured in accordance with ASTM C478, *Standard Specification for Precast Reinforced Concrete Manhole Sections*, latest revision ("O" ring joints),

or AASHTO M-199 (gasketed joints). The standard joint shall be sealed with plastic cement putty meeting Federal Specification SS-C-153. An "O" ring or "mastic" joint seal may be used. The "O" ring joint shall conform to the requirements of ASTM C443 *Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.* Type Concrete used in the construction of the manholes shall have a minimum 28-day compressive strength of 4000-psi air entrained (with 4 to 6 percent air) conforming to ASTM C33 *Standard Specification for Concrete Aggregates* and ASTM C94 *Standard Specification for Ready-Mixed Concrete*. Manholes shall have monolithic base and eccentric flat top as applicable. See **Standard Detail 516.01**. Structures are not permitted to have steps. Acceptable manufacturers are: Carolina Precast Concrete, Inc., Oldcastle Precast, N. C. Products Concrete Corporation, Stay-Right Tank, or Tindall Precast Concrete Products, Inc.

Manhole Size Determination:

a. Unless shown otherwise, the minimum diameter of manholes shall be 5 feet.
b. Manholes with 16-inch diameter or larger pipe shall be a minimum of 6 foot diameter.

2.3.10 PRECAST UNDERGROUND CONCRETE UTILITY STRUCTURES

Structures of precast reinforced concrete shall be designed and manufactured in accordance with ASTM C858, *Standard Specification for Underground Precast Concrete Utility Structures*, latest revision with preformed butyl rubber joint sealant meeting ASTM C990, *Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed flexible Joint Sealants*, latest revision. Type Concrete used in the construction of the Utility Structures shall have a minimum 28-day compressive strength of 4000-psi air entrained (with 4 to 6 percent air) conforming to ASTM C33 *Standard Specification for Concrete Aggregates* and ASTM C94 *Standard Specification for Ready-Mixed Concrete*. Unless shown otherwise on the drawings, structures are not to have steps. Steel reinforcing shall conform to the requirements of ASTM C857, *Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures,* latest revision. Structures shall be designed for an H20-44 loading in traffic areas. Acceptable manufacturers are: Carolina Precast Concrete, Inc., Oldcastle Precast, N. C. Products Concrete Corporation, Stay-Right Tank, or Tindall Precast Concrete Products, Inc.

2.3.11 PIPE SADDLE SUPPORT - ADJUSTABLE

Adjustable Pipe Saddle Support - For Dry Conditions 2½-inch through 36-inch pipe: Material to be cast iron saddle formed to ductile iron pipe, with lock nut, and special cast iron reducer. Vertical adjustment range to be from 0 up to 4½ inches. Adjustable pipe saddle supports shall comply with Federal Specification WW-H-171E (Type 39). Pipe saddle supports shall equal or exceed the *Standon* Model S92, as manufactured by Material Resources, Inc., Hillsboro, OR., or Grinnell Figure 259.

Adjustable Pipe Saddle Support For Wet or harsh corrosive conditions 2-inch through 24-inch pipe: Material to be steel saddle formed to ductile iron pipe, lock nut, and special steel reducer. Vertical adjustment range to be from 0 up to 4½ inches. Material to be 100% 304 stainless steel with saddles formed of ductile iron pipe. Saddle strap to meet ASTM A36/A36M *Standard Specification*

for Carbon Structural Steel. Collar and base cups ASTM A53 *Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless* D.O.M. tubing. Thread stud to meet ASTM A36/A36M, rolled thread, grade ASTM A307 *Standard Specification for Carbon Steel Bolts and Studs, 60,000-PSI Tensile Strength*. Base Plate to meet ASTM A36/A36M sheet steel, 0.25-inch. Pipe saddle support shall equal or exceed the *Standon* Model S92, as manufactured by Material Resources, Inc., Hillsboro, OR., or approved equal.

2.3.12 SERVICES

A. **Small Services: 3/4-inch and 1-inch Water Services**:

Type K Copper, soft drawn; comply with ASTM B-88, *Standard Specification for Seamless Copper Water Tube*, FS WW-T-799 (2-inch and smaller pipe). Services shall be ¾-inch to 1-inch and shall be one continuous run from main to meter with no joints or couplings in between. On these water services, the fittings shall be brass AWWA C-800, compression copper type fittings. See **Standard Details 513.04** and **519.01**.

Taps shall be made with a service saddle.

Service Saddles: Saddles shall be all bronze saddle with a double bronze strap and a grade 60 neoprene "O" ring gasket attached to the body. The saddle casting, straps, and nuts shall be water works bronze 85-5-5-5. The saddle shall have CC tapered corporation stop threads. See **Standard Detail 513.04**. Acceptable service saddle manufactures and models are:

Manufacturer	Model
Ford	**202B Series**
Mueller	**BR2B**
Smith Blair	**325-000 Series**

5/8 x 3/4-inch and 1-inch meter setter/yoke: 5/8-inch x ¾-inch and 1-inch meter setters/yokes shall conform to AWWA C800 and be factory tested for water-tightness before shipping. Setters shall be comprised of all brass and copper padlock wing stop inlet ball valve (lockable cut-off), angle double check outlet valve, with inlet and outlet copper connections and a 12-inch rise. See **Standard Detail 519.01**. Acceptable meter setter/yoke manufacturers and models are:

Size	Manufacturer	Model
5/8-inch x ¾-inch	Ford	**VHC-72-12W-44-33-G**
1-inch	Ford	**VHC-72-12W-44-44-G**
Both 5/8-inch x ¾-inch and 1-inch	Mueller	**H-1470-2A (12” height)**

Meter boxes - Standard Cast Iron: Meter boxes shall be 12-inch deep cast iron boxes having the same approximate weight as, and lids interchangeable with, the MBX-1 as manufactured by Southern Foundry or East Jordan Iron Works V-8404-1. Meter boxes shall be supported on 6 standard concrete bricks, which shall in turn be supported by a minimum of 6 inches of #57 or #67 washed stone. One standard solid brick shall be placed vertically on each end of the box over

the inlet/outlet slot. Boxes shall be set in such a manner that the centerline of the meter shall be 10 inches below the top of the box and shall provide adequate clearance for the meter. All meter boxes shall also be backfilled and supported outside the box with fine graded sand. The Town will not set water meters until such time as meter setters and boxes are set to proper grade. Unless a traffic model box is used, meter boxes shall not be installed in driveways, roads of closer than 3 feet to a fire hydrant and shall not be installed in parking lots or sidewalks unless shown on the plan or prior approvals are obtained from the Town Engineer.

Meters:

Displacement meters shall comply with AWWA C700. Acceptable meter manufacturers and models are:

Manufacturer	Size	Model
Badger	5/8" x ¾"	**Recordall**
Badger	1"	**Recordall**

Meters shall be *Itron* Automatic Meter Reading (AMR) Encoder Receiver Transmitter (ERT) module equipped.

B. **2-Inch Water Services:**

Type K Copper, soft drawn; comply with ASTM B-88, *Standard Specification for Seamless Copper Water Tube*, FS WW-T-799. Water service pipe for 2-inch connections shall be type "K" soft drawn copper with compression type joints with brass fittings and shall be one continuous run from main to meter with no joints or couplings in between. On these water services, the fittings shall be compression type brass fittings.

The service line for a 2-inch meter shall consist of a 2-inch tap, 2-inch type K soft drawn copper service line, a threaded x compression adapter, a 2-inch threaded Iron Body Gate Valve and a 2-inch x 4-inch long threaded (iron pipe thread) brass nipple. See **Standard Detail 519.03,** sheet 2. Acceptable iron body gate valve manufacturers and models are:

Manufacturer	Model
American Flow Control	**2502SS**
Clow (M&H)	**F6103**
Mueller	**H-2360-8**

Service saddles: service saddles shall be 2-inch all bronze saddle with double bronze straps and with a grade 60 neoprene "O" ring gasket attached to the body. The saddle casting, straps, and nuts shall be water works bronze 85-5-5-5. The saddle shall have 2-inch iron pipe threads. Acceptable service saddle manufacturers and models are:

Manufacturer	Model
Ford	**202B Series**
Mueller	**BR2B**

Smith Blair	**325-000 Series**

2-inch meter setter/yoke: Meter Setters shall be constructed from 85-5-5-5 Brass (AWWA C800) and copper tubing, and factory tested for water-tightness before shipping. 2-inch meter setter/yoke shall be comprised of all brass and copper padlock wing inlet ball valve (lockable cut-off), angled double check valve, 1 ¼-inch by-pass line with a 1 ¼-inch stop ball valve, in-line double check valve, stabilizer bars, and brace pipe eyelets for 1-inch pipe. Outlet connections are to be compression. See **Standard Detail 519.03**. Acceptable meter setter/yoke manufacturers and models are:

Size	Manufacturer	Model
2-inch	Ford	**VBHH77-18BHC-11-77** (standard 18-inch rise) Ford Drawing No. B-95270-02
2-inch.	Mueller	**Mueller H-1423-2 (**must specify 2-inch meter with 18-inch rise)

Meter Boxes, Standard Cast Iron: Meter boxes shall be cast iron boxes having the same approximate weight as, and lids interchangeable with, the MBX-5A as manufactured by Capitol Foundry for 2 inch meters. Meter boxes shall be supported by standard concrete bricks, which shall in turn be supported by a minimum of 4 inches of #57 or #67 washed stone. The Town will not set water meters. Unless a traffic model box is used, meter boxes shall not be installed in driveways, roads of closer than 3 feet to a fire hydrant and shall not be installed in parking lots or sidewalks unless shown on the plan or prior approvals are obtained from the Town Engineer. Meters will be supplied and set by the developer.

