



**SPECIAL PROVISIONS
FOR
WATER DISTRIBUTION SYSTEMS**

**Johnson County
BROS-3715(663)--8J-52**

**Effective Date
January 22, 2020**

THE STANDARD SPECIFICATIONS, SERIES 2015, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

156125.01 DESCRIPTION.

A. General.

Furnish, construct, test and disinfect water mains, valves, fire hydrants and appurtenances.

B. Submittals.

Comply with Article 1105.03 of the Standard Specifications, as well as the additional requirements listed below. Submit to the Engineer the following drawings or details for approval prior to installation. One copy of each with the approval stamp shall be kept at the work site at all times.

1. Shop and Working Drawings.

- a. Pipe layout with valves, fitting and hydrants shown
- b. Valves
- c. Hydrants
- d. Fittings
- e. Bolts
- f. Joints
- g. Tapping sleeves, couplings, and special piping materials
- h. Polyethylene
- i. Thrust block designs and details

2. Certificates.

Sworn certificates of shop tests showing compliance with appropriate standard for all piping materials.

3. Manufacturer's Literature.

- a. Catalog cuts of joints, couplings, gaskets, fasteners and other accessories.
- b. Brochures and technical data, coating and linings, and proposed method of application.

4. Plans for initial operations and final operations: Special prepared drawings and typed list of sequences of steps are needed prior to any operation of water distribution system. Submit 2 weeks prior to date of planned operation.

C. Delivery, Storage, and Handling.

Comply with Section 1106 of the Standard Specifications, as well as the following:

1. Remove pipe and fittings contaminated with mud and surface water from the site; do not use in construction unless thoroughly cleaned, inspected and approved by the Engineer.
2. Remove valves, fire hydrants, and appurtenances contaminated with mud and surface water from the site; do not use in construction unless thoroughly cleaned, inspected and approved by the Engineer.

D. Scheduling and Conflicts.

Comply with Article 1108.02, I of the Standard Specifications, as well as the following:

1. Notify the Engineer 2 working days in advance of testing or disinfection operations to coordinate the operations.
2. The Engineer or his/her representative is required to be in attendance during testing or disinfection.

156125.02 MATERIALS.

All products used for this work shall be from the list of "Accepted Products for Water Distribution Materials" found in Appendix A of this Special Provision.

A. Water Main.

1. Ductile Iron Pipe (DIP).

a. Minimum Wall Thickness.

1) **4 inch through 24 inch sizes:** Special thickness Class 52 according to AWWA C151.

2) **Restrained Joints:** Special thickness Class 53 according to AWWA C151.

b. Joint Type: Use push-on joint type, except as otherwise specified in the contract documents or as authorized by the Engineer. Trenchless installation requires restrained joint pipe.

1) **Push-on:** According to AWWA C900 or AWWA C905.

2) **Integral Restrained Joint:** AWWA C900 or AWWA C905 pipe with restraining system manufactured integrally into pipe end.

3) **Mechanical Restrained Joint:** Ductile iron mechanical device designed for joint restraint of AWWA C900 or AWWA C905 pipe complying with the requirements of ASTM F 1674.

c. Markings on Pipe.

1) Name of manufacturer.

2) Size and class.

3) Spigot insertion depth gauge.

4) National Sanitation Foundation (NSF) seal.

2. Bolts for Water Main and Fittings.

Use corrosion resistant bolts.

a. Tee-bolts and Hexagonal Nuts for Mechanical Joints

1) High strength, low alloy steel manufactured according to AWWA C111.

2) Provide ceramic filled, baked on, fluorocarbon resin coating for bolts and nuts.

3) Include factory applied lubricant that produces low coefficient of friction for ease of

installation.

b. Other Bolts and Nuts: Stainless steel.

