

ARTICLE V
STANDARD SPECIFICATIONS
for
WATER MAIN CONSTRUCTION

- V.1 General
- V.2 Buy America
- V.3 Materials and Equipment
- V.4 Installation of Ductile Iron Water Main
- V.5 Laying of Pipe
- V.6 Setting Hydrants
- V.7 Anchorage
- V.8 Field Testing
- V.9 Backfilling
- V.10 Removal, Restoration, and Maintenance of Surface
- V.11 Sterilization of Mains
- V.12 GPS of Fittings

ARTICLE V

STANDARD SPECIFICATIONS

for

WATER MAIN CONSTRUCTION

V.1 GENERAL

- A. The work covered by this Article V of the specification consists in furnishing all labor, equipment, supplies and materials, and in performing all operations in connection with the construction of Ductile Iron Pipe water main and related appurtenances in accordance with the Recommended standards for Water Works, 2012 Edition (commonly referred to as "The 10 State Standards"). The following recognized standards [State of Nebraska, Department of Transportation (NDOT) 2017 Standard Specifications for Highway Construction, the American Water Works Association Standards (AWWA), American Standards for Testing and Materials (ASTM), American Association of State Highway and Transportation Officials (AASHTO), City of Norfolk Nebraska Standard Details, etc. or the latest revisions thereof] shall apply except as here in after provided. All specifications included in this Article V will pertain except that special notations on the plans, in the Special Provisions or in the General Provisions shall have precedence.
- B. The Contractor shall make all connections to existing mains as indicated on the plans. Only City of Norfolk Water Division personnel shall operate valves that are part of the City's water system, (this includes all valves that isolate this construction from the existing system). The Contractor shall give the City's Water Division 48 hour notice prior to their needing the valve(s) operated. The Contractor is also prohibited from operating fire hydrants without direct permission from the City Water Division.

V.2 BUY AMERICA

- A. The Buy America rule requires that steel or iron materials are to be produced domestically, and only those products which are brought to the construction site and permanently incorporated into the completed project are covered.
- B. All manufacturing processes to produce steel or iron materials (i.e., smelting, and any subsequent process which alters the steel or iron material's physical form or shape, or changes its chemical composition) must occur within one of the 50 states, the District of Columbia, Puerto Rico, or in the territories and possessions of the United States, to be considered of domestic origin. This includes processes such as casting, rolling, extruding, machining, bending, grinding, drilling, and

coating. Coating includes epoxy coating, galvanizing, painting, and any other coating that protects or enhances the value of the material. Upon request the manufacturer shall include a statement on the material test report or certification that all material described above except the coating material is a domestic product.

- C. For a manufactured product to be considered produced in the United States, the cost of the components of the manufactured product that are mined, produced, or manufactured in the United States must be greater than 55% of the total cost of all components of the manufactured product, unless another standard for determining the minimum amount of domestic content of the manufactured product has been established under applicable law or regulation.

City reserves the right to waive "Buy America" V.2 in the event of price, availability of materials and other considerations.

V.3 MATERIALS AND EQUIPMENT

- A. Unless otherwise specified on plans or in the Special Provisions all materials furnished for work on this contract shall be new materials. No salvaged or revised materials shall be furnished.
- B. All pipe shall be ductile iron manufactured in accordance with the requirements of the current version of ANSI/AWWA Standard C151/A21.51. The pipe thickness shall be designed in accordance with the current version of ANSI/AWWA Standard C150/A21.50. All pipe will have a cement mortar lining in accordance with the current version of ANSI/AWWA Standard C104/A21.4, and the joints shall conform to the current version of ANSI/AWWA Standard C111/A21.11 for mechanical and push-on joints. Unless otherwise specified all pipe shall be Pressure Class 350. Bidders shall state in their proposal the brand and type of pipe that they propose to furnish.
- C. Polyethylene encasement should be a single layer of cross laminated polyethylene encasement, with a 4 mil. thickness. All buried or concrete encased ductile pipe including all straight pipe, bends, tees, adapters, closure pieces and other fittings or specials and all valves shall be provided with at least one wrap of polyethylene encasement. Polyethylene tube protection should be installed in accordance with the current version of ANSI/AWWA C105/A21.5 METHOD A. Circumferential wraps of tape shall be placed every 10' and at all valves and fittings. Preparation of pipe shall include but shall not be limited to removal of lumps of clay, mud, cinders etc. prior to installation.
- D. All mechanical joint fittings shall be as tabulated in manufacturer's catalogue and manufactured in accordance with the requirements of the current version of ANSI/AWWA Standards C110/A21.10 and C153/A21.53. Unless otherwise specified all fittings shall be Class D.
- E. Cement mortar lining for pipe and fittings shall conform to the current version of ANSI/AWWA Standard C104/A21.4 and unless otherwise specified all pipe and fittings furnished under this contract shall be cement mortar lined.

