02510 - WATER DISTRIBUTION

(Last revised 3/29/10 w/ DWQ comments, 5/3/10)

SELECTED LINKS TO SECTIONS WITHIN THIS SPECIFICATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

The latest edition or version of the following shall apply.

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

B. AWWA C600: *Standard for Installation of Ductile-Iron Water Mains and their Appurtances*

C. AWWA C605: *Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings*

D. AWWA C900: *Pressure Pipe and Fabricated Fittings (4" through 12") for Water Distribution*

E. City of Wilson *Backflow Prevention and Cross Connection Control Ordinance*

F. City of Wilson *Pre-Approved Material/Product List*

G. City of Wilson *Right-of-Way Regulations and Procedures*, latest edition

H. North Carolina State Building Code: Plumbing Code, latest Edition

I. Section 00825 PRODUCT SUBSTITUTION

J. Section 02275 – TRENCHING, BACKFILLING AND COMPACTION OF UTILITIES.

K. Uni-Bell Handbook, Latest Edition

L. UNI-B-8: *Recommended Practice for Direct Tapping of PVC Pressure Pipe (Nominal Diameters 6-12 inch)*

M. UNI-PUB-8: *Tapping Guide for AWWA C900 Pressure Pipe*

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 City as specified within this and other sections of this manual.

A. **City Engineer**: The City Engineer or his or her authorized representative.

B. **City**: Refers to the City of Wilson.

C. **Contractor**: Refers to a Contractor licensed in the State of North Carolina to perform public utility construction.

D. **Easement**: An instrument that depicts/describes and conveys rights and privileges to the City for the placement, access to and maintenance of a utility line across and/or on the property of a second party. Ownership of the land remains with the second party.

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

F. **Shall**: Means a mandatory requirement.

G. **Water Distribution ORC**: The City's "Operator in Responsible Charge" over the City of Wilson's water distribution system in the Water Resources Division.

H. **Water Distribution/Wastewater Collection Manager**: The City's Water Distribution/Wastewater Collection Manager, Water Distribution ORC or their authorized representative.

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

J. **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. **PVC**: Polyvinyl Chloride
E. **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) 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,
h. Seal of the testing agency that verified the suitability of the pipe and the materials for potable water or fire prevention (NSF, FM),
i. UL approval indicated by a green UL sticker applied to pipe.

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 within this specification. The use of ASTM standard specification references without a year designation implies the most current applicable specification.

B. Standard Abbreviations:

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
FDA	Food and Drug Administration
FM	Factory Mutual System
FS	Federal Specifications
MSDS	Material Safety Data Sheets
NCDENR	North Carolina Department of Environment and Natural Resources

NCDOT	North Carolina Department of Transportation
NSF	National Sanitation Federation International
NFPA	National Fire Protection Association
ORC	System **"**Operator in Responsible Charge"
OSHA	Occupational Safety and Health Administration
UL	Underwriters Laboratories, Inc.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

Materials used for the construction of water mains and appurtenances in the City's water distribution system shall be new, free of defects, and meet the highest standards set forth. An authorized City representative must inspect, review, and approve all materials to be used for water lines and appurtenances prior to installation. At the option of the City, any material installed without inspection will have to be sufficiently removed for inspection and review. Any additions, deletions, or changes from the City approved plan set must be submitted to City 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 City Engineer or Water Resources will approve materials not specified but deemed equal, on a case-by-case basis. The City's Product and Design Review Committee (PDRC) meets monthly or on an "as-needed" basis to evaluate new products for incorporation into these specifications. If submitting new products, submit in accordance with Section 00825 *Product Substitution*. New materials approved for the water distribution system will be incorporated into these specifications after approval by the PDRC.

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 ABOVE 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 or barriers 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 either DIP or PVC meeting these specifications.

D. **WATER MAINS CROSSING BELOW 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 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 existing 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 12-inch vertical separation shall be maintained between the lines. When local conditions prevent a 12-inch vertical separation, the following construction shall apply:

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

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 sewer manholes provided that the applicable provisions of paragraph B, *Parallel Installations, Unusual Conditions*, above, are also met.

G. **SANITARY SEWER AND WATER SERVICES**: The separation requirements for water and sewer services 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 separated by 5 feet of undisturbed or compacted earth.

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 the City of Wilson Backflow Prevention Cross Connection Control Ordinance (Section 44-30 of the City Code) latest adoption as applicable. See paragraph 2.2.3 for Backflow Preventers device specifications.

1.11 SERVICE INTERRUPTION

Contact the City of Wilson 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 City Engineer and Water Resources, 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 City Engineer and Water Resources. Except as needed for fire suppression purposes, the City of Wilson will be the sole operator of all valves and hydrants on the City's water distribution system. Adequate notification 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 City Engineer and Water Resources shall be notified of the specific valves closed at the earliest reasonable time following such valve closure.

   Before shutting off any main, Contractor shall be responsible for notifying residents in writing at least **48** hours in advance of cut off. For City force projects, the City shall notify residents. The City shall be notified at least **48** hours 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.

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 City 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 City of Wilson requires adherence to the following procedures prior to shutting off water service on any existing City line:

1) The Contractor must receive approval for shut-off from the City 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 BRASS PIPE

Brass Pipe shall meet ASTM B43 *Standard Specification for Seamless Red Brass Pipe, Standard Sizes*, schedule 40 or 80, with ANSI B1.20.1 pipe threads.

2.1.2 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.

2.1.3 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) 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 City upon request. All certified tests, hydrostatic and material are to be performed by an independent testing laboratory at the expense of the pipe manufacturer.

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 City'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 and AWWA C111/ANSI A21.11.

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 2.1.3.B.3 for specific specs on restraint system and 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 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 City's Engineer.

B. **Ductile Iron Fittings**

Fittings shall be ductile iron, grade 70-50-05, and shall conform to AWWA C110/ANSI A21.10 *Standard for Ductile-Iron and Gray-Iron Fittings* or AWWA C153/ANSI 21.53 *American National Standard for Ductile-Iron Compact Fittings for Water Service*, 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 *Standard for Cement–Mortar Lining for Ductile-Iron Pipe and Fittings*. The fittings shall be tested and the manufacturer shall provide certified test results when requested by City. This testing shall include hydrostatic proof testing of fittings. Glands, gaskets, and bolts shall conform to AWWA C111/ANSI A 21.11 *Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings*. The use of push on fittings is not permitted. Acceptable manufacturers are: American Cast Iron Pipe Company, Griffin Pipe Company, 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 350 for pipes sizes 4 through 24 inches, class 250 for pipe sizes 30 through 48 inches, 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 for pipes sizes 4 through 24 inches, class 250 for pipe sizes 30 through 48 inches, 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 512.07** for a common application of the restraint system.

See Pre-Approved Product List for acceptable manufacturers and models of mechanical joint restraint systems.

2.1.4 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, manufactured from compounds conforming to PVC 1120 material with a cell classification of 12454-B as defined in ASTM D1784 *Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds*, Pressure Class 150, DR 18. Pipe 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 (see table below). Pipe joints shall include elastomeric gaskets and shall be integral bell type coupling. The integral bell coupler shall meet the requirements of ASTM D3139 *Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals* and utilizes the gasket sealing system meeting the specification defined in ASTM F477 *Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe*. Lubricant and gaskets are to be supplied with the pipe by the manufacturer of the pipe.

The minimum pipe stiffness shall be 364 psi.

In accordance with ASTM D1599, *Standard Test Method for Resistance to Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings,* a minimum pipe burst of 755 psi shall be withstood without failure.

The pipe must be able to withstand an impact of 100 foot-pounds without visible evidence of shattering or splitting as specified in ASTM D2444, *Standard Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight*).

C900 pipe shall be used with ductile iron fittings (restrained joint).

Nominal Size (in)	Pipe OD (in)	Min Wall Thickness (in)
6	6.900	.383
8	9.050	.503
10	11.100	.617
12	13.200	.733

Fusible C900 pipe, used for directional drilling, shall only be used with written approval from the City Engineer. See paragraph 3.1.6, below.

2.1.5 HIGH DENSITY POLYETHYLENE WATER PIPE FOR HORIZONTAL DIRECTIONAL DRILLING (HDD) APPLICATIONS

A. All polyethylene pipe, tubing, and fittings shall conform to all applicable provisions and requirements of the latest revision of AWWA C906 (*4" through 8"*), CSA B137.1, and/or ASTM F714 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 PE34 with a minimum cell classification of PE 345464C for PE3408/PE3608 materials, as defined in ASTM D3350. In conformance with AWWA C906, CSA B137.1, and/or ASTM F714 they shall have a PPI recommended Hydrostatic Design Basis (HDB) of 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 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 City or their representative. Qualified manufacturers shall be verified by the Project Engineer.

