

Section 02511

WATER LINES

PART 1 GENERAL

1.01 SUMMARY

This Section includes specifications that identify requirements for both small diameter water lines (20 inches and smaller) and large diameter water lines (24 inches and larger). When specifications for large diameter water lines differ from those for small diameter water lines, large diameter specifications will govern for large diameter pipe.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices

1. Payment for water lines installed by open-cut including pipe offset sections or within limits of Potentially Petroleum Contaminated Area (PCCA) is on linear foot basis for each size of pipe installed. Separate pay items are used for each type of installation.
 - a. Mains: Measure along axis of pipe and include fittings and valves.
 - b. Branch Pipe: Measure from axis of water line to end of branch.
2. Payment for “Furnish and Install by Trenchless Construction” is on linear foot basis for each size of carrier pipe installed and includes all costs for the installation of water line by dry auger, slurry auger, directional drill or tunnel method. No extra payment will be made for the cost of a primary liner if necessary to facilitate the Contractor’s trenchless method. Unless specified on the Plans, the choice of trenchless method is at the Contractor’s discretion.
3. Payment for “Furnish and Install by Trenchless Construction with Primary Liner” is on linear foot basis for each size of carrier pipe and includes all cost for the installation of water line inside primary liner by dry auger, slurry auger, or tunnel method. Unless specified on the Plans or prohibited elsewhere in the specifications, the choice of primary liner system and trenchless method is at the Contractor’s discretion. Partial payments will be made as measured according to the schedule provided in Section 02517 – “Water Line in Tunnel”.
4. Payment for interconnection is on lump sum basis for each interconnection identified on Plans. Payment will include tapping sleeve and valves piping, connections and other related Work necessary for construction as shown on Plans or specified herein.
5. Payment for removal of existing internal elliptical or dished head plug is on unit price basis for each internal elliptical or dished head plug removed. Payment will include deletion of plug, drainage or dewatering of water lines, repair of damaged linings, rechlorination and items incidental to operation.
6. Payment for plug and clamp is on a unit price basis for each size of pipe.

7. Payment for drainline connection with service manhole is on unit price basis for each drainline shown on Plans. Payment includes valve, access manhole, and connection.
 8. Payment for access manway with service manhole is on unit price basis for each access manway shown on Plans. Payment includes valve and access manhole.
 9. When directed by Project Manager to install extra fittings as required to avoid unforeseen obstacles, payment will be based on the following:
 - a. Each extra fitting requested by Project Manager and delivered to jobsite will be paid according to unit price for “Extra Fittings in Place.”
 - b. Payment will include and be full compensation for items necessary for installation and operation of water line.
 10. Payment for pipe, pipe support structures, including pipe guards will be paid on a linear foot basis for each aerial crossing. Payment includes related Work performed in accordance with related Sections.
 11. No separate payment is to be made for pavement removal or replacement of surface improvements for augering, tunneling, or other trenchless methods of installation unless otherwise indicated in the Contract Documents.
 12. Refer to Section 01270 – “Measurement and Payment” for unit price procedures.
- B. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for Work in this Section is included in total Stipulated Price.

1.03 REFERENCES

- A. ANSI A21.11/AWWA C111 –Rubber-Gasket Joints for Ductile - Iron Pressure Pipe and Fittings.
- B. ANSI/NSF Standard 61 – Drinking Water System -Health Effects.
- C. ASTM A36/A36M – Standard Specification for Carbon Structural Steel.
- D. ASTM A126 – Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
- E. ASTM A536 – Standard Specification for Ductile Iron Castings.
- F. ASTM B21/B21M – Standard Specification for Naval Brass Rod, Bar, and Shapes.
- G. ASTM B98/B98M – Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.
- H. ASTM B301/B301M – Standard Specification for Free-Cutting Copper Rod, Bar, Wire, and Shapes.

- I. ASTM B584 – Standard Specification for Copper Alloy Sand Castings for General Application.
 - J. ASTM E165/E165M – Standard Practice for Liquid Penetrant Examination for General Industry.
 - K. ASTM E709 – Standard Guide for Magnetic Particle Testing.
 - L. ASTM F1674 – Standard Test Method for Joint Restraint Products for Use with PVC Pipe.
 - M. AWWA C206 –Field Welding of Steel Water Pipe.
 - N. AWWA C207 –Steel Pipe Flanges for Waterworks Service - Sizes 4 Inches through 144 Inches.
 - O. AWWA C217 - Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Water Pipelines
 - P. NACE SP0274 – High-Voltage Electrical Inspection of Pipeline Coatings.
 - Q. NACE SP0188 – Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
 - R. ISO 9001: 2015 or latest - Quality Management Systems – Requirements
 - S. City of Houston Spec 2558
- 1.04 SUBMITTALS
- A. Conform to requirements of Section 01330 – “Submittal Procedures”.
 - B. Conform to submittal requirements of applicable Section for type of pipe used.
 - C. Photographs: Submit photographs conforming to requirements of Section 01321 – “Construction Photographs” prior to commencement of construction.
 - D. Submit critical location report meeting the requirements of Section 02317 – “Excavation and Backfill for Utilities”.
 - E. Submit Lone Star notification transmittal number prior to beginning excavation.
 - F. Submit, a minimum of 15 days before beginning pipe laying operations, layout drawing identifying proposed sections for disinfecting, hydrostatic testing and site restoration for entire project for review and approval. Layout drawing to identify sequence of sections for:
 - 1. Disinfection; not to exceed 4,000 linear feet per section.
 - 2. Hydrostatic testing and transfer of services; to immediately follow sequence of disinfected section.
 - 3. Site restoration; not to exceed limits specified; sequence in order of

disturbance.

