



**PHOENIX ENGINEERING
& SURVEYING, LLC**

Civil Engineers • Planners • Surveyors

**3855 S. Northern Blvd.
Independence, MO 64052**

**(816) 743-9000
FAX (816) 743-9700**

WATERLINE SPECIFICATIONS

BRADEN PARK VILLAGE WATER LINE REPLACEMENT

Benton County, Missouri

WATERLINES

The purpose of this specification is to govern the furnishing of all materials, labor, equipment, tools, superintendence, and other services necessary to construct water mains, complete with appurtenances including extensions and relocations at the locations shown on the plans, in accordance with the requirements of applicable Sections of the General Provision and Covenants, and as provided for in the Special Provisions.

MATERIALS

Pipe and Fittings

A. Poly(vinyl chloride) Pipe and Fittings:

Rigid PVC compound used in the manufacture of piping systems shall comply with the material requirement of ASTM D 1784, have a cell classification of 12454 and be in accordance to the requirements of NSF 61 for use in potable water. The piping system components should conform to NSF Standard 14 and the following ASTM standards:

| | |
|-------------------|-------------------------------|
| · Pipe | ASTM D 2241 (SDR-21, 200 psi) |
| · Fittings-socket | ASTM D 2466 |
| · Valves | ASTM F 1970 |
| · Solvent cement | ASTM D 2564 |
| · Primer | ASTM F 656 |

PVC SDR pipe is marked as prescribed in ASTM D 2241 as follows: Manufacturer, Nominal Pipe Size, IPS PVC, SDR #, and/or the pressure rating in psi for water at 73°F (23°), ASTM D2241, and NSF 61 Potable.

Joints for PVC pipe shall be slip-on type with integral bell and spigot pipe, or pipe with extruded type couplings, meeting the requirements of ASTM D3139, except flexible elastomeric gaskets meeting the requirements of ASTM F477, shall be synthetic rubber. Natural rubber will not be acceptable.

B. Ductile-Iron Fittings:

Ductile-iron fittings shall be complete with all accessories and shall be ASTM A536, Grade 70-50-05, conforming to ANSI A21.10/AWWA C110, 350 psi pressure rating. Joints shall be of the standard mechanical joint type conforming to ANSI A21.11/AWWA C111. All fittings shall be cement mortar lined conforming to ANSI A21.4/AWWA C104 and shall be coated inside and out with a bituminous coating. Fittings shall have distinctly cast upon them the pressure rating and letters "DI" or "DUCTILE".

C. Cast-Iron Fittings:

Cast-iron fittings in sizes 4 inches through 12 inches shall be complete with all accessories and shall conform to ANSI A21.10, 250 psi pressure rating. Joints shall be of the standard mechanical joint type conforming to ANSI A21.10/AWWA C110. All fittings shall be cement mortar lined conforming to ANSI A21.4/AWWA C104, and shall be coated inside and out with a bituminous coating.

Valves and Valve Boxes:

A. Valves:

The type, size, and location of valves shall be as shown on the Plans. Except as modified or provided herein, all valves in pipelines shall be 200 psi, PVC ball valves.

B. Valve Ends:

Valve ends shall allow for solvent-weld connection to SDR-21 200 psi PVC.

D. Tapping Valves:

The size and location of the tapping valves shall be as shown on the plans. The valves shall be 200 psi, iron body, double disc or resilient-seated gate valves with non-rising stems conforming with all applicable requirements of ANSI/AWWA C500 and C509, except that the outlet end shall be standard mechanical joint end conforming to ANSI A21.11/AWWA C111 and the inlet end shall have an inlet flange conforming to ANSI B16.1 for cast iron flanges, Class 125.

E. Valve Boxes, Bases, Lids and Covers:

1. Valve Box:

Boxes shall be 6 inch, Class 22, CIP; 6 inch, Class 50, DIP; or 6 inch, Class 200, PVC pipe.

2. Lids and Covers

Valve lids and covers shall be 6 inch PVC caps, installed outside of paved areas. Valves shall not be installed in paved areas.

