Technical Specifications for Waterline Construction

Virgin Islands Water and Power Authority
ST. THOMAS, U.S. VIRGIN ISLANDS

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PROJECT WATER DISTRIBUTION SYSTEM SPECIFICATIONS

1. GENERAL REQUIREMENTS

1.1 Project Description

A. Furnish, deliver, install, test, disinfect, and place into service all water distribution piping, fittings, valves, hydrants, water service connections, casing pipe, and related appurtenances shown on the Drawings and specified herein.

B. All work shall be performed in accordance with the Contract Documents, applicable AWWA, ASTM, ANSI, and Federal Highway standards, and the requirements of the Engineer.

1.2 References and Applicable Standards

A. The following standards are referenced throughout these Specifications:

1. AWWA C600 – Installation of Ductile-Iron Mains.
2. AWWA C651 – Disinfecting Water Mains.
3. AWWA C900 – PVC Pressure Pipe.
4. AWWA C509 – Resilient-Seated Gate Valves.
5. AWWA C502 – Dry-Barrel Fire Hydrants.
6. ANSI/AWWA A21.10/C110 – Ductile-Iron and Gray-Iron Fittings.
7. ANSI/AWWA A21.11/C111 – Rubber-Gasket Joints.
8. ANSI/AWWA A21.50/C150 – Thickness Design of Ductile-Iron Pipe.
9. ANSI/AWWA A21.51/C151 – Ductile-Iron Pipe.
10. ASTM D1784 – PVC and CPVC Compounds.
11. ASTM D1785 – PVC Plastic Pipe.
12. ASTM D3139 – Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
13. ASTM F402 – Safe Handling of Solvent Cements and Primers.
14. Federal Highway Project Specifications FP-14, where applicable.

B. Where conflicts exist between the referenced standards and these Specifications, the requirements of the Contract Documents and the direction of the Engineer shall govern.

1.3 Related Work

A. Earth excavation, trenching, bedding, backfill, fill, and grading.

B. Cast-in-place concrete, including thrust blocks and valve box pads.

C. Pavement removal and restoration.

D. Valves, hydrants, and water distribution appurtenances.

1.4 Submittals

A. Submit manufacturer's literature, shop drawings, product data, certifications, installation instructions, and test reports for all major materials.

B. Submittals shall include, as applicable:

1. Pipe and fittings.
2. Joint materials and gaskets.
3. Restrained joints and restraint devices.
4. Valves and hydrants.
5. Water meters and meter boxes.
6. Service connection materials.
7. Casing pipe and casing seals.
8. Coatings and linings.
9. Manufacturer's installation instructions.

1.5 Quality Assurance

A. All materials shall be new, suitable for potable-water service, and conform to the applicable standards specified herein.

B. The Contractor shall inspect materials upon delivery and remove defective or damaged materials from the project site.

C. The Engineer reserves the right to inspect materials at the manufacturer's facility or at the project site.

1.6 Safety Requirements

A. The Contractor shall provide adequate trench protection, shoring, sheeting, bracing, dewatering, and other safety measures necessary to perform the work safely.

B. Work shall comply with applicable safety requirements and the requirements of the Engineer.

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2. DUCTILE-IRON PIPE AND FITTINGS

2.1 Ductile-Iron Pipe

A. Ductile-iron pipe shall be designed in accordance with ANSI/AWWA A21.50/C150.

B. Pipe shall conform to ANSI/AWWA A21.51/C151.

C. Unless otherwise indicated, ductile-iron pipe shall have a minimum Thickness Class 52.

D. Buried ductile-iron pipe shall receive the specified exterior protective coating.

E. Interior surfaces shall receive cement-mortar lining in accordance with the applicable AWWA requirements.

2.2 Ductile-Iron Fittings

A. Fittings shall conform to ANSI/AWWA A21.10/C110 and shall have a pressure rating suitable for the associated pipeline.

B. Provide mechanical-joint, push-on, flanged, or grooved-end fittings as indicated on the Drawings.

C. Fittings shall be suitable for potable-water service.

2.3 Nonstandard Fittings

A. Nonstandard fittings shall have the same diameter and minimum thickness as standard fittings.

B. Nonstandard fittings shall meet the applicable requirements for standard fittings except for laying length and end configuration.

