

# **Fairfax Water**

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**8560 Arlington Boulevard  
Fairfax, Virginia 22031**

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## **CONSTRUCTION PRACTICE MANUAL**

### **WATER MAIN INSTALLATION SPECIFICATIONS FOR DEVELOPERS**

**March 2015**

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## SECTION 00070

### INTRODUCTION AND DEFINITIONS

#### INTRODUCTION

The Fairfax Water Construction Practice Manual establishes the technical requirements for construction of water mains to be owned, operated and maintained by Fairfax Water; and provides contractors and developers with a set of guidelines to ensure conformance with Fairfax Water's construction principles. Although the goal of this manual is to be comprehensive, it is understood that a unique situation may arise requiring a modification of Fairfax Water's standard construction. Final acceptance of any system, including variances from and exceptions to these guidelines when deemed appropriate, is ultimately at the direction and discretion of Fairfax Water. This manual is a supplemental reference, to be used in conjunction with Fairfax Water's Approved Products List, Standard Details, the Fairfax County Public Facilities Manual (PFM) and all other Fairfax Water publications governing construction, and is not intended to supersede any of these documents.

#### DEFINITIONS

Definitions: The following words and terms, or pronouns used in their stead, shall, wherever they appear in this document, be construed as follows, unless a different meaning is clear from the context:

"Approved Drawings" shall mean only those drawings specifically referred to as such in the Specifications pertaining to the Developer's project drawings approved by Fairfax County.

"Approved Products List" shall mean the document, latest edition, published by Fairfax Water that lists by category, manufacturers' products approved for use in the Fairfax Water system available at: <http://www.fairfaxwater.org/developers/index.htm>, latest edition.

"Fairfax Water" shall mean the organization and its representatives chartered by the Virginia State Corporation Commission as a public, non-profit water utility.

"Authorized Representative" shall mean a representative of Fairfax Water acting within the scope of his duties.

"Contractor" shall mean the corporation, limited liability company, partnership or other entity which contracts with the Developer to perform the Work.

"Developer" shall mean the entity that has obtained an Approved Plan from Fairfax County.

"Engineer" shall mean the Engineer or Engineers employed by the Developer to act as such and designated to observe the performance of the Work of the Contractor.

"Project" shall mean the entire improvement, which is subject to the Specifications.

"Standard Details" shall mean those details provided by Fairfax Water within this document and found at: <http://www.fairfaxwater.org/developers/index.htm>, latest edition.

"Shop Drawings" shall mean all drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for the Contractor and submitted by the Contractor or Developer to illustrate some portion of the Work. Shop Drawings are not Approved Drawings as so defined.

"Specifications" shall mean all of the directions, requirements and standards of performance applying to the Work, hereinafter detailed and designated as such.

"Work" shall mean everything explicitly or implicitly required to be furnished and done by the Contractor or Developer pursuant to the Specifications and Approved Drawings.

END OF SECTION 00070

## SECTION 00200

### INSTRUCTION TO CONTRACTORS AND DEVELOPERS

#### PART 1 GENERAL

##### 1.01 DESCRIPTION

- A. This Section specifies the general policies and procedures for Fairfax Water Construction and Final Acceptance requirements.

##### 1.02 REQUIREMENTS FOR CONSTRUCTION

- A. Fairfax Water maintains a list of Approved Products, which may be found online at:<http://www.fairfaxwater.org/developers/index.htm>. Please refer to this list before ordering materials; this list supersedes any product information mentioned in the manual.
- B. Fairfax Water Standard Details may be found at:  
<http://www.fairfaxwater.org/developers/index.htm>
- C. Fairfax Water does not issue or obtain permits for construction. The contractor shall obtain all necessary permits prior to beginning work.
- D. The Developer/Engineer/Contractor is responsible for providing two copies of County approved and stamped Rough Grading or Minor Site Plans to Fairfax Water prior to construction. One copy of the Land Use Permit, showing water installation/removal is approved, shall be provided with Rough Grading Plans. The Developer/Engineer/Contractor does not need to supply copies of County stamped approved Site Plans as these are routed to Fairfax Water by the County.
- E. Rough Grading Plan approval by Fairfax Water allows the contractor to install the water mains; however, prior to construction the developer must submit a letter to Fairfax Water's Construction Department stating the mains will not be filled, flushed, tested, tapped, sampled, or connected to any active Fairfax Water line until Fairfax County site plan approval is obtained and approved plans are transmitted to Fairfax Water. Please call the Fairfax Water Construction Department at (703) 289-6387 or (703) 289-6388 for letter requirements.
- F. Prior to beginning work, construction plans must be approved and all easements recorded. Please call the Fairfax Water Construction Department at (703) 289-6387 or (703) 289-6388 to confirm that this has been completed before scheduling work.
- G. All scheduled outages require a minimum of 72 hours notice so that Fairfax Water may provide sufficient notice to its customers. All scheduled outages which affect customers must take place Tuesday through Thursday; no outages will be scheduled for Mondays, Fridays, Weekends, or any Holidays. All shutdowns will only be scheduled which do not affect Fairfax Water's normal operation. The Contractor may be required to work overtime, nights and weekends in making these connections if connections need to be made at times other than those specified.
- H. All water outages shall be at the discretion of the Fairfax Water Inspector.
- I. Provide the Fairfax Water Construction Department a minimum 72-hour notice prior to starting work at (703) 289-6388.
- J. Schedule a meeting with the Fairfax Water Inspector or Inspection Supervisor prior to starting work in order to review materials, sequencing plan and constructability issues.
- K. Once construction starts, all issues that cannot be resolved by the Fairfax Water Inspector or Inspection Supervisor will be handled by the Chief Construction Engineer who can be reached at 703-289-6351.

- L. Fairfax Water maintains a List of Approved Wet Tap Contractors. Only contractors and their foremen who are on this list are authorized to make taps in our system. Please consult this list before scheduling a wet tap to assure that the contractor you intend to use is on this list. See list of approved wet tap contractors, which may be found online at:  
[http://www.fairfaxwater.org/developers/wet\\_tap\\_list.htm](http://www.fairfaxwater.org/developers/wet_tap_list.htm)
- M. A Fairfax Water Inspector must be present to inspect all aspects of the water main construction to assure conformance with approved plans and Fairfax Water specifications (i.e. materials, bedding, backfill, polyethylene encasement, thrust blocks, restraining systems, all connections etc.). If the work has been backfilled without inspection, it will be rejected and the contractor will be required to re-excavate it for inspection prior to filling, testing, and sampling.
- N. All ductile iron pipe shall be push-on joint. Mechanical joint pipe will not be allowed unless specifically approved by the Fairfax Water Inspector.
- O. All ductile iron pipe shall be encased in polyethylene tubing in accordance with the DIPRA specification and bedded and encased in VDOT 21A stone per Fairfax Water Standard Details.

### 1.03 REQUIREMENTS FOR FINAL ACCEPTANCE

#### A. General:

1. All water mains and appurtenances installed, tested, sampled, and placed in service.
2. All easements recorded.
3. All plans and revisions approved.
4. Refer to Fairfax Water Standard Details, Fairfax Water Design Practice Manual, and the Fairfax County PFM for additional details and/or requirements.

#### B. Valve Boxes:

1. All valve boxes intact, to grade, cleaned out and centered over operating nut.
2. All valves operating properly.
3. Valve Box lids with Fairfax Water identifier.
4. Concrete pads installed around valve boxes in non-paved areas.
5. Operating nut or valve stem extension within four feet of finished grade.
6. Minimum two-inch overlap between top and bottom sections of valve boxes.
7. No paving adjusters will be permitted.

#### C. Fire Hydrants:

1. Fire Hydrants facing correctly and functioning properly.
2. Grade around fire hydrant to bury line.
3. Painted in accordance with Fairfax Water specifications.
4. No plantings or structures within five feet of fire hydrant.
5. Hydrant proper distance from curb.

6. Fire hydrant not in sidewalk.

D. Corrosion Control:

1. Corrosion Control measures in place per approved plan and functioning properly.
2. Recent test report.
3. Certification Letter indicating properly functioning system.
4. As Builts of test stations submitted and approved.
5. Test Station boxes intact with numbers in brass marker.
6. Test Stations in non-paved areas with concrete pad.

E. Meter Boxes:

1. Standard Fairfax Water approved Meter boxes and lids.
2. Meter set fifteen inches below surface grade.
3. Top of box matches surface grade.
4. Lid and box intact and not damaged.

F. Easement Areas:

1. Easements properly graded.
2. Easement restoration complete per approved plan.
3. Structures and Plantings are in conformance with easement agreement language.
4. No other utilities located parallel in easement.

G. Asphalt Paving:

1. Final lift of asphalt in place.

Note: This is not an exhaustive list; there may be additional requirements that have not been named above.

END SECTION 00200



## SECTION 01330

### SUBMITTALS

#### PART 1 GENERAL

##### 1.01 DESCRIPTION OF REQUIREMENTS

- A. This Section specifies the general methods and requirements of submissions applicable to Shop Drawings, and Product Data. Detailed submittal requirements are specified in subsequent sections.
- B. All submittals shall be clearly identified by reference to Section Number, Paragraph, Drawing Number or Detail as applicable. Submittals shall be clear and legible and of sufficient size for presentation of data.

##### 1.02 SHOP DRAWINGS AND ENGINEERING DATA.

###### A. General

1. Submittals shall verify compliance with all current Fairfax Water published Approved Products and Standard Details, and shall include drawings and descriptive information in sufficient detail to show the kind, size, arrangement, and operation of component materials and devices; the external connections, anchorages, and supports required; performance characteristics; and dimensions needed for installation and correlation with other materials and equipment. When an item consists of components from several sources, Contractor shall provide a complete initial submittal including all components. Unless otherwise stated on the approved plans, or directed by a Fairfax Water Inspector, Shop Drawings and Product Data consistent with the published Approved Products list do not need to be submitted for Fairfax Water approval.
2. Where required, Shop Drawings shall be sealed by a professional engineer registered in the Commonwealth of Virginia.
3. All submittals, regardless of origin, shall be stamped with the approval of the Engineer.
4. When requested, two copies of each shop drawing and necessary data shall be submitted to Fairfax Water.
5. Facsimile (fax) copies will not be acceptable.
6. Electronic Submittals: The Contractor has the option to transmit submittals electronically in a PDF format to Fairfax Water.
7. Submittals shall contain:
  - a. The date of submission and the dates of any previous submissions.
  - b. The Project title and number.
  - c. Contractor identification.
  - d. The names of:
    - 1) Contractor
    - 2) Supplier

3) Manufacturer

- e. Identification of the product, with the section number, page and paragraph(s).
- f. Field dimensions, clearly identified as such.
- g. Relation to adjacent or critical features of the work or materials.
- h. Applicable standards, such as ASTM or Federal Standards numbers.
- i. Identification of deviations from Approved Drawings and Specifications.
- j. Identification of revisions on resubmittals.
- k. A blank space suitably sized for any necessary Contractor, Engineer, or Fairfax Water stamps.
- l. Where calculations are required to be submitted by the Contractor, the calculations shall have been checked by a qualified individual other than the preparer. The submitted calculations shall clearly show the names of the preparer and of the checker.

PART2 PRODUCTS  
(Not Used)

PART 3 EXECUTION  
(Not Used)

END OF SECTION 01330

## SECTION 01720

### FIELD ENGINEERING AND SURVEYING

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. The requirements related to construction to designated lines, grades and elevations.

##### 1.02 CONSTRUCTION TO LINES AND GRADES

- A. All work shall be constructed in accordance with the lines, grades, and elevations shown on the Approved Drawings. The full responsibility for keeping alignment and grade shall rest upon the Contractor. Included shall be preparation of cut sheets.

##### 1.03 SURVEYS

- A. Horizontal and Vertical Controls: Base horizontal and vertical control points will be established or designated by the Engineer. All additional survey, layout, preparation of cut sheets, and measurement work shall be performed by a Registered Land Surveyor, licensed in the Commonwealth of Virginia, employed by the Contractor or Developer as a part of the Work. Stake-out for all water mains, with offsets of 8'-12', shall be performed at intervals of 50 feet, at all appurtenances, and as otherwise directed by Fairfax Water. Contractor shall submit cut sheets for review and approval by Fairfax Water prior to beginning water main installations. Cut sheets shall be stamped with the seal of a Professional Engineer or Registered Land Surveyor, licensed in the State of Virginia. The Contractor shall not begin work until provided a Fairfax Water-approved copy of the cut sheet.

##### 1.04 PROTECTION OF SURVEY DATA

- A. Safeguarding Points: The Contractor shall safeguard all points, stakes, grade marks, monuments, and benchmarks made or established on the Work. The Contractor shall re-establish them if disturbed or destroyed and rectify all improperly installed Work.
- B. Safeguarding Property Corners: The Contractor shall safeguard all existing and known property corners, monuments, and marks adjacent but not related to the Work and shall re-establish them if disturbed or destroyed.

##### 1.05 RECORDS

- A. Maintain a complete, accurate log of all control and survey work as it progresses.
- B. Maintain an accurate record of all changes, revisions and modifications. See Design Practice Manual regarding plan revision requirements and procedures.

END OF SECTION 01720

## SECTION 02315

### EXCAVATING, BACKFILLING, AND COMPACTING

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Excavating Trenches for Water Mains and Appurtenant Facilities.
- B. Rock Excavation
- C. Backfilling and Compacting

##### 1.02 REFERENCES

- A. Land Use Permit Manual, Virginia Department of Transportation.
- B. Road and Bridge Specifications, Virginia Department of Transportation.
- C. ASTM D698 - Test Methods for Moisture Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5 lb. Hammer and 12-inch Drop.
- D. Manual of Accident Prevention in Construction. Associated General Contractors of America.
- E. Occupational Safety and Health Standards-Excavation; Final Rule 29 CFR Part 1926, OSHA.

##### 1.03 SUBMITTALS

- A. Submit Shop Drawings and material certificates of compliance in accordance with Section 01330 – Submittals.
- B. Materials and Certifications:
  - 1. Select Fill: Submit letter of certification and list of material composition and properties from each supplier of Type A and Type B select fill.
  - 2. Compaction Test Reports: Submit reports for each location of field compaction test. Reports shall include results of field density tests, moisture content, and degree of compaction.

##### 1.04 DEFINITIONS

- A. Utility: Buried pipe, conduit, or cable, surface features such as swales and ditches, and overhead wires or cables including their supports.
- B. Earth: The softer materials of the outer surface of the earth. The basic constituents are the products of rock disintegration, glaciation, and erosion, consisting of boulders, cobbles, pebbles, sand, silt, and clay.
- C. Rock: The hard, firm and stable parts of the earth's crust which shall include all materials which cannot be removed by excavation equipment of appropriate size and power for the diameter pipe being installed and requires blasting or manual or mechanical barring, wedging or hammering for removal from their original beds. Specifically included are ledges, bedrock, boulders, cement, grout, masonry or concrete larger than 1 cubic yard in volume.

##### 1.05 ADDITIONAL REGULATORY REQUIREMENTS

- A. Naturally Occurring Asbestos: The Contractor shall comply with all applicable regulations of OSHA and the Fairfax County Health Department concerning Working requirements in areas containing naturally occurring asbestos deposits.

## PART 2 PRODUCTS

### 2.01 FILL MATERIALS

- A. Select Fill: Select fill shall meet the following requirements:
  - 1. Type A - Unpurchased Material: Type A - unpurchased material shall consist of clean earth, inspected and approved by the Engineer, which has been obtained by the Contractor from sources outside the Work and not meeting the criteria for Type B indicated below.
  - 2. Type B - Crushed Stone: Type B - Crushed Stone shall consist of 21A crushed stone conforming to VDOT specifications, or an approved substitute. NOTE: No. 57 stone shall be used (in lieu of 21A stone) at creek crossings and in areas containing groundwater.
- B. Suitable Fill: Suitable fill material shall conform to the following requirements.
  - 1. Type I: Type I material shall consist of clean earth excavated from the trench containing no stone larger than 3/4 inch across.
  - 2. Type II: Type II suitable material may be substituted for Type I suitable material, in the area from 12 inches above top of pipe to original grade. Type II material shall contain good earth and stone excavated from the trench.
    - a. Stone material contained in Type II suitable fill shall not exceed 6 inches across and shall be uniformly distributed.
    - b. Type II suitable material shall not consist of more than 50 percent stone by volume.

### 2.02 BEDDING MATERIALS

- A. Bedding: Pipe bedding shall be Type B Crushed Stone and shall meet the requirements of Paragraph 2.01.A.2 above.

## PART 3 EXECUTION

### 3.01 PREPARATION

- A. Identify: Required lines, levels, contours, and datum.
- B. Protect Existing Vegetation: Protect plant life, lawns, and other features remaining as a portion of final landscaping.
- C. Protect Existing Features: Protect bench marks, existing structures, fences, sidewalks, paving, mailboxes, gas line markers, curbs, and other similar features from excavation equipment and vehicular traffic.
- D. Clearing: The site of all open cuts and excavation shall be first cleared of trees, stumps, shrubs, underground and other obstructions prior to excavation.
  - 1. Clearing within easements and rights-of-way shall be limited to the construction limits shown on the Approved Drawings.
  - 2. Remove and dispose of cleared materials and debris unless otherwise directed by the Inspector.
  - 3. Remove topsoil and stockpile for use in restoration of excavated areas.

### 3.02 EARTH EXCAVATION

- A. Shaping and Trimming: Excavate trenches to the widths and depths specified below, except where indicated otherwise.

1. Trench width at bottom of pipe:

Nominal Pipe Diameter (Inches)	Trench Width (Inches) Ductile Iron
3 – 4	24
6 – 16	OD + 18
24 - 36	OD + 24
48	OD + 30

2. Trench Bottom: Grade and align pipe trench bottoms to provide bearing for the full length of the pipe barrel. Provide bell holes for the proper assembly of pipe joints.

- B. Additional Excavation: In the event the Inspector determines the bedding materials in any area to be unsuitable, with or without the concurrence of the Contractor, the Contractor shall promptly follow the direction of the Inspector in addressing such condition. Where additional excavation has been ordered and approved, the Contractor shall replace the removed material as directed by the Inspector.
- C. Unauthorized Excavation: Wherever the excavation is carried beyond or below the lines and grades given by the Approved Drawings, except as specified above, all such excavated space shall be refilled with such material and in such manner as may be directed by the Inspector in order to ensure the stability of the various structures.
- D. Disposal of Material: Top soil suitable for final grading shall be stored on the site separately from other excavated material. Other surplus excavated material unsuitable for backfilling or in excess of that required for constructing fills and embankments as shown on the Approved Drawings shall be removed by the Contractor.
- E. Removal and disposal of Petroleum-Contaminated Soil and Groundwater: In areas where petroleum-contaminated soils are encountered along the proposed water main alignment, the contractor, as directed by Fairfax Water, shall remove and dispose of all contaminated soils within the pipeline trench where the Total Petroleum Hydrocarbon (TPH) concentration exceeds 50 mg/kg. The contractor shall remove the subject soils as directed by Fairfax Water in accordance with applicable regulations of the Virginia Department of Environmental Quality (VDEQ), the U.S Environmental Protection Agency (EPA), Occupational Safety and Health Administration (OSHA), and industry-recognized removal procedures. Suitable clean fill material will be put in place above newly installed water main, if non-paved area, in accordance with Fairfax Water's standard Trench Details.

The Contractor shall also obtain all necessary permits and inspections as required by local, state, and federal laws, rules, and regulations for the proper handling of the contaminated soil from its generation to its disposal.

3.03 ROCK EXCAVATION

- A. Limits of Rock Excavation: Excavate rock within the widths and depths specified for earth excavation and specified in this paragraph.
  - 1. Proposed Structures: Excavate only to the bottom of structure.
  - 2. Rock Trench: Remove rock to a minimum of 6 inches below the bottom of pipe and replace with 6 inches of Type B select fill material for pipe bedding.
  - 3. Existing Structures: Excavate rock within 5 feet of existing structures and utilities by wedging, barring or other approved method.
- B. Blasting
  - 1. Blasting shall not be permitted.
  - 2. Rock excavation may be performed by the use of a rock trenching machine or other approved method. Machine shall be adequate to excavate rock of the type and in the quantities necessary to perform the work required by this project.

3. When the use of a rock trenching machine is inappropriate (such as at utility crossings), rock shall be excavated by barring, wedging or other approved methods.

C. Protection of Backfill Material

1. Excavated materials from rock excavation operations, that are deemed suitable for use as backfill, shall be placed back in the trench, compacted, and protected from inclement weather prior to re-excavation for, and during new pipeline installation. If the Contractor fails to protect the suitable material, thereby allowing it to become unsuitable, he shall provide suitable select fill..
2. Unsuitable Materials: Refer to the provisions for disposal of materials under the earth excavation requirements of this specification section.