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, 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 C906 or CSA B137.1; PPI-PE3408. 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. Certifications by Factory Mutual System approvals (FM) and National Sanitation Foundation (NSF). In all cases, the specifications and requirements of the fittings supplied shall comply with the appropriate section of AWWA C906 or CSA B137.1. The pipe manufacturer shall supply all fittings and adapters.

Joints shall be heat fusion per ASTM 2657 and per manufacturer's written instructions.

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. The minimum shall be Class 150, pressure rating 150 for pipe 4-inch through 8-inch.

H. **Marking**

Pipe and tubing shall be marked in accordance with either of 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.

J. **Drilling Fluid**

Bentonite drilling mud compatible with the environment shall be used unless otherwise approved by the City Engineer. Waste oil or environmentally non-compatible polymers cannot be part of composition.

2.1.6 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, City, 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**: See Pre-Approved Product List for acceptable spider/skid manufacturers and models. Also see paragraph 3.1.3A and **Standard Detail C07.03** for location of spiders. For bolted connections, bolts, and nuts shall be 304 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. See Pre-Approved Product List for acceptable casing end seal manufacturers and model number; information located under Sanitary Sewer section.

2.1.7 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 Association (AREA) Manual for Railway

Engineering, latest revision and AASHTO *Standard Specification for Highway and Bridges*, latest edition. 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.

2.1.8 CARRIER PIPE FOR CASINGS AND TUNNELS

Carrier pipe shall be mechanical joint or restrained joint ductile iron pipe of the class indicated on the drawings but no less than pressure class 250 psi (minimum thickness class 50). See paragraph 2.1.3, Ductile Iron Pipe.

2.2 VALVES AND FIRE HYDRANTS

2.2.1 AIR RELEASE VALVE

Air release valves shall be 2-inch Pressure Air Release Valves with cast iron bodies, ASTM A240 *Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications*, type 302 stainless steel floats, bronze trim and buna-n seats. Air release cast iron bodies shall conform to ASTM A48 *Specification for Gray Iron Castings,* Class 35 and/or ASTM A126*, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings*, as applicable. Air release valves shall also meet AWWA *C512 AWWA Standard for Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service*. 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.

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 flat top, eccentric precast reinforced cones are to be used. However, the use of an eccentric cone must first be approved by the City Engineer or Water Resources. See **Standard Detail 516.01**.

See Pre-Approved Product List for acceptable air release valve manufacturers and models.

2.2.2 ANGLE VALVES

Angle valves must comply with AWWA C800 *Underground Service Line Valves and Fittings* as manufactured by Ford for 1-inch through 2-inch services, 300-psi minimum working pressure. Angle valves must be a ball type valve and must be accessible for operation from the surface of the ground for routine interruption of flow through the service line. See **Standard Details 515.01, 515.02** and **515.03**.

See Pre-Approved Product List for acceptable angle valve manufacturers and models.

2.2.3 BACKFLOW PREVENTERS:

A. **Double Check Detector Valve Assemblies:** Heavy duty double check detector valve assemblies shall conform to the requirements of these specifications with a

minimum working pressure of 175-psi. Assemblies shall meet the basic requirements of ASSE 1048 and AWWA Standard C510 for Double Check Valves. Double check detector valve assemblies shall be approved by the *Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California,* be listed by *Underwriters Laboratories, Inc*., and approved by *Associated Factory Mutual*. The unit shall be a complete assembly including UL Listed shut off valves and ball type test cocks. The bypass line shall consist of an approved backflow preventer equal to the fire line assembly and the water meter on the bypass meeting these specifications. The bypass meter on double check detector valve assemblies 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.

Provide bolted cover with air-bleed device for access to internal parts. All parts must be replaceable without having to remove the device from the line. All internal metal parts shall be either bronze or stainless steel. Include threaded bypass taps in inlet and outlet for bypass meter connection.

Double check valve assemblies shall be approved for installation in the horizontal position with an external arrow cast into the body indicating the direction of flow during system operation.

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

1) **Test Cocks**: All assemblies shall be equipped with 4 test cocks located as required by the *Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California*. All test cocks shall be the lever-type bronze ball valves or bronze ball valves with raised slotted operating stems. All test cocks shall be of a resilient seated design. The number 1 test cock shall be a required part of the assembly upstream of the number 1 shut off valve of an approved assembly.

2) **¾" to 2" Double Check Detector Valve Assemblies**: Devices shall have bronze body or stainless steel bodies and bonnets. Valves shall be resilient seat full port, line size, lever type, ¼ turn bronze ball valves with a blowout proof stem with a pressure rating of 400-psi (water, oil, or gas).

3) **2 ½" to 10" Double Check Detector Valve Assemblies**: Devices shall have bronze, stainless steel, or epoxy coated ductile iron bodies and bonnets. Valves shall have flanged, hand-wheel operated, resilient wedged gate valves that open left, close right. Double check detector valve assemblies shall have flanged ends complying with the dimensional requirements of ANSI B16.1. Double check detector valve assemblies for fire line applications shall have flanged OS&Y operated gate valves on the main line and ball valves on the bypass line. Unless valves are bronze or stainless steel, the interior and exterior surfaces of all large body cast iron valves shall be coated with 5 to 10 mils of a fusion bonded epoxy coating. Epoxy coatings shall comply with AWWA *C550 Protective Epoxy Interior Coating for Valves and Hydrants*.

If special tools or devices are required to repair or maintain an assembly, they shall be supplied to the City by the manufacturer at no extra cost to the City.

B. **Double Check Valve Assemblies:** Heavy duty double check valve assemblies shall conform to the requirements of these specifications with a minimum working pressure of 175-psi. Assemblies shall meet the basic requirements of ASSE 1015 and AWWA Standard C510 for Double Check Valves. Double check valve assemblies shall be approved by the *Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California,* be listed by *Underwriters Laboratories, Inc*., and approved by *Associated Factory Mutual*. The unit shall be a complete assembly including UL Listed shut off valves and ball type test cocks.

Each assembly shall consist of two positive seating tight closing check modules with captured springs and rubber seat discs. The check modules seat and seat disc shall be replaceable. Provide bolted cover with air-bleed device for access to internal parts. All parts must be replaceable without having to remove the device from the line. All internal metal parts shall be either bronze or stainless steel.

Double check valve assemblies shall be approved for installation in the horizontal position with an external arrow cast into the body indicating the direction of flow during system operation.

1) **Test Cocks**: All assemblies shall be equipped with 4 test cocks located as required by the *Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California*. All test cocks shall be the lever-type bronze ball valves or bronze ball valves with raised slotted operating stems. All test cocks shall be of a resilient seated design. The number 1 test cock shall be a required part of the assembly upstream of the number 1 shut off valve of an approved assembly.

2) **¾" to 2" Double Check Valve Assemblies**: Devices shall have bronze body or stainless steel bodies and bonnets. Valves shall be resilient seat full port, line size, lever type, ¼ turn bronze ball valves with a blowout-proof stem with a pressure rating of 400-psi (water, oil, or gas).

3) **2 ½" to 10" Double Check Valve Assemblies**: Devices shall have bronze, stainless steel, or epoxy coated ductile iron bodies and bonnets. Valves shall have flanged, hand-wheel operated, resilient wedged gate valves that open left, close right. Double check valve assemblies shall have flanged ends complying with the dimensional requirements of ANSI B16.1. Unless valves are bronze or stainless steel, the interior and exterior surfaces of all large body cast iron valves shall be coated with 5 to 10 mils of a fusion bonded epoxy coating. Epoxy coatings shall comply with AWWA C550 *Protective Epoxy Interior Coating for Valves and Hydrants*.

If special tools or devices are required to repair or maintain an assembly, they shall be supplied to the City by the manufacturer at no extra cost to the City.

C. **RPZ (Reduced Pressure Zone) Assemblies**

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.

The reduced pressure backflow preventer shall consist of two independently operating, spring loaded, "Y" pattern check valves, and one hydraulically dependent differential relief valve.

Operation:
In a nonflow condition, check valves on the by-pass and mainline units are closed with pressure between the checks, called the relief valve 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.

1) **3/4" to 2" RPZ Assemblies**:

The assembly shall meet the requirements of ASSE Standard 1013; AWWA Standard Code C511; 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. The assembly shall be rated for minimum 175 PSI water working pressure and water temperature range from 32°F to 140°F.