B. Fittings.

1. For DIP and PVC Pipe:

- a. Comply with AWWA C110 (ductile iron or gray iron) or AWWA C153 (ductile iron) rated for 350 psi.
- b. **Joint Type:**
 - 1) For all pipe sizes, use restrained mechanical joint system. Provide follower gland using breakaway torque bolts to engage thrust restraint.
Minimum pressure rating same as connecting pipe. For fittings between dissimilar pipes, the minimum pressuring rating is the lesser of the two pipes.
Suitable for buried service.
 - 2) Joint restrain system to be field installable, field removable, and re-installable.
 - 3) Use of alternate restraint systems must be approved by the Engineer.
- c. **Lined:** Cement mortar lined according to AWWA C104 with asphalt coating.
- d. **Wall Thickness:** Comply with AWWA C153.
- e. **Gaskets:** Comply with AWWA C111.

2. Pipe Coupling.

- a. **Center Sleeve (Center Ring):** Steel pipe or tubing complying with ASTM A 53 or ASTM A 512, or formed carbon steel with a minimum yield of 30,000 psi.
- b. **End Ring (Follower Ring):** Ductile iron complying with ASTM A 536, or steel meeting or exceeding the requirements of ASTM A 576, grade 1010-1020.
- c. **Gaskets:** New rubber compounded for water service and resistant to permanent set.
- d. **Bolts and Nuts:** High strength, low alloy corrosion resistant steel or stainless steel.

C. Concrete Thrust Blocks.

1. Use Iowa DOT Class C concrete.
2. Comply with the contract documents for dimensions and installation of thrust blocks. Comply with Iowa DOT Standard Road Plan WM-101.
3. Use for all pipe sizes 12 inches in diameter or larger or when specified.

D. Pipeline Accessories.

1. Polyethylene Wrap.

- a. Comply with AWWA C105.
- b. Provide tubes or sheets with 8 mil minimum thickness.

2. Tracer System: Comply with Iowa DOT Standard Road Plan WM-102.

- a. **Tracer Wire.**
 - 1) Solid Single Copper Conductor.
 - 2) **Size:** No. 12 AWG
 - 3) **Insulation Material:** Linear low-density polyethylene (LLDPE) installation suitable for direct burial applications.
 - 4) **Insulation Thickness:** 0.045 inches, minimum.
- b. **Ground Rod:** 3/8 inch diameter, 60 inch steel rod uniformly coated with metallically bonded electrolytic copper.
- c. **Ground-rod Clamp:** High-strength, corrosion-resistant copper alloy.
- d. **Splice Kit:** See Tracer Wire Connector under the Accepted Products for Water Distribution

Materials.

E. Special Gaskets.

1. For soils contaminated with gasoline, use nitrile gaskets.
2. For soils contaminated with volatile organic compounds, contact Engineer for the required gaskets.
3. For other soil contaminants, contact the Engineer for the required gasket.

F. Water Service Pipe and Appurtenances.

1. **Controlling Standards:** Jurisdictional policies and procedures, plumbing and fire codes.
2. **Materials**
 - a. **Copper Pipe.**
 - 1) Comply with ASTM B 88.
 - 2) Wall Thickness: Type K.
 - b. **DIP:** As specified in Article 4150.02, A. Polyethylene wrap is required.
 - c. **PVC Pipe:** ASTM D 1785, Schedule 80 or ASTM D 2241, SDR 21. Provide solvent weld joints for all pipes.
 - d. **Brass Pipe:** Red, seamless, according to ASTM B 43.
 - e. **Polyethylene Pipe:** Class 200, according to AWWA C901.
3. **Corporations, Stops, and Stop Boxes:** See appendix.