3.04 BACKFILLING

A. Pipe Trenches: Backfill trenches to original grade or to such other grades as shown or directed.

1. Manual Backfilling: Backfill around pipe manually with Type B select fill, from 6 inches below the pipe up to 6 inches above the pipe in non-paved areas, unless specified otherwise herein. Limits of select fill in paved (roadway) areas, at stream crossings, under asphalt trails, or other designated areas shall be as defined on the Trench details on the Approved Drawings. If rock is encountered, backfill around pipe (with select fill) from below pipe, in accordance with limits of rock excavation defined in paragraph above, up to 6 inches above the pipe. This material shall be placed in layers approximately 6 inches thick, up to the limits indicated (on the trench details) on the Approved Drawings, each layer being thoroughly tamped and compacted in place to a minimum of 95% of maximum dry density in accordance with ASTM D698 and VDOT Road and Bridge specifications. Tamp using tools of approved weight to the following points:

<u>Nominal Pipe Diameter</u>	<u>Top of Manual Backfilling</u>
16 Inches and Under	12 Inches Above Top of Pipe
Greater than 16 Inches	6 Inches Above Top of Pipe

2. Backfilling by machine: After backfilling around the pipes as specified above, the remainder of the trench may be backfilled by machine with suitable fill, but the Work shall be done in such a way as to prevent dropping of material directly on top of the pipe or structure. Material shall be deposited in uniform horizontal layers up to 2 feet in depth and compacted to a minimum 85% density in accordance with ASTM D698. If, due to rain or other causes, the material is too wet for satisfactory compaction, it shall be allowed to dry partially before compacting.
3. Select fill: Where select fill material is required by the Inspector to bed and backfill the pipe, this material shall be consolidated to the identical points specified where suitable fill material is used as backfill. The use of select material shall be based upon the actual trench conditions encountered and depth shall be determined by the Inspector.
4. Prevention of Settlement: Where structures such as pipelines, walks, asphalt trails, driveways and roadways are to be constructed or replaced later, on backfilled areas, the entire backfill in such areas placed in layers, rolled, rammed, or otherwise thoroughly compacted to a minimum of 95% of maximum dry density to prevent settlement.
5. Use of water for compaction is prohibited.

B. Backfilling Around Structures: Backfilling around thrust collars, and other structures and conduits shall be performed manually.

1. Removal of foreign matter: Remove lumber, rubbish, braces and refuse from behind walls prior to starting backfill operation.
2. Backfill shall be compacted to a minimum 95% density.

- C. Backfilling in VDOT Right-Of-Way: The following additional requirements apply for work performed in VDOT right-of-ways:
  - 1. Backfill compaction: All backfill shall be placed in layers of not greater thickness than 6 inches, and shall be compacted to at least 95% of maximum dry density in accordance with Virginia Department of Transportation Road and Bridge Specifications. Compact with pneumatic tampers or by other approved methods. Compaction by water shall not be permitted.
  - 2. Rejection of unsuitable materials: The VDOT inspector or the Fairfax Water Inspector may, at their discretion, reject backfill material which they determine to be unsuitable.
  - 3. Backfill requirements beneath aggregate surfaces: When the excavation is made beneath aggregate surfaces, the top 10 inches of the trench must be replaced in accordance with the requirements of Section of 02700.
- D. Compaction testing by an independent testing laboratory approved by Fairfax Water shall be provided.
  - 1. At least one compaction test shall be made for each 250 linear feet of pipeline installed. Test location and depth will be as directed by Fairfax Water or VDOT. Testing shall be continued along the backfill benching so as not to delay pipe laying activities.

### 3.05 EARTH EMBANKMENTS AND AREAS OF FILL

- A. General: Fills and embankments, required for the construction or completion of the Work shall be constructed where shown on the Approved Drawings and to the lines and grades given by the Engineer.
- B. Removal of Vegetation: The entire surface of the ground to be covered with embankment shall be stripped of all grass, vegetation, topsoil, or destructible material of any kind, including rubbish, before any embankment material is placed.
- C. Embankment Materials: Earth embankment shall be made of the best material available from the excavation, so far as this is sufficient and of satisfactory character. No rubbish or other destructible matter shall be used in embankments. Any additional material needed for earth embankment shall be from borrow pits approved by the Engineer, and this material shall be reasonably free from vegetable matter, large boulders, or rocks, greater than 6 inches in diameter, and shall be a material that can be solidly compacted and will remain stable when wet.
- D. Water main installation in areas of fill: Wherever water main is to be installed upon proposed fill, the fill material shall be placed, compacted, and tested to a minimum of 2 feet above the top of the proposed water main elevation in accordance with this section, prior to water main installation.
- E. Placement and Compaction Requirements: Wherever any structure is to be built upon embankments or fill, the earth for the embankment shall be placed in layers of 8 inches in loose depth, and each layer shall be thoroughly sprinkled and compacted before the next layer is added. If, due to rain or other causes, the material is too wet for satisfactory compaction, it shall be allowed to dry partially before compacting. The layers shall extend entirely across the fill and shall be approximately level. Each layer shall be thoroughly compacted by the travel of trucks, where possible, or other machines. If ordered by the Engineer, the earth shall be compacted by rolling with a sheeps foot or tamping roller having a minimum weight on each tamper of 200 pounds per square inch of cross-sectional tamping area. The earth embankment, as specified above, shall be left to stand for as long a time as possible during the progress of construction and shall not be built upon until approved by the Engineer. The Contractor shall conduct compaction testing in accordance with this Section.
- F. Finish grading: Before leaving the Work or before topsoil is placed, the top and slopes of all embankments shall be carefully trimmed to the slopes, lines and grades established by the Engineer, and any depressions shall be brought to grade with acceptable material. In general, for lawn areas, the embankments shall be fine graded to a true surface 4 inches



below the established grade. For other areas, the embankments shall be fine graded to the established grade.

- G. Removal of unsatisfactory material: If any of the material is not sufficiently compacted in and by the methods being used, such material shall be removed from the embankment and replaced with approved material compacted to meet the required density.

### 3.06 RESTORATION

- A. Complete finish grading and restoration of excavated areas in accordance with the Approved Drawings.
- B. Pavement: Refer to the provisions of the Approved Drawings and the Virginia Department of Transportation Special Provisions for Pavement Open Cuts.

END OF SECTION 02315

## SECTION 02400

### TRENCHLESS CROSSINGS AND OPEN CUT CASINGS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Trenchless Crossings: Perform crossings by one or more of the following methods:
  - 1. Boring
  - 2. Liner plate tunneling
- B. Pipe Installation: Pipe installation within encasing conduit

##### 1.02 REFERENCES

- A. ASTM A123 Standard Specification for Zinc (Hot-dip Galvanized) Coatings on Iron and Steel Products
- B. ASTM A153 Standard Specification for Zinc Coating (Hot-dip) on Iron and Steel Hardware
- C. ASTM A307 Standard Specification for Carbon Steel Bolts and Studs
- D. ASTM C62 Specification for Building Brick (Solid Masonry Units Made From Clay or Shale)
- E. AREMA Manual for Railway Engineering – American Railway Engineering and Maintenance-of-Way Association (AREMA)

##### 1.03 DEFINITIONS

- A. Trenchless Crossing: The installation of a system consisting of conduit and appurtenances such as tunnel liner plate or casing pipe and a carrier pipe (water main) by one or a combination of methods commonly known as jacking, boring or tunneling. Trenchless Crossing shall be considered equivalent with Tunneled Crossings in these documents.
- B. Open Cut Casing: The installation of steel casing pipe and a carrier (water main) by the open trench excavation method.

##### 1.04 SUBMITTALS

- A. Submit Shop Drawings, installation procedures and qualifications, and material certificates of compliance in accordance with Section 01330 – Submittals.
- B. Shop Drawings: Furnish Shop Drawings for the following items:
  - 1. Casing pipe
  - 2. Casing insulators:
    - a. Type
    - b. Number
    - c. Spacing
    - d. Installation instructions
  - 3. Liner plate:
    - a. Cross section dimensions
    - b. Diameter
    - c. Thickness
    - d. Grout hole locations

- C. Methods and Procedures: Provide an outline of the methods and procedures, including drawings, specifications and methods of operation for the following:
  - 1. Boring/Jacking equipment and methods: Provide materials outlining methods of operation, design and specifications for boring operation.
  - 2. Liner plate construction methods: Provide an outline of the methods to be used in prosecuting Work.
  - 3. Open cut casing methods: Provide an outline of the methods to be used in prosecuting work.
- D. Design Data:
  - 1. Liner plate: Submit design drawings and load computations for liner plate. Drawings shall be sealed and signed by a Professional Engineer registered in the Commonwealth of Virginia.
  - 2. Grout mixture: Submit grout mixture design for filling voids outside liner plate.

1.05 QUALIFICATIONS

- A. Trenchless Crossing and Open Cut Casing Contractor: Trenchless Crossings shall be constructed by personnel fully qualified and experienced for the Work. The Contractor shall have a minimum of five (5) years experience of the type, size and complexity similar to work on this project. Qualifications shall be submitted to Fairfax Water upon request.

1.06 REGULATORY REQUIREMENTS

- A. Governmental Agencies: Cooperate with the governmental agency such as Virginia Department of Transportation (VDOT) or other agency with jurisdiction over the roadway or crossing.
  - 1. Materials shall conform to the regulating agency's standards or Fairfax Water's if more rigorous.
  - 2. The approval of all materials and methods shall be obtained from the appropriate agency prior to start of Work.

PART 2 PRODUCTS

2.01 STEEL CASING PIPE

- A. Materials: Welded steel pipe for boring and jacking highway crossings shall be carbon steel, in accordance with ASTM A139, Grade B, and shall have the following minimum wall thickness:
  - 1. Wall thickness:
 

DIAMETER	MINIMUM THICKNESS
16 inches to 36 inches	0.375 inches
42 inches and greater	0.50 inches
  - 2. Joints: for casing pipe shall be squared and continuously welded.
- B. Size: See Approved Drawings for casing pipe size required.

2.02 CASING INSULATORS

- A. Approved Manufacturers: In accordance with Fairfax Water's Approved Products List.

2.03 END CLOSURES

- A. Materials:
  - 1. Brick: ASTM C62 grade MW or better
    - a. New, whole bricks of uniform standard commercial size with straight parallel edges and square corners.

2. Mortar: composed of one part cement, two parts sand, and water.

#### 2.04 GROUT

- A. Materials: Grout for filling voids outside of liner plates shall consist of portland cement, fine aggregate, and water.
  - 1. Fine aggregate: refer to Section 03300 Cast In Place Concrete
  - 2. Admixtures: Submit information on admixtures proposed to improve flow ability of grout mixture.

#### 2.05 LINER PLATE

- A. Approved Manufacturers: In accordance with Fairfax Water's Approved Products List.

#### 2.06 CORROSION CONTROL

- A. Refer to Section 13110 for requirements.

#### 2.07 SLED ASSEMBLIES

- A. Provide design where project requirements dictate.

### PART 3 EXECUTION

#### 3.01 PREPARATION

- A. Identify: Required lines, levels, contours and datum.

#### 3.02 PROTECTION

- A. Existing Structures: Protect existing structures and benchmarks from excavation equipment.
- B. Highways: Protect highway being crossed from damage or disturbance due to excavation or settlement.
- C. Utilities: Maintain and protect above and below grade utilities that are to remain. Contractor shall be responsible for verifying locations of all underground utilities at Trenchless Crossings.

#### 3.03 ACCESS PIT CONSTRUCTION

- A. Safety: Take all measures necessary to assure safe working conditions including the following:
  - 1. Provide protective concrete barriers and steel plating at top of access pits.
  - 2. Provide excavation support system in accordance with OSHA and other applicable standards.
- B. Water Control: Maintain excavation free of water.
- C. Bore Pit Requirements: Size the access pits to permit the Work to be performed safely and at the lines and grades shown on the Approved Drawings.

#### 3.04 TRENCHLESS CROSSING CONSTRUCTION

- A. General: The Contractor has the option of installing liner plate in lieu of jacking or boring.
  - 1. Increase in size of encasing conduit or other material changes required by the Contractor's selection of liner plate shall be his responsibility. Any changes must be approved by Fairfax Water before installation.
  - 2. Carrier pipe within casing/liner plate installation shall be restrained.
- B. Boring Method:
  - 1. Boring machine: Boring machines shall afford adequate protection against loss of ground, and permit ground support adjacent to trenchless crossing's face as required by ground conditions.

- a. Use a method of advancing the boring machine that ensures correct alignment at all times without binding or imposing excessive loads on the initial trenchless crossing supports or upon the supporting ground.
  2. Deviation from line and grade shall not exceed 3 inches in any direction at any point along the casing pipe.
- C. Liner Plate Method:
1. General: Discontinue trenchless crossing operations when cave-ins or loose materials are encountered or anticipated. Provide approved shoring and fill voids in accordance with VDOT requirements with pressure grouting prior to continuing Work.
    - a. Bulkhead trenchless crossing heading at any interruption of the tunneling operation.
    - b. Conduct trenchless crossing operation continuously on a 24-hour basis when so directed by VDOT or other agency with jurisdiction over the crossing.
  2. Trimming excavation: Exercise care in trimming excavation surface to provide a snug fit of liner plates against undisturbed material.
    - a. Advance excavation only the amount required for installation of the succeeding liner plate section.
    - b. Support vertical face of excavation to prevent sloughing.
  3. Rock excavation and removal: Remove rock encountered in the excavation by means of air hammers in a manner that minimizes the occurrence of voids outside the liner plates.
  4. Deviation from line and grade shall not exceed 3 inches in any direction, at any point along the trenchless crossing.
  5. Grouting: Place a uniform Portland cement grout mixture under pressure behind the liner plates to fill voids existing between liner plate and undisturbed material.
    - a. Install a threaded plug in each grout hole as grouting is completed there.
    - b. Keep grouting of liner plate within 4 feet of tunnel heading. Grout entire length of liner plate installed when trenchless crossing operations cease overnight.
- D. Open Cut Casing Method:
1. Excavate trench and provide 6-inch compacted select fill bedding for steel casing pipe.
  2. Deviation from line and grade: Deviation from line and grade shall not exceed 3 inches in any direction at any point along the casing pipe.
- E. Corrosion Control:
1. Install test stations and other corrosion control measures in accordance with Section 13110- Cathodic Protection.

### 3.05 CARRIER PIPE INSTALLATION

- A. Pipe Joints: Assemble carrier pipe for installation within casing pipe or liner plate tunnel in accordance with Sections 02510.
- B. Casing Insulators: Install insulators in accordance with Approved Drawings. Center-to-center spacing shall not exceed that indicated on Fairfax Water Standard Details.

### 3.06 END CLOSURES

- A. Masonry Closures: Seal ends of encasing conduit with brick masonry and mortar.
- B. Drainage from encasing conduit: Provide means for drainage from encasing conduit.

END OF SECTION 02400

## SECTION 02510

### DUCTILE IRON PIPE (DIP) WATER MAINS AND APPURTENANCES

#### PART 1 GENERAL

##### 1.01 DESCRIPTION

###### A. Scope:

1. Contractor shall furnish all materials and labor, supervision, tools, equipment and incidentals required to furnish, deliver and install the Work.
2. It is the purpose of the Approved Drawings to provide a complete and workable piping system. Miscellaneous fittings and accessories not specified in the Approved Drawings may be necessary to complete the Work shall also be provided as a part of this Work.

##### 1.02 RELATED SECTIONS

- A. Section 02315 – Excavating, Backfilling, and Compacting
- B. Section 02512 – Thrust Restraints
- C. Section 02513 – Disinfection of Water Distribution Systems
- D. Section 02514 – Leakage Tests
- E. Section 02700 – Paving and Surfacing
- F. Section 02920 – Lawns and Grasses
- G. Section 03300 – Cast-In-Place Concrete
- H. Section 13110 – Cathodic Protection

##### 1.03 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise required by the Approved Drawings.
  1. AWWA/ANSI C110/A21.10 American National Standard for Ductile-Iron and Gray-Iron Fittings.
  2. AWWA/ANSI C111/A21.11 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
  3. AWWA C115/A21.15-American National Standard for Flanged Ductile-Iron Pipe with Threaded Flanges.
  4. ANSI Standard B16.1 Cast Iron Pipe Flanges and Flanged Fittings.
  5. AWWA C600 Installation of Ductile-Iron Water Mains and Appurtenances.
  6. AWWA/ANSI C104/A21.4 American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
  7. AWWA/ANSI C151/A21.51 American National Standard for Ductile-Iron Pipe Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water or Other Liquids.
  8. ASTM A325 Specification for High Strength Bolts for Structural Steel Joints.
  9. AWWA/ANSI C153/A21.53 Ductile-Iron Compact Fittings for Water Service.
  10. AWWA C500/C509 Gate Valves for Water and Sewerage Systems.
  11. AWWA C504 Rubber Seated Butterfly Valves.
  12. AWWA C502 Dry-Barrel Fire Hydrants.

13. AWWA C206 Field Welding of Steel Pipe.
14. Commonwealth of Virginia/State Board of Health, Waterworks Regulations.
15. Fairfax Water, Planning and Engineering Division, Approved Products List.
16. Fairfax Water, Planning and Engineering Division, Design Practice Manual.

#### 1.04 SUBMITTALS

- A. Shop Drawings: Upon request, submit for the following in accordance with Section 01330:
  1. Pipe, fittings, valves and valve boxes, and specials
  2. Adapters
  3. Mechanical couplings
  4. Temporary bulkheads
  5. Connections to other mains
  6. Valve or other water main closures
  7. Product Data: as required to completely describe the materials being furnished including, but not limited to:
    - a. Design drawings, calculations, specifications, and product data sheets necessary to fully describe all materials, components, and finished products and to show conformance with the Approved Drawings.
    - b. Dimension drawings showing full details of the pipe.
  8. Other items required by the Approved Drawings, or requested by the Inspector.
- B. Letter of Certification from Contractor: Upon request, the Contractor shall submit a letter certifying that valves, pipe, fittings and related items comply with Fairfax Water's Approved Product List whenever applicable.
- C. Affidavit of Compliance: Upon request, the Contractor shall furnish affidavit of compliance certifying that the Materials being furnished comply with all applicable provisions of referenced AWWA Standards and Fairfax Water Standards.
- D. Acceptance of any submittal by Fairfax Water shall not relieve the Contractor of his responsibility to meet the requirements of the Approved Drawings and Fairfax Water Standards.
- E. Laying Schedules: Furnish laying schedules for ductile iron water mains 24-inches in diameter and larger.
  1. Contractor shall submit layout drawings and tabulated schedules designating each pipe, fitting, special, and accessory item necessary to complete the Work in sequence of installation. Coordinate identification of each piece with shop drawings, product data, and marking schedule.
  2. Include the following information:
    - a. Quantities and laying lengths of each piece.
    - b. Centerline stations and offsets with respect to the Project baseline at each change in horizontal or vertical geometry.
    - c. Centerline grade with respect to horizontal between each change of grade.
    - d. Centerline elevation referenced to Project vertical datum at each change in horizontal geometry and grade.
    - e. Orientation of outlets and bends.
    - f. Joint opening dimensions other than zero for each joint, to nearest 1/8-inch: top or bottom, left or right.

- g. Laying schedules shall not allow deflection of restrained joints.
  - h. Areas requiring special embedment conditions as shown on the Drawings.
3. Laying schedule joint opening shall not exceed 75 percent of the pipe manufacturers maximum recommended joint opening.

F. Installation Experience:

- 1. Experience in the installation of ductile iron pipe is required. The Contractor shall thoroughly familiarize himself with all specific manufacturing and installation requirements of the pipe material shown on the Approved Drawings.
- 2. The Contractor shall provide the services of a competent superintendent and pipe installation crew, who shall have been in charge of installing at least 10,000 linear feet of ductile iron pipe in similar field conditions.
- 3. Upon request, the Contractor shall submit the pipe Superintendent's and pipe installation crew's experience in installing the pipe material and joint types to be used. Give project titles, pipe diameter and length, locations, reference contacts, addresses, and telephone numbers.

1.05 REGULATORY REQUIREMENTS

- A. Commonwealth of Virginia/State Board of Health: Water main installation shall be in accordance with the Waterworks Regulations of the State Board of Health.
- B. Reduction of Lead in Drinking Water Act. All products and materials shall comply with Public Law 111-380.