Valve body and caps including relief valve body and cover shall be bronze or stainless steel. 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 valves shall be resilient seat full port, line size, lever type, ¼ turn bronzes ball valves with blowout-proof stem with a pressure rating of 400-psi (water, oil, or gas).

If special tools or devices are required to repair or maintain an assembly, they shall be supplied to the City by the manufacturer at no extra cost to the City.

2) **2 ½" to 10" RPZ Assemblies:**

The assembly shall meet the requirements of ASSE Standard 1013; AWWA Standard Code C511; CSA Standard B64.5; and approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California, UL Listed and FM approved. RPZ backflow preventers shall conform to the requirements of these specifications suitable for supply pressures of 175-psi and water temperatures of 110°F.

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. Unless valves are bronze or stainless steel, the interior and exterior surfaces of all large body cast iron valves shall be coated with 5 to 10 mils of a fusion bonded epoxy coating. Epoxy coatings shall comply with AWWA C550 *Protective Epoxy Interior Coating for Valves and Hydrants*.

RPZ's are to be furnished with flanged hand-wheel operated OS&Y gate valve shutoffs. Valves shall have resilient wedged gate valves that open left, close right. RPZ assemblies and valves shall have flanged ends complying 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.

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

RPZ assemblies shall be approved for installation in the horizontal position with an external arrow cast into the body indicating the direction of flow during system operation.

By-pass meter: 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 fire line service.

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 City or Wilson specifications as noted elsewhere in these specifications.

If special tools or devices are required to repair or maintain an assembly, they shall be supplied to the City by the manufacturer at no extra cost to the City.

4) **RPZ Test Cocks**: All assemblies shall be equipped with 4 test cocks located as required by the *Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California*. All test cocks shall be the lever-type bronze ball valves or bronze ball valves with raised slotted operating stems. All test cocks shall be of a resilient seated design. The number 1 test cock shall be a required part of the assembly upstream of the number 1 shut off valve of an approved assembly.

2.2.4 CURB VALVES

Curb valves must comply with AWWA C800 *Underground Service Line Valves and Fittings* as manufactured by Ford for 1-inch through 2-inch services, 300 psi minimum working pressure. Curb valves must be a full port opening and a ball

type valve. Ball valves must be accessible for operation from the surface of the ground for routine interruption of flow through the service line. See **Standard Details 515.01, 515.02** and **515.03**.

See Pre-Approved Product List for acceptable curb valve manufacturers and models.

2.2.5 BALL VALVES: ¼ TURN STAINLESS STEEL BALL VALVES

One-quarter (1/4) 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 (water, oil, or gas). 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**.

2.2.6 GATE VALVES

A. **Gate Valves, Ductile Iron Resilient Wedge (4 inches through 30 inches)**: All gate valves shall be iron body of the resilient wedge type complying with AWWA C509 *Resilient-Seated Gate valves for Water Supply Service* and shall be UL listed and FM approved for a working pressure of 200-/250-psi and hydrostatically tested at twice the working pressure (400-/500-psi) to the requirements of both AWWA and UL/FM. 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 *Protective Epoxy Interior Coatings for Valves and Hydrants* and shall be certified to NSF 61.

The valve body and bonnet shall be coated interior and exterior with fusion bonded thermosetting plastic or epoxy meeting ASTM D429 *Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates,* AWWA C550 *Protective Epoxy Interior Coatings for Valves and Hydrants* and shall be certified to NSF 61. Interior coating material shall be formulated from materials deemed acceptable in the FDA document, Title 21, *Food and Drugs*, Chapter 1, Subchapter B, Part 175.300 *Resinous and Polymeric Coati*ngs (latest revision). Coatings shall not contain coal tar. Minimum thickness of interior and exterior coating shall be 5 to 10 mils.

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.

NRS for 16-inch and larger valves: 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 to 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.

All gate valves 4 through 30 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 clockwise (right) and shall be equipped with a 2-inch square AWWA operating nut.

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

B. **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.

See Pre-Approved Product List for acceptable gate valve manufacturers.

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. Stainless steel bolt and nut threads to be NC threads, fluorocarbon coated with Nylatron GS self-lubricating washers. The sleeve and gasket shall provide full wrap-around (360 degree) pipe coverage, 150-psi maximum working pressure/maximum 200-psi test pressure. Sleeve to be provided with a full gasket of gridded virgin GBR compounded for water service per ASTM D2000-80M4AA607 *Standard Classification System for Rubber Products in Automotive Applications*.

18-8 stainless steel flange to have recessed edge to be able to accept the standard tapping valves. A carbon steel flange is not acceptable. Flange must conform to AWWA C207 *AWWA Standard for Steel Pipe Flanges for Waterworks Service—Sizes 4 In. Through 144 In.*, class D, ANSI 150 lb (ANSI B16.5) drilling. Test plug to be 18-8 stainless steel ¾" with standard square head. Gasket to be gridded virgin GPR compound for water service.
Outlet gasket to be gridded virgin Buna-N compounded for water service per ASTM D2000.

See **Standard Detail 513.02**.

Tapping Valves: Resilient seat iron body tapping valves shall be epoxy coated (minimum 5-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. Tapping valves without the raised lip on the tapping flange side are not permitted. Valve ends shall be mechanical joint by flange. Valves shall open clockwise (right) 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).

See Pre-Approved Product List for acceptable tapping sleeve and valve manufacturers and models.

2.2.8 FIRE HYDRANTS

Fire hydrants shall comply with ANSI/AWWA C502 *Dry-Barrel Fire Hydrants*, latest revision, UL 246 and Factory Mutual 1510. Hydrants shall be hub end, triple nozzle, improved AWWA type. Interior coating to be in accordance with AWWA C550. Minimum working pressure shall be 200-psi. Hydrants shall consist of the following:

1) Hydrants shall be of the compression type closing with line pressure and shall be of the traffic model breakaway type (breakaway coupling designed to fracture when the hydrant is impacted). The breakaway coupling shall be made of either cast iron or a steel tube that will allow for the rotation of the upper barrel to position the nozzle in any direction without removing the breakaway coupling or shutting down the hydrant.
2) Two 2½-inch fire nozzles and one 4½-inch steamer nozzle, National Standard fire-hose coupling screw threads.
3) 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.
4) Hydrant to be dry top. 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 shall have an o-ring sealed lubrication reservoir for providing periodic lubrication of the operating threads.
5) The downward travel of the main valve assembly shall be controlled by a travel stop device that sits in the bottom of the shoe.
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) 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.
8) All O-rings that seal the main valve seat shall bear against a non-corrodible and non-abrasive metallic surface.
9) The hydrant foot valve opening shall be 5¼ inches.
10) The mains valve assembly shall include double drain outlets design to operate each time the hydrant is operated. The hydrant drain holes shall momentarily force flush with each operation.
11) All hydrants must include cast or ductile epoxy lined shoe (minimum 5 mils), rubber drain seals and positive protective valve stop device. Hydrants shall have a 6-inch mechanical joint inlet elbow.
12) The hydrant barrel shall be of sufficient length to provide a minimum bury of 4 feet.
13) All nozzles shall be provided with caps and chains.

14) All hydrant extension kits, flange kits, stems, couplings or other repair parts must be of the original hydrant manufacturer. Only two 12-inch extension kits are allowed up to a maximum of 24 inches.
15) Hydrants are to be painted with 2 coats of Sherwin Williams or approved equal paint. Public hydrant barrels are to be painted forest green with the bonnet painted fluorescent white. Hydrants within private enclosures shall be painted federal safety red.

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

See **Standard Details 514.02** and **514.03.**

See paragraph 3.2.5, Fire Hydrants for installation requirements.

See Pre-Approved Product List for acceptable fire hydrant manufacturers and models.

2.2.9 BLOW OFF - SERVICEABLE

Blow off units for mains up through 12 inches shall be a 2-inch non-freezing and self draining blow off hydrant. The bury depth of the blow off hydrant shall be specified to match the bury depth of the main being serviced by the blow off hydrant but shall not have a bury depth greater than 42 inches. Blow off hydrant shall have a 2-inch vertical FIP inlet and a 2-inch NPT nozzle outlet. The hydrant shall be operated by turning a top-mounted 9/16-inch square operating nut counterclockwise to open; clockwise to close. Hydrant must seal the drain outlet in all positions from ¼-turn open to fully open. All internal working parts, the inlet and the outlet, shall be low-lead brass. All working parts shall be serviceable from above with no digging required. All wear parts (o-rings and valve seat) shall be commonly available dimensions and materials; none may be of vendor-unique design. See **Standard Detail 514.01**.