G. Valves.

1. **General.**
 - a. **Valve Body:** Manufacturer's name and pressure rating cast on valve body.
 - b. **Direction of Opening:** Opening direction is counterclockwise as viewed from the top, unless otherwise specified in the contract documents or as directed by the City.
 - c. **Joints:** For buried installations, use mechanical joints per AWWA C111.
2. **Gate Valves.**
 - a. **Standards:** Comply with AWWA C509 (gray iron or ductile iron) and NSF 61.
 - b. **Stem Seals:** Double O-rings permanently lubricated between seals. Lubricant certified for use in potable water.
 - c. **External Bolts and Hex Nuts:** Stainless steel according to ASTM A 240, Type 304.
3. **Tapping Valve Assemblies.**

Gate valve complying with AWWA C509.
4. **Gasket**
 - a. To completely surround pipe
 - b. Minimum thickness 0.125 inch.
5. **Outlet Flange.**
 - a. Stainless steel, according to ASTM A 240, Type 304.
 - b. ANSI B16.1, 125 pound pattern.
6. **Hex Nuts and Bolts.**

Stainless Steel according to ASTM A240, Type 304.

H. Fire Hydrant Assembly.

1. **Material:** Comply with AWWA C502.
2. **Manufacturers:** See appendix.
3. **Features.**
 - a. **Breakaway Items:** Stem coupling and flange.
 - b. **Inlet Nominal Size:** 6 inch diameter.
 - c. **Inlet Connection Type:** Mechanical joint.
 - d. **Hose Nozzles:** Two, each 2 1/2 inches in diameter, caps attached to hydrant with chains.
 - e. **Direction of Opening:** Clockwise, unless otherwise specified.
 - f. **Items to be Specified:** The following items will be specified by the Jurisdiction or in the contract documents.
 - 1) Operating nut: 1 1/2 inches, standard pentagon.
 - 2) Pumper nozzle: One 4 1/2 inch pumper nozzle.
 - 3) Nozzle threads: National standard hose threads.
 - 4) Main valve nominal opening size: 4 1/2 inches on mains smaller than 12 inches in diameter, 5 1/4 inches on main 12 inches and larger in diameter.
 - g. **Barrel Extensions:** Solid barrel without threading; only on (single) extension installed per hydrant.
4. **Painting.**
 - a. Shop coating according to AWWA C502.
 - b. Above grade exterior coating type will be Safety Red unless otherwise specified by the Engineer.
5. **External Bolts and Hex Nuts:** Stainless steel according to ASTM A 193, Grade B 8.
6. **Gate Valve:** Comply with this Special Provision.
7. **Pipe and Fittings:** Comply with this Special Provision.

I. Appurtenances.

1. **Flushing Device (Blowoff):** As specified in the contract documents.
2. **Valve Box.**
 - a. **Applicability:** For all buried valves.
 - b. **Manufacturer:** See appendix.
 - c. **Type:** Slip (slide) type.
 - d. **Material:** Gray iron.
 - e. **Cover:** Gray iron, labeled "WATER".
 - f. **Wall Thickness:** 3/16 inch, minimum.
 - g. **Inside Diameter:** 5 inches, minimum.
 - h. **Length:** Adequate to bring top to finished grade, including valve box extensions, if necessary.
 - i. **Factory Finish:** Asphalt coating.
 - j. **Valve Box Centering Ring:** Include in installation.
3. **Valve Stem Extension:** Provide as necessary to raise 2 inch operating nut to within 5 or 6 feet of the finished grade. Stem diameter shall be according to valve manufacturer's recommendations, but not less than 1 inch. It shall also be stainless steel.
4. **Stainless Steel Repair Clamps:**

- a. All stainless steel, single section, double section, or triple section, depending upon size of main.
- b. Shall have stainless steel bolts and nuts.

J. Disinfection Agent - Chlorine.

1. Liquid Chlorine complying with AWWA B300 and AWWA B301.
2. Sodium Hypochlorite complying with AWWA B300.
3. Calcium Hypochlorite complying with AWWA B300.
4. All disinfecting agents to be NSF 60 certified. Supply and store in the original container.