2.4 Joint Types

A. Push-on joints shall conform to ANSI/AWWA A21.11/C111.

B. Gaskets shall be suitable for potable-water service and compatible with the pipe and operating conditions.

C. Flanged joints shall conform to applicable ANSI/AWWA requirements.

D. Restrained joints shall be provided where indicated or required to prevent joint separation under pressure.

2.5 Sleeve-Type Couplings

A. Sleeve couplings shall have a pressure rating at least equal to the associated pipeline.

B. Buried couplings shall be suitable for underground service and provided with corrosion-resistant bolts and nuts.

C. Gaskets shall be suitable for the liquid conveyed.

2.6 Filling Rings

A. Provide filling rings where necessary to achieve proper alignment and connection between adjoining piping and equipment.

B. Filling rings shall conform to the applicable flange standards and shall be suitable for the intended service.

2.7 Tapped Connections

A. Tapped connections shall provide a watertight joint with adequate resistance to pullout.

B. Use tapered threads for tapped connections.

C. Where the required tap exceeds the allowable size for the pipe wall, provide a suitable tapping saddle, boss, tee, or other approved fitting.

2.8 Pipe Lining and Coating

A. Interior surfaces shall be cement-mortar lined where specified.

B. Exterior surfaces of buried ductile-iron pipe and fittings shall receive the specified protective coating.

C. Ductile-iron surfaces that will be encased in concrete shall remain uncoated unless otherwise directed.

D. Machined surfaces shall be protected against corrosion during storage and installation.

2.9 Gaskets, Bolts, and Nuts

A. Gaskets shall be suitable for potable-water service.

B. Bolts and nuts shall conform to the applicable ASTM and ANSI requirements.

C. Bolt size and quantity shall conform to the applicable flange standard.

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3. PVC PRESSURE PIPE

3.1 PVC Pipe, Fittings, and Specials

A. PVC pressure pipe shall conform to AWWA C900.

B. For 4-inch through 12-inch pipe, provide Class 200, DR 14 PVC pipe unless otherwise indicated.

C. Standard pipe lengths shall be approximately 20 feet unless otherwise specified.

D. Fittings shall have a pressure rating at least equal to that of the pipe.

3.2 Elastomeric Gasket Joints

A. PVC pressure pipe shall utilize elastomeric gasket joints.

B. Solvent-cement joints shall not be used for the main pressure piping unless specifically approved.

C. Gaskets shall be synthetic rubber suitable for potable-water service and compatible with the proposed operating conditions.

3.3 Pipe Handling and Storage

A. Store PVC pipe in a location approved by the Engineer.

B. Provide temporary shading and protect pipe from excessive heat buildup.

C. Do not use coverings that cause excessive temperature accumulation.

D. Handle pipe carefully to prevent cracking, gouging, distortion, or other damage.

3.4 Pipe Installation

A. Inspect the excavation before placing pipe.

B. The trench bottom shall be firm, stable, and free of obstructions.

C. Install pipe to the lines and grades shown on the Drawings.

D. Provide continuous and uniform support beneath the pipe barrel.

E. Excavate bell and coupling holes so that the pipe barrel receives the bearing pressure.

F. Do not support pipe permanently on stones, blocks, saddles, or other unsuitable materials.

G. Maintain the interior of the pipe free of dirt, water, debris, and foreign material.

H. Open ends shall be protected with watertight temporary plugs whenever installation is not in progress.

3.5 Trench and Bedding Requirements

A. Place pipe on properly prepared and compacted bedding in accordance with the applicable earthwork specifications.

B. Place clean backfill material around the pipe and carefully compact beneath the lower half of the pipe.

C. Fill and compact bell holes with suitable material.

D. Prevent pipe flotation when groundwater or trench water is present.

3.6 Restrained Joints

A. Provide restrained joints where indicated or required to prevent separation under operating pressure.

B. Restraint systems shall be suitable for the pipe material, diameter, pressure, and installation conditions.

3.7 Cleaning and Protection

A. Prevent earth, water, and other materials from entering the pipeline.

B. Clean the interior of the pipeline before testing and final acceptance.

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4. WATER SERVICE CONNECTIONS

4.1 Service Piping

A. Furnish and install 3/4-inch, 1-inch, and 2-inch water service connections as indicated or directed by the Engineer.

B. Service piping shall be suitable for potable-water service.

C. Polyethylene service tubing shall comply with the applicable AWWA requirements.

D. Service piping installed beneath roads or driveways shall have a minimum cover of 18 inches unless otherwise specified.

E. Service piping installed elsewhere shall have a minimum cover of 12 inches unless otherwise indicated.

4.2 Corporation Stops

A. Corporation stops shall be brass or bronze and suitable for potable-water service.

B. Install corporation stops in accordance with the manufacturer's recommendations.

C. Service taps shall generally be installed in the upper quadrant of the main above the spring line unless otherwise directed.

