SP-121045
(New)

Iowa Department of Transportation

SPECIAL PROVISIONS

FOR

WATER MAIN

Polk County
STP–S–CO77(164)––5E–77

Effective Date
April 21, 2015

THE STANDARD SPECIFICATIONS, SERIES 2012, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

I. GENERAL INFORMATION

A. Submittals

1. The Des Moines Water Works (DMWW) will review all Shop Drawings for materials related to water main construction. Shop Drawings shall be provided to DMWW 2 weeks prior to any water main construction. The Contractor shall submit these Shop Drawings to:

Des Moines Water Works
Attn.: Katie Kinsey
2201 George Flagg Parkway
Des Moines, Iowa 50321

B. Preparation

1. Notify DMWW (515-283-8729) 48 hours prior to the start of any water main related construction.

2. Verify proposed grades prior to construction to ensure adequate finished cover will be provided over all water mains.

3. The Contractor shall arrange for all survey required to install water main on line and grade as shown on the Plans.

4. The Contractor shall arrange with DMWW for all valves and hydrants to be operated only by DMWW's personnel.

C. Connections to the Existing Water System

1. Connections to the existing DMWW's system shall be coordinated with the DMWW and scheduled a minimum of 48 hours in advance. Customers who will be without water shall be notified by the Contractor a minimum of 24 hours in advance. Water main shutdowns may need to be completed outside normal working hours to minimize impact on affected customers. No additional compensation will be paid for work outside normal working hours.

D. Abandonment of Existing Facilities

1. Existing river pipe shall be abandoned as shown on the Plans.

2. River pipe shall be capped incidental to water main construction.

E. Buy America

1. The Contractor is responsible for complying with the Buy America requirements, found in paragraph 1107.06 of the Standard Specifications, for all products of iron, steel, or a coating of steel which are incorporated into the water main construction.

II. BASIS OF PAYMENT

A. No other payment will be made for work covered by this Special Provision, but will be considered incidental to the contract unit price bid for the individual items for which the work was done. Payment for each item shall be considered full compensation for furnishing all material, equipment, tools, labor, and warranty for the construction of each item including excavation, backfill, compaction, and other incidental work to complete the construction in accordance with the contract documents.

III. INDEX OF SECTIONS

A. Section 02220 – Excavating, Backfilling, and Compacting for Water Main and River Pipe

B. Section 02600 – Protection of Water Supply

C. Section 02610 – Pipe for Water Main and River Pipe

D. Section 02640 – Valves and Hydrants

E. Section 02674 – Pressure Testing Water Mains

F. Section 02675 – Disinfection of Water Distribution Systems

G. Section 13110 – Cathodic Protection

Section 02220 Excavating, Backfilling, and Compacting for Water Main and River Pipe

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Part 1 General

1.1 Summary of Work

A. Excavating, backfilling, and compacting specifications, as applicable, for installation of water main and appurtenances.

1.2 Related Sections

A. Section 02610 – Pipe for Water Main and River Pipe.
B. Section 02640 – Valves and Hydrants.

1.3 References

A. American Society for Testing and Materials (ASTM) D2922 – Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
B. American Society for Testing and Materials (ASTM) D3017 – Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
C. American Society for Testing and Materials (ASTM) D698 – Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft3).

1.4 Submittals

A. In addition to those submittals identified in the Standard Specifications, the following items shall also be submitted for materials provided by the Contractor:
   1. Concrete mix design for concrete encasement.
   2. Cylinder strength test results from mix design prior to placing any concrete.
   3. Compression strength test results.

1.5 Measurement and Payment

A. Stabilization Material:
   1. Include cost for all material, equipment, labor, and associated work necessary to complete work associated with stabilization materials in the unit bid price for “Trench Foundation” on the Proposal.
   2. Estimated quantity shown on Proposal for “Trench Foundation” is not to be used as an indication of site conditions that will be encountered during the course of the Work.

B. Concrete Encasement:
   1. Include cost for all material, equipment, labor, and associated work necessary to complete work associated with concrete encasement material in the unit bid price for “Concrete Encasement” on the Proposal.
   2. Maximum quantity shall be plan quantity, unless lengths are extended by the Engineer and DMWW.
   3. Includes excavation, temporary sheeting and shoring, forms, rock bedding, reinforcing steel, concrete, pipe supports, testing and associated work.
   4. Measurement will be per linear foot along the centerline of the encased pipe.
   5. Payment will be at the contract unit price per linear foot of concrete encasement constructed.

Part 2 Products

2.1 Excavated Materials

A. Topsoil shall be stripped, grubbed, and stockpiled for finished grading.

B. Backfill material shall be:
   1. Approved for use by the Engineer.
   2. Selected material taken from the excavation or select borrow material, if sufficient quantities of compliant excavated material are not available.
   3. Inorganic clays, clayey sands, or inorganic and clayey silts, compatible with and having an obtainable density no less than adjacent soils.
   4. Free of lumps or clods over 3 inches in the largest dimension.
   5. Free of foreign debris including rocks, organic materials, and man-made debris.
   6. Material that is not frozen.

2.2 Bedding Material

A. Ductile iron pipe and polyvinyl chloride pipe: Bed pipe using material taken from the excavation with the following characteristics:
   1. Inorganic clay, clayey sand, or inorganic and clayey silt.
   2. Free of lumps or clods over 2 inches in the largest dimension.
   3. Free of foreign debris including rocks, organic materials, and man-made debris.
   4. With a soil moisture range of optimum moisture to 4% above optimum moisture content.
   5. Material that is not frozen.

2.3 Stabilization Material

A. When required by field conditions, stabilization material shall be crushed limestone, dolomite, or quartzite generally meeting the following characteristics:
   1. 2-inch nominal maximum size.
   2. 95% retained on a 3/4-inch screen.
   3. Generally free from deleterious substances as determined by the Engineer.

2.4 Borrow Materials

A. If sufficient quantity of suitable material is not available from excavations, material shall be obtained from approved off-site sources. Off-site sources must hold a National Pollutant Discharge Elimination System (NPDES) permit from the IDNR for storm water discharge associated with construction activity.

B. Borrow materials, including topsoil and backfill material, shall conform to specifications for excavated materials in Part 2.1.
C. Topsoil borrow material shall be:
   1. Natural loam and humus with characteristics consistent with the existing topsoil on site.
   2. Finely graded and free of clumps larger than 2 inches in the largest dimension.
   3. Free of man-made materials and debris.
   4. Free of rock or organic matter, including wood and roots, greater than 3/4-inch, in the largest dimension.
   5. Comprised of less than 0.5% clay.

2.5 Special Pipe Embedment and Encasement Material

A. Install concrete pipe encasement at river crossing as shown and detailed on the construction drawings.
   1. Concrete:
      a. Class C or M mix.
      b. Compressive strength of at least 3,000 psi at 7 days and 4,000 psi at 28 calendar days.
   2. Reinforcing Steel:
      a. Placed continuous in the concrete per the construction drawing detail.
   3. Comply with material requirements of Section 2403 of the Standard Specifications.

Part 3 Execution

3.1 General

A. General Description
   1. Complete trenching, backfilling, and compacting for water main in accordance with Section 2552 of the Standard Specifications.
B. Quality Assurance
   1. The Engineer shall be given the opportunity to review excavated or borrowed soils prior to placement as backfill.
   2. DMWW will commission and compensate a qualified soils engineer to develop Proctor curves indicating moisture-density relationships for all soil types used as backfill.
   3. Proctor curves and soil analysis information shall be used in determining proper compaction of the soils placed.
C. General Safety
   1. Blasting shall not be permitted.
   2. Safety and protection:
      a. Provide shoring, sheeting, and bracing, as required, to protect the Work, adjacent property, private or public utilities, and workers.
      b. Strictly observe laws and ordinances regulating health and safety measures.
      c. Excavations that DMWW's personnel are required to enter shall comply with OSHA standards.
D. Soil Testing
   1. Field tests for density and moisture content shall be performed by the soils engineer, defined in Part 3.1.B above, to ensure that the specified density is being obtained. Testing shall be done using ASTM D2922 nuclear methods or another method approved by the Engineer.
   2. Density tests shall be taken at finished grade, at 3 feet below finished grade, and as directed by the Engineer under special conditions. Test locations shall be selected by the Engineer immediately prior to performing tests. Excavate, as directed by the Engineer, for tests at intermediate depths. As a minimum, density tests shall be taken at approximately 200-foot intervals along the trench. Additional tests shall be required at the following locations:
      a. Over jacking pits where casing was installed.
      b. Immediately adjacent to all structures.

3. When test results indicate compaction is not as specified:
    a. Additional tests will be required in both directions from the failed test until satisfactory results are obtained.
    b. All material between the satisfactory tests shall be removed, replaced, and recompacted in lifts to meet specifications. Compaction corrections shall be made at no expense to the DMWW.
    c. Recompacted areas shall receive density tests provided at the same frequency as the original tests. Testing of recompacted areas shall be at the Contractor's expense.
4. If petroleum-based materials are detected in the soils, the Contractor shall notify the Engineer. Appropriate action will be taken by the DMWW.
5. Tests that are not conducted in the presence of the Engineer, or are conducted at locations not selected by the Engineer, will be rejected.

E. Protection of Utility Lines
1. Conduct trenching operations to avoid damaging underground utilities.
2. Underground utilities that are shown on the Drawings, located or identified for Contractor prior to trenching, shall be protected. Damage resulting from trenching or backfilling shall be repaired by the Contractor or utility company at the Contractor's expense.
3. Underground utilities discovered by the Contractor shall be protected.

3.2 Disposal of Excavated Material

A. Remove excess material excavated for the water main trench from the site and in compliance with environmental regulations.
B. Backfill consisting of suitable material, which comes from an off-site source, must conform to Part 2.1.

3.3 Trench Excavation

A. Strip and stockpile topsoil for finished grading. A minimum of 12 inches of topsoil must be segregated from other materials in agricultural areas.
B. Trenches shall be excavated so as to:
1. Follow lines and grades as indicated on the plans.
2. Provide uniform bearing on undisturbed soil and continuous support along the entire length of the pipe.
3. Prevent over-excavation in locations where suitable subgrade conditions exist.
4. Provide vertical trench walls to an elevation no less than 12 inches above the pipe.

C. Unstable trench bottoms, as determined by the Engineer, shall be corrected as follows:
1. Over-excavate the trench to stable soil or to a maximum of 2 feet below the bottom of the pipe.
2. If stable soil is reached, the trench shall be brought back to grade using suitable backfill material or bedding material compacted to 90% Standard Proctor Density.
3. If stable soil is not reached after 2 feet of over-excavation, 1 foot of the specified trench stabilization material shall be placed in the trench bottom and compacted. The trench shall then be brought back to grade using suitable backfill material or bedding material compacted to 90% Standard Proctor Density.
4. Pipe shall be placed only after the trench bottom has been fully stabilized.

D. Remove stones encountered during excavation. When large rocks are encountered, they shall be broken away to an elevation 6 inches below the bottom of the proposed improvement. Voids created through removal of stones shall be filled with approved backfill material and thoroughly compacted to 90% Standard Proctor Density.
E. Trench bottoms shall be excavated deeper at the location of bell joints to permit the body of the pipe to rest uniformly supported upon the trench bottom. Bell holes shall be no longer than is necessary for practical installation of the pipe.
F. The length of trench to be opened at one time shall be as follows:
1. In extended runs, open trench length shall not exceed 100 feet.
2. In street crossings, trench shall not be open in more than one lane at a time, unless specified differently in traffic control plan.
3. Backfill driveways and entrances immediately after placement of pipe.

G. Excavated material shall be placed:
   1. As approved by the Engineer when these specifications do not apply.
   2. Compactly along sides of excavation.
   3. To provide continuous access to fire hydrants and utility valves.
   4. To provide as little inconvenience as possible to public travel.
   5. To minimize damage to adjacent lawns and planted areas.

3.4 Pipe Bedding

A. Bed pipe with 4-inch thick layer of specified bedding material for pipes 20-inch and larger.
B. Place bedding alongside of the pipe to an elevation above the springline (no lower than half the height of the pipe).
C. Mechanically compact bedding material in the immediate vicinity of the pipe to assure uniform support of the pipe beneath the springline.
D. Compact bedding to a minimum of 90% Standard Proctor Density.
E. Obtain required compaction within a soil moisture range of optimum moisture to 4% above optimum moisture content.
F. Do not damage pipe coating or wrapping system during bedding placement and compaction.