See paragraph 3.2.6 for blow off hydrant installation requirements.

See Pre-Approved Product List for acceptable blow off hydrant manufacturers and models.

2.2.10 CORPORATION STOPS

Compression Fittings: Corporation stops for 1-inch through 2-inch taps only shall be all bronze tapered or CC tapered threaded inlet by compression copper outlet, complying with AWWA C800 *Underground Service Line Valves and Fittings* as manufactured by Ford. Corporation stops shall be full port opening with a ball type valve, 300 psi working pressure. See **Standard Details 513.04, 515.01, 515.02** and **515.03**.

See Pre-Approved Product List for acceptable corporation stop manufacturers.

2.3 MISCELLANEOUS APPURTENANCES

2.3.1 BEDDING – COARSE AGGREGATE

Coarse aggregate bedding material, when specified, shall be clean coarse aggregate No. 57 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 BEDDING – FINE AGGREGATE

Fine aggregate bedding material, when specified, shall be well graded from coarse to fine and consist of stone screenings. It shall be composed of rough surfaced and angular grains of quartz or other hard durable rock.

Stone screenings shall be so graded that no more than 20 percent by weight will pass the No. 200 sieve when tested by dry sieving in accordance with AASHTO T27, *Sieve Analysis of Fine and Coarse Aggregates*.

Stone screenings shall be produced from stone which has a maximum percentage of wear of 55 percent when tested in accordance with AASHTO T96 using test grading A.

When subjected to 5 cycles of the soundness test, the weighted average loss shall be not more than 15 percent.

2.3.3 FLANGES COUPLING ADAPTERS

Flanged coupling adapters shall comply with AWWA/ANSI C219 *Bolted, Sleeve-Type Couplings for Plain-End Pipe* and NSF 61 listed, minimum 150-psi working pressure. Cast iron flanges shall comply with ASTM A536 and delivered coated with a factory applied fusion bonded epoxy coating.

The flanged coupling adapter shall have a follower flange and body that is made of cast iron per ASTM A536. The follower flanges shall be color coded to identify the general type of pipe the flange is to fit (blue for ductile iron, red for IP sizes).

The mating flange shall have a bolt circle, bolt size and spacing to AWWA C207 class D, ANSI 150 pound flange drilling dimensions.

The coupling gasket and O-ring mating flange gasket shall be Nitrile (Buna-N) NSF 61 listed, compounded to resist water, oil, acids, and alkalies. The temperature range of the gasket shall be -20ºF to +180ºF.

The gaskets shall have the color of follower flange it is compatible with molded into it.

Bolts and nuts to be 304 stainless steel.

See Pre-Approved Product List for acceptable coupling manufacturers.

2.3.4 HYDRAULIC CEMENT

Hydraulic cement shall meet the requirements of ASTM C465, *Standard Specification for Processing Additions for Use in the Manufacture of Hydraulic Cements*, ASTM C595, *Standard Specification for Blended Hydraulic Cements and* ASTM C1157, *Standard Performance Specification for Hydraulic Cement,* as applicable.

2.3.5 MANHOLE FRAME AND COVERS

A. 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 Specification for Drainage, Sewer, Utility, and Related Castings*. 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 21 13/16 inches. Manholes castings are to be uncoated. The bearing surface of the frames and covers shall be machined and the cover shall seat firmly into the frame without rocking. Covers are to be embossed along the perimeter with the name "CITY OF WILSON." Cover shall read "WATER" in the center and "Confined Space".

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

B. **Cast Iron Riser Rings** (for non-watertight applications): Manhole riser rings 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. Rings shall be uncoated and provided in 1-inch, 1 ½-inch and 2-inch heights. Placement of rings in combination is not acceptable. A ring must bed/nest in the original frame and not in another ring. See **Standard Detail C06.04**.

B. See Pre-Approved Product List for acceptable casting manufacturers and models.

2.3.6 MISCELLANEOUS CONCRETE WORK

Concrete class (NCDOT) correlation 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 valve box stabilizing pads, thrust collars and concrete encasement. All exposed concrete shall be air entrained.

2.3.7 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 *Standard Specification for Precast Reinforced Concrete Manhole Sections* (gasketed joints). The standard joint shall be sealed with hydraulic cement both on the inside and outside of the riser joints. 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 eccentric flat top as applicable. See **Standard Detail 516.01**. Structures are not permitted to have steps.

See Pre-Approved Product List for acceptable casting manufacturers.

2.3.8 PREFORMED PLASTIC GASKETS (JOINT SEALER)

Preformed plastic gaskets shall meet Federal Specification SS-S-00210-A *Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints*, Type 1, Rope Form or Type 2, Flat Type. Sag or flow resistance and chemical resistance shall meet ASTM C990 *Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants*. Preformed butyl gaskets shall be used with structures meeting ASTM C478, ASTM C990 and AASHTO M198. Minimum rope diameter to be 3/4-inch or as required for the size structure.

See Pre-Approved Product List for acceptable joint sealer manufacturers.

2.3.9 PIPE SADDLE SUPPORT - ADJUSTABLE

Adjustable Pipe Saddle Support - For Dry Conditions 3-inch through 36-inch pipe: Material to be cast iron or aluminum 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).

See Pre-Approved Product List for acceptable pipe saddle support manufacturers and models.

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.

See Pre-Approved Product List for acceptable pipe saddle support manufacturers and models.

2.3.10 SERVICES

A. **Small Services: 1-inch Water Services**:

Type K Copper, soft drawn; comply with ASTM B88, *Standard Specification for Seamless Copper Water Tube*, FS WW-T-799 (2-inch and smaller pipe). Services shall be 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 C800, compression copper type fittings. See **Standard Details 515.01** and **515.02** and paragraphs 2.2.2 Angle Valves, 2.2.4 Curb Valves and 2.10 Corporation Stops.

Taps shall be made with a service saddle.

Service Saddles (required on all service taps**)**: Saddles 1-inch or greater shall be all bronze saddle with a double bronze strap and a grade 60 neoprene "O" ring gasket attached to the body complying with AWWA C800 *Underground Service Line Valves and Fittings*. The saddle casting, straps, and nuts shall be water works bronze 85-5-5-5. The saddle shall have CC tapered threaded outlet and a seal providing a drip tight connection when used on cast iron, ductile iron, PVC, and asbestos cement pipe. See **Standard Detail 513.04**. See Pre-Approved Product List for acceptable service saddle manufacturers and models.

1-inch service: 1-inch services shall serve single family dwellings with a ¾-inch x 1-inch meter minimum. The single-family service is comprised of a bronze double strap service saddle, a 1-inch corporation stop, 1-inch type K copper tube service, and an angle valve.

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 Capitol 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 washed stone. One standard solid brick shall be placed vertically on the end of the box over the unused inlet/outlet slot. Boxes shall be set in such a manner that the top of the angle valve is 6 to 10 inches below the bottom of the meter box cover to provide adequate clearance for the meter. All meter boxes shall also be backfilled and supported outside the box with native material or, if required by the City Engineer or Water Resources, fine graded sand. The City will not set water meters until such time as meter setters and boxes are set to proper grade. Meter boxes shall **not** be installed in driveways, roads, closer than 3 feet to a fire hydrant, or in parking lots or sidewalks unless prior approval has been obtained from the City Engineer or Water Resources.

Small Meters: Displacement meters shall comply with AWWA C700 *AWWA Standard for Cold-Water Meters -- Displacement Type, Bronze Main Case.* Multi-jet meters shall comply with AWWA C708 *Cold-Water Meters - Multijet Type*. Meters shall be *Itron* Automatic Meter Reading (AMR) Encoder Receiver Transmitter (ERT) module equipped.

See Pre-Approved Product List for approved manufacturers and models.

Meter Register: Meters to be rolled-sealed register, with low flow indicator, cast bronze main case, cast bronze bottom plate, with brass or stainless steel casing bolts and bronze register box. All dials to read in cubic feet.

B. **1 ½ and 2-Inch Water Services:**

Type K Copper, soft drawn; comply with ASTM B88, *Standard Specification for Seamless Copper Water Tube*, FS WW-T-799. Water service pipe for 1 ½-inch and 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 1 ½-inch and 2-inch meter shall consist of a bronze double strap saddle (**Standard Detail 513.04**), a type K soft drawn copper service line, a corporation stop, and a meter setter and meter box. See **Standard Detail 515.03**.

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 (**Standard Detail 513.04**). The saddle casting, straps, and nuts shall be water works bronze 85-5-5-5. The saddle shall have 2-inch iron pipe threads.