- F. Portland Cement: All concrete for the project shall use Type IP cement in accordance with the NDOR standard specifications. This includes concrete used for retaining walls, storm sewer structures, sanitary sewer structures, and all concrete surfacing.
- G. All fire hydrants shall conform to the current version of ANSI/AWWA Standard C502. Hydrant size and type will be as noted on the proposal. Unless otherwise specified, they shall be 5 1/2 foot bury set at the established finish grade. All nozzles shall be bronze with National Standard hose coupling threads. Each hydrant shall be furnished with a 6-inch auxiliary gate valve and roadway box with proper valve box adaptor 11.
- H. All two-way hydrants shall be 4 1/2" or 5 1/4" main valve opening and shall be Mueller Super Centurion 250 No. A-420 or A-422, American Darling B-84B, Kennedy K81D, or approved equal.
- I. All steamer hydrants shall be Mueller Super Centurium 250 No. A-423, American Darling B-84B, Kennedy K81D, or approved equal.
- J. All gate valves furnished under these specifications shall meet or exceed the requirements of the current version of ANSI/AWWA Standard C500 for gate valves for Ordinary Water Works Service, and of the type and size shown on the plans and in the proposal. All valves shall be Mueller Model #2361-20, Clow Model #F-6100, American Darling Series 2500, Kennedy Series 7571 or approved equal. Unless otherwise stated on the plans, in the special provisions, or on the bid proposal all valves shall be valves that open to the left (counterclockwise).
- K. All butterfly valves furnished under these specifications shall meet or exceed the requirements of the current version of ANSI/AWWA Standard C504 for butterfly valves for Ordinary Water Works Service, and of the type and size shown on the plans and in the proposal. All valves shall be Mueller Lineseal III, Clow Model #4500, Valmatic American Series 2000, or approved equal. Unless otherwise stated on the plans, in the special provisions, or on the bid proposal all valves shall be valves that open to the left (counterclockwise).
- L. The roadway box shall be Tyler cast iron valve boxes, two-piece 664 or 666-S. The cost of furnishing and setting roadway boxes shall be included in the price of the valves. All valve boxes will be installed with the appropriate valve box adaptor II. When a Tracer Wire is needed, a 3/16" inch hole shall be drilled 4 1/2" inches from the top of the valve box. The Tracer Wire shall spiral up on the outside of the valve box, ran though the drilled hole and coiled inside with enough wire to extend 12" above ground.
- M. All tapping valves furnished under these specifications shall meet or exceed the requirements of the current version of ANSI/AWWA Standard C500 for gate valves for Ordinary Water Works Service and of the type and size shown on the proposal. All valves shall be either American Flow Control series 2500 4" to 36", Mueller a-2360-16 4" to 12" and the 2361-16 14" to 36" or Clow model F6114, or approved equal. Unless otherwise stated on the plans in the special provisions or on the bid proposal all valves shall be valves that open to the left (counterclockwise).

- N. All tapping tees shall be Smith Blair 664, Romac SST or Ford FTSC with epoxy coating and stainless steel bolts, or approved equal.
- O. All 1 ½” and 2” service taps on cast iron or ductile pipe shall be a Mueller –DR2S or Ford style 202B series with a double allow strap design with the current version of ANSI/AWWA tapper (C.C.) thread or approved equal.
- P. Service lines will be installed with a wooden blocking under the corporation elbow to provide for expansion, contraction and settlement. Sand shall be install within 2” inches of the bottom of the service line to provide bedding for the block. It is at this time an inspection of the service line will be needed by the City Water Division. Inspections shall be completed; Monday thru Friday, 8 am till 4 pm. Inspection requests after 4pm shall be performed the following business day.
- (a) Service lines 2” and below shall be (a) soft tempered “type K” copper service tubing or (b) plastic service tubing.

(a-1) For soft tempered “**type K” copper service tubing**, All Corporation stops will meet or exceed the requirements of the current version of ANSI/AWWA C800-14. Corporation stops shall be of all bronze or brass construction and will be labeled NL (No Lead) unless otherwise specified on the plans or Special Provisions. Corporation stops shall be of the following:

Ford F600	A.Y. McDonald 74701
Ford FB600	

or approved by Engineer.