3.5 Backfilling

A. Backfilling of trenches shall be done only after pipe installation, jointing, and bedding are complete, inspected, and approved.
B. Backfill material shall comply with Part 2 above.
C. Backfill shall be mechanically tamped with impact or vibrating compaction equipment.
D. Place backfill in layers and compact to the required density.
E. Backfill shall be:
   1. Compacted to 90% Standard Proctor Density to a level one foot above the pipe.
   2. For the remainder of the trench:
      a. Public rights-of-way shall be compacted to 95% Standard Proctor Density.
      b. Easement areas shall be compacted to 95% Standard Proctor Density.
   3. Within a soil moisture range of optimum moisture to 4% above optimum moisture content.
F. Protect pipe coating or pipe wrapping system from damage during backfill operations.
G. Hydraulic compaction or water jetting of the pipe trenches shall not be permitted.
H. Adjust moisture content of material that exceeds optimum moisture range, but is otherwise acceptable, by spreading and aerating or otherwise drying as necessary until moisture content is within required moisture range and required compaction can be obtained.
I. Adjust moisture content of material that is below optimum moisture, but is otherwise acceptable, by wetting as necessary until moisture content is within required moisture range and required compaction can be obtained.

3.6 Grading

A. Finish-grade surfaces with a well-compacted, free-draining, uniform surface without obstructive protrusions or depressions.
B. Place topsoil at a uniform depth equal to the surrounding topsoil, but not less than 4 inches.
C. Place topsoil to a minimum depth of 6 inches when ample native topsoil is available.
D. Place topsoil only under lawn and planted areas.

3.7 Control of Water

A. Install pipe in the dry.
B. Dewater as necessary to prevent water from entering the pipe or rising around the pipe.
C. Water pumped or diverted from the excavation site shall not be:
   1. Pooled anywhere on the site.
   2. Removed in such a manner as to disperse silt.
   3. Placed on surfaces heavily traveled by pedestrian traffic.
D. Installed pipe shall not be used as a conduit for trench dewatering.

E. Surface water shall be controlled as follows:
   1. Divert surface water to prevent entry into the pipe trenches.
   2. Remove surface water accumulated in the pipe trenches and other excavations prior to continuation of excavation Work.
   3. Remove surface water saturated soil from the excavation.
F. Control groundwater as follows:
   1. Where groundwater is encountered, trenches and other excavations shall be dewatered, as necessary, to permit the proper execution of the Project.
   2. When large quantities of groundwater are encountered, trenches shall be stabilized with the specified stabilization material, and pipe shall be bedded as specified.
G. Dewatering River Crossing:
   1. Maintain water levels 2 feet or more below the bottom of excavations in saturated cohesionless (sand and/or gravel) soils to prevent upward seepage which could reduce subgrade support.
   2. Install dewatering system (well points or shallow wells) when working in cohesionless soils.
   3. Do not pump groundwater from open excavation in sand and gravel below natural groundwater level.
   4. In cohesive soils with no wet sand seams or layers it may be possible to control water seepage by draining groundwater to temporary construction pumps and pumping it outside perimeter of excavation.
   5. Do not discharge silt and similar materials from the project site by any dewatering activities.
   6. Maintain dewatering operations until structures or piping installation are completed and backfilled.

3.8 Disposal of Unsuitable or Excess Material

A. Surplus material and material not suitable for backfill shall be disposed of off-site at a location provided by Contractor.
   1. Off-site disposal locations must hold a National Pollutant Discharge Elimination System (NPDES) permit from the IDNR for storm water discharge associated with construction activity.
   2. Transportation of such material shall be provided by Contractor.

3.9 Cleanup and Restoration

A. The site in and around the excavation shall be cleared of mud and construction debris to a condition equal to, or better than, that existing prior to trenching Work.
B. Remove construction remnant materials from the site.
C. Damage to adjacent property suffered during installation Work shall be repaired to a condition equal to, or better than, that existing prior to trenching Work.

**** END OF SECTION ****

Section 02600 Protection of Water Supply

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Not used.

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Part 1 General

1.1 Summary of Work

A. This Section describes Iowa Department of Natural Resources requirements for protection of water supply systems.

1.2 Related Sections

A. Section 02220 – Excavating, Backfilling, and Compacting for Water Main and River Pipe.
B. Section 02610 – Pipe for Water Main and River Pipe.
C. Section 02640 – Valves and Hydrants.
D. Section 02674 – Pressure Testing Water Mains.
E. Section 02675 – Disinfection of Water Distribution Systems.

1.3 References

A. Iowa Wastewater Facilities Design Standards.

Part 2 Products

Not used.

Part 3 Execution

3.1 General Installation Requirements

A. Lay water mains to avoid high points where air can accumulate. Grade piping so that proposed hydrants will be at the highest points.
B. Do not locate hydrants within 10 feet of sanitary sewers or storm drains.
C. Plug hydrant drain ports in areas where groundwater rises above the water main and pump the hydrant barrel dry following construction.
D. Pressure test and disinfect new water mains prior to placing them in service.

3.2 Separation Distance

A. Horizontal separation of water mains from gravity sewers:
   1. Provide a horizontal separation distance of at least 10 feet between water mains and gravity sewer mains, unless both of the following conditions can be met:
      a. The bottom of the water main is at least 18 inches above the top of the sewer.
      b. The water main is placed in a separate trench with a minimum 3-foot horizontal separation.
   2. When it is impossible to obtain the required 3-foot horizontal clearance and 18-inch vertical separation, the sewer must be replaced with water main quality materials having a minimum pressure rating of 150 psi and meeting the requirements of Section 02610. In no case shall the linear separation be less than 2 feet.

B. Horizontal separation of water mains from sewer force mains:
   1. Provide a horizontal separation distance of at least 10 feet between water mains and sewer force mains, unless both of the following conditions can be met:
      a. The force main is constructed of water main quality materials having a minimum pressure rating of 150 psi and meeting the requirements of Section 02610.
      b. The water main is laid at least 4 linear feet from the sewer force main.

C. Vertical separation of water mains from sanitary sewer crossovers:
   1. Provide a vertical separation of at least 18 inches from the bottom of the water main to the top of the sanitary sewer whenever possible where water mains cross over sanitary sewers. If 18 inches cannot be met, provide a minimum vertical separation of 6 inches and place the water main inside 20-feet of a larger diameter polyvinyl chloride water main casing pipe with no casing chocks centered on the sanitary sewer..
   2. Provide a vertical separation of at least 18 inches from the bottom of the sanitary sewer to the top of the water main in cases where water mains cross under the sanitary sewer. Place the water main inside 20-feet of a larger diameter polyvinyl chloride water main casing pipe with no casing chocks centered on the sanitary sewer.
   3. Adequately support both water and sanitary sewer pipes and provide watertight joints.

D. Vertical separation of water mains from storm sewer crossovers:
   1. Provide a vertical separation of at least 18 inches from the bottom of the water main to the top of the storm sewer whenever possible where water mains cross over storm sewers. If 18 inches cannot be met, provide a minimum vertical separation of 6 inches and construct one of the following:
      a. Verify the storm sewer has gasketed joints.
      b. The water main shall be 20-feet of ductile iron pipe material with nitrile gaskets.
      c. Encase the storm sewer.
      d. Encase the water main.
   2. Provide a minimum vertical separation of at least 18 inches from the bottom of the storm sewer to the top of the water main in cases where water mains cross under storm sewer mains and construct one of the following:
      a. Verify the storm sewer has gasketed joints.
      b. The water main shall be 20-feet of ductile iron pipe material with nitrile gaskets.
      c. Encase the storm sewer.
      d. Encase the water main.
   3. Adequately support both water and storm sewer pipes and provide watertight joints.

E. Separation of water mains from sewer manholes:
   1. No water pipe shall pass through or come in contact with any part of a sewer manhole.
   2. Provide a horizontal separation distance of at least 10 feet between water mains and sewer manholes.

F. Advise Engineer and DMWW should physical conditions exist such that exceptions to Part 3.2 of this Section are necessary.

3.3 Water Crossings

A. Above-water crossings:
   1. Adequately support and anchor pipe used for above-water crossings.
   2. Protect pipe from damage and freezing.
   3. Ensure pipe is accessible for repair or replacement.

B. Underwater crossings:
   1. Use restrained joint pipe for water mains entering or crossing streams that are 15 feet in width or larger.
      a. Place the top of the water main a minimum of 5 feet below the natural bottom of the streambed.
      b. Securely anchor the water main to prevent movement of the pipe and provide easily accessible shutoff valves located outside the floodway at each end of the water crossing.
      c. Backfill the trench with crushed rock or gravel.
      d. Seed, sod, or otherwise protect the streambank from erosion upon completion of the Project.
   2. For smaller streams, the same requirements shall apply except that shutoff valves do not need to be located immediately adjacent to the water crossing.
   3. Water crossings, in areas where no evidence of erosion exists, are excluded from these requirements.
   4. DMWW will electronically pinpoint leaks in leiu of inserting a small meter to determine leakage and obtain water samples on each side of shutoff valve.

3.4 Depth of Cover and Width of Trench

A. Provide 5 feet minimum depth of cover from the top of the pipe to the ground surface unless noted otherwise on the plans.
B. Where possible, provide an additional 1 foot of cover under pavement.
C. Insulate water mains where conditions prevent adequate earth cover as noted on the plans, or directed by the Engineer or DMWW.
D. Provide a trench width adequate to lay and joint pipe properly but not more than 12 inches on either side of the pipe.

**** END OF SECTION ****

Section 02610 Pipe for Water Main and River Pipe

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Part 1 General

1.1 Summary of Work

A. This Section includes water mains, fittings, and specials as shown on the Contract Drawings, complete with accessories.

1.2 Related Sections

A. Section 02220 – Excavating, Backfilling, and Compacting for Water Main and River Pipe.
B. Section 02600 – Protection of Water Supply.
C. Section 02640 – Valves and Hydrants.
D. Section 02674 – Pressure Testing Water Mains.
E. Section 02675 – Disinfection of Water Distribution Systems.
F. Section 13110 – Cathodic Protection.

1.3 References

A. American National Standards Institute (ANSI) B16.1 – Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800.
B. American Society for Testing and Materials (ASTM) A320 – Standard Specification for Alloy Steel Bolting Materials for Low-Temperature Service.
C. American Society for Testing and Materials (ASTM) A536 - Standard Specification for Ductile Iron Castings.

D. American Water Works Association (AWWA) C104 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
E. American Water Works Association (AWWA) C105 – Polyethylene Encasement for Ductile Iron Pipe Systems.
F. American Water Works Association (AWWA) C110 – Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In., for Water and Other Liquids.
G. American Water Works Association (AWWA) C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
H. American Water Works Association (AWWA) C115 – Flanged Ductile Iron Pipe With Threaded Flanges.
I. American Water Works Association (AWWA) C150 – Thickness Design for Ductile Iron Pipe.
J. American Water Works Association (AWWA) C151 – Ductile Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
K. American Water Works Association (AWWA) C153 – Ductile-Iron Compact Fittings, 3 In. Through 24 In. and 54 In. Through 64 In. for Water Service.
L. American Water Works Association (AWWA) C600 – Installation of Ductile Iron Water Mains and Their Appurtenances.
M. American Water Works Association (AWWA) C605 – Underground Installation of Polyvinyl Chloride Pressure Pipe and Fittings.
N. American Water Works Association (AWWA) C900 – Polyvinyl Chloride Pressure Pipe, 4 In. Through 12 In., for Water Distribution.
O. American Water Works Association (AWWA) C905 – Polyvinyl Chloride Water Transmission Pipe, Nominal Diameters 14 In. Through 36 In.

1.4 Submittals

A. In addition to those submittals identified in the Standard Specifications, the following items shall also be submitted for materials provided by the Contractor:
    1. Manufacturer's certification that materials furnished is in compliance with the applicable requirements of the referenced standards and this specification.
    2. Drawings and manufacturer's data showing details of the pipe and fittings to comply with this specification.
    3. Class of pipe and fittings.
    4. Materials test reports.
    5. Tabulated layout schedule.
    6. Restrained joint details for DMWW's approval.
    7. Information related to welded-on outlets:
        a. Representative proof test data confirming hydrostatic test results and safety factors for welded-on outlets.
        b. Documentation showing pipe manufacturer has minimum of 5 years experience in fabricating and testing outlets of similar size and configuration as needed on this Project.
        c. Quality assurance program for welding.
B. Provide dimensional drawings, fabrication details, functional description, and properly identified catalog data on pipe and equipment to prove complete compliance with Drawings and specifications.

1.5 Measurement and Payment

A. Water Main:
   1. Include cost for all material, equipment, and labor necessary to comply with this Section in the appropriate unit price bid on the Proposal for each type and size of pipe material.
   2. Includes excavation, temporary sheeting and shoring, dewatering unless noted otherwise, water main pipe as specified, tangent outlets where specified, polyethylene wrap, thrust restraint, tracer wire system, furnishing, placing and compacting bedding and backfill material, testing, and disinfection.
   3. Measurement will be per linear foot along the centerline of the pipe including the length through the fittings.
   4. Maximum quantity shall be plan quantity, unless lengths are extended by the Engineer and DMWW.
   5. Payment will be at the contract unit price per linear foot for each type and size of pipe installed.

B. River Pipe
   1. Include cost for all material, equipment, and labor necessary to comply with this Section in the appropriate unit price bid on the Proposal for each type and size of pipe material.
   2. Includes excavation, temporary sheeting and shoring, dewatering, pipe as specified, polyethylene wrap for ductile iron pipe, thrust restraint, tracer wire system, furnishing, placing and compacting bedding and backfill material.
   3. Measurement will be per linear foot along the centerline of the pipe including the length through the fittings.
   4. Maximum quantity shall be plan quantity, unless lengths are extended by the Engineer and DMWW.
   5. Payment will be at the contract unit price per linear foot for each type and size of pipe installed.