C. **Large Meter Services (3-inch and larger)**

Piping: For services greater than 2 inches, the water service pipe shall be 4, 6, 8, 10, or 12 inches in diameter and shall be constructed of ductile iron pipe. 3-inch diameter pipe is not allowed in the Town's distribution system. 3-inch meters shall be served by a 4-inch tap and 4-inch service line. Ductile iron fittings shall be used on these services. Taps on existing lines may be made by using the appropriate size tapping sleeve and valve. On a new line, the connection shall be made with a tee and valve.

Large Meter Vaults: Meter vaults for 3-inch and larger meters shall be constructed of precast concrete with a floor drain with a connection that is compatible with 4-inch diameter ductile iron pipe. Meter vault floors shall be sloped toward the drain. Sump pumps are not permitted unless a written request is approved by the Town Engineer. Meter vaults shall have aluminum, cast-in-place double leaf, and spring-loaded doors with slam locks. Doors shall be lockable by padlock using a factory built-in steel pin or angles. Doors are to be rated at 300 psf in pedestrian areas. Vaults are not permitted in traffic areas. The vault doors shall be located over the water meter. See specification section 2.3.15**,** *Vault Access Hatch*, below. See **Standard Detail 519.04**. Acceptable meter vault door manufactures and models are:

Manufacturer	Model[a]

Bilco	**JD-2AL**
Halliday Products	**SeriesW2S4848**
US Foundry & Manufacturing Corporation	**Type THD 48x48 W/OP**

[a] Hatch opening to be sufficient to allow pulling meter out of access opening in the horizontal position but no less than 36 inches by 36 inches square in dimension.

Precast meter vaults shall be as manufactured by Old Castle Concrete or Stay-Rite Tank Company. See 02275 – *Trenching, Backfilling and Compaction of Utilities*, paragraph 3.3.2 C for bedding requirements for Structures. Vaults shall have steps spaced 12 inches on center from the vault lid to the floor. Minimum meter vault dimensions shall be as follows below.

Meter Size	Minimum Vault Size
3-inch	8'-6" L x 6'-0" W x 6'-6" H
4-inch	10'-0" L x 8'-0" W x 6'-6" H
6-inch	10'-0" L x 8'-0" W x 6'-6" H
8-inch	12'-0" L x 9'-0" W x 6'-6" H

Combinations Vaults: Combination vaults shall be designed and constructed to provide the following minimum clearances between the pipe, fittings or vault walls:

Conflict	Minimum Clearance (inches)
Vault side wall to side of pipe, valve or meter	12
Vault end wall to nearest bolted connection	12
Pipe to pipe, fitting or valve	18
Top of OS&Y valve stem (fully opened) to vault ceiling	6

See sheet 1 of **Standard Detail 519.04**.

Meters: Compound meters shall comply with AWWA C702. Turbo meters shall comply with AWWA C701. Meters shall be provided with strainers and shall be Itron AMR ERT equipped.

Turbo meters shall only be used in irrigation applications.

Acceptable manufacturers and models are:

Manufacturer	Size	Model
Badger	**2" through 6"**	**Compound**
Badger	**2" through 10"**	**Recordall II**

D. **Meter Setting**

Contractor shall furnish and install meters 2 inches and larger.

All meters shall be *Itron* Automatic Meter Reading (AMR) Encoder Receiver Transmitter (ERT) module equipped.

2.3.13 TIE-RODS

A. **Stainless Steel Threaded Tie Rods**: Threaded tie rods shall be type 316 stainless steel thread rods (all thread) meeting ASTM A193, *Standard Specification for Alloy-steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications*. No duck lugs will be allowed.

2.3.14 VALVE BOXES

Adjustable valve boxes shall be US made gray cast iron of the dimensions shown in **Standard Detail 513.01** *(2-Piece Adjustable Screw Valve Box and Cover* Detail*)* of these specifications. Lids shall be heavy duty traffic weight with the word "water" cast into the lid. Provide cast-iron telescoping top section of length required for depth of burial of valve and bottom section with base of size to fit over valve. Acceptable valve box manufacturers and models are:

Manufacturer	Model
East Jordan Iron Works	**4906-20**
Southern Foundry	**562A**

2.3.15 VAULT ACCESS HATCH

A. **Non-Traffic Areas**: The aluminum access frames and covers are manufactured with 1/4-inch thick, one-piece aluminum extruded frame, with a continuous concrete anchor as part of the one-piece extrusion. The door panels are 1/4-inch thick aluminum diamond plates, to withstand a live load of 300 lbs. per square foot, with a safety factor of times 1.5. The doors are provided with stainless steel hinges with tamper-proof fasteners. All hardware is stainless steel. The doors open to 90 degrees and lock automatically in that position with a stainless steel positive locking arm and a stainless steel release handle. Doors are provided with a stainless steel lifting handle, stainless steel locking bar. Doors shall be lockable by padlock using a factory built-in steel pin or angles. The doors will close flush with the top of the frame, resting on a 1/2-inch wide lip around the entire inside of the frame for added support.

Vaults in pedestrian areas shall have recessed latch.

B. **Traffic Areas** – Vaults are not permitted in traffic areas.

C. **Guarantee and Manufacturer**: The aluminum access frames and covers shall carry a 10-year guarantee against defects in materials and workmanship. The frame and cover shall equal or exceed the units manufactured by Halliday Products, Inc. or The Bilco Company.

PART 3 – EXECUTION

INSTALLATION – PIPE AND FITTINGS

3.1 PIPE & FITTINGS

Refer to Section 02275, TRENCHING, BACKFILLING AND COMPACTION OF UTILITIES.

3.1.1 DUCTILE IRON PIPE

A. **DIP Installation**

1) **Trenching & Bedding**: Refer to section 02275, *Trenching, Backfilling, and Compaction of Utilities*.

2) **Installation of DIP Water Mains**: Comply with AWWA C600, *Installation of Ductile Iron Water Mains and Their Appurtenances*.

3) **Pipe Laying - Separation**: The contractor shall comply with the NCDENR standards for separation of water mains from sanitary sewers or storm drainage lines. See Part 1 – GENERAL, *paragraph 1.9 – Project Conditions* of this specification.

4) **Materials, Storage, and Handling:** See paragraph 1.7 – *Product Delivery, Storage and Handling*.

B. **Construction:**

1) **Construction**: Water mains and fittings shall be installed with approved tools in accordance with the requirements of ANSI/AWWA Standard Specification C600, *Installation of Ductile Iron Water Mains and Their Appurtenances*, which is herein made part of the specification by reference.

Construct piping to accurate lines and grades avoiding localized high points and support as required on drawings or described in specifications. When temporary supports are used, ensure that sufficient rigidity is provided to prevent shifting or distortion of pipe.

Pipe shall be laid with bell ends upgrade and facing the direction of laying.

Due care shall be taken in the storing and handling of pipes, fittings and valves to avoid contamination with the ground and prevent foreign matter from entering pipe and fittings. String out no more pipe than can be installed in a day. Gaskets shall be lubricated as per manufacturer's recommendations.

Pipe, fittings, and valves shall be carefully handled and lowered into the trench. Under no circumstances shall any pipe or fitting be dumped or rolled into the trench, or be allowed to drop against the pipe or fitting already in the trench. Great care shall be taken to prevent the pipe lining and coating from being damaged, and the Contractor shall not install any damaged pipe. The contractor shall be responsible for removal and disposal of damaged pipe.

Prior to being lowered in to the trench, all pipes shall be carefully inspected to see that each pipe is clean. If necessary, pipes shall be fitted together to ensure sufficient opening for the gasket or joint compound and smooth inside flow line.

Special care shall be taken to ensure that the pipe is well bedded on a solid foundation, and any defects due to settlement shall be made good by the Contractor at his own expense. Bell holes shall be dug sufficiently large to

ensure the making of proper joints. Special precautions shall be exercised to prevent any pipe barrel or bell from resting on rock. A minimum of 6 inches is required between rock and the bottom of pipe (see **Standard Detail 511.03** and paragraph 3.2.5 F – *Cushioning Pipe in Rock*, of 02275 – *Trenching, Backfilling, and Compaction of Utilities*). If the bed formed in the bottom of the trench is too low, the pipe shall be removed, clean stone placed in the bottom, and a new bed prepared for the pipe. In no case shall the pipe be brought to grade by blocking under the barrel of the pipe. A uniform support shall be provided for the entire length of the pipe.

Whenever a pipe requires cutting, to fit in the line or to bring it to the required location, the work shall be done in a satisfactory manner with an approved cutting tool or tools which will leave a smooth end at right angles to the axis of the pipe, and not otherwise damage the pipe or liner. When the cut end is to be assembled in a *Fastite* bell, an adequately smooth (without sharp edges) bevel should be ground or filed on the cut edge to prevent damage to or dislodgement of the gasket during assembly. Generous bevels are advantageous in the assembly of field prepared ends. The approved methods of cutting pipe are: rotary type, abrasive wheel, and snapcutter on DIP. No welding, flame cutting or flame tapping will be allowed.