Specials

A. General:

Air release, meter, and pressure reducing valve vaults shall be 18-inch diameter dual-wall HDPE conforming to ASTM D 2412. Access lid castings shall be as noted in the Special Provisions or as shown on the plans.

B. Pressure-Reducing Valves

Pressure-reducing valves shall be designed to provide tight shutoff under conditions of no flow and shall not "hunt" under ordinary flow conditions. Pressure-reducing valves shall be as noted in the Special Provisions, selected and sized as recommended by the valve manufacturer. Pressure-reducing valves shall be suitable for operation under the pressure and flow conditions as shown on the plans.

C. Combination Air Valves

Combination air-release and vacuum-relief valves shall be installed at the locations indicated on the plans. Each valve assembly shall be installed complete with appropriate piping and valves as shown on the plans. All piping and isolation valves shall be brass except for the air outlet from the valve which shall be brass or copper tubing.

D. Tapping Sleeves:

Tapping sleeves shall be standard mechanical joint type for iron pipe and shall comply with all applicable requirements of ANSI A21.10/AWWA C110 for iron fittings. Tapping sleeves shall be furnished with a flanged outlet conforming in dimensions and drilling to ANSI B16.1, Class 125.

Bedding Material

A. Pipe Embedment:

Embedment for pipe shall be in accordance with these specifications and details of the laying condition as specified.

B. Granular Bedding:

Granular bedding shall be crushed rock or pea gravel with not less than 95% passing 3/4" sieve and not less than 95% retained on a 3/8" sieve, sand, or other fine-grained non-acidic granular material, to be placed in not more than 6 inch layers and compacted by slicing with a shovel or vibrating.

C. Buckshot:

Buckshot aggregate material may be used in lieu of granular materials for embedment of PVC pipe and for backfilling pavement excavations. Place in not more than 6 inch layers and compact by slicing with a shovel or vibrating. The gradation for the material shall be as follows:

| <u>Sieve Size</u> | <u>Percent Passing by Weight</u> |
|-------------------|----------------------------------|
| 3/8-inch | 100 |
| No. 4 | 60-80 |
| No 10 | 0-15 |

D. Hand-Placed Embedment:

Hand-placed embedment shall be finely divided job-excavated material free from debris, organic material, frozen materials, and stones placed by machine or hand in uniform layers not more than 8 inches thick and tamped around the water main. Granular embedment material may be substituted for all or part of this type of embedment.

Location Wire and Tape:

Location wire or detection marking tape shall be buried above plastic water main.

A. Location Wire:

Location wire shall be No. 9 bare aluminum wire laid directly on top of PVC pipe and connected to valve boxes and existing iron piping as shown on the Standard Drawing.

B. Detection Marking Tape

Detection marking tape shall be solid aluminum foil core tape completely encased in polyethylene jacket, 5.5 mills thick minimum, 6 inches wide, Allen System, Inc. A Detectatape® or Reef Industries, Inc. ATerra Tape D® or approved equal.

The detection tape marking tape shall be blue in color and have **Buried Water Line Below** printed on the tape at 20 to 30 inch intervals. The detection and marking tape shall be installed directly above the centerline of the pipe and 18-24 inches below finish grade.

CONCRETE

A. Scope:

This specification is intended primarily for concrete thrust blocks, encasements and vaults. Concrete for all driveway, sidewalk, roadway and/or curb and gutter replacement shall conform to the requirements of Section 2301, 2302, 2200 of the latest edition of the *Standard Specification and Design Criteria*, published by the American Public Works Association, Kansas City Chapter and the appropriate authority having jurisdiction thereof.

B. General:

The concrete shall be MCIB A618-1-4 as designated by the Mid-West Concrete Industry Board, Inc., Kansas City, Missouri

1. The cement shall be Portland Cement type I unless high early strength is required in which instance type III shall be used. All cement shall conform to the "Standard Specification for Portland Cement," ASTM C150.
2. All aggregates shall conform to the appropriate bulletins and specifications of the Mid-West Concrete Industry Board, Inc.
3. Water for mixing and curing concrete shall be clean and free from injurious amounts of sewage, oil, acid, alkali, salt or organic matter. Only potable water will be acceptable without testing. Total water content of concrete shall not exceed 6.5 gallons of water per 100 pounds of cement in the mix.
4. Ready-mixed concrete shall be used unless otherwise permitted by the Engineer. Ready-mixed concrete shall be mixed and delivered in accordance with the requirements set forth in the "Standard Specifications for Ready-Mixed Concrete," ASTM C94.