4.3 Service Saddles

A. Provide double-strap stainless-steel service saddles with suitable gaskets.

B. Saddles shall be compatible with the diameter and material of the main.

4.4 Meters and Meter Boxes

A. Provide water meters of the size and type indicated.

B. Meter boxes shall be suitable for the specified meter and service configuration.

C. Meter boxes shall be installed plumb, level, accessible, and protected from damage.

4.5 Curb Stops and Boxes

A. Provide brass curb stops suitable for potable-water service.

B. Curb boxes shall be adjustable and provided with covers marked "WATER."

C. Install curb stops in accessible locations and protect them from distortion or damage.

4.6 Check Valves

A. Provide check valves where indicated.

B. Check valves shall be suitable for the service pressure and potable-water application.

4.7 Branch Connections

A. Provide brass tees, unions, bends, and other branch fittings as shown on the Drawings.

B. Branch fittings shall be corrosion-resistant internally and externally.

4.8 Customer Service Connections

A. Inspect all service connections for proper operation and leakage.

B. Flush service piping with chlorinated water prior to placing the service into operation.

C. Protect the existing potable-water system from contamination during construction.

5. STEEL AND DUCTILE-IRON CASING PIPE

5.1 Casing Pipe Requirements

A. Provide casing pipe for waterline crossings beneath storm sewers or other utilities where indicated.

B. Casing installation shall maintain the required alignment, grade, clearance, and structural protection.

5.2 Steel Casing Pipe

A. Steel casing pipe 6 inches and smaller shall conform to the applicable ASTM requirements specified in the Contract Documents.

B. Steel casing pipe from 8 inches through 54 inches shall conform to ASTM A139 Grade B unless otherwise specified.

C. Steel casing pipe shall receive the specified protective coating.

5.3 Ductile-Iron Casing Pipe

A. Ductile-iron casing pipe shall conform to ANSI/AWWA A21.50/C150 and A21.51/C151.

B. Ductile-iron casing shall have the required exterior protective coating and shall be suitable for the intended crossing conditions.

5.4 Carrier Pipe

A. Carrier pipe shall be installed within the casing without damage.

B. Carrier pipe shall maintain proper line and grade without sags or high points.

C. Carrier pipe joints shall remain fully seated and watertight.

5.5 Casing Spacers and Seals

A. Maintain the carrier pipe concentric within the casing.

B. Provide casing spacers or approved supports at intervals not exceeding 10 feet unless otherwise approved.

C. Seal the annular space between the casing and carrier pipe with an approved modular casing seal.

5.6 Storm Sewer and Utility Crossings

A. Coordinate crossings with existing utilities before excavation.

B. Maintain adequate separation and structural protection as indicated on the Drawings.

C. Provide dewatering, shoring, and excavation support as necessary.

5.7 Casing Installation and Alignment

A. Install casing to the required line and grade.

B. Once casing installation begins, continue the work without unnecessary interruption.

C. Provide adequate sheeting, shoring, and bracing for work pits and excavations.

5.8 Annular Space Filling

A. Where specified, fill the annular space between the carrier and casing pipe with suitable sand.

B. Introduce the material carefully to maintain the carrier pipe at the required line and grade.

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6. VALVES, HYDRANTS, AND APPURTENANCES

6.1 Gate Valves

A. Provide resilient-wedge gate valves conforming to AWWA C509.

B. Gate valves shall have a minimum working pressure suitable for the water system and, unless otherwise indicated, not less than 200 psi for 4-inch through 12-inch valves.

