

**Section 02510****WATER MAINS****1.0 GENERAL****1.01 SECTION INCLUDES**

- A. Installation of water mains, including valves, fire hydrants, wet connections, cut and plug of mains, disinfection, and hydrostatic testing for pipelines.
- B. References to Technical Specifications:
  - 1. Section 01200 - Measurement and Payment Procedures
  - 2. Section 01350 - Submittals
  - 3. Section 02514 - Fire Hydrant Assembly
  - 4. Section 03300 - Cast-in-Place Concrete
  - 5. Section 02512 - Polyethylene Wrap
  - 6. Section 02417 - Augering Pipe for Water Lines
  - 7. Section 02515 - Water Tap and Service Line Installation
  - 8. Section 02318 - Excavation and Backfill for Utilities
  - 9. Section 02980 - Pavement Repair
  - 10. Section 01450 - Testing Laboratory Services
  - 11. Section 02634 - Ductile Iron Pipe and Fittings
- C. Referenced Standards:
  - 1. Texas Commission on Environmental Quality (TCEQ)
  - 2. American Water Works Association (AWWA)
  - 3. American Society for Testing and Materials (ASTM)

**1.02 MEASUREMENT AND PAYMENT**

- A. Measurement for water mains open cut or augered, with or without casing, is on a linear foot basis for each size of pipe installed.  
Mains: Measure along axis of pipe and include fittings and valves.  
Branch Pipe: Measure from axis of main to end of branch.
- B. Refer to Section 01200 – Measurement and Payment Procedures.

**1.03 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  - 1. Pipe shall bear Underwriter's Laboratories (UL) or Factory Mutual (FM) label.

2. Pipe material acceptable without penalty to State's community fire insurance rating agency.
3. System acceptable to City and TCEQ.
4. Bacteriological disinfection acceptable to local health officials and Texas Department of Health, and TCEQ.
5. Water taps and draw off lines in compliance with local municipal specifications and regulations.

#### **1.04 SUBMITTALS**

- A. Make Submittals required by this Section under the provisions of Section 01350 – Submittals.
- B. Product Data:
  1. Obtain from pipe manufacturer installation instructions, manuals, and printed recommendations, except for Owner furnished pipe.
  2. Retain product data on job site for reference.
  3. Submit certified record of tests of pipe, fittings, or valves upon request of Engineer.
  4. Submit hydrant manufacturer flow and friction loss curve.
- C. Samples:
  1. Notify City when system is pressure tested and disinfected. City will take all samples for bacteriological testing as required by TCEQ.

#### **1.05 PRODUCT HANDLING**

- A. Deliver pipe to trench in sound, undamaged condition.
- B. Cut pipe neatly avoiding sharp, ragged, or unbeveled, plain ends and do not damage lining by cutting.
- C. Remove damaged or rejected materials from project site.

#### **1.06 ENVIRONMENTAL REQUIREMENTS**

- A. Do not lay pipe when it is raining or when trench is muddy, soft, or contains standing water.
- B.

**2.0 PRODUCTS****2.01 POLYVINYL CHLORIDE (PVC) PRESSURE PIPE**

- A. Conform to requirements of Section 02534 - PVC Pipe. All pipe used for water mains shall be blue.

**2.02 HIGH DENSITY POLYETHYLENE**

- A. Conform to requirements of Section 02532W - HDPE

**2.03 STEEL PIPE AND FITTINGS FOR LARGE DIAMETER WATER LINES**

- A. Conform to requirements of Section 02513 - Steel Pipe and Fittings for Large Diameter Water Lines.

**2.04 DUCTILE IRON PIPE AND FITTINGS**

- A. Conform to requirements of Section 02634 - Ductile Iron Pipe and Fittings.

**2.05 FIRE HYDRANTS**

- A. Conform to requirements of Section 02514 - Fire Hydrant Assembly.

**2.06 VALVES**

- A. General: Conform to requirements of Section 02541 – Water and Wastewater Line Valves.
1. Manual operators:
    - a. Provide hand wheel manual operators for in-plant valves.
    - b. Equip buried valves with 2 in. square operating nuts.
  2. Furnish no less than one operating key with each lot of 10 buried valves with nut operators.
  3. Rotation:
    - a. Direction: OPEN COUNTERCLOCKWISE (OPEN LEFT).
  4. Shop coating:
    - a. Shop coat ferrous metal surfaces of valves both interior and exterior for corrosion protection.
    - b. Protect internal and external iron surfaces of valves with coating of 4 mils of two-part thermosetting epoxy: AWWA C 550.
  5. Working and test pressures:
    - a. Valves 2 in. through 12 in.: 200 psi working pressure, 400 psi hydrostatic test pressure.
    - b. Valves 14 in. through 36 in.: 150 psi working pressure, 300 psi hydrostatic test pressure.

