

## SECTION 02664

## WATER MAINS

## PART 1 GENERAL

## 1.01 SECTION INCLUDES

- A. Installation of water mains.

## 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.
  - 1. Mains: Measure along axis of pipe and include fittings and valves.
  - 2. Branch Pipe: Measure from axis of main to end of branch.

## 1.03 SUBMITTALS

- A. Submittals shall conform to requirements of all provisions and sections of these specifications.
- B. Conform to submittal requirements of applicable specification section for type of pipe used.
- C. Submit preconstruction and post construction photographs if required.

## PART 2 PRODUCTS

## 2.01 PIPE MATERIALS

- A. Install pipe materials (as per this section) which conform to following:
  - 1. Section 02610 - Ductile Iron Pipe (DIP) and Fittings.
  - 2. Section 02611 - Steel Pipe and Fittings.
  - 3. Section 02620 - Polyvinyl Chloride (PVC) Pipe.
- B. Type of pipe materials used are identified on Drawings.

## PART 3 EXECUTION

## 3.01 GENERAL

- A. Conform to applicable specification sections 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. Lay pipe with bell ends facing in direction of laying.
- C. Lay pipe to lines and grades shown on drawings. Use adequate surveying methods and equipment and 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 for on-site record drawings.
- D. Confirm that separation from gravity sanitary sewers and manholes or force mains have minimum clearance of nine feet in all directions unless a special design is provided for on the drawings.
- E. Where above clearance cannot be attained, and a special design has not been provided on Drawings, obtain direction from Owner's Representative before proceeding with construction.
- F. Inform Owner's Representative if any unmetered sprinkler or fire line connections exist which are not shown on Drawings to be transferred to new main. Make transfer only after approval by Owner's Representative.
- G. Keep pipe trenches free of water which might impair pipe laying operations. Prevent pipe bells from coming in contact with subgrade. Grade pipe trenches to provide uniform support along bottom of pipe. Excavate for bell holes for proper sealing of pipe joints after bottom has been graded and in advance of placing pipe. Lay not more than 100 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 all 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.

### 3.02 HANDLING, CLEANING AND INSPECTION

- A. Handling:
  - 1. Place pipe along project site where storm water or other water will not enter or pass through pipe.
  - 2. Pipe and Fittings: Loaded, transported, unloaded and otherwise handled in manner and by methods which will prevent damage of any kind thereto. 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. Use every precaution 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 using carpet or some other suitable type of 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.
  5. Repair damage to pipe or protective lining and coating before final acceptance by Owner at no additional cost to Owner.
  6. Reject pipe with visible cracks and 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 all pipe laying and joining operations are completed, clean inside of pipe and remove all 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.

### 3.03 EARTHWORK

- A. Conform to applicable provisions of Section 02227 - Excavation and Backfilling for Utilities and Section 02317 - Augering Pipe for Water Lines.
- B. Bedding: Use bedding materials in conformance with Section 02229 - Utility Backfill Materials and detail in Drawings.
- C. Backfill: Use bank run sand or earth or native soil as specified in Section 02229 Utility Backfill Materials and in accordance with detail in Drawings.
- D. Place material in uniform layers of prescribed maximum loose thickness and wet or dry material to approximately optimum moisture content. Compact to prescribed density. Take laboratory field density tests at Owner's Representative's discretion.
- E. Pipe Zone: Including 6-inch pipe bedding and backfill to 12 inches above top of pipe.

### 3.04 PIPE CUTTING

- A. Cut pipe 12-inch and smaller with standard wheel pipe cutters. Cut pipe larger than 12-inch in manner approved by Owner's Representative. Make all cuts smooth and at right angles to axis of pipe. Bevel plain end with heavy file or grinder to remove sharp edges.

### 3.05 PIPING INSTALLATION

- A. Do not lay pipe unless subgrade is free of water. Do not lay pipe when it is raining or when trench is muddy or soft. Make adjustments of pipe to line and grade by scraping away subgrade or filling in with granular material. Wedging or blocking up bell will not be acceptable.
- B. Do not install pipe at greater depth than its design allows.
- C. Protection of Pipeline: Securely place stoppers or bulkheads in all openings and in end of line when construction is stopped temporarily and at end of each day's work.
- D. For nonmetallic pipe, install magnetic locator tape continuously along the top of the pipe.
- E. Temporary services and mains shall be installed to ensure no interruption of water supply during installation of new water mains and services.