156125.03 CONSTRUCTION.

A. Pipe Installation.

1. General.

- a. Do not use deformed, defective, gouged, or otherwise damaged pipes or fittings.
- b. Keep trench free of water. Clean pipe interior prior to placement in the trench.
- c. Install pipe with fittings and valves to lines/grades specified in the contract documents.
- d. Clean joint surfaces thoroughly and apply lubricant approved for use with potable water and recommended by the manufacturer.
- e. Push pipe joint to indication line on spigot end of pipe before making any joint deflections.
- f. Limit joint deflections to 1 degree less than pipe manufacturer's recommended maximum limit.
- g. Tighten bolts in a joint evenly around the pipe.
- h. Install concrete thrust blocks on all fittings 12 inches in diameter or larger (comply with Iowa DOT Standard Road Plan WM-101). For fittings larger than 12 inches, install restrained joints, and when specified in the contract documents, also install concrete thrust blocks.
- i. Keep exposed pipe ends closed with rodent-proof end gates at all times when pipe installation is not occurring.
- j. Close ends of installed pipe with watertight plugs during nights and non-working days. Do not allow any water from the new pipeline to enter the existing distribution system piping until testing and disinfection are successfully completed.

2. Trenched.

- a. Excavate trench and place pipe bedding and backfill material as specified in Section 2552 of the Standard Specifications, except that water main shall be backfilled with either of the following and compacted to 95% standard proctor density:
 - 1) Suitable excavated material in accordance with Section 2552 of the Standard Specifications. If excavated material is not suitable, then;
 - 2) Class A roadstone (Gradation No. 11 of the Standard Specifications).
- b. All water main shall be provided with Class P-2 trench bedding (Iowa DOT Standard Road Plan SW-104).
- c. Provide uniform bearing along the full length of the pipe barrel. Provide bell holes.

3. Trenchless: Comply with Section 2553 of the Standard Specifications.

B. Additional Requirements for DIP Pipe Installation.

1. Utilize full-length gauged pipe for field cuts. Alternatively, field-gauge pipe selected for cutting to verify the outside diameter is within allowable tolerances.

2. Cut the pipe perpendicular to the pipe barrel. Do not damage the cement lining. Bevel cut the ends for push-on joints according to the manufacturer's recommendations.
3. Encase all pipe, valves, and fittings with polyethylene wrap according to this Special Condition.

C. Polyethylene Encasement Installation.

1. Apply polyethylene encasement to buried ductile iron pipe and to buried fittings, fire hydrants, and appurtenances. The polyethylene encasement is used to prevent contact between the pipe and the bedding material, but need not be airtight or watertight.
2. Install polyethylene encasement according to AWWA C105, using tubes or flat sheets, and pipe manufacturer's recommendations.
3. Do not expose the polyethylene encasement to sunlight for long periods before installation.
4. Remove all lumps of clay, mud, cinders, etc. on the pipe surface before encasing the pipe. Take care to prevent soil or bedding material from becoming trapped between the pipe and polyethylene.
5. Lift polyethylene-encased pipe with a fabric-type sling or padded cable.
6. Secure and repair encasement material using polyethylene tape, or replace as necessary.

D. Tracer System Installation.

1. Install with all buried water main piping (comply with Iowa DOT Standard Road Plan WM-102 for tracer wire installation).
2. Begin and terminate the system at all connections to existing mains.
3. Install wire continuously along the lower quadrant of the pipe. Do not install wire along the bottom of the pipe. Attach wire to the pipe at the midpoint of each pipe length; use 2 inch wide, 10 mil thickness polyethylene pressure sensitive tape.

Install splices only as authorized by the Engineer. Allow the Engineer to inspect all below-grade splices of tracer wire prior to placing the backfill material.