See Pre-Approved Product List for acceptable service saddle manufacturers and models.

1 ½-inch and 2-inch metersetter: Metersetters shall be constructed from 85-5-5-5 Brass (AWWA C800 *Underground Service Line Valves and Fittings*) and copper tubing, and factory tested for water-tightness before shipping. The meter setter/yoke shall be comprised of all brass and copper padlock wing inlet ball valve (lockable cut-off) inlet, angled check valve outlet, by-pass line with a stop ball valve, stabilizer bars, and brace pipe eyelets for 1-inch pipe. Outlet connections are to be compression. See **Standard Detail 515.03**.

1 ½-inch and 2-inch Meters: See Small Meters.

See Pre-Approved Product List for acceptable metersetter manufacturer and model.

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 1 ½-inch and 2-inch meters. Meter boxes shall be supported by standard concrete bricks, and the blocks infilled with a minimum of 3 to 4 inches of #57 washed stone. 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 City Engineer. Meter box and meter to be provided by the City and installed by contractor. The City will not set water meters.

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 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 Enclosures: All large meter applications are to be installed in a freeze-proof enclosure. Underground vaults are not permitted. Meter installation shall have a straight pipe (spool) 5 times the diameter of the meter before and 3 times the diameter after the meter with a 2-inch test port installed between the meter and outlet valve. The meter is also to have a by-pass line the same size as the meter. A strainer shall be installed in front of the meter, between the meter and the first inlet valve. All valves to be OS&Y resilient seat wedge with rising stems. Meters must be installed 18 inches above concrete floor. Pipe entering and exiting must be ductile iron pipe.

See sheet 1 of **Standard Detail 515.04**.

Large Meters: All meters 3 inches and larger must be a compound or turbine meter. Turbo meters shall comply with AWWA C701 AWWA *Standard for Cold-Water Meters—Turbine Type, for Customer Service*. Compound meters shall comply with AWWA C702 *Cold-Water Meters-Compound Type*. Turbo meters only shall be used in irrigation applications. Meters shall be provided with strainers and shall be Itron AMR ERT equipped.

Meter Register: Meters to be rolled-sealed register, with low flow indicator, coast bronze main case, cast bronze bottom plate, with brass or stainless steel casing bolts. All dials to read in cubic feet.

See Pre-Approved Product List for acceptable meter manufacturer and model.

D. **Construction Responsibility/Duties When Making Service or Main Taps.**

The following process describes the conventional process for making service taps on existing lines:

1. 1-inch, 1 ½-inch and 2-inch Taps: Upon payment of a fee, the City of Wilson will make the tap.

2. Taps 4-inches and larger:
   a. The Contractor excavates to expose the line.
   b. The Contractor provides all materials and places tapping sleeve and valve on all existing mains. City of Wilson makes tap and tests.
   c. The City makes the tap and invoices the Contractor for labor, equipment and a tap fee.
   d. The Contractor backfills, compacts and closes trench; replacing pavement if applicable.

2.3.11 VALVE BOXES

A. **Valve Boxes**: Adjustable valve boxes shall be manufactured from iron conforming to ASTM A48, Class 35B as noted in section 3.1 of AASHTO M 306 *Standard Specification for Drainage, Sewer, Utility, and Related Castings*. Valve box dimensions shall conform to **Standard Detail 513.01** *(Standard Screw Valve Box 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.

B. **Cast Iron Riser Rings**: Valve box adjusting rings 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. Valve box adjusting rings shall be provided in 1-inch, 2-inch, and 3-inch heights. Placement of rings in combination is not acceptable. A ring must bed/nest in the original frame and not in another ring. See **Standard Detail C06.05**.

See Pre-Approved Product List for acceptable valve box and adjusting ring manufacturer and model.

2.3.12 WARNING TAPE, LOCATOR WIRE, BALL MARKERS

A. **Ball Markers for PVC Pipeline Paths and Tees**: Ball marker shells shall be constructed of high-density, watertight polyethylene that is impervious to minerals, chemical and temperature extremes normally found in underground environments. Ball marker contents shall be a mixture of propylene glycol and water. The mixture shall be biodegradable and harmless to humans, wildlife and the environment.

Ball markers shall be specifically designed such that when detected by an electronic locator they are identified as a “water” ball marker.

See Pre-Approved Product List for acceptable ball marker manufacturer and model number.

B. **Locator Wire**: Size 12 gauge insulated single-strand solid or multi-strand copper wire shall be installed above all non-ferrous water mains and force mains; attached every 5 feet to the water main with zip ties. 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 Detail 511.01**.

C. **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 (ANSI Z535.1 Safety Colors) 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 above the top of the pipe. See **Standard Detail 511.01**.

Standard color code for tape and wire:

Blue: Water Systems
Green: Sewer Force Mains

See Pre-Approved Product List for acceptable underground warning tape manufacturers.

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**: DIP 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.

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

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 a 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 C01.01** and paragraph 3.2.5 F – *Cushioning Pipe in Rock*, of Section 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.

Cutting 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°/260
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 12 inches and smaller. Mains 16 inches and larger 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 City Engineer or Water Resources is required. See Table 02275.1 of section 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 sides 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) **Installation of Mechanical Joint Restraint Systems**

i. Comply with the requirements of AWWA C600 *Standard for Installation of Ductile-Iron Water Mains and their Appurtenances*.

ii. The mechanical joint restraint system is intended for use on ductile iron pipe conforming to ANSI/AWWA C151/A21.51. Mechanical joint restraint systems are not to be used on PVC unless the joint restraint system is designed for PVC pipe.

iii. In cold weather, the gasket should be warmed to facilitate assembly of the joint.

iv. Unless otherwise required by Restraint System manufacture, bolts are to be torqued in accordance with the requirements of the restraint system manufacturer using a torque-indicating wrench.

d) **Installing Slip 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 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.

For cuts made on City maintained streets, refer to the City of Wilson *Backfilling Compaction, & Patching Policy* as well as Standard **Detail C01.03**. If the cut is on an NCDOT roadway, the applicable NCDOT standard pavement repair details pavement width and patching requirements shall apply.

Driveway crossings shall be completed within 48 hours after the initial cutting of the pavement.

Concrete Pavement: If a section of pavement is to be removed, and the cut is within 2 feet of an existing control or expansion joint, remove the concrete to the nearest control joint or expansion joint. Replace concrete pavement with a thickness of at least 1-inch greater than the thickness of the original section removed. All replaced concrete, expansion joints, or reinforcing (if any) shall meet the applicable requirements of the Manual of Specification Standards, and Design. Where the pavement exhibits signs of significant distress in the form of extensive cracks, notify the City Engineer for directions and/or guidance on the extent of concrete pavement removal and repair.

C. **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.

D. **Connections to Existing Mains**

The Contractor shall furnish all materials for connection to existing water mains. City shall be the sole operator of all valves and fire hydrants except in emergency cases followed by notification of City Engineer and Water Resources.

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 is responsible for notification distribution. City shall be notified at least 1 week in advance of request for making a wet tap or cut-in.

E. **Removal of Asbestos Cement Pipe**

The contractor is hereby advised that some of the pipe within the City 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 City.

F. **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.

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. City 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.

G. **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 section 02275 – *Trenching, Backfilling, and Compaction of Utilities*.

H. **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 City Engineer or Water Resources.

Services: When abandoning services 2-inch or less in diameter, the service shall be cut 1-foot from main. The saddle and corporation stop shall be removed and replaced with a repair clamp.

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 or the tee or tapping sleeve can be removed. Location of abandonment shall be approved by a City Engineer or Water Resources.

3.1.2 C900 PVC PIPE

A. **Use of PVC Water Pipe**: PVC water pipe shall only be used with 12-inch or smaller pipe.

B. **PVC Pipe Installation**

1) **Trenching & Bedding**: Refer to section 02275, *Trenching, Backfilling, and Compaction of Utilities* except no stone bedding is to be used beneath PVC water pipe.

2) **Installation of PVC Water Mains**: Comply with AWWA C605, *Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for* Water and the *Uni-bell Handbook of PVC Pipe*, latest edition. Tapping of PVC pressure pipe shall be in strict accordance with *AWWA C605, UNI-B-8 and UNI-PUMB-8.*

Unless directed otherwise by the City Engineer, C900 PVC water pipe bedding shall be Type 4 minimum (see **Standard Detail 511.02**). Pipe subgrade and bedding is to be prepared per paragraph 3.1.1.B except that AWWA C605 shall apply where reference is made to AWWA C600 in paragraph 3.1.1.B.