The Contractor shall be required at the end of the day's work to keep the end of the line, under construction, plugged to prevent foreign matter from entering pipe and fittings. A watertight plug shall be placed in the bell of the last joint of pipe laid. The pipe shall not be used as a means of draining ground water from the area.

Maximum horizontal deflections for ductile iron pipe shall meet AWWA C600, latest revision or pipe manufacturer's recommendation.

Allowable Joint Deflection of Slip Joint Pipe

Size (inches)	Nominal Laying Length (feet)	Maximum Allowable Deflection	
		Offset per Length (inches)	Deflection Angle (degrees/radius,ft)
6	18	19	5°/205
8	18	19	5°/205
12	18	19	5°/205
16	18	15	4°/26
20	18	11	3°/340
24	18	11	3°/340

Ref: AWWA C600

a) **Minimum Pipe Bury**: Mains shall be installed to the depth that provides 36 inches of cover below finished grade for mains 8 inches and smaller. Mains larger than 8 inches shall be provided with a minimum of 42 inches of cover below finished grade. In the event site conditions prevent adherence to minimum cover requirements, approval of an alternate design by the Town Engineer is required. See Table 02275.1 of 02275 – *Trenching, Backfilling, and Compaction of Utilities*.

b) **Installing Mechanical Joint Pipe**

i. Gaskets shall not be exposed to oil, grease, ozone, extensive heat, sunlight, or other elements that would degrade the gasket. Store gasket in a cool dark place until installation in accordance with manufacturer's recommendations.

ii. Clean socket and plain end thoroughly, removing mud, oil, gravel, or any other foreign matter. Gaskets shall be lubricated. Paint the bell and the spigot with soap solution (half cup granulated soap dissolved in 1 gallon of water). Slip ductile iron gland on spigot end with the lip extension of the gland toward the end of the pipe. Paint rubber gasket with or dip into the soap solution and place on the spigot end with thick edge toward the gland.

iii. Push the spigot end forward to seat in the bell. Then, press the gasket into the bell so that it is located evenly around the joint. Move the gland into position, insert bolts, and screw nuts up finger tight. Then tight all nuts to torque listed below (excerpted from Table 2 of AWWA C600):

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

Tighten nuts on alternate side of the gland until pressure on the gland is equally distributed.

iv. Permissible deflection in mechanical joint pipe shall not be greater than listed in Table 4 of AWWA C600.

Allowable Joint Deflection Mechanical Joint Pipe			
Size (inches)	Nominal Laying Length (feet)	Maximum Allowable Deflection	
		Offset per Length (inches)	Deflection Angle (degrees/radius,ft)
6	18	27	7°-07'/145
8	18	20	5°-21'/195
12	18	20	5°-21'/195
16	18	13.5	3°-35'/285
20	18	11	3°-00'/340
24	18	9	2°-23'/450

Ref: AWWA C600

c) **Installing Push on pipe**

i. Gaskets shall not be exposed to oil, grease, ozone, extensive heat, sunlight, or other elements that would degrade the gasket. Store gasket in a cool dark place until installation in accordance with manufacturer's recommendations.

ii. Clean the socket and 8 inches of the outside of the plain end thoroughly, removing mud, gravel, or any other matter that might cause the front of the gasket to protrude into the path of the entering spigot. Flex rubber gasket and apply lubricant supplied with the pipe to the plain end and to the inside surface of the gasket before assembly. Start the spigot end of the pipe in to the socket with care. The circumferential stripe on the plain end provides a visual indication for checking the proper insertion of the joint. Insert gasket fully in the gasket recess of the socket, large end of the gasket entering first. For assurance of proper gasket positioning, a thin automotive, blade-type feeler gauge can be used for quick and easy probing to confirm a properly installed gasket position around the joint. Then complete the joint by forcing the plain end to the bottom of the socket with a forked tool or jack-type device.

2) **Cutting Pavement/Driveways**

Where the water line is in an existing paved area, the edges of the pavement for the water line shall be cut in a straight line, parallel to the pipe on each side. Perform cutting operations prior to installation of water line to avoid excessive removal of asphalt. Care shall also be taken during installation of pipe to avoid damage to adjoining paved surfaces. Refer to the applicable Town or NCDOT standard pavement repair details pavement width and patching requirements. Driveway crossings shall be completed within 48 hours after the initial cutting of the pavement.

3) **Protection of Pavement**

Whenever the water line is to be placed in or near a paved street, the contractor shall provide pads or take necessary precautions to protect the pavement from damage by construction equipment. Pavement damage by cleats or tracked equipment, or by any other means, shall be repaired by the contractor.

C. **Connections to Existing Mains**

The Contractor shall furnish all materials for connection to existing water mains. Town shall be the sole operator of all valves and fire hydrants.

In making connections to the existing distribution system, valves shall be set as shown on the plans.

See paragraph 1.12, Coordination for limitations on valve operation and system shut down.

Before shutting off any main, residents are to be notified in writing at least 48 hours in advance of cut off. The Contractor shall provide assistance to Town in notification distribution. Town shall be notified at least 1 week in advance of request for operation of valves and making either a wet tap or cut-in.

If the connection to the existing mains requires a wet tap, such tap shall be done by a firm experienced and equipped to do this type of work. All materials and labor shall be provided by the contractor to include, but not necessary limited to

the sleeve, valve, tapping machine, accessories, installation, and testing of such materials to complete the work. Town shall have the right to approve the firm or crew performing the work.

Work shall be scheduled at least one week in advance through the Town's Construction Inspector. A Town Representative/Construction Inspector shall be present during the operation. After installation of the tapping sleeve and valve and prior to performing the tap, the assembly shall be pneumatically tested at a pressure equal to the test pressure of the new line installed. Such pressure shall be maintained with no loss for a minimum time of 15 minutes.

D. **Removal of Asbestos Cement Pipe**

The contractor is hereby advised that some of the pipe within the Town distribution system may contain asbestos. Removal, handling, and disposal of asbestos cement pipe shall be performed in accordance with applicable EPA and OSHA regulations and applicable Federal, State and local regulations. Documentation and paperwork as well as a chain of custody are to be provided to Town.

E. **Utility Protection**

Take necessary precautions to protect existing utilities from damage due to any construction activity. The contractor shall locate existing utilities, culverts, and structures (above or below ground), before any excavation starts and coordinate work with utility companies. Protect, maintain in service, and prevent damage to utilities not designated to be removed. Omission from or inclusion of located utility items on plans does not constitute non-existent or definite location. Secure and examine local utility surveyor records for available location data including building service lines. Contact underground damage protection services by contacting **NC One Call Center** at least 48 hours before you dig.

811 Know what's below. Call before you dig.

The contractor shall protect, maintain in service, and prevent damage to utilities not designated to be removed. When utilities are encountered and are not shown on drawings or when locations differ from those shown on drawings, notify the Project Engineer for instruction before proceeding. In the event that a gas line, water line, power cable or conduit, or telephone cable or conduit is broken or damaged, the contractor shall give immediate notice to the proper authorities and shall be responsible for any damage to persons or property caused by such breaks. If a service pipe supplying water or gas to an adjoining house is broken, the contractor shall repair same at once. Town may, at the contractor's expense, repair any such service without prior notice to Contractor.

Should it become necessary to move the position of any underground structure, the contractor may be required to do such work.

The Contractor shall be responsible for protecting all existing utilities that could be damaged by excavation near the proposed line. Trench boxes may be necessary to prevent sloughing, etc., as well as to protect workmen, the motoring public, and the pavement. Failure to use a box, which subsequently results in damage to an existing line or other public improvements, shall be cause for liability against the Contractor for the repair costs.

F. **Surface or Ground Water in Trenches/Pipe**

When ground water is encountered, the contractor shall pump, or otherwise remove any water that accumulates in the trenches and shall perform all work necessary to keep the trenches clear from water while pipe is being laid. No pipe shall be constructed in water and water shall not be allowed to drain through the pipe. At the end of the day, the open end of the pipe shall be kept closed by placing a watertight fitting plug into the bell end to prevent washing of any foreign matter into the line. All water removed from the trench shall be conveyed in a proper manner to a suitable point of discharge and shall comply with the applicable erosion and sedimentation laws. See also paragraph 3.1.6, *Dewatering* of 02275 – *Trenching, Backfilling, and Compaction of Utilities*.

G. **Abandoning of an Existing Water Services/Lines**

Removal of Lines from Service: The Contractor shall remove abandoned lines from active service upon completion of replacement line, and after transfer of service to a replacement line. Under circumstances where the line to be abandoned is 2 inches or less in diameter and threaded galvanized pipe is screwed into a mechanical joint plug, the line may be deleted from active service through removal of the galvanized line from the mechanical joint plug and replaced with a threaded brass plug. Under circumstances where the line to be abandoned is connected to a lead joint cross or tee, the section of line being intercepted which contains the lead joint cross or tee shall be replaced with mechanical joint fittings or straight pipe using mechanical joint sleeves. All plastic fittings shall be replaced with ductile iron or other fittings approved by the Town Engineer.

Services: When abandoning services 2-inch or less in diameter, the line shall be cut at the corporation stop on the main or as close to the main as possible and a minimum one-foot segment of the line removed.