1.06 DELIVERY, STORAGE AND HANDLING OF MATERIALS

- A. Ductile Iron Pipe: Loading, unloading, handling, inspection and storage of ductile iron and gray iron pipe, fittings, accessories, and appurtenances shall be performed in accordance with AWWA C600 and approved submittals.
  - 1. Store pipe, fittings, valves, and appurtenant materials in a manner that will protect them from becoming dirty or damaged prior to installation.
    - a. Pipe, fittings, valves, and appurtenant materials, which are visibly dirty, shall be cleaned to the Inspector's satisfaction or replaced at the Contractor's expense prior to installation.
- B. Arrange deliveries of products in accordance with construction schedules to facilitate inspection prior to installation.
- C. Coordinate deliveries to avoid conflict with Work and conditions at site.
- D. Do not have products delivered to Project site until related Shop Drawings have been approved by Fairfax Water.
- E. Use web slings or forklifts to handle the pipe. Metal chains, cable tongs or other equipment likely to cause damage to the coating shall not be used. Hooks shall not be used on the ends of the pipe.
- F. Where forklifts are used, their bearing surfaces must be padded with protective forklift sleeves/pads or suitable material approved by Fairfax Water.
- G. Web slings shall be of a type and width that will not damage the coating. Slings shall not pass through the pipe.
- H. If cables or chains are used during transportation, they must be properly padded with approved suitable material to protect the coating from damage. Use padded separator strips between pipe and cable or chains.
- I. Pipe, fittings, and specials shall be unloaded opposite to or as close to the place where they are to be laid as is practical to avoid unnecessary handling.



- J. Materials cracked, gouged, chipped, dented or otherwise damaged will not be accepted. Minor defects in the pipe or coatings may be repaired at the site by a method approved by the manufacturer of the materials and by the Inspector. Damaged pipe, fittings, specials and accessories shall be repaired or replaced by the Contractor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fairfax Water publishes an Approved Products List, which lists, by category, manufacturer's products approved for use in Fairfax Water's system. Manufacturers' products covered by the categories included in this document that are not specifically listed are not approved for use. Copies of this document are available from Fairfax Water's internet website- <http://www.fairfaxwater.org/developers/index.htm>.

2.02 PIPE AND FITTINGS

- A. Ductile Iron Pipe:

- 1. Pipe Materials: Ductile iron pipe shall meet the requirements of ANSI/AWWA Standards C151/A21.51. For pipe buried in the ground, the minimum thickness shall be Class 52, unless shown differently on the Approved Drawings. Ductile iron pipe installed at a depth greater than 14 feet, and where indicated on the Approved Drawings, shall be thickness Class 53. The minimum nominal pipe wall thickness for 16-inch, 24-inch, and 48-inch, diameter pipe shall be:

Pipe Class	16-inch	24-Inch	48-inch
Class 52	0.32 inches	0.40 inches	0.64 inches
Class 53	0.34 inches	0.43 inches	0.70 inches]

- a. Gauged Pipe: Gauged pipe shall be circular pipe that has been checked by the Pipe Manufacturer to meet the outside diameter tolerance for joints throughout its length. Pipe meeting these requirements shall be called "gauged full-length pipe" and will be marked with a 4-inch wide green band painted on the pipe barrel.
- b. If grinding or milling is necessary to meet the requirements for gauged pipe, only pipe having 2 pipe thickness classes greater than those called for in the purchase order shall be machined. In no case will the machined thickness of the pipe be less than the pipe thickness class shown on the Approved Drawings or specifications.
- 2. Pipe joints shall be in accordance with the following:
  - a. Push-on rubber gasket joints shall be of the bell and spigot type meeting the requirements of ANSI/AWWA Standard C111/A21.11 in all respects except details of the joint. The joint shall be of a type that employs a single elongated grooved gasket to affect the joint seal. The joint shall be listed in the Fairfax Water Approved Products.
  - b. Flanged joints shall meet the applicable requirements of AWWA Standard C110 and C115 and ANSI Standard B16.1 and shall be faced and drilled to ANSI Class 125 (Ductile) standard template. Ductile iron pipe with threaded flanges shall have a minimum pipe wall thickness of 0.31 inch below the threads of machined section. Flange bolts shall straddle the centerline of the pipe or fitting. Bolts and nuts shall be low-carbon steel in accordance with ASTM A307, Grade B. Bolt-studs and nuts shall be furnished at insulated flanges in accordance with ASTM A193, Grade B7.
    - 1) For flanged pipe, flanges with long hubs shall be silver soldered or screwed on the end of the pipe in the shop and the face of the flange and end of the pipe refaced together. There shall be no leakage through the pipe threads and the flanges shall be designed to prevent corrosion of the threads from outside.
    - 2) Where tap or stud bolts are required, flanges shall be tapped. Unless otherwise shown on the Approved Drawings or specified, flanges shall meet the applicable requirements of ANSI Standard A21.10 and B16.1. They shall be accurately

faced at right angles to the pipe with bolt holes drilled smooth and true, and shall be coated with rust veto immediately after facing and drilling.

- 3) Gaskets for flanged joints shall be rubber with cloth inserts. Gaskets shall be full-faced, unless directed otherwise by the Inspector.
  - c. Joints with locking features shall have the ability to transmit axial load across the joint without separation or leakage. The appurtenances necessary to achieve these results shall be corrosion resistant and the restraining bolts shall be low alloy steel.
  - d. Beveled joints shall allow greater joint deflections than those shown in the appropriate tables in AWWA C600. The interior surfaces of the bell may be cast or machined to accomplish this increase in deflection; however, in no case will the bell thickness be less than the pipe barrel thickness. Beveled pipe shall have the permissible deflection marked on the pipe barrel.
3. Fittings: All fittings shall conform to the applicable requirements AWWA C110 or C153 and the following:
- a. Standard pattern fittings shall conform to one of the following:
    - 1) Class 250 cast iron fittings.
    - 2) Class 350 ductile iron fittings (24-inch diameter or smaller).
  - b. Mechanical joint fittings shall conform to one of the following:
    - 1) Compact mechanical joint fittings shall be ductile iron, Class 350, in accordance with the requirements of ANSI/AWWA Standard C153/A21.53.
    - 2) Mechanical joint assemblies, including gaskets, glands, bolts, and nuts shall be in accordance with the requirements of ANSI/AWWA Standard C111/A21.11 and shall be furnished with all fittings. Glands for all fittings larger than 12-inches shall be ductile iron. Bolts and nuts shall be low-alloy steel. Mechanical joint bolt holes shall straddle the centerlines of the fittings.
    - 3) Provide mechanical joint assemblies in unrestrained areas. Mechanical joint pipe is not permitted in restrained areas.
  - c. Push-on rubber gasket joints shall be of the bell and spigot type and shall conform to the applicable requirements of ANSI/AWWA Standard A21.10 and shall be of the lightest class permitted for the class of pipe in which the fitting is used.
  - d. Flanged fittings shall meet the applicable requirements of ANSI Standard A21.10 and ANSI/ASME Standard B16.1, with flanges meeting the requirements of ANSI/AWWA Standard A21.10. ANSI fittings shall be of the lightest class conforming to the pressure ratings of the water mains that they connect. Flanges, flange facing, drilling and protecting shall be as specified for centrifugally cast pipe. Bolt holes shall straddle the centerlines of the fittings. Bolts and nuts shall be low-carbon steel in accordance with ASTM A307, Grade B. Bolt-studs and nuts shall be furnished at insulated flanges in accordance with ASTM A193, Grade B7.
  - e. Wall castings and make-up pieces, such as bell and bell, bell and spigot, bell and flange, flange and flange, flange and spigot, and flange and flare shall meet the requirements of ANSI Standard A21.10 and shall be of the lightest class that is standard for the class of pipe in which they are used.
  - f. Furnish flange-to-plain end adapters where shown on the Approved Drawings or where otherwise accepted. The plain end joint shall be a mechanically compressed rubber gasket with follower ring. The inside diameter of the adapter shall be greater than the outside diameter of the plain end of the pipe being joined to provide a means of disassembly after installation.
  - g. Where special fittings are required, they shall be of an accepted design and shall have the same diameters and thickness as standard fittings, unless otherwise

required. Their laying lengths and other functional dimensions shall be determined by their positions in the water mains and by the particular piping materials to which they connect.

- h. Provide Flanged Joints and Flange Insulation Kits where shown on the Approved Drawings.
  - i. Unless otherwise shown on the Approved Drawings or specified, furnish and install seals meeting the specifications in the Approved Products List for all pipes passing through walls or floors of structures.
- 4. All pipe and fittings shall be cement mortar lined in accordance with ANSI/AWWA Standard C104/A21.4 including the bituminous seal coat. Double mortar thickness shall be provided. All 4-inch through 24-inch pipe and fittings shall receive exterior dielectric coating, in accordance with the requirements of Paragraph 3.04J, and to the limits indicated in Section 13110-Cathodic Protection.
  - 5. Joint Lubricant: Use vegetable type soap of viscous solution consistency. The joint lubricant shall be approved by the National Sanitation Foundation (NSF) for use in potable water. Petroleum-based or other type of lubricants that can damage the gasket shall not be used.

## 2.03 VALVES

- A. Butterfly Valves: Valves 14-inches and larger shall be butterfly valves, unless otherwise specified. The locations of Butterfly Valves are shown on the Approved Drawings.
  - 1. Butterfly valves shall have mechanical joint ends unless otherwise shown or specified. Furnish complete mechanical joint assemblies including glands, gaskets, high strength cast iron bolts and nuts.
  - 2. Butterfly valves with flanged ends may be specified for installation in vaults or for buried service. Bolts and nuts shall be ASTM T-304 Stainless Steel. Bolt-studs and nuts shall be furnished at insulated flanges in accordance with ASTM T-304.
  - 3. Butterfly valves shall be class 150B.
  - 4. Butterfly valves shall conform to AWWA C504.
  - 5. Butterfly valves shall operate counter-clockwise (left) to open.
- B. Gate Valves: All valves through 12-inches shall be gate valves, unless otherwise specified. Valve locations are shown on the Approved Drawings.
  - 1. 4-inch and larger valves shall have mechanical joint ends and shall be furnished with complete mechanical joint assemblies including glands, gaskets, Stainless Steel bolts and nuts (ASTM T-304, Grade B), unless otherwise shown on the Approved Drawings.
  - 2. 2-inch and smaller valves shall be furnished with threaded ends.
  - 3. Gate valves shall conform to AWWA C500 or C509.
  - 4. Valves shall operate counter-clockwise (left) to open.

## 2.04 RESTRAINED JOINT WATER MAIN PIPING IDENTIFICATION TAPE

- A. Tape shall be marked "Caution, Restrained Joint Pipe Below."
- B. All restrained joint piping shall be identified in the field with identification tape to be installed during backfill operations and laid one foot above water main piping.

## 2.05 HYDRANTS

- A. Technical Requirements:
  - 1. Fire hydrants shall be 3-way class, with 5-1/4" main valve opening, one 4-1/2" pumper outlet and two 2-1/2" hose outlets, equipped with National Standard fire hose coupling threads.

2. The hydrant shoe shall have at least one all bronze drain outlet.
3. The hydrant shoe and barrel may be made of different material.
4. The complete interior of the shoe shall be epoxy coated if the O-ring is in contact with cast iron.
5. If the bottom O-ring is in contact with brass, no epoxy coating of the interior of the shoe is required.
6. Hydrants shall be furnished with a breakaway feature that will break cleanly on the underside of flange upon impact. This shall consist of a break flange with a breakable stem coupling. Breakable bolts will not be accepted. This break flange shall also permit 360-degree rotation of the upper barrel to position nozzles in any desired position.
7. The hydrant shall be operational opening left.

#### 2.06 RESTRAINING GLANDS

- A. Technical Requirements:
  1. Refer to requirements under Section 02512-Thrust Restraints.

#### 2.07 VALVE BOXES

- A. Technical Requirements:
  1. All valve boxes shall be cast iron in accordance with ASTM A48 and FCWA Standard Details.
  2. Valve boxes shall have outside ledge under top ring. Top, outside slip pipe shall not have flange at bottom.

#### 2.08 POLYETHYLENE ENCASUREMENT

- A. Approved Manufacturers: In accordance with Fairfax Water's Approved Products List.
- B. Reference Standards: ANSI/AWWA C105/A21.5, Class B Materials: Seamless 4 mils thick high-density cross-laminated polyethylene. Flat tube form, minimum width based on nominal pipe diameter in accordance with recommendations by Ductile Iron Pipe Research Association.

#### 2.09 FKM GASKET WATER MAIN PIPING IDENTIFICATION TAPE

- A. Tape shall be marked "Caution, FKM (Viton) Gasket Pipe Below," or similar language as approved by Fairfax Water.
- B. All FKM-gasketed water main installation shall be identified in the field with identification tape to be installed during backfill operations and laid one foot above water main piping.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

- A. Verify existing field conditions.
- B. Perform test pits at least 500 feet in advance of all utility crossings and interconnection locations, and as required on the Approved Drawings.
- C. Inspect water main materials for cleanliness and absence of damage.
- D. Verify that excavation base is dry and ready to receive the Work and that excavation, foundations, dimensions and elevations are as indicated on laying schedules (for 24-inch and larger diameter pipe) or accepted by Inspector.
- E. Verify that rated working pressure of the item to be installed is satisfactory for the service shown on the Approved Drawings.

### 3.02 GENERAL

- A. Installation of each pipe joint and appurtenance shall be made in the presence of an Inspector. The Contractor shall coordinate his construction activities daily with the Inspector and shall notify the Inspector 48 hrs. minimum prior to each installation.
- B. Install materials as shown, specified, or recommended by the manufacturer and in conformance with reference standards and accepted Shop Drawings.
- C. Cover over the pipe shall be as shown on the Approved Drawings, specified or otherwise accepted by the Inspector.
- D. Earthwork shall be as shown on the Approved Drawings and specified in the applicable Sections of these Specifications.
- E. Take field measurements as necessary to ensure proper fitting of Work.
- F. Changes in alignment and grade shall be made by deflecting joints or with beveled or mitered pipe except where bends or fittings are shown.
- G. All materials shall be carefully examined for cracks, dents, damage or other defects before installation. Defective materials shall be rejected, removed and replaced. Any material found to be broken or defective after it has been installed shall be rejected, removed and replaced as specified in this Section.

### 3.03 PREPARATION

- A. Ductile Iron Pipe and Fittings:
  - 1. Push-on Joints
    - a. Thoroughly clean the groove and bell socket and insert the gasket, making sure that it faces the proper direction and is correctly seated.
    - b. After cleaning any dirt or foreign material from the plain end, apply lubricant in accordance with the pipe manufacturer's recommendations.
    - c. When pipe is cut in the field, bevel the plain end with a heavy file or an air-driven grinder to remove all sharp edges.
  - 2. Mechanical Joints: The socket and plain end shall be wiped clean of all sand and dirt and any excess coating in the bell shall be removed. The plain end, bell socket and gasket shall be washed with a soap solution.
  - 3. Flanged Joints: Rust-prevention grease shall be removed from the flanges using a solvent-soaked rag. The flanges and gasket shall then be wiped clean of all dirt and grit.
  - 4. All joints shall be made in the presence of an Inspector.
  - 5. Keep a sufficient quantity of joint lubricant, gaskets, welding rod, joint lining and coating material on hand at all times.

### 3.04 DUCTILE IRON PIPE INSTALLATION

- A. Excavating, Trenching and Backfilling: shall be in accordance with Section 02315.
  - 1. All Work shall be constructed in accordance with the lines and grades shown on the Approved Drawings. Contractor shall assume the full responsibility for establishing and maintaining alignment and grade.
  - 2. The Contractor shall lay all pipes in trenches in accordance with the pipe manufacturer's approved laying schedule, when applicable, and the requirements of Section 02315 and this Section.
  - 3. In areas where excavated soils contain a Total Petroleum Hydrocarbon (TPH) concentration level of 10 mg/kg, or to the extent directed by Fairfax Water, the contractor shall install fluorocarbon rubber (FKM) gaskets, as approved by Fairfax Water, in

accordance with the pipeline manufacturer's installation requirements. Refer to Section 02315 for removal and disposal requirements of petroleum-contaminated soils.

B. Pipe Laying:

1. Proper and suitable tools and appliances for the safe and convenient cutting, handling and laying of the pipe and fittings shall be used. The pipe and fittings shall be thoroughly cleaned by power washing before they are laid and shall be kept clean until they are accepted in the completed Work. Special care shall be exercised to avoid leaving bits of wood, dirt and other foreign particles in the pipe. If any such particles are discovered before final acceptance of the Work, they shall be removed and the pipe, valves and fittings replaced. All mains shall be kept absolutely clean during construction. In matters not covered by these Specifications, laying of ductile iron pipe shall meet the requirements of AWWA Standard C600. Exposed ends of uncompleted lines shall be capped or otherwise temporarily sealed with approved watertight bulkheads at all times when pipe laying is not actually in progress.
2. Pipe laid in excavations shall be laid on good foundation, trimmed to shape and, secured against settlement. At joints, enough depth and width shall be provided to permit the making of the joints and the inspection of the bottom half of the joint. All elbows and tees shall be properly backed up and anchored so that there will be no movement of the pipe in the joints due to internal or external pressure. Pipes shall have solid bearing throughout their entire length.
3. The Contractor shall lay all pipes in strict accordance with the manufacturer's recommended procedures. When it is necessary to deflect pipe from a straight line, in either the horizontal or the vertical direction, or as otherwise directed by the Approved Drawings or the laying schedule for curves, pipe deflections shall have a maximum joint deflection eighty per cent of the value shown in the joint deflection tables in AWWA C600. Under normal laying conditions, the depth of cover shall be 4 feet.
4. Where pipe is laid in rock trenches, a minimum space of 6 inches of the rock shall be removed below the outside bottom of the pipe and shall be filled with select material to the limits of, and in accordance with Section 02315 before the pipe is laid.
5. When special beddings are shown on the Approved Drawings or are ordered by the Inspector, they shall conform to the requirements of Section 02315 of these Specifications.
6. Temporary bulkheads shall be installed at the ends of sections where adjoining water mains have not been completed. All such bulkheads shall be removed when the need for them has passed or when ordered by the Inspector.

C. Joining Pipe and Fittings:

1. When joining pipes and fittings, the Work shall be done in strict accordance with the requirements of AWWA C600, the manufacturer's printed instructions, approved submittals and these Specifications.
2. Push-on joints shall be assembled with general procedure to be as follows:
  - a. Prepare pipe and joint as described in this specification Section.
  - b. Push the plain end into the bell of the pipe. Keep the joint straight while pushing. Make deflection after the joint is assembled.
3. Mechanical joints shall be assembled with general procedure to be as follows:
  - a. Prepare the socket and plain end as described in this specification section.
  - b. Place the gland on the plain end with the lip extension toward the plain end of the pipe, followed by the gasket with the narrow edge of the gasket toward the end of the pipe.

- c. The pipe shall be pushed into the bell socket and the gasket pressed firmly and evenly around the entire socket. The gland is then pushed up to the bell and centered on the pipe. Glands may require a wedge under the top side to assist in centering the gland lip against the gasket.
- d. The bolts shall then be inserted and tightened with the fingers until all are even. A ratchet wrench shall be used to complete the tightening of the bolts, care shall be exercised to tighten the opposite nuts to keep the gland square with the socket and the bolt stress evenly distributed. The following torque shall be applied:

<u>BOLT SIZE</u>	<u>TORQUE</u>
5/8-inch	45-60 Ft. lb.
3/4-inch	75-90 Ft. lb.
1-inch	100-120 Ft. lb.
1 1/4-inch	120-150 Ft. lb.

- 4. Flanged joints: shall be assembled with general procedure to be as follows:
  - a. Prepare flanges in accordance with the requirements of this specification Section.
  - b. The flanges shall be accurately aligned, using a spirit level, and pipe properly supported before the gasket and bolts are inserted. The rubber gasket shall be carefully placed to ensure full flow and proper sealing of the joint.
  - c. Bolt threads shall be given a light coat of thread lubricant and then inserted and the nuts turned up by hand. Bolts shall then be pulled up with a wrench employing the crossover method. Applied torques shall be in strict accordance with the manufacturer's requirements.
- D. Pipe Cradles Encasements and Other Support: Where concrete cradles or encasements are required, they shall be constructed in accordance with Section 03300 of these specifications, and the Approved Drawings.
- E. Thrust Restraints: Thrust Restraints including restraining glands, concrete anchors and thrust collars, or other approved restraining devices shall be in accordance with Section 02512 of these specifications, and the Approved Drawings.
- F. Temporary Bulkheads: At the ends of sections where adjoining pipelines have not been completed and are not ready to be connected, install temporary, externally braced test plugs approved by the Inspector. All such externally braced test plugs shall be removed when the need for them has passed or when ordered by the Inspector.
- G. Pipe Installed within Structures and Concrete Encasements: Where temporary support are used, they shall be sufficiently rigid to prevent shifting of the pipe. No reinforcing in structure or concrete encasements shall touch the pipe.
- H. Sanitary Sewer Crossings:
  - 1. Maintain required separation between water and sewer facilities in accordance with Virginia State Board of Health "Water Works Regulations".
  - 2. Provide concrete pier supports for existing sanitary sewer pipe crossing over the water main in accordance with Approved Drawings.
- I. Utility Crossings:
  - 1. Separation of 6-inch or less requires expansion material and shall be Rodofam No. 327 manufactured by W.R. Grace and Co., Vinylfoam No. 327 as manufactured by W.R. Grace and Co., or Vinylfoam No. 327 as manufactured by Sonneborn-Cotech.
- J. Cathodic Protection: Provide field-applied dielectric coating per Section 13110 for:
  - 1. Buried mechanical joints, buried bolts, nuts, couplings harness tie rods, saddles, iron and steel anchors, and other connecting hardware.
  - 2. Service clamps, other transition fitting between copper services and ductile iron pipe.

