



Iowa Department of Transportation

**SPECIAL PROVISIONS**  
**for**  
**WATER DISTRIBUTION SYSTEM**

**Johnson County**

**ESIM-080-6(285)243- -0S-52**

**Effective Date**  
**December 15, 2009**

**THE ENGLISH STANDARD SPECIFICATIONS, SERIES OF 2009, ARE AMENDED BY THE FOLLOWING MODIFICATIONS. THESE ARE SPECIAL PROVISIONS AND SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.**

## **PART 1 DESCRIPTION**

### **1.01 SUMMARY**

- A. Section Includes:
1. Underground water main piping, fittings, joints and appurtenances.
  2. Disinfection and hydrostatic testing of potable water distribution system.
  3. Testing and reporting results.
  4. Thrust restraint.

### **1.02 REFERENCES**

- A. This special provision references the following documents. In their latest edition, the referenced documents form a part of this special provision to the extent specified herein. In case of conflict, the requirements of this specification shall prevail. One copy of all references shall be kept on the site, readily available and accessible to the Engineer during normal working hours. Copies may be obtained from the organizations or from the City of Iowa City Water Department at cost plus 15%.
- B. *American National Standards Institute and American Water Works Combined Standards:*
1. ANSI/AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
  2. ANSI/AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.
  3. ANSI/AWWA C110 - Ductile-Iron and Gray-Iron Fittings, 3 inch through 48 inch, for Water and Other Liquids.
  4. ANSI/AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
  5. ANSI/AWWA C115 - Flanged Ductile-Iron Pipe with Threaded Flanges.
  6. ANSI/AWWA C150 - Thickness Design of Ductile-Iron Pipe.
  7. ANSI/AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast, for Water and Other Liquids.
  8. ANSI/AWWA C153 - Ductile-Iron Compact Fittings, 3 inch through 16 inch, for Water and Other Liquids.
  9. ANSI/AWWA C500 - Gate Valves for Water and Sewerage Systems.
  10. ANSI/AWWA C502 - Dry-Barrel Fire Hydrants.
  11. ANSI/AWWA C504 - Rubber Seated Butterfly Valves.
  12. ANSI/AWWA C506 - Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types.
  13. ANSI/AWWA C509 - Resilient Seated Gate Valves for Water and Sewerage Systems.
  14. ANSI/AWWA C512 - Air/Vacuum Valve.
  15. ANSI/AWWA C550 - Protective Epoxy Interior Coatings for Valves and Hydrants.
  16. ANSI/AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
  17. ANSI/AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
  18. ANSI/AWWA C651 - Disinfecting Water Mains.
  19. ANSI/AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 inch through 12 inch for Water.
  20. ANSI/AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe, 14 inch through 36 inch for Water.
  21. ANSI/AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
- C. *American National Standards Institute and American Society for Testing Materials Combined Standards:*

1. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 kg) Rammer and 18 inch (457 mm) Drop.
- D. *American Association of State Highway and Transportation Officials:*
  1. AASHTO T180 - Moisture-Density Relations of Soils Using a 10 lb. (4.54 kg) Rammer and an 18 in. (457 mm) Drop.

### 1.03 SUBMITTALS

- A. Product Data: Provide data indicating pipe and pipe accessories.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Test Reports: Indicate results comparative to specified requirements.
- D. Certificate: Certify that cleanliness of water distribution system meets or exceeds specified requirements.
- E. Submit the following as appropriate for each valve and hydrant provided.
  1. Outline and installation drawings for equipment and fixtures furnished.
  2. Equipment performance data and operating characteristics.
  3. Manufacturer's catalog data, marked to indicate materials being furnished as standard equipment, fixtures, specialties, and accessories.
- F. Operation and Maintenance manuals.

### 1.04 QUALITY ASSURANCE

- A. The Contractor shall employ and pay for services of the independent testing laboratory for tests required to show compliance with the specifications. Test results submitted directly to the Engineer. Selection of the testing laboratory is subject to approval of the Engineer.
- B. Whenever a percentage of compaction is indicated or specified, use percent of maximum density at optimum moisture as determined by ASTM D698-00a.
- C. Perform work in accordance with ANSI/AWWA C651.
- D. Pipe: Nominal pipe size, material code designation, standard dimension ratio, pressure rating, manufacturer's name or trade mark, National Sanitation Foundation seal, and appropriate ASTM designation numbers marked on pipe.
- E. Fittings and Valves: Manufacturer's name and pressure rating marked on body.

### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products in accordance with manufacturer's instructions.
- B. Deliver and store valves in shipping containers with labeling in place.
- C. Deliver, store and handle materials according to manufacturers instructions.
- D. Protect plastic materials from sunlight.

### 1.06 WARRANTY

- A. Full warranty against defects in materials and quality for two years after final acceptance by the Contracting Authority, including all parts, labor, and expenses.

### 1.07 SEQUENCING/SCHEDULING

- A. Coordinate scheduling, submittals, and work elements to assume efficient and orderly sequence of installation of interdependent construction elements.

### 1.08 PROJECT RECORD DOCUMENTS

- A. Accurately record location of pipe runs, fittings, connections, hydrants, valves, and depth of cover.
- B. Identify and describe unexpected variations in subsoil conditions or discovery of uncharted utilities.
- C. Disinfection report; record:
  1. Type and form of disinfectant used.