- G. For water lines to be field welded, submit proof of certification of field welders per AWWA C206. Indicate certified procedures and position each welder is qualified to perform. Provide documentation of the most recent weld qualification test date and continuity of use in each process for which the welder or welding operator is required.

1.05 RELATED REQUIREMENTS

- A. Section 01110 – “Summary of Work”
- B. Section 01270 – “Measurement and Payment”
- C. Section 01321 – “Construction Photographs”
- D. Section 01330 – “Submittal Procedures”
- E. Section 01740 – “Restoration of Site”
- F. Section 02317 – “Excavation and Backfill for Utilities”
- G. Section 02320 – “Utility Backfill Materials”
- H. Section 02425 – “Tunnel Excavation and Primary Liner”
- I. Section 02477 – “Augering Pipe and Conduit”
- J. Section 02501 – “Ductile Iron Pipe and Fittings”
- K. Section 02502 – “Steel Pipe and Fittings”
- L. Section 02506 – “Polyvinyl Chloride Pipe”
- M. Section 02507 – “Prestressed Concrete Cylinder Pipe”
- N. Section 02514 – “Disinfection of Water Lines”
- O. Section 02515 – “Hydrostatic Testing of Pipelines”
- P. Section 02517 – “Water Line in Tunnel”
- Q. Section 02518 – “Steel Pipe and Fittings for Large Diameter Water Lines”
- R. Section 02528 – “Polyethylene Wrap”
- S. Section 02588 – “Cleaning and Television Inspection [City of Houston Standard Specification]”
- T. Section 02613 – “Bar-Wrapped Steel Cylinder Pipe”
- U. Section 16061 – “Joint Bonding and Electrical Isolation”
- V. Section 16062 – “Corrosion Control Test Stations”

1.06 – 1.13 NOT USED

PART 2 PRODUCTS

2.01 MANUFACTURER(S) (NOT USED)

2.02 MATERIALS AND/OR EQUIPMENT

A. Pipe Materials

1. Install pipe materials which conform to following:
 - a. Section 02501 – “Ductile Iron Pipe and Fittings”: For pipe sizes 6-inch in diameter and larger.
 - b. Section 02502 – “Steel Pipe and Fittings”: Use limited to above ground piping within plant sites and aerial crossings, in pipe sizes 20-inch diameter and smaller. Piping to be welded steel pipe with flange or approved restraint joint connections, unless otherwise shown on Plans.
 - c. Section 02506 – “Polyvinyl Chloride Pipe”: For pipe sizes 30-inch in diameter and smaller only.
 - d. Section 02507 – “Prestressed Concrete Cylinder Pipe”: For pipe sizes 20-inch in diameter and larger.
 - e. Section 02518 – “Steel Pipe and Fittings for Large Diameter Water Lines”: For pipe sizes 24-inch in diameter and larger.
 - f. Section 02613 – “Bar-Wrapped Steel Cylinder Pipe”: For pipe sizes 20-inch in diameter through 60-inch.
2. Conform to American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 61 and have certified by an organization accredited by ANSI.
3. Type of pipe materials used is Contractor’s option unless specifically identified on the Plans. The type of pipe material used for a certain water line size must be the same material throughout the project for that specific size unless otherwise identified on the Plans.
4. Provide minimum of $\frac{3}{8}$ inch inside joint recess between ends of pipe in straight pipe sections.
5. Pipe Manufacturer: Performance history shall be minimum 5 years of successful field installations with proposed pipe diameter and proposed type of pipe joint. In absence of 5-year performance history for proposed pipe diameter, the following items shall be required for review by Project Manager prior to approval:
 - a. Quality Assurance Program. Submit certified quality assurance program addressing all aspects of pipe manufacturing process, including coating and lining applications. Certified program shall be

ISO 9001; 2015 or other equivalent industry standard nationally recognized program.

- b. Hydrostatic Joint Test. Perform hydrostatic test of proposed joint at proposed pipe diameter in presence of Project Manager. Test duration shall be minimum 8 hours at 150 psi with no leakage, with pipe cylinder deflected at joint to 3 percent of nominal diameter, with maximum allowable joint engagement deflection.
- c. Provide minimum four (4) weeks' notice to Project Manager for hydrostatic joint test. Submit test procedures to Project Manager for approval.

Project Manager's decision as to acceptability of joint is final.

B. Restrained Joints

1. Ductile-Iron Pipe: See Section 02501 – “Ductile Iron Pipe and Fittings”.
2. PVC Pipe: See Section 02506 – “Polyvinyl Chloride Pipe”. Perform hydrostatic testing in accordance with ASTM F1674.
3. Prestressed Concrete Cylinder Pipe, Bar-Wrapped Pipe, and Steel Pipe: Welded joints (see paragraph 3.03.G.3).
4. As an alternative to pipe with an integral restrained joint system, restrained joint fittings may be provided where required on DIP and PVC pipe meeting the following requirements:
 - a. Restraint devices: Manufacture of high strength ductile iron, ASTM A536. Working pressure rating twice that of design test pressure.
 - b. Bolts and connecting hardware: High strength low alloy material in accordance with ANSI A21.11/AWWA C111.
5. Ductile Iron Pipe in augered holes, provide restrained joints that are integral to both the bell and spigot ends, and do not extend beyond or increase the outside diameter of the bell.