C. Fittings:
   1. Include cost for all material, equipment, and labor necessary to comply with this Section in the appropriate unit price bid on the Proposal for each type and size of fitting.
   2. Includes excavation, temporary sheeting and shoring, dewatering, restrained joint fittings, polyethylene wrap, thrust restraint, tracer wire system, furnishing, placing and compacting bedding and backfill material, testing, and disinfection. Testing and disinfection not required on fittings for river pipe.
   3. Maximum quantity shall be plan quantity, unless quantity is extended by the Engineer and DMWW.
   4. Measurement will be by count.
   5. Payment will be at the contract unit price for each type and size of fitting installed.

Part 2 Products

2.1 Ductile Iron Pipe (Water Main)

A. Manufacture pipe in accordance with AWWA C151.
B. Provide pressure class pipe per AWWA C150.
C. Minimum pipe class:
   1. Special Thickness Class 52 except where noted on the construction drawings as other Special Thickness Class.
   2. Pipe with welded-on bosses or outlets including outlet candidate pipe: Special Thickness Class 53 minimum.
D. Provide asphaltic outside coating per AWWA C151, 1 mil in thickness.
E. Cement Mortar Lining:
   1. Provide pipe with standard thickness cement mortar lining per AWWA C104.
   2. Seal-coat cement mortar lining in accordance with AWWA C104.

2.2 Polyvinyl Chloride Pipe C-905 (River Pipe)

A. Manufacture pipe in accordance with AWWA C905.
B. Pipe shall be Class 165 (DR 25) with ductile iron pipe equivalent outside diameters.
C. Pipe shall be blue in color.

2.3 Ductile Iron Pipe (River Pipe)

A. Manufacture pipe in accordance with AWWA C151.
B. Provide pressure class pipe per AWWA C150.
C. Minimum pipe class: Special Thickness Class 52.
D. Provide asphaltic outside coating per AWWA C151, 1 mil in thickness.
E. Cement Mortar Lining:
    1. Provide pipe with standard thickness cement mortar lining per AWWA C104.
    2. Seal-coat cement mortar lining in accordance with AWWA C104.

2.4 Fittings

A. Fittings shall be compact in accordance with AWWA C153, or full size in accordance with AWWA C110.
    1. Use of welded-on tangential outlets permitted for hydrant assemblies and elsewhere where shown on plans.
        a. Parent pipe and branch outlet: manufactured in accordance with AWWA C151.
        b. Minimum working pressure rating: 250 psi.
        c. Minimum factor of safety: 2.0 based on proof of design hydrostatic test results.
        d. Welded-on outlets may be fabricated by pipe manufacturer at facility other than facility where parent pipe is produced.
        e. Pipe manufacturer and fabricator must have:
            (1) Minimum of 5 years experience in fabricating and testing outlets of similar size and configuration.
            (2) Fully documented welding quality assurance system.
B. Material of construction shall be ductile iron in accordance with AWWA C110.
C. Joints:
    1. Mechanical in accordance with AWWA C111, or restrained, as indicated on the plans.
        a. Gaskets: SBR Rubber or as indicated on the plans.
        b. T-bolts and hex-head nuts for mechanical joints in accordance with AWWA C111.
            (1) Material: low carbon alloy weathering Cor-Ten steel.
            (2) Coating: Cor-Blue fluorocarbon resin.
            (3) Color: blue.
            (4) Approved Manufacturers:
                (a) Birmingham Fastener Manufacturing Fluorocarbon Coated T-Head Bolt.
                (b) Or approved equal.
    2. Flanged in accordance with AWWA C115, as indicated on the plans, with ANSI Class 125 full-faced flange.
        a. Gaskets: SBR Rubber, of thickness compatible with machine tolerances of flange faces. Minimum thickness: 1/8-inch.
        b. Nuts and bolts: Conform to ASTM A320, Type 304.
D. Pressure Rating:

SIZE (INCHES)	PRESSURE RATING (PSI)
3 - 24	350
30 - 48	250
54 - 64	150

E. Provide asphaltic outside coating per AWWA C110, 1 mil in thickness.
F. Cement Mortar Lining:
    1. Provide standard thickness cement mortar lining per AWWA C104.
    2. Seal-coat cement mortar lining in accordance with AWWA C104.

2.5 Joints

A. Joints shall be push-on using an integral bell with a rubber gasket or mechanical in accordance with AWWA C111, or restrained as indicated on the plans.
B. Follower glands for mechanical joints shall be ductile iron.
C. T-bolts and hex-head nuts for mechanical joints in accordance with AWWA C111.
    1. Material: low carbon alloy weathering Cor-Ten steel.
    2. Coating: Cor-Blue fluorocarbon resin.
    3. Color: blue.
    4. Approved Manufacturers:
        a. Birmingham Fastener Manufacturing Fluorocarbon Coated T-Head Bolt.
        b. Or approved equal.
D. Solvent cement joints are strictly prohibited.
E. Provide flanged joints for connections to flanged valves, hydrant valves, and other flanged fittings where shown on plans. Conform to AWWA C115 with ANSI Class 125 full-faced flange.
    1. Gaskets: SBR Rubber, of thickness compatible with machining tolerances of flange faces. Minimum thickness: 1/8-inch.
    2. Nuts and bolts: Conform to ASTM A320, Type 304.
F. Joint bonds: No. 2 AWG-HMWPE stranded copper cable per Section 13110.

2.6 Restrained Joints

A. Mechanical Joint
    1. Incorporate restraint for all mechanical joints into the design of the follower gland.
    2. Retainer gland design shall impart multiple wedging actions against the pipe, increasing its resistance as pressure increases.
    3. Restrained joints to consist of a mechanical joint with retainer gland or manufacturer's proprietary-restrained joint.
    4. Dimensions shall conform to the requirements of AWWA C111 and AWWA C153.
    5. Pressure rating:
        a. Minimum of 235 psi for PVC pipe.
        b. Minimum of 350 psi for ductile iron pipe sizes 16-inch and smaller.
        c. Minimum of 250 psi for ductile iron pipe sizes 18-inch and larger.
    6. Color:
        a. Red for PVC pipe.
        b. Black for ductile iron pipe.
    7. Materials for construction:
        a. Body, wedge segments, and break-off bolt assemblies: Grade 65-45-12 ductile iron as specified by ASTM A536.
        b. Coating to be electrostatically applied and heat cured.
            (1) Approved manufacturers:
                (a) MEGA-BOND by Ebaa Iron, Inc.
                (b) CORRSAFE by Sigma.
                (c) Starbond by Star Products.
                (d) Resicoat R2-ES by Tyler Union.
                (e) Or approved equal.
    8. Minimum factor of safety of 2.
    9. Ductile iron retainer wedge segments shall be heat treated to a minimum Brinell Hardness Number of 370.
    10. Twist-off nuts, the same size as hex-head nuts for T-bolts, shall be incorporated into the design to ensure proper actuating torque is applied during installation.
    11. Approved manufacturers for PVC pipe glands:
        a. Megalug by EBAA Iron Inc. Series 2000PV.
        b. One-Lok by Sigma Series SLCE.
        c. Stargrip by Star Products Series 4000.
        d. TUFGrip by Tyler Union Series 2000.
        e. Or approved equal.

12. Approved manufacturers for ductile iron pipe glands:
    a. Megalug by EBAA Iron Inc. Series 1000.
    b. One-Lok by Sigma Series SLDE.
    c. Stargrip by Star Products Series 3000.
    d. TUFGrip by Tyler Union Series 1000.
    e. Or approved equal.

B. Ductile Iron Pipe Joint
    1. Restraint for in-line ductile iron pipe shall consist of the manufacturer's proprietary-restrained joint.
    2. Restraint joints to have a minimum pressure rating of 250 psi.

2.7 Polyethylene Pipe Encasement Material

A. Polyethylene encasement shall be manufactured in accordance with AWWA C105.
B. Linear low-density polyethylene film.
C. Minimum thickness shall be 8 mils.
D. Color: Blue.
E. Physical Properties:
    1. Tensile strength 3600 psi, minimum
    2. Elongation 800%, minimum
    3. Dielectric strength 800 V/mil, minimum
    4. Impact resistance 600 g, minimum
    5. Propagation tear resistance 2550 gf, minimum
F. Flat-width tubing of the following sizes shall be used:

Pipe Size	Tubing Width
3 inches	14 inches
4 inches	14 inches
6 inches	16 inches
8 inches	20 inches
12 inches	27 inches
16 inches	34 inches
20 inches	41 inches
24 inches	54 inches
30 inches	67 inches
36 inches	81 inches

G. Markings shall contain the following information spaced every 2 feet apart:
    1. Name of manufacturer.
    2. Year of manufacture.
    3. ANSI/AWWA C105-A21.5.
    4. 8-mil low linear density polyethylene (LLDPE).
    5. Applicable range of nominal pipe diameter.
    6. Warning-Corrosion Protection-Repair Any Damage.
H. Sheet material can be used to wrap irregular-shaped valves and fittings.
I. 2-inch-wide, 10-mil-thick pressure-sensitive polyethylene tape shall be used to close seams and hold overlaps.

2.8 Tracer System

A. Tracer Wire:
    1. No. 12 AWG extra-high-strength copper clad steel conductor (EHS-CCS) manufactured by Copperhead Industries, or pre-approved equal.
        a. Insulation: 45 mil, high-density, high molecular weight polyethylene (HDPE) and rated for direct burial at 30 volts.
        b. EHS-CCS Conductor: 21% conductivity for locates purposes with a minimum 1150 pounds break load.
        c. Origin of copper clad steel manufacture is required and steel core must be manufactured in the United States.
        d. Color: Blue.

B. Anode Ground Rod:
   1. 1# x 1.315-inch D x 18.5-inch L, magnesium drive in anode manufactured by Copperhead Industries, or pre-approved equal.
   2. Cap installed on one end of anode ground rod to be HDPE.
   3. Provide a beveled pointed end on anode ground rod opposite of the cap to aid in hammering into the ground.
   4. Wire from cap for anode ground rod to tracer wire connection:
      a. No. 14 AWG copper clad steel (HS-CCS) manufactured by Copperhead Industries or approved equal.
      b. Insulation: 30 mil, high-density, high molecular weight polyethylene (HDPE) and rated for direct burial at 30 volts.
      c. Length: 10 feet.
         (1) HS-CCS Conductor: 21% conductivity for locates purposes with a minimum 250 lbs. break load.
      d. Color: Red.

C. Wire Splice Connector:
   1. Tracer wire splices shall only be used to connect the anode ground rod to the tracer wire.
   2. Tracer wire splices will not be allowed between anode ground rods and connection terminal.
   3. Splices used for tracer wire repair must be approved by the Engineer and DMWW.
      a. Splice Kit: 3M Scotchcase 3832 Buried Service Wire Splice Kit with Burndy KS15 8-14 AWG Splice Bolt.
      b. Or approved equal.

D. Tracer Wire Connection:
   1. Rhino TriView TracerPed, or approved equal.
      a. Three internal terminals with two shunts.
      b. 5-foot white plastic triangular post.
      c. Removable top cap with lock.
      d. Three 2-7/8-inch by 14-inch custom vinyl decals No. SD-5594K.
      e. Tri-grip anchor.

2.9 Cathodic Protection

A. Cathodic protection system materials per Special Provisions, Section 13110.

Part 3 Execution

3.1 Handling, Storage, and Shipping

A. Handle the pipe carefully.
B. Blocking and hold-downs shall be used during shipment to prevent movement or shifting.
C. Pipe with damage to the cement mortar lining will be rejected with field-patching not permitted.
D. For shipment and storage, small pipe shall not be telescoped inside larger pipe.
E. Handle pipe materials by use of nylon straps, wide canvas or padded slings, wide-padded forks and skids, or other approved means designed to prevent damage to the polyethylene encasement. Unpadded chains, sharp edges or buckets, wire ropes, narrow forks, hooks, and metal bars are unacceptable.
F. Dropping or rolling of pipe material is not permitted.
G. PVC pipe shall not be stored in direct sunlight for prolonged periods of time.
H. Pipe shall be protected to prevent dirt or debris from entering the pipe.

3.2 General Pipe Installation

A. Protect pipe joints from injury while handling and storing.
B. Use no deformed, defective, gouged, or otherwise impaired pipe.
C. Excavate and prepare trench as specified in Section 02220.
D. Install ductile iron pipe in accordance with AWWA C600.