### 3.06 JOINTS AND JOINTING

- A. Rubber Gasketed Bell-and-Spigot Joints (PVC and DIP):
  - 1. Lubricate gaskets with nontoxic water-soluble lubricant before pipe units are joined.
  - 2. Fit pipe units together in manner to avoid twisting or otherwise displacing or damaging rubber gasket.
  - 3. After the 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.
  - 4. Where preventing movement of 12" diameter or greater pipe due to thrust is necessary, provide the following restrained joints, or equal:
    - a. Ductile-Iron Pipe:
      - (1) Super-Lock Joint by Clow Corporation/McWane Ductile.
      - (2) Flex-Ring or Lok-Ring by AMERICAN Cast Iron Pipe Company.
      - (3) TR-Flex or Field-Lok 350 by U.S. Pipe.
    - b. PVC Pipe:
      - (1) Fittings: Series 2000 PV Fitting Restrainer by EBAA Iron, Inc. (MEGALUG), or approved equal.
      - (2) Bell and Spigot: Series 1500/1600/1900 Joint Restrainer by Ebba Iron, Inc., or approved equal.
    - c. Steel Pipe: Welded joints (see Part 3.05C)

**B. Flanged Joints (DIP, Steel):**

1. 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 centerline. Do not exceed 3/64 inch per foot inclination of flange face from true alignment.
2. Use full-face gaskets for all flanged joints. Provide 1/8-inch thick cloth inserted rubber gasket material. Cut gaskets at the factory to proper dimensions.
3. Use galvanized or black nuts and bolts to match flange material. Use cadmium-plated steel nuts and bolts underground. Tighten bolts progressively to prevent unbalanced stress. Draw bolts tight to ensure proper seating of gaskets.

**C. Welded Joints (Steel):**

1. Joints: AWWA C206. Full-fillet, single lap-welded slip type either inside or outside, or double butt-welded type; use automatic or hand welders; provide complete penetration of deposited metal with base metal; provide filler metal suitable for use 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.
2. 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 proper 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.
3. Align piping and equipment so that no part is offset more than 1/8 inch. Set all 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, care shall be taken to avoid damage to linings and coatings.
4. 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.
5. Welding Rods: Compatible with metal to be welded to obtain strongest bond, E-70XX.
6. 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.

7. 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.
8. Do not weld under any weather condition that would impair strength of weld, such as wet surface, rain or snow, dust or high winds, unless work is properly protected.
9. Tack weld of same material and make by same procedure as completed weld. Otherwise, remove tack welds during welding operation.
10. Remove dirt, scale and other foreign matter from inside piping before tying in sections, fittings or valves.

D. Joint Grout (Steel):

1. Mix grout 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. Use grout within 20 minutes after mixing. Discard grout that has set. Retempering of grout by any means is not permitted.
2. Prepare grout in small batches to prevent stiffening before it is used. Any grout which has become so stiff that proper placement cannot be assured without retempering by any means shall be wasted. Provide grout for filling grooves of such consistency that it will adhere to ends of pipe.
3. Surface Preparation: Remove all 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 all foreign materials from all metal surfaces in contact with grout.
4. Follow established procedures for hot and cold weather concrete placement.
5. 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.
6. Grouting exterior joint space: Use minimum 9-inch-wide Ethafoam "diaper" or wrapper placed around pipe and over joint. 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 the 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 a structurally protective material. Do not remove band from joint.