(a-2) For soft tempered “**type K” copper service tubing**, All Quarter turn fittings (90 Degree Elbow) will meet or exceed the requirements of the current version of ANSI/AWWA C800-14. Quarter turn fittings shall be of all bronze or brass construction and labeled as NL (No Lead) unless otherwise noted in the Special Provisions. Quarter turn fittings shall be of the following:

Ford L04-33	A.Y. McDonald 74776
Ford L04-44	

or approved by Engineer.

(a-3) For soft tempered “**type K” copper service tubing**, All Curb stops will meet or exceed the requirements of the current version of ANSI/AWWA C800-14. Curb stops shall be of all bronze or brass construction and labeled as NL (No Lead) unless otherwise noted in the Special Provisions. Concrete blocking (minimum 8” X 8” flat block) shall be place under the Curb Stop. Curb stops shall be of the following:

Ford B-22-333	A.Y. McDonald 76100
Ford B-44-333	A.Y. McDonald 76100-22

or approved by Engineer.

Ford 51 Series
Ford 52 Series
or approved by Engineer.

A.Y. McDonald 6133T

(b-5) An insulated copper tracer solid wire shall be installed adjacent to underground non-metallic water service piping. The tracer wire shall not be less than 12-gauge copper solid wire with insulation suitable for direct burial. The tracer wire shall be attached to the curb box cap and shall terminate at the corporation. Tracer wire will be taped to the service line at distances no greater than 5 feet. Tracer wire shall meet the following specifications:

Tracer Wire: An insulated copper tracer solid wire will be installed adjacent to underground non-metallic water service piping. The tracer wire will not be less than 12-gauge copper wire with insulation suitable for direct burial. The tracer wire will be attached to the curb box cap, corporation, and curb stop. Tracer wire shall meet the following specifications; Minimum 12 AWG solid wire with jacket thickness of 4 mil, insulation thickness 15 mil and minimum nominal ID of .131”.

(b-6) For **plastic service tubing**, Curb stop boxes shall be furnished with an extension of the type with a stationary rod arch pattern base. The Curb box cap will have a terminal screw for the tracer wire and have the word "Water" cast on it. Curb box caps stops shall be of the following:

Ford PL-LID-TW
or approved equal.

McDonald 5607-LTW

- Q. If placement of a curb stop cannot meet the requirements as outlined in Section V.4 and the curb stop must be placed in the sidewalk or walkway, then a Ford PS shall be utilized.
- R. The Contractor shall bring clean sand to support the water service line. After City inspection, Contractor shall backfill with fill sand to 30 inches below original grade. Top Soil shall be used to backfill to original grade. Tamping method and equipment must be as approved by the Engineer.

V.4 INSTALLATION OF DUCTILE IRON WATER MAINS

- A. Ductile iron pipe, fittings, valves, hydrants, and accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such materials be dropped. Pipe handled on skid ways shall not be skidded or rolled against pipe already on the ground. In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench.
- B. Pipe shall be so handled that the coating and lining will not be damaged. If, however, any part of the coating or lining is damaged, the repair shall be made by the Contractor at his expense in a manner satisfactory to the Engineer.

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- C. The water main shall be laid and maintained to the required lines and grades with fittings, valves, and hydrants at the required locations; spigots centered in bells; and all valves and hydrants stems plumb. Bell holes shall be provided at each joint to permit the jointing to be made properly. A valve box shall be provided for every valve unless otherwise noted on the plans or in the Special Provisions. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the wrench nut of the valve, with the box cover flush with the surface of the finished pavement or such other level as may be directed.
- D. Wherever existing utility structures or branch connections leading to them (including but not limited to sanitary sewers, storm sewers, water lines, gas lines, electrical lines, telephone lines, cable TV lines etc.) present an obstruction to the grade and alignment of the pipe, they shall be permanently supported, removed, relocated or reconstructed by the Contractor or through cooperation with the Owner of the utility, structure or obstruction involved. In instances where location or reconstruction is impractical, a deviation from line and grade will be ordered and the change shall be made in the manner directed. No deviation shall be made from the required line or grade except with the written consent of the Engineer.
- E. The Contractor shall proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures, both known and unknown, may be determined, and he shall be held responsible for the repair of such structures when broken or otherwise damaged because of carelessness on his part.
- F. Whenever, in the opinion of the Engineer, it is necessary to explore and excavate to determine the location of existing underground structures, the Contractor shall make explorations and excavations for such purposes.
- G. All pipe shall be laid to the minimum depth of cover over the water pipe of five and one-half feet (5.5') measured from the established street grade or the surface of the permanent improvement to the top of the barrels of the pipe. Deviations from this will be as shown on the plans.
- H. The trench shall be dug so that the pipe can be laid to the alignment and depth required and only so far in the advance as the Engineer shall permit. The width of the trench shall be ample to permit; the pipe to be laid and jointed properly, the backfill to be placed and compacted as specified, and the workmen to work therein safely and efficiently. Wherever necessary to prevent caving, excavations in unstable material (such as sand, gravel or sandy soil) shall be adequately sheeted and/or braced so that workmen may work therein safely and efficiently. Where sheeting and/or bracing is used the trench width shall be increased accordingly, and the sheeting and/or bracing shall also allow for the handling of specials (i.e. fire hydrants). Trench sheeting shall remain in place until the pipe has been laid, tested for defects, repaired if necessary, and the earth around it compacted to a depth of two feet over the top of the pipe. The cost of furnishing, placing, and removing the sheeting and bracing, and the leaving in place of sheeting and bracing indicated on the plans, shall be included in the price bid for the work.
- I. The Contractor shall be required, at his own expense, to keep trenches free from water during progress of the work unless otherwise indicated on the plans or in the Special Provisions. It is