Remove any mud, sand, or other foreign matter from the bell and spigot ends of the pipe. Carefully clean the gasket area.

With a clean applicator (brush or hand) lubricate the entire surface of the pipe from the spigot end to the depth of entry mark and contact surface of the gasket with lubricant.

Brace the bell to avoid disturbing the already installed joints. Align the pipe, insert the spigot into the bell and push until the entry mark is reached. Do not insert past the entry mark line.

3) **Locator Tape, Wire and Locator Balls:** When installing PVC C900 pipe, a metallic locator tape is to be installed over the center line at 12 to 18 inches above the top of water main. A tracer wire shall also be placed on top of the pipe, tied to the pipe at 5-foot intervals with zip ties, with the terminal ends of the wire located at valves for accessibility. When directed by the City Engineer or Water Resources a locator ball may be required to be placed. See **Standard Detail 511.01** and paragraph 2.3.12 for detectable tape and tracer wire specifications.

4) **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.

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

3.1.3 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 C07.03**. Boring across roads and railways shall be performed by dry boring and jacking a steel encasement pipe under the pavement or rail. The encasement shall be located in an area that is relatively free from material such as rock and stone that may hamper the boring operation. If requested by the City Engineer, the Contractor shall submit a complete plan and schedule for pipe installation prior to the commencement of such work. The submission shall include complete details of the sheeting, shoring and bracing for the protection of the roadbed and the materials and equipment pertinent to the boring operation. The Contractor shall not proceed with the pipe installation until he has received approval of the plan and schedule from the City Engineer.

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

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

The pipe shall be 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 ANSI/AWS D1.1 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 using pull-on flexible end seals and stainless steel bands as shown on **Standard Detail C07.03** or enclosed using brick and mortar. 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 2.1.6 B, Spiders/Skids for Encasement Pipes*. Unless otherwise shown on the drawings, one spider shall be placed at each bell end, one at each spigot end, and one at centered between the two pipe ends (3 spiders per joint) of the carrier pipe. A spider is also required at each end of the encasement pipe (see **Standard Detail C07.03** for location of spiders). Spiders are to be bolted together using stainless steel bolts and nuts.

See Pre-Approved Product List for acceptable spider/skid manufacturers and models.

3.1.4 TUNNELING METHOD

A. **GENERAL**:

1) The contractor shall submit shop drawings to City 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, at an approved location, 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) Trim the periphery of the tunnel smoothly to fit the outside of the steel liner plate as nearly as practical. All blasting shall conform to requirements for blasting in *Section 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. Start grouting at the bottom of the tunnel liner plates and proceed upward progressively and simultaneously on both sides of the tunnel. Install liner plates no more than 6 feet ahead of grout section. Prohibit traffic over ungrouted sections of tunnel unless this section is in solid rock. Thoroughly dry-mix grout ingredients before adding water. After adding water, mix the batch for 3 minutes. Batches shall be of size to allow continuous placement of freshly mixed grout. Grout not used within 30 minutes after mixing shall be discarded. Placing shall be quick and continuous. Placement shall be under pressure with a grout pump. The period between installation of the tunnel liner plate and the placing of grout shall not exceed 7 hours, without the approval of the City. 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' of liner plate,
   ii. At more frequent intervals than 6' 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 three 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 or to daylight 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 City or NCDOT if installation is under roadway.

D. See also **PART 2 – PRODUCTS**, Section 2.1.7, "*Tunnel Liners and Appurtenances.*"

3.1.5 HORIZONTAL DIRECTIONAL DRILLING (HDD) 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 City Engineer, which outlines guidelines for handling, joining, installing, embedding, and testing of the

Polyethylene Pipeline. These guidelines shall be used as reference material by City's Engineer or Water Resources in their 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 City Engineer or Water Resources before ordering material or beginning installation of the HDPE. Contractor shall also submit to City Engineer or Water Resources proposed subcontractor's name as well as references on who he/she plans to use on this project. All subcontractors/installers must be approved by City Engineer or Water Resources.

3.1.6 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 City Engineer.

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 City 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 City 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 pipe 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 City of Wilson specifications.

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 City Engineer or Water Resources before ordering material or beginning installation of the Fusible C900 pipe. Contractor shall also submit to the City Engineer or Water Resources proposed Subcontractor's name as well as references on who he/she plans to use on this project. All subcontractors/installers must be approved by the City Engineer or Water Resources.

3.2 VALVES AND FIRE HYDRANTS

A. **Valve Applications**

Above Ground Vault Applications		
Use	**Size**	**Type**
Valves	2-inch and smaller	¼-turn Stainless Steel Ball Valve
	3-inch and larger	OS&Y, NRS
Relief Valves	1- and 2-inch	Air/Vacuum Release Valves
Regulating	All	Pressure-regulating Valves, Flow-regulating valves
Detecting Unauthorized Water Usage	All	Double Detector Check Valves
Backflow Prevention	All	USC approved RPZ and Double Check Valve Assemblies (UL/FM rated)
Below Ground		
Use	**Size**	**Type**
Isolation Valves	All	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 will be required on 16-inch and larger mains unless, at the discretion of the City Engineer or Water Resources, excepted otherwise.

Valves must match line size.

B. **Setting Valve Boxes**: 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 centered plumb over the operating nut of the valve. The valve must be set so that it does not transmit shock from traffic or stress to the valve.

Valve boxes set on blow offs 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. See example in **Standard Detail 514.03**.

Valve box cover must be set flush with the finished ground surface or pavement. All valve boxes installed in the shoulder of the road in rough terrain must have a precast concrete collar set around the valve box (see **Standard Detail 516.02**).

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 City Engineer. As shown on the drawings, the Contractor shall construct a concrete pad set flush with grade and top of the box in a 12 inch thick x 2’ x 2’ concrete stabilizing pad placed around the valve box in

paved areas. No extra payment will be made for this item. Valve boxes placed in unpaved areas shall be provided with a precast shoulder slab "donut" (**Standard Detail 516.02**).

D. **Valve Box Removal:** When shown on the drawings or directed by the City 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 Division of Water Resources.

3.2.2 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 City. 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 City of Wilson 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 the tapping sleeve and valve and all other materials required, place the tapping sleeve and valve on the main. However, the City of Wilson will make the tap and test.

A variable level tapping sleeve connection, shown on **Standard Detail 513.03**, may only be used when approved by the City Engineer or Water Resources.

3.2.3 VALVE AND FIRE HYDRANT OPERATION

A. **New Construction**

1. Except in emergencies, it shall be unlawful for any contractor to operate on the City of Wilson's water distribution system except in the present of the Water Distribution/Wastewater Collection Manager or Distribution Personnel, or the City Engineer or his representative and then only with prior notification and approval as outlined in paragraph E below. The Water Distribution/Wastewater Collection Manager may require that the valve only be operated by Water Distribution Division Personnel. Failure to comply with these requirements shall be grounds for suspension of pipe-laying operations until written assurance can be obtained from the company official that such non-compliance will not occur again.

2. Contractors should be aware that the City of Wilson regards any violation of these requirements as ground to justify punitive measures.

B. **Existing Mains**

It shall be unlawful for any person to operate any valve in the City of Wilson's water distribution system. If a valve needs to be operated, the notification procedure in paragraph E below shall be followed and personnel from the Water Distribution Division will operate the valve.

C. **Hydrants and Valves on Private Property**

It shall be unlawful for any person to operate any valve which controls fire hydrants or fire protection lines in private property such as shopping centers, group house, etc. after these lines and hydrants have been tested and accepted by the City. If maintenance is needed for any part of the private system, the Water Distribution ORC should be notified following the procedures outlined in paragraph E below. In addition, any fire hydrant that is out of service must be reported to the Fire Department. A serious safety problem could arise if hydrants are inoperable due to valves being fully or partially closed without the knowledge of the Fire Department.

D. **Emergencies**

In the case of an emergency, a contractor or plumber shall be allowed to take measures with respect to valve and fire hydrant operation as are necessary for the protection of life and property. Notification must be made to the City as soon as possible after the emergency, stating what the emergency was and the measures taken to correct it.

E. **Notification Procedur**es

1. The contractor shall notify the Water Distribution ORC to request the operation of any valves. Twenty-four hours notice is requested if no water customers will be affected. Forty-eight hours notice is required if any customers will be affected (i.e. out of water for any period of time). It is the responsibility of the contractor to notify the affected customer(s) **48**-hours in advance of disrupting the water service prior to work.