3. Pipe embedded in concrete anchor blocks or otherwise in contact with concrete, extending through the concrete adjacent 6 inches in both directions.
  4. Provide other corrosion control measures where indicated per Section 13110.
- K. Polyethylene Encasement: Provide and install in accordance with ANSI/AWWA C105/A21.5.
1. Contractor shall install a single layer of 4 mil cross-laminated polyethylene over water mains under 24 inches in diameter and a double layer for 24 inches and larger in diameter.
  2. Overlapping Sections: Provide 2-foot overlap between sections of polyethylene. Completely tape overlapping sections to hold securely in place during backfilling, using compatible polyethylene tape.
  3. Repair of Openings in Encasement: Repair holes, slits, or openings of any size, to restore integrity of polyethylene in accordance with manufacturer's recommendation.
  4. Installation at Hydrants and Interconnections: Provide opening or other means at base of hydrant riser to avoid water accumulation under encasement because of water relief.
  5. Backfill around polyethylene encasement shall be 21A stone, in accordance with the Standard Details.
- L. All work performed by the Contractor shall conform to applicable sections of the Virginia State Board of Health "Waterworks Regulations" and these Specifications during the installation, testing and disinfection of waterworks facilities.

### 3.05 VALVES AND HYDRANTS

- A. Joints: Joints shall be made up in accordance with the procedures outlined in this specification Section.
- B. Valves:
1. Valves shall be carefully erected in their respective positions free from distortion and strain with operators vertical unless otherwise shown on the Approved Drawings. The valves shall be placed and left in satisfactory operating condition. Restrain valves as required.
  2. Unless otherwise shown or specified, direct burial valves and valves in vaults or manholes shall have 2-inch square operating nuts. If the operating nut is 4-feet or more below grade, it shall be provided with extended shafts and 2-inch operating nuts extending to 3-feet below grade.
  3. Natural rubber seat rings shall be coated with an approved opaque material that shall protect the rubber from attack by ozone and other deleterious materials.
  4. Rubber seated valves, which are to be stored for longer than three months shall be partially opened to prevent damage or permanent deformation to the seat ring.
  5. Valve boxes shall be adjusted with the tops at the proper grade. Valve boxes in unpaved areas shall be installed with concrete in accordance with the Standard Details. The top section of the valve box will overlap the lower section with a minimum lap of 2-inches.
- C. Hydrants: Hydrants shall stand plumb and shall have their hose nozzles parallel to the water main and their pumper nozzles facing the street or as directed by the Inspector. The hydrant shall be turned on its base in order to have the pumper nozzles facing the street. All hydrants shall be painted in accordance with Section 09900.

### 3.06 CONNECTIONS TO THE WATER SYSTEM

- A. The Contractor shall connect the pipelines to existing water mains and make provisions for the phase connections, as shown on the Approved Drawings. When system shutdown is



necessary, the Contractor shall provide the Fairfax Water a minimum of 72 hours notice prior to each scheduled tie-in, so that advance notice may be given to the affected customers.

- B. Fairfax Water will coordinate closing all valves in making shutdown and open all valves in restoring pressure to the existing main and initiating pressure in the new installation. Connections to water mains shall be made by the Contractor only after complete preparation for such Work has been made.
- C. At each location where a new water main is to be connected to the existing water main, the Contractor shall not order material for the connection until he has dug a test pit and verified the exact location, size, outside diameter, roundness, elevation, material, joint location, type and direction of the existing water main. The Contractor shall dig test pits only in the presence of the Inspector. If the test pit shows there is a conflict with an existing utility or a water main connection has to be modified, the Contractor shall submit test data information to the Engineer. The Engineer will review and modify the Approved Drawings as required.
- D. Prior to the commencement of any water main interconnection work, the Contractor shall have all necessary materials, tools and equipment at the work site. Pipe, fittings and valves shall be pre-assembled as much as possible to reduce the time of water service interruption. In addition, the geometry of the connection shall be verified by the Contractor prior to starting the connection. Where existing mains are provided with fittings for the purpose of connecting to the new main, the Contractor shall remove the plugs or bulkheads, clean the ends, prepare them for connection to the new pipeline, and make the new joint.
- E. The Contractor shall work continuously and expeditiously around the clock using multiple crews until the connections are successfully installed and water service is restored. Where the new water main is to be connected at more than one point to the existing water system, connections must proceed simultaneously. All connection work must be successfully completed within the time specified by Fairfax Water, unless noted differently in writing by Fairfax Water. The Contractor shall commit the necessary personnel and equipment required to perform the simultaneous connections within the time constraints agreed to by Fairfax Water. Proposed water mains must be in service before the existing water mains can be abandoned.
- F. The water released by cutting or opening existing mains shall be removed and the excavation kept dry until all necessary Work within the excavation has been completed.
- G. The Contractor shall provide all necessary labor and equipment to cut a sample (coupon) from existing ductile iron and cast iron pipe that will be tied into, removed, or abandoned as part of this project. Size, location, and number of coupons shall be as directed by the Owner. Coupons produced as a result of tapping operations shall also be collected. The Contractor shall provide coupons to the Fairfax Water Inspector upon completion of work.

### 3.07 AIR RELEASE AND BLOW-OFF CONNECTIONS

- A. Air Release or Blow-Off Connections: Connections for air releases and blow-offs shall be installed in accordance with the details on the Approve Drawings.
- B. Provide approved tapping saddles where pipe walls are insufficient to embed three threads in metal.

### 3.08 LEAKAGE TESTS

- A. Perform leakage tests in accordance with Section 02514. Make necessary repairs and repeat tests until required results are obtained.

### 3.09 DISINFECTION

- A. Disinfect finished water mains and appurtenances in accordance with Section 02513. Repeat disinfection and testing until required results are obtained.

### 3.10 ABANDONMENT OF EXISTING WATER MAINS

- A. Upon completion of the installation, acceptance, and placing into service of the proposed water main within the limits indicated on the Approved Drawings, or as directed by the

Inspector. Abandonment of existing mains will include, but not be limited to: closing all valves, removing valve boxes, waterline markers, cutting and plugging existing water mains, removing existing water mains (as required), backfilling, compacting, and other associated work, where indicated on the Approved Drawings and where directed by the Inspector. Refer to the Design Practice Manual and Approved Drawings for additional abandonment requirements.

### 3.11 METERS, SERVICE CONNECTIONS, AND PRIVATE FIRE LINES

#### A. Generally

1. Exterior meters less than 3 inches will be installed by Fairfax Water.
2. Interior meters 3 inches and larger and fire lines will be installed by the Contractor. For additional information regarding meters and service installation specifications see Fairfax Water Standard Details.
3. All exterior meters with domestic service tapped off fire lines will be installed by the Contractor.
4. Meters will be furnished to the Contractor after all testing has passed and connection fees are paid. For additional information regarding obtaining a meter contact Customer Service at (703) 698-5600 and review the Rules and Regulations Governing the Furnishing of Water Service, which may be found online at <http://www.fcwa.org/customer/rules.htm>.

END OF SECTION 02510

## SECTION 02512

### THRUST RESTRAINTS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Concrete Thrust Anchors
- B. Concrete Thrust Collars
- C. Mechanical Joint Restraints

##### 1.02 SUBMITTALS

- A. Submit material lists and calculations for thrust restraints not shown or different from that shown on the Drawings, in accordance with Section 01330 – Submittals.
- B. Submit description and installation instructions for restraining glands.

##### 1.03 REFERENCES

- A. ASTM A325 Specification for High Strength Bolts for Structural Steel Joints
- B. ASTM A536 Specification for Ductile Iron Castings.
- C. AWWA C111 Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
- D. AWWA C153 Ductile Iron Compact Fittings for Water Service.
- E. AWWA C110 Ductile Iron and Gray Iron Fittings, 3-Inch through 48-Inch, for Water and Other Liquids.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS

- A. Fairfax Water publishes an Approved Products List, which lists, by category, manufacturer's products approved for use in Fairfax Water's system. Manufacturers' products covered by the categories included in this document that are not specifically listed are not approved for use. Copies of this document are available from Fairfax Water's internet website – <http://www.fairfaxwater.org/developers/index.htm>.

##### 2.02 RESTRAINING GLANDS

- A. Mechanical joint restraint shall be provided in the design of the follower gland and shall include a restraining mechanism which, when actuated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Flexibility of the joint shall be maintained after burial. Glands shall be manufactured of ductile iron conforming to ASTM A536. Restraining devices shall be manufactured of ductile iron, heat-treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to AWWA C111 and AWWA C153. The mechanical joint restraint device shall have a working pressure of at least 250 psi (sizes greater than 16-inches) and 350 psi (sizes 3-inch through 16-inch).
  - 1. EBAA Seal gaskets, manufactured by EBAA Iron, Inc., are required if using Megalug Series 1100 restraining glands.
- B. Other acceptable joint restraint systems for push-on joints for Ductile Iron Pipe are specified in the Fairfax Water Approved Products List.

## 2.03 MIXES

- A. Concrete for Thrust Anchors: Provide concrete in accordance with the requirements of Section 03300.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Provide thrust restraints shown or otherwise necessary to resist movement in new or existing water mains.
- B. Restrain existing valves as directed by Fairfax Water Inspector when making connections to existing facilities.

### 3.02 CONCRETE THRUST ANCHORS

- A. Provide concrete thrust anchors at all bends, tees, plugs, caps, and hydrants, and where shown otherwise on the Approved Drawings.
- B. Dimensions: Refer to the Approved Drawings or Fairfax Water published Standard Details for thrust anchor dimensions.
- C. Installation: Bearing area for thrust anchors shall be against undisturbed earth. The face of the excavation shall be flat and at the proper angle to the fitting.
  - 1. Install thrust anchors such that pipe and fitting joints are accessible for repair.
  - 2. Brace the elbow (bowl) of each hydrant against the required area of unexcavated earth at the end of the trench with concrete thrust anchor.
- D. Installation: Provide and place concrete in accordance with requirements of Section 03300.

### 3.03 CONCRETE

- A. Curing: Cure all concrete thrust anchors for a minimum of seven days prior to pressure testing, unless noted otherwise (i.e. locations of high-early strength concrete) on the Approved Drawings.
- B. Backfilling: Backfill around concrete thrust anchors according to the requirements of Section 02315 - Excavating, Backfilling and Compacting, and the following:
  - 1. Do not backfill thrust collars or thrust anchors until a minimum of four hours has elapsed.

### 3.04 RESTRAINING GLANDS

- A. Install mechanical joint restraint in accordance with the manufacturer's instructions.

END OF SECTION 02512

## SECTION 02513

### DISINFECTION OF WATER DISTRIBUTION SYSTEMS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Disinfection: Disinfection of potable water distribution and transmission systems.
- B. Testing: Testing and reporting results.

##### 1.02 REFERENCES

- A. AWWA B300 - Standard for Hypochlorites.
- B. AWWA B301 - Standard for Liquid Chlorine.
- C. AWWA C651 - Standards for Disinfecting Water Mains.
- D. Waterworks Regulations - Commonwealth of Virginia/State Board of Health.

##### 1.03 SUBMITTALS

- A. Test Reports: Indicate results comparative to specified requirements.
- B. Dechlorination methods and chemicals to be used as specified herein.

##### 1.04 PROJECT RECORD DOCUMENTS

- A. Record Documents: Submit prior to project final acceptance:
  - 1. Disinfection report; record:
    - a. Type and form of disinfectant used.
    - b. Date and time of disinfectant injection start and time of completion.
    - c. Test locations.
    - d. Initial and 24-hour disinfection.
    - e. Date and time of flushing start and completion.
    - f. Disinfectant residual after flushing in ppm for each outlet tested.
  - 2. Bacteriological report; record:
    - a. Date issued, project name.
    - b. Time and date of water sample collection.
    - c. Name of person collecting sample.
    - d. Test location, sample source.
    - e. Initial and 24-hour disinfectant residuals in ppm.
    - f. Coliform bacteria test results.
    - g. Certification that water conforms, or fails to conform, to bacterial standards of Virginia Department of Health and Fairfax Water.

##### 1.05 QUALITY ASSURANCE

- A. Performance Standard: Work shall be performed in accordance with the Virginia State Board of Health "Water Works Regulations," AWWA C651, and as modified herein.
- B. Bacteria Tests will be performed by Fairfax Water laboratory. See Quality Control Section for additional criteria.

PART 2 PRODUCTS

2.01 DISINFECTION CHEMICALS

- A. Chemicals: AWWA B300, Hypochlorite, or AWWA B301, Liquid Chlorine.

2.02 OTHER PRODUCTS

- A. Corporation Stops: Mueller H-10013 Corporation Stops

PART 3 EXECUTION

3.01 EXAMINATION

- A. Cleaning and Inspection: Verify that the water main has been cleaned and inspected.

3.02 EXECUTION

- A. Disinfection of Water Mains under 24 Inches: Disinfect water mains in accordance with AWWA C651 and the Commonwealth of Virginia/State Board of Health Waterworks Regulations.

1. Filling and Contact: When installation has been completed, the main shall be filled with water at a rate no greater than 1 ft/s, which is approximately two turns of the source valve. The Inspector will be present during this procedure to verify that the Contractor is adhering to this requirement.

- B. Disinfection of Water Mains 24-Inches and Greater: Disinfection of water mains 24-inches and greater in diameter shall be performed in the following manner:

1. Filling and Contact: When installation has been completed, the main shall be filled with water at a rate no greater than 1 ft/s, which is approximately two turns of the source valve. The Inspector will be present during this procedure to verify that the Contractor is adhering to this requirement.
2. Continuous Feed Method: The Contractor shall follow the requirements of the Commonwealth of Virginia/State Board of Health Waterworks Regulations and AWWA Standard C651 for the continuous feed method except that the method shall give a 24-hour chlorine residual of not less than 25 mg/l.
3. Slug Method: The Contractor shall follow the requirements of the Commonwealth of Virginia/State Board of Health Waterworks Regulations and AWWA Standard C651 for the slug method.

- C. Disinfectant Level: Disinfectant level should be checked and maintained in the following manner:

1. Chlorine Residual: A chlorine residual shall be taken at the farthest point from the location where water is introduced when the new water main is charged. The minimum reading is to be 25 mg/l, which is required for proper disinfecting. If less than 25 mg/l is measured, an additional chlorine solution is to be added to obtain the 25 mg/l before the water main is pressure tested.
2. Disinfection Time: Allow the 25 mg/l to sit for a minimum of 24 hours before pressure testing, but no longer than 5 days.
3. Precautions: Precautions shall be taken to assure that air pockets are eliminated. Water shall remain in the pipe for at least 24 hours, if the water temperature is less than 41° F (5° C), the water shall remain in the pipe for at least 48 hours. Valves shall remain closed so that the strong chlorine solution in the main being disinfected shall not flow into water mains in active service.

- D. Fairfax Water will provide the water for the initial filling of the water main, testing and chlorination, unless otherwise directed by the Inspector. If requested, the Contractor shall submit a detailed filling and testing procedure to the Inspector for review and approval, in accordance with Section 02514. The Contractor shall provide all pumps, hoses, control valves, approved cross-connection control (backflow prevention) devices, sleeves,

plugs/caps, and other equipment associated with the filling, leakage testing, sampling and flushing the water main. The Inspector will provide the meter and pressure gauges for testing purposes.

- E. Leakage Testing: Pressure test water main in accordance with Section 02514.
- F. Flushing: The water main shall be flushed at locations approved by the Inspector, and in the following manner:
  - 1. General: Let water flow at the maximum rate possible until it is clear (<1.0 NTU) and a chlorine residual is obtained which is comparable to the source water. The Inspector will advise the Contractor on how long to flush.
    - a. The Inspector will be present at the start of the flushing process to verify procedures.
  - 2. Flushing from fire hydrants:
    - a. Open fire hydrant valve, street valve and source valve completely for free discharge. Use the diffuser if necessary.
    - b. If a fire hydrant cannot provide for a free discharge even with a diffuser, either install a hand control valve on the 2-1/2-inch hose connection (with fire hose if necessary) or use the fire hydrant street valve to control flow. Do not use the fire hydrant valve to control flow.
  - 3. Flushing from Blow-Offs: For blow-offs, attach the 2-inch connector pipe with adapter and attach hose if required, and open blow-off valve to control flow.
  - 4. Time Requirements: If more than a week has elapsed between the pressure test and sampling, the new main shall be re-flushed upon direction of the Inspector. If the time period has been in excess of a month or transported water was utilized for pressure testing, special procedures may be required as directed by the Inspector.

### 3.03 QUALITY CONTROL

- A. Water Samples: In accordance with the Virginia State Board of Health "Water Works Regulations," bacteriological samples shall be collected at regular intervals not to exceed 2000 feet. Two negative samples shall be collected at least 24 hours apart for each sample location.
  - 1. Scheduling: After the water main has been pressure tested, the Inspector will schedule collection of the samples. Samples will not be scheduled in advance of a passing pressure test.
  - 2. Cancellations: Cancellations or sample failures will be scheduled in turn with original samples.
  - 3. Unsatisfactory Sample: If the samples fail, the Contractor shall reschedule and repeat the flushing and sampling process.
  - 4. Additional Disinfection: If the second set of samples fail, the water main shall be disinfected again, with a chlorine solution and shall be allowed to sit for a minimum of 24 hours. The flushing and sampling process shall then be repeated.
- B. Failure to Meet Quality Standards
  - 1. Water Quality: Should the initial treatment, as determined by the laboratory tests, fail to result in a water comparable in quality to the water served to the public from the existing water supply system, disinfection and flushing shall be repeated until satisfactory results are obtained.

3.04 PROTECTION

A. Discharge of Disinfected Water:

1. Discharge: The Contractor shall assume full responsibility for the discharge of disinfected water. Disinfected water with a free chlorine residual in excess of 2.0 mg/l shall not be discharged into Fairfax Water's distribution system.
2. Controls: The Contractor shall provide siltation control as required to protect against soil erosion in accordance with Virginia Erosion and Sediment Control Law and Regulations.
3. Responsibilities: The Contractor shall be responsible for any damage to vegetation, trees, streams, ponds, and lakes caused by the discharge of heavily chlorinated water. The Contractor shall perform the necessary measures to dechlorinate the water prior to discharging water into any stormwater system, estuary, or other environmentally sensitive area, in accordance with AWWA C651. Damages or injury to customers served by Fairfax Water resulting from discharges of disinfection water into the system shall be the responsibility of the Contractor and shall be remedied at his expense. Acceptable chemicals used for dechlorination are listed in Appendix C, Table C-3, AWWA Standard C651 - "Disinfecting Water Mains." The Contractor's proposed dechlorination agent shall be submitted to Fairfax Water for approval prior to its use.

END OF SECTION 02513



## SECTION 02514

### LEAKAGE TESTS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Hydrostatic pressure and leakage tests

##### 1.02 SUBMITTALS

- A. Upon Inspector request, submit detailed description of filling and testing procedures including, but not limited to, the following:
  1. Schedule of test sections and piezometric test elevations in accordance with the requirements of Section 01330.
  2. Type and location of bulkheads; provisions for thrust restraint.
  3. Proposed sources of water and points of introduction into the pipeline.
  4. Proposed equipment and methods for admitting test water and filling and dewatering the pipeline.
  5. Proposed sequence of activities.
  6. Proposed methods and details for testing pipe, joints, closures, etc., installed after completion of hydrostatic tests.

#### PART 2 PRODUCTS

##### 2.01 MEASURING DEVICES

- A. The Inspector will provide good quality meters and pressure gauges, calibrated and suitable for use in testing.

#### PART 3 EXECUTION

##### 3.01 GENERAL

- A. The water mains shall be tested for leakage by the Contractor in the presence of the Inspector. A maximum of 2,500 linear feet of water main may be tested at one time, unless otherwise approved by the Inspector.
- B. Each section of water main between adjacent butterfly valves (assemblies) shall be tested separately. The maximum differential pressure across any butterfly valve during testing shall not exceed the test pressure recommended by the valve manufacturer, or as specified by the Inspector. The Contractor shall provide all temporary bulkheads and thrust restraint to isolate the water main test section, and shall provide all long solid sleeves necessary to make the permanent connection to the system.
- C. The Contractor shall notify Fairfax Water when the Work is ready for testing and tests shall be made as soon thereafter as practicable under the direction of the Inspector. Personnel for reading meters, gauges or other measuring devices will be furnished by Fairfax Water, but all other labor, equipment and materials shall be furnished by the Contractor, unless otherwise specified.
- D. Testing of the pipelines shall not be made until at least seven days have elapsed after all concrete thrust blocking has been installed.
- E. The Inspector reserves the right to check the completed pipeline for vertical alignment prior to filling with water and testing. The Contractor shall not allow water in any pipelines without the permission of the Inspector.