2. Date and time of disinfectant injection start and time of completion.
  3. Test locations.
  4. Initial and 24-hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
  5. Date and time of flushing start and completion.
  6. Disinfectant residual after flushing in ppm for each outlet tested.
- D. Bacteriological report; record:
1. Date issued, project name, and testing laboratory name, address, and telephone number.
  2. Time and date of water sample collection.
  3. Name of person collecting samples.
  4. Test locations.
  5. Initial and 24-hour disinfectant residuals in ppm for each outlet tested.
  6. Coliform bacteria test results for each outlet tested.
  7. Certification that water conforms, or fails to conform, to bacterial standards of Iowa Department of Natural Resources.
  8. Bacteriologist's signature and authority.

### **1.09 FIELD MEASUREMENTS**

- A. Verify that field measurements and elevations are as indicated.

### **1.10 QUALIFICATIONS**

- A. Testing Firm: Company specializing in testing potable water systems, certified and approved by the State of Iowa for microbiological testing.

### **1.11 REGULATORY REQUIREMENTS**

- A. Conform to applicable Iowa Department of Natural Resources and State Health Department code or regulation for performing the work of this Section.
- B. Provide certificate of compliance from authority having jurisdiction indicating approval of water system.

## **PART 2 MATERIALS**

### **2.01 WATER PIPE**

- A. Ductile Iron Pipe: ANSI/AWWA C151, Class 52, inside nominal diameters as shown on the Plans. All materials shall be of domestic manufacture.
1. Exterior Coating: Asphaltic coating, 1-mil thickness.
  2. Interior Coating: ANSI/AWWA C104 standard thickness cement lining with seal coat.
  3. Joints: ANSI/AWWA C111, rubber gasket, push-on or mechanical joint type.
  4. Fittings: ANSI/AWWA C153/A21.53 and ANSI/AWWA C110/A21.10, ductile iron, mechanical joints, asphaltic exterior coating 1-mil thick, ANSI/AWWA C104 standard thickness interior cement lining with seal coat. Working pressure 350 PSI.
  5. Polyethylene Jacket: ANSI/AWWA C105, polyethylene encasement for ductile iron piping for water and other liquids.
  6. Bolts and nuts.
    - a. Corten
    - b. Ductile Iron
    - c. Stainless steel
  7. Restrained Joint Ductile Iron Pipe:
    - a. Restrained joint design: Flexible type, capable of being deflected 3 degrees after assembly.
    - b. Restrained joint design: Boltless "lock ring" type for DIP.

- c. Spigot end restrained joint pipe for bolted connection to mechanical joint fittings and valves may also be required.
- d. Restraining gaskets not acceptable.
- 8. Approved Manufacturers:
  - a. American
  - b. Clow
  - c. Griffin
  - d. McWane
  - e. Tyler
  - f. US Pipe
  - g. Engineer-Approved Equivalent
- B. Restraining mechanisms, tie rods, clamps or other components of dissimilar metal shall be protected against corrosion by hand application of a suitable coating or by encasement of the entire assembly with 8-mil thick (0.2 mm) loose polyethylene film in accordance with ANSI/AWWA C105/A21.5.

## 2.02 FITTINGS

- A. General:
  - 1. Ductile iron compact fittings, mechanical joint, AWWA C153, 350 psi minimum pressure rating in cases where compact fittings are available; ductile iron standard fittings, mechanical joint, AWWA C110, 250 psi minimum pressure rating, only when C153 fittings are unavailable. Asphaltic exterior coating 1-mil thick, AWWA C104 standard thickness interior cement lining with seal coat.
  - 2. Bolts and nuts as specified for ductile iron pipe.
  - 3. Wrap fittings with polyethylene film, as specified for ductile iron pipe.
  - 4. Bed fitting with granular pipe bedding, as specified.
- B. Couplings: Install where indicated on the Plans. Ductile iron with stainless steel bolts and nuts. Working pressure of 150 psi. Connections shall be made with solid sleeves and mechanical joint retainer glands by EBAA Iron Sales, Inc. (Megalug), Clow Corporation, American Cast Iron Pipe Company or Engineer-approved equivalent.
- C. Cutting-In-Sleeves: Install where indicated on the Plans. As manufactured by EBAA Iron Sales, Inc., Clow Corporation, American Cast Iron Pipe Company, or Engineer-approved equivalent.
- D. Mechanical Joint Retainer Glands: Install where indicated on the Plans. As manufactured by EBAA Iron Sales, Inc. (Megalug), Clow Corporation, American Cast Iron Pipe Company, or Engineer-approved equivalent.
- E. Mechanical Joint Caps and Plugs: Install where indicated on the Plans. MJ caps and plugs by EBAA Iron Sales, Inc., Clow Corporation, American Cast Iron Pipe Company, or Engineer-approved equivalent.
- F. Anchoring Pipe and Couplings: Install where indicated on the Plans. Utilized for hydrant leads, branch line stubs, and dead ends, in conjunction with mechanical joint pipe, fittings, valves, and hydrants. MJ anchoring pipe, couplings, and fittings by EBAA Iron Sales, Inc., Clow Corporation, American Cast Iron Pipe Company, or Engineer-approved equivalent.
- G. Mechanical Joint Tapping Sleeves and Crosses: Install where indicated on the Plans. Cast iron two-section construction. Mechanical joint ends, flanged outlet for tapping valve. Tapping sleeve and crosses by Mueller Company, Clow Corporation, American Cast Iron Pipe Company, or Engineer-approved equivalent.
- H. Stainless Steel Tapping Sleeves: Install where indicated on the Plans. All stainless steel two-section construction with stainless steel flanged outlet for tapping valve. Stainless steel bolts and nuts.
- I. Mechanical Joint Split Repair Sleeves: Install as approved to repair main breaks. Cast iron two-section construction, mechanical joint ends.