- B. Gate Valves (2 in. Through 36 in.):
1. Buried valves:
    - a. Comply with AWWA C500, non-rising stem (NRS); resilient wedge.
    - b. Epoxy-coated ductile iron body and bonnet, inside screw.
    - c. Bronze: Seat and disc rings, stem and mountings, and disc wedges.
    - d. "O" ring sealed stem and 2 in. square operating nut.
    - e. Valves 2 in. through 12 in.: Vertical type without by-passes.
    - f. Valves 16 in. through 36 in.: Horizontal type with enclosed steel bevel gears resilient wedge, standard size by-pass valves.
    - g. Stuffing box and bonnet bolts and nuts to be 304 stainless steel.
    - h. Install in section of horizontal pipe.
    - i. Mechanical joint ends with gasket complying with AWWA C 111.
    - j. Acceptable product:
      - 1) East Jordan, American Flow Control, Mueller Co. "A-2380 Series"
- C. Tapping Valves and Tapping Sleeves:
1. Tapping sleeves shall be solid stainless steel and valves shall conform with all others as mentioned above.
- D. Valve Boxes:
1. Cast iron, threaded screw extension sleeve type, adjustable suitable for depth of cover over pipe, with base and cover.
  2. 3/16 in. thick, 5 in. diameter minimum.
  3. Provide with suitable cast iron bases and covers.
  4. Covers: Cast name designating type of service, e.g., "WATER" for water service.

## 2.07 RELATED MATERIALS

- A. Concrete: As specified in Section 03300 – Cast-in-Place Concrete.

- B. Meter Box:
  - 1. Cast iron to Owner's dimensions: ASTM A 48.
- C. The service line between Curb stop and Corporation Stop shall be CTS Polyethylene, SDR – 9.
- D. Corporation and Curb Stops and Fittings: ASTM B 62, NSF 61 lead free

### **3.0 EXECUTION**

- A. Conform to requirements in Section 02534 - PVC Pipe, Section 02634 - Ductile Iron Pipe and Fittings, Section 02532W – HDPE, Section 02635 Steel Pipe and Fittings, and Section 02513 - Steel Pipe and Fittings for Large Diameter Water Lines.

#### **3.02 PREPARATION**

- A. Thoroughly clean pipe interiors of foreign matter before being lowered into trench.
- B. Clean hydrant and valve interiors of foreign matter before installation.
- C. Employ workmen who are skilled and experienced in laying pipe of type and joint configuration being furnished. Provide watertight pipe and pipe joints.
- D. Lay pipe to lines and grades shown on Drawings and Details.
- E. If asbestos-cement (A.C.) pipe is encountered, follow safety practices outline in American Water Works Association's publication, "Work Practices for A/C Pipe". Strictly adhere to "recommended practices" contained in this publication and make them "mandatory practices" for this project.
- F. For pipe diameters 36 inches and greater, clearly mark each section of pipe and fitting with unique designation on inside of pipe along with pressure class. Locate unique identifying mark minimum of five 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.
- G. 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.

#### **3.03 INSTALLATION**

- A. Inspection:
  - 1. Carefully examine each piece of pipe for soundness and specifications compliance after delivery at trench before placing in trench.