C. Valves shall be non-rising stem type with 2-inch square operating nuts.

D. Valves shall be fusion-bonded epoxy coated where specified.

6.2 Tapping Saddles and Valves

A. Provide tapping saddles suitable for the existing main.

B. Tapping valves shall conform to the requirements for gate valves specified herein.

C. Verify the outside diameter of the existing pipe before performing tapping operations.

6.3 Cutting-In Valves

A. Cutting-in valves shall be suitable for the pipe size, material, pressure, and operating conditions.

B. Install valves in accordance with the manufacturer's instructions.

6.4 Air and Vacuum Release Valves

A. Provide air and vacuum release valves where indicated.

B. Valves shall have a minimum working pressure suitable for the water system.

C. Install valves plumb and accessible for inspection and maintenance.

6.5 Fire Hydrants

A. Fire hydrants shall conform to AWWA C502.

B. Hydrants shall be installed plumb and properly connected to the water main.

C. Provide concrete or other approved support beneath and behind the hydrant as required.

D. Provide adequate drainage material around hydrant drains.

E. Hydrants shall have the required hose and pumper connections.

6.6 Valve Boxes

A. Provide valve boxes for all buried valves and stops.

B. Valve boxes shall be adjustable and centered over the valve.

C. Set the top of the valve box flush with the finished surface.

D. Valve boxes shall not bear on the valve or water main.

E. Provide concrete pads around valve boxes where indicated.

6.7 Operating Wrenches

A. Provide operating wrenches suitable for the installed valves.

B. Provide additional wrench extensions where valve depth requires them.

6.8 Coatings and Corrosion Protection

A. Coatings shall be suitable for potable-water service.

B. Repair damaged coatings in accordance with the coating manufacturer's recommendations.

C. Provide protective wrapping or other corrosion protection for metallic components where required by the Engineer.

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7. CONSTRUCTION EXECUTION

7.1 Pre-Installation Inspection

A. Inspect all pipe, fittings, valves, hydrants, and appurtenances before installation.

B. Reject and remove cracked, damaged, defective, or otherwise unsuitable materials.

C. Inspect excavations to verify required depth, grade, alignment, and stability.

7.2 Material Handling and Storage

A. Handle all materials in a manner that prevents damage.

B. Protect materials from dirt, debris, excessive sunlight, heat, water, and other conditions that may affect their performance.

7.3 Trench Excavation and Preparation

A. Excavate trenches to the required dimensions, elevations, and grades.

B. Provide adequate trench protection and dewatering.

C. Remove unsuitable materials and replace them with approved bedding or backfill materials where directed.

7.4 Pipe Bedding and Installation

A. Provide continuous support beneath the pipe barrel.

B. Install pipe accurately to the required horizontal and vertical alignment.

C. Do not force pipe into position by striking the pipe or bell.

D. Keep pipe interiors clean throughout construction.

7.5 Pipe Alignment and Grade

A. Maintain the pipe alignment and grade shown on the Drawings.

B. Joint deflection shall not exceed the manufacturer's or applicable AWWA requirements.

C. Do not use joint deflection to compensate for improper excavation or alignment.

7.6 Joint Assembly and Restraint

A. Clean all joint surfaces before assembly.

B. Install gaskets and joint components in accordance with the manufacturer's instructions.

C. Provide proper lubrication where required.

D. Tighten mechanical joints and bolted connections uniformly using an appropriate torque wrench.

7.7 Thrust Blocks and Restraint Systems

A. Provide concrete thrust blocks at bends, tees, hydrants, and other fittings where indicated.

B. Thrust blocks shall bear against undisturbed earth or approved structural support.

C. Provide mechanical restraint systems where indicated or where required by the Engineer.

7.8 Utility and Sewer Crossings

A. Verify existing utility locations before beginning crossing work.

B. Provide casing pipe, carrier pipe, spacers, seals, and other protective measures where specified.

C. Maintain required separation and protect existing utilities from damage.

7.9 Temporary Plugs and Pipeline Protection

A. Close all open pipe ends with watertight temporary plugs when work is not in progress.

B. Do not remove plugs until measures are in place to prevent water, soil, debris, or other contaminants from entering the pipeline.

7.10 Backfilling and Compaction

A. Place approved material around and over the pipe in controlled lifts.

B. Compact backfill in accordance with the applicable earthwork specifications.

C. Restore pavement, sidewalks, landscaping, and other disturbed surfaces upon completion.

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8. TESTING AND COMMISSIONING

8.1 Pressure and Leakage Testing

A. Clean the pipeline before testing.

B. Perform pressure and leakage testing in accordance with applicable AWWA requirements and the Contract Documents.

C. Repair all leaks and defective joints identified during testing and repeat testing until acceptable results are achieved.

8.2 Hydrostatic Testing

A. Conduct hydrostatic testing after the pipeline has been installed and sufficiently restrained.

B. Test pressure and duration shall be as required by the applicable AWWA standard and project requirements.

8.3 Waterline Disinfection

A. Disinfect potable-water mains in accordance with AWWA C651.

B. The specifications provided require the tablet method.

C. Provide a minimum chlorine concentration of 25 mg/L with a minimum contact period of 24 hours, unless otherwise directed by the Engineer or applicable current standard.