- J. Stainless Steel Repair Clamps: Install as approved to repair main breaks. All stainless steel, single section, double section, or triple section, depending upon size of main. Stainless steel bolts and nuts.

**2.03 BORINGS**

- A. Casing pipe: Uncoated, smooth wall welded steel pipe, ASTM A139; use for railroad, street and highway crossings or where shown on the Plans.
  - 1. Minimum wall thickness:

<u>Pipe Diameter</u> (Inches)	<u>Wall Thickness</u> (Inches)
20 or less	0.375
24	0.375
30 or greater	0.375
  - 2. Welded joints: Comply with American Welding Society Code of Arc and Gas Welding in Building Construction.
  - 3. Bevel or space ends of pipe to insure penetration of weld for full thickness of pipe.
- B. Casing skids: Water main 4 inches diameter and larger installed through casing shall have pressure treated wood skids thick enough to provide clearance between the casing and the pipe couplings strapped to the pipe.
- C. Casing skid strapping material: Stainless steel bands or straps and not wires.
- D. Grouting for voids, abandoned holes by boring, jacking or tunneling; and annular space at ends of casing: Shall be a sand cement slurry with a minimum of two (2) sacks of cement per cubic yard and a minimum of water to assure satisfactory placement.
  - 1. Annular space at ends at ends of casing can be sealed with concrete or grout (as specified above).

**2.04 VALVES**

- A. Resilient Seated Gate Valves:
  - 1. All valves shall be of the iron-body resilient-wedge type with non-rising stems, sizes 3-inch NPS through 12-inch NPS in diameter.
  - 2. All valves by the same manufacturer.
  - 3. Specification Standard: ANSI/AWWA C509.
  - 4. Body, Bonnet, Stuffing Box: Cast iron or ductile iron.
  - 5. Bolts and Nuts: Stainless steel.
  - 6. Valve Ends: Mechanical joint or push-on ends.
  - 7. Wedge: Cast iron or ductile iron, resilient coated.
  - 8. Stem: Manganese bronze, non-rising stem.
  - 9. Seals: Synthetic rubber O-rings.
  - 10. Stem Extensions: Steel, noted on the Plans if required.
  - 11. Operator: 2" square nut.
  - 12. Coating: ANSI/AWWA C550 epoxy coating, both inside and outside of body, bonnet, and stuffing box.
  - 13. Pressure Rating: 200 psi, bubble-tight closure.
  - 14. Direction of Operation: left Counterclockwise to open.
  - 15. Smooth, unobstructed waterway with a diameter not less than the full nominal diameter of the valve.
  - 16. Wrap valves with polyethylene encasement.
  - 17. Approved Manufacturers:
    - a. Clow, Model: F-6100
    - b. Kennedy, Model: Fig. 1571-X
    - c. Mueller, Model: Resilient Wedge
    - d. Engineer-approved equivalent.

- B. Tapping Valves: Use resilient-seated gate valves for tapping with one flanged end and one mechanical joint end. Wrap valves with polyethylene encasement. Clow Corporation, F-6114 or Engineer-approved equivalent.
- C. Valve Boxes: Furnish valve boxes for all buried valves. Boxes shall include standard or oval base as required, center section and top section with cover. Boxes cast iron with screw type adjustment. For valves on water system, the cover marked WATER. Tyler series 6650, or Engineer approved equivalent.

## 2.05 HYDRANTS

- A. Specification Standard: AWWA Standard C502.
  - 1. Type of shutoff: Compression.
  - 2. Type of construction: Break flange or break bolt.
  - 3. Main valve opening: 4 ½ inches for 12-inch and under.  
5 ¼ inches for 16-inch and above.
  - 4. Nozzle arrangement and size: 3 nozzle - Two 2-1/2 inch hose nozzles and one 4-1/2 inch pumper nozzle.
  - 5. Nozzle thread: National Standard Hose Threads.
  - 6. Type of inlet connection: Mechanical Joint.
  - 7. Size of inlet connection: 6 inch.
  - 8. Depth of bury: Distance from ground line to top of connecting pipe shall be 5-1/2 feet minimum, or otherwise as indicated on the Plans.
  - 9. Extensions required to adjust hydrant to finished grade, per manufacturer's recommendations.
  - 10. Direction of opening: open to right (clockwise)
  - 11. Packing: Conventional or O-Ring.
  - 12. Size and shape of operating nut: 1-1/2" Standard Pentagon
  - 13. Working pressure: 150 psi.
  - 14. Color: Safety Red
  - 15. City of Iowa City Standard.
  - 16. Paint: Tnemec Series 2H Primer, Tnemec Series 10 Finish
- B. Wrap hydrant base and barrel up to finish grade with polyethylene encasement. Slit film at hydrant base at drain-back opening.
- C. Approved manufacturers:
  - 1. Clow F-2545.
  - 2. Kennedy Guardian K-81
  - 3. Mueller SuperCenturion 200 or 250
  - 4. American-Darling F-2500, MK73-1 and B-84-B.
  - 5. Engineer-Approved Equivalent

## 2.06 THRUST RESTRAINT

- A. Mechanical Restraint:
  - 1. Threaded Rod: 3/4" diameter stainless steel or corten.
  - 2. Nuts: Ductile iron, corten or stainless steel.
  - 3. Eye bolts: 3/4" diameter corten.
  - 4. Duc-Lugs: Ductile iron.
  - 5. Collar Clamps: Minimum 3/8" thick steel, include large diameter extra thick washers.
  - 6. Restraining mechanisms, tie rods, clamps or other components of dissimilar metal shall be protected against corrosion by hand application of a suitable coating or by encasement of the entire assembly with 8-mil thick (0.2 mm) loose polyethylene film in accordance with ANSI/AWWA C105/A21.5.
  - 7. Manufacturer shall be engineer approved.
- B. Concrete:

1. Use cast-in-place concrete thrust blocks for joints requiring restraint, which are not restrained by other means.
2. Minimum compressive strength of 3000 psi.