C. Couplings and Appurtenances for Large Diameter Waterline

1. Flexible (Dresser-type) Couplings.
 - a. Install where shown on Plans or where allowed by Project Manager for CONTRACTOR's convenience. Use galvanized flexible couplings when installed on galvanized pipe which is cement lined, or when underground. Provide gaskets manufactured from Neoprene or Buna-N.
 - b. For steel pipe; sleeve-type flexible couplings. Thickness of middle ring equal to or greater than thickness of pipe wall.
 - c. Provide approved flanged adapter couplings for steel pipe.

- d. Use Type 316 stainless steel bolts, nuts, and washers where flexible couplings are installed underground. Coat entire coupling with 20-mil of bitumastic 300m as manufactured by Carboline or approved equal, or coat entire coupling with Denso petrolatum or approved equal.
2. Flap Valves: Provide on discharge of manhole drainline as shown on Plans.
 - a. Body and Flap: ASTM A126-B cast iron.
 - b. Seats: ASTM B21/B21M-CA482 or ASTM B301/B301M-CA145 bronze.
 - c. Resilient Seat: Buna-N.
 - d. Hinge Arms: ASTM B584-CA865 high tensile bronze.
 - e. Hinge pins: ASTM B98/B98M-CA655 silicon bronze.

2.03 – 2.04 NOT USED

PART 3 EXECUTION

3.01 GENERAL / MANUFACTURER(S) (NOT USED)

3.02 PREPARATION

- A. Conform to applicable installation specifications for types of pipe used.
- B. Employ workmen who are skilled and experienced in laying pipe of type and joint configuration being furnished. Provide watertight pipe and pipe joints.
- C. Lay pipe to lines and grades shown on Plans.
- D. Confirm that 9 feet minimum separation from gravity sanitary sewers and manholes or separation of 4 feet minimum from force mains as specified in this Section in all directions unless special design is provided on Plans.
- E. Where above clearances cannot be attained, and special design has not been provided on Plans, obtain direction from Project Manager before proceeding with construction.
- F. Inform Project Manager if unmetered sprinkler or fire line connections exist which are not shown on Plans. Make transfer only after approval by Project Manager.
- G. For projects involving multiple subdivisions or locations, limit water line installation to maximum of two project site locations. Maximizing two pipe installation crews shall be permitted, unless otherwise approved by Project Manager.
- H. CONTRACTOR is responsible for handling necessary installations and removal of chlorination and testing taps and risers.
- I. If asbestos-cement (A.C.) pipe is encountered, follow safety practices outlined in OSHA 29 CFR 1926.1101.

- J. For pipe diameters 36 inches and greater, clearly mark each section of pipe and fitting with unique designation on inside of pipe. Locate unique identifying mark minimum of 5 feet away from either end of each section of pipe. Provide one unique identifying mark in middle of each fitting. Place markings at consistent locations. Use permanent black paint and minimum letter height of 4 inches to mark designations.
- K. Contractor is responsible for assuring chosen manufacturer fulfills requirements for extra fittings and, therefore, is responsible for costs due to downtime if requirements are not met.
- L. Do not remove plugs or clamps during months of peak water demands; June, July, and August, unless otherwise approved by Project Manager.

3.03 ERECTION/INSTALLATION APPLICATION AND/OR CONSTRUCTION

A. Handling:

1. Place pipe along project site where storm water or other water shall not enter or pass through pipe.
2. Load, transport, unload, and otherwise handle pipe and fittings to prevent damage of any kind. Handle and transport pipe with equipment designed, constructed and arranged to prevent damage to pipe, lining and coating. Do not permit bare chains, hooks, metal bars, or narrow skids or cradles to come in contact with coatings. Where required, provide pipe fittings with sufficient interior strutting or cross bracing to prevent deflection under their own weight.
3. Hoist pipe from trench side into trench by means of sling of smooth steel cable, canvas, leather, nylon, or similar material.
4. For large diameter water lines, handle pipe only by means of sling of canvas, leather, nylon, or similar material. Sling shall be minimum 36 inches in width. Do not tear or wrinkle tape layers.
5. Use precautions to prevent injury to pipe, protective linings, and coatings.
 - a. Package stacked pipe on timbers. Place protective pads under banding straps at time of packaging.
 - b. Pad fork trucks with carpet or other suitable material. Use nylon straps around pipe for lift when relocating pipe with crane or backhoe.
 - c. Do not lift pipe using hooks at each end of pipe.
 - d. Do not place debris, tools, clothing, or other materials on pipe.
 - e. Place pipe on timbers, tires or soil berms at the jobsite. Do not place pipe directly on the ground.