- F. All air valves shall be installed as indicated on the Approved Drawings and individually checked for proper operation prior to filling the water main for testing. If for any reason it is necessary to drain the water main, the Contractor shall take all precautions required to ensure the safety of personnel entering and inspecting the water main. When draining the water main, all air valves shall be rechecked for proper operation. Pipelines containing large orifice valves shall be filled at a maximum rate of one foot per second.
- G. Perform disinfection and bacteriological sampling in accordance with Section 02513.

3.02 TESTING

- A. The pipeline shall be filled with water in accordance with Section 02513 for a minimum of 24 hours immediately prior to testing for leakage.
- B. The piping shall be tested under the greater of a hydrostatic pressure of 150 psi or 150 per cent of the maximum expected working pressure at the high point of the line unless otherwise shown or directed by the Inspector. Additionally, if required by the Inspector, a leakage test at working pressure shall be performed. Air shall be purged from the pipeline through previously installed appurtenances in the pipe prior to testing. The test pressure shall be applied to the piping by means of a hand pump, or other approved method, and shall be maintained for minimum of two hours. The test pressure shall not vary by more than plus or minus 5 psi and may be pumped back up to the target test pressure only once per hour.
- C. The maximum allowable water usage during leakage testing shall be determined by the following formula:

$$L = \frac{SD(P)^{0.5}}{148,000}$$

Where:

L = allowable usage, in gallons per hour

S = length of pipe tested, in feet

D = nominal diameter of the pipe, in inches

P = average test pressure during the leakage test, in pounds per square inch (gauge)

Actual usage shall be the amount of water (per hour) used to pump the line back up to the target test pressure. If the actual usage amount exceeds the "allowable usage" determined by the formula above, the test has failed.

3.03 REPAIRING LEAKS

- A. When leakage occurs in any test, defective pipe, valves, fittings, appurtenances, or joints shall be located and repaired by the Contractor. If the defective portions cannot be so located, the Contractor shall remove and reconstruct as much of the original Work as necessary to obtain a water main that does not exceed the allowable usage upon testing.

END OF SECTION 02514

## SECTION 03200

### CONCRETE REINFORCEMENT

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Steel Reinforcing Bars
- B. Steel Reinforcing Fabric

##### 1.02 REFERENCES

- A. ACI-318 Building Code requirements for reinforced concrete
- B. Concrete Reinforcing Steel Institute (CRSI) Manual of Practice
- C. ASTM A615 Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement
- D. ASTM A185 Welded Steel Wire Fabric for Concrete Reinforcement
- E. ASTM A497 Welded Deformed Steel Wire Fabric for Concrete Reinforcement
- F. ACI 315 Manual of Standard Practice for Detailing Reinforced Concrete Structures

##### 1.03 SUBMITTALS

- A. Shop Drawings: Submit completely detailed Shop Drawings and schedules for steel reinforcing bars in accordance with Section 01330 - Submittals.
- B. Certificates: Submit mill test certificates for the Chemical and Physical properties of steel reinforcing bars and steel welded wire fabric in accordance with the requirements of Section 01330.

##### 1.04 DELIVERY, STORAGE AND HANDLING

- A. Delivery: Reinforcing steel, as delivered to the Work, shall be in bundles strongly tied. Each group of both bent and straight bars shall be identified with a metal tag giving the identifying number corresponding to the bar schedules and diagrams. All reinforcing shall be properly stored in an orderly manner, at least 12-inches off the ground, and keep clean and protected from the weather.
- B. Protection: Reinforcing steel shall be delivered without rust other than such as may have been accumulated during transportation to the Work. It shall at all times be fully protected from moisture, grease, dirt, mortar or concrete. Before being placed in position, it shall be thoroughly cleaned of all loose mill scale and rust and of any dirt, coatings or other material that might reduce the bond. If there is a delay in depositing concrete, the steel shall be inspected and satisfactorily cleaned immediately before the concrete is placed.

#### PART 2 PRODUCTS

##### 2.01 MATERIALS

- A. Reinforcing Steel: Reinforcing steel shall be in accordance with the provisions of ACI 318 and Concrete Reinforcing Steel Institute (CRSI) Manual of Standard Practice and the following.
- B. Bars: Bars for concrete reinforcement shall be new steel rolled from open hearth steel billets and shall meet the requirements of ASTM A615, Grade 60. Rerolled materials shall not be permitted. Bars shall be deformed in conformity with ASTM A615 and shall be free of defects. Spiral reinforcing steel shall be fabricated from cold drawn wire in accordance with ASTM A82 or hot rolled plain or deformed bars conforming to ASTM A615, Grade 60.

- C. Welded Wire Fabric: Fabric shall be of the electrically welded type, with wires arranged in rectangular patterns of the sizes shown or specified.
  - 1. Welded smooth wire fabric shall conform to ASTM A185
  - 2. Welded deformed wire fabric shall conform to ASTM A497

## 2.02 FABRICATION

- A. Bending Steel Bars: Bars shall be cut to required length and accurately bent by approved methods before placing. Bars shall be bent in the shop unless written approval of field bending is obtained from the Inspector. If field bending is permitted, it shall be done only when the air temperature is above 30 degrees F where the bending operation is performed. Bars shall have a minimum inside radius of bend as specified in the CRSI Manual of Standard Practice.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Bars:
  - 1. Placement: The bars shall be placed in the exact positions and with the spacing shown or required, and shall be securely fastened in position at the intersections to prevent displacement during the placing of the concrete. The bars shall be fastened with black annealed wire of not less than 16 gauge or other approved devices. Spacing chairs of type approved by the Inspector shall be furnished and properly placed to support and hold reinforcing bars in position in all beams and slabs, including slabs poured directly on the subgrade. Splices in tension reinforcement shall be as specified in the latest edition of ACI 318. Bar splices shall be staggered, where possible.
    - a. The lap lengths for reinforcement bars spaced less than 6" on center shall be increased by 25%. Where a smaller bar laps with a larger bar, the lap length for the smaller bar shall govern.
    - b. Maintain minimum 1-1/2" clearance between rebar and pipes, sleeves or anchor rings.
  - 2. Projecting Ends: On any section of the Work where horizontal bars run further than the length of the forms, the form or head against which the work ends shall be perforated at the proper places to allow the bars to project through a distance at least equal to the lap specified. The projecting ends, however, unless otherwise directed by the Inspector, shall be of different lengths so that laps in bars in the same plane do not occur adjacent to each other.
- B. Welded Wire Fabric: Steel reinforcing fabric shall be placed in the positions shown, specified, or required to fit the Work. Suitable spacing chairs or supports shall be furnished and placed to maintain the mesh in correct location. Where flat mesh is required, the mesh shall be rolled or otherwise straightened to make a perfectly flat surface before placing. The length of laps not indicated shall be approved by the Inspector.
  - 1. Extend all slab reinforcement into the floor slab, wall or roof in accordance with the ACI Code. If such extensions are not obtainable, the bars shall terminate with a standard hook.
  - 2. Cut or bend reinforcing steel bars as needed so that they do not continue through openings in slabs and walls.

### 3.02 PROTECTION

- A. Unless otherwise noted on the Shop Drawings, the following concrete covers shall be provided for reinforcement in cast-in-place concrete:
  - Concrete cast against and permanently exposed to earth: 3"

Formed concrete exposed to earth, liquid or weather:  
#5 and Smaller: 1-1/2"  
#6 and #11: 2"  
Formed concrete not exposed to earth, liquid or weather: 1-1/2"

END OF SECTION 03200

## SECTION 03300

### CAST-IN-PLACE CONCRETE

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Concrete Materials
  - 1. Cement
  - 2. Aggregates
    - a. Sand
    - b. Stone and Gravel
  - 3. Water
  - 4. Admixtures

##### 1.02 REFERENCES

- A. ACI 212 Guide for Use of Admixtures in Concrete.
- B. ACI 304 Placing Concrete by Pumping Methods
- C. ACI 306 Recommended Practice for Cold Water Concreting.
- D. ACI 308 Recommended Practice for Curing Concrete
- E. ACI 318 Building Code Requirements for Reinforced Concrete
- F. ACI 347 Recommended Practice for Concrete Formwork
- G. ACI 614 Recommended Practice for Measuring, Mixing and Placing Concrete
- H. ASTM C33 Specification for Concrete Aggregates
- I. ASTM C39 Compressive Strength of Cylindrical Concrete Specimens
- J. ASTM C42 Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
- K. ASTM C94 Specification for Ready Mix Concrete
- L. ASTM C109 Compressive Strength of Hydraulic Cement Mortars
- M. ASTM C136 Sieve Analysis of Fine and Coarse Aggregates
- N. ASTM C138 Test for Unit Weight, Yield and Air Content of Concrete
- O. ASTM C143 Test for Slump of Portland Cement Concrete
- P. ASTM C150 Specification for Portland Cement
- Q. ASTM C171 Sheet Materials for Curing Concrete
- R. ASTM C172 Sampling Fresh Concrete
- S. ASTM C173 Test for Air Content of Freshly Mixed Concrete by Volumetric Method
- T. ASTM C191 Time of Setting of Hydraulic Cement by Vicat Needle
- U. ASTM C192 Making and Curing Concrete Specimens in the Laboratory
- V. ASTM C260 Air-entraining Admixtures for Concrete
- W. ASTM C309 Liquid Membrane-Forming Compounds for Curing Concrete
- X. ASTM C494 Chemical Admixtures for Concrete

- Y. ASTM C596 Measuring the Drying of Shrinkage of Mortar Containing Portland Cement
- Z. ASTM C827 Tests for Early Volume Change of Cementitious Mixtures
- AA. ASTM D412 Specification for Concrete Drain Tile
- BB. Federal Specification TT-S227E
- CC. Federal Specification TT-S230C
- DD. Corps of Engineers C572
- EE. VDOT Road and Bridge Specifications, Latest Edition.

#### 1.03 DEFINITIONS

- A. Class A. Concrete: Class A concrete is high-strength concrete intended principally for precast concrete units.
- B. Class B. Concrete: Class B concrete is designed for high strength and watertightness and is intended for use in reinforced concrete structures such as thrust collars, columns, walls, beams, slabs, and, in general, where forms, other than simple forms, are required.
- C. Class C Concrete: Class C concrete is designed for high strength and watertightness and is intended for use for bottoms of structures, electrical duct encasement, and, in general, where concrete is deposited directly on the bottoms of slopes or excavations and where only simple forms are required.
- D. Class D Concrete: Class D concrete is designed as low-strength, plain or reinforced concrete and is intended for use in workmats beneath structures, soil stabilization, pipe cradles, encasement, corrosion control test station pads, guard posts, thrust anchors, filling and other similar purposes.
  - 1. Boulders or Rock Fragments: Clean boulders or rock fragments excavated during construction may be embedded, in quantities approved by the Inspector, in large volumes of concrete to provide added bulk.
    - a. Place boulders or rock fragments carefully so that no voids are left in the concrete.
- E. High-Early Strength Concrete: High-Early strength concrete is designed to achieve Class B-Class D 7-day compressive strengths in as little as 1-day and is intended for use in situations where thrust anchors and collars need to achieve 7-day compressive strength early in order to minimize out of service water mains. High-Early strength concrete may be used only when shown on the Approved Drawings or approved by the Inspector.
- F. Architectural Concrete: Is defined as the ultimately exposed areas of exterior and interiors of buildings, chambers, galleries, vaults, foundations, parapets (including portions to be covered by roofing or flashing material), tanks and basins limited on the interior to a point that is 2 feet below the normal water level.
- G. Mass Concrete: Mass concrete is any cast-in-place concrete with dimensions large enough to require that measures be taken to cope with the generation of heat and attendant volume change to reduce cracking.

#### 1.04 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings in accordance with the requirements of Section 01330 for the following:
  - 1. Architectural formwork
  - 2. Steel forms
- B. Samples: Provide representative samples of the following items in accordance with the provisions of Section 01330.
  - 1. Aggregate: Provide a 50-pound sample 15 days prior to the first day concrete is used.

2. Fine Aggregate for Architectural Concrete: Submit a representative color sample for approval 15 days prior to the first day of use.
- C. Concrete Mix Design: Concrete mix designs shall be prepared and submitted to the Engineer for approval for each type required.

#### 1.05 REGULATORY REQUIREMENTS

- A. American Concrete Institute: Perform Work covered by this Section in accordance with the requirements of the American Concrete Institute.
- B. Concrete shall conform to applicable sections of VDOT Road and Bridge Specifications.

#### 1.06 DELIVERY, STORAGE AND HANDLING

- A. Cement:
  1. Delivery: Cement delivered to the jobsite shall be in strong, well made bags marked with the brand, name of manufacturer and net weight.
  2. Storage: Store cement in weathertight building with a wood floor raised above the ground and protected from dampness.
    - a. Stack and store individual shipment in a manner that permits each shipment to be readily accounted for at all times.
    - b. Provide all facilities necessary to permit sampling and inspection of each shipment.
    - c. Do not use cement that has deteriorated.
    - d. Cement remaining in storage prior to shipment for a period exceeding 6-months after testing shall be re-tested and rejected if it fails to meet any requirements of these Specifications.
    - e. Do not use previously accepted cement that has been in storage more than 1 year from the time of original acceptance.
- B. Aggregate: Keep aggregates clean and free from all other materials during transportation and handling. Keep fine and coarse aggregates separated from each other until measured in batches and placed in the mixture.
  1. Stockpiling: Unless finish screening is provided at the batch plant, stockpile aggregates in a manner to prevent segregation and in accordance with ACI Standard 614.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. W. R. Grace and Co.
- B. Sonneborn-Contech
- C. Sika Chemical Corporation of Lyndhurst, NJ.

#### 2.02 MATERIALS

- A. Cement: Provide Standard Portland Cement, Type I, Type II, or Type III (High-Early strength) which meets the requirements of ASTM C150:
  1. Domestic manufacturers: Provide cement that is produced domestically.
  2. Architectural Concrete: Provide cement that is uniform in color and type from one manufacturer for use in architectural concrete.
- B. Fine Aggregate: Fine aggregate shall be natural sharp sand meeting the requirements of ASTM C33 except as modified herein:
  1. Limits for deleterious substances: The limits for deleterious substances shall be as set forth in Table 1 of ASTM C33 for concrete subject to abrasion.



2. Color: Fine aggregate for architectural concrete shall be of one type and color.
  - a. Fine aggregate subjected to the test for organic impurities and producing a color darker than standard will be rejected without exceptions.
3. Soundness: Fine aggregate shall meet the requirements of the soundness test set forth in paragraph 7.1 of ASTM C33.
4. Fine aggregate for mortar and grout: Fine aggregate for mortar and grout shall be well graded within the following limits by weight when tested in accordance with ASTM C1126.

SIEVE	PERCENTAGE PASSING
No. 4	100
No. 8	96 to 100
No. 16	40 to 65
No. 30	15 to 35
No. 50	5 to 15

- C. Coarse Aggregate: Coarse aggregate shall consist of gravel or crushed stone and shall meet the requirements of ASTM C33. The limits for deleterious substances and physical property requirements given in Table 3 of ASTM C33 shall apply for each class designation without exception. Coarse aggregate shall be graded according to Sizes 46 and 57 in Table 11 of the Standard.
  1. Coarse Aggregate Specification: Size No. 57 shall be used for all thin or closely reinforced concrete work, such as floors and roofs less than 7-inches thick, walls less than 9-inches thick, and all beams. For all other concrete work, Size No. 46 shall be used.
  2. Color: Coarse aggregate for concrete shall be of one type and color.
- D. Admixtures: The use of admixtures shall be limited to the following:
  1. Air-entraining: All concrete, except Class D, shall contain an air-entraining admixture conforming to ASTM C260 and sufficient to produce from 4.5 to 6.5 percent entrained air in the concrete.
  2. Water reducing: Water reducing admixtures, conforming to ASTM C494, Type A, shall be used when approved by the Engineer.
  3. Set retarding: Set retarding admixtures, conforming to ASTM C494, Type D, shall be used when approved by the Engineer.
  4. Fly ash: Fly ash, for use in flowable fill, shall conform to Section 241 of the VDOT Road and Bridge Specifications.
- E. Water: Water used in mixing concrete shall be clean and shall not contain deleterious amounts of acids, alkalies or organic materials. All water shall be furnished from sources approved by the Engineer.
- F. Expansion Joint Material: Joint filler shall be closed-cell PVC foam of the thickness shown, and shall be Rodofoam No. 327 as manufactured by W.R. Grace and Co., Vinylfoam No. 327 as manufactured by W.R. Grace and Co., and Vinylfoam No. 327 as manufactured by Sonneborn-Cotech, or approved equal.
- G. Waterstops: Provide waterstops made of extruded polyvinyl chloride.
  1. Requirements for plastic and waterstops: Provide plastic waterstops that meet the requirements of Corps of Engineer Specification ORD-C572, except as modified herein.
    - a. The Shore A durometer hardness shall be between 65 and 75.
    - b. The minimum tensile strength shall be 1850 psi.
    - c. Specific gravity shall not exceed 1.38.

- d. Waterstops shall have ribbed longitudinal strips.
- 2. Dimensions: Unless otherwise shown, provide waterstops which are flat, a minimum of 6-inches wide, not less than 1-1/4-inches thick at the narrowest point, and not less than 3/8-inches thick immediately adjacent to the center.
- H. Membrane Waterproofing: Provide membrane waterproofing which meets the requirements of ASTM C309 and is a semi-flexible material composed of an asphaltic core to which is bonded on independent weather proof coating. The coating is to be bonded during the manufacturing process.
  - 1. Protective coating requirements: Protective coating shall form a continuous layer over the waterproofing core.
  - 2. Membrane vapor transmission rate: Membrane shall have a constant rate of water vapor transmission not greater than 0.0066 grains per square foot per hour measured in accordance with ASTM E96.
- I. Joint Sealant: Joint sealant materials may be either a single component urethane compound meeting the requirements of Fed. Spec. TT-S-230C or a two-component urethane compound meeting the requirements of Fed. Spec. TT-S-227E, except as modified herein.
  - 1. Urethane sealant: The urethane sealant shall be 100 percent polymer, non-extended, containing no solvent, lime, or coal tar. Color shall be as selected by the Engineer, but shall not be black. Sealant properties shall conform to the following Table:
 

PROPERTY	VALUE	TEST METHOD
Maximum Final cure (days)	10	ASTM D412
Tensile strength (psi)	75-50	ASTM D412
Minimum elongation (1%)	400	ASTM D412
Modulus @ 100% elongation (psi)	35-50	Fed. Spec.
Shore A hardness	20-35	Shore Durometer
Solid content (1%)	98-100	
Peel content (1%)		Fed. Spec.
<hr/>		
PROPERTY	VALUE	TEST METHOD
Minimum recovery (1%)	90	Fed. Spec.
Initial tack-free cure (hrs.)	24-48	Fed. Spec.
  - 2. Joint sealant for unbonded joints: Where removable concrete slabs are not poured in place, horizontal and vertical joints shall be filled with self-leveling or non-sagging colma joint sealer, respectively, as manufactured by the Sika Chemical Corporation of Lyndhurst, NJ, or approved equal.
- J. Sheet Curing Materials:
  - 1. Paper shall consist of only ply of an approved type of fiber reinforced waterproof building paper, consisting of cross fibers embedded in asphalt between two layers of waterproof building paper.
  - 2. Polyethylene film shall be white, opaque sheeting a minimum of 4 mils in thickness. The sheeting shall be manufactured from virgin resins and shall contain no scrap or additives.

2.03 MIXES

- A. Concrete: Concrete to be used in the respective places shown on the Approved Drawings or as specified shall be divided according to compressive strength.
- B. Concrete classifications: Refer to these Specifications, Approved Drawings, and Fairfax Water Specifications to determine which class of concrete to use in a given application.
  - 1. Class A concrete shall have 7-day test strength of 3400 psi and 28-day test strength of 5000 psi.