2. Remove rejected pipe and fittings from site of work and replace with sound pipe.
  3. Pipe and fittings will be rejected because of any of the following:
    - a. Cracks in pipe or fittings.
    - b. Damaged or cracked ends.
    - c. Damaged gaskets or gasket grooves.
    - d. Less than minimum wall thickness.
    - e. Defects and deformations.
- B. Cleaning:
1. Clean interior of pipe and fittings of foreign matter before laying.
  2. Keep interiors and ends clean during installation.
  3. Keep joint contact surfaces clean during installation.
  4. Take precautions to prevent foreign material from entering pipe during installation.
  5. Do not place rubbish, tools, rags, or other materials in pipe.
  6. Whenever pipe laying is stopped, place plugs in uncompleted ends of pipe.
- C. Installation:
1. Install pipe, couplings, and fittings in accordance with pipe manufacturer's recommendations. Conform to applicable installation specifications for types of pipes use.
  2. Install gaskets and lubricants as recommended by manufacturer.
  3. Full length of each barrel of pipe shall rest solidly on pipe bed with recesses excavated to accommodate bells and joints.
  4. Take up and relay pipe that has grade or joint disturbed.
  5. Do not joint pipe with water in trench.
  6. Keep water out of trench until jointing is completed.
  7. Do not lay water pipe closer than 10 ft. horizontally from sanitary sewer.
  8. Do not locate joints at cross-overs with sanitary sewers closer than 9 ft. from cross-over point.

9. Where water lines cross sanitary sewers, construct in accordance with the City of Pearland Engineering Design Criteria Manual for water line or TCEQ standards whichever is more stringent<sup>10</sup>. Where pipe ends are left for future connections, install valve and plug or cap end. Forty feet minimum line section required between valve and plug or cap end.
  11. Install concrete thrust blocking at bends and tees and at ends of lines to provide adequate reaction backing.
  12. Lay not more than 100 feet of pipe in trench ahead of backfilling operations.
  13. Dig trench proper width as shown in details. When trench width below top of pipe becomes 4 feet wider than specified, install higher class of pipe or improved bedding, as determined by Engineer. No additional payment will be made for higher class of pipe or improved bedding.
  14. Use adequate surveying methods and equipment; employ personnel competent in use of this equipment. Horizontal and vertical deviations from alignment as indicated on Drawings 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.
  15. Before assembling couplings, lightly coat pipe ends and outside of gaskets per manufacturer's specification.
  16. Prevent damage to coating when placing backfill. Use backfill material free of large rocks or stones, or other material which could damage coatings.
- D. Setting Valves, Valve Boxes and Fire Hydrants:
1. Set plumb.
  2. Center valve boxes on valves.
  3. Where feasible, locate valves outside area of roads and streets.
  4. Carefully tamp back fill around each valve box to distance of 4 ft. on all sides or to undisturbed trench face if less than 4 ft.
  5. Set hydrants at elevation so that connecting pipe will not have less cover than mains.
  6. Set hydrants on concrete pad.
  7. Depth of bury of hydrant is defined as distance from bottom of inlet pipe to ground line.

8. Place concrete thrust block back of hydrant opposite pipe connections set against vertical face of trench to prevent from blowing off line.
  9. Use 5/8 in. stock stainless steel bridle rods and rod collars.
  10. Place not less than 5 cu. ft. of broken stone around base of hydrant to ensure drainage.
  11. Compact backfill to grade in accordance with specification section 02318 – Excavation and Backfill for Utilities
  12. Tighten stuffing boxes.
  13. Test hydrant and valve in opened and closed position to ensure that parts are in working condition.
- E. Joints and Jointing:
1. Rubber Gasketed Bell-and-Spigot Joints for PVC, Steel, and Ductile Iron Pipe:
  2.
    - 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 per manufacturer's specification.
    - 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 16-inch diameter or greater pipe is necessary due to thrust, use restrained joints as shown on Drawings.
      - 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. Except for PVC pipe, provide means to prevent full engagement of spigot into bell as shown on Drawings. Means may consist of wedges or other types of stops as approved by Engineer.



2. Flanged Joints where required on Ductile Iron Pipe, or Steel Pipe:
  - a. AWWA C 207. 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.
  - c. Use stainless steelnuts and bolts to match flange material. Use stainless steelnuts 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.
  - 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, conforming to ANSI A 21.11 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 gasket conforming to ANSI A 21.11 mechanical joint gaskets.
3. Welded Joints (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: AWWA C 206. 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. 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 3/4 inch as long as 1 1/2 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 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 1/16 inch offset. Use line-up clamps for this purpose; however, take care to avoid damage to linings and coatings.
- f. Protect epoxy or cement 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-7018. Root or "Stringer" pass shall be performed with 6011 rods and Filler and Cap shall be done using 7018 rods.
- h. Deposit metal in successive layers to provide at least 2 passes or beads for automatic welding and 3 passes or beads for manual welding in completed weld.
- i. Deposit no more than 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. Otherwise, remove tack welds during welding operation.
- l. Remove dirt, scale, and other foreign matter from inside piping before tying in sections, fittings, or valves.
- m. Welded Joints for Large Diameter Water Lines:

- 1) Furnish pipe with trimmed spigots and interior welds for 36 inch and larger pipe.
- 2) Use exterior welds for 30 inch and smaller.
- 3) Only one end may be miter cut. Miter end cuts of both ends of butt-welded joints may be used for joint deflections of up to 2 ½ degrees.
- 4) For large diameter water lines, employ an independent certified testing laboratory, approved by Engineer, 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 test reports to Engineer for review. Engineer has final decision as to suitability of welds tested.
  - A) Weld acceptance criteria:
    - i) Cracking.
    - ii) Lack of fusion/penetration.
    - iii) Slag which exceeds one-third (t) where (t) equals material thickness.
    - iv) 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.
    - v) Relevant linear indications in which length of linear indication exceeds three times its width.
    - vi) 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. Provide cylindrical corrosion barriers for epoxy lined steel pipe 24 inch diameter and smaller, unless minimum wall thickness is 0.5 inches or greater.

- 1) In addition to welding requirements contained herein Paragraph 3.06, conform to protection fitting manufacturer's installation recommendations.
  - 2) Provide services of technical representative of manufacturer available on site at beginning of pipe laying operations. Representative to train welders and advise regarding installation and general construction methods. Welders must have 12 months prior experience installing protection fittings.
  - 3) All steel pipe is to have cutback 3/4 inch to no greater than 1 inch of internal diameter coating from weld bevel.
  - 4) Furnish steel fittings with cylindrical corrosion barriers with shop welded extensions to end of fittings. Extension length to measure no less than diameter of pipe. Shop apply lining in accordance with AWWA C210 or AWWA C213.
  - 5) All steel pipe receiving field adjustments are to be cold cut using standard practices and equipment. No cutting using torch is to be allowed.
4. Restrained Joints:
- a. For existing water lines and water lines less than 16 inches in diameter, restrain pipe joints with concrete thrust blocks.
  - b. Thrust restraint lengths shown on Drawings are minimum anticipated lengths. These lengths are based on deflections indicated for large diameter lines and ductile iron pipe for small diameter lines. Adjustments in deflections or use of other pipe material may result in reduction or increase of thrust lengths. Perform calculations by pipe manufacturer to verify proposed thrust restraint lengths. Submit calculations for all pipe materials sealed by a registered Professional Engineer in State of Texas for review by Engineer. Make adjustments in thrust restraint lengths at no additional cost to City.
  - c. Passive resistance of soil will not be permitted in calculation of thrust restraint.
  - d. 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 Drawings. Otherwise, provide restraint joints for a minimum length of 16 feet on each side of beveled joints.
  - e. Installation:

- 1) Install restrained joints mechanism in accordance with manufacturer's recommendations.
  - 2) Examine and clean mechanism; remove debris and other foreign material.
  - 3) Apply gasket and joint NSF 61 FDA per manufacturer's specification.
  - 4) Verify gasket is evenly seated.
  - 5) Do not over stab pipe into mechanism
- f. Prevent any lateral movement of thrust restraints throughout pressure testing and operation.
- g. 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.
5. Joint Grout (Steel Pipe):
- a. Mix cement grout mixture by machine except when less than 1/2 cubic yard is required. When less than 1/2 cubic yard is required, grout may be hand mixed. Mix grout only in quantities for immediate use. Place grout within 20 minutes of 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 retempering. Use grout for filling grooves of such consistency that it will 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 5/8-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. Joint pointing may be omitted on potable water pipelines if joint bands are protected by zinc metalizing or other approved protective coatings.
- 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 approved flexible sealer, such as Flex Protex 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. Obtain written acceptance from Project Engineer of inside joints before proceeding with next day's pipe laying operation. 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.
6. Large Diameter Water Main Joint Testing: In addition to testing individual joints with feeler gauge approximately 1/2 inch wide and 0.015-inch thick, use other joint testing procedure approved or recommended by pipe manufacturer which will help ensure watertight installation prior to backfilling. Perform tests at no additional cost to City.
7. Make curves and bends by deflecting joints or other method as recommended by manufacturer and approved by the Engineer. 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 Drawings.
  - 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 the Engineer 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.
8. Closures Sections and Approved Field Modifications to Steel 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; 3/8 inch from surface of steel plate or middle third of lining or coating thickness for mortar thickness less than 3/4 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 of butt strap over adjacent piece on butt-strap closures.
- F. Cathodic Protection Appurtenances:
- 1. Where identified on Drawings, modify pipe for cathodic protection as detailed on Drawings and specified. Unless otherwise noted, provide insulation kits including test stations 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 Drawings.
  - 2. Bond joints for pipe installed in tunnel or open cut, except where insulating flanges are provided. Weld strap or clip between bell and spigot of each joint or as shown on Drawings. 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 the Engineer
  - 3. Bonding Strap or Clip: Free of foreign material that may increase contact resistance between wire and strap or clip.