## **2.07 DISINFECTION CHEMICALS**

- A. Chemicals:
  1. ANSI/AWWA B301, Liquid Chlorine.
  2. ANSI/AWWA B300, Liquid Sodium Hypochlorite.
  3. ANSI/AWWA B300, Granular or Tablet Calcium Hypochlorite.

## **2.08 POLYETHYLENE ENCASEMENT**

- A. Polyethylene encasement, flat sheet or split tube, 8 mil (0.20 mm) thickness, as per ANSI/AWWA C105, for use with all buried ductile iron and steel pipe, fittings, valves and operators, and hydrants.

## **2.09 TRACER WIRE**

- A. Use tracer wire on water mains: No. 12 AWG solid copper conductor with Type THHN insulation in yellow or orange. Tracer wire to be installed on all buried water main. Terminate neatly in tracer wire terminal box as shown on hydrant detail on the plans.
- B. Splices: Use 3M Vinyl Insulated Butted Seam butt connectors (MVU14BC) and 3MITCSN Heat Shrinkable cable sleeves (ITCSN-0400), Twister DM Plus Wire Connectors or Engineer-Approved Equivalent.
- C. Ground rod: Copperweld or Engineer-Approved Equivalent installed as shown on Plans.

## **2.10 SERVICE LINE MATERIALS**

- A. All water service materials shall meet or exceed current ANSI/AWWA-C800 specifications and shall be made in accordance with ASTM B-62. The manufacturer shall furnish a certificate indicating all new materials meet the specifications. All valves, fittings and pipe shall be inspected several times during the manufacturing process and pressure tested with air under water before shipment. All water service materials shall be visually inspected before installation. Brass and copper are soft metals and care in handling shall be exercised to avoid damaging threads or distorting piping, valves or fitting bodies.
- B. Water service brass for services 2 inches and smaller will be *purchased from* the City Water Division. The Contractor shall use the brass goods furnished by the Water Division on work under this contract only and not on private property.
- C. Service line: Type K copper tubing, ASTM B88, flared joint fittings, sizes as shown on the Plans.
- D. Service saddles: Brass bodies, stainless steel straps, O-ring seal, AWWA taper threaded outlet, 150 psi minimum working pressure, for use with PVC water main, sizes as shown on the Plans. A.Y. McDonald, Smith Blair, Mueller, or Engineer-approved equivalent.
- E. Corporation stops: Brass bodies, AWWA taper threaded inlet, flare connection outlet for copper service pipe, 150 psi minimum working pressure, sizes as shown on the Plans. A.Y. McDonald, Mueller, or Engineer-approved equivalent.
- F. Couplings: Brass with flare or compression connections for copper service pipe, 150 psi minimum working pressure, sizes as shown on the Plans. A.Y. McDonald, Ford, Mueller, or Engineer-approved equivalent. Couplings 2 inches and smaller will be purchased from the City Water Division.
- G. Curb stops: Brass bodies without drain, ball valve type, flare connection inlet and outlet for copper service pipe, 150 psi minimum working pressure, sizes as shown on the Plans. A.Y. McDonald, Mueller, or Engineer-approved equivalent.

- H. Curb boxes: Extendable two-piece type, cast iron arch pattern base section, steel pipe upper section, lid type to be selected by Engineer, total height as required to extend from curb stop body at service line to finish grade elevation as shown on the Plans. A.Y. McDonald or Engineer-approved equivalent. Curb boxes 2 inches and smaller will be purchased from the City Water Division.
- I. Materials purchased from the City Water Division are available at the Water Division at 2551 North Dubuque Street during normal working hours. The Water Division will provide an accounting for materials supplied and the Contractor will be required to keep records of materials used at each service connection.

## **PART 3 CONSTRUCTION**

### **3.01 EXAMINATION**

- A. Verify that trench cut and excavation base are ready to receive work and excavations, dimensions, and elevations are as indicated on Plans.
- B. Verify that piping system has been cleaned, inspected and pressure tested.
- C. Perform scheduling and disinfection activity with startup, testing, adjusting and balancing, demonstration procedures, including coordination with related systems.

### **3.02 PREPARATION**

- A. All mains shall be bedded with granular material from trench bottom, and up a minimum of 1-foot above the top of the main. Cost of bedding shall be considered incidental to pipe installation.
- B. Trench backfill shall consist of suitable backfill placed in one-foot lifts in accordance with the plans.
- C. At hydrant installations, backfill with granular material to 18" above bottom of hydrant stand pipe.
- D. Where new construction crosses or closely parallels existing utilities or utility services, excavate in advance or pipe laying; determine locate and crossing arrangements including line and grade.