2. Class B concrete shall have 7-day test strength of 2700 psi and 28-day test strength of 4000 psi.
  3. Class C concrete shall have 7-day test strength of 2700 psi and 28-day test strength of 4000 psi.
  4. Class D concrete shall have 7-day test strength of 1300 psi and 28-day test strength of 2000 psi.
  5. High-Early Strength concrete shall have 1-day test strength equal to the applicable Class B,C,or D 7-day test strength requirement above.
- C. Concrete mix design: Prepare mix designs for each type of concrete required in accordance with ACI 613.
1. Concrete of any class, which is to be placed by pumping methods, shall require a separate mix design.
- D. Admixtures: Admixtures shall be used as directed in these Specifications.
1. When more than one admixture is to be used, each admixture shall be dispensed separately into the mix, and at separate times during the mixing in accordance with ACI 212.
- E. Cement content: Concrete, except Class D, shall not contain less than 517 pounds of cement per cubic yard.
- F. Water-cement ratio: Concrete mixtures shall be proportioned to give adequate workability for the use intended without exceeding the following prescribed quantities of mixing water:

<u>CONCRETE CLASS</u>	<u>TOTAL WATER – U.S. GALLONS PER 94 LB. SACK OF CEMENT</u>
B	5-1/2
C	5-1/2
D	7-1/4

1. For Class A and High-Early strength concrete, the quantity of mixing water shall be determined based on either laboratory trial batches or field experience in accordance with ACI 318.
  2. The quantity of water used in each batch shall be the total quantity, including surface moisture contained in the aggregates.
- G. Ready mixed concrete: Ready mixed concrete shall meet the requirements of ASTM C94 except as modified in these Specifications.

## 2.04 GROUT

- A. Grout: Grout shall be a flowable, prepackaged, non-shrink and non-stain grout without dependence on gas expansion forces or enlargement of metal particles for its non-shrink characteristics.
- B. Packaging: The grout shall be packed in moisture-proof bags with general instructions for placement printed on the bag.

## PART 3 EXECUTION

### 3.01 PREPARATION

- A. Measurement and Mixing: Measurement and mixing of concrete shall be subject to the review of the Engineer in all respects and shall be performed in accordance with the recommendations of ACI 304, as modified herein.
  1. Measuring requirements: Measure cement, fine and coarse aggregates separately by weight by equipment providing accuracy within 1 percent of the net load weighed. Water shall be measured by a suitable device, accurate to within 1 percent of the total amount required for the batch.

2. Measuring equipment: The accuracy of the weighting equipment shall meet the requirements of the United States Bureau of Standards and standard testing weights and other necessary equipment shall be available at all times for testing the equipment.
  3. Mixing: Concrete shall be mixed in rotary, batch type mixer of adequate design to produce a thorough mix, homogenous in composition and uniform in color. Each batch of 1 cubic yard or less shall be mixed not less than 1-1/2 minutes after the last of the ingredients have been added to the mixer. The mixing time shall be increased 15 seconds for each additional cubic yard or fraction thereof.
- B. Ready-Mixed Concrete:
1. Rate of delivery: The rate of delivery of the mixed concrete shall be such that the interval between placing of fresh concrete in contact with concrete already placed from previous batches shall not exceed 45 minutes. The elapsed time between the introduction of mixing water to the cement and aggregates and depositing concrete in the Work shall not exceed 60 minutes, including mixing and agitating time.
  2. Delivery equipment: Delivery of concrete in non-agitating equipment shall not be permitted.
  3. Addition of water: No water shall be added to the concrete at the site unless accepted by the Engineer for a specific batch. Acceptance of such addition to one batch shall not be construed as acceptance of additions to subsequent deliveries.

### 3.02 INSTALLATION

- A. Forms:
1. General: The design and engineering of the formwork, as well as its construction, shall be the responsibility of the Contractor. Forms shall be designed, detailed and constructed in accordance with ACI 347 including all tolerances, except as modified herein. Beam and girder soffits shall be erected with a camber as indicated on the Approved Drawings. Where camber is not given, a minimum camber of 1/4-inch in 10-feet of span shall be provided. The forms shall be sufficiently braced, shored, and wedged to prevent deflection.
    - a. Provide 3/4-inch bevel strips at the external angles of walls, beams, pilasters and columns and girders.
    - b. Provide sufficient forms for repeated uses to ensure the required rate of progress.
      - 1) Thoroughly clean and inspect all forms before use.
    - c. Apply a suitable form oil to the inside surface immediately before, during, or after erection of forms or thoroughly wet form just prior to placing concrete.
      - 1) No form oil shall be permitted on the reinforcing steel.
    - d. The Contractor shall be responsible for remedying any defects resulting from form use, inspection and prior acceptance by the Engineer notwithstanding.
  2. Plywood forms: Forms for all interior exposed concrete surfaces and designated areas of exterior exposed concrete surfaces shall be constructed of plywood not less than 5/8-inch thick for straight sections and 3/8-inch thick for curved sections. Plywood shall be Douglas Fir, 5-ply for 5/8-inch or thicker, and 3-ply for 3/8-inch, made with a waterproof glue and manufactured especially for concrete formwork. Edges shall be square in both directions, and adjoining panels shall match in thickness, width, and length. Full-size sheets of plywood shall be used. Forms shall be placed so that marking will be symmetrical. Plywood shall be thoroughly oiled on contact faces and edges with raw linseed oil or other accepted form of lacquer.
  3. Steel forms: Construct forms accurately in modular sizes and in such minor multiple widths and lengths as will permit plates and filler to be erected to correct alignment.

- a. Coat steel forms prior to each use with a light, clear paraffin-base oil or other acceptable commercial preparation that shall not discolor concrete.
- b. Wire brush plates after each use.

B. Placing Concrete:

1. General: Place concrete only in presence of the Inspector in forms that have been accepted by him. Where procedure is not specified, place concrete in accordance with ACI 304.
2. Continuous Operation: Concreting operations shall be continuous until the section, panel, or scheduled placement is completed. Should the concreting operations be unavoidably interrupted, construction joints shall be formed at proper locations as specified.
3. No Placement after Initial Set: No concrete shall be placed after its initial set has occurred, and no re-tempered concrete shall be used under any conditions.
4. Minimum Handling: Concrete shall be conveyed and placed with minimum handling and by means of buckets, buggies, chutes, pumps, or other approved equipment that will prevent segregation of the ingredients. The slope and length of chutes shall be subject to the acceptance of the Inspector. Outlets of chutes, hoppers, and conveyor belts shall be provided with suitable baffles to prevent segregation. Apparatus shall be kept clean and flushed with water before and after each run. Concrete shall be deposited in the forms as close as possible to its final position and, in no case, more than 5-feet in a horizontal direction therefrom. Re-handling of concrete will not be permitted.
5. Placement in Layers: Place concrete in layers shallow enough so that the previous layer is still soft when the next layer is added. The two layers can be vibrated together.
  - a. The maximum layer depth shall not exceed 18-inches.
  - b. The elapsed time between placing layers shall not exceed 45 minutes.
6. Elimination of Voids: Take special care to place concrete against the forms, particularly in angles, and corners in order to prevent voids, pockets and rough areas and to assure continuous contact of the entire surface of the reinforcing steel and inserts with concrete.
  - a. Rod or spade concrete, if needed, to work coarse material away from forms.
7. Protection: Protect freshly placed concrete against damage from the elements or other sources.
8. Vibrating: Consolidate all concrete by means of mechanical internal vibrators applied directly into the concrete in a vertical position.
  - a. The intensity and duration of vibration shall be sufficient to cause concrete to flow, to compact thoroughly and to embed reinforcement, pipes, conduits, and similar Work completely. Vibrators shall not, however, be used to cause concrete to move more than a short distance horizontally. Vibrators shall be inserted and withdrawn at points 18- to 30-inches apart, and vibration shall be stopped immediately when sheen of mortar first appears on the surface.
  - b. Vibrators shall operate at a speed of not less than 4500 cycles per minute. Each tool shall weigh approximately 15 pounds and shall be capable of producing a visible effect upon concrete mixture with a 1-inch slump for a distance of at least 18-inches from the vibrator. A sufficient number of vibrators shall be on hand to assure that the incoming concrete can be properly compacted within 15 minutes after placing. Reserve vibrators shall be on hand for the time when others are being serviced. No placement of any concrete shall be made with a single vibrator on hand.

C. Special Requirements:

1. Hot Weather Requirements: Follow the requirements of ACI 305 and the following for placement of concrete during hot weather.

- a. Concrete in excess of 90 degrees F. at the time of placement shall not be used.
  - b. A water reducing set retarding admixture may be used in accordance with the provisions of these Specifications when concrete temperature is consistently about 75 degrees F. and a noticeable decrease in slump or an increase in mixing water demands occur.
2. Cold Weather Requirements: Follow the requirements of ACI 306 and the following for placement of concrete during cold weather.
- a. Set accelerators shall not be permitted.
  - b. Protect concrete placed in the Fall from the time of the first frost until mean daily temperature at the site falls below 40 degrees F. from freezing for a minimum period of 24 hours after it is placed.
  - c. While mean daily temperatures are below 40 degrees F., the temperature of the concrete shall be not less than 50 degrees F. and shall be maintained at this temperature for at least 72 hours, or, if structural requirements are critical, until such time as is required to develop the necessary compressive strength. The internal temperature for concrete at the time of placing during this period shall not exceed 60 degrees F.
  - d. Protect concrete, placed in the spring after mean daily temperature rises above 40 degrees F. from freezing in a similar manner to that described in the preceding sentences, until danger of freezing is past.
- D. Curing:
1. General: Follow recommendations of ACI 318 and the following for curing concrete.
- a. Protect concrete surfaces, which will normally be exposed to the atmosphere, against drying too rapidly for a minimum period of 7 days.
    - 1) Refer to requirements of applicable subparagraphs on hot or cold weather curing.
  - b. Curing procedure shall begin immediately following placing the concrete.
    - 1) If a delay in application of curing procedure occurs, cover concrete with moistened burlap held in complete contact with the surface or kept moist by continuous sprinkling.
  - c. Use one of the following methods, subject to approval of the Inspector, for curing concrete.
2. Water Curing: Use quilted covers, wetted and applied to the concrete surface as soon as forms have been removed or, in the case of slabs, as soon as concrete has set sufficiently to prevent marring of finish.
- a. Quilted covers shall consist of an outer covering of burlap or cotton, and a needled, punched or sandwiched inner layer of cotton batting, in all weighing a minimum of 20 ounces per square yard.
  - b. Maintain covering materials in a thoroughly saturated condition sufficient to show the presence of free water between mat and concrete surface at all times throughout curing period.
3. Sheet Curing: Sheet curing of concrete slabs is accomplished through use of sheet materials such as waterproof paper or polyethylene film, both meeting the requirements of ASTM C171, applied to the concrete surface as soon as it has set sufficiently to prevent marring.
- a. Wet concrete surface thoroughly, then place sheet goods in direct contact and anchor in a manner that assures continuous contact during curing period.
  - b. Lap sheet materials a minimum of 3-inches, then tape, glue or cement seams.

- c. Sheeting materials shall not discolor concrete surface.
  - 4. Membrane Curing: Begin membrane curing immediately after removal of forms, or in the case of uniformed surfaces, as soon as water sheen is no longer visible on the concrete surface.
    - a. Coat the entire exposed surface with a liquid membrane-forming compound containing a temporary color indicator.
    - b. Apply membrane coating by means of an approved pressure spray distributor at the rate of 1 gallon of material per 200 square feet of concrete surface.
      - 1) Do not apply membrane curing to the faces of construction joints or other surfaces against which additional concrete will be placed. Keep those surfaces continuously wet by other means.
      - 2) Do not apply membrane coating to surfaces which are to be covered with a coating material applied directly to the concrete or with a covering material bonded to the concrete, such as other concrete, liquid floor hardener, waterproofing, damp-proofing, membrane roofing, floor painting and other coatings and finish materials, unless otherwise specified.
  - 5. Special Requirements:
    - a. During hot weather, protect concrete surfaces from drying by continuous moist curing for a period of at least 24 hours.
      - 1) Start curing procedure as soon as concrete surface has hardened sufficiently to withstand surface damage.
      - 2) If moist curing is not carried beyond 24 hours, cover surface, while damp, with a suitable heat-reflecting plastic covering or spray with a white pigmented curing compound.
    - b. During cold weather, protect concrete against freezing in accordance with ACI 306 and the following:
      - 1) When protection against low temperatures is removed at the end of the required period, remove it in a manner such that the resulting temperature drop in any part of the concrete does not exceed 40 degrees F. during the first 24-hour period.
      - 2) Do not permit concrete in heated enclosures to dry out.
- E. Joints and Bonding: Make construction joints where indicated or permitted. Locate joints to assure stability, strength and watertightness.
  - 1. Corners: Build all corners monolithically. Concrete on either side of the corners shall be continuous to the points shown on the Approved Drawings or as directed.
  - 2. Placing Concrete in Beams, Girders, or Slabs: Allow a minimum of 2 hours to elapse after concrete in the columns or walls before depositing concrete in beams, girders, or slabs supported thereon.
  - 3. Horizontal Keyways: Build horizontal keyways to facilitate the drainage of flushing water from the keyways.
  - 4. Requirements for Joints: Provide joints with continuous straight and regular keys or grooves.
    - a. Bring exposed concrete surfaces to a true level line at the top of all horizontal construction joints.
    - b. In the case of exposed construction joints, locate a row of form ties in the concrete 4- to 6-inches from the joint to tighten the forms for subsequent sections of construction.
    - c. Install waterstops, where required, in accordance with the provision of these Specifications.

5. Continuous Placing between Construction Joints: The placing of concrete shall be carried on continuously between the construction joints shown on the Approved Drawings or as directed by the Engineer.
  - a. If, for any reason, it becomes necessary to stop placing concrete at locations other than those indicated, both the proposed location and method of making the joint shall be subject to the Inspector's approval.
6. Placement against Existing Concrete: Concrete surfaces, against which the new concrete is to be placed, shall be thoroughly cleaned and wetted. Just prior to placing new concrete, horizontal surfaces and joints shall be slushed with at least 2-inches of cement grout of the same mixture as the concrete but with coarse aggregate omitted. Special care shall be used in placing and puddling concrete at vertical joints to ensure a bond with existing concrete. Vertical construction joints shall not be made in watertight construction, unless shown on the Approved Drawings.

F. Finishing Concrete Surfaces:

1. General: Finish exposed exterior concrete surfaces to achieve neat and smooth architectural effects, except where textured surface is indicated.
  - a. Finish top edges of wall within a 1/2-inch radius, unless beveled edges or other details are shown.
  - b. Immediately after stripping the forms, without exception, inspect all concrete surfaces. Remove all fins, offsets, burrs, ridges or other unsightly marks from the concrete surfaces.
  - c. Tie holes, pour joints, voids, stone pockets, or other defective areas shall be patched, in accordance with the recommendations of the manufacturers of the various bonding compounds, before the concrete is thoroughly dry. Defective areas shall be chipped away or bush-hammered to a depth of not less than 1-inch with all edges perpendicular. Obtain a roughened dust-free surface. The areas to be patched, including at least 5-inches of the adjoining surface, shall be wetted continually for a minimum of 1 hour prior to placing the patching mortar. A bonding material or agent consisting of a mixture of cement, water and an additive, the amount as recommended by the manufacturer, such as EUCO liquid, Rhoplex 330 or approved substitute, shall then be scrubbed onto the surface, followed immediately by the patching mortar. The material for patching shall consist of the same material and of approximately the same proportions as used for the concrete, omitting the coarse aggregate and mixing with water and an additive as previously specified. For exposed concrete, white cement shall be substituted for part of the gray cement so that the patch will match the color of the surrounding concrete. The proportion of white and gray cement shall be as determined by the patches made on the sample panels. The amount of water shall be as little as consistent with the requirements of handling and placing. The mortar shall not be re-tempered. The mortar shall be thoroughly compacted and screed off so as to leave the patch slightly higher than the surrounding surface. It shall then be left undisturbed for a period of 1 to 2 hours to permit initial shrinkage before being finally finished. The patch shall be finished to match the adjoining surface and shall be cured as specified for the original concrete.
2. Exterior concrete surfaces: Exposed exterior concrete surfaces defined as architectural concrete, except in the case of textured concrete surfaces, shall be given a uniform light rubbed finish.
  - a. After the patching has been completed, the surfaces shall be given a uniform rubbed finish as follows: Mix 1 part Portland Cement and 1-1/2 parts fine sand with sufficient water to make a grout having the consistency of thick paint. Wet the concrete surface, and brush the grout uniformly over the entire area, completely filling air bubbles and holes. Immediately after applying the grout, float the surface with a wood float, scouring the wall vigorously. Allow the cement to set for 1 or 2 hours, depending upon the weather.



If hot and dry, keep the walls damp during this period using a fine fog spray. When the grout has hardened sufficiently so that it can be scraped from the surface with the edge of a steel trowel without removing the grout from the small air holes, cut off all that can be so removed. Allow the surface to dry thoroughly, and then rub it vigorously with burlap to remove completely all dried grout. There should be no visible film of grout remaining after this rubbing, and no grout shall be left on the surface overnight. Sufficient time shall be allowed for grout to dry after it has been cut with the trowel, so that it can be wiped off clean with the burlap. The finished surfaces shall have a uniform, fine sand finish.

- G. Expansion Joints: Provide joint filler for all expansion joints; finish expansion joints with a joint sealant where shown or specified.
1. Placing joint filler: Place joint filler against the completed portion of the Work before concrete for next section is placed.
    - a. Fasten filler to hardened concrete with a compatible adhesive in accordance with the manufacturer's instructions.
    - b. Extend filler through the thickness of the wall or slab.
      - 1) Joint filler shall be flush with the finished surface, except where a joint sealant is shown.
    - c. In joints having a waterstop, fit filler accurately on each side of the waterstop to prevent intrusion of concrete.
  2. Joint prime and sealant application: Prepare joint surfaces by removing all foreign matter and concrete laitance so that concrete surfaces are free of all oil, grease, wax, waterproofing compounds or form release materials prior to application of primer and sealant.
    - a. Prime all concrete joint surfaces without exceptions.
    - b. Priming of other surfaces shall be according to the sealant manufacturer's recommendations and subject to Inspector's approval.
    - c. Apply primer by brushing or spraying on joint surfaces.
    - d. Apply sealant within 2- to 24-hours after application of the primer.
    - e. For horizontal joints, apply sealant by pouring directly from a suitably shaped container or by flowing from a bulk-loading gun.
    - f. Fill vertical joints from a gun, beginning at the bottom to avoid bulging and the formation of air voids.
    - g. Fill overhead joints from a gun, by laying a bead along each side of the joint and then filling the middle.
    - h. Immediately after application, tool sealant in accordance with manual instructions in order to establish contact with joint surfaces and to provide a smooth sealant face.
  3. Joint Depth: Control joint depth with the use of joint fillers and backup materials.
    - a. Fillers and backup material in contact with sealant shall be non-impregnated and free from asphalt, creosote, oil or extractable plasticizer.
    - b. Backup material shall be closed cell polyethylene foam, such as Sealtight Backer Rod or Sonofoam Backer Rod with a diameter 1/4-inch larger than the joint width.
    - c. Joint widths and sealant depths shall be as shown, except that sealant depth shall not exceed 1/2-inch.
- H. Waterstops: Waterstops for corners and intersections shall be prefabricated so that only butt joints need to be made in the field.

1. Corners and Intersections: Field fabrication of corners and intersections requires the Inspector's approval. Miter and assemble corners and intersections with approved equipment as described for field joints.
  2. Field Joints: Make field joints by cutting the ends of the sections to be spliced so they will form a smooth, even butt joint.
    - a. Heat the cut ends with splicing tool until plastic melts. Press ends together until the plastic cools.
    - b. Splicing shall cause as little damage to the continuity of the ribbed strips as possible.
- I. Unbonded Joints: Where removable concrete slabs are poured in place, slab must be prevented from bonding to walls or other rigid parts of the structure.
1. Preventing bonding: Prevent bonding by the use of membrane waterproofing material
    - a. Place material over the bearing surface of the wall or other supporting part of the structure in order to isolate it from the new concrete being placed.
    - b. Install material in layers as required to produce a total thickness of at least 1/8-inch.
  2. Filling unbonded joints: Where removable concrete slabs are not poured in place, fill horizontal and vertical joints with self-leveling or non-sagging Colma joint sealer
- J. Mass Concrete: Any concrete placement of 100 or more cubic yards with a minimum dimension of 3 feet will be considered mass concrete.
1. Provisions during Placement: Make special provision to lower the temperature of the concrete as it is placed and to limit the maximum temperature rise in the concrete during hydration.
    - a. The provisions may include pre-cooling the mix, reduction in cement content and substitution of pozzolan or blast furnace slag cement for part of the Portland Cement, as approved by the Engineer.
  2. Provisions after Placement: Make provisions to avoid thermal shock due to too rapid cooling of the concrete after the initial curing period.