6. Repair damage to pipe or protective lining and coating before final acceptance.
 7. For cement mortar lined and coated steel pipe and PCCP, permit no visible cracks wider than 1/16 except
 - a. In surface laitance of centrifugally cast mortar.
 - b. In sections of pipe with steel reinforcing collars or wrappers.
 - c. Within 12 inches of pipe ends.
 8. Repair pipe with visible cracks that exceed project specifications. If cracks cannot be repaired to specification remove from project site.
- B. Cleaning: Thoroughly clean and dry interior of pipe and fittings of foreign matter before installation, and keep interior clean until Work has been accepted. Keep joint contact surfaces clean until jointing is completed. Do not place debris, tools, clothing, or other materials in pipe. After pipe laying and joining operations are completed, clean inside of pipe and remove debris.
- C. Inspection: Before installation, inspect each pipe and fitting for defects. Reject defective, damaged or unsound pipe and fittings and remove them from site.
- D. Earthwork
1. Conform to applicable provisions of Section 02317 – “Excavation and Backfilling for Utilities”, Section 02425 – “Tunnel Excavation and Primary Liner”, and Section 02447 – “Augering Pipe and Conduit”.
 2. Bedding: Use bedding materials in conformance with Section 02320 – “Utility Backfill Materials”.
 3. Backfill: Use bank run sand or earth or native soil as specified in Section 02320 – “Utility Backfill Materials”. Backfill excavated areas in same day excavated. When not possible, cover excavated areas using steel plates on paved areas and other protective measures elsewhere.
 4. Place material in uniform layers of prescribed maximum loose thickness and wet or dry material to approximately optimum moisture content. Compact to prescribed density. Water tamping is not allowed.
- E. Pipe Cutting
- Cut pipe 12 inches and smaller with standard wheel pipe cutters. Cut pipe larger than 12 inches in manner approved by Project Manager. Make cuts smooth and at right angles to axis of pipe. Bevel plain end with heavy file or grinder to remove sharp edges.
- F. Piping Installation
1. General Requirements:
 - a. Lay pipe in subgrade free of water.

- b. Make adjustments of pipe to line and grade by scraping away subgrade or filling in with granular material.
 - c. Properly form bedding to fully support bell without wedging or blocking up bell.
 - d. Open Cut Construction: Keep pipe trenches free of water which might impair pipe laying operations. Grade pipe to provide uniform support along bottom of pipe. Excavate for bell holes after bottom has been graded and in advance of placing pipe. Lay not more than nominal city block length of not more than 300 feet of pipe in trench ahead of backfilling operations. Cover or backfill laid pipe if pipe laying operations are interrupted and during non-working hours. Place backfill carefully and simultaneously on each side of pipe to avoid lateral displacement of pipe and damage to joints. If adjustment of pipe is required after it has been laid, remove and re-lay as new pipe.
 - e. Auger Construction: Install pipe in augers in accordance with Section 02447 – “Dry and Slurry Augering of Pipe and Conduit”.
 - f. Tunnel Construction: Install pipe in tunnels in accordance with Sections 02425 – “Tunnel Excavation and Primary Liner” and 02517 – “Water Line in Tunnel”.
 - g. Prevent damage to coating when placing backfill. Use backfill material free of large rocks or stones, or other material which could damage coatings.
2. Install pipe continuously and uninterrupted along each street on which Work is to be performed. Obtain approval of Project Manager prior to skipping any portion of Work.
 3. Before assembling couplings, lightly coat pipe ends and outside of gaskets with pipe lubricant, cup grease or liquid vegetable soap to facilitate installation. Protection of Pipeline: Securely place stoppers or bulkheads in openings and in end of line when construction is stopped temporarily and at end of each day’s work.
 4. Perform critical location Refer to Section 02317 – “Excavation and Backfill for Utilities” for additional requirements at critical locations.
 5. Use adequate surveying methods and equipment; employ personnel competent in use of this equipment. Horizontal and vertical deviations from alignment as indicated on Plans shall not exceed 0.10 feet. Measure and record “as-built” horizontal alignment and vertical grade at maximum of every 100 feet on record drawings.
 6. Assessment of deflection may be measured by Project Manager at location along pipe. Arithmetical averages of deflection or similar average measurements will not be deemed as meeting intent of standard. Refer to pipe material specifications for maximum allowable pipe deflection.
 7. Laying Large Diameter Water Line

- a. Lay not more than 50 feet of pipe in trench ahead of backfilling operations.
 - b. Dig trench proper width as shown. When trench width below top of pipe becomes 4 feet wider than specified, install higher class of pipe or improved bedding, as determined by Project Manager. No additional payment will be made for higher class of pipe or improved bedding.
 - c. Prevent damage to coating when placing backfill. Use backfill material free of large rocks or stones, or other material which could damage coatings.
 - d. Perform holiday test to detect coating voids in accordance with NACE SP0274.
 - e. Repair detected holidays in accordance with manufacturer's recommendations.
 - f. Before assembling couplings, lightly coat pipe ends and outside of gaskets with cup grease or liquid vegetable soap to facilitate installation.
 - g. Prior to proceeding with critical tie-ins submit sequence of Work based on findings from "critical location" effort.
8. Perform following additional procedures when working on plant sites.
- a. Seventy-two hours prior to each plant shut down or connection, schedule coordination meeting with Project Manager. At this meeting, present proposed sequencing of Work and verification of readiness to complete Work as required and within time permitted. Do not proceed with Work until Project Manager agrees key personnel, equipment, and materials are on hand to complete Work.
 - b. Prior to fully excavating around existing piping, excavate as minimal as possible to confirm type and condition of existing joints. Verify size, type, and condition of pipe prior to ordering materials or fully mobilizing for Work.
 - c. Do not proceed with connections to existing piping and identified critical stages of Work unless approved by Project Manager.
 - d. Make connections to existing piping only when two valves are closed off between connection and source of water pressure. Do not make connection relying solely on one valve, unless otherwise approved by Project Manager.
 - e. Perform critical stages of Work identified on Plans at night or during low water demand months as specified in Section 01110 – "Summary of Work".
 - f. Excavation equipment used on plant sites to have smooth bucket; no teeth or side cutters.