Mains: When an existing water main is replaced with a new water main, abandonment of the existing line is required once it is no longer in service. All mains are to be abandoned at source, valve removed, and the “tee” or tapping sleeve plugged with a mechanical plug. Location of abandonment shall be approved by a Town representative.

3.1.2 STEEL ENCASEMENT PIPE – DRY BORING & JACKING OR OPEN CUT

A. **General**: Where required, steel encasement pipe shall meet the length as shown on the plans and the thickness and diameter as shown on **Standard Detail C07.01**. Boring across roads and railways shall be performed by dry boring and jacking a steel encasement pipe under the pavement or rail. The encasement shall be located in an area that is relatively free from material such as rock and stone that may hamper the boring operation.

Construction shall be executed in such a manner as to prevent settlement of the ground surface above the pipeline.

All operations of the contractor shall be subordinate to the free and unobstructed use of the right of way of the passage of traffic without delay or danger to life, equipment, or property. Installation shall be in accordance with of the *NCDOT*

Standard Specifications for Roads and Bridges, latest revision or AREA, as applicable.

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

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

All carrier piping shall be mechanical joint ductile iron pipe with restrained joints supported by spiders.

Manufactured Spiders/Skids: The spiders necessary to support the carrier pipe inside of the steel encasement pipe shall be in accordance with *paragraph 2.1.5 B, Spiders/Skids for Encasement Pipes*. Unless otherwise shown on the drawings, one spider shall be placed at each bell end and one at each spigot end (2 spiders per joint) of the carrier pipe as well as at each end of the encasement pipe (see **Standard Detail C07.01** for location of spiders).

3.1.3 TUNNELING METHOD

A. **General**:

1) The contractor shall submit shop drawings to Town Engineer for approval prior to construction. All liner plates and ribs used in the tunnel shall be of one type. All material removed shall be disposed of off the site by the Contractor.

2) All operations of the Contractor shall be subordinate to the free and unobstructed use of the rights of way for passage of traffic without delay or danger to life, equipment, or property. The Contractor shall provide all necessary bracing, bulkheads, and shields to ensure complete safety to all traffic at all times. The Contractor shall provide all traffic control devices as necessary and as shown on the approved traffic control plan at no additional cost.

B. **Tunneling (Boring Method):**

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

2) Smoothly pave the bottom of the tunnel with concrete. Pull the carrier pipe in place a joint at a time. Securely block each section in place.

C. **Tunneling (Hand Mining)**

1) Commence tunneling operation from a pit, with the bottom excavated to plan grade, and sheeted or shored if necessary.

2) All blasting shall conform to requirements for blasting in *02275 – Trenching, Backfilling and Compaction of Utilities*.

3) Install the steel liner plates immediately after the excavated material has been removed, and remove the material not more than 24 inches ahead of the installed liner plates.

4) Grout all voids between the soil and tunnel liner plates. The maximum grouting pressure shall be 30-psi. Start grouting at the bottom of the tunnel liner plates and proceed upward progressively and simultaneously on both sides of the tunnel. Install liner plates no more than 6 feet ahead of grout section. Prohibit traffic over ungrouted sections of tunnel unless this section is in solid rock. Thoroughly dry-mix grout ingredients before adding water. After adding water, mix the batch for 3 minutes. Batches shall be of size to allow continuous placement of freshly mixed grout. Grout not used within 30 minutes after mixing shall be discarded. Placing shall be quick and continuous. Placement shall be under pressure with a grout pump. The period between installation of the tunnel liner plate and the placing of grout shall not exceed 7 hours, without the approval of Town Engineer. Upon completion of grouting, fill grout plugs with provided grout hole plugs.

   A pump shall be provided for placing the grout which shall be capable of exerting sufficient pressure to assure the filling of all voids between the liner plate and the undisturbed ground. Minimum acceptable pressure to fill voids will be 5 psi. The maximum grouting pressure shall be 30-psi.
   Pumping of grout shall be done:
   i. At the completion of the installation of approximately each 6-foot of liner plate,
   ii. At more frequent intervals than 6-foot if conditions indicate the necessity, and
   iii. At the end of a work shift or for stopping of work for any reason.

5) Smoothly pave the bottom of the tunnel with concrete: After installation of the tunnel liner plates, the contractor shall pour concrete pavement on the bottom quadrant (invert) of the tunnel, the surface of the pavement being parallel to the liner plate, with screed rails embedded in it, on line and grade for the installation of pipe in the tunnel.

6) The periphery of the tunnel shall be trimmed smooth to fit the outside of the steel liner plate as nearly as is practical, so that the void outside the plates is a minimum.

7) After installation of the casing pipe or the tunnel liner, pull the carrier pipe in place a joint at a time. Securely block each section in place. Each joint of the carrier pipe shall be supported at two points by steel saddles or by steel spiders, strapped to the carrier pipe with steel straps. The carrier pipe shall be blocked, in place to the prevent flotation.

8) Close tunnel liner ends to protect against entrance or foreign matter. The open ends of the casing pipe or tunnel shall be closed off by an 8-inch grout or masonry block wall prior to backfilling. A steel drain line to a 1 cubic yard French drain shall be provided.

9) If installation is under railway tracks, all permits shall be obtained and Railway Company shall be notified prior to such installation. The same shall apply to contacting the applicable Municipality or NCDOT if installation is under a roadway.

D. See also **PART 2 – PRODUCTS**, Section 2.1.6, "*Tunnel Liners and Appurtenances."*

3.1.4 HORIZONTAL DIRECTIONAL DRILLING OF HDPE WATER PIPE

A. HDPE pipe shall be installed by Horizontal Directional Drilling (HDD) using a surface mounted rig, first to drill a guided hole along a bore path consisting of a shallow arc and then to pull a string of pipe into the hole. Pull back is facilitated by a back-reamer, which enlarges the hole to approximately one and a half times the pipe diameter. Drilling fluids are injected into the bore hole to stabilize the hole and lubricate the pipe and drill-string. Tracking equipment is used to guide and direct the drilling.

1) Mechanical Restraint

When Polyethylene pipe is pressurized, it expands slightly and shortens slightly. Shortening may be enough to disjoin unrestrained mechanical joints that are in line with PE pipe. Disjoining can be prevented by installing external joint restraints at mechanical connections, by installing line anchors, or by a combination of both. Contractor shall install mechanical connections with joint restraint at each connection to mechanical joint pipe.

Note: Poisson Effect pipe shortening must be taken into account whenever the pipe is pressurized, both during the pressure testing, and when it is placed in service. Because pressures are usually higher during pressure testing (up to 150% of the system pressure rating), pipe expansion and Poisson Effect pipe shortening may be slightly greater during pressure testing. Before pressure testing, all mechanical joint restraints must be completely installed and secured per manufacturer's instructions. Concrete in-line anchors and thrust blocking (if used) must be fully cured (minimum of 21 days for 3,000 psi or 7 days for 4,500 psi concrete) and properly backfilled before testing. Restraint is not required at PE to PE butt fusion joints. Restraint is not required at bolted flanged joints.

Mechanical coupling: Stainless steel internal stiffeners shall be used on all couplings to increase the seal. All couplings shall have restraint devices per the manufacturer's recommendation and installed per the Manufacturer's direction.

B. **Installation and Testing**

The Manufacturer shall supply an Installation Manual to Town Engineer, which outlines guidelines for handling, joining, installing, embedding, and testing of the Polyethylene Pipeline. These guidelines shall be used as reference material by Town's Engineer in his determination of the required procedures.

Joints between plain ends of Polyethylene pipe shall be made by butt fusion when possible. The pipe manufacturer's fusion procedures shall be followed at all times as well as the recommendations of the fusion machine manufacturer. The wall thicknesses of the adjoining pipes and fittings shall have the same DR at the point of fusion.

When saddle connections are fusion welded, the Manufacturer's recommended saddle fusion procedures shall be used.

If mechanical fittings (which are designed for, or tested and found acceptable for use with Polyethylene pipe) are utilized for transitions between pipe materials, repairs, joining pipe sections, saddle connections, or at other locations; the recommendation of the Mechanical Fitting manufacturer must be followed. These procedures may differ from other pipe materials.

On each day butt fusions are to be made, the first fusion of the day shall be a trial fusion. The trial fusion shall be allowed to cool completely, and then fusion test straps shall be cut out. The test strap shall be 12 inches long or 30 times the wall thickness in length (minimum) and 1 inch or 1.5 times the wall thickness in width (minimum). Bend the test strap until the ends of the strap touch. If the fusion fails at the joint, a new trail fusion shall be made, cooled completely, and tested. Butt fusion of pipe to be installed shall not commence until a trail fusion has passed the bent strap test.

Socket and Straddle fusions shall be tested by a bent strap test as described by the Pipe manufacturer. The pipe manufacturer shall provide visual guidelines for inspecting the butt, saddle, and socket fusion joints.

Pressure testing shall be conducted in accordance with manufacturer's recommended procedure. Pressure testing shall use water as the test media. Pneumatic testing is prohibited.

C. **Shop Drawings**

Contractor shall submit shop drawings and details on the proposed HDPE pipe, fittings, bore methods, etc., for review and approval of Town Engineer before ordering material or beginning installation of the HDPE. Contractor shall also submit to Town Engineer proposed subcontractor's name as well as references on which he/she plans to use on this project. All subcontractors/installers must be approved by Town Engineer.