### 3.03 FIELD TESTS

- A. Slump Tests: Conduct slump tests in accordance with ASTM C143 and the following
1. Allowable Slump: Provide a concrete mixture that has a slump of 5-inches or less if placement is to be done by pumping and 4-inches or less if placement is to be accomplished by methods other than pumping.
  2. Tolerances: A tolerance of up to 1-inch greater than these amounts shall be allowed for individual batches provided the average to all batches or the 10 most recent batches, whichever is fewer, does not exceed the maximum allowable slump.
  3. Excessive Slump: Concrete with excessive slump shall be rejected and no additional concrete shall be delivered until the cause of the deficiency is determined and corrected.
- B. Air Content Tests: Tests to determine air content of fresh concrete shall be taken twice daily, at least 4 hours apart and shall be performed in accordance with the applicable ASTM Standards.
1. Number of tests required. Unless otherwise required, a minimum of one strength test shall be made for each 50 cubic yards or fraction thereof for each mix design of concrete placed in any one day, except that in case shall a given mix design be represented by less than 5 tests.
  2. Sample collection and storage: Sampling of fresh concrete shall be in accordance with ASTM C172. Laboratory and field test cylinders shall be made and, for the first 24 hours, cured and stored in a tightly constructed, firmly braced wooden box, constructed to maintain the temperature immediately adjacent to the specimens in range of 60 degrees

F. to 80 degrees F. and prevent loss of moisture from the specimens. The storage temperature shall be thermostatically controlled when necessary.

- a. Loss of moisture shall be prevented by covering cylinders with wet burlap, damp sand or other approved means. Test cylinders cast in cardboard molds shall not be stored in contact with wet burlap, damp sand or any other material that will allow the outside surfaces of the mold to absorb water for the first 24 hours. Cylinders shall be removed from storage after 24 hours, and after removal of molds, the laboratory-cured cylinders shall be stored in a moist condition in the laboratory at a temperature of 65 degrees F. to 75 degrees F. until the time of the test. The field-cured cylinders shall be removed from storage after 24 hours and stored in the structure as near the point of sampling as practicable, with the same protection on all surfaces as the structure that they represent.
3. Testing: Cylinders shall be tested in accordance with ASTM C39. Each strength test will consist of 3 laboratory-cured and 1 field-cured cylinders. One laboratory-cured cylinder shall be tested at 7 days. Normally 2 laboratory-cured cylinders and 1 field cured cylinder shall be tested at 28 days. If the 7-day laboratory cured-cylinder is not satisfactory, one of the remaining laboratory-cured cylinders shall be tested at 7 days instead of 28 days. Testing requirements for High-Early strength concrete will be directed by the Inspector.
  4. Testing Laboratory: The concrete testing laboratory will be employed directly by the Developer, which will pay all fees associated with concrete testing work. The Contractor shall assist the testing laboratory whenever necessary to accomplish the required tests.
  5. Strength requirements: The average strength of the test cylinders for any portion of a structure shall be equal to or greater than the strength specified, and at least 90 percent of all tests shall indicate a strength equal to or greater than the strength specified. In cases where the average strength of the test specimens for any portion of the structure falls below the specified requirements, the Engineer shall order a change in the mix proportions or water content for the remaining portion of the Work and shall require the Contractor to secure test specimens of the hardened concrete represented by these cylinders. The number of test cylinders for each concrete placement shall be as directed by the Inspector. Specimens shall be secured and tested in accordance with ASTM C42.
  6. Failure to achieve required strength: If the specimen tests further substantiate that the concrete represented by the cylinders and specimens is below the specified strength requirements, the concrete shall be removed and replaced at the expense of the Contractor.

#### 3.04 CLEANING

- A. Removal of Forms: Forms shall not be removed until the concrete has hardened sufficiently to support its own load plus any superimposed loads that may be placed thereon. Forms, form ties and bracing shall not be removed without the specific permission of the Contractor's registered professional engineer.

END OF SECTION 03300

SECTION 03400  
PRECAST CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Precast Concrete Vaults

1.02 REFERENCES

- A. ASTM C 857 Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
- B. ASTM C 858 Underground Precast Utility Structures
- C. ASTM C 891 Installation of Underground Precast Concrete Utility Structures
- D. ASTM C 1037 Inspection of Underground Precast Concrete Utility Structures
- E. VDOT Road and Bridge Specifications
- F. VDOT Road and Bridge Standards

1.03 DEFINITIONS

- A. Class A Concrete: Refer to Section 03300 for definition

1.04 SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings, associated details, and design calculations for the following items in accordance with Section 01330– Submittals.
  - 1. Precast concrete vaults
- B. Design Data: Submit design data, sealed and signed by a professional engineer, for the following items in accordance with Section 01330– Submittals.
  - 1. Precast concrete vaults
- C. Test Reports: Submit test reports for the following in accordance with Section 01330 - Submittals.
  - 1. Slump
  - 2. Air content
  - 3. Compressive strength

PART 2 PRODUCTS

2.01 MATERIALS

- A. Materials shall be in accordance with Fairfax Water's Approved Product List.

2.02 MANUFACTURED UNITS

- A. Precast Vaults shall be in accordance with Fairfax Water's Approved Product List.

### 2.03 TESTS

- A. Slump: Perform slump tests in accordance with the requirements of ASTM C143 and Section 03300.
- B. Air Content: Perform tests for air content in accordance with the requirements of ASTM C138 or ASTM C173.
- C. Strength: Perform strength tests in accordance with ASTM C39 for each mix design of six concrete cylinders at intervals as follows:

<u>Test Intervals</u>	<u>Number of Cylinders</u>
3 Days	Test 1 cylinder
7 Days	Test 2 cylinders
28 Days	Test 3 cylinders

### 2.04 VAULT DETAILS

- A. Manufacture vaults to the dimensions shown on the Approved Drawings and in accordance with approved submittals. Comply with ASTM C 857 and C 858.

### 2.05 INSPECTION DURING MANUFACTURE

- A. Comply with ASTM C 1037.
- B. Inspector shall be an individual assigned by the manufacturer.

### 2.06 PIPE AND FITTINGS

- A. Pipe, fittings, and appurtenances shall be in accordance with Section 02510.

### 2.07 ACCESS HATCHES AND LADDER

- A. Access hatches and ladder shall be in accordance with Section 05500.

## PART 3 EXECUTION

### 3.01 GENERAL

- A. Comply with ASTM C 891.

### 3.02 PREPARATION

- A. Field Measurements: Verify that accuracy of survey benchmark and elevations are as intended.
- B. Excavation for Precast Vaults: Excavate for precast vaults in accordance with the requirements of Section 02315 - Excavating, Backfilling and Compacting.
- C. Preparation for Setting Vaults: Prepare subgrade in accordance with manufacturer's recommendations.

### 3.03 INSTALLATION

- A. Installation of Precast Vaults: Install precast vaults in accordance with the manufacturer's recommendations and the requirements of these specifications.
- B. Pour a concrete false floor in accordance with Fairfax Water Standard Details.

END OF SECTION 03400

## SECTION 05500

### METAL FABRICATIONS

#### PART 1 GENERAL

##### 1.01 SECTION INCLUDES

- A. Metal Fabrications
  - 1. Access doors
  - 2. Vault ladders
  - 3. Safety posts

##### 1.02 RELATED SECTIONS

- A. Section 03400 - Precast Concrete Vault

##### 1.03 REFERENCES

- A. ASTM A27 Specification for Mild to Medium Strength Carbon-Steel Castings for General Application.
- B. ASTM A47 Specification for Malleable Iron Castings
- C. ASTM A48 Specification for Gray Iron Castings
- D. ASTM A148 Specification for High-Strength Steel Castings for Structural Purposes.
- E. ASTM B26 Specification for Aluminum-Alloy Sand Castings
- F. ASTM B148 Specification for Aluminum-Bronze Sand Castings
- G. AISC Steel Construction Manual, Latest Edition

##### 1.04 SUBMITTALS

- A. Product Certification: Upon request, submit manufacturer's certification in accordance with the requirements of Section 01330, showing the true weights of the castings or comply with the provisions of "Certification" Article of this document.
- B. Submit Shop Drawings and installation instructions for access doors, safety posts and ladders.

#### PART 2 PRODUCTS

##### 2.01 MANUFACTURERS

- A. Fairfax Water publishes an Approved Products List, which lists, by category, manufacturer's products approved for use in Fairfax Water's system. Manufacturers' products covered by the categories included in this document that are not specifically listed are not approved for use. Copies of this document are available from Fairfax Water's internet web site – <http://www.fairfaxwater.org/developers/index.htm>.

##### 2.02 MATERIALS

- A. Standards: Metal castings shall meet the requirements of the following standards:
  - 1. Gray Iron: ASTM A48
  - 2. Malleable Iron: ASTM A47
  - 3. Carbon Steel: ASTM A27
  - 4. Alloy Steel: ASTM A148

5. Aluminum: ASTM B26
6. Aluminum Bronze: ASTM B148
7. Silicon Bronze: Navy Specification 46B28
8. Manganese Bronze: Federal Specification QQ-B-726d

#### 2.03 CASTINGS

- A. Castings: Castings shall be made accurately to the dimensions shown on the Approved Drawings.
- B. Grinding: Grind or plane castings where necessary to secure perfectly flat and true surfaces.
- C. Thicknesses: Make allowances in patterns needed so that specified thicknesses are not reduced.
- D. Defective Castings: Plugging of defective castings shall not be permitted. Defective castings shall be replaced.

#### 2.04 VAULT ACCESS DOORS

- A. In accordance with Fairfax Water's "Approved Product List".

#### 2.05 ACCESS LADDERS

- A. In accordance with Fairfax Water's "Approved Product List".

### PART 3 EXECUTION

#### 3.01 INSTALLATION

- A. Install products as indicated on the Approved Drawings and in accordance with manufacturer's instructions.

END OF SECTION 05500



SECTION 09900  
SPECIAL COATINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Damp-proofing concrete vaults
- B. Painting ferrous metals above grade
- C. Painting ferrous metals in vaults
- D. Coating aluminum surfaces in contact with cementitious materials
- E. Interior vault piping
- F. Safety striping for concrete vaults

1.02 SUBMITTALS

- A. Submit all product information for each coating system, in accordance with the requirements of Section 01330.
- B. Submit color charts for each coating system.

1.03 COLORS

- A. Fairfax Water shall select colors to be used, unless denoted otherwise herein.

1.04 SURFACES TO RECEIVE COATINGS

- A. Ferrous metal at or above the ground
- B. Ferrous metal inside vaults below the ground
- C. Aluminum in contact with cementitious materials
- D. Interior vault piping
- E. Interior vault entryways, as shown on Shop Drawings
- F. The following items shall not be field coated, but shop coated by the manufacturer as specified for each item.
  - 1. Buried Butterfly and Gate Valves
  - 2. Buried Ductile Iron Pipe

1.05 QUALITY ASSURANCE

- A. Air Quality Regulations: All paint shall conform to the applicable air quality regulations at the point of application. Any paint material that cannot be guaranteed by the manufacturer to comply, whether specified by product designation or not, shall not be used.
- B. Compatibility: It shall be the responsibility of the Contractor to ensure the compatibility of the field painting products that will be in contact with each other or which will be applied over shop painted or previously painted surfaces. Paint used in successive field coats shall be produced by the same manufacturer and be system compatible per manufacturer. Paint used in the first field coat over shop painted or previously painted surfaces shall cause no wrinkling, lifting, or other damage to underlying paint.
- C. Field Priming: In general, surfaces of equipment, steel, and cast iron are specified to be shop primed. Any such surfaces which have not been shop primed shall be field primed. Shop coatings that are damaged or have failed, and have been determined unsuitable by the Inspector, shall be removed and the surfaces field primed. Galvanized, stainless steel, and insulated surfaces shall be field primed. Primers used for field priming, unless otherwise

required for repair of shop primers, shall be as specified in the Paint Schedule (Paragraph 3.06).

## PART 2 PRODUCTS

### 2.01 PAINTS

- A. Hydrants
  - 1. Hydrant Barrel: Sherwin-Williams SHER-CRYL HPA (High Performance Acrylic) – Safety Red, Gloss (#B66R300)
  - 2. Tops and Caps: Sherwin-Williams Bond Plex WB (Water Based) Acrylic – Aluminum, Gloss (#B71S200)
  - 3. Where indicated by Fairfax Water, the top shall be painted in Safety Red and the barrel and caps shall be painted Aluminum in lieu of the above.
- B. Interior Vault Piping
  - 1. Base Coat: Sherwin-Williams Macropoxy 646 – Fairfax Water Green (#52300049563)
  - 2. Middle Coat: Sherwin-Williams Macropoxy 646 – SW4029 Pillar White
  - 3. Top Coat: Sherwin-Williams Macropoxy 646 – Fairfax Water Green (#52300049563)
- C. Guard Posts
  - 1. Primer: Sherwin-Williams Pro-Cryl Universal Primer – Off White (#B66W310) or Gray (#B66A310), 1 coat
  - 2. Finish: Sherwin-Williams DTM Acrylic Coating – Semigloss Ultradeep Base (#B66T204) in 4086 Safety Blue, 1 coat
- D. Safety Striping for Concrete Vaults
  - 1. Primer: Sherwin-Williams Loxon Concrete & Masonry Primer (#A24W8300), 1 coat
  - 2. Finish: Sherwin-Williams Industrial Enamel – Safety Yellow (#B54Y37), 2 coats

### 2.02 ASPHALTIC COATINGS AND DAMP-PROOFING OF PRESSURE REDUCING VALVE VAULT

- A. Carboline Bitumastic 50 or functional equal approved by Fairfax Water.

## PART 3 EXECUTION

### 3.01 GENERAL

- A. All coatings shall be brought to the job site in originally sealed and labeled containers of the paint manufacturer and shall be subject to inspection by Fairfax Water.
  - 1. Store paint inside, protect against freezing.
  - 2. No adulterant, unauthorized paint thinner or other material not included in the paint formulation shall be added to the paint for any reason.
- B. Prior to applying coatings, surfaces shall be cured, dry, and clean, free of grease or foreign material, and properly sandblasted, ground, pores filled and sanded, in accordance with Paragraph 3.02 below.
- C. Coatings shall be applied in accordance with the Manufacturer's recommendations and at such times as approved by the Inspector. All pipes shall be empty when painted. If dew or moisture conditions are prevalent, delay application until the temperature of the surface to be painted is 5 degrees F above the dew point and the surfaces are dry. The Contractor shall provide dehumidifying or heating equipment if needed to prevent sweating.

- D. Thoroughly mix paint each time any is withdrawn from the container. Keep paint containers tightly closed except when paint is being withdrawn.
- E. Coatings shall be applied in strict accordance with the manufacturer's instructions and shall be performed in a manner satisfactory to the Inspector. The application of each coat shall be at the rate required to achieve at least the minimum dry mil thickness specified herein.
- F. No new coat shall be applied until the previous coat has dried. Under no condition shall additional coats be applied until the preceding coat has dried at least the minimum time called for. Drying time shall be construed to mean "under normal conditions" and within the range of application stated by the manufacturer. Where conditions other than normal exist because of the weather, such as with high humidity, or when damp-proofing and painting is done in confined spaces, a longer drying time will be necessary. Adequate ventilation shall be maintained at all times.
- G. It shall be the Contractor's responsibility to ensure that all surfaces are properly prepared, the proper primer applied to the correct mil thickness, and the finish coat is compatible with the primer coat and applied to the correct mil thickness. This applies to all material, whether the total process is done in the shop or in the field, or partially in shop and partially in the field.

### 3.02 SURFACE PREPARATION

- A. All surfaces to be painted or coated shall be prepared in a workmanlike manner, and in accordance with the manufacturer's instructions, with the objective of obtaining a smooth, clean, and dry surface. No coating shall be applied before the prepared surfaces are approved by the Inspector.
- B. All ferrous metals shall have rust, dust, scale, and any other foreign substance removed to a SSPC SP-10, "NEAR WHITE" finish by sandblasting. Regardless, whether the ferrous metal is to be shop or field primed, the cleaned surfaces shall be free of any material that would cause improper bond of the coating. Cleaned metal shall be primed the same day that it is cleaned to prevent new rust from forming.

### 3.03 DAMP-PROOFING

- A. All exterior walls of all vaults from finished grade down to the top of the bottom slabs shall be damp-proofed on the exterior surface with two coats of coal tar coating. The coal tar pitch shall be applied in accordance with the manufacturer's instructions to a minimum dry mil thickness of 9 mils per coat. Drying time between coats shall be not less than 24 hours.
- B. The exterior walls of all precast concrete structures shall be damp-proofed in the shop as specified above. Structural joints shall be coated in the field after installation of the precast concrete structure with damp-proofing as specified above. Damp-proofing damaged as a result of shipping, installation, or any other reason shall receive two touch-up coats of damp-proofing as specified above.

### 3.04 ASPHALTIC COATINGS

- A. Apply to all metal that is to be embedded in or fastened to cementitious materials.
- B. Apply in accordance with manufacturer's instructions.

### 3.05 PAINTING

- A. Apply paint to exposed ferrous metals whether below ground within vaults, or above ground. Items to be painted include cast or ductile iron piping, fasteners, valves, valve operators, covers, guard posts, fire hydrants, etc. Apply paint in accordance with paragraph 3.06 of this Special Provision.
- B. Any material that is to be painted and arrives at the construction site with a Bitumastic coating or a priming system not specified in the following schedule shall have the Bitumastic coating or improper primer removed by sandblasting and the proper primer applied. Sandblasting shall be to a SSPC SP-10 "NEAR WHITE" finish.

- C. Paint shall be of the type as manufactured for the purpose intended and shall be applied in accordance with the manufacturer's instructions to the surfaces in such a manner as indicated in the following schedule. Any material that is properly shop primed does not need to be field primed unless the shop primer is damaged, in which case the damaged area shall be properly cleaned, and the indicated field primer applied. The field primer indicated in the schedule shall also be applied to all material which is not shop primed.

### 3.06 PAINT SCHEDULE

- A. Hydrants
1. Primer: Hydrant Manufacturer's Shop Primer
  2. Top Coat:
    - a. Type: epoxy
    - b. Thickness: 5 mils
    - c. Min. drying time: 7 hrs @ 70 degrees F
- B. Interior Vault Piping
1. Base Coat
    - a. Type: epoxy
    - b. Thickness: 3-4 mils dry film thickness
    - c. Min. drying time: 8 hrs @ 77 degrees F
  2. Middle Coat
    - a. Type: epoxy
    - b. Thickness: 3-4 mils dry film thickness
    - c. Min. drying time: 8 hrs @ 77 degrees F
  3. Top Coat
    - a. Type: epoxy
    - b. Thickness: 3-4 mils dry film thickness
    - c. Min. drying time: 8 hrs @ 77 degrees F
- C. Guard Posts
1. Primer
    - a. Type: epoxy
    - b. No. of Coats: 1
    - c. Thickness: 5 mils
    - d. Min. drying time: 7 hrs @ 70 degrees F
  2. Top Coat
    - a. Type: polyurethane
    - b. Thickness: 1.5 mils
    - c. Min. drying time: 24 hr
- D. Safety Striping for Concrete Vaults
1. Primer
    - a. Type: acrylic

- b. No. of Coats: 1
  - c. Thickness: 8 mils
  - d. Min. drying time: 24 hr
2. Finish
- a. Type: enamel
  - b. No. of Coats: 2
  - c. Thickness: 5 mils per coat
  - d. Min. drying time: 8 hr between coats @ 77 degrees F

END OF SECTION 09900

## SECTION 13110

### CATHODIC PROTECTION

#### PART 1 GENERAL

##### 1.01 DESCRIPTION

- A. These specifications define materials and installation practices to minimize corrosion and to provide facilities for long-term corrosion monitoring of the proposed pipelines.
- B. Installation of corrosion control components shall be in accordance with the following specifications, and Approved Drawings. All installation practices and components shall be approved by Fairfax Water.
- C. The corrosion control system shall include electrical continuity (joint bonding), insulated flanges, and corrosion control test facilities.