E. Install River Pipe as gravity sewer in accordance with Section 2504 of the Standard Specifications. Install to the line and grade shown on the plans.
F. Prepare the trench bottom with sufficient exactness before the pipe is installed so that only minor movement of the pipe will be necessary after installation.
G. Clean pipe interior prior to placement in the trench.
H. Install pipe to the line and grade shown on the plans with an allowable tolerance of 3 inches, plus or minus.
I. Maintain uniform bearing along the full length of the pipe barrel at all times. Blocking the pipe up will not be acceptable. Excavate trench bottoms deeper at the location of bell joints to permit the body of the pipe to rest uniformly supported upon the trench bottom. Bell holes shall be no longer than is necessary for practical installation of the pipe.
J. Clean joint surfaces of dirt and foreign matter using a wire brush before jointing pipe.
K. Lubricate gasket and pipe bell. Furnish a vegetable-soap lubricant meeting manufacturer's recommendations. Lubricant shall be approved for use with potable water.
L. Make joints in strict accordance with manufacturer's recommendations.
M. Joint deflections shall be within the manufacturer's specifications for maximum deflections.
N. Bolts on mechanical joints or flanged joints shall be tightened evenly around the pipe by alternating from one side of the pipe to the other. Follow manufacturer’s installation specifications for electric isolation flanges to prevent damage during bolt torquing.
O. Install joint bonds as shown on the plans to bond across each joint except across flange isolation kits.
P. Cut pipe in a neat manner without damage to the pipe or the cement mortar lining, if any. Leave a smooth end at right angles to the axis of the pipe. Cut pipe ends shall be beveled for push-on-type joints in accordance with manufacturer's recommendations.
Q. No pipe shall be installed in water, nor shall water be allowed to rise in the trench around the pipe.
R. Place watertight bulkheads on the exposed ends of the pipe at all times when the pipe installation is not actually in progress.
S. Install cathodic protection system as shown on plans and specified in Section 13110.
T. Place backfill and compact around pipe as outlined in Section 02220.

3.3 Installation of Polyethylene Pipe Encasement Material

A. Use polyethylene encasement material on buried ductile iron pipe, fittings, rods, and appurtenances in accordance with AWWA C105, Method A.
B. Use polyethylene tubing to encase pipe.
C. Cut tubing 2 feet longer than pipe section. Overlap tubing 1 foot at each end of pipe.
D. Gather and lap tubing to provide a snug fit.
E. Secure lap at quarter points with polyethylene tape. Secure each end of tube with a complete wrap of polyethylene tape.
F. The polyethylene encasement shall prevent contact between the pipe and bedding material, but is not intended to be a completely airtight and watertight enclosure.
G. Repair damaged polyethylene encasement material using polyethylene tape, or replace the damaged section.
H. Pick and move polyethylene-encased pipe with nylon slings; wire rope is not permitted.

3.4 Thrust Blocks

A. Provide concrete thrust blocks at changes in alignment, tees, and dead ends for pipe less than or equal to 20 inches in diameter, or as shown on the plans.
B. Carry thrust blocks to undisturbed soil that will provide adequate bearing.
C. The bearing area of thrust blocks, in square feet, shall be as shown on the plans. Minimum thickness for any thrust block shall be 1.5 times outside pipe diameter or 18 inches, whichever is greater.
D. Hold thrust blocks back 3 inches from bolts, nuts, glands, or other jointing materials. Ensure joints could be remade without disturbing thrust block.
E. Provide bond breaker between thrust block and pipe. Polyethylene encasement material will be considered an acceptable bond breaker.

F. Provide thrust blocks at connections to existing water mains.

3.5 Tracer System Installation

A. Install tracer wire with buried piping.
B. Duct tape tracer wire to the pipe every 5 feet in the 3 or 9 o'clock position opposite of the anode beds to prevent damage to the wire during backfill and future construction exposure.
C. Install anode ground rods adjacent to connections to existing piping and at each fire hydrant.
D. Terminate tracer wire in tracer wire connection next to each fire hydrant or other locations directed by Engineer or DMWW.
E. Wire splice connectors can only be used to connect ground rods to tracer wire. Wire splice connectors are not allowed at any other locations unless approved by Engineer and DMWW. Provide long enough roll of tracer wire to not need the use of wire splices connectors
F. Allow DMWW to inspect underground splices prior to backfilling.
G. Tracer wire installation is considered incidental to water main installation.

3.6 Cathodic Protection System Installation

A. Install magnesium anode cathodic protection system as shown on the plans and specified in Special Provisions, Section 13110.
B. Install insulated bond cables across all non-welded ferrous pipe joints per Special Provisions, Section 13110.

3.7 Testing and Chlorination

A. Perform hydrostatic and leakage tests in accordance with Section 02674.
B. Disinfect water mains in accordance with Section 02675.
C. Pressure testing and chlorination of river pipe is not required.
D. Tracer Wire Test:
    1. Conducted by DMWW prior to acceptance of Project.
    2. Correct any discontinuities found in the tracer system.
    3. Correct any electrical discontinuities in the pipe joint bonding.
E. Cathodic Protection System Test:
    1. Conducted by DMWW, or DMWW's representative, prior to acceptance of Project.
    2. DMWW's testing to determine effectiveness of polyethylene encasement.
    3. Based on results of DMWW's testing, Contractor may be required to install additional anodes and test stations at locations along pipeline as directed by the DMWW.
        a. DMWW will provide materials needed to install additional cathodic protection system components.
        b. DMWW will negotiate a price with Contractor as compensation for installation of additional anodes and test stations.

**** END OF SECTION ****

Section 02640 Valves and Hydrants

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Part 1 General

1.1 Summary of Work

A. This Section includes valves and hydrants as shown on the plans, complete with accessories.

1.2 Related Sections

A. Section 02220 – Excavating, Backfilling, and Compacting for Water Main and River Pipe.
B. Section 02610 – Pipe for Water Main and River Pipe.

1.3 References

A. American National Standards Institute (ANSI) B16.1 – Cast Iron Pipe Flanges and Flanged Fittings.
B. American Society for Testing and Materials (ASTM) A320 – Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service.
C. American Society for Testing and Materials (ASTM) B584 – Copper Alloy Sand Castings for General Applications.
D. American Water Works Association (AWWA) C105 – Polyethylene Encasement for Ductile-Iron Pipe Systems.
E. American Water Works Association (AWWA) C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
F. American Water Works Association (AWWA) C115 – Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.

G. American Water Works Association (AWWA) C153 – Ductile Iron Compact Fittings.
H. American Water Works Association (AWWA) C502 – Dry-Barrel Fire Hydrants.
I. American Water Works Association (AWWA) C509 – Resilient-Seated Gate Valves for Water Supply Service.
J. American Water Works Association (AWWA) C515 – Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service.
K. American Water Works Association (AWWA) C550 – Protective Interior Coatings for Valves and Hydrants.
L. American Water Works Association (AWWA) C600 – Installation of Ductile-Iron Water Mains and Their Appurtenances.

1.4 Submittals

A. Submit manufacturer's certification that materials furnished is in compliance with the applicable requirements of the referenced standards and this Section.
B. Provide dimensional drawings, fabrication details, functional description, and properly identified catalog data on all items to prove complete compliance with Drawings and specifications.

1.5 Measurement and Payment

A. Valves:
   1. Include cost for all material, equipment, and labor necessary to comply with this Section in the appropriate unit price bid on the Proposal for each type and size of valve.
   2. Includes excavation, temporary sheeting and shoring, dewatering, valve, valve box, valve box adapter, valve box and stem extensions if required, polyethylene wrap, thrust restraint, furnishing, placing and compacting bedding and backfill material, testing, and disinfection.
   3. Measurement will be by count.
   4. Payment will be at the contract unit price for each type and size of valve installed.

B. Hydrant Assembly:
   1. Include cost for all material, equipment, and labor necessary to comply with this Section in the appropriate unit price bid on the Proposal for each hydrant assembly.
   2. Includes excavation, temporary sheeting and shoring, dewatering, hydrant, anchoring pipe, fittings, gate valve, valve box, valve box adapter, valve box and stem extensions if required, polyethylene wrap, thrust restraint, furnishing, placing and compacting bedding and backfill material, testing, and disinfection.
   3. Measurement will be by count.
   4. Payment will be at the contract unit price for each hydrant assembly installed.

C. Elastomeric Check Valve:
   1. Include cost for all material, equipment, and labor necessary to comply with this Section in the appropriate unit price bid on the Proposal for each type and size of valve.
   2. Includes excavation, temporary sheeting and shoring, dewatering, check valve, all components required for proper installation, and manual adjustment of adjacent revetment to accommodate valve.
   3. Measurement will be by count.
   4. Payment will be at the contract unit price for each type and size of valve installed.

Part 2 Products

2.1 Gate Valves

A. Provide resilient-seated gate valves manufactured in accordance with AWWA C509 or AWWA C515.
   1. Type of service: buried service handling potable water with a pH range of 9.5 to 9.8.
   2. Minimum pressure rating: 250 psi.
   3. Furnish valves with non-rising stem.
   4. Provide 2-inch by 2-inch wrench operating nut that opens valves when turned in clockwise direction (open to the right), unless noted otherwise on the Drawings.
   5. Valve gearing for 20-inch to 48-inch valves:
      a. Provide valve with gear box.
      b. Provide vertical valve unless otherwise specified on the Drawings.
      c. The following gear ratios shall be used for the corresponding sizes:

Valve Size	Gear Ratio
20-inch	3 to 1
24-inch	3 to 1
30-inch	6 to 1
36-inch	6 to 1
42-inch	8 to 1
48-inch	8 to 1

      d. Totally enclosed type, oil-filled, and designed for buried and submerged service.
      e. Materials of construction:
         (1) Gear housing: ductile iron.
         (2) Gears: carbon steel.
         (3) Pinion shaft: 304 stainless steel.
         (4) Input shaft shall be designed with a ball bearing and sealed with o-rings.
         (5) Exposed hex nuts and bolts: 304 stainless steel.

B. Materials of Construction:
   1. Body and bonnet: ductile iron.
   2. Gate: cast or ductile iron fully encapsulated with synthetic rubber.
   3. Stem and stem nut: bronze.
   4. O-rings: Buna-N.
   5. Exposed hex bolts and nuts: 304 stainless steel.
   6. Joints:
      a. Mechanical in accordance with AWWA C111.
         (1) Gaskets: Buna-N or nitrile.
         (2) Nuts and bolts:
            (a) All T-bolts and hex-head nuts for mechanical joints in accordance with AWWA C111.
            (b) Material: low carbon alloy weathering Cor-Ten steel.
            (c) Coating: Cor-Blue fluorocarbon resin.
            (d) Color: blue.
            (e) Approved Manufacturers:
               1) Birmingham Fastener Manufacturing Fluorocarbon Coated T-Head Bolt.
               2) Or approved equal.
      b. Flanged in accordance with AWWA C115, as indicated on the plans, with ANSI Class 125 full-faced flange.
         (1) Gaskets: Buna-N or nitrile, of thickness compatible with machining tolerances of flange faces. Minimum thickness: 1/8-inch.
         (2) Nuts and bolts: 304 stainless steel.

C. Design valve to:
   1. Allow replacement of upper O-ring while valve is under pressure in the full-open position.
   2. Not permit metal-to-metal contact between gate and body.
   3. Accommodate full-size tapping machine shell cutter.

D. Horizontal valves shall consist of a cleaning system on both sides of the gate. The cleaning system shall consist of materials that will not cause corrosion.
E. Interior and exterior valve coating shall be minimum 10-mil-thick fusion-bonded epoxy per AWWA C550.
F. Operating valve through 500 cycles at rated pressure must not result in disbondment or degradation of the coating. Certification will be required for manufacturers not listed below.
G. Indicate manufacturer, casting year, size, working pressure, and body material (ductile iron) in valve casting.
H. Manufacturers' Models for 4-inch to 16-inch valves:
    1. Clow Model 2638.
    2. American Flow Control Series 2500.
    3. Mueller 2300 Series.
    4. M & H Style 4067.
    5. Approved equal.
I. Manufacturers' Models for 20-inch to 48-inch valves:
    1. Clow Model 2638.
    2. American Flow Control Series 2500.
    3. Mueller 2300 Series.
    4. Approved equal.

2.2 Hydrants (Polk County)

A. Hydrants shall be manufactured in accordance with AWWA C502.
B. Hydrants shall be dry-barrel, breakaway type designed to break near the ground line on impact. Breaking ring or flange shall be one piece or split and shall contact retaining ring for its full circumference.
C. Provide flanged connections for head and base to hydrant barrel.
D. Provide 6-inch mechanical joint shoe with harnessing lugs.
E. Provide 4-1/2-inch minimum diameter main valve with bronze seat ring. Thread seat ring directly to bronze bushing or drain ring that is securely locked to hydrant shoe.
F. Provide pentagon-shaped operating nut with weather cap. Dimension from point to flat at top of operating nut: 1-3/16-inch.
G. Provide two 2-1/2-inch hose nozzles and one 4-inch pumper nozzle with caps; nozzle caps shall have nut with dimensions identical to operating nut:
    1. Hose nozzle threads
        a. Outside diameter of male thread: 3-1/16 inches
        b. Diameter at root of male thread: 2-7/8 inches
        c. Threads per inch: 7-1/2
        d. Length of nozzle threads: 1 inch
        e. Cut off at top of threads: 1/4 inch
    2. Pumper nozzle threads
        a. Outside diameter of male thread: 4-31/32 inches
        b. Diameter at root of male thread: 4-19/32 inches
        c. Threads per inch: 4
        d. Length of nozzle threads: 1-1/2 inches
        e. Cut off at top of threads: 1/4 inch
H. Provide markings cast-in-bonnet that indicate direction of opening. Hydrants shall open clockwise (to the right).
I. Provide anti-thrust washers for ease of operation.
J. Provide grease chamber or oil reservoir, sealed by means of O-rings, for lubrication of operation threads. Provide lubricant suitable for contact with potable water.