4. Install ground rods adjacent to connections to existing pipe in native, undisturbed soil and at locations specified in the contract documents or as directed by the Engineer.
5. Bring two wires to the surface at each fire hydrant location and terminate with a tracer wire station (Iowa DOT Standard Road Plans WM-102 and WM-201) set flush with the grade adjacent to the hydrant.
6. Final inspection of the tracer system will be conducted at the completion of the project and prior to acceptance by the owner. Verify the electrical continuity of the system. Repair discontinuities.
7. A minimum of 18 inches of wire slack at every tracer wire terminal box lid shall be installed.
8. Every splice along the tracer wire shall have a minimum of 18 inches of wire slack added to the line.
9. No uninsulated wire shall be installed along any length of run or at splice points. All exposed wire

shall be mended as directed by the Engineer, and all splices shall include dielectric grease.

10. Ground rods should be placed 6 to 10 inches from the pipe and not make contact with any part of the water system or any other utility.

E. Fire Hydrant, Valve and Appurtenance Installation.

1. Install according to the contract documents.
2. Apply polyethylene wrap to all iron pipe, valves, fire hydrants, and fittings.
3. Set tops of valve boxes to finished grade, unless otherwise directed by the Engineer.
4. Check the working order of all valves by opening and closing through entire range. Before opening the valves, check with the Jurisdiction on operating requirements.
5. Test and disinfect all valves, fire hydrants, and appurtenances as components of the completed water main.

F. Flushing Device (Blowoff).

Install and construct as specified in the contract documents.

G. Fire Hydrant.

1. Install according to Iowa DOT Standard Road Plan WM-201.
2. If the fire hydrant valve is positioned adjacent to the water main, attach it to an anchor tee.
3. If the fire hydrant valve is positioned away from the water main, restrain all joints between the valve and water main.
4. Fire Hydrant Depth Setting.
 - a. Use adjacent finished grade to determine setting depth.
 - b. Set bottom of breakaway flange between 2 and 5 inches above finished grade.
 - c. If finished grade is not to be completed during the current project, consult with the Engineer for proper setting depth.
5. Coordinate installation with tracer wire installation.
6. Orient fire hydrant nozzles as directed by the Engineer.

H. Adjustment of Existing Valve Box or Fire Hydrant.

1. **Minor Valve Box Adjustment:** For existing adjustable boxes that have sufficient adjustment range to bring to finished grade, raise or lower valve box to finished grade. Valve boxes should be centered over valve operating nut and run straight (not angled).
2. **Valve Box Extension:** For existing valve boxes that cannot be adjusted to finished grade, install valve box extensions as required.
3. **Fire Hydrant Adjustment.**
 - a. Add extension barrel sections and stems as necessary (12 inch maximum extension height) to set existing fire hydrant at finished grade.
 - b. Paint exterior of new barrel section to match existing fire hydrant unless otherwise specified.

I. Conflicts.**1. Horizontal Separation of Gravity Sewers from Water Mains.**

- a. Separate gravity sewer mains from water mains by a horizontal distance of at least 10 feet unless:
 - The top of sewer main is at least 18 inches below the bottom of the water main, and
 - The sewer is placed in a separate trench or in the same trench on a bench of undisturbed earth at a minimum horizontal separation of 3 feet from the water main.
- b. When it is impossible to obtain the required horizontal clearance of 3 feet and a vertical clearance of 18 inches between sewers and water mains, the sewers must be constructed of water main materials meeting the requirements of Article 4150.02, A of the Standard Specifications. However, provide a linear separation of at least 2 feet.

2. Separation of Sewer Force Mains from Water Mains.

Separate sewer force mains and water mains by a horizontal distance of at least 10 feet unless:

- a. The force main is constructed of water main materials meeting a minimum pressure rating of 150 psi and the requirements of Article 4150.02, A of the Standard Specifications, and
- b. The sewer force main is laid at least 4 linear feet from the water main.