Casing Pipe:

Casing pipe shall be used where required at railroad or highway crossings. The casing pipe shall be in accordance with the Special Provisions and meet the requirements of the railroad or highway authority with regard to type of material, wall thickness and coating of casing pipe. No casing will be installed without the approval of the involved highway or railroad authority.

CONSTRUCTION DETAILS

INSTALLATION

General

Laying of ductile-iron pipe, and poly(vinyl chloride) pipe, installation of valves, and hydrants; and embedment and backfill shall conform to the following specifications and the details as shown on the plans.

1. Unless otherwise specified or shown on the plans, the water mains shall be laid to have a minimum cover of 42 inches, measured from the finished grade or from established street grades shown on the plans.
2. Whenever pipe laying is stopped, the open end of the line shall be sealed with a watertight plug which will prevent trench water from entering the pipe.
3. Where the pipe is to be installed inside a casing pipe or tunnel liner, creosoted timber skids shall be strapped to each pipe before it is placed in the casing pipe or tunnel liner in accordance with these specifications and as shown on the plans. Sand fill shall be used when shown on the plans or required by the Special Provisions. The ends of each casing pipe or tunnel liner shall be closed with a dry brick wall or as shown on the plans. The closures for each casing pipe or tunnel liner shall not be constructed until all testing of the line has been completed and accepted.

Poly(vinyl chloride) Pipe:

1. **Handling**
Pipe, fittings, and other accessories shall at all times be handled with care to avoid damage. Under no circumstances shall they be dropped. Pipe fittings, shall be handled as specified for ductile-iron pipe. Any damaged pipe shall be rejected.
2. **Cutting Pipe:**
All pipe shall be cut with a saw or special cutting tool. Cutting shall be done in a neat manner without damage to the pipe. Cuts shall be smooth, straight and at right angles to the pipe axis. After cutting, the end of the pipe shall be dressed and beveled. beveling shall be done with a specifically designed beveling tool. Hand beveling will not be allowed. When cutting pipe with couplings, mark the field cut pipe end the same distance in as the mark appearing on the original full-length pipe section.
3. **Cleaning:**
The interior of all pipe and fittings shall be thoroughly cleaned of foreign matter before being installed and shall be kept clean until the work has been accepted.
4. **Pipe Laying:**
PVC pipe shall be installed in strict accordance with the requirements and instructions of the pipe manufacturer. It shall be protected from lateral displacement and deflection by pipe embedment material installed as specified for pipe embedment and as shown on the Standard Drawings. No pipe shall be laid under unsuitable trench conditions. Whenever pipe laying is stopped, the open end of the line shall be sealed with a watertight plug which will prevent trench water from entering the pipe.

JOINTING

A. Push-on Joints:

The gasket seat in the bell end shall be wiped clean after which the gasket should be placed. A thick film of lubricant should be applied to all of the inner surface of the gasket and on the spigot end of the pipe.

The lubricant and the gaskets shall be as recommended and supplied by the manufacturer of the pipe being used. The lubricant shall be odorless, tasteless, nontoxic, and suitable for use in potable water.

Field-cut pipe shall be bevel filed to remove any sharp or rough edges which might otherwise damage the gasket.

B. Mechanical Joints:

The mechanical joint shall be used only when shown on the plans.

C. Flanged Joints:

When bolting flanged joints, care shall be taken to ensure that there is no restraint on the opposite end of the pipe or fitting which would prevent uniform gasket compression or which would cause unnecessary stress in the flanges. One flange shall be free to move in any direction while the flange bolts are being tightened. Bell-and-spigot joints shall not be packed or assembled until all flanged joints affected thereby have been tightened. Bolts shall be tightened gradually and at a uniform rate so that gasket compression is uniform.