3.1.5 HORIZONTAL DIRECTIONAL DRILLING OF PVC C900 FUSIBLE WATER PIPE

C900 fusible PVC pipe (6- through 12-inch pipe) shall only be used with written approval from the Town Engineers.

A. PVC C900 pipe shall be installed by Horizontal Directional Drilling (HDD) using a surface mounted rig; first to drill a guided hole along a bore path consisting of a

shallow arc and then, to pull a string of pipe into the hole. Pull back is facilitated by a back-reamer, which enlarges the hole to approximately one and a half times the pipe diameter. Drilling fluids are injected into the borehole to stabilize the hole and lubricate the pipe and drill-string. Tracking equipment is used to guide and direct the drilling.

B. **Installation and Testing**

The Manufacturer shall supply an Installation Manual to the Town Engineer, which outlines guidelines for handling, joining, installing, embedding, and testing of the Fusible C900 Pipeline. These guidelines shall be used as reference material by the Town Engineer in his determination of the required procedures.

Joints between plain ends of Fusible C900 pipe shall be made by butt fusion when possible. The pipe manufacturer's fusion procedures shall be followed at all times as well as the recommendations of the fusion machine manufacturer. The wall thicknesses of the adjoining pipes and fittings shall have the same DR at the point of fusion.

When saddle connections are fusion welded, the Manufacturer's recommended saddle fusion procedures shall be used.

If mechanical fittings are utilized for transitions between pipe materials, repairs, joining pipe sections, saddle connections, or at other locations; the recommendation of the Mechanical Fitting manufacturer must be followed.

Pressure testing shall be conducted in accordance with Town of Clayton specifications.

Comment [w1]: The process for installing the Fusible C900 is supposed to be the same as HDPE, although I do not believe it is subject to the Poisson Effect as greatly as HDPE.

Comment [w2]: Would this apply to the Fusible C900?

C. **Shop Drawings**

Contractor shall submit shop drawings and details on the proposed Fusible C900 pipe, fittings, bore methods, etc., for review and approval of the Town Engineer before ordering material or beginning installation of the Fusible C900 pipe. Contractor shall also submit to the Town Engineer proposed Subcontractor's name as well as references on which he/she plans to use on this project. All subcontractors/installers must be approved by the Town Engineer.

3.1.6 PVC PIPE

PVC pipe shall only be used with written approval from Town Engineer.

3.2 VALVES AND FIRE HYDRANTS

A. **Valve Applications**

1) **Valves – vault/above ground applications**:

a. Ball Valves 2-inch and smaller: 1/4Turn Stainless Steel Ball Valve

b. Gate valves 2-inch and larger: NRS OS & Y

c. Relief Valves: Air/Vacuum Release Valves

d.	Water-Regulating Valves:	Pressure-regulating valves Flow-regulating valves
e.	Detection of unauthorized water:	Detector Check Valves
f.	Backflow prevention:	Reduced Pressure Zone Backflow Preventers – USC approved Double Check Valve Assemblies – UL/FM rated

2) **Valves – below ground applications**: Non-rising stem.

3.2.1 GATE VALVES

A. **Setting of valves and valve boxes**: Valves shall be installed with stems in a vertical plane through the pipe axis and perpendicular to the pipe axis. The contractor shall clean the valves before installation and check for satisfactory operation. Valve nut extensions shall not be installed unless approved by Town Engineer.

Nipples for 4-inch through 12-inch valves shall be cut so that the valves are installed no more than 4 feet from the fitting (centerline to centerline). 2-inch valves shall be installed with a 4-inch long brass nipple.

All valves adjacent to tees or bends shall be tied to the fitting either with the restraint flange joint restraint system or with ASTM A307 threaded stainless steel tie rods. See **Standard Detail 512.06** for number and diameter of tie rods).

Valves must match line size.

B. All underground valves without gearing or operators shall be equipped with a 2-piece valve box with lid (see **Standard Detail 513.01**). Valve boxes shall be set on concrete brick placed beneath the bottom outstanding flange of the valve box. Place a minimum of 1 inch of earth cushion beneath the concrete brick and the valve and the valve box set in alignment with the valve stem centered on the valve nut, set in a manner to prevent transmitting shock or stress to the valve. Valve box cover must be set flush with the finished ground surface or pavement. The contractor shall be responsible for keeping valve boxes clean and free of any foreign matter until acceptance of the project.

C. **Valve Box Adjustment**: The Contractor shall adjust valve boxes to final grade at the time designated by the Town Engineer. As shown on the drawings, the Contractor shall construct a concrete pad set flush with grade and top of the box in a 6 inch thick x 2' x 2' concrete stabilizing pad placed around the valve box in unpaved areas. No extra payment will be made for this item. Valve boxes in easements are to be provided with a valve box marker post as manufactured by Pipeline Supply, Sanford, NC, or approved equal. See **Standard Detail 513.03.**

D. **Valve Box Removal:** When shown on the drawings or directed by the Town Engineer, the Contractor shall remove existing valve box(es), place select fill, stone or other material and repair pavement. Salvaged valve box(es) are to be delivered to the Public Works Operations Center.

3.2.2 VALVES 16 INCHES AND LARGER (GATE OR BUTTERFLY VALVES)

Valves with gearing or operators shall be installed in a manhole. The manhole shall be constructed/set in such a way as to prevent transmitting any load or shock to the valve. It is also to be set in such a way that the packing, operator, and other parts of valve are readily accessible for minor repairs. When set in a manhole, the valve is to be flanged joint and set with a flanged coupling adapter on one end to permit valve removal for maintenance. Manholes shall be constructed in accordance with the **Standard Detail 513.09**. Manhole opening shall be positioned over the operating nut. Valves are to be coated. Either a gate valve or a butterfly valve may be used.

3.2.3 TAPPING SLEEVES AND VALVES

Tapping sleeves and valves shall be installed in accordance with the manufacturer's recommendations at locations shown on the plans. The Contractor shall make connection to existing water mains in the manner shown on the plans or otherwise in a manner which is satisfactory to the Town. With prior approval, when taps are made on asbestos cement pipe, the Contractor shall excavate at the location of the tap and measure the diameter of the pipe prior to selecting a tapping sleeve to ensure the sleeve will fit the pipe (this information shall be provided to the Town of Clayton on the as-built drawings). See **Standard Detail 513.02**. Contactor is responsible for traffic control, excavating, dewatering, and safe access in the trench at the time of tap. The Contractor is to provide taping sleeve and valve.

3.2.4 AIR RELEASE VALVES

Air release valves are to be used to bleed air during filling of a water line and to automatically vent air that collects in the water lines. Pressure air release valves shall be located as shown on the drawings. The valve shall be housed in a precast concrete eccentric manhole and shall be installed in accordance with **Standard Details 516.01** (2-inch Air Release Valve and Manhole). All pipe and fittings are to be brass including the plumbing gate valve. Air release valve locations shall be as shown on the plans and as otherwise directed by Town Engineer.

3.2.5 FIRE HYDRANTS

A. **Construction**: Fire hydrants shall be installed where shown upon the plans or as directed by the Fire Marshall and/or Town Engineer. Hydrants shall be set upon a concrete block in such manner as to preclude the possibility of settlement of hydrants. Place loose #57 stone around the hydrant elbow. See **Standard Details 514.04 and 514.05**.

Hydrants are to be located at right of way line and set to the height prescribed by **Standard Details 514.04 and 514.05** with the pumper nozzle facing or pointing to the street or fire access lane. A resilient seat gate valve shall be installed with an anchor tee. Care shall be taken to keep concrete away from bolts and weep holes. Hydrants must be set with the stem vertical/plumb and the flange above grade. The Contractor is responsible for determining barrel length and ordering to meet conditions. Where adjustments in height are needed, provide extension kits at no additional cost. However, only one 24-inch riser extension is allowed per hydrant. Where hydrants are set behind guardrails, the pumper nozzle shall

be set with its centerline a minimum of 12 inches and a maximum of 18 inches above the top of the guardrail.

A Town representative must inspect fire hydrants prior to backfilling.

B. Hydrants are to be rodded to the valve with 3/4" diameter threaded rods. Where hydrant branches exceed 20 feet, rods are to be attached to the hydrant and the rods to a thrust block behind the first full joint of pipe on the hydrant branch between the hydrant and the leg valve. If test pressures are expected to exceed 200 psi, rod with a minimum of 4 rods.

Threaded tie rods shall be type 316 stainless steel thread rods (all thread) in accordance with paragraph 2.3.13. No duck lugs will be allowed. Restraint flange joint restraint systems are preferred over tie rods.

Operation and Painting: Hydrants, upon installation and prior to acceptance of the project, shall be painted and greased, the cap is to be sprayed (non-petroleum based) after installation, and individually operated in front of an Town representative to verify the hydrant is wet. Paint is to be Sherwin Williams Industrial Enamel or equal. The hydrant barrel and bonnet is to be painted red. Surfaces to be painted shall be free of oil, dirt and rust. See **Standard Detail 514.07**. Do not remove chains.

C. **Hydrant Bagging – Not Permitted**:

D. **Valving of Main**: A leg valve is required on all hydrant legs. Install hydrant valve on anchor tee. When valve is placed outside the pavement, provide a concrete stabilizing pad in accordance with **Standard Detail 513.03**.