G. Anchorage of Fittings:

1. Anchor tees, elbows and plugs in water mains with concrete thrust blocks.
2. Place blocks so that joints will be accessible for inspection and repair.

H. Handling:

1. Place pipe along project site where storm water or other water will 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.
6. Repair damage to pipe or protective lining and coating before final acceptance.
7. For cement mortar line and coated steel pipe, permit no visible cracks longer than 6 inches, measured within 15 degrees of line parallel to pipe longitudinal axis of finished pipe, except:
  - a. In surface laitance of centrifugally cast concrete.
  - b. In sections of pipe with steel reinforcing collars or wrappers.
  - c. Within 12 inches of pipe ends.

8. Reject pipe with visible cracks (not meeting exceptions) and remove from project site.
- I. 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.
- J. Inspection: Before installation, inspect each pipe and fitting for defects. Reject defective, damaged or unsound pipe and fittings and remove them from site.

### 3.04 WET CONNECTIONS

- A. Definitions:
  1. Wet connections consist of isolating sections of pipe to be connected with installed valves, draining the isolated sections, and completing the connections.
  2. Connection of 2 inch or smaller lines, which may be referred to on Plans as "2 inch standard connections" or "gooseneck connections" will be measured as 2" wet connections. This item is not to be used as any part of a 2-inch service line.
- B. Materials:
  1. Corporation stops and saddles shall conform to requirements of Section 02515-Water Tap and Service Line Installation.
  2. Valves shall conform to requirements of Section 02541 – Fire Hydrant Assembly.
  3. Brass fittings shall conform to requirements of AWWA C800.
- C. Execution:
  1. Plan wet connections in such manner and at such hours as to least inconvenience public. Notify Public Works Department at least 48 hours in advance of making connections.
  2. DO NOT OPERATE VALVES ON MAINS IN USE BY OWNER. Owner will handle, at no cost to Contractor, all operations involving opening and closing valves for wet connections.
  3. Conduct connection operations when Inspector is at job site. Connection work shall progress without interruption until complete, once existing mains have been cut or plugs have been removed for making connections.

D. 2-Inch Wet Connections:

1. Tap water main. Provide and install corporation stops, saddles, as required for line and grade adjustment; and brass fittings necessary to adapt to existing main. Provide one Corporation Stop at main line and one Curb Stop at meter. The service line between Curb Stop and Corporation Stop shall be CTS Polyethylene, SDR-9.

### 3.05 CUT, PLUG AND ABANDONMENT OF MAINS

A. Materials:

1. Concrete for thrust blocks: Class B conforming to requirements of Section 03305.
2. Plugs and clamps shall be suitable for type of pipe to be plugged.

B. Execution:

1. Do not begin cut, plug and abandonment operations until replacement main has been constructed, disinfected, and tested, and all service lines have been transferred to replacement main.
2. Install plug, clamp, and concrete thrust block and make cut at location shown on Plans.
3. Main to be abandoned shall not be valved off and shall not be cut or plugged other than at supply main or as shown on Plans.
4. After main to be abandoned has been cut and plugged, check for other sources feeding abandoned main. If sources are found, notify Engineer immediately. Cut and plug abandoned main at point of other feed as directed by Engineer.
5. Plug or cap all ends or openings in abandoned main in an acceptable manner approved by Engineer.
6. Remove and dispose of all surface identifications such as valve boxes and fire hydrants. Valve boxes in improved streets, other than shell, may be poured full of concrete after removing cap.
7. Backfill all excavations in accordance with Section 02318 – Excavation and Backfill for Utilities.
8. Repair all street surfaces in accordance with Section 02980 – Pavement Repair.