D. Restrained Joints:

Restrained joints and anchoring joints shall be installed in strict accordance with the pipe manufacturer's recommendations.

Connection to Existing Mains:

The contractor shall furnish and install all fittings necessary to join the existing and new water mains as shown on the plans.

The City shall be given at least 24 hours notice prior to turning off any water supply mains. The contractor shall coordinate tie-ins with the City to minimize down time.

Setting Valves and Fittings:

All valves, fittings, plugs and caps shall be set and joined to the pipe in the manner heretofore specified for cleaning, laying and joining pipe, except that large valves may require special support so that the pipe will not be required to support the valve weight.

Each valve shall be inspected before installation to ensure that all foreign substances have been removed from within the valve body, and shall be opened and closed to see that all parts are in first-class working condition. Gate valves shall be set vertical in the horizontal pipeline. Valves and pipe shall be supported in such a manner as to prevent stress in either with no deflection in the valve/pipe joint.

Valve boxes and lids shall be installed at each valve and shall be supported and maintained centered and plumb over the operating nut of the valve. The valve box shaft shall not transmit shock or stress to the valve. Install valve box covers flush with the surface of the finished area or as directed by the Engineer.

All bends and tees shall be provided with thrust blocks of plain concrete, as specified. All dead ends on new mains shall be closed with plugs or caps suitably restrained to prevent blowing off under test pressure.

Thrust Restraint:

A. Fittings:

All plugs, caps, tees, bends and other fittings, unless otherwise specified, shall be provided with reaction blocking or suitably restrained joints as shown on the plans or Standard Drawings.

B. Thrust Blocks:

Vertical and horizontal reaction blocking shall be concrete as specified herein. Thrust blocks shall be installed between solid ground and the fitting to be restrained. Concrete shall be located to contain the resultant thrust force and permit access to pipe and fitting joints for repairs.

C. Restrained Joints:

Restrained push-on or mechanical joints, mechanical joint anchoring fittings, and mechanical joints utilizing set screw ductile-iron retainer glands may be used in lieu of concrete thrust blocking if so indicated on the plans or approved by the Engineer.

Embedment and Backfilling:

Embedment and backfill shall be accomplished in accordance with the laying condition as specified and as shown on the plans or the Standard Drawings.

Pipe Embedment

Embedment for pipe shall be in accordance with these specifications and details of the laying condition as indicated on the plans.

Trench Backfill

Backfill for the entire length of the pipeline shall be compacted full depth of the trench above the embedment.

1. Compacted backfill shall be finely divided job-excavated material free from debris, organic material, frozen materials, and stones larger than 6 inches in greatest dimension. Masses of moist, stiff clay shall be used.
2. Whenever, in the opinion of the Engineer, the material excavated from the trenches is not suitable for backfilling, or there is a deficiency of material suitable for backfilling, the Contractor shall provide suitable material. The Contractor shall remove all excess excavated materials and shall dispose of them at locations provided by the Contractor.
3. At the option of the Contractor, compacted backfill may be either job-excavated material or granular bedding.

Placement and Compaction

1. Job-excavated materials shall be placed in uniform layers not exceeding 8 inches in uncompacted thickness. Increased layer thickness may be permitted for noncohesive material if the Contractor demonstrates to the satisfaction of the Engineer that the specified compacted density will be obtained. The method of compaction and the equipment used shall be appropriate for the material to be compacted and shall not transmit damaging shocks to the pipe.
2. Granular bedding and buckshot aggregate used for backfill shall be placed in uniform layers not exceeding 6 inches and compacted by slicing with a shovel or vibrating.
3. Compaction in undeveloped areas shall be equivalent to existing soils and adequate to prevent significant future settlement. Finish grade shall be slightly mounded.
4. Compaction under all pavements and shoulders, driveways, and sidewalks shall be the following percent of maximum density at optimum moisture content as determined by the Standard Proctor Test, ASTM D698:

| <u>Location</u> | <u>Cohesive Soils</u> | <u>Cohesionless Materials</u> |
|--------------------|---------------------------|-----------------------------------|
| Top 6 Inches | 95% | 80% |
| Remainder of Depth | 90% | 75% |

5. Compaction under street or highway back slopes, berms, median strips, and developed yards shall be 90 percent for the entire length.
6. Backfill failing to meet required densities shall be removed or scarified and recompacted as necessary to achieve specified results.