### **3.03 PIPE AND FITTING INSTALLATION**

- A. Install pipe and appurtenances in accordance with AWWA C600 and C605.
- B. Lay pipe to slope gradients noted on Plans.
- C. Refer to Paragraph 3.02 for trenching, backfilling, and compacting requirements. Do not displace or damage pipe when compacting.
- D. Handling: Handle pipe and appurtenances in such a manner as to ensure delivery to the trench in a sound, undamaged condition. Use of web slings or end hooks not allowed.
- E. Inspection for Defects: Before installation, inspect pipe and appurtenances for defects and, when applicable, tap the pipe with a light hammer to detect cracks. Reject defective, damaged, or unsound pipe and appurtenances.
- F. Cutting: Cut pipe, when necessary, in a neat and good quality manner without damage to the pipe, interior lining, and exterior coating. Perform cutting with an approved mechanical cutter, using a wheel cutter when applicable and practicable.
- G. Beveling: Grind smooth and bevel cut ends and rough edges using methods recommended by the manufacturer and approved by the Engineer.
- H. Pipe Joints: Pipe joints in accordance with AWWA C600 and C605 and as recommended by manufacturer; use minimum amount of gasket lubricant; apply to gasket only; do not apply lubricant to inside of bell.

- I. Cleaning and Protection of Pipelines: Clean pipe interior of foreign material before lowering into trench; keep clean at all times; when pipe laying is not in progress, including lunch breaks, nights, weekends, and other non-working periods, securely close open ends of pipe and fittings with watertight plugs.
- J. Pipe Deflections:
  - 1. Deflections from a straight line or grade, as required by vertical curves, horizontal curves, or offsets, shall not exceed the manufacturer's recommendations for the type and size of pipe and joint being used.
  - 2. If the alignment requires deflections in excess of the manufacturer's limitations, then bend fittings or a sufficient number of shorter lengths of pipe shall be utilized to provide angular deflections within the limits set forth.
- K. Pipe Gradient:
  - 1. In certain instances, it may be required that a positive gradient be maintained for pressure lines. All such locations are noted on the Plans.
  - 2. Where changes from positive to negative grades occur, air release or combination air release and air/vacuum valves and utility accesses required as shown on the Plans.
- L. Separation Between Water Mains and Sewer Lines:
  - 1. At locations where water mains cross storm drains, drainage tile or sanitary sewers and the vertical separation between the bottom of the water main and the top of the sewer or drain is less than 18 inches, or where the water main is below the sewer or drain, a length of pipe should be centered at the sewer to be crossed so that the joints will be approximately equal distance from the sewer. When a water main crosses under a sewer, a vertical separation of 18 inches between the bottom of the sewer and the top of the water main shall be maintained. If the sewer and/or sewer service is not 18 inches above the water main, then the sewer and/or sewer service will be replaced with materials and joints that are equivalent to water main standards of construction with tight waterproof joints, for a distance of 10 feet on each side of water main.
  - 2. Water mains shall be separated at least 10 feet horizontally from any sanitary sewer. Where this separation is not possible, the bottom of the water main shall be 18 inches above the top of the sewer and the water main shall be laid in a separate trench or in the same trench on a bench of undisturbed earth. As a minimum, the horizontal separation shall be at least 3 feet.
  - 3. Water mains shall be separated from sewer force 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 requirements of these standards;
    - b. Water main is laid at least four linear feet from the sewer force main.
  - 4. Care shall be taken in compacting the backfill beneath the sewer and any misalignment of the sewer or joints loosened shall be corrected before proceeding with the backfill.
  - 5. No water pipe shall pass through or come in contact with any part of a sewer utility access. A minimum horizontal separation of 3 feet shall be maintained.
- M. Depth of Cover: The depth of cover over water mains from the top of the pipe to the ground surface shall be sufficient to prevent freezing. The minimum depth shall be 5 ½ feet, or otherwise as shown on the Plans.
- N. Installation - Valves and Hydrants
  - 1. Set valves and hydrants on solid bearing.
  - 2. Center and plumb valve box over valve. Set box cover flush with finished grade.
  - 2. Install all buried valves and operators and hydrants with polyethylene encasement, 8-mil (0.20 mm) thickness, as per ANSI/AWWA C105.

**3.04 PROTECTION**

- A. Protect finished installation.
- B. Maintain areas free of waste materials, debris, and rubbish.

**3.05 RESTRAINT**

- A. Anchorage
  - 1. Provide anchorage lugs for flanged or bell and spigot fittings and/or socket clamps with interconnecting tie rods where there is a possibility of pulling of the joint under pressure.
- B. Restrained Joint Ductile Iron Pipe
  - 1. Provide restrained joint ductile iron pipe as indicated on the Plans.
  - 2. Submit restrained joint styles and detailed designs by the pipe manufacturer to Engineer prior to manufacture. Include detailed laying schedules.
  - 3. Field cutting of restrained joint pipe not allowed, except for the locations that utilize a "field-cut" restrained joint end kit as provided and recommended by the pipe manufacturer.
  - 4. These "field-cut" locations noted on the Plans shall not be used at any other locations.
- C. Concrete Thrust Blocks
  - 1. Provide cast-in-place concrete thrust blocks at bends, tees, and dead ends placed against undisturbed soil.