2. The following information is requested:
    a. Name of person calling
    b. Company name
    c. Location of valves
    d. Date and time needed
    e. Reason for the operation of valve(s)
    f. Whether to open or close

F. **Enforcement**
Due to the potential seriousness associated with the unauthorized operation of valves, the City of Wilson will pursue any violations of this section to the fullest extent allowed by law.

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 constructed as shown on the drawings. The valve shall be housed in a precast concrete eccentric flattop manhole and shall be installed in accordance with **Standard Details 516.01** (Air Release Manhole for Water Mains). All pipe and fittings are to be brass. Ball valves are to be stainless steel ¼-turn. Air release valve locations shall be as shown on the plans and as otherwise directed by City Engineer. See also paragraph 3.3.3 *Manhole Installation for Air Release Valves*.

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 City Engineer. Place the hydrant on #57 stone base. Hydrants must be set with the stem vertical/plumb and the flange above grade. Backfill the hydrant with 3 cubic feet of loose #57 stone ensuring that the stone is placed at least 6 inches above the weep hole opening in the hydrant. See **Standard Details 514.02 and 514.03**.

Hydrants are to be located within the right of way and set to the height prescribed by **Standard Details 514.02 and 514.03** with the pumper nozzle facing or pointing to the street or fire access lane. 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, no more than 2 risers, up to a maximum of 24 inches, are allowed per hydrant. When hydrants are approved by the City Engineer or Water Resources to be 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.

When set in the lawn space between the sidewalk and the curb or between the sidewalk and the property line, no portion of the hydrant or nozzle cap may be within 6 inches of the sidewalk. A clear space of not less than 3 feet shall be provided on all sides of a fire hydrant.

A resilient seat gate valve shall be installed with an approved mechanical joint restraint system.

B. Mechanical joint restraint systems are to be used in anchoring the hydrant to the leg valve and main. Mechanical joint restraint systems are to be used on all fittings.

A City representative must inspect fire hydrants prior to backfilling.

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 City representative to verify the hydrant is wet. Paint is to be Sherwin Williams Industrial Enamel or equal. The hydrant barrel is to be painted forest green and the bonnet fluorescent white. Surfaces to be painted shall be free of oil, dirt and rust. See **Standard Detail 514.02** and **514.03**. Do not remove chains.

C. **Hydrant Bagging**: Hydrants not in service shall be bagged. Notify Water Resources if a fire hydrant is bagged.

D. **Valving of Main**: A leg valve is required on all hydrant legs. Install hydrant valve on mechanical joint hydrant tee or with a standard tee with an approved joint restraint system. When valve is placed outside the pavement, provide a concrete stabilizing pad in accordance with **Standard Detail 516.02**.

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

3.2.6 BLOW OFF INSTALLATION

Blow-Off Assembly for Mains (6-inch to 12-inch): Blow-off assemblies for either permanent or future extensions shall consist of a minimum of one 18-foot long joint of DIP (actual length of restraint as required per **Standard Detail 512.06**), a standard MJ plug with joint restraint system tapped (I.P. threads) for a 2-inch pipe, a 2-inch I.P. threaded schedule 40 brass pipe (with elbow) connection between the blow off hydrant and the cap, 2-inch I.P. threaded vertical outlet blow off hydrant, and a valve box (see **Standard Detail 513.01**; minimum ID = 5 ¼ inches), and concrete stabilization pad. The valve box to be set on concrete brick and the hydrant on a 4x4x16 solid concrete block. Provided a minimum of 3 cubic feet of #67 stone around drain and base of blow off as shown on **Standard Detail 514.01**.

Ensure that the hydrant is free to move vertically within the valve box to prevent transmission of traffic loads to the hydrant. The hydrant should not be jammed or wedged against the valve box interior.

The blow off is to be set such that the top of the operating nut is 6 inches +/- below finished grade.

For units set in unpaved areas, the contractor is responsible for providing the necessary temporary outlet protection to prevent erosion of both stabilized and unstabilized earthen surfaces.

When the unit is used for blowing off heavily chlorinated water, a dechlorinating device is required. Disposal of heavily chlorinated water shall meet the applicable sections of AWWA C651, latest revision.

3.2.7 BACKFLOW PREVENTERS

See sections within this document as well as the City of Wilson B*ackflow Prevention Cross-Connection Control Ordinance*, latest adoption as applicable.

3.3 MISCELLANEOUS APPURTENANCES

3.3.1 SERVICES

A. **General**: All fees must be paid and work scheduled with the City 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 and Tap Requirements:**

a. 1-inch, 1 ½-inch and 2-inch taps are to be made using an all bronze double strap tapping saddle. The service saddled shall provide a drip tight connection when used on DIP or PVC water mains. See **Standard Detail 513.04**.
b. 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. See **Standard Detail 513.02.**
c. Tap Location: Taps made on the same side of the main shall be no closer than 24 inches apart and staggered a minimum of 1-inch vertically to avoid damage to main. Taps may not be placed closer than 24 inches

from end of pipe for pipe up to 16 inches in diameter. See **Standard Detail 513.04** for typical tap detail on water main.

d. Service taps made on ductile iron pipe shall also be subject to the requirements of AWWA C600, *Installation of Ductile Iron Water Mains and their Appurtenances, latest revision.*
e. Service taps made on PVC C900 shall also be subject to:
   i. The requirements of AWWA C605, *Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings*.
   ii. UNI-PUB-8: Tapping Guide for AWWA C900 Pressure Pipe

Service Connections on "In-Service" water mains.	
Size Connection	**Responsibility**
1-inch through 2-inch services	Upon payment of a fee, the City will make the tap, run service line and set meter box and setter (as applicable). City will also set meter when requested for construction or after final plumbing inspection.
3-inch and larger services	Contractor excavates line, provides all materials. City makes tap and invoices Contractor for labor, equipment and a tap fee. Contractor backfills, compacts and closes trench; replaces pavement, etc. Contractor sets meter.

2) **Tap Location**: Water service pipe shall be one continuous run, from main to meter angle stop/curb valve. Line shall have no joints or couplings in between. Service lines shall run perpendicular to the main in a straight line to the meter box/property served. No sharp bend of the service line will be permitted. **Service lines shall not be located beneath driveways**.

3) **Tap Bedding/Backfill:** 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 24 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 conform to the requirements of Table 2275.3 of 02275 *Trenching, Backfilling, and Compaction of Utilities*. In landscaped areas, the surface shall be left smooth and uniform with the adjacent surface.

B. **1-inch Service Taps**: All 1-inch taps into water mains shall be made using an all bronze double strap tapping saddle with an all bronze corporation stop (compression fitting on service pipe). Pipe must be Type K copper with compression fittings. 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. Multiple taps in the same section of the pipe shall be staggered (see **Standard Detail 513.04**).

C. **1 ½-inch and 2-inch Service Taps**: 1 ½-inch and 2-inch taps shall be made using all bronze double strap saddle. Water service pipe shall be type K soft copper with compression fittings. Taps shall be made at a 45° angle to the pipe. See sheet **Standard Detail 515.03** and paragraph 2.3.10 B.

All 1 ½-inch and 2-inch services as well as the meter installation are to be inspected by the Water Distribution Division.

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 City 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 5/8-inch x ¾-inch and 1-inch meters shall be installed within the utility strip behind the curb. Meter boxes shall be set on 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 6 to 10 inches of clearance between the top of the box and the top of the curb or angle valve. 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 515.01**.

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 6 inches of #57 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 515.03**.

Meter setters with high by-pass lines 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 or near the street side edge of the 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 Above Ground Meter Vaults**: Meter vaults for 3-inch and larger meters shall be placed level in an insulated enclosure with locking access doors and heater. See **Standard Detail 515.04**. Meters and fittings shall be supported by pipe stands.

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 H 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 City and be delivered to the Water Resources Division. *Water services shall be classified for payment as to their location in relation to the new water main and the centerline of the street.*

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

3.3.2 RESTRAINTS: THRUST COLLARS & JOINT RESTRAINT SYSTEMS

A. **Thrust Collars:** Thrust collars shall be constructed as shown in **Standard Detail 512.05** for pipes up through and including 36 inches in diameter. The thrust collar shall consist of a wedge action restrainer gland (see paragraph 2.1.3 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, provide one full joint of ductile iron pipe with restraint joint fittings. 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.

B. **Joint Restraint System:** A joint restraint system shall consist of a wedge action restrainer gland placed at a fitting or length of pipe sufficient to resist the thrust imposed on the fitting or line. Unless designed otherwise, the length of pipe for a particular fitting shall be as shown in **Standard Detail 512.06**. Joint restraint systems are to be installed in accordance with the manufacturers written requirements.