- g. Submit to Project Manager Lone Star Notification transmittal number prior to beginning excavation.
 - h. Before each “dig” with mechanical excavator, probe ground to determine potential obstructions. Repeat procedure until existing pipe is located or excavation reaches desired elevation. Perform excavations within 1 foot to existing piping by hand methods.
 - i. Provide 72 hour notice to pipe manufacturer’s representative when connecting or modifying existing prestressed or pretension concrete cylinder pipe.
 - j. Provide field surveyed (horizontal and vertical elevations) “as-builts” of new construction and existing underground utilities encountered. Submit in accordance with Section 01330 – “Submittal Procedures”.
 - k. Prior to performing plant work to be done on weekend, provide list of sites and contact person with phone numbers to Project Manager by noon on Thursday of week. Contact person must be accessible during weekend, have cell phone, and be authorized to make emergency decisions.
9. For tie-ins to existing water lines, provide necessary material on hand to facilitate connection prior to shutting down existing water line. Provide a minimum of 2 weeks notice prior to shutting down existing water line.

G. Joints and Jointing

- 1. Rubber Gasketed Bell-and-Spigot Joints for Concrete Cylinder Pipe, Bar Wrapped Pipe, PVC, Steel, and DIP:
 - a. After rubber gasket is placed in spigot groove of pipe, equalize rubber gasket cross section by inserting tool or bar recommended by manufacturer under rubber gasket and moving it around periphery of pipe spigot.
 - b. Lubricate gaskets with nontoxic water-soluble lubricant before pipe units are joined.
 - c. Fit pipe units together in manner to avoid twisting or otherwise displacing or damaging rubber gasket.
 - d. After pipe sections are joined, check gaskets to ensure that no displacement of gasket has occurred. If displacement has occurred, remove pipe section and remake joint as for new pipe. Remove old gasket, inspect for damage and replace if necessary before remaking joint.
 - e. Where preventing movement of pipe is necessary due to thrust, use restrained joints as shown on Plans.
 - 1) Include buoyancy conditions for soil unit weight when computing thrust restraint calculations.

- 2) Do not include passive resistance of soil in thrust restraint calculations.
 - f. Provide means to prevent full engagement of spigot into bell in accordance with Paragraph 2.02.A.4. For PVC pipe installed by trenchless, means may consist of an approved bell insertion protection system. Use feeler gauge to verify water-tightness of each steel or PCCP/Bar Wrapped pipe joint prior to application of joint grout. Perform feeler gauge test from interior of pipe, immediately after installation and after backfilling and compaction. Perform feeler gauge test in accordance with manufacturer's recommendations to determine if the joint is within tolerance. Provide results to Project Manager. Notify Project Manager immediately when a joint is found to be out of tolerance or fails feeler gauge test, and submit repair plan for approval by Project Manager.
2. Flanged joints where required on concrete cylinder pipe, bar wrapped pipe, ductile iron pipe, or steel pipe:
 - a. AWWA C207. Prior to installation of bolts, accurately center and align flanged joints to prevent mechanical prestressing of flanges, pipe, and equipment. Align bolt holes to straddle vertical, horizontal, or north-south center line. Do not exceed 3/64 inch per foot inclination of flange face from true alignment.
 - b. Use full-face gaskets for flanged joints. Provide 1/8-inch-thick cloth inserted rubber gasket material. Cut gaskets at factory to proper dimensions. In PPCA areas, provide Viton (FKM) type gaskets, or approved equal, for water lines and appurtenances requiring gaskets.
 - c. Provide ASTM A193 Grade B7 high strength steel stud bolts with ASTM A194 heavy hex nuts. Use cadmium-plated steel nuts and bolts underground. Tighten bolts progressively to prevent unbalanced stress. Maintain at all times approximately same distance between two flanges at points around flanges. Tighten bolts alternately (180° apart) until all are evenly tight. Draw bolts tight to ensure proper seating of gaskets. Provide Denso petrolatum based tape as manufactured by Carboline or approved equal for all exposed portions of nuts, bolts, and pipe.
 - d. Full length bolt isolating sleeves and washers shall be used with flanged connections.
 - e. For in-line flange joints 30 inches in diameter and greater and at butterfly valve flanges, provide Pyrox G-10 with nitrite seal, Type E LineBacker gasket as manufactured by Pipeline Seal and Insulator, Inc., or approved equal conforming to ANSI A21.11 mechanical joint gaskets. For in-line flange joints sized between 12 inches in diameter and greater and 24 inches in diameter and smaller, provide Phenolic PSI with nitrite seal, Type E LineBacker gasket as manufactured by Pipeline Seal and Insulator, Inc., or approved equal conforming to ANSI A21.11 mechanical joint gaskets.