essential that the discharge of the trench dewatering pumps be conducted to natural drainage channels, drains or storm sewers. All dewatering discharge shall be free of sediment and other pollutants. If necessary dewatering discharge shall be filtered to ensure all sediment and pollutants remain on site and are properly disposed of.

- J. The trench shall be excavated to the depth required so as to provide a uniform and continuous bearing and support for the pipe on solid and undisturbed ground conforming to the required grade. Any part of the bottom of the trench excavated below the specified grade shall be corrected with approved material thoroughly compacted as directed by the Engineer. The finished subgrade shall be prepared accurately by means of hand tools.
- K. When the trench bottom at the required grade is soft and in the opinion of the Engineer, cannot support the pipe, a further depth shall be excavated as directed and refilled with approved material thoroughly compacted, or other approved means shall be adopted to assure a firm foundation for the pipe. Extra compensation shall be allowed for the extra work required.
- L. All surface materials which, in the opinion of the Engineer, are suitable for reuse in restoring the surface shall be kept separate from the general excavation material as directed by the Engineer.
- M. All excavated material shall be piled in a manner that will not endanger the work or the movement of traffic and that will avoid obstructing sidewalks and driveways. Hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, fire and police call boxes, or other utility controls shall be kept unobstructed and accessible. Gutters shall be kept clear or other satisfactory provisions made for street drainage, and natural watercourses shall not be obstructed.
- N. To protect pedestrians, direct and control vehicular traffic, and prevent damage to property, the Contractor shall provide safety devices in accordance with the latest version of the Manual on Uniform Traffic Control Devices. The Contractor is also responsible for maintenance of these devices including updating/changing them to accommodate the changes of the construction area. In addition, the Contractor shall enclose all material piles, equipment and pipe which may serve as obstructions to traffic (pedestrian or vehicular) by fences or barricades and when the visibility is poor, lights shall also be used.
- O. The Contractor shall carry on the work in a manner which will cause the least interruption to traffic, and may close to through traffic on low traffic streets but must maintain access to all properties unless prior approval is given by the Engineer. These closures shall not be more than two consecutive blocks, including the cross street(s) intersected. Where traffic must cross open trenches, the Contractor shall provide suitable bridges at street intersections and driveways.
- P. Temporary support, adequate protection and maintenance of all underground and surface structures, drains, sewers and other obstructions encountered in the progress of the work shall be furnished by the Contractor at his expense and under the direction of the Engineer. The structures which may have been disturbed shall be restored upon completion of the work.

- Q. Trees, shrubbery, fences, poles and all other property and surface structures shall be protected unless their removal is shown on the plans or authorized by the Engineer. When it is necessary to cut roots and tree branches, such cutting shall be done under the supervision and direction of the Engineer.

- R. Prior to the Contractor making connections to existing mains, or in cutting into the present system, at least 48 hours notice shall be give to the City's Water Division by the Contractor. When the water pressure must be shut off for construction purposes, the Contractor is responsible for notifying all of the affected property owners at least 48 hours prior to the time when he desires to have the water pressure shut off, and shall arrange with the City Water Division to have the water shut off at that time. The Water Division shall close the necessary valves and drain the system to the best of their ability, but it is the contractor's responsibility to take care of any and all water, which may run into his trench, and he shall also hasten the work as much as possible. The Contractor shall arrange to have his men, tools, materials, pumps, etc. on the ground previous to the time of shutting off pressure to avoid all possible delay. Whenever (in the judgment of the City's Water Division) it is considered advisable to have the water shut off at night rather than in the daytime, the Contractor shall arrange to do such work during the nightttime. It shall be the contractor's responsibility to supply plenty of adequate lighting for this nighttime work.