**3.06 BORING AND CASING**

- A. General: Install by boring and casing certain water mains and service lines under specific highways and streets as designated on the Plans.
- B. Encase all water mains and service lines that cross State highways as a minimum from toe of foreslope to toe of foreslope.
  - 1. Water lines with inside diameter greater than two (2) inches must be encased from right-of-way line to right-of-way line or as otherwise shown on the plans.
  - 2. Pits for boring, tunneling, or jacking not permitted closer to the roadway than toe of fill in fill sections or toe of foreslopes in ditch sections or two feet from back-of-curb in urban sections.
- C. Casing and pipeline installations accomplished by dry jacking, augering, or tunneling methods.
  - 1. The use of water under pressure (jetting) or puddling will not be permitted to facilitate augering, pushing, or jacking operations.
  - 2. Some borings may require water to lubricate cutter and pipe, and under such conditions are considered dry boring.
- D. Conduct boring or tunneling operations in such a manner as not to be detrimental to the roadway being crossed where suitable soil conditions exist.
- E. If excessive voids or too large a bored hole are produced during casing or pipeline installations, or if it is necessary to abandon a bored or tunneled hole, prompt remedial action shall be taken by the Contractor, subject to the approval of an authorized representative of the IDOT or the County or City.
- F. Fill all voids or abandoned holes by boring, jacking, or tunneling by pressure grouting when deemed necessary by the IDOT or the County or City. Grout material shall be sand cement slurry with a minimum of two (2) sacks of cement per cubic yard and a minimum of water to assure satisfactory placement.
- G. Bored or tunneled installations shall have a hole diameter which shall not exceed the outside diameter of the water main or casing by more than 1-1/2 inches on pipes with an inside diameter of 12 inches or less, or 2 inches on pipes with an inside diameter greater than 12 inches.

- H. Minimum length of casing pipe determined by toe to toe of foreslopes of road being crossed, or right-of-way line to right-of-way line of State highway being crossed, or as shown on the Plans.
- I. Water main 4 inches in diameter and larger installed through casing shall have pressure treated wood skids thick enough to provide clearance between the casing and the pipe couplings strapped to the pipe before it is installed in the casing.
  - 1. Strap four wooden skids in place at 90-degree axis points along the full length of the pipe, excluding the bell and spigot areas at both ends of the pipe.
  - 2. Skid leading edges shall be rounded and notches cut for the strapping so the assembled unit is smooth.
  - 3. Strapping material: Stainless steel bands or straps and not wires.
  - 4. Install pipe and skid assembly through the casing by pushing or pulling as per the pipe manufacturer's recommendations.
- J. Space between the carrier pipe and the casing shall be left open and not filled. Securely close ends of casing.
- K. All borings under Federal and State highways in strict accordance with these specifications, the IDOT permit for the work, the IDOT Policy Manual for Accommodating Utilities on the Primary Road System, latest revision, and requirements of the IDOT Resident Maintenance Engineer.

**3.07 CLEANING, FLUSHING, AND DISINFECTION OF PIPING AND APPURTENANCES**

- A. Cleaning
  - 1. During the progress of pipe installation, thoroughly clean each piece of pipe, valve and fitting before final installation.
- B. Flushing
  - 1. Hydrants may be used for flushing.
  - 2. Complete preliminary flushing prior to the disinfection of the water lines, except when the tablet method is used. The tablet method used only with written approval from the Engineer.
  - 3. Flushing done at a site which will not cause damage to private or public property.
  - 4. Preliminary flushing velocity not less than 2.5 feet/second and discharged to storm sewers or natural drainage ways.
  - 5. The rate of flow required to produce the specified minimum velocity of 2.5 feet/second at 40 psi residual pressure is listed below:

Pipe Size (in.)	Flow Required to Produce 2.5 fps Velocity (GPM)
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4	100
6	220
8	390
10	610
12	880
14	1,200
16	1,565
20	2,450
24	3,525

With 40 psi residual pressure, one 2-1/2 inch hydrant outlet nozzle will discharge approximately 1,000 GPM and a 4-1/2 inch hydrant nozzle will discharge approximately 2,500 GPM.

C. Disinfection:

1. All new cleaned or replaced water mains shall be disinfected in accordance with AWWA Standard C651 before being put into service.
2. Continuous Feed Method:
  - a. Flow water from the existing distribution system or other approved sources of supply into newly laid water line at a constant and measured rate.
  - b. This water shall receive chlorine also at a constant and measured rate.
  - c. Proportion two flows so chlorine concentration in the newly laid pipe is a minimum of 25 mg/l free chlorine.
  - d. Apply chlorine solution to the water line with a pump suitable for feeding chlorine solutions.
  - e. The point of application shall be through a tap in the new water line within 10 feet of the valve to be used for admitting water into the line.
  - f. Manipulate valves during application of the chlorine to prevent the treatment dosage from flowing back into the line supplying the water.
  - g. Chlorine application shall be continuous until the entire main is filled.
  - h. Retain chlorinated water in the water line for at least 24 hours.
  - i. As the chlorinated water flows past tees and crosses, related valves not used for isolating the water line, shall be operated to disinfect all appurtenances.
  - j. At the end of this 24 hour period, the treated water shall contain not less than 10 mg/l chlorine throughout the length of the main.
  - k. Chlorine Solution:
    1. The chlorine water solution is prepared by (1) using a vacuum-operated gas chlorinator and booster pump for chlorine-gas solution-feed, (2) by using a metering pump with liquid sodium hypochlorite, or (3) by using a metering pump with a solution prepared by dissolving calcium hypochlorite in water in the proportion required for the desired concentration.
    2. A 1 percent chlorine solution requires approximately 1 pound of calcium hypochlorite (70% chlorine) in 8.5 gallons of water.
    3. The table below shows the minimum rate of chlorine solution feed for a 1 percent chlorine solution for various water flow rates to obtain a 25 mg/l available chlorine content.