##### 1.02 SUBMITTALS

- A. Product Data: Submit manufacturer catalog cuts or other descriptive information for the specific materials required on this project for approval.
  - 1. Packaged Magnesium Anodes
  - 2. Test Stations and Terminal Boards
  - 3. Shunt
  - 4. Shorting Bars
  - 5. Wire and Cable
  - 6. Thermite Welding Equipment
  - 7. Coating for Thermite Welds
  - 8. Insulating Flanges
  - 9. External Coating for Insulating Flanges, Mechanical Joints and Unions
  - 10. Insulated Flange Internal Coating
  - 11. Mastic Coating
  - 12. Test Station Terminal Lugs
  - 13. Electrical Tape
  - 14. Electrical Coating Compound
  - 15. Field Test Equipment and Calibration Sheets
  - 16. Warning Tape
  - 17. Survey Markers
  - 18. Steel Hand Stamp
  - 19. Test Station Concrete
  - 20. Guard Post
  - 21. Solder
  - 22. Separator Mesh

- B. Quality Assurance: Submit in conjunction with product data:
  1. Installation and Test Personnel Qualifications for Pipe Joint Bonding and Corrosion Control Hardware
  2. Qualifications of NACE International Certified Corrosion Specialist
  3. Proposed Test Data Forms
- C. Close-Out: Submit prior to placing the water main in-service:
  1. Letter of Compliance
  2. Record Drawings
  3. Test Report

### 1.03 QUALITY ASSURANCE

- A. Qualifications: Installation, quality assurance, and testing personnel must have demonstrated experience with similar work.
  1. Must be specifically named in qualification submittal and have completed at least three successful corrosion control systems within last three years for underground pipelines of similar type, similar size and equal complexity.
  2. Must be full-time contractor or subcontractor employees. Part-time or contract personnel hired only for this work will not be permitted.
  3. Only personnel approved by Fairfax Water are permitted. Personnel changes during course of project must be minimized and submitted to Fairfax Water at least two weeks prior to planned implementation.
- B. Supervision: Employ a Corrosion Specialist certified by NACE International to perform the following:
  1. Oversee and certify installation and related testing. Including pipe joint bonding, magnesium anodes groundbeds, and corrosion control equipment. Individual must participate in field activities to extent required by work.
  2. Issue letter of compliance indicating all corrosion control measures are satisfactorily installed and comply with Approved Drawings. The letter of compliance shall be signed by the NACE International Corrosion Specialist.
- C. Electrical Safety Specialist: Provide an individual trained and qualified in electrical safety familiar with construction and mitigation of work performed within areas of AC included voltages and currents.

## PART 2 PRODUCTS

### 2.01 MAGNESIUM ANODES

- A. Approved Manufacturers: See Fairfax Water's Approved Products List.
- B. Materials: See Fairfax Water's Approved Products List.

### 2.02 TEST STATIONS

- A. Flush Mount Valve Box Type
  1. Approved Manufacturers: See Fairfax Water's Approved Products List.
- B. Materials: See Fairfax Water Standard Details and Approved Products List.

### 2.03 CURRENT MEASURING SHUNT

- A. Materials: See Fairfax Water Standard Details and Approved Products List.

## 2.04 WIRE AND CABLE

- A. Materials: See Fairfax Water Standard Details and Approved Products List.

## 2.05 THERMITE WELDING EQUIPMENT

- A. Approved Manufacturers: See Fairfax Water Approved Products List.
- B. Materials: Mold, weld metal, other material and equipment per manufacturer's recommendations for particular pipe/cable material and size. Only material and equipment from same manufacturer is allowed. Adapter sleeves shall be utilized for all thermite welds.

## 2.06 THERMITE WELD COATING MATERIALS

- A. Thermite weld coating material:
  - 1. See Fairfax Water Standard Details and Approved Products List.

## 2.07 INSULATING FLANGES

- A. Approved Manufacturers: See Fairfax Water Standard Details and Approved Products List.
- B. Materials: See Fairfax Water Standard Details and Approved Products List.

## 2.08 INSULATING UNIONS

- A. Approved Manufacturers: See Fairfax Water Standard Details and Approved Products List.
- B. Material: See Fairfax Water Standard Details and Approved Products List.

## 2.09 EXTERNAL COATING FOR INSULATING FLANGES AND MECHANICAL COUPLINGS

- A. General Requirements:
  - 1. All coatings used on project shall be from same manufacturer and as specified herein. All products comprising completed coating system shall be compatible and the same products shall be used throughout the project. Pipe surfaces that will come in contact with potable water inside the pipeline (e.g. spigot ends of bell and spigot joints) shall be coated with materials having NSF-61 certification.
- B. Field Applied Petrolatum Tape:
  - 1. Approved Manufacturers: See Fairfax Water Approved Products List.
  - 2. Materials: Compatible primer; mastic for profiling around joints, bolts and other irregular shapes; petrolatum impregnated fabric tape; outer protective wrap. All materials shall be by the same manufacturer.

## 2.10 INTERNAL PIPE COATING FOR INSULATED FLANGES

- A. Approved Manufacturers: See Fairfax Water Approved Products List.
- B. Materials: See Fairfax Water Approved Products for NSF-61 approved coating for use in potable water systems.

## 2.11 WIRE CONNECTORS & TERMINATIONS

- A. Terminal Lugs
  - 1. Approved Manufacturers: See Fairfax Water Approved Products List.
  - 2. Materials: See Fairfax Water Standard Details and Approved Products List.
- B. Butt Splices:
  - 1. Approved Manufacturers: See Fairfax Water Approved Products List.
  - 2. Materials: See Fairfax Water Standard Details and Approved Products List.



## 2.12 ELECTRICAL TAPE

- A. Vinyl Plastic
  - 1. Approved Manufacturers: See Fairfax Water Approved Products List.
- B. Rubber Splicing
  - 1. Approved Manufacturers: See Fairfax Water Approved Products List.

## 2.13 FIELD TEST EQUIPMENT

- A. As determined by Contractor to meet specific requirements. All electrical instruments must bear evidence of calibration within 1 year of testing.

## 2.14 UTILITY WARNING TAPE

- A. Approved Manufacturers: See Fairfax Water Approved Products List.
- B. Materials: See Fairfax Water Approved Products List.

## 2.15 SURVEY MARKERS

- A. Approved Manufacturers: See Fairfax Water Approved Products List.
- B. Materials: See Fairfax Water Approved Products List.

## 2.16 STEEL HAND STAMP

- A. Approved Manufacturers: See Fairfax Water Approved Products List.
- B. Materials: See Fairfax Water Approved Products List.

## 2.17 TEST STATION CONCRETE

- A. Materials: Ready-mix concrete conforming to ASTM C94. Minimum allowable 28-day compressive field strength shall be 3,000 psi when cured and tested in conformance with ASTM C31 and ASTM C39. Portland cement shall be Type 1.

## 2.18 GUARD POST

- A. Steel pipe (4 inches in diameter) with welded cap on top. See Fairfax Water Standard Details for additional specifications.

## 2.19 SOLDER

- A. Materials: 0.062-inch diameter 60/40 Solder with 3.5 percent type RMA rosin core.

## 2.20 SEPARATOR MESH

- A. Approved Manufacturers: See Fairfax Water Approved Products List.
- B. Materials
  - 1. The separator mesh shall be a medium density flexible polyethylene webbing pad (mesh pattern), nominal thickness 0.156 inch.

## 2.21 POLYETHYLENE ENCASEMENT

- A. Approved manufacturers: See Fairfax Water Approved Products List.
- B. Materials: See Fairfax Water Standard Details and Approved Products List.

# PART 3 EXECUTION

## 3.01 INSTALLATION

- A. Handling of Pipe
  - 1. At the project site, the pipe shall not be handled with metal chains, cables, unpadded tongs, forklifts or other equipment likely to cause damage to the pipe shop coating or

score the pipe surface.

2. Storing of the pipe shall be on padded 12-inch wide (minimum) skids or select loamy or sand dirt berms, where possible. In urban areas, pipe should be suspended on padded skids. Where skid chucks are used in contact with the pipe, they should be padded with several layers of padding material. Padded chucks should be placed such that pipe is nested on the skid rather than the chuck. The coated pipe shall not be laid on pavement without benefit of padding at contact points.
  3. If cables or chains are used during transportation, they must be properly padded with approved, suitable material as required to protect the pipe surface from damage while in transit. Use of a padded horizontal separator strip between successive rows of pipe is necessary to prevent damage to the pipe surface.
  4. At all times during construction of the pipeline, the Contractor shall take every precaution to prevent damage to the protective shop coating and scoring of the pipe surface. No metal tools or heavy objects shall be permitted to come into contact unnecessarily with the pipe surface.
- B. Thermite Welding: Attach test wires and bond cables to the piping by thermite welding.
1. General: All thermite welds shall be made as shown on the Approved Drawings and in accordance with the manufacturer's recommendations using the proper combination of equipment for the pipe and wire size being welded. All welding materials and equipment shall be the product of a single manufacturer.
  2. Area Preparation: Assure that the area where the attachment is to be made is absolutely dry. Remove mill coating, dirt, grime and grease from the pipe or fitting surface at the weld location by wire brushing or by the use of suitable safety solvents. Clean an area (two inches square) of the pipe or fitting surface at the weld location to a bright shiny surface, free of all serious pits and flaws by use of a mechanical grinder.
  3. Cable Preparation: Prepare the wire for welding by assuring that the cable is absolutely dry. The cable shall be free of dirt, grease and other foreign products. Cut the cable in such a way as to avoid flattening or forcing out of round. To prevent deformation of the cable, cut the cable with cable cutters. Remove the insulation in a manner that will avoid damage to strands. Install adapter sleeves for all bonds and test wires in accordance with the manufacturer's recommendations prior to welding. Either prefabricated factory sleeved joint bonds or bond wire with formed sleeves made in the field is acceptable. Hold the cable at an approximate 30 degree angle to the pipe surface when welding.
  4. Installation: Install thermite welds in accordance with the manufacturer's written instructions. Deliver packaged weld charges to job site in new, unopened dry containers. Replace completed welds having burnt wire strands and wire strands not completely covered with weldment.
  5. Testing: When the weld has cooled, remove the weld slag and test the weldment for strength by striking a sharp blow with a two-pound hammer while pulling firmly on the wire in direction parallel to pipe. Replace unsound welds and retest weldments.
    - a. Documentation: Record adequacy of each bond cable and test wire weld based on the above procedure and visual inspection before and after coating welds area. Data recorded for each bond cable and test wire to include date of inspection, name of inspection personnel, pipeline station number, quantity and gauge of wire installed, and simple statement (e.g. "satisfactory") regarding proper installation. Provide field sketches where tabular data alone is not sufficient to document pipe alignment and bonding configuration.
  6. Cleaning and Replacing Molds: Thoroughly clean mold and mold covers after completion of each weld to assure that no slag will penetrate into the next weld. Replace molds periodically and where there is pitting or other wear conditions.

7. Coating Thermite Welds: After soundness of the weld has been verified, thoroughly clean with a stiff wire brush and coat with an elastomeric cap. The elastomeric cap shall extend on all four sides beyond the cleaned area onto the pipe surface. Apply primer over the entire weld area and over the entire area where the elastomeric cap will be placed. Allow primer to dry. Push the dome of the prefabricated cap containing elastomeric material firmly into weld area. Lift the wire away from the pipe and apply the elastomeric material completely around and underneath the wire. Push the wire back down on the pipe.
- C. Bonded Joints: Install bond cables across each joint in accordance with the limits indicated in the Approved Drawings using the thermite weld process.
1. All new pipeline joints, including those on pipe, fittings, valves and branch connections including hydrants. Do not bond across insulating devices including PVC inserts. Do not bond between new ductile iron and prestressed concrete pipe.
- D. Test Stations: Includes terminal box, concrete pad, guard post, survey marker, wire leads, PVC conduit, utility warning tape and monitoring equipment.
1. General: Type of test station; number, size and color of wires; and wire routing are shown on the Approved Drawings. Unless otherwise noted or approved by Fairfax Water, test stations for pipelines buried under pavement shall be located outside paving limits. Test stations shall be sufficiently set back from vehicle traffic lanes so that they can be accessed for maintenance without extensive traffic control or other special safety precautions.
  2. Wire Routing: Install test and monitoring equipment wires in a wiring harness arrangement routed along the bottom of the pipe trench where practical. Form harness by taping wires together at intervals of 10 feet. Install wires leaving the pipe trench in PVC conduit when terminal box is not installed over water main.
  3. Utility Warning Tape: Install 1 foot above PVC conduit.
  4. Guard Post and Concrete Pad:
    - a. Guard Post: Provide with concrete anchor at locations required by test station schedule. Coat portion not buried in accordance with Section 09900.
    - b. Concrete Pad: Provide for each flush mount test station. Non-reinforced concrete pad formed around test station shall be 24 inches by 24 inches by 8 inches sloped away from terminal box.
    - c. Survey Marker: Mount flush with concrete during pad construction. Stamp test station number in accordance with Fairfax Water's standards.
- E. Insulated Flanges: Unless noted otherwise, install with a test station and two test wires attached to pipe on each side of flange.
1. Preparation: Clean mud, dirt, grease, oil and other contaminants from flange surfaces. Check flange face and bolt hole tolerances and verify clearances prior to installing insulating materials.
  2. Internal Coating: Two coats dielectric internal pipe coating, minimum dry film thickness per coat - 10 Mils. Surface preparation, coating application and cure times per manufacturer. Unless noted otherwise, apply internal coating three feet or to nearest fitting from flange face in both directions.
  3. Installation: Install insulated flange gasket, sleeves and washers under clean and dry conditions in accordance with manufacturer's written instructions. Two insulating washers required for each bolt (one for each side of flange). Properly torque bolts per insulating material manufacturer's instructions to avoid damage to insulating components and otherwise ensure electrical separation between flange faces and between each bolt

and each flange. Do not use conductive grease or other material to facilitate flange assembly that could compromise electrical integrity of insulating materials.

4. Initial Testing: After assembly, directly measure electrical resistance between each bolt and one flange using an ohm meter or other approved low voltage resistance meter. Resistances less than 10 megohm are not acceptable and require insulator replacement, cleaning and drying of insulator surfaces, and/or other corrective action. If any bolt fails the 10 megohm minimum resistance requirements, all bolts must be retested after corrections are made. Tests shall also be performed across the insulating flange to assure that the central gasket is providing effective insulation between the flanged faces prior to coating.
5. External Coating: Coat buried insulating flanges with approved heat shrink sleeve. Surface preparation and coating application shall be as specified by manufacturer, including use of filler material to provide smooth contour around bolts and from transition between pipe and flange.
6. Final Testing before Backfilling: A final test of the insulating flange shall be made from the attached test wires prior to backfilling. Tests shall be repeated from the insulating flange test wires after backfilling and after the test wires have been brought to grade.

F. Clearance of Piping to Other Structures

1. 12 inches of natural clearance shall be maintained between the piping and other structures, where possible. When 12 inches of clearance cannot be maintained, install a medium density flexible polyethylene mesh pattern webbing pad, nominal thickness 0.156 inch, around piping and secure with non-metallic tape.

G. Concrete Buttresses, Support Blocks, Anchor Blocks

1. Position reinforcing rods used in the construction of support blocks, anchor blocks and other concrete structures so that they are not in contact with the piping. Maintain a minimum 2 inches of spacing between all reinforcing steel and the pipe and any pipe anchors.
2. When placing concrete in direct contact with ductile iron piping, apply the mastic coating to the external surface of the ductile iron piping prior to placing the concrete. Clean all dirt, moisture, oil, grease, and other contaminants from the piping surface. Thoroughly mix the mastic coating and apply a coat of approximately 12 mils of coating to the piping surface. Allow the coating to dry to touch (approximately 20 minutes) and apply a second coat of mastic of approximately 12 mils in thickness. Allow to dry before placing the concrete.

### 3.02 TESTS

- A. GENERAL: The Inspector will witness test to ensure proper operation and compliance of test stations installation in accordance with Fairfax Water requirements and plan details of the Cathodic Protection system. The Contractor shall coordinate with Fairfax Water to schedule field test with the Inspector, at least two weeks in advance. Note: In the event field tests indicate deficiencies in the system, the Contractor will be responsible for correcting deficiencies and re-testing the Cathodic Protection system.
1. Test Data Forms: Record test data in a uniform format pre-approved by the Inspector. Include test data, personnel, and instrumentation used on each sheet.
  2. Testing Summary:
    - a. Pre-Backfill Tests:
      - 1) Bonded joint and test wire integrity

- 2) Insulated joint effectiveness
  - b. Post-Backfill Tests:
    - 1) Pipe continuity test
    - 2) Pipe-to-soil AC and DC potential measurements
    - 3) Pipe current flow measurements
    - 4) Anode potential and current measurements
    - 5) Insulated joint effectiveness
  - c. Improper materials or installation determined by testing shall be corrected by the Contractor.
  3. Schedule:
    - a. Pre-Backfill Tests: Complete as work progresses.
    - b. Post-Backfill Tests: Complete prior to Final Acceptance approval.
    - c. Test Report: Letter of Compliance; Record Drawings: Submit no later than 10 working days before application for Beneficial Use.
  4. Test Report:
    - a. Raw test data for all pre-backfill and post-backfill tests.
    - b. Test set-ups and schematics.
    - c. Summary tabulations and theoretical calculations.
    - d. Letter of Compliance.
    - e. Record Drawings.
    - f. Recent Test Report and Letter of Compliance at time of Final Acceptance.
- B. Pre-Backfill Test Procedures:
1. Bonded joint and test wire integrity tests:
    - a. Conduct visual inspection and hammer test including required documentation per installation section of this Specification.
  2. Insulated joint effectiveness tests:
    - a. Test electrical effectiveness of each buried dielectric insulating joint after installation into pipe system and no sooner than two days before backfilling.
    - b. Perform initial resistance tests between each bolt and flange in accordance with installation section of this Specification.
    - c. Perform tests for completed insulators by a) use of a high-frequency isolation tester manufactured specifically for this purpose, and by b) measuring electrical potential between mating flanges before, during and immediately after application of a direct test current to the pipe on one side of the flange of no less than 1 ampere. Documented data for test b) shall include all potentials and applied test current.
    - d. Acceptance Criteria:
      - 1) High frequency isolation tester: "Acceptable", "Satisfactory" or other similar direct meter reading, and
      - 2) Electrical potential/applied current: Apply test current to one side of the flange insulator; a positive potential shift on the side of the flange where current is applied, and a negative potential shift on the side of the flange opposite of where

current is applied indicates that the insulator is effective.

C. Post-Backfill Test Procedures:

1. Pipe Continuity Tests:

- a. Measure and record longitudinal resistance of pipe between consecutive test stations, and between test stations and intermediate hydrant laterals. Determine resistance using Ohm's Law by impressing a direct test current across pipe span and measuring resultant voltage drop across same span. Use of temporary test points at locations other than test stations and hydrants require approval by the Inspector.
- b. Documentation: Include applied test current, measured voltage before application of current, with current applied and immediately after interrupting test current, calculated resistance and corresponding theoretical resistance (Paragraph C below) in test report.
- c. Acceptance Criteria: Maximum acceptable span resistance - 110% of the sum of:
  - 1) Number of pipe joints multiplied by theoretical resistance of a joint bond, determined by number of bond wires per joint and wire gauge.
  - 2) Length of pipe multiplied by theoretical resistance per unit length, determined by pipe diameter, wall thickness and resistivity.

2. Pipe-to-Soil Potential Measurements:

- a. Record at all test stations and hydrants used for post-backfill continuity measurements, and on both sides of all insulating devices.
- b. Collect using a temporary copper/copper sulfate reference electrode placed on grade within one foot of test station and using buried reference electrode where installed.
- c. Collect at all locations prior to connecting anodes at test stations, and then after anodes have been connected at all test stations for a minimum of 2 hours.

3. Pipe Current Flow Measurements:

- a. Record for all test stations having 4-wire current measuring spans. Documentation to include span length, magnitude and polarity of static voltage across pipe span, longitudinal resistance of span determined in a manner similar to post-backfill continuity test, and calculated magnitude and direction of current.
- b. Make static voltage measurements with positive terminal of voltmeter connected to black test wire (upstream or downstream of test station) and negative terminal connected to white wire (at test station). Static pipe current flow (magnitude and direction) to be calculated and recorded by dividing static voltage by span resistance.
- c. Collect at all locations prior to connecting anodes at test stations, and then after anodes have been connected at all test stations for a minimum of 2 hours.

4. Anode Potential and Current Measurements:

- a. Measure and record open-circuit potential between each anode cable at each test station and a temporary copper/copper sulfate reference electrode placed on grade within one foot of test station. Collect open circuit potential data with no other influencing anodes connected to main.
- b. Measure and record anode current at each test station using permanently installed current measuring shunt. Document shunt voltage drop, shunt resistance, and calculated current.
- c. Acceptance Criteria:
  - 1) Open-Circuit Potential: Magnitude 1.6 volts or greater.

- 2) Anode Current: Minimum 0.02 ampere per anode, adjusted to account for number of anodes included in circuit at any given location (e.g. 15 anodes - minimum 0.30 ampere).
5. Insulated Joint Effectiveness Tests: Test each joint. Procedures and acceptance criteria in accordance with pre-backfill insulated joint effectiveness tests.

END OF SECTION 13110

## APPENDIX A

### FAIRFAX WATER - STANDARD DETAILS

Refer to Standard Details found at:

<http://www.fairfaxwater.org/developers/index.htm>



## **APPENDIX B**

### **FAIRFAX WATER – APPROVED WET TAP CONTRACTOR LIST**

Only approved personnel working for Approved Contractors will be allowed to perform wet taps. Fairfax Water maintains a list of Approved Contractors, which may be found online at:  
<http://www.fairfaxwater.org/developers/index.htm>

## APPENDIX C

### FAIRFAX WATER – APPROVED PRODUCTS LIST

Refer to Approved Product List found at:

<http://www.fairfaxwater.org/developers/index.htm>