K. Painting:
   1. Prepare surfaces to be coated according to SSPC-SP6, commercial blast cleaning.
   2. Coat hydrant in accordance with AWWA C502 and coating manufacturer's instructions.
   3. Tnemec epoxy paint system
      a. Interior surfaces, other than machined surfaces, shall be coated with asphaltic coating.
      b. Exterior surfaces below grade shall be coated with two coats of asphaltic coating.
      c. Exterior surfaces above grade shall be primed using a polyamide epoxy system, Tnemec Series 20, FC20 or 66, and painted using an aliphatic acrylic polyurethane system, Tnemec Series 75, or approved equal. Provide total dry mil thickness of 5 to 7 mils.
      d. Exterior surfaces above grade shall have 2 to 4 mils dry thickness of clear coat applied after paint has been allowed to dry thoroughly.
      e. Color:
         (1) Asphaltic coating: Black.
         (2) Primer: White (AA83).
         (3) Paint: Bright Yellow (SC02).
         (4) Bonnet: Safety Green (SC07).
         (5) Caps: Bright Yellow (SC02).
   4. TGIC Protective Coating only with prior approval from Des Moines Water Works.
      a. Color:
         (1) Asphaltic coating: Black.
         (2) Base coat: Red Oxide Epoxy IF1947T.
         (3) Paint: Dandelion Yellow TGIC.
         (4) Bonnet: Des Moines Water Works Green TGIC.
         (5) Caps: Dandelion Yellow TGIC.
   5. Approved equal.
      a. System must be approved by DMWW prior to bid opening.

L. Materials of Construction:
   1. Breakaway stem coupling: steel, cast iron, or stainless steel.
   2. Bonnet barrel, shoe, gate, and nozzle caps: cast iron.
   3. Threaded internal components exposed to water, valve seats, and nozzles: bronze.
   4. Cotter pins, drive pins, bolts, and screws exposed to water: stainless steel or brass.
   5. Exterior bolts, nuts, set screws, and other miscellaneous fasteners: stainless steel or bronze. Any metal component in contact with water shall comply with the requirements of ASTM B584 copper alloy UNS No. C89520 or UNS No. C89833. Residual lead levels of the metal shall not exceed 0.25% by weight as cast or extruded.

M. Manufacturers:
   1. Clow Medallion.
   2. Mueller Centurion.
   3. Approved equal.

2.3 Hydrants (Johnston)

A. Hydrants shall be manufactured in accordance with AWWA C502.
B. Hydrants shall be dry-barrel, breakaway type designed to break near the ground line on impact. Breaking ring or flange shall be one piece or split and shall contact retaining ring for its full circumference.
C. Provide flanged connections for head and base to hydrant barrel.
D. Provide 6-inch mechanical joint shoe with harnessing lugs.
E. Provide 5-1/4-inch minimum diameter main valve with bronze seat ring. Thread seat ring directly to bronze bushing or drain ring that is securely locked to hydrant shoe.
F. Provide pentagon-shaped operating nut with weather cap. Dimension from point to flat at top of operating nut: 1-1/2-inch.
G. Provide two 2-1/2-inch hose nozzles and one 4-1/2-inch pumper nozzle with caps with national standard nozzle threads.

H. Provide markings cast-in-bonnet that indicate direction of opening. Hydrants shall open counterclockwise (to the left).
I. Provide anti-thrust washers for ease of operation.
J. Provide grease chamber or oil reservoir, sealed by means of O-rings, for lubrication of operation threads. Provide lubricant suitable for contact with potable water.
K. Painting:
    1. Prepare surfaces to be coated according to SSPC-SP6, commercial blast cleaning.
    2. Coat hydrant in accordance with AWWA C502 and coating manufacturer's instructions.
    3. Tnemec epoxy paint system
        a. Interior surfaces, other than machined surfaces, shall be coated with asphaltic coating.
        b. Exterior surfaces below grade shall be coated with two coats of asphaltic coating.
        c. Exterior surfaces above grade shall be primed using a polyamide epoxy system, Tnemec Series 20, FC20 or 66, and painted using an aliphatic acrylic polyurethane system, Tnemec Series 75, or approved equal. Provide total dry mil thickness of 5 to 7 mils.
        d. Exterior surfaces above grade shall have 2 to 4 mils dry thickness of clear coat applied after paint has been allowed to dry thoroughly.
        e. Color:
            (1) Asphaltic coating: Black.
            (2) Primer: White (AA83).
            (3) Paint: Bright Yellow (SC02).
            (4) Bonnet: Safety Green (SC07).
            (5) Caps: Bright Yellow (SC02).
    4. TGIC Protective Coating only with prior approval from Des Moines Water Works.
        a. Color:
            (1) Asphaltic coating: Black.
            (2) Base coat: Red Oxide Epoxy IF1947T.
            (3) Paint: Dandelion Yellow TGIC.
            (4) Bonnet: Des Moines Water Works Green TGIC.
            (5) Caps: Dandelion Yellow TGIC.
    5. Approved equal.
        a. System must be approved by DMWW prior to bid opening.
L. Materials of Construction:
    1. Breakaway stem coupling: steel, cast iron, or stainless steel.
    2. Bonnet barrel, shoe, gate, and nozzle caps: cast iron.
    3. Threaded internal components exposed to water, valve seats, and nozzles: bronze.
    4. Cotter pins, drive pins, bolts, and screws exposed to water: stainless steel or brass.
    5. Exterior bolts, nuts, set screws, and other miscellaneous fasteners: stainless steel or bronze. Any metal component in contact with water shall comply with the requirements of ASTM B584 copper alloy UNS No. C89520 or UNS No. C89833. Residual lead levels of the metal shall not exceed 0.25% by weight as cast or extruded.
M. Manufacturers:
    1. Clow Medallion.
    2. Mueller Centurion.
    3. Approved equal.

2.4 Joints for Valves and Hydrants

A. Joints shall be mechanical in accordance with AWWA C111, or restrained as indicated on the plans.
B. Follower glands for mechanical joints shall be ductile iron.

C. Bolts:
   1. All T-bolts and hex-head nuts for mechanical joints in accordance with AWWA C111.
      a. Material: low carbon alloy weathering Cor-Ten steel.
      b. Coating: Cor-Blue fluorocarbon resin.
      c. Color: blue.
      d. Approved Manufacturers:
         (1) Birmingham Fastener Manufacturing Fluorocarbon Coated T-Head Bolt.
         (2) Or approved equal.
   2. All bolts and hex nuts for flanged joints shall be 304 stainless steel.
D. Flange joints shall have 1/8-inch rubber ring gaskets for nominal diameters of 24 inches or less and 1/8-inch rubber ring gaskets for nominal diameter greater than 24 inches.
E. Gaskets shall be elastomeric or nitrile in accordance with AWWA C111.

2.5 Retainer Glands

A. Incorporate restraint for all mechanical joints into the design of the follower gland.
B. Retainer gland design shall impart multiple wedging actions against the pipe, increasing its resistance as pressure increases.
C. Restrained joints to consist of a mechanical joint with retainer gland or manufacturer's proprietary-restrained joint.
D. Dimensions shall conform to the requirements of AWWA C111 and AWWA C153.
E. Pressure rating:
   1. Minimum of 235 psi for PVC pipe.
   2. Minimum of 350 psi for ductile iron pipe for sizes 16-inch and smaller.
   3. Minimum of 250 psi for ductile iron pipe for sizes 18-inch and larger.
F. Color:
   1. Red for PVC pipe.
   2. Black for ductile iron pipe.
G. Materials for construction:
   1. Body, wedge segments, and break-off bolt assemblies: Grade 65-45-12 ductile iron as specified by ASTM A536.
   2. Coating to be electrostatically applied and heat cured.
      a. Approved manufacturers:
         (1) MEGA-BOND by Ebaa Iron, Inc.
         (2) CORRSAFE by Sigma.
         (3) Starbond by Star Products.
         (4) Resicoat R2-ES by Tyler Union.
         (5) Or approved equal.
H. Minimum factor of safety of 2.
I. Ductile iron retainer wedge segments shall be heat treated to a minimum Brinell Hardness Number of 370.
J. Twist-off nuts, the same size as hex-head nuts for T-bolts, shall be incorporated into the design to ensure proper actuating torque is applied during installation.
K. Approved manufacturers for PVC pipe glands:
   1. Megalug by EBAA Iron Inc. Series 2000PV.
   2. One-Lok by Sigma Series SLCE.
   3. Stargrip by Star Products Series 4000.
   4. TUFGrip by Tyler Union Series 2000.
   5. Or approved equal.
L. Approved manufacturers for ductile iron pipe glands:
   1. Megalug by EBAA Iron Inc. Series 1000.
   2. One-Lok by Sigma Series SLDE.
   3. Stargrip by Star Products Series 3000.
   4. TUFGrip by Tyler Union Series 1000.
   5. Or approved equal.

2.6 Valve Boxes

A. Provide cast iron screw-type adjustable valve box with cast iron stay-put cover marked "WATER" for each buried valve.
B. Minimum inside diameter of valve boxes shall be 5-1/8 inches.
C. Tyler No. 6850, or approved equal.
D. Valve boxes shall be installed upon the valve with the use of a rubber Valve Box Adapter II as manufactured by Adaptor Inc., or approved equal.

2.7 Polyethylene Encasement Material

A. Polyethylene encasement shall be manufactured in accordance with AWWA C105.
B. Linear low-density polyethylene film.
C. Minimum thickness shall be 8 mils.
D. Color: Blue.
E. Physical Properties:
    1. Tensile strength 3600 psi, minimum.
    2. Elongation 800%, minimum.
    3. Dielectric strength 800 V/mil, minimum.
    4. Impact resistance 600 g, minimum.
    5. Propagation tear resistance 2550 gf, minimum.
F. Sheet material can be used to wrap irregular-shaped valves and fittings.
G. 2-inch-wide, 10-mil-thick pressure-sensitive polyethylene tape shall be used to close seams and hold overlaps.

2.8 Elastomeric Check Valve

A. Check valve to be all rubber of the flow operated check type with a slip-on connection.
B. Check valve designed to fit over the specified pipe outside diameter and attached by means of vendor furnished stainless steel clamps.
C. The port area shall contour down to a duckbill, which shall allow passage of flow in one direction while preventing reverse flow.
D. Duckbill must be a curved bill pointed in the downstream direction.
E. Maximum backpressure = 10 psi.
F. Approved manufacturers:
    1. Red Valve Tideflex Series TF-2.
    2. Or approved equal.

Part 3 Execution

3.1 Handling, Storage, and Shipping

A. Handle valves and hydrants carefully.
B. Use blocking and hold-downs during shipment to prevent movement or shifting.

3.2 General Installation Requirements

A. Protect valves and hydrants from injury while handling and storing.
B. Use no defective, damaged, or otherwise impaired materials.
C. Prepare excavation as outlined in Section 02220.
D. Install valves and hydrants in accordance with AWWA C600.
E. Clean interior of valve or hydrant prior to placement in the trench.
F. Install valves and hydrants to the line and grade as shown on the plans.
G. Install valves and hydrants plumb.
H. Clean joint surfaces of dirt and foreign matter using a wire brush before jointing.
I. Lubricate gasket and bell. Furnish a vegetable-soap lubricant meeting manufacturer's recommendations. Lubricant shall be approved for use with potable water.
J. Make joints in strict accordance with manufacturer's recommendations.

K. Bolts on mechanical joints or flanged joints shall be tightened evenly around the pipe by alternating from one side of the pipe to the other. Follow manufacturer's installation specifications for electrical isolation flanges to prevent damage during bolt torquing.
L. Backfill and compact around hydrants and valves as outlined in Section 02220.

3.3 Valve Installation

A. Do not support valves off of piping.
B. Ensure that valve box is centered over operating nut.

3.4 Hydrant Installation

A. Anchor auxiliary valve to hydrant tee.
B. Install hydrant with break flange more than 1 inch and less than 7 inches above finished grade.
C. The use of hydrant extensions will not be allowed to set hydrant to the appropriate height unless approved by DMWW and Engineer. Hydrant extensions, if approved, must be from same manufacture as the fire hydrant.
D. Use restrained joints in hydrant branch.
E. Set hydrant on a solid concrete cinder block not smaller than 8-inches by 16-inches by 4-inches.
F. Provide poured concrete thrust blocks behind hydrant and hydrant tee.
G. Ensure hydrant drain is free-flowing and unobstructed in areas where normal groundwater level is below the drain opening.
H. Provide not less than 1 cubic yard of open-graded granular fill around base of hydrant for drainage.