8.4 Flushing

A. After disinfection, flush the pipeline thoroughly with clean water.

B. Continue flushing until the water meets the specified chlorine residual requirements.

8.5 Chlorine Residual Requirements

A. After flushing, the specifications provided require the residual chlorine concentration to be less than 0.2 ppm.

B. Prevent chlorinated water from contaminating existing water mains or the surrounding environment.

C. Neutralize chlorinated water when required prior to discharge.

8.6 Final Inspection and Acceptance

A. Conduct final inspection after successful testing, disinfection, flushing, and restoration.

B. Correct all deficiencies identified by the Engineer before final acceptance.

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9. CONSTRUCTION QUALITY CONTROL

9.1 Material Inspection

A. Inspect all materials upon delivery.

B. Verify material certifications and compliance with specified standards.

C. Remove damaged or nonconforming materials from the project site.

9.2 Installation Inspection

A. Inspect pipe alignment, grade, joints, fittings, valves, hydrants, services, casing installations, and thrust restraint.

B. Verify that all components are installed in accordance with the Drawings and Specifications.

9.3 Testing and Documentation

A. Maintain records of pressure tests, leakage tests, disinfection, flushing, chlorine residuals, and inspections.

B. Submit testing records to the Engineer for review and acceptance.

9.4 Compliance with AWWA and ASTM Standards

A. All applicable materials and construction procedures shall comply with the referenced AWWA, ASTM, ANSI, and other applicable standards.

9.5 Defective Material and Workmanship

A. Remove and replace defective materials or workmanship at no additional cost to the Owner.

B. Repairs shall be completed in a manner acceptable to the Engineer.

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10. PROJECT CLOSEOUT

10.1 Final Restoration

A. Restore all disturbed roads, sidewalks, driveways, landscaping, drainage facilities, and other surfaces to their required condition.

10.2 As-Built Documentation

A. Provide accurate as-built information showing the final location, alignment, depth, size, material, valves, hydrants, services, fittings, and other appurtenances.

10.3 Final Testing Records

A. Submit complete records of all required pressure testing, leakage testing, disinfection, flushing, and water-quality testing.

10.4 Final Inspection

A. The Engineer shall conduct a final inspection following completion of all work.

B. Correct all deficiencies identified during the final inspection.

10.5 Project Acceptance

A. The project shall not be considered complete until all specified work, testing, restoration, documentation, and corrective work have been completed and accepted by the Owner.

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11. REFERENCES AND STANDARDS

The work shall conform to the applicable requirements of the following standards, as referenced throughout these Specifications:

11.1 AWWA Standards

- AWWA C502 – Dry-Barrel Fire Hydrants
- AWWA C509 – Resilient-Seated Gate Valves
- AWWA C600 – Installation/Hydrostatic Testing of Water Mains
- AWWA C651 – Disinfecting Water Mains
- AWWA C900 – PVC Pressure Pipe
- ANSI/AWWA A21.10/C110 – Ductile-Iron Fittings
- ANSI/AWWA A21.11/C111 – Rubber-Gasket Joints
- ANSI/AWWA A21.50/C150 – Thickness Design of Ductile-Iron Pipe
- ANSI/AWWA A21.51/C151 – Ductile-Iron Pipe

11.2 ASTM Standards

- ASTM D1784
- ASTM D1785
- ASTM D3139
- ASTM F402
- Other applicable ASTM standards referenced in the Contract Documents

11.3 ANSI Standards

Applicable ANSI standards for pipe, fittings, joints, flanges, valves, and associated components shall apply as specified.

11.4 Federal Highway Specifications

Federal Highway Project Specifications FP-14 shall apply where specifically referenced for excavation, backfill, aggregate, casing, and related construction activities.

11.5 Manufacturer Requirements

All products shall be installed in accordance with the manufacturer's current written installation instructions unless those instructions conflict with the Contract Documents.

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12. APPENDICES

12.1 Construction Drawings

Provide approved construction drawings, plan sheets, profiles, details, and revisions.

12.2 Standard Details

Provide applicable standard details for:

- Water main installation

- Service connections
- Valve installations
- Fire hydrants
- Thrust blocks
- Restrained joints
- Casing crossings
- Meter installations
- Valve boxes

12.3 Testing Forms and Records

Provide:

- Pressure test records
- Leakage test records
- Disinfection records
- Chlorine residual records
- Flushing records
- Final inspection records

12.4 Material Certifications

Provide manufacturer certifications confirming compliance with applicable project specifications and standards.

12.5 Product Data and Submittals

Provide approved manufacturer's product data, shop drawings, technical literature, installation instructions, and other required submittals.