7. Interior Joints for Pipe Smaller than 24-Inch: 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.
  8. 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 the joint bands are protected by zinc metallizing or other approved protective coatings.
  9. Remove and replace all improperly cured or otherwise defective grout at no additional cost to Owner.
  10. 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 all steel in joint area. Fill interior of joint with grout in normal manner after joint closure.
- E. Joint Testing:
1. In addition to testing individual joints with feeler gage approximately 1/2-inch wide and 0.015-inch thick, use any other joint testing procedure approved or recommended by pipe manufacturer which will help ensure watertight installation prior to backfilling. These tests shall be made at no additional cost to Owner.
  2. On any joint or seam welded after hydrostatic testing or not subjected to hydrostatic testing, test 100 percent of welded joint by methods as described in section on Welded Joints. Owner reserves right to require Contractor to make additional tests at Owner's expense except that if tests performed at Contractor's expense or Owner's expense indicate an unacceptable weld, then cost of test, subsequent repair of rejected weld and test of repaired weld shall be borne by Contractor.
- F. Make curves and bends by deflecting joints or other method as approved by manufacturer and Owner's Representative.
1. Deflection of pipe joints shall not exceed maximum deflection recommended by AWWA and pipe manufacturer, unless otherwise indicated on Drawings.
  2. If deflection exceeds maximum allowable, the contractor shall remove and install new pipe.
  3. Contractor shall replace, repair or reapply coatings and linings as required above.
  4. No additional payment will be made for above described work.

5. Assessment of deflection may be measured by Owner at any location along pipe. Arithmetical averages of deflection or similar average measurement methods will not be deemed as meeting intent of standard.
6. Contractor may submit details of other methods of providing curves and bends for consideration by Owner's Representative, and if deemed satisfactory, shall be installed at no additional cost to Owner.
7. When rubber gasketed pipe is laid on a curve, joint pipe in a straight alignment and then deflect to curved alignment.

G. Closures and Field Modifications:

1. Apply welded-wire fabric reinforcement to interior and exterior of all 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.
2. Fill all exposed interior and exterior surfaces with nonshrink grout.

3.07 SECURING, SUPPORTING AND ANCHORING

- A. Support piping as shown on Drawings and as specified herein, to maintain line and grade and prevent transfer of stress to adjacent structures.
- B. Where shown on Drawings, anchor pipe fittings and bends installed on water main by welding consecutive joints of pipe together to distance each side of fitting. Restrained length, as shown on Drawings, assumes that installation of pipe and subsequent hydrostatic testing begin 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).
- C. Provide adequate temporary blocking of fittings when making connections to distribution system and during hydrostatic tests. Provide sufficient anchorage and blocking to resist all stresses and forces encountered while tapping existing waterline.

3.08 THRUST RESTRAINT

- A. For new water lines 12 inches in diameter and larger, restrain joints as specified in Part 3.06 A.4 of this section. The new water line shall also be additionally restrained with concrete thrust blocking.
- B. For existing waterlines and waterlines less than 12 inches in diameter, restrain pipe joints with concrete thrust blocks or provide joints as specified in Part 3.06A.4 of this section.
- C. Prevent any lateral movement of thrust restraints throughout pressure testing and operation. Place 2500 psi concrete conforming to Section 03305, Concrete for Utility Construction, for

blocking at each change in direction of existing water lines, and water lines 12 inches in diameter and smaller to brace pipe against undisturbed trench walls. Complete 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.

### 3.09 POLYETHYLENE WRAP

- A. Double wrap all ductile iron pipe and appurtenances (except fire hydrants) with 8-mil polyethylene film.
- B. Conform to requirements of Section 02630 - Polyethylene Wrap.

### 3.10 CLEANUP, RESTORATION AND PAYMENT

- A. Provide "cleanup" and "restoration" crews to work closely behind pipe laying crews, and where necessary, during chlorination, testing, service transfers, abandonment of old mains, backfill and surface restoration.
- B. Upon completion of water line installation in a street and prior to moving to another, chlorinate and pressure test. Provide City a sampling point every 1000 L.F. for testing. Begin transfer of services no later than seven calendar days after successful completion of chlorination and pressure testing.
- C. After completion of transfer of services, but no later than 21 calendar days after successful completion of chlorination and pressure testing, begin abandonment of old mains, backfill, resod, and placement of sidewalks and pavements.
- D. Do not begin construction of additional sections if above conditions are not met.

### 3.11 CLEANING PIPING SYSTEMS

- A. Remove construction debris or foreign material and thoroughly clean and flush piping systems. Provide temporary connections, equipment and labor for cleaning.

### 3.12 DISINFECTION OF WATERLINES

- A. Conform to requirements of Section 02675 - Disinfection of Waterlines.

### 3.13 FIELD HYDROSTATIC TESTS

- A. Conform to requirements of Section 02676 - Hydrostatic Testing of Pipelines.

END OF SECTION