3.5 Installation of Polyethylene Pipe Encasement Material

A. Polyethylene encasement material shall be used on buried valves and the buried portion of hydrants in accordance with AWWA C105.
B. Wrap valves using polyethylene sheet material to prevent contact with bedding. Secure sheet to adjacent pipe and just below valve operation nut using polyethylene tape.
C. Wrap buried portions of hydrants using 24-inch flat-width polyethylene tubing. Secure tubing to hydrant barrel just below grade using polyethylene tape.
D. The polyethylene encasement shall prevent contact with bedding material, but is not intended to be an airtight and watertight enclosure.
E. Damaged polyethylene encasement material shall be repaired using polyethylene tape, or the damaged section shall be replaced.

3.6 Thrust Blocks

A. Provide concrete thrust blocks at hydrants and hydrant tees.
B. Carry thrust blocks to undisturbed soil that will provide adequate bearing.
C. The bearing area of thrust blocks, in square feet, shall be as shown on the plans. Minimum thickness for any thrust block shall be 1.5 times outside pipe diameter or 18 inches, whichever is greater.
D. Hold thrust blocks back 3 inches from bolts, nuts, glands, or other jointing materials. Ensure joints could be remade without disturbing thrust block.
E. Provide bond breaker between thrust block and pipe or hydrant. Polyethylene encasement material will be considered an acceptable bond breaker.

3.7 Removal of Abandoned Fire Hydrants and Valve Boxes

A. Surface restoration items including pavement removal and replacement, seeding, or sodding, needed to remove abandoned fire hydrants or valve boxes shall be paid in accordance with appropriate bid item in contract.
B. All other items related to removal of abandoned fire hydrants and valve boxes including repairs to traffic loops and lawn irrigations systems shall be incidental to contract.
C. Abandoned fire hydrants shall be removed by disconnecting the pipe from the fire hydrant at the shoe.

D. Abandoned fire hydrants shall be returned to Des Moines Water Works at 408 Fleur Drive unless DMWW and Engineer approves their disposal.
E. All excavations for fire hydrant removals shall be backfilled and restored according to Section 02220 of these specifications.
F. Abandoned valve boxes shall have the entire top section of the valve box removed and the lower section and excavation backfilled and restored according to Section 02220 of these specifications.

**** END OF SECTION ****

Section 02674 Pressure Testing Water Mains

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1.2 Related Sections
1.3 References
1.4 Measurement and Payment

Part 2 Products
Not used.

Part 3 Execution
3.1 Pressure Testing

****

Part 1 General

1.1 Summary of Work
A. Pressure test water mains in accordance with this Section.

1.2 Related Sections
A. Section 02610 – Pipe for Water Main and River Pipe.

1.3 References
A. American Water Works Association (AWWA) C600 – Installation of Ductile Iron Water Mains and Their Appurtenances.
B. American Water Works Association (AWWA) C605 – Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.

1.4 Measurement and Payment
A. Work under this Section is incidental to the unit price bids for water main construction.

Part 2 Products
Not used.

Part 3 Execution

3.1 Pressure Testing
A. Perform Work in accordance with AWWA C600 and AWWA C605.
B. Test piping at 200 psi or as indicated on the plans for 2 hours.
C. Fill and flush new piping with potable water, ensuring that all trapped air is removed.
D. Isolate new piping from the existing system.
E. Pressure test new piping in sections by isolating each section using the in-line gate valves. Relieve pressure on non-test side of the gate valve.
F. Pressurize the new piping to the test pressure at the lowest point in the isolated system. Do not pressurize to more than 5 psi over the test pressure at the lowest point in the isolated system.
G. Monitor pressure in the line being tested for a period of not less than 2 hours.

H. If at any point during that 2-hour period the pressure drops to 5 psi below the test pressure, re-pressurize by pumping water into the line in sufficient quantity to bring the pressure back to between the test pressure and 5 psi above the test pressure. Accurately measure the amount of water required to re-pressurize the main.
I. At the end of the 2-hour period, if pressure in the line has dropped below the test pressure, re-pressurize to the test pressure. Accurately measure the amount of water required to re-pressurize the main.
J. Allowable leakage, in gallons, per hour of testing shall equal $(LD(P)^{½}) / 148,000$.
    L = length of pipe section being tested in feet
    D = nominal diameter of pipe in inches
    P = average test pressure in psig
K. Leakage equals the total amount of water required to keep the line pressurized during the 2-hour test period and re-pressurize the line at the end of the test period.
L. If the average leakage per hour is less than the allowable leakage, the pressure test is acceptable.
M. If the average leakage per hour is more than the allowable leakage, the pressure test is not acceptable. Locate and make approved repairs as necessary until leakage is within the specific allowance.
N. If pressure in the isolated line never drops to the test pressure, having started no more than 5 psi above the test pressure, the pressure test is acceptable.
O. If pressure in the isolated line never drops to the test pressure, having started no more than 5 psi above the test pressure, the pressure test is acceptable.
P. Repair visible leaks regardless of the amount of leakage.

**** END OF SECTION ****

Section 02675 Disinfection of Water Distribution Systems

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Part 3 Execution
3.1 Examination
3.2 Chlorination of Piping
3.3 Flushing Chlorinated Piping
3.4 Bacteriological Testing

****

Part 1 General

1.1 Summary of Work
A. Disinfect water mains and 2-inch and larger water services in accordance with this Section.

1.2 Related Sections
A. Section 02220 – Excavating, Backfilling, and Compacting for Water Main and River Pipe.
B. Section 02610 – Pipe for Water Main and River Pipe.

1.3 References
A. American Water Works Association (AWWA) B300 –Hypochlorites.
B. American Water Works Association (AWWA) B301 –Liquid Chlorine.
C. American Water Works Association (AWWA) C651 –Disinfecting Water Mains.

1.4 Measurement and Payment
A. Work under this Section is incidental to the unit price bids for water main construction.

Part 2 Products

2.1 Chlorine
A. Calcium hypochlorite granules conforming to AWWA B300.
B. Liquid chlorine conforming to AWWA B301.

2.2 De-chlorination Chemicals
A. Vita-D-Chlor (Ascorbic Acid) by Integra Chemical Company.
B. Vita-D-Chlor, Neutral (Sodium Ascorbate) by Integra Chemical Company.
C. No-Chlor (Ascorbic Acid) by Measurement Technologies.
D. Approved equal.

Part 3 Execution

3.1 Examination

A. Water for disinfection will be provided by DMWW for two disinfection attempts. If additional attempts are necessary, the Contractor will be billed for water used at the normal rate set for industrial customers.
B. Disinfection of piping shall take place only after satisfactory pressure testing.
C. Ensure piping to be disinfected is isolated from portion of the distribution system that is in service.
D. Review procedures and coordinate disinfection with DMWW.
E. Perform Work in accordance with AWWA C651.
F. Bacteriological samples shall be taken and tested by the DMWW to ensure satisfactory disinfection.

3.2 Chlorination of Piping

A. Provide equipment and materials necessary to complete chlorination.
B. Use the continuous feed method as outlined in AWWA C651.
C. Prior to feeding chlorine, fill and flush new piping to remove trapped air and particulates. Provide equipment and materials necessary to obtain a minimum flushing velocity of 2.5 fps in piping to be disinfected. When flushing velocities of 2.5 fps cannot be obtained, the pipe shall be swabbed until the pipe is free of debris. Type of swab and procedures for use shall be approved by DMWW prior to its use.
D. Induce flow of potable water through the new piping at required flushing velocity. Make provisions for diverting and disposing of flushing water in manner that does not damage surroundings. Repair any damage caused by flushing activities.
E. At a point within five pipe diameters of the connection to the existing distribution system, introduce highly chlorinated water in sufficient quantity to provide at least 25 mg/L free chlorine in the new piping. Provide all metering and feed equipment and temporary chlorination taps. Remove the temporary chlorination taps and cap the main once the main passes.
F. Introduce highly chlorinated water continuously until the entire section of new piping contains a minimum of 25 mg/L free chlorine. Do not exceed 100 mg/L free chlorine.
G. Isolate the newly chlorinated piping for a contact period of at least 24 hours, and not more than 48 hours, taking care not to backflow chlorinated water into the existing potable water system.
H. After the contact period, water in the new piping must have a residual-free chlorine content of not less than 10 mg/L. If the residual is less than 10 mg/L, rechlorinate as outlined above.

3.3 Flushing Chlorinated Piping

A. After the contact period, flush the recently chlorinated piping with potable water.
B. Continue flushing until the chlorine residual in the new piping is equal to the chlorine residual in the existing distribution system.
C. Isolate the new piping from the existing distribution system for a period of not less than 24 hours.
D. Chlorinated water, which is flushed from the new piping, shall be dechlorinated and disposed of so not to cause damage to the environment. Conform to state and federal requirements.
E. De-chlorinate all water from flushing activities and testing before it is released into the ground, stream, or storm sewers. Method to be approved by the DMWW prior to any flushing activities.

3.4 Bacteriological Testing

A. Immediately following flushing of pipelines and again at least 24 hours after flushing pipelines, samples will be taken and tested by DMWW.
B. The DMWW reserves the right to take and test additional samples 48 hours after flushing.
C. Approximately one sample will be taken for each 1,200 feet of new water main.
D. Additional samples may be taken at the discretion of the DMWW.
E. Samples must show the absence of coliform organisms and other contaminants and meet requirements of the Iowa Department of Natural Resources to be considered acceptable.
F. If any sample is not satisfactory with either sampling, the piping represented by that sample must be flushed and rechlorinated by the Contractor at the discretion of, and as directed by, the DMWW.

**** END OF SECTION ****

Section 13110 Cathodic Protection

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3.7 Installation of Wire, Cable, and Splices
3.8 Installation of Exothermic Welds and Connection Devices
3.9 Post-Installation Testing of Cathodic Protection Systems

****

Part 1 - General

1.1 Summary of Work

A. Cathodic protection for 36-inch, 30-inch, and 6-inch diameter ductile iron pipe with field-applied polyethylene encasement using sacrificial anode system.

1.2 Related Sections

A. Section 02220 – Excavating, Backfilling, and Compacting for Water Main and River Pipe.
B. Section 02610 – Pipe for Water Main and River Pipe.

1.3 References

A. American Society for Testing and Materials (ASTM) – Applicable testing methods and materials.
B. National Association of Corrosion Engineers (NACE) International Standard Practice SP0169 (latest edition) – Control of External Corrosion on Underground or Submerged Metallic Piping Systems.
C. National Electrical Code (NEC), latest edition.
D. National Electrical Manufacturers Association (NEMA) – Standards and Specifications.
E. Underwriters Laboratories, Inc. (UL) – Standards for safety.

1.4 Submittals

A. Product Data
   1. Submit manufacturer's specifications, recommendations, and installation instructions for each of the following product categories and all applicable product subheadings specified in this Section:
      a. Electrical Continuity Bond Cables – Ductile Iron Pipe
      b. Corrosion Monitoring Test Stations, Buried Reference Electrodes and Calibrated Shunts
      c. Electrical Isolation Devices and Petrolatum Tape Overwrap
      d. Galvanic Anodes
      e. Wire, Cable, and Splices
      f. Exothermic Welds and Connection Devices
   2. Manufacturer's product submittals shall be incorporated into a single document to demonstrate that the items have been properly coordinated and will function properly as a unit.
   3. A notation shall be made on each shop drawing submitted as to the item's specific use either by a particular type number referenced in the contract documents, or by a description of the item's specific location.

1.5 Measurement and Payment

A. Include cost for all materials, equipment and labor necessary to install the cathodic protection described in this Section in the lump sum price bid for "Cathodic Protection" on the Proposal.
B. Includes excavation, continuity bonding, test stations, isolation devices, reference electrodes, anodes, wiring and cables, coordination with DMWW, testing, and associated work. Payment will be at the lump sum price.
C. Payment will be at the lump sum price.

Part 2 - Products

2.1 Approved Material Suppliers

A. Subject to meeting the requirements of this specification, cathodic protection materials are available from the following manufacturers-suppliers:
   1. Mesa Products, Inc., (918-627-3188).
   2. Brance-Krachy, Inc., 4411 Navigation Blvd., Houston, TX 77011 (713-225-0349).
   3. Champion Corrosion Products, (830-303-8505).

2.2 Warranty on Contractor-Provided Materials

A. All Contractor-provided materials shall be guaranteed for a period of two years.
B. The two-year period shall commence at the time of the final installation of all components by the Contractor and after the system has been tested and properly adjusted for operation by the DMWW's Corrosion Engineer.

2.3 Electrical Continuity Bond Cables – Ferrous Pipe

A. High molecular weight polyethylene insulated stranded copper cable shall be used for continuity bond cables installed across all non-welded ferrous pipe joints.
B. Insulation shall conform to ASTM D1248 – Specification for Plastic Molding and Extrusion Materials, Type 1, Class C, Grade 5 and be configured as follows:
   1. No. of Strands: seven
   2. Outer Jacket Thickness: 0.110 inches
   3. Length: 18 inches (min.)
C. The quantity and size of continuity bond cables required for each pipe joint shall be as shown on the CP Installation Detail Drawings included hereinafter in this Section.