3. Welded joints (concrete cylinder pipe, bar wrapped pipe, steel pipe):
 - a. Prior to starting Work, provide certification of qualification for welders employed on project for type of Work procedures and positions involved.
 - b. Joints: Comply with AWWA C206 for welded joints. Full-fillet, single lap-welded slip-type either inside or outside, or double butt-welded type; use automatic or hand welders; completely penetrate deposited metal with base metal; use filler metal compatible with base metal; keep inside of fittings and joints free from globules of weld metal which would restrict flow or become loose. Do not use mitered joints. For interior welded joints, complete backfilling before welding. For exterior field-welded joints, provide adequate working room under and beside pipe. Use exterior welds for 30-inch and smaller.
 - c. For PCCP and bar wrapped, furnish welded joints with trimmed spigots and interior welds for 36-inch and larger pipe.
 - d. Bell-and-spigot, lap-welded slip joints: Deflection may be taken at joint by pulling joint up to $\frac{3}{4}$ inch as long as 1½-inch minimum lap is maintained. Spigot end may be miter cut to take deflections up to 5 degrees as long as joint tolerances are maintained. Miter end cuts of both ends of butt-welded joints may be used for joint deflections of up to 5 degrees.
 - e. Align piping and equipment so that no part is offset more than $\frac{1}{8}$ inch. Set fittings and joints square and true, and preserve alignment during welding operation. For butt welded joints, align abutting ends to minimize offset between surfaces. For pipe of same nominal wall thickness, do not exceed $\frac{1}{16}$ inch offset. Use line-up clamps for this purpose; however, take care to avoid damage to linings and coatings.
 - f. Protect coal-tar-epoxy lining during welding by draping an 18-inch-wide strip of heat resistant material over top half of pipe on each side of lining holdback to avoid damage to lining by hot splatter. Protect tape coating similarly if external welding is required.
 - g. Welding rods: Compatible with metal to be welded to obtain strongest bond, E-70XX.
 - h. Deposit metal in successive layers to provide at least two passes or beads for automatic welding and three passes or beads for manual welding in completed weld.
 - i. Deposit no more than $\frac{1}{4}$ inch of metal on each pass. Thoroughly clean each individual pass with wire brush or hammer to remove dirt, slag, or flux.
 - j. Do not weld under weather condition that would impair strength of weld, such as wet surface, rain or snow, dust or high winds, unless Work is properly protected.

- k. Make tack weld of same material and by same procedure as completed weld.
- l. Remove dirt, scale, and other foreign matter from inside piping before tying in sections, fittings, or valves.
- m. Employ an independent certified testing laboratory, approved by Project Manager, to perform weld acceptance tests on welded joints. Include cost of such testing and associated work to accommodate testing in contract unit price bid for water line. Furnish copies of all test reports to Project Manager for review. Project Manager has final decision as to suitability of all welds tested.

Weld acceptance criteria:

- 1) Conduct in accordance with ASTM E165/E165M- Standard Test Method for Liquid Penetrant Examination and ASTM E709 Standard Guide for Magnetic Particle Examination. Use X-ray methods for butt welds, for 100 percent of joint welds.
- 2) Examine welded surfaces for the following defects:
 - a) Cracking.
 - b) Lack of fusion/penetration.
 - c) Slag which exceeds one-third (t) where (t) equals material thickness.
 - d) Porosity/Relevant rounded indications greater than 3/16 inch; rounded indication is one of circular or elliptical shape with length equal to or less than three times its width.
 - e) Relevant linear indications in which length of linear indication exceeds three times its width.
 - f) Four or more relevant 1/16-inch rounded indications in line separated by 1/16 inch or less edge to edge.
- n. After pipe is joined and prior to start of welding procedure, make spigot and bell essentially concentric by jacking, shimming or tacking to obtain clearance tolerance around periphery of joint except for deflected joints.
- o. Furnish each welder employed steel stencil for marking welds, so work of each welder can be identified. Mark pipe with assigned stencil adjacent to weld. When welder leaves job, stencil must be voided and not duplicated. Welder making defective welds must discontinue work and leave project site. Welder may return to project site only after recertification.
- p. Scaffolding: Do not drag scaffolding or other items along interior of

pipe.

- q. For steel pipe 30-inch diameter and greater, after welding of joint, provide mortar coating for internal joint surfaces of mortar lined pipe, and epoxy for internal surfaces of epoxy lined pipe.
4. Harnessed joints (concrete cylinder pipe, bar wrapped pipe):
- a. Use of snap-ring type restrained joints on pipe is limited to 20-inch through 48-inch diameters.
 - b. Position snap-ring joint bolt on top (12 o'clock portion). Provide minimum ½-inch joint recess. Use joint "diapers" minimum of 12 inches wide.
 - c. For field adjustments with deflections beyond manufacturer's recommendations:
 - 1) Field trim spigot.
 - 2) Do not engage ring.
 - d. Harnessed joints are not permitted in areas defined on Plans as potentially petroleum contaminated material, in tunnels, or at bend greater than 5 degrees.
 - e. Install harness type joints including snap rings at straight sections of pipe.
5. Restrained Joints
- a. For existing water lines regardless of diameter, and new water lines less than 16 inches in diameter, restrain pipe joints with concrete thrust blocks unless otherwise shown on Plans.
 - b. Thrust restraint lengths shown on Plans are minimum anticipated lengths. These lengths are based on deflections indicated and on the use of the following pipe materials as the basis of design: Dielectric coated steel pipe for pipe sizes 30 inches and larger, or PVC pipe for pipe sizes 30- inches and smaller. Adjustments in deflections or use of other pipe material may result in reduction or increase of thrust lengths. Pipe manufacturer or representative to perform thrust restraint calculations in accordance with latest revision of applicable standard for pipe material chosen. Submit calculations for all pipe materials sealed by a registered Professional Engineer in State of Texas for review by Project Manager. Make adjustments in thrust restraint lengths at no additional cost.
 - c. Passive resistance of soil will not be permitted in calculation of thrust restraint.