V.5 LAYING OF PIPE

- A. Proper implements, tools and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and convenient prosecution of the work. All pipe, fittings, valves and hydrants shall be carefully lowered into the trench piece by piece by means of a derrick, ropes or other suitable tools or equipment, in such a manner as to prevent damage to water main materials and protective coatings and linings. Under no circumstances shall equipment or water main materials be dropped or dumped into the trench.

- B. All lumps, blisters, and excess coal-tar coating shall be removed from the bell-and-spigot end of each section of pipe. Before the pipe is laid, the outside of the spigot and the inside of the bell shall be wire-brushed, wiped clean and dried, free from oil and grease.

- C. Every precaution shall be taken to prevent foreign material from entering the pipe during laying operations. No pipe shall be laid in water or when, in the opinion of the Engineer, trench conditions are unsuitable. Methods used to accomplish this shall be approved by the Engineer. No tools, clothing, debris or other material shall be placed inside the pipe. All dead ends on new mains shall be closed with plugs or caps that match the pipe material, with or without a blow off cock, as shown on the drawings. All plugs or caps shall be properly restrained.

- D. After placing a length of pipe in the trench, the spigot end shall be centered in the bell and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with approved backfill material tamped under it except at the bells. Pipe and fittings which do not allow a sufficient and uniform space for joints shall be removed and replaced with pipe and fittings of proper dimensions to insure such uniform space.

- E. Pipe shall be laid with bell ends facing in the direction of laying, unless directed otherwise by the Engineer. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by the Engineer.
- F. The cutting of pipe for inserting valves or fittings shall be done in a neat and workmanlike manner without damage to the pipe or cement lining and so as to leave a smooth end at right angles to the axis of the pipe. The flame cutting of pipe by means of an oxyacetylene torch shall not be allowed.
- G. Whenever it is necessary to deflect joints from a straight line the amount of deflection shall not exceed manufactures recommendation nor shall deflection exceed 5 degrees per joint on all pipe sizes up to 12 inches and 3 degrees per joint on pipe sizes greater than 12 inches. Joints adjacent to valves and fittings shall not be deflected unless permission is obtained from the Engineer.
- H. The location at the end of each service line shall be marked by placing a U-shaped ½” rebar stake. The u-shaped rebar shall be 12” in length and shall be placed 14” below grade directly next to the curb box.
- I. The curb stops and valve boxes shall be placed according to the following requirements:
 - a) Curb Stops:
 - 1) The curb stop shall be placed 7’ from the ROW/Property line on the public side.
 - 2) The curb stop shall not be placed in the sidewalk or future sidewalk.
 - 3) The curb stop shall not be placed closer than 7’ from the back of curb.

If all three of these conditions cannot be met, then please contact the City Engineering office for further direction.

- b) Valve Boxes:
 - 1) The valve box shall not be placed in the sidewalk, future sidewalk, or curb lines unless approved by city engineer.

V.6 SETTING HYDRANTS

- A. Hydrants shall be located as shown or as directed, and in a manner to provide complete accessibility, and also in such a manner that the possibility of damage from vehicles or injury to pedestrians will be minimized.
- B. When placed behind the curb, the fire hydrant shall be set a minimum of 6 feet from the back of curb line. When set in the lawn space between the curb and the sidewalk, or between the sidewalk and the property line, no portion of the hydrant or nozzle cap shall be within 6 inches of the sidewalk. The height of the fire hydrant shall be adjusted so that the hydrant break away flange is within 3” at grade and such that the distance from the top of curb to the center of the outlet nozzle shall be a minimum of 18 inches. All hydrant locations and grades will be staked by the Engineer.

- C. All hydrants shall stand plumb and shall have their nozzles parallel with or at right angles to the curb face with the pumper nozzle facing the curb.
- D. Each hydrant shall be connected to the main with a 6 inch ductile iron branch controlled by an independent 6 inch gate valve (with accompanying valve box), except as otherwise directed. Hydrants shall be thoroughly cleaned before setting.
- E. A drainage pit shall be constructed as shown on the plan for each hydrant installed.