2.4 Corrosion Monitoring Test Stations

A. Non-Metallic Post-Type Test Stations
   1. Monitoring stations shall be a non-metallic post-type station mounted on a non-metallic conduit post. Test station shall be furnished with a covered terminal board equipped with terminal posts to permit ready access and testing and shall be constructed as follows:
      a. Terminal Board: Polycarbonate plastic (clear).
      b. Binding/Terminal Posts: Nickel-plated marine brass (six minimum).
      c. Conduit Post: UV stabilized polyethylene (white).
   2. Subject to meeting the requirements of this specification, acceptable manufacturer's products which may be incorporated into the work include the following or an approved equal:
      a. Tinker & Rasor Company (909-890-0700), Model T-3.

B. Flush-Mounted Test Station Enclosures
   1. Test station shall be contained in a heavy-duty, polymer concrete, flush-to-grade utility enclosure able to withstand incidental traffic and constructed as follows:
      a. The open bottom body shall be constructed of polymer concrete having a minimum compressive strength of 87 MPa.
      b. The cover shall be constructed of polymer concrete having a non-skid surface and shall cover the body of the enclosure. Cover shall be capable of withstanding a minimum of 20,000 pounds without failure in accordance with the requirements ANSI/SCTE 77/T15 applications.
      c. Cover shall have a minimum of two hex-capped stainless steel hold-down bolts placed at opposite corners and shall be labeled "CP TEST" in minimum 1-inch high letters.
   2. Subject to meeting the requirements of this specification, acceptable manufacturer's products which may be incorporated into the work include the following or an approved equal:
      b. Duravault LLC. (909-267-9657) Model PC132412STB.
      c. New Basis, Inc. (951-787-0600) Model PCA132412S.

C. Prepackaged Cu-$CuSO_4$ Reference Electrodes
   1. Description: Cu-$CuSO_4$ electrodes shall be used for soil environments to provide a stable electrical benchmark from which to measure the cathodic protection system's effectiveness. Electrodes shall be constructed as follows:
      a. Element: Copper rod encapsulated in a proprietary backfill electrolyte containing high purity copper sulfate crystals and a chloride ion trap to prevent contamination of the electrolyte.
      b. Service life of the reference electrode shall be no less than 20 years.
      c. Lead Wire: No. 14 RHH-RHW (yellow) stranded copper wire. Lead wire shall be sufficiently long to reach its termination point without splicing.
   2. Subject to meeting the requirements of this specification, acceptable manufacturer's products which may be incorporated into the work include the following or an approved equal:
      a. Borin Manufacturing, Inc. (310-822-1000) Model SRE-007-CUY.
      b. GMC Electrical, Inc. (909-947-6016) Model CU-1-UGPC.

D. Calibrated Shunts
   1. Description: Color-coded calibrated shunts shall be used to connect the cathodic protection system's anode header cable and structure return connection circuits.
   2. Subject to meeting the requirements of this specification, acceptable manufacturer's products which may be incorporated into the work include the following or an approved equal:
      a. Tinker & Rasor Company (909-890-0700), Yellow 0.01 ohm shunt plate rated at 8 amps.

2.5 Electrical Isolation Devices and Petrolatum Tape Overwrap

A. Flange Isolation Kit (FIK) Assemblies
   1. Isolation flange gaskets shall be constructed as follows:
      a. Flange ≤ 10 inches: Full-faced polytetrafluoroethylene with aluminosilicate microspheres (Garlock Blue Gylon® 3505, or approved equal).
      b. Flange > 10 inches: Full-faced synthetic fiber with proprietary rubber binder (AquaSwell™, or approved equal).
   2. Isolation bolt sleeves shall be constructed as follows:
      a. Flange ≤ 24 inches: Full-length 1/32-inch thick spiral-wound Mylar.
      b. Flange > 24 inches: Full-length 1/32-inch thick G-10 Epoxy Glass.
   3. Isolation Washers: Double 1/8-inch thick G-10 Epoxy Glass.
   4. Backup Washers: Double 1/8-inch thick Type 304 stainless steel.
   5. FIK materials shall be certified by an independent certification agency to meet the requirements of the NSF-61 Standard.
   6. Subject to meeting the requirements of this specification, acceptable manufacturer's products which may be incorporated into the work include the following or an approved equal:
      a. Garlock Pipeline Technologies, Inc. (303-988-1242).
      b. Central Plastics Company. (405-273-6302).
      c. Maloney Technical Products, Inc. (817-923-3344).

B. Prefabricated Flange Isolator (PFI)
   1. Prefabricated flange isolators suitable for direct burial shall be constructed of two matching ANSI/AWWA flange faces each with 3-foot lengths of ductile iron pipe having either plain or mechanical joint ends, and a factory-installed isolating gasket kit complete with flange bolts, nuts, and isolating bolt sleeves and washers. Manufacturer shall have a demonstrated experience with not less than five similar installations on potable water transmission mains of similar size and pressure.
   2. The factory-installed isolating flange kit shall be meet the requirements of the NSF-61 Standard shall be constructed as follows:
      a. Gasket: Full faced G-10 Epoxy Glass w/double EPDM O-Ring.
      b. Bolt Sleeves: Full-length 1/32-inch thick G-10 Epoxy Glass.
      c. Isolation Washers: Double 1/8-inch thick G-10 Epoxy Glass.
      d. Backup Washers: Double 1/8-inch thick zinc-plated carbon steel.
   3. Prefabricated flange isolators shall be coated on the inside with NSF/ANSI 61 approved TNEMEC Series 141 Pota-Pox-Plus Gray Epoxy (or equal) applied to a total dry film thickness of 7 to 12 mils. The inside and outside coating shall be held back 10 inches from each the end of the pipe.
   4. The flange cavity shall be filled with wax or other suitable corrosion preventative material to prevent backfill intrusion that could damage the isolation gasket. The entire flange including the bolts and nuts shall be encapsulated with wax tape to provide further protection against corrosion. After the wax tape has been applied, the exterior of all the wax tape shall be coated with a protective 80 mil tape to provide additional strength and protection during handling and backfill operations.
   5. The prefabricated flange isolator shall be hydrostatically tested to 1.5 times the rated operating pressure of 150 psi and withstand an electrical resistance of greater than 20 mega ohms at 500 DC volts. Test results shall be provided with delivery of each prefabricated flange isolator.
   6. Subject to meeting the requirements of this specification, acceptable manufacturer's products which may be incorporated into the work include the following or an approved equal:
      a. Garlock Pipeline Technologies, Inc. (303-988-1242) Model Electro-Flange™.

C. Petrolatum Tape-Wrap Encapsulation of Buried Isolation Devices
   1. Exposed metallic surfaces of buried isolation devices shall be encapsulated in a three-part cold-applied petrolatum tape coating consisting of a primer, profiling mastic, and a low-temperature petrolatum tape.
      a. Primer:
         (1) Solids Content: 100%
         (2) Specific Gravity: 1.08
         (3) Specific Volume: 26 cubic inches/pound
         (4) Flash Point: > 356 ºF
         (5) Coverage: 10-22 square feet/pound
      b. Profiling Mastic:
         (1) Solids Content: 100%
         (2) Specific Gravity: 0.605
         (3) Specific Volume: 46 cubic inches/pound
         (4) Flash Point: 356 ºF
         (5) Coverage: Varies by application
      c. Low-Temperature Petrolatum Tape:
         (1) Thickness: 46 mils
         (2) Maximum Service Temperature: 122 ºF
         (3) Roll Width: 2 inches to 12 inches
         (4) Roll Length: 33 feet
         (5) Coverage with 55% Overlap: 87 square feet of tape per 100 square feet of pipe
   2. Subject to meeting the requirements of this specification, acceptable manufacturer's products which may be incorporated into the work include the following or an approved equal:
      a. Denso NA, Inc. (281-821-3355) Denso Paste S105/Profiling Mastic/LT Tape.
      b. Central Plastics, Inc. (800-654-3872) Model STAC Coating System.
      c. The Tapecoat Company (800-758–6041), Model Envirocoat System.

2.6 Galvanic Anodes

A. Magnesium Anodes
   1. Description: Magnesium anodes shall be capable of delivering a minimum efficiency of 500 amp-hours per pound of magnesium and shall have the following metallurgical analysis:
   2. Metallurgy:
      a. Aluminum: 0.01% (max.)
      b. Manganese: 0.50% - 1.3%
      c. Copper: 0.02% (max.)
      d. Nickel: 0.001% (max.)
      e. Iron: 0.03% (max.)
      f. Other (each): 0.05% (max.)
      g. Other (total): 0.30% (max.)
      h. Magnesium: Balance
   3. Packaged Magnesium Anode Backfill
      a. Magnesium anodes shall be packaged within a cotton sack in a special chemical backfill having the following proportions:
      b. Ground Hydrated Gypsum:75%
      c. Powdered Bentonite: 20%
      d. Anhydrous Sodium Sulfate: 5%
      e. Backfill shall have a grain size such that 100% is capable of passing a 20-mesh screen and a 100-mesh screen shall retain 50 %.
      f. Backfill shall completely surround the anode ingot without voids.

4. Anode Lead Wire
   a. The standard lead wire for a magnesium anode shall be at least 10 foot length of No. 12 AWG solid copper wire with Type TW (red) thermoplastic insulation
   b. Lead Wire Connection to Anode Core
      (6) Magnesium anodes shall be cast with a minimum 20 gauge galvanized steel core.
      (7) One end of the anode shall be recessed to expose the core for silver-soldering the lead wire.
      (8) The silver-soldered lead wire connection and anode recess shall be filled with an electrical potting compound before packaging.
5. Magnesium Anode Physical Parameters

Anode Weight (#)		**Nominal Package Dimensions**	
Bare Anode	**Pkg'd Anode**	**Length (in.)**	**Dia. (in.)**
48	98	38	8.0

2.7 Wire, Cable, and Splices

A. Anode Header Cable and Structure Return Connection (Direct Burial)
   1. High molecular weight polyethylene insulated stranded copper cable shall be used for all underground portions of the cathodic protection system's anode header cable and structure return connection circuits. Insulation shall conform to ASTM D1248 – Specification for Plastic Molding and Extrusion Materials, Type 1, Class C, Grade 5.
   2. The DC cables shall be sized as follows:
      a. No. of Strands: seven
      b. Outer Jacket: 0.110-inch thickness
      c. Anode Header Cable: No. 8 AWG (red)
      d. Structure Return Connection: No. 8 AWG (blue)

B. Test Wires for Cathodic Protection System Monitoring
   1. Oil and gas resistant insulated/jacketed stranded copper wire shall be used for structure connections as part of the system's monitoring circuits. Insulation shall conform to ASTM Standard UL-83 for Thermoplastic Insulated Wires.
   2. The test wires shall be sized as follows:
      a. No. of Strands: 19
      b. Primary Insulation: 0.015-inch thick thermoplastic
      c. Outer Jacket: 0.004-inch thick nylon (structure color code as shown on drawings)

C. Compression Crimp Splice Connectors
   1. All underground spliced connections used within the DC cathodic protection circuit shall be made through the use of copper compression crimp connectors.
      a. The proper size connectors shall be used in accordance with the manufacturer's recommendations.
      b. Connectors shall be crimped with a hand tool capable of delivering a minimum of 12 tons of compressive force.

D. Splice Encapsulation
   1. All underground spliced connections used within the DC cathodic protection circuit shall be sealed with rubber and plastic tape contained within a waterproof coating.
   2. Subject to meeting the requirements of this specification, acceptable manufacturer's products which may be incorporated into the work include the following or an approved equal:
      a. 3M Electrical Products (1-888-364-3577) - Scotch Brand 23 Rubber Splicing Tape.
      b. 3M Electrical Products (1-888-364-3577) - Scotch Brand 33+ Vinyl Electrical Tape.
      c. 3M Electrical Products (1-888-364-3577) - Scotchkote Electrical Coating.

2.8 Exothermic Welds and Connection Devices

A. All connections used within the DC cathodic protection system circuit shall be by exothermic welds.
   1. The proper size welders, metal charges, and wire sleeves shall be used in accordance with the manufacturer's recommendations. Do not mix different manufacturers' products.
      a. When connecting to horizontal ductile iron or cast iron structures, use a maximum of 32-gram weld metal charge and furnaces designated specifically for cast iron.
      b. When connecting to horizontal carbon steel structures, use a maximum of 25-gram weld metal charge and furnaces designated specifically for carbon steel.
   2. Subject to meeting the requirements of this specification, acceptable manufacturer's products which may be incorporated into the work include the following or an approved equal:
      a. Continental Industries (918-627-5210), Model Therm-O-Weld.
      b. ERICO International Corporation (440-248-0100), Model Cadweld

B. Coating of Wire and Cable Connections to Structures
   1. A pre-fabricated plastic sheet with an igloo-shaped dome and entry tunnel filled with an oil- and gas-resistant elastomeric rubber and a primer-less elastomeric tape for bonding directly to the structure.
   2. Subject to meeting the requirements of this specification, acceptable manufacturer's products which may be incorporated into the work include the following or an approved equal:
      a. Continental Industries (918-627-5210), Model Therm-O-Cap PC.
      b. The Tapecoat Company (800-758–6041), Model Royston Handy Cap IP.