See Pre-Approved Product List for acceptable manufacturers and models of mechanical joint restraint systems).

3.3.3 MANHOLE INSTALLATION FOR AIR RELEASE VALVES

Manhole bases for air release valves shall be placed on a level 18-inch bed of #57 stone that has been thoroughly and firmly consolidated. The stone is to be placed to within 12 inches of the bottom of the pipe. 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 or hydraulic cement to prevent infiltration. Flat tops shall be used for air release manholes. 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. See also paragraph 3.2.4, Air Release Valves.

Hydraulic cement shall be applied both on the inside and outside of at all riser joints.

See **Standard Details 516.01** (Air Release Manhole for Water Mains).

3.4 TESTING AND DISINFECTION

3.4.1 GENERAL

Pipelines shall be tested, in sections between valves, as soon as the respective section is complete. 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 1 ½" and 2" services shall be installed complete with setters (Contractor shall provide a meter, approved by City, for pressure testing). There shall be no bypass around the meter used for pressure testing.

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

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

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

H. Pressure testing is to be performed before pavement is put down.

I. Approval shall come from City's Inspector on section of line to be tested.

J. Contractor may install smaller services either prior to or after testing and disinfection.

3.4.2 ORDER OF OPERATIONS

A. **Pretest Inspection**: Perform pretest inspection with a City representative. The City representative is to request scheduling of this inspection and testing. The City representative shall visually inspect the installation prior to testing to ensure that all fire hydrants, valves and other appurtenances are properly located, operable and installed at proper grade. All defects shall be corrected prior to any testing.

B. **Flush Main**: Prior to performing the pressure test, the main shall be flushed. Flushing of water mains shall be done in the presence of the City representative. No valve or hydrants owned by the City of Wilson should be operated by contractors without the express written permission of the City representative, City

Engineer, Water Distribution ORC, or the Assistant Director of Public Services/Water Resources.

C. **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.

D. **Pressure Test**: A pressure test shall be scheduled with a City 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.***

E. **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 City 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*.

F. **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*. Take bacteriological samples with bottles received from the City's Water Treatment Facility lab.

1) Pipe subjected to contaminating materials shall be treated as directed by City Engineer. Should such treatment fail to cleanse the pipe, replacement shall be required. The City 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.

G. **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. City 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 City Engineer or his designated representative.

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 City 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 City personnel shall operate water valves on City'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 slight 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 City's inspector 48 hours in advance of any expected test. The contractor shall pretest all mains for a period of 2 hours before notifying City 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 shown in Table 6A excerpted below (in accordance with Section 5.2, Table 6A - Hydrostatic Testing of AWWA C 600-93, *AWWA Standard for Installation of Ductile Iron Water Mains and Their Appurtenances*). For PVC pipe, the test procedure and allowable leakage shall be as specified in the latest edition of the Uni-Bell Plastic Pipe Association Handbook of PVC pipe, Chapter X, Construction. No leakage shall be allowed for services.

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

The City's inspector will verify 1 pressure test – the final observation of the test section. A fee may be charged if the City 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 for DIP shall not exceed the quantity determined by Table 6A (excerpted from AWWA C600-93), attached. For PVC C900 Pipe, allowable leakage shall not exceed the quantity determined by Table 10.5 *Testing Allowance for PVC Pipe with Elastomeric Joints* excerpted from Uni-Bell Handbook of PVC Pipe, attached.

   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 C-651, *Disinfecting Water Mains*. The contractor shall disinfect water mains and accessories in accordance with the procedures listed below and meet the requirements of City. 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 shall not be taken from a hose.

The Contractor will prepare a Sampling Log, including a sketch of the sampling points, as specified by the City. 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 City 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 by the City Inspector to the City of Wilson Water Treatment Facility for analysis. Results of the analyses shall be furnished to the

Contractor and City representative 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 – One form is permitted – granular (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 bleach. 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. **Method 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-hour 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) **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 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 Water Treatment laboratory. Test results cannot be read until **48** 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 the second sampling, the main shall be re-chlorinated by the contractor and new tests performed prior to moving to the next section of main. Cleaning and disinfecting will be the responsibility of the contractor. City will furnish necessary water 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 or as directed by the City representative.

Primary sampling points are blow-offs, 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 in place, after acceptance, by the placement of a repair clamp.

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 City and the Contractor cooperatively.

1) The City'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 City'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 City'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 City'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 the City of Wilson Water Treatment Facility laboratory. Samples cannot be collected if any type of precipitation is falling.

<u>SAMPLING</u>

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 City's inspector will check both chlorine concentration.

a. The chlorine concentration must be less than 4ppm for consumption purposes but greater than or equal to 0.2 ppm free chlorine 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 the City's Water Treatment Facility 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 Colilert® method. The test must yield a negative plate count. **This test requires 48 hours of incubation before the result is obtained.**

6) The test results must be negative for fecal coliform.
   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 City, 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.

AWWA C600 TABLE 6A
ALLOWABLE PRESSURE TEST LEAKAGE
(Allowable Leakage per 1000 ft. of Pipeline * in gph)

(This table is excerpted from AWWA C-600, Section 5.2 Table 6A)

AVG. TEST PRESSURE PSI	NOMINAL PIPE DIAMETER-IN.																
	2	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48	54
450	0.32	0.48	0.64	0.95	1.27	1.59	1.91	2.23	2.55	2.87	3.18	3.82	4.78	5.73	6.69	7.64	8.60
400	0.30	0.45	0.60	0.90	1.20	1.50	1.80	2.10	2.40	2.70	3.00	3.60	4.50	5.41	6.31	7.21	8.11
350	0.28	0.42	0.56	0.84	1.12	1.40	1.69	1.97	2.25	2.53	2.81	3.37	4.21	5.06	5.90	6.74	7.58
300	0.26	0.39	0.52	0.78	1.04	1.30	1.56	1.82	2.08	2.34	2.60	3.12	3.90	4.68	5.46	6.24	7.02
275	0.25	0.37	0.50	0.75	1.00	1.24	1.49	1.74	1.99	2.24	2.49	2.99	3.73	4.48	5.23	5.98	6.72
250	0.24	0.36	0.47	0.71	0.95	1.19	1.42	1.66	1.90	2.14	2.37	2.85	3.56	4.27	4.99	5.70	6.41
225	0.23	0.34	0.45	0.68	0.90	1.13	1.35	1.58	1.80	2.03	2.25	2.70	3.38	4.05	4.73	5.41	6.03
200	0.21	0.32	0.43	0.64	0.85	1.06	1.28	1.48	1.70	1.91	2.12	2.55	3.19	3.82	4.46	5.09	5.73
175	0.20	0.30	0.40	0.59	0.80	0.99	1.19	1.39	1.59	1.79	1.98	2.38	2.98	3.58	4.17	4.77	5.36
150	0.19	0.28	0.37	0.55	0.74	0.92	1.10	1.29	1.47	1.66	1.84	2.21	2.76	3.31	3.86	4.41	4.97
125	0.17	0.25	0.34	0.50	0.67	0.84	1.01	1.18	1.34	1.51	1.68	2.01	2.52	3.02	3.53	4.03	4.53
100	0.15	0.23	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50	1.80	2.25	2.70	3.15	3.60	4.05

*** For pipe with 18 ft. nominal lengths. To obtain the recommended allowable leakage for pipe with 20 ft. nominal lengths, multiply the leakage calculated from the table by 0.9. If the pipeline under test contains sections of various diameter, the allowable leakage will be the sum of the computed leakage for each size.**

TABLE 10.5
UNI-BELL HANDBOOK OF PVC PIPE
TESTING ALLOWANCE FOR PVC PIPE WITH ELASTOMERIC JOINTS

(U.S. gallons per hour)
Testing Allowance per 1,000 ft or 50 joints

AVG. TEST PRESSURE (PSI)	NOMINAL PIPE DIAMETER-IN.													
	4	6	8	10	12	14	16	18	20	24	30	36	42	48
50	0.19	0.29	0.38	0.48	0.57	0.67	0.76	0.86	0.96	1.15	1.43	1.72	2.01	2.29
100	0.27	0.41	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.62	2.03	2.43	2.84	3.24
150	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99	2.48	2.98	3.48	3.97
200	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72	1.91	2.29	2.87	3.44	4.01	4.59
250	0.43	0.64	0.85	1.07	1.28	1.50	1.71	1.92	2.14	2.56	3.20	3.85	4.49	5.18

City of Wilson
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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