V.7 ANCHORAGE

- A. The bowl of each hydrant shall be well braced against unexcavated earth at the end of the trench with concrete blocks, or it shall be tied to the pipe with suitable metal tie rods or clamps, as shown or directed by the Engineer.
- B. All plugs, caps, tees, and bends shall be provided with a reaction backing (or blocking), or movement shall be prevented by attaching suitable metal rods or clamps as shown or directed by the Engineer.
- C. Concrete blocking shall be placed between undisturbed soil and the fitting to be anchored; the area of bearing on the pipe and on the ground in each instance shall be that shown in standard details or as directed by the Engineer. The backing shall, unless otherwise shown or directed, be so placed that the pipe and fitting joints will be accessible for repair.
- D. A metal harness of tie rods and pipe clamps of adequate strength to prevent movement may be used in place of reaction backing if approved by the Engineer. Hot dip galvanized, or otherwise rustproof treated material shall be used.

V.8 FIELD TESTING

- A. All water mains, appendutures, fittings, valves, and hydrants shall be tested for water tightness in accordance with the Hydrostatic Testing Section of the current version of ANSI/AWWA Standard C600. Deviations in this test procedure may be permitted by the Engineer, if, in his opinion, the circumstances are such as to require deviation.

Section 1: Pressure Test

After the pipe has been laid, all newly lain pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 1.5 times the working pressure at the point of testing. All valves and hydrants shall be operated only by city staff.

- (a) Test pressure restrictions. Test pressures shall:

1. Not be less than 1.25 times the working pressure at the highest point along the test section, or a minimum of 125 psi.
2. Not exceed pipe or thrust-restraint design pressures.
3. Be of at least 2-hour duration.
4. Not vary by more than +/- 5 psi (0.35 Bar) for the duration of the test.
5. All pressure tests shall be verified by City of Norfolk water personnel or their approved agent.
6. Not exceed twice the rated pressure of the valves of hydrants. Hydrant auxiliary valve shall be in the open position during testing. NOTE: Valves shall not be operated in either direction at differential pressure exceeding the rated pressure.
7. Not exceed the rated pressure of the valves when the pressure boundary of the test section includes closed, resilient-seated gate valves or butterfly valves.

(b) Pressurization. Each valved section of pipe shall be filled with water slowly and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the owner. Valves shall not be operated in together the opening or closing direction at differential pressures above the rated pressure. It is good practice to allow the system to stabilize at the test pressure before conducting the leakage test.

(c) Air removal. Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants. If permanent air vents are not located at all high points, the contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure removed and plugged or left in place at the discretion of the owner.

(d) Examination. Any exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damage or defective pipe, fittings, valves, or hydrants that are discovered following the pressure test shall be repaired or replaced with sound material, and the test shall be repeated until it is satisfactory to the owner.

Section 2: Leakage Test

The leakage test shall be conducted concurrently with the pressure test.

(a) Testing allowance defined. Testing allowance shall be defined as the maximum quantity of makeup water that can be added into a pipeline undergoing hydrostatic pressure testing, or any valved section thereof, to maintain pressure within 5 psi (34.5 kPA) of the specified test pressure (after the

pipeline has been filled with water and the air has been expelled). The testing allowance is exceeded if the quantity of makeup water is greater than that determined by the following formula:

In inch-pound units,

$$L = \frac{SD \sqrt{P}}{148,000}$$

Where:

L = testing allowance (makeup water) (gph)

S = length of pipe tested (ft)

D = nominal diameter of the pipe (in.)

P = average test pressure during hydrostatic test (psi [gauge])

In Metric Units,

$$L_m = \frac{SD \sqrt{P}}{794797}$$

Where:

L_m = testing allowance (makeup water) (l/hr)

S = length of pipe tested (m)

D = nominal diameter of the pipe (mm)

P = average test pressure during the hydrostatic test (kPa)

(b) These formulas are based of the testing allowance of 10.49 gpd/mi/in. (0.971 L/d/km/mm) of nominal diameter at a pressure of 150 psi (1,034 kPa). Values of testing allowance at various pressures are shown in are shown in Tables 5A and 5B. When testing against closed metal-seated valves, an additional testing allowance per closed valve of 0.0078 gal/hr/in. (1.2 mL/hr/mm of nominal valve size shall be allowed. When hydrants are in the test section, the test shall be against the main valve in the hydrant.

(c) Acceptance of installation. Acceptance shall be determined on the basis of testing allowance only. If any test of a new pipeline requires a quantity of makeup water greater that the testing allowance specified, repairs or replacement shall be accomplished in accordance to the purchaser's documents. All visible leaks are to be repaired regardless of the allowance used for testing.