Part 3 - Execution

3.1 General

A. Examine the areas and conditions under which cathodic protection materials are to be installed, and notify DMWW in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

B. Install all cathodic protection components and equipment according to the following CP Installation Detail Drawings shown in the construction drawings.
   1. Drawing No. CP-01: Continuity Bonding of Ductile Iron Push-On or Mechanical-Joint Pipe
   2. Drawing No. CP-02: Exothermic Weld Procedure for Ductile Iron Pipe (Horizontal Only)
   3. Drawing No. CP-03.A: Rubber & Tape Wye Splice on Sacrificial Anode Cable Connections
   4. Drawing No. CP-03.B: Rubber & Tape Butt Splice on Sacrificial Anode Cable Connections
   5. Drawing No. CP-04.A: Potential Test Station (PTS)
   6. Drawing No. CP-04.B: PTS Terminal Board Installation Details
   7. Drawing No. CP-05.A: Casing Test Station (CTS)
   8. Drawing No. CP-05.B: CTS Terminal Board Installation Details
   9. Drawing No. CP-06.A: Isolation Test Station (ITS)
   10. Drawing No. CP-06.B: ITS Terminal Board Installation Details
   11. Drawing No. CP-07.Ao: Foreign Crossing (Over) Test Station (FTS)
   12. Drawing No. CP-07.Au: Foreign Crossing (Under) Test Station (FTS)
   13. Drawing No. CP-07.B: FTS Terminal Board Installation Details
   14. Drawing No. CP-08.A: Anode Test Station (ATS)
   15. Drawing No. CP-08.B: ATS Terminal Board Installation Details
   16. Drawing No. CP-09.f: Flush-Mounted Enclosure for Test Station Terminal Board & Wires
   17. Drawing No. CP-09.p: Post-Type Enclosure for Test Station Terminal Board & Wires
   18. Drawing No. CP-10: Flange Isolation Kit (FIK)
   19. Drawing No. CP-11: Not Used
   20. Drawing No. CP-12: Not Used
   21. Drawing No. CP-13: Pre-Fabricated Flange Isolator (PFI)
   22. Drawing No. CP-14: Not Used

3.2 Field Quality Control

A. Contractor's Quality Control System
   1. The Contractor shall implement a quality control system to ensure the cathodic protection system components conform to the applicable plans and specifications established by the Contract Documents.
   2. The quality control system shall ensure that standards for materials, workmanship, construction, and functional performance are adhered to throughout the course of the Work.
   3. The Contractor's superintendent shall be used to monitor the Contractor's quality control system.
   4. Contractor may, at his own expense, furnish the services of a NACE-certified corrosion engineer to monitor compliance with these Specifications.

3.3 Installation of Electrical Continuity Bond Cables – Ferrous Pipe

A. General
   1. Inspect each cable to ensure a continuous electrical conductor with no cuts or tears in the cable insulation.
   2. Attach cable to water main by the exothermic welding process.
   3. Cover all exothermic welds with a pre-fabricated igloo-shaped domed plastic elastomeric rubber cover as described in this specification.

B. Method:
   1. Perform exothermic welding of bond cables in accordance with the manufacturer's instructions.
   2. Do not use any exothermic weld equipment that is damp or wet.

C. Post-Installation Visual Inspection: Inspect all electrical continuity bond cable connections by visually examining each exothermic weld connection for strength and suitable coating prior to backfilling.

D. Post-Installation Continuity Testing: Contractor shall use one (or more) of the following procedures to verify all bonded pipe joints are electrically continuous prior to backfilling. All data shall be documented for the job record and submitted each day to the DMWW and also summarized and submitted to the DMWW at the completion of the project.
   1. Static: Measure the electrical potential at each side of selected bonded connections with a copper/copper-sulfate reference electrode (CSE). Leave the CSE in a stable location. Potentials must be identical on both sides of the subject bonded joint.
   2. Resistance: Measure the resistance through the selected bonded joint with a suitable volt-ohm measurement device. Resistances of 0.001 ohms or less are acceptable.
   3. Current-Applied: Position a CSE at a stable location adjacent to the bonded structure. Impress a temporary 12 VDC current on the structure. Record current-applied pipe-to-soil potential readings along the structure relative to the stable CSE. Current-applied potential measurements referenced to the stable CSE must be nearly identical (less than ±5 mV) along the structure to indicate electrical continuity. Voltage drops through the structure shall be considered in determining electrical continuity by this method.

E. Acceptance Criterion: If, in the opinion of the DMWW, any exothermic weld is deficient, the Contractor shall remove and replace the deficient welded connection at no expense to the Des Moines Water Works.

F. Backfilling of Bond Cables:
   1. Perform backfilling that will prevent damage to the bond cables and connections to the water main.
   2. If construction activity damages a bond cable, the Contractor shall remove and replace the bond cable at no expense to the Des Moines Water Works.

3.4 Installation of Corrosion Monitoring Test Stations

A. General: Install the required number of test stations at the locations noted or shown on the Drawings or as directed by the DMWW.
B. Reference Electrode
   1. Keep permanent reference electrodes dry and protect from freezing before installation.
   2. Remove plastic or paper shipping bags from around the reference electrode prior to installation.
   3. Place reference electrode in native soil within 12 to 36 inches of the water main.
C. Test Wires
   1. Provide test station lead wires that are continuous with no cuts or tears in the insulation covering the conductor.
   2. Attach test leads to the water main by the exothermic welding process.
   3. Connect all test station wires to one side of the terminal board using the test station manufacturer's standard binding posts at the locations shown on the Plans.
   4. Install wire shunt plate and shorting bars to the opposite side of terminal board from the incoming wires.
   5. Install shunt plate last to permit easy removal from terminal board without having to disassemble other test station wire and cable connections.
D. Test Station Terminal Board and Flush-Mounted Enclosure
   1. Install test station terminal board within color-coded cap and mount vertically to white PE pipe.
   2. Set the PE pipe within enclosure and support with a minimum 6-inch gravel base to support and drain the inside of the enclosure.
   3. Extend bottom of PE pipe to a minimum of 24-inches below bottom of enclosure and install top of test station head with a minimum separation of 2-inch from bottom of enclosure cover
   4. Thoroughly backfill and compact the area immediately surrounding the enclosure to prevent settling.
   5. Set the top of the enclosure flush to no more than one quarter-inch lower than the final pavement to prevent the enclosure from being struck by snowplow blades.
E. Post-Installation Backfilling
   1. Protect test leads during the backfilling operation to avoid damage to the wire insulation and integrity of the conductor.
   2. Protect permanent reference electrode during backfilling to avoid damage to the electrode and its lead wire.
   3. If, in the opinion of the DMWW, the installation of the test station wires or the reference electrode is deficient, the Contractor shall remove and replace these components at no expense to the Des Moines Water Works.
F. Provisions for Future Locating of Flush Test Stations Enclosures
   1. Drive a vertical 12-inch long No.5 steel rebar flush into the ground and immediately alongside the enclosure to facilitate locating with a magnetic sensing device.
   2. Provide sub-meter GPS coordinates for all test stations on as-built drawings.

3.5 Installation of Electrical Isolation Devices and Petrolatum Tape Overwrap

A. General: Install the required number of electrical isolation devices at the locations noted or shown on the Drawings or as directed by the DMWW.
B. Flange Isolation Kit (FIK) Procedure:
   1. Inspect the gasket kit and verify that the material is as specified and that the material is not damaged.
   2. Clean the bolting materials. Apply lubricant or anti-seizing compound to all threads required for alignment with nuts and nut facings.
   3. Align flange faces so that they are parallel and concentric with each other and within 0.010 inch without external loading or springing.
   4. Line up bolt holes by driving two tapered drift pins in opposite directions to each other into two diametrically opposite bolt holes.

5. Insert insulating sleeves into bolt holes. Sleeves must slide in easily; if not, flanges must be realigned. Do not force sleeves into bolt holes.
6. Assemble studs/bolts as follows:
    a. Run one nut on each stud so that two full threads are showing beyond the nut.
    b. Slide steel backup washer onto stud and insert into bolt hole. If flange requires two-sided insulation, add an insulating washer after the steel washer.
    c. From the opposite end of the stud, place an insulating washer, steel backup washer, and a nut; tighten by hand.
7. Torque the first two studs at diametrically opposite locations to a maximum of 30% of the final torque value in a star pattern.
8. Repeat star-torquing pattern at each bolt by increasing torque to 50-60% of final value.
9. Continue torquing all studs in a star pattern using the specified torque setting (100%) until there is no further rotation of the nuts.

C. Pre-fabricated Flange Isolators (PFI): Follow manufacturer's written instructions for the specific device to be installed.
D. Acceptance:
1. Immediately after any electrical isolation device has been installed in accordance with the manufacturer's specifications, an electrical isolation test shall be conducted by the Contractor using a radio frequency isolating test meter or other approved method applicable to the isolation device.
2. If, in the opinion of the DMWW, the installation of the electrical isolation device is deficient, the Contractor shall remove and replace these components at the Contractor's expense.

E. Sealing Buried Isolation Devices:
1. After any buried isolation device has been tested and found to be 100% effective, all exposed metallic surfaces shall be encapsulated in a three-part non-toxic, petrolatum tape wrap before burial.

3.6 Installation of Galvanic Anodes

A. General: Install the required number of anodes at the locations noted or shown on the Drawings or as directed by the DMWW.
B. Method
1. Remove plastic or paper shipping bags from around prepackaged anodes prior to installation.
2. Install in the manner and at the dimensions from the water main as shown on the CP Installation Details. Field modifications shall be made only with the approval of the DMWW.
3. Handle galvanic anodes in such a manner to avoid damaging anode materials and wire connections.
4. Attach anode lead wire to insulated header cable or route lead wire directly to pipe or test station as required.
5. Field splices of a factory-fabricated anode lead wire are permitted only when performed in accordance with these Specifications.
6. Install prepackaged anodes with compacted backfill material, such that no voids exist between the anode material and the backfill.
7. In soils that do not exhibit any signs of moisture content or granular soils that have no cohesive strength, pour 5 gallons of water over the anode after backfilling and tamping have been completed to a point about 6 inches above the anode. After the water has been absorbed by the earth, backfilling shall be completed to the ground surface level.

3.7 Installation of Wire, Cable, and Splices

A. Install underground wires, cables, and connections at a minimum 36 inches below final grade with a minimum separation of 6 inches from other underground structures.
B. Crimp Connectors:
   1. All spliced connections will be made by the use of copper compression crimp connectors.
   2. Contractor must furnish a hand tool capable of generating a minimum of 12 tons of compressive force to install crimp connectors. Use only tools compatible with Burndy copper compression taps.
C. Seal splices against water penetration as follows:
   1. Clean and then wrap with a minimum of two half-lapped layers of rubber electrical tape.
   2. Apply two half-lapped layers of plastic electrical tape.
   3. Cover with a fast-drying electrical sealant.

3.8 Installation of Exothermic Welds and Connection Devices

A. All exothermic welding shall be performed in accordance with the manufacturer's recommendations for welding equipment, weld metal charge size, and applicability to the structure. Do not use exothermic weld equipment if the graphite mold is wet.
B. Structure Surface Preparation
   1. All bare metal shall be free of dust, dirt, grease, oil and other foreign matter.
   2. Practical removal shall be by either power or hand wire brushing.
   3. Grinding or filing shall remove any sharp edges or burrs.
C. Installation of Elastomeric Cover over Exothermic Welds
   1. Clean the pipe surface which is to be covered by removing all moisture, dirt, grease and other contaminants.
   2. The weld areas shall be no more than warm to the touch before applying the elastomeric cover.
   3. Remove the release paper from the back of the mastic pad. Avoid touching the exposed elastomeric tape.
   4. Apply the mastic pad to the structure by firmly pressing on all edges making sure that the tunnel area of the plastic dome completely covers the lead wire entering the exposed copper of the connection.
   5. Push the dome of the plastic weld cap firmly over the exothermic weld area and the wire entering the weld cap.

3.9 Post-Installation Testing of Cathodic Protection Systems

A. General: Des Moines Water Works will provide services of a NACE-certified Cathodic Protection Specialist for periodic field inspections and final commissioning services of cathodic protection systems installed for all pipe materials in accordance with the following NACE International reference standard and test method:
   1. NACE International Standard Practice SP0169 (latest edition).
   2. NACE International Standard Test Method TM0497 (latest edition).
B. Energizing: Assist Des Moines Water Works and Des Moines Water Work's Cathodic Protection Specialist during initial energizing of the cathodic protection systems.

**** END OF SECTION ****