**3.06 HYDROSTATIC TESTING**

- A. Hydrostatically test all new water pipelines for liquids before connecting to water distribution system.
- B. Pipelines shall be tested in lengths between valves, or plugs, of not more than 1,500 feet unless greater length is approved by Engineer.
- C. Conduct hydrostatic tests in presence of Engineer.
- D. Preparation:
  - 1. Disinfect water system pipelines prior to hydrostatic testing.
- E. Test Procedures:
  - 1. Furnish, install, and operate connections, pump, meter and gages necessary for hydrostatic testing.
  - 2. Allow pipeline to sit minimum of 24 hours from time it is initially disinfected until testing begins, to allow pipe wall or lining material to absorb water. Contractor should be aware that periods of up to 7 days may be required for mortar lining to become saturated.
  - 3. Expel all air and apply a minimum test pressure of 125 psi or 150 psi as directed by Engineer.
  - 4. Maintain test pressure for 8 hours. If a large quantity of water is required to maintain pressure during test, testing shall be discontinued until cause of water loss is identified and corrected.
- F. Allowable Leakage for Water Mains:
  - 1. During hydrostatic tests, no leakage will be allowed for sections of water mains consisting of welded joints.
  - 2. Maximum allowable leakage for water mains with rubber gasketed joints: 11.65 gallons per inch nominal diameter per mile of pipe per 24 hours while testing at the required pressure.
- G. Correction for Failed Tests:
  - 1. Repair all joints showing visible leaks on surface regardless of total leakage shown on test. Check all valves and fittings to ensure that no leakage occurs that could affect or invalidate test. Remove any cracked or defective pipes, fittings and valves discovered during pressure test and replace with new items.
  - 2. Repeat test until satisfactory results are obtained.

**3.07 DISINFECTION**

- A. All waterlines constructed shall be promptly disinfected before any tests are conducted on waterlines and before waterlines are connected to water distribution system.
- B. Water for disinfection and flushing will be furnished without charge to Contractor.
- C. Preparation:
  - 1. Furnish all required temporary blind flanges, cast-iron sleeves, plugs, and other items needed to facilitate disinfection of new mains prior to connecting them to water distribution system. Normally, each valved section of waterline requires two each 3/4-inch taps. A 2-inch minimum blow-off is required for waterlines up to and including 6-inch diameter.
  - 2. Fire hydrants shall be used as blow-offs to flush newly constructed waterlines 8-inch diameter and above. Where fire hydrants are not available on waterlines, locations and designs for blow-offs shall be as indicated on Plans. Install temporary blow-off valves and remove promptly upon successful completion of disinfection and testing. Abandon by turning off corp and using a stainless steel cap.
  - 3. Slowly fill each section of pipe with water in a manner approved by Engineer. Average water velocity when filling pipeline should be less than 1 fps and shall not, under any circumstance, exceed 2 fps. Before beginning disinfection operations, expel all air from pipeline.
  - 4. All excavations made shall be backfilled immediately after installation of risers or blow-offs.
  - 5. Install blow-off valves at end of main to facilitate flushing at all dead-end water mains. Install permanent blow-off valves/auto flusher per drawing LI
- D. Disinfection:
  - 1. Use not less than 100 parts of chlorine per million parts of water. Introduce chlorinating material to water lines in accordance with AWWA C651. After contact period of not less than 24 hours, flush system with clean water until residual chlorine is no greater than 1.0 parts per million parts of water. Open and close valves in lines being sterilized several times during contact period. If super-chlorinated water (i.e. chlorine concentration above 4mg/l) is used for cleaning water main disinfection and flushing, the water must be dechlorinated prior to discharge. The water discharged into the stormsewer system or natural waterway must meet the Clean Water Act (33 USC § 1251 et seq.) and any subsequent amendments thereof.
  - 2. If a chemical compound is used for a sterilizing agent, it shall be placed in pipes as directed by Engineer.

E. Bacteriological Testing:

1. After disinfection and flushing of waterlines, bacteriological tests will be performed by Owner or testing laboratory in accordance with Section 01450 – Testing Laboratory Services. If test results indicate need for additional disinfection of waterlines based upon Texas Department of Health and TCEQ requirements, Contractor shall perform additional disinfection operations at no additional cost to the Owner.

E. Completion:

1. Upon completion of disinfection and testing, remove risers except those approved for use in subsequent hydrostatic testing, and backfill excavation promptly.

**END OF SECTION**