E. Fire hydrants are to be pressure tested with the main.

3.2.6 BACKFLOW PREVENTERS

See Town of Clayton Cross-Connection/Backflow Protection Ordinance (Chapter 53) latest adoption as applicable.

3.3 MISCELLANEOUS APPURTENANCES

3.3.1 SERVICES

A. **General**: All fees must be paid and work scheduled with the Town before the tap can be made. All materials must be on-site, trenches open, and shoring and traffic control devices in-place before the tap is made. Contractor may be required to provide traffic control plan that meets all MUTCD regulations.

1) **Allowable Tapping methods:**

a. ¾-inch and 1-inch taps are to be made by all bronze double strap tapping saddle. See **Standard Detail 513.04**.
b. 2 inch taps are to be made by all bronze double strap tapping saddle. See **Standard Detail 519.03**.
c. Taps 4-inches and larger are to be made using an all stainless steel tapping sleeve or a fitting. Iron body sleeves are not permitted.

d. **Tap Location**: No closer than 24 inches from end of pipe up to 16" diameter.
e. Service taps shall also be subject to the requirements of AWWA C600, *Installation of Ductile Iron Water Mains and their Appurtenances, latest revision.*

Service Connections on "In-Service" water mains.	
Size Connection	**Responsibility**
¾-inch through 1-inch services	Contractor makes tap and runs service line and sets meter box and setter (as applicable). Town sets meter.
2-inch and larger services	Contractor makes tap, runs service line, sets meter box or vault, and furnishes all material. Contractor sets meter.

2) **Tap Location – 3/4-inch through 2-inch Copper Service Lines**: Taps 2-inches and smaller shall be made no closer than 24 inches apart (see **Standard Detail 513.04**). Water service pipe shall be one continuous run, from main to meter setter, of copper pipe with no joints or couplings in between. Service lines shall run perpendicular to the main in a straight line between the water main to the meter box/property served. No sharp bend of the service line will be permitted. Service lines shall not be located beneath driveways.

Firm bedding with at least 18 inches of cover shall be provided from the corporation to near the meter setter. Copper service lines shall have a minimum of 30 inches of cover from the water line to the top of the back of curb or centerline of the drainage ditch.

Backfill shall be free of rocks or large objects that could crimp or damage the line. Service line trenches in traffic areas shall be tamped to achieve 95% Standard Proctor Density. In landscaped areas, the surface shall be left smooth and uniform with the adjacent surface.

B. **¾-inch and 1-inch taps**: All 3/4 –inch and 1-inch taps into water mains shall be made using an all bronze Mueller BR2B double strap tapping saddle, both with an all bronze corporation stop. Corporation stop for saddles shall have AWWA Standard CC tapered threads. Taps shall be made at a 45° angle above the horizontal on the upper half of the pipe. A bend or "gooseneck" in the service line shall be provided in the service line as it leaves the corporation stop to provide for expansion/contraction and flexibility. A double strap shall be used on both PVC and AC pipe. Multiple taps in the same section of the pipe shall be staggered (see **Standard Detail 513.04**).

C. **2-inch taps**: 2-inch taps shall be made using a 2-inch Ford 202B or Mueller BR2B all bronze double strap saddle. Water service pipe for 2-inch connections shall be type K hard copper with compression fittings. For short distances between the main and the meter, threaded brass pipe may be used. Taps shall be made at a 90° angle to the pipe. See sheet 2 of **Standard Detail 519.03** and paragraph 2.3.12 B.

D. **Large taps**: Taps 4-inch and larger shall be made using all stainless steel tapping sleeves and tapping valves for existing lines or a tee and valve on new

lines. A Town representative must inspect all service connections prior to backfilling. Only one 4-inch or larger tap shall be made per joint of pipe on AC and/or pit cast (gray iron) pipe. The outside diameter of the pipe must be measured at the location of the tap to determine the appropriately sized tapping saddle.

E. **Meter Boxes and Setters – Installation**:

1) **Small Meter Boxes**: Meter boxes for 3/4-inch, 5/8-inch, and 1-inch meters shall be installed at and within right-of-way line. Meter boxes shall be set on a concrete brick with one brick set vertical at each end to cover the elongated slot. The box and brick shall be set on undisturbed grade. All meter boxes shall be set so that there is 10 inches of clearance between the top of the box and the centerline of the meter setter. The meter setter shall be straight, level and centered in the box. Meter boxes shall be set to avoid inflow of surface water into the box. See **Standard Detail 519.01**.

Meter yoke for ¾"- and 1-inch meters shall be provided with a 36-inch long copper tailpiece extending horizontally out the back of the meter box, or beyond the edge of the sidewalk when meter box is set in sidewalk, the end turned up with the end either plugged or crimped. A steel sediment fence channel post is to be set beside the turned up tail section for protection. See **Standard Detail 519.01**.

2) **2-inch Meter Boxes**: Meter boxes for 2-inch meters shall be placed with a concrete brick on each end to cover elongated slot. Concrete bricks shall be placed underneath meter box for support. The box and brick shall be set on NCDOT #57 or #67 stone. Meter boxes shall be set so that there is 12 inches of clearance between the top of the box and the cut-off nut on the meter setter. The meter setter shall be straight, level and centered in the box. Meter boxes shall be set to avoid inflow of surface water. See **Standard Detail 519.03**.

Meter setters for 2-inch meters shall be provided with a section of copper pipe extending buried 24 inches and extending 2 feet horizontally out the back of the meter box, or 2 feet beyond the edge of the sidewalk when meter box is set in sidewalk, and the end either plugged or crimped. Setters are to be perpendicular to meter and vertical. Meter shall be set by contractor at time the tap is installed for proper spacing. Stabilizer bars are required to be provided on setter.

F. **Large Meter Vaults**: Meter vaults for 3-inch and larger meters shall be placed level on a 12-inch bed of #57 stone that has been thoroughly and firmly consolidated. Meters and fittings shall be supported by pipe stands. Vault doors shall be centered over the meter and otherwise located as shown on **Standard Detail 519.04**. The Town reserves the right to require drains in meter vaults.

G. **Grounding to Water Services**: Grounding shall not be allowed to be connected to meter boxes or vaults. As a minimum, place meter boxes/vaults no closer than 10 feet from a building. If unavoidable, place a grounding jumper around meter box/vault.

H. **Abandoning Water Services**: see paragraph 3.1.1 G *Abandoning of Existing Water Services/Mains*.

I. **Water Service Replacement:** All existing water services along the water main are to be reconnected to the new water main. Contractor shall install a new corporation stop, service line between proposed water line and existing service at the water meter box, and a new meter setter and new water meter, if necessary. All taps in PVC pipe shall be accomplished through the use of shell type hole cutter which will retain the coupon or plugs. Existing meter setters will be the property of the Town and be delivered to the Operations Center. *Water services shall be classified for payment as to their location in relation to the new water main and the centerline of the street.*

Relocation of water meters to the existing right of way, including all necessary materials, labor, and surface restoration shall be considered incidental to the water service replacement and be included in the unit price bid for the item.

J. **Testing**: All taps and services shall be pressure tested with the main.

3.3.2 RESTRAINTS/CONCRETE THRUST BLOCKING

A. **Thrust Blocking**: Thrust Blocking must be installed at all fittings and changes in direction of the pipe line. Thrust blocks shall be constructed from 3000 psi concrete (at 28 days) and poured against an undisturbed earth trench wall. Concrete thrust blocking shall be constructed in accordance with **Standard Detail 512.01**. Sacrete is not permitted. Concrete anchors may be unformed but minimum dimensions must be maintained. All fittings and pipe shall be wrapped in plastic prior to installation of concrete to ensure that bolts and nuts are free of concrete and debris to allow accessibility for future repairs. When soft, mucky, unsuitable, or unstable soils are encountered, thrust shall be resisted by running tie rods to solid foundations by removing the soft materials and replacing it with ballast of sufficient size and weight to resist thrust.

Vertical upward thrust at fittings or vertically deflected joints shall be resisted with thrust collars of adequate size and weight to resist thrust. See **Standard Detail 512.04**.

Pipe manufacturer's installation manuals shall be followed for the anchoring of valves and fittings in difficult locations unless superseded by the requirements of these specifications.

Concrete thrust blocking is not recommended where the blocking may bear on other utilities or where the area behind the block may be excavated in the future.

A Town representative must inspect all blocking and anchoring prior to backfilling.

B. **Rodding:** 4-inch and larger valves and assemblies of fittings shall be secured to a blocked fitting by threaded rods with eyebolts. Refer to **Standard Detail 512.06** for the minimum size and number of rods needed for various test pressures. No more than one coupling shall be allowed between rods. Rodding length between fittings shall not exceed 20 feet. When the length between fittings exceeds 20 feet, place a thrust collar on the line and rod to the thrust collar.

All eyebolts and threaded steel rods shall be shall be type 316 stainless steel thread rods. See paragraph 2.3.13, Tie-Rods.