3. Separation of Sewer and Water Main Crossovers.

- a. Vertical separation of sanitary and storm sewers crossing under any water main should be at least 18 inches when measured from the top of the sewer to the bottom of the water main. If physical conditions prohibit the separation, the sewer may be placed not closer than 6 inches below a water main or 18 inches above a water main. Maintain the maximum feasible separation distance in all cases. The sewer and water pipes must be adequately supported and have watertight joints. Use a low permeability soil for backfill material within 10 feet of the point of crossing.
- b. Where the sanitary sewer crosses over or less than 18 inches below a water main, locate one full length of sewer pipe of water main material so both joints are as far as possible from the water main.
- c. Where the storm sewer crosses over or less than 18 inches below a water main, locate one full length of sewer pipe of water main material or reinforced concrete pipe (RCP) with flexible gasket joints meeting ASTM C443 so both joints are as far as possible from the water main.

J. Water Service Stub.

1. Install water service pipe, corporations, stops, and stop boxes according to local Jurisdiction requirements.
2. Construct trench and place backfill material according to Standard Road Plans SW-101 and SW-104.

K. Sequence of Testing and Disinfection.

Perform operations according to AWWA C651 in the sequence below. Successfully complete each operation before continuing to the next operation. The City will provide reasonable quantities of water for flushing and testing. All main shall pass bacteriological sampling before pressure testing. Testing Segments shall be no longer than 1,200 feet. All legs or laterals shall be tested as separate segments. Water main must pass all testing before any main or service taps are made.

1. **Continuous-Feed or Slug Method (After Water Main Installation):** The sequence of testing and disinfection may be modified with approval of the Engineer.
 - a. Perform initial flush.
 - b. Perform disinfection.
 - c. Flush after disinfection.

- d. Perform bacteriological sampling.
- e. Perform pressure and leak testing.

2. Tablet Method (Concurrent with Water Main Installation): Use this method only if approved by the Engineer. Modify the procedure for flushing, disinfection, and pressure and leak testing as needed if tablet method is used.

- a. Perform disinfection.
- b. Flush after disinfection.
- c. Perform bacteriological sampling.
- d. Perform pressure and leak testing.

L. Initial Flushing.

1. Flushing.

- a. Coordinate flushing with the Engineer.
- b. Flush pipe prior to disinfection using potable water.
- c. Measure flushing velocity.
- d. Obtain a minimum flushing velocity of 3 feet per second in the pipe to be disinfected.

2. Minimum Flushing Rate: According to AWWA C651, Table 3, based on 40 psi residual pressure (see table below).

Table 150429.03-1: Minimum Flushing Rate

Pipe Diameter (inches)	Flow Rate for Flushing (gpm)	Number of Taps ²			Number of 2 1/2" Fire Hydrant Outlets ¹
		1"	1 1/2"	2"	
4	100	1	-	-	1
6	200	-	1	-	1
8	400	-	2	1	1
10	600	-	3	2	1
12	900	-	-	2	2
16	1,600	-	-	4	2

¹With a 40 psi pressure in the main with the fire hydrant flowing to atmosphere, a 2 1/2 inch fire hydrant outlet will discharge approximately 1000 gpm; and a 4 1/2 inch fire hydrant outlet will discharge approximately 2500 gpm.

²Number of taps on pipe based on discharge through 5 feet of galvanized iron pipe with one 90 degree elbow.

3. Property Protection: Protect public and private property from damage during flushing operations.

M. Disinfection.

1. General.

- a. Disinfect according to AWWA C651. The tablet method contained in AWWA C651 is not to be used unless approved by the Engineer.
- b. Keep piping to be chlorinated isolated from lines in service and from points of use.
- c. Coordinate disinfection and testing with the Engineer.
- d. Obtain and test water samples, unless otherwise provided by the Engineer.

2. Procedure.

- a. Induce a flow of potable water through the pipe.
- b. Introduce highly chlorinated water to the pipe at a point within 5 pipe diameters of the pipe's connection to an existing potable system, or within 5 pipe diameters of a closed end, if there is no connection to an existing system.