Water Feed Rate (GPM)	1% Chlorine Solution Feed Rate (GPM)
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100	0.25
200	0.50
300	0.75
400	1.00
500	1.25

3. Tablet Method:
  - a. The Contractor may use the tablet method for disinfection only if written permission is given by the Engineer.
  - b. Place 5-gram tablets of HTH 70% free chlorine or other chlorine compound of equal strength, in each piece of piping installed, in accordance with the following schedule:

Pipe Sizes
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Length of Pipe (feet)	4"	6"	8"	10"	12"	16"	20"	24"	30"	36"
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13	1	1	1	2	3	4	7	9	15	21
18	1	1	2	3	4	6	9	13	20	28
20	1	1	2	3	4	7	10	14	22	32
40	1	2	4	5	7	13	20	28	44	63

NOTE: HTH tablets to be used only on iron, steel, or concrete pipe. Continuous feed method shall be used to disinfect PVC pipe. Use of chlorine powder not acceptable.

- c. Secure the tablets to the upper surface of pipe at each joint by means of a food-grade adhesive such as Permatex Form-A-Gasket No. 2 and Permatex Clear RTV Silicone Adhesive Sealant, by Loctite Corporation, Kansas City, KS.
  - d. Fill the pipe slowly with water and allowed to stand for 24 hours to effectively disinfect the piping system. If the water temperature is less than 41°F ( 5°C), the water shall be allowed to stand for 48 hours.
  - e. Maintain minimum of 10 mg/l free residual chlorine concentration throughout the 24 hour (or 48 hour) disinfection period.
- D. Final Flushing:
- 1. After the applicable retention period, flush heavily chlorinated water from the main until the chlorine concentration of the water leaving the line is no higher than that generally maintained in the system or less than 1 mg/l.
  - 2. Determine the chlorine residual to ascertain that the heavily chlorinated water has been removed from the water line.
- E. Samples:
- 1. Procedure
    - a. After final flushing and before the new water main is placed into service, collect two consecutive sets of acceptable samples at least 24 hours apart. Collect from the end of each test section and test for bacteriological quality to show the absence of coliform organisms.
    - b. Collect at least one set of samples from every 1200 feet of new main, plus one set from the end of the line and at least one set from each branch.
    - c. Analyze samples after refilling the water line with potable water.
    - d. Collect samples for bacteriological analysis in sterile bottles treated with sodium thiosulfate.
    - e. Do not use hose or fire hydrant in collection of samples.
    - f. Install a standard corporation cock installed in the main with a copper tube goose neck assembly, if necessary.
  - 2. Test Failure
    - a. If the initial disinfection fails to produce satisfactory samples, repeat flushing and disinfection until satisfactory samples are obtained.
    - b. Use continuous feed method in these subsequent disinfections.
  - 3. When the samples are satisfactory, perform hydrostatic pressure test.

### 3.08 HYDROSTATIC TEST

- A. Test all pressure lines for leakage after satisfactory completion of cleaning, flushing, and disinfection of piping and appurtenances.
- B. Subject newly laid piping or any valved section of piping to a hydrostatic pressure test for at least two (2) hours.
- C. Conduct pressure tests on individual piping sections between valves in order to test the integrity of the valves as well as the piping.

- D. The test pressure shall be 150 psi, or as directed by the Engineer. The test pressure not less than 1.25 times the working pressure at the highest point along the test section and not less than 1.5 times the working pressure at the point of testing.
- E. Before applying the pressure, completely expel air from the system being tested.
- F. Install, at Contractor's expense, corporation cocks as required at all high points in the system if necessary to completely expel all air.
- G. After all the air has been expelled, remove corporation cocks and plug or close prior to testing. Engineer to determine whether the corporation cocks are removed or left in place.
- H. Determine amount of leakage by adding water to the system by means of a pump where pressure within the system is maintained within 5 psi of the test pressure.
- I. Allowable leakage shall not exceed 11.65 gallons per mile per inch diameter per 24 hours for pipe in 18 foot lengths, 10.5 gallons for pipe in 20 foot lengths, and proportionally varied for other lengths at a test pressure of 150 psi.
- J. When testing at pressures other than 150 psi, allowable leakage shall not exceed that computed as follows:

$$L = \frac{ND\sqrt{P}}{7400}$$

- Where:
- L = Allowable leakage (gallons per hour)
  - N = Number of joints in length being tested
  - D = Nominal diameter of the pipe (inches)
  - P = Average test pressure (psi) (gauge)

- K. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gallons per hour per inch of nominal valve size is allowed.
- L. Perform the test against closed hydrant, with the auxiliary valve open.
- M. Determine acceptance on the basis of allowable leakage.
- N. If any test of pipe laid discloses leakage greater than that specified above, the Contractor shall, at no expense to the Contracting Authority, locate and repair the defective material until the leakage is within the specified allowance.
- O. Repair all visible leaks regardless of the amount of leakage.
- P. Damaged or defective pipe, fittings, or valves, hydrants, or joints discovered in the pressure test shall be replaced by the Contractor and the test repeated until the test results are satisfactory.