C. **Thrust Collars:** Thrust collars shall be constructed as shown in **Standard Detail 512.02** for pipes up through and including 36 inches in diameter. The thrust collar shall consist of a wedge action restrainer gland (see paragraph 2.1.2 Ductile Iron Fittings, paragraph B. 3 of this specification for manufacturer and model number of approved restrainer gland) placed around a joint of ductile iron pipe encased in a reinforced 3000 psi concrete block. Where the blocking provides thrust resistance for fittings, threaded rods shall be connected to the restraint flange fitting secured to a full joint of ductile iron pipe. On dead end lines, the thrust collars must be placed on a full joint of ductile iron pipe just after the terminal end line valve.

3.3.3 VAULT CONSTRUCTION

During the contract, the contractor may be required to perform vault related construction. Prior to performing such work, all materials, specifications, and additional costs (items not bid in other sections,), shall be approved before commencing work.

3.3.4 MANHOLE INSTALLATIONS

Manhole bases shall be placed on a level 18-inch bed of #57 stone that has been thoroughly and firmly consolidated. Voids around the pipe, joints, grade rings, and other openings in the manhole shall be thoroughly and neatly grouted inside and outside with a non-shrink gout to prevent infiltration. A maximum of 2 grade rings or one grade ring and one course of concrete bricks will be allowed to bring the rim and cover to finished grade. If additional height is required, a riser must be installed.

Flat tops shall be used for air release manholes.

3.4 TESTING AND DISINFECTION

3.4.1 GENERAL

Pipelines shall be tested, in sections between valves, as soon as the installation is completed. Using this method, errors in workmanship can be identified immediately and leaks can be fixed quickly and with minimum expense. Prerequisite Conditions for Testing and Disinfection shall be as follows:

A. Pipelines and appurtenances have been laid and the trench backfilled.

B. Hydrants shall be properly located, operable and plumb and at correct elevation.

C. Valves shall be properly located, operable and at correct elevation. Valve boxes or manhole shall be centered over operating nuts and the top of the box or manhole shall be at proper elevation.

D. All services shall be installed complete with setters (Contractor shall provide a meter, approved by Town, for pressure testing). There shall be no bypass around the meter used for pressure testing.

E. All reaction anchors have had sufficient set of 7 days or high early strength concrete may be used to reduce the curing time to 3 days. For high early concrete mix, use 4,500-psi or greater concrete. Temporary bracing shall not be allowed.

F. Lines shall be properly vented where entrapped air is a consideration.

G. All visible leaks, broken or cracked pipe, valves, hydrants, etc. shall be repaired.

H. Air release valves shall be installed complete and in place after pressure test.

I. All construction activities on the project, that requires trenching or excavation within the limits of the water location shall be completed. Pavement base course and curb and gutter shall be in place before sampling. Pressure testing is to be performed before pavement is put down.

J. Approval from Town's Inspector on section of line to be tested.

3.4.2 ORDER OF OPERATIONS

A. **Fill Line:** After all prerequisites are met, fill the system slowly with water, at a velocity of approximately 1 foot per second, while necessary measures are taken to eliminate all air at the highest points of the system where air may collect in pockets. After filling, shut off system in order to prevent contaminated water from flowing back in the line supplying the water.

B. **Pressure Test**: A pressure test shall be scheduled with a Town representative performing the test 48 hours in advance. Testing shall be in accordance with section 3.4.3, *Pressure Tests & Leakage*. ***If an existing gate valve is known to be leaking, chlorination must be performed prior to pressure testing.***

C. **Flushing:** Allow filled system to set undisturbed for a minimum of 24 hours, then begin flushing operations. The section of main to be disinfected shall be flushed through blowoff assemblies. Flushing shall be a velocity of not less than 2.5 feet per second to remove sediment and other foreign matter until the water runs clear. The contractor shall be responsible for making adequate provisions for drainage of large volume of flushing water, including proper dechlorination/disposal of chlorinated water. Any damages that may occur from this operation shall be the sole responsibility of the contractor. In conjunction with beginning flushing, a Town representative will perform a high range chlorine concentration test. Chlorine concentration of 50 mg/l minimum must be provided. Allow chlorinated water to set in the test section for 24 hours. The chlorine concentration shall not drop below 20 ppm within a minimum period of 24 hours. See section 3.4.4, *Disinfection and Bacteriological Testing*.

D. **Sampling**: Check chlorine and turbidity. After allowing the system to flush so that at least two volumes of water pass through the main, the bacteria sample shall be collected at regular intervals not exceeding 1,200 feet, and tested for bacteriological quality. The contractor shall be responsible for making adequate provisions for drainage of large volume of flushing water, including proper

dechlorination/disposal of heavily chlorinated water. See section 3.4.4, *Disinfection and Bacteriological Testing*.

1) Pipe subjected to contaminating materials shall be treated as directed by Town Engineer. Should such treatment fail to cleanse the pipe, replacement shall be required. The Town shall bear no portion of any cost sustained by the contractor in meeting this specification.

2) Services shall be included in the main line disinfection process. The contractor shall have the same responsibility for laterals as for the mains in regard to bearing full cost of any corrective measures needed to comply with either the bacteriological test or other such requirements.

3) After As-Builts have been submitted and reviewed, and NC State Certification of the water main has been received, the water main shall be placed in service.

E. **Final**: After final flushing, flow all hydrants to confirm the valves are open.

3.4.3 PRESSURE TESTS & LEAKAGE

The contractor shall test and disinfect completed sections of water line, including service lines, fire hydrants, and fittings with water. Town reserves the right to test all lines. This testing, however, does not relieve the contractor of his responsibility to repair or replace any cracked or defective pipe within the 12-month warranty period. All work necessary to secure a tight line shall be done at the contractor's expense. Testing shall be performed in the presence of Town Engineer.

All additions or replacements to water system, including fire lines and backflow prevention devices, shall be tested and chlorinated before being placed in service. Such work must take place under the supervision of Town Engineer.

The newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for two hours to a leakage test with a constant test pressure of 150% of design working pressure, but no less than 150 psi. The test pressure shall be allowed to build up slowly using a hand pump or power pump to the test pressure. Only Town personnel shall operate water valves on Town's existing water system. Extreme care shall be used to prevent backflow into the potable water supply. The lines should be allowed to stand under pressure for a period of 24 hours prior to the test. Air should be vented from all high points just prior to the test. Only clean water, free of dirt and other debris, from a clean container shall be used for testing. The contractor shall notify Town's inspector 48 hours in advance of any expected test. The contractor shall pretest all mains for a period of 2 hours before notifying Town for a final pressure test. No final pressure test will begin after 2:00 PM. The maximum allowable leakage shall be no greater than allowances determined by formulas presented in AWWA C-600 and C-605. No leakage shall be allowed for services.

Tapping sleeve and valve shall be pneumatically tested in place prior to tapping of the existing line in accordance with the manufacturer's recommendations.

The Town's inspector will verify 1 pressure test – the final observation of the test section. A fee will be charged if the Town inspector is required to make more than 1 trip to verify a pressure test or conduct purity sampling on the same section of main being tested.

A. **Acceptance Tests:**

1) **Pressure Test**: Subject the pipe system to a hydrostatic pressure test. Raise the pressure by pump to 150-psi, 150% of design working pressure, or test pressure as shown on the drawings, whichever is greater. Measure pressure at the low point on the system compensating for gauge elevation. Maintain this pressure (+ or – 5 psi) for 2 hours. If pressure cannot be maintained using reasonable pumping rate, determine cause, repair, and repeat the test until successful. Contactor shall be responsible for all labor, materials, and equipment to perform the testing.

2) **Leakage Test**: Leakage shall be defined as the quantity of water that must be supplied into the pipe to maintain the test pressure, after all air in the pipeline has been expelled and the pipe has been tested for a duration of 2 hours. Leakage shall not exceed the quantity determined by formulas presented in AWWA C-600 or C605, for ductile and PVC respectively. Updated leakage tables may be available from the Public Water Supply Division of North Carolina Department of Natural Resources.

   If leakage exceeds allowances, the contractor shall be responsible for locating and repairing leaks, and retesting of line until successful.

   No leakage will be allowed for all welded steel pipe. If leaks are revealed by test, repair by rewelding. Peening of leaks will not be allowed. A certified welder must perform all welding.

3.4.4 DISINFECTION AND BACTERIOLOGICAL TESTING

Pipe Disinfection and Bacteriologic Testing: comply with ANSI/AWWA C651, *Disinfecting Water Mains*. The contractor shall disinfect water mains and accessories in accordance with the procedures listed below and meet the requirements of Town. Bacteriological testing shall comply with Section 5 of AWWA C651. All samples shall be tested for bacteriological (chemical and physical) quality in accordance the *Standard Methods for the Examination of Water and Wastewater*; and shall show the absence of coliform organisms and the presence of chlorine residual. The lines shall not be placed in service or pressure tested until a negative bacteriological report has been received.

Samples cannot be collected if any type of precipitation is falling.

All sampling pipe shall be copper, brass, or PVC.

The contractor is responsible for furnishing all material and construction sampling points and for taking the samples. Temporary pipes used for sampling shall be composed of sections of vertical pipe terminating into a 90-degree horizontal bend and nipple at least 18 inches above ground level. Copper tubing used for sampling shall terminate horizontally with the ground, at least 18 inches above

ground level. It may be difficult to obtain passing samples from outlets other than those listed above. Samples will not be taken from a hose.