Table 5A Hydrostatic testing allowance per 1,000 ft of pipeline* - gph

Average Test Pressure Psi	<u>Nominal Pipe Diameter, in.</u>											
	3	4	6	8	10	12	14	16	18	20	24	30
450	0.43	0.57	0.86	1.15	1.43	1.72	2.01	2.29	2.58	2.87	3.44	4.30
400	0.41	0.54	0.81	1.08	1.35	1.62	1.89	2.16	2.43	2.70	3.24	4.05
350	0.38	0.51	0.76	1.01	1.26	1.52	1.77	2.02	2.28	2.53	3.03	3.79
300	0.35	0.47	0.70	0.94	1.17	1.40	1.64	1.87	2.11	2.34	2.81	3.51
275	0.34	0.45	0.67	0.90	1.12	1.34	1.57	1.79	2.02	2.24	2.69	3.36
250	0.32	0.43	0.64	0.85	1.07	1.28	1.50	1.71	1.92	2.14	2.56	3.21
225	0.30	0.41	0.61	0.81	1.01	1.22	1.42	1.62	1.82	2.03	2.43	3.04
200	0.29	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72	1.91	2.29	2.87
175	0.27	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61	1.79	2.15	2.68
150	0.25	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99	2.48
125	0.23	0.30	0.45	0.60	0.76	0.91	1.06	1.21	1.36	1.51	1.81	2.27
100	0.20	0.27	0.41	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.62	2.03

* If the pipeline under test contains sections of various diameters, the testing allowance will be the sum of the testing allowance for each size.
 + Calculated on the basis of Eq 1.

Table 5B Hydrostatic testing allowance per 300 m of pipeline* - L/hr

Average Test Pressure kPA	<u>Nominal Pipe Diameter, mm.</u>											
	76	102	152	203	254	305	356	406	457	508	610	762
3,000	1.57	2.11	3.14	4.20	5.25	6.31	7.36	8.36	9.45	10.50	12.61	15.75
2,800	1.52	2.04	3.04	4.05	5.07	6.09	7.11	8.11	9.13	10.15	12.18	15.22
2,600	1.46	1.96	2.93	3.91	4.89	5.87	6.85	7.81	8.80	9.78	11.74	14.67
2,400	1.41	1.89	2.81	3.75	4.70	5.64	6.58	7.51	8.45	9.39	11.28	14.09
2,200	1.35	1.81	2.69	3.59	4.50	5.40	6.30	7.19	8.09	8.99	10.80	13.49
2,000	1.28	1.72	2.57	3.43	4.29	5.15	6.01	6.85	7.71	8.58	10.30	12.86
1,800	1.22	1.63	2.43	3.25	4.07	4.88	5.70	6.50	7.32	8.14	9.77	12.20
1,600	1.15	1.54	2.29	3.06	3.83	4.60	5.37	6.13	6.90	7.67	9.21	11.50
1,400	1.07	1.44	2.15	2.87	3.59	4.31	5.03	5.73	6.45	7.17	8.62	10.76
1,200	0.99	1.33	1.99	2.65	3.32	3.99	4.65	5.31	5.98	6.64	7.98	9.96
1,000	0.91	1.22	1.81	2.42	3.03	3.64	4.25	4.85	5.45	6.06	7.28	9.10
800	0.81	1.09	1.62	2.17	2.71	3.26	3.80	4.33	4.88	5.42	6.51	8.14
600	0.70	0.94	1.41	1.88	2.35	2.82	3.29	3.75	4.23	4.70	5.64	7.05

* If the pipeline under test contains sections of various diameters, the testing allowance will be the sum of the testing allowance for each size.
 + Calculated on the basis of Eq 2.

V.9 BACKFILLING

- A. All backfill must be compacted to a minimum of 96 percent of the maximum dry density as determined by (AASHTO T99, ASTM D698) Standard Proctor. The Contractor shall backfill from the bottom of the trench to the top of the pipe with sand, and the balance of the trench shall be backfilled using suitable material from the excavation.
- B. Utility Trenches: A minimum of one density test and moisture content shall be made for every 500 lineal feet of trench per four (4) feet of depth. A minimum of one (1) standard density and optimum moisture determination shall be made for each project/subdivision and one (1) additional test of each change in the backfill.
- C. Under existing or future pavements the backfill shall be placed and compacted in lifts of eight (8") inches maximum loose thickness.
- D. The Contractor shall bring all backfill material to not more than 4% above or 2% below the optimum moisture content before backfilling as determined by (AASHTO T99, ASTM D698) Standard Proctor.
- E. Tamping machinery and equipment shall be as approved by the Engineer. Machines too light for achieving the desired compaction and those that might damage the pipe will not be approved. The method of using the machines must also be as approved by the Engineer.
- F. For private development of public infrastructure, the Developer shall hire a recognized testing laboratory or consulting engineering firm to perform in-place density tests on trench backfill according to City of Norfolk Engineering Policy 2019-01. For projects bid through the City, the City shall be responsible for the testing.
- G. When in-place density tests are performed, the tests shall be performed in accordance with the procedures set forth in:

ASTM D 2167 (Rubber Balloon Method)

ASTM D 1556 (Sand Cone Method)

ASTM D 2922 (Nuclear Method)

- H. If the tests show non-compliance with the plans and specifications, the backfill shall be removed, replaced, and retested by the Contractor without extra compensation and at no extra cost to the Developer.