- c. Introduce water containing a minimum of 25 mg/L free chlorine until the entire new pipe contains a minimum of 25 mg/L free chlorine.
- d. Retain chlorinated water in the pipe for at least 24 hours and no more than 48 hours.
- e. After 24 hours, a detectable free chlorine residual of:
 - 1.) Greater than or equal to 0.2 mg/L for the tablet method or
 - 2.) Greater than or equal to 10 mg/L for the continuous feed method shall be found at each sample point.

N. Final Flushing.

1. Flush pipe using potable water until chlorine residual equals that of the existing potable water system.
2. Dispose of chlorinated water to prevent damage to the environment. Dechlorinate highly chlorinated water from testing before releasing into the ground or sewers. Obtain Engineer approval prior to flushing activities.
 - a. Check with the local sewer department for the conditions of disposal to the sanitary sewer.
 - b. Chlorine residual of water being disposed will be neutralized by treating with one of the chemicals listed in the following table.

Table 150429.03-2: Amounts of Chemicals Required to Neutralize Various Residual Chlorine Concentrations in 100,000 Gallons of Water

Residual Chlorine Concentration mg/L	Sulfur Dioxide (SO ₂) lb	Sodium Bisulfite (NaHSO ₃) lb	Sodium Sulfite (Na ₂ SO ₃) lb	Sodium Thiosulfate (Na ₂ S ₂ O ₃ + 5H ₂ O) lb	Ascorbic Acid (C ₆ O ₈ H ₆) lb
1	0.8	1.2	1.4	1.2	2.1
2	1.7	2.5	2.9	2.4	4.2
10	8.3	12.5	14.6	12.0	20.9
50	41.7	62.6	73.0	60.0	104

O. Pressure and Leak Testing.

1. Secure unrestrained pipe ends against uncontrolled movement.
2. Isolate new piping from the existing water system.
3. Fill and flush all new piping with potable water. Ensure all trapped air is removed.
4. Pressurize the new pipe to the test pressure at the highest point in the isolated system. Do not pressurize to more than 5 psi over the test pressure at the highest point in the isolated system.
5. Test and monitor the completed piping system at 1.5 times the system working pressure or 150 psi, whichever is greater, for 2 continuous hours.
6. The addition of makeup water is not allowed.
7. If the measured pressure loss does not exceed 5psi, the test will be considered acceptable.
8. Repair all visible leaks regardless of the amount of leakage.

P. Bacteria Sampling.

Test water mains according to AWWA C651. Repeated failure to produce satisfactory bacteriological

results, or if other water quality is affected, will require corrective action up to and including repeating the disinfection procedure or physically cleaning the main as approved by the Engineer.

Q. System Trace.

All tracer wire terminal boxes shall be to grade, located appropriate distance from hydrant or valve, and with tracer wire correctly attached. The Engineer shall complete a trace to the new pipe(s), including connections to the existing main. Any tracing deficiencies noted by the Engineer shall be corrected and retraced until the entire system traces correctly.

R. Putting Water Main in Service.

1. The following verifications are required to be coordinated with the City and completed by the Contractor:
 - a. All new valves are to be located and tested to verify operation. Remove the valve box lid, insert the valve key and open and close each valve.
 - b. Fire hydrants shall be tested to verify operation.
 - c. Flow tests shall be conducted to verify that all components of the water system are fully open and operational and to determine fire flow capacity.
2. Put completed water system in service only after obtaining permission from the City.

156125.04 METHOD OF MEASUREMENT.

A. Water Main.

1. Trenched.

Each type and size of pipe installed in an open trench will be measured in linear feet along the centerline of the pipe, including the length through the fittings.

2. Trenchless.

Each type and size of pipe installed by trenchless methods will be measured in linear feet along the centerline of the pipe.

B. Fittings.

Each type and size of fitting installed as specified in the contract documents or as required for proper installation of the water main will be counted.