- d. Include buoyance conditions for soil unit weight when computing thrust restrained calculations.
 - e. For 16-inch lines and larger use minimum 16-foot length of pipe in and out of joints made up of beveled pipe where restraint joint lengths are not identified on Plans. Otherwise, provide restraint joints for a minimum length of 16 feet on each side of beveled joints.
 - f. Installation
 - 1) Install restrained joints mechanism in accordance with manufacturer's recommendations.
 - 2) Examine and clean mechanism; remove dirt, debris and other foreign material.
 - 3) Apply gasket and joint NSF 61 FDA food grade approved lubricant.
 - 4) Verify gasket is evenly seated.
 - 5) Do not over stab pipe into mechanism.
 - g. Prevent any lateral movement of thrust restraints throughout pressure testing and operation.
 - h. Place 2500 psi concrete conforming to Section 03315 – "Concrete for Utility Construction", for blocking at each change in direction of existing water lines, to brace pipe against undisturbed trench walls. Finish placement of concrete blocking, made from Type I cement, 4 days prior to hydrostatic testing of pipeline. Test may be made 2 days after completion of blocking if Type II cement is used.
6. Joint grout (concrete cylinder pipe, bar wrapped pipe, mortar coated steel pipe):
- a. Mix cement grout mixture by machine except when less than ½ cubic yard is required. When less than ½ cubic yard is required, grout may be hand mixed. Mix grout only in quantities for immediate use. Place grout within 20 minutes after mixing. Discard grout that has set. Retempering of grout by any means is not permitted.
 - b. Prepare grout in small batches to prevent stiffening before it is used. Do not use grout which has become so stiff that proper placement cannot be assured without rettempering. Use grout for filling grooves of such consistency that it shall adhere to ends of pipe.
 - c. Surface Preparation: Remove defective concrete, laitance, dirt, oil, grease, and other foreign material from concrete surfaces with wire brush or hammer to sound, clean surface. Remove rust and foreign materials from metal surfaces in contact with grout.
 - d. Follow established procedures for hot and cold weather concrete

- placement.
- e. Complete joint grout operations and backfilling of pipe trenches as closely as practical to pipe laying operations. Allow grouted exterior joints to cure at least 1 hour before compacting backfill.
 - f. Grouting exterior joint space: Hold wrapper in place on both sides of joint with minimum $\frac{3}{8}$ -inch-wide steel straps or bands. Place no additional bedding or backfill material on either side of pipe until after grout band is filled and grout has mechanically stiffened. Pull ends of wrapper together at top of pipe to form access hole. Pour grout down one side of pipe until it rises on other side. Rod or puddle grout to ensure complete filling of joint recess. Agitate for 15 minutes to allow excess water to seep through joint band. When necessary, add more grout to fill joint completely. Protect gap at top of joint band from backfill by allowing grout to stiffen or by covering with structurally protective material. Do not remove band from joint. Proceed with placement of additional bedding and backfill material.
 - g. Interior joints for pipe 24 inches and smaller: Circumferentially butter bell with grout prior to insertion of spigot, strike off flush surplus grout inside pipe by pulling filled burlap bag or inflated ball through pipe with rope. After joint is engaged, finish off joint grout smooth and clean. Use swab approved by Project Manager for 20-inch pipe and smaller.
 - h. Protect exposed interior surfaces of steel joint bands by metallizing, by other approved coatings, or by pointing with grout.
 - i. Remove and replace improperly cured or otherwise defective grout.
 - j. Strike off grout on interior joints and make smooth with inside diameter of pipe.
 - k. When installed in tunnel or encasement pipe and clearance within casing does not permit outside grout to be placed in normal manner, apply flexible sealer, such as Flex Protex by Gifford-Hill America, or equal, to outside joint prior to joint engagement. Clean and prime surfaces receiving sealer in accordance with manufacturer's recommendations. Apply sufficient quantities of sealer to assure complete protection of steel in joint area. Fill interior of joint with grout in normal manner after joint closure.
 - l. Interior joints for water lines 30 inches and larger: Clean joint space, wet joint surfaces, fill with stiff grout and trowel smooth and flush with inside surfaces of pipe using steel trowel so that surface is smooth. Accomplish grouting at end of each Work day. Interior joints will be inspected by Project Manager by video inspection services and/or by physical inspection. Video inspection shall be in accordance with section 02558 – "Cleaning and Television Inspection [City of Houston Standard Specification]". During inspection, insure no delamination of joint mortar has occurred by striking joint mortar lining with rubber mallet. Remove and replace delaminated mortar lining.