V.10 REMOVAL, RESTORATION, AND MAINTENANCE OF SURFACE

- A. The Contractor shall remove pavement and road surfaces as a part of the trench excavation, and the amount removed shall depend upon the width of trench specified for the installation of the pipe and the width end length of the pavement area required to be removed for the installation of gate valves, specials, manholes, or other structures.

Revised 02/2023

- B. The Contractor shall use a concrete saw cutting the full depth of the slab to assure the removal of the pavement along straight lines. The face of the remaining pavement shall be vertical and undamaged.
- C. If the Contractor removes or damages pavement or surfaces, such pavement and surfaces shall be replaced or repaired at the expense of the Contractor to the satisfaction of the Engineer.
- D. The Contractor shall replace all surface material, and shall restore paving (unless otherwise specified), curbing, sidewalk, gutters, shrubbery, fences, sod and other surfaces disturbed, to a condition equal to that before the work began, furnishing all labor and material incidental thereto. The subgrade for the new pavement must first be approved by the Engineer prior to placing concrete. No pavement shall be replaced until backfill compaction has been approved by the Engineer.
- E. Surplus material, tools and temporary structures shall be removed by the Contractor, and all dirt, rubbish, and excess earth from excavation shall be hauled away by the Contractor, and the construction site shall be left clean, to the satisfaction of the Engineer.
- F. Following the certification of completion by the Engineer, the Contractor shall maintain the surface of the unpaved trenches, curbs, sidewalks, gutters, shrubbery, fences, sod, and other surfaces disturbed for the period described in the General Provisions.
- G. All material and labor required for the maintenance of the trenches and adjacent structures shall be supplied by the Contractor and the work shall be done in a manner satisfactory to the Engineer.

V.11 STERILIZATION OF MAINS

- A. Before being placed in service, all new water distribution systems, or extensions to existing systems, or any valved section of such extension, or any replacement in the existing water distribution system shall be sterilized in accordance with the current version of ANSI/AWWA C651.
- B. The Contractor shall sterilize by the use of calcium hypochlorite tablets (comparable to commercial products known as "HTH", "Perchloron", and "Maxochlor"). The tablets shall be placed at each pipe joint in a sufficient number such that a minimum of 50-ppm available chlorine shall be present in the line. The newly laid pipe shall be filled very slowly (by the City Water Division) to avoid washing the tablets to the extremity of the pipeline. Disinfection tablets shall comply with NSF/ANSI 60.
- C. The treated water shall be retained in the pipe long enough to destroy all non-spore-forming bacteria. This period shall be at least 24 hours or as directed by the Engineer. In the process of chlorinating newly laid water pipe, all valves or other appurtenances shall be operated while the pipe line is filled with the treated water. After the chlorine treated water has been retained for the required time, the chlorine residual at pipe extremities and at other representative points shall be at least 5 ppm.

- D. Following sterilizations, all treated water shall be thoroughly flushed from the newly laid pipe line at its extremities by City Water Division until the replacement water throughout its length shall, upon test, both chemically and bacteriologically, be proven equal to the water quality served the public from the existing water supply system, and approved by the Department of Health and Human Services having jurisdiction. The bacteriological test shall at a minimum consist of two consecutive test samples taken a minimum 24 hours apart by City Water Division with both samples showing non-detect (N.D.) Coliform Growth. Samples shall be taken for every 1200 feet of pipe plus one additional sample at the end of the main.
- E. If the Contractor wishes to sterilize by a method other than the method indicated above; or it becomes necessary to re chlorinate the line; the Contractor shall submit in writing his proposed method to the Engineer for approval. The method chosen shall be in accordance with the current version of ANSI/AWWA Standard.
- F. The furnishing of materials and the labor and all other costs incidental to testing and sterilization shall be borne by the Contractor and merged into his bid price for construction of water mains.

V.12 GPS OF FITTINGS

- A. Contractor shall give city staff 24 business hour notice during business hours to GPS all water apparatuses.