The Contractor will prepare a Sampling Log, including a sketch of the sampling points, as specified by the Town. The samples shall be taken in standard sterilized bacteria sample bottlers marked with the sample location. The Contractor is responsible for collecting samples and doing so in the presence of a Town representative. Samples can only be taken Monday through Thursday no later than 1:00 PM. Chlorine injected on Friday yielding a 48-hour contact time will be reviewed and approved on a case by case basis.

Samples shall be delivered to a State certified testing laboratory for analysis. Results of the analyses shall be furnished to the Town directly from the testing laboratory with the project name and the testing location(s) referenced on each result. In the event that two successive bacteriological tests fail for any given section(s), that section(s) of the main shall be re-chlorinated, re-sampled, and re-analyzed.

Sampling Costs: Contractor is responsible for all testing costs.

A. **Forms of chlorine for disinfecting**

1) Calcium hypochlorite – Two forms are available – granular and tablets (both with 65% available chlorine). It will normally require 6.5 lbs. of Calcium Hypochlorite to produce a concentration of 50mg/L of available chlorine in 10,000 gallons of water. (Warning Note: *This chemical must not be used on solvent-welded or on screwed-joint steel pipe because of the danger of fire or explosion from the reaction of the joint compounds with the calcium hypochlorite*!)

2) Sodium hypochlorite – is supplied in strengths of 5.25% to 16% available chlorine. The required amount of sodium hypochlorite to produce a 50mg/L concentration of available chlorine in 10,000 gallons of water can be calculated from the following formula:

Gallons of Sodium Hypochlorite needed = 50 ÷ % of available chlorine

B. **Methods of chlorine application**

The contractor will inject a chlorine solution as specified in AWWA Standard C651, latest revision, into the water main. Chlorination shall be in accordance with the following guidelines for calcium hypochlorite granules:

Pounds of calcium Hypochlorite granules per 1000 feet of pipe to provide 50 ppm

6-inch diameter pipe	0.93 lbs.
8-inch diameter pipe	1.68 lbs.
12-inch diameter pipe	3.77 lbs.
16-inch diameter pipe	6.71 lbs.
20-inch diameter pipe	10.50 lbs.
24-inch diameter pipe	15.11 lbs.
30-inch diameter pipe	23.61 lbs.

The chlorine solution shall be injected in the section of the main nearest an existing main. The chlorine solution shall result in a chlorination concentration of 50 ppm or greater. Chlorine injected on Friday yielding a 48 contact time will be reviewed and approved on a case by case basis. Manually operated pumps shall not be used to inject the solution into the main.

1) **Application for Continuous Feed**

Taps will be made at the control valve at the upstream end of the line and at all extremities of the line including valves. These taps shall be located in such a manner as to allow chlorine solution to be fed into all parts of the line.

The chlorine solution shall be circulated in the main opening of the control valve while systematically manipulating hydrants and taps at the line extremities. The Chlorine solution must be pumped in at a constant rate for each discharge rate in order that a uniform concentration will be produced in the lines.

2) **Continuous feed method** – Potable water shall be introduced into the pipe main at a constant flow rate. Chlorine shall be added at a constant rate to this flow so that the chlorine concentration in the water in the pipe is a least 50mg/L. The chlorinated water shall remain in the main at least 24 hours, after which, the chlorine concentration in the water shall be at least 10mg/L. All valves and appurtenances shall be operated while the chlorinated water remains in the main.

C. **Bacteriologic Tests- General**: Before the water main is placed in service, all samples shall be collected at regular intervals not exceeding 1,200 feet and tested for bacteriologic quality and shall show the absence of both background growth (gram positives) and coliform organisms.

Samples for bacteriological analysis shall be collected in sterile bottles treated with sodium thiosulfate. A chain of custody shall accompany the samples delivered to the plant. Test results cannot be read until 24 hours after sample has been run by lab. If laboratory results indicate the presence of coliform bacteria, the samples are unsatisfactory. If laboratory results indicate background growth masking the detection of coliform bacteria, the sample will be considered unsatisfactory. If the line fails second sampling, the main shall be re-chlorinated by the contractor and new tests performed prior to moving to the next section of main. The tablet method cannot be used in repeated disinfecting.

Cleaning and disinfecting will be the responsibility of the contractor. Town will furnish water and operate all necessary valves for these operations. The contractor shall be responsible for loading, hauling, discharging of water, and dechlorinating device.

Samples for bacteriological analysis shall be collected for each section of pipe between main line valves after flushing is completed.

Primary sampling points are blow-offs (see the table of *Minimum Blow-off sizes*, paragraph D, below), 2-inch setters and all fire lines. Sampling will be allowed at hydrants if available to flush and sample the entire section of newly laid pipe. Otherwise, the contractor shall install a flushing and sampling tap consisting of a corportaion cock installed in the pipe with a temporary copper pipe. Such additional work required for this shall be at the contractor's expense and is to be properly abandoned after acceptance.

D. **New Water Mains Disinfection and Purity Testing - Procedure**

STEP 1: Disinfection

The contractor is responsible for furnishing all taps and materials required to satisfactorily disinfect the water system. The following steps will be completed by Town and the Contractor cooperatively.

1) The Town's inspector will witness the flushing of the section of main to be disinfected until the water appears clear.

   The contractor is responsible for adequate disposal of the large volumes of water generated from flushing and dechlorinating device.

2) The contractor will inject a chlorine solution as specified in Section 4 of the AWWA Standard C651, latest revision, into the water main.

   a. Do not use manually operated pumps to inject the solution into the main.
   b. The chlorine solution shall result in a chlorine concentration of 50 ppm or greater.
   c. The chlorine solution should be injected in the section of main nearest an existing water main.

3) The Town's Inspector will draw water from the following areas until at least 50 ppm chlorine concentration has been measured at all points of discharge at which time each point will be closed:
   - end of the main
   - hydrants
   - lateral lines
   - other connections

   a. The Town's Inspector will close all control valves feeding water into the main.
   b. The chlorine concentration shall not drop below 20 ppm within a minimum period of 24 hours.

c. Sometime after the 24-hour period expires, the Town's inspector will check the chlorine concentration to confirm that it has not dropped below 20 ppm.

STEP 2: Preparing for Purity Testing

The contractor is responsible for furnishing all material and constructing sample points.

1) The Contractor is responsible for preparing a Sampling Log that includes a sketch of sampling points.

2) The contractor must ensure that each sample point terminates horizontally at least 18" above ground level.

3) **SAMPLES WILL NOT BE TAKEN FROM A HOSE.**

Samples are to be taken on Monday through Thursday, no later than 1:00 PM.

STEP 3: Purity Testing

The Contractor is responsible for collecting and submitting samples to a State certified testing laboratory. Samples cannot be collected if any type of precipitation is falling. A list of approved laboratories is located at http://www.ncwater.org/pws/Compliance/electronic_reporting.html.

SAMPLING

1) Before chlorinating is performed, the Contractor will first flush the new water main. The main must be flushed so that two volumes of water pass through the main.

2) The Town's inspector will check both chlorine concentrations.

   a. The chlorine concentration must be less than 4ppm for consumption purposes but greater than or equal to 2 ppm for testing purposes.

   If the chlorine concentration is not within these limits, the Contractor must flush and rechlorinate the water line and resample at a later date.

3) If the chlorine concentration is within limits, the Contractor will collect samples from the new main and from an approved/control water main in the distribution system.

   Obtaining a control sample allows the laboratory to compare the water quality in the distribution system with that in the new water main.

4) On the day of collection, the Contractor will deliver the collected sample to a State certified laboratory. Samples may be delivered only Monday through Thursday no later than 1:00 PM.

5) The laboratory personnel will conduct a total coliform test using the membrane filter method. **This test required 24 hours of incubation before the result is obtained.**

6) The test results must be negative for coliform and E. Coli bacteria.
   a. If the samples from the water main are positive, the main must be disinfected again which means Step 1 must be repeated in its entirety. This will prolong testing.
   b. In the rare event that the samples from the control main are positive, the control main must be flushed and resampled at a later date. This will prolong testing.

E. **Dechlorination**: No discharge of heavily chlorinated water into a storm sewer or a stream will be permitted unless the discharge is first treated by a neutralizing chemical applied to the water to be wasted to neutralize throughly the residual chlorine. A dechlorinating device is required. Disposal of heavily chlorinated water shall meet the applicable sections of AWWA C651, latest revision.

3.5 FINAL ACCEPTANCE

Upon completion of water main installations and prior to acceptance, the Contractor shall provide adequate and competent personnel to conduct, in conjunction with Town, an inspection of each valve and hydrant on the newly completed main. The purpose of this inspection shall be to ensure the operability and location of each valve and to further ensure that all valves are left in the open position.

Fire hydrants shall be greased and painted.

Flow tests are to be performed on each hydrant to verify both that flows are in line with the design flows and that all line and leg valves are open.

Upon receipt of State Certification, the main valve serving the new section of main(s) shall be turned on and placed into service.

Town of Clayton
Water Pressure Test Report

Location: _____

Test Made by: _____ Time: _____ Date: _____
Test Requested by: _____

Make of Hydrant: _____
Nozzle Size: _____
Static Pressure: _____ psi
Residual Pressure: _____ psi

	Hydrant #1	Hydrant #2	Hydrant #3
Pitot Reading:			
Flow (GPM):			

Sketch:

END OF SECTION 02510

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