## **PART 4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT**

### **4.01 WATER PIPE**

- A. Payment by the lineal foot of pipe laid in the trench as measured, for each diameter, type, and class in the Bid Schedule. The contractor will be paid the contract unit price per lineal foot of each size of water main pipe installed. Restrained joint pipe is noted on plans and considered incidental to water pipe. Deductions will be made from the measured length for valves and other appurtenances. The unit prices as bid shall include the furnishing of all labor, equipment and materials necessary to install the water main in accordance with the contract documents. This price also includes MJ glands, gaskets, bolts, polyethylene wrap and the installation of these items. This work shall include all excavation, installing and joining of pipe and fittings, removal and disposal of water, backfill, sheeting and shoring, disposal of excess excavated material, protection of existing structures and utilities, clean-up and all other operations unless specifically covered by other pay-items specified under this contract.

### **4.02 FITTINGS**

- A. Each fitting will be measured by the pound. The contractor will be paid the unit price per pound of fitting. Weight of a fitting is defined by the specified body weight of the AWWA C153 fitting or manufacturers equivalent standard. Gaskets, gland rings and bolts are not included in the weight and are considered incidental to the fitting. For fittings that are not available in AWWA C153 compact size, then weight will be determined by weight of AWWA C110 fitting. Mainline line tee(s) to the hydrants, excluding the piping from the tee to the hydrant, are to be considered as fittings and will be measured and paid for accordingly. This shall be considered full payment for materials, equipment, excavation, installation and all associated incidental work.

#### **4.03 SPECIAL FITTINGS AND COUPLINGS**

- A. Includes couplings, cutting-in sleeves, retainer glands, anchoring pipe and couplings, repair sleeves and clamps, etc. Includes accessories and installation of Special fittings and couplings. Payment shall be considered incidental to the installation of the water main pipe.

#### **4.04 BORED, JACKED AND TUNNELED PIPE**

- A. Payment by the lineal foot of jacked, bored or tunneled distance called out on Plans. Includes casing pipe, skids, bands, excavation, backfill, materials, and labor. The contractor will be paid the contract unit price per lineal foot of each size of carrier pipe installed. The unit prices as bid shall include the furnishing of all labor, equipment and materials necessary to install the water main in accordance with the contract documents. This work shall include all excavation, installing and joining of pipe and fittings, removal and disposal of water, backfill, sheeting and shoring, disposal of excess excavated material, protection of existing structures and utilities, clean-up and all other operations unless specifically covered by other pay-items specified under this contract.

#### **4.05 VALVES**

- A. Each valve will be measured as a single unit. The contractor will be paid the contract unit price for each valve installed. This shall be considered full payment for equipment, excavation, installation and materials including concrete blocking, crushed stone, bolts, gland rings, gaskets, valve box and lid, and extension if required.

#### **4.06 HYDRANTS**

- A. Each hydrant will be measured as a single unit. The contractor will be paid the contract unit price for each hydrant installed. This shall be considered full payment for equipment, excavation, installation and materials including hydrant, isolation valve, and piping from the main to the hydrant. Main line tee(s), excluding the piping from the tee to the hydrant, are included in the bid item for "Water Main Fittings".

#### **4.07 THRUST RESTRAINT**

- A. Concrete thrust blocking and other restraint accessories including threaded rods, nuts, eyebolts, restrained joint pipe where indicated and mechanical joints shall be considered incidental to the installation of water main fittings and hydrants.

#### **4.08 DISINFECTION**

- A. Disinfection of water mains shall be considered incidental to the installation of water main pipe and fittings.

#### **4.09 TRACER WIRE**

- A. Tracer wire shall be considered incidental to the installation of water main pipe and fittings.

**4.10 POLYETHYLENE WRAP**

- A. Polyethylene wrap shall be considered incidental to the installation of pipe, fittings, valves, and hydrants.

**4.11 SERVICES**

- A. Each service shall be measured as a single unit. The contractor will be paid the contract unit price for each service installed. The unit prices as bid shall include the furnishing of labor, equipment and materials necessary to install the services in accordance with the contract documents. This price also includes tap, saddle (if any), corporation stop, curb stop and box, and reconnections to existing service line.

**4.12 SERVICE LINE**

- A. Payment by the lineal foot of service line as measured. The contractor will be paid the contract unit price per lineal foot of each size of water service pipe installed. The unit prices as bid shall include the furnishing of all labor, equipment and materials necessary to install the service lines in accordance with the contract documents. This work shall include all excavation, installing and joining of pipe and fittings, removal and disposal of water, backfill, sheeting and shoring, disposal of excess excavated material, protection of existing structures and utilities, clean-up and all other operations unless specifically covered by other pay-items specified under this contract.

**4.13 REMOVAL OF EXISTING WATER MAIN**

- A. Payment by the lineal foot of existing water main removed as measured. The contractor will be paid the contract unit price per lineal foot of water main pipe removed. The unit prices as bid shall include the furnishing of all labor, equipment and materials necessary to remove the pipe in accordance with the contract documents. This work shall include all cutting, removal and disposal of pipe, excavation, plugging, backfill, sheeting and shoring, disposal of excess excavated material, protection of existing structures and utilities, clean-up and all other operations unless specifically covered by other pay-items specified under this contract.

**4.14 REMOVAL OF EXISTING VALVES AND HYDRANTS**

- A. Each hydrant and valve shall be measured as a single unit. The contractor will be paid the contract unit price for each valve and hydrant removed. The unit prices as bid shall include the furnishing of all labor, equipment and materials necessary to remove the valve and hydrant in accordance with the contract documents. This work shall include all cutting, removal and disposal of valve and hydrant, excavation, plugging, backfill, sheeting and shoring, disposal of excess excavated material, protection of existing structures and utilities, clean-up and all other operations unless specifically covered by other pay-items specified under this contract.