C. Water Service Stubs by Length.

1. Water Service Pipe.

Each type and size of water service pipe will be measured in linear feet along the centerline of the pipe.

2. Water Service Corporation.

Each type and size of water service corporation will be counted.

3. Water Service Curb Stop and Box.

Each type and size of water service curb stop and box will be counted.

D. Valve (Butterfly or Gate).

Each type and size of valve will be counted.

E. Tapping Valve Assembly.

Each size of tapping valve assembly will be counted.

F. Fire Hydrant Assembly.

Each fire hydrant assembly will be counted.

G. Valve Box Adjustment, Minor.

Minor adjustment of an existing valve box by raising or lowering the adjustable valve box is incidental.

H. Valve Box Extension.

Each existing valve box adjusted to finished grade by adding a valve box extension will be counted.

I. Fire Hydrant Adjustment.

Each existing fire hydrant adjusted to finished grade by addition of an extension barrel section and stem will be counted.

J. Testing and Disinfection.

None.

156125.05 BASIS OF PAYMENT.**A. Water Main.****1. Trenched.**

Payment will be made at the unit price per linear foot for each type and size of pipe. Unit price includes, but is not limited to, trench excavation, dewatering, furnishing bedding material, placing bedding and backfill material, tracer system, testing, disinfection, and polyethylene wrap for ductile iron pipe and for fittings.

2. Trenchless.

Payment will be made at the unit price per linear foot for each type and size of pipe. Unit price includes, but is not limited to, furnishing and installing pipe; trenchless installation materials and equipment; pit excavation, dewatering, and placing backfill material; tracer system; testing; and disinfection.

B. Fittings.

Payment will be made at the unit price for each type and size of fitting. Unit price includes, but is not limited to, restrained joints and thrust blocks

C. Water Service Stubs by Length.**1. Water Service Pipe.**

Payment will be made at the unit price per linear foot of each type and size of water service pipe. Unit price includes, but is not limited to, trench excavation, dewatering, furnishing bedding material, installation of tracer wire system for non-metallic service pipe, and placing bedding and backfill material.

2. Water Service Corporation.

Payment will be made at the unit price for each type and size of water service corporation.

3. Water Service Curb Stop and Box.

Payment will be made at the unit price for each type and size of water service curb stop and box.

D. Valve (Butterfly or Gate).

Payment will be at the unit price for each type and size of valve. Unit price includes, but is not limited to, all components attached to the valve or required for its complete installation, including

underground or above ground operator, square valve operating nut, valve box and cover, valve box extension, and valve stem extension.

E. Tapping Valve Assembly.

Payment will be at the unit price for each tapping valve assembly. Unit price includes, but is not limited to, tapping sleeve, tapping valve, the tap, valve box and cover, valve box extension, and valve stem extension.

F. Fire Hydrant Assembly.

Payment will be at the unit price for each fire hydrant assembly. Unit price includes, but is not limited to, the fire hydrant, barrel extensions sufficient to achieve proper bury depth of anchoring pipe and height of fire hydrant above finished grade, and components to connect the fire hydrant to the water main, including anchoring pipe, fittings, thrust blocks, pea gravel or porous backfill material, and fire hydrant gate valve and appurtenances, except tapping valve assembly if used.

G. Valve Box Adjustment, Minor.

Minor adjustment of an existing valve box by raising or lowering the adjustable valve box is incidental.

H. Valve Box Extension.

Payment will be at the unit price for each valve box extension.

I. Fire Hydrant Adjustment.

Payment will be at the unit price for each adjustment of an existing fire hydrant. The unit price for each adjustment of an existing fire hydrant includes, but is not limited to, removal and reinstallation of the existing fire hydrant; furnishing and installing the extension barrel section and stem; and all other necessary appurtenances.

J. Testing and Disinfection.

Testing and disinfection of water systems is incidental to the construction of pipe and fittings.