- m. Work which requires heavy equipment to be over water line, must be completed before mortar is applied to interior joints.
 - n. Do not apply grout to joints that are out of tolerance until acceptable repairs are made.
7. Large diameter water main joint testing: In addition to testing individual joints with feeler gauge approximately ½ inch wide and 0.015-inch thick, use other joint testing procedure approved or recommended by pipe manufacturer which shall help ensure watertight installation prior to backfilling. These tests shall be made at no additional cost.
8. Make curves and bends by deflecting joints or other method as recommended by manufacturer and approved by Project Manager. Submit details of other methods of providing curves and bends which exceed manufacturer's recommended deflection prior to installation.
- a. Deflection of pipe joints shall not exceed maximum deflection recommended by pipe manufacturer, unless otherwise indicated on Plans.
 - b. If deflection exceeds that specified but is less than 5 percent, repair entire deflected pipe section such that maximum deflection allowed is not exceeded.
 - c. If deflection is equal to or exceeds 5 percent from that specified, remove entire portion of deflected pipe section and install new pipe.
 - d. Replace, repair, or reapply coatings and linings as required.
 - e. Assessment of deflection may be measured by Project Manager at location along pipe. Arithmetical averages of deflection or similar average measurement methods will not be deemed as meeting intent of standard.
 - f. When rubber gasketed pipe is laid on curve, join pipe in straight alignment and then deflect to curved alignment.
9. Closures sections and approved field modifications to steel, concrete cylinder pipe, bar wrapped pipe and fittings:
- a. Apply welded-wire fabric reinforcement to interior and exterior of exposed interior and exterior surfaces greater than 6 inches in diameter. Welded-wire fabric: minimum W1; maximum spacing 2 inches by 4 inches; ⅜ inch from surface of steel plate or middle third of lining or coating thickness for mortar thickness less than ¾ inch.
 - b. Fill exposed interior and exterior surfaces with nonshrink grout.
 - c. For pipe diameters 36 inches and greater, perform field welds on interior and exterior of pipe.
 - d. For large diameter water lines, provide minimum overlap of 4 inches on

each side of butt-strap closures.

H. Cathodic Protection Appurtenances

1. Where identified on, modify pipe for cathodic protection as detailed on and specified. Unless otherwise noted, provide isolation kits at connections to existing water system or at locations to isolate one type of cathodic system from another type, between water line, access manhole piping and other major openings in water line, or as shown on. See Specification Section 16061 – “Joint Bonding and Electrical Isolation”.
2. At all cased crossings, install casing spacers and end seals as shown on. See Specification Section 16061 – “Joint Bonding and Electrical Isolation”.
3. Ensure electrical isolation between carrier pipe and primary tunnel liner prior to backfill of tunnel shaft.
4. Install test stations as shown on the. See Specification Section 16062 – “Corrosion Control Test Stations”.
5. Bond joints for pipe installed in tunnel or open cut, except where isolating flanges are provided. Weld strap or clip between bell and spigot of each joint or as shown on. No additional bonding required where joints are welded for thrust restraint. Repair coatings as specified by appropriate AWWA standard, as recommended by manufacturer, and as approved by Project Manager.
6. Bonding Strap or Clip: Free of foreign material that may increase contact resistance between wire and strap or clip.

I. Securing, Supporting, and Anchoring

1. Support piping as shown on Plans and as specified in this Section, to maintain line and grade and prevent transfer of stress to adjacent structures.
2. Where shown on Plans, anchor pipe fittings and bends installed on water line by welding consecutive joints of pipe together to distance each side of fitting. Restrained length, as shown on Plans, assumes that installation of pipe and subsequent hydrostatic testing begins upstream and proceed downstream, with respect to normal flow of water in pipe. If installation and testing differs from this assumption, submit for approval revised method of restraining pipe joints upstream and downstream of device used to test against (block valve, blind flange or dished head plug).
3. Use adequate temporary blocking of fittings when making connections to existing systems and during hydrostatic tests. Use sufficient anchorage and blocking to resist stresses and forces encountered while tapping existing water line.

J. Polyethylene Wrap for Ductile Iron Pipe

Conform to requirements of Section 02528 – “Polyethylene Wrap”.

K. Disinfection of Water Lines

Conform to requirements of Section 02514 – “Disinfection of Water Lines”.

3.04 REPAIR/RESTORATION

- A. Provide cleanup and restoration crews to work closely behind pipe laying crews, and where necessary, during chlorination, testing, service transfers, abandonment of old water lines, backfill and surface restoration.
- B. For large diameter water lines, do not install more than 2,000 linear feet of water line, without previous 2,000 linear feet being restored in accordance with Section 01740 – “Restoration of Site”. Schedule paving crews so repaving Work shall not lag behind pipe laying Work by more than 1,000 feet. Failure to comply with this requirement shall be considered a material breach of the Contract and subject to termination in accordance with the General Conditions.

3.05 – 3.06 NOT USED

3.07 CLEANING

Remove construction debris or foreign material and thoroughly broom clean and flush piping systems. Provide temporary connections, equipment, and labor for cleaning. Project Manager must inspect water line for cleanliness prior to filling.

3.08 DEMONSTRATION / TESTING AND INSPECTION

- A. Field Hydrostatic Tests

Conform to requirements of Section 02515 – “Hydrostatic Testing of Pipelines”.

3.09 – 3.10 NOT USED

END OF SECTION