Disinfection and Testing

A. Disinfection:

After installation, the entire main shall be flushed and disinfected by chlorination. Flushing shall be carried out until a turbidity-free water is obtained from all points along the main. The Contractor shall disinfect the main or prepare the main for disinfection by the City when so noted in the Special Provisions.

1. Chlorination by the Contractor shall conform to AWWA C651 and be performed using a 1 percent chlorine solution prepared from granular calcium hypochlorite [1 pound of HTH per 8 gallons of water]. Water entering the new main shall receive a dose of the chlorine solution fed at a constant rate such that the water will not have less than 25 mg/l free chlorine.

**Chlorine Required to Produce 25 mg/l
Concentration in 100 feet of Pipe**

| <u>Pipe Diameter</u> | <u>1 Percent Chlorine Solution</u> |
|----------------------|------------------------------------|
| <u>inch</u> | <u>Gal.</u> |
| 3 | 0.13 |
| 4 | 0.16 |
| 6 | 0.36 |
| 8 | 0.65 |
| 10 | 1.02 |
| 12 | 1.44 |

2. The chlorinated water shall be retained in the main for at least 24 hours, during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances.
3. At the end of the 24-hour period, the treated water in all portions of the main shall have a residual of not less than 10 mg/l free chlorine.
4. Mains shall be flushed and bacteriological tests performed in accordance with AWWA C651 prior to placing in service. The flushing water shall be disposed of without damage to public or private property.
5. The contractor shall repeat disinfection procedure, including bacteriological testing, should initial treatment fail to yield satisfactory results.

B. Hydrostatic Testing:

The contractor shall perform hydrostatic pressure and leakage tests in accordance with AWWA C600 procedures. Where practicable, mains shall be tested in lengths between line valves or plugs of no more than 1,500 feet in length.

Conduct test at a pressure of 150 psi measured at the highest point of the main. Duration of the test shall be not less than 2 hours. Maintain pressure throughout test +/- 5 psi of test pressure.

Leakage test shall be conducted concurrently with the pressure test. Acceptable when leakage does not exceed that determined by the following formula:

$$L = \frac{SDP^2}{133,200}$$

where L = Maximum allowable leakage in gallons per hour
 S = Length of pipe tested in feet
 D = nominal internal diameter of pipe being tested in inches
 P = average actual leakage test pressure in psi

When testing against closed metal-sealed valves an additional leakage per closed valve of 0.0078 gal/hr/in of nominal valve size shall be allowed. When hydrants are in the test section, the test shall be made against the closed hydrant.

All visible leaks at exposed joints and all leaks evident on the surface where joints are covered shall be repaired regardless of total leakage as shown by test. All pipe, fittings, valves and other materials found to be defective under test shall be removed and replaced at the Contractor's expense.

Lines which fail to meet test shall be repaired and retested as necessary until the test requirements are met.

Surface Restoration

Seeding and Sodding:

All unpaved areas cut by the line of trench or excavation or damaged during the work shall be seeded or sodded when specifically indicated on the plans. Seeding and Sodding shall conform with Section 2400 of the latest edition of the "Standard Specifications and Design Criteria" as published by the Kansas City Metropolitan Chapter of the American Public Works Association.

Sidewalks and Driveways

All paved sidewalk and driveway areas cut by the line of trench or excavation or damaged during the work shall be replaced. Sidewalk and driveway replacement shall conform to the requirements of Section 2301 of the latest edition of the "Standard Specifications and Design Criteria" as published by the Kansas City Metropolitan Chapter of the American Public Works Association.

Streets and Curbing

All paved street, shoulder and curbing areas cut by the line of trench or excavation or damaged during the work shall be replaced to conform to the lines and grades of the original pavement and shall be of equal quality, thickness and appearance to that removed. Paving and curb replacement shall conform to the requirements of Section 2200 of the latest edition of the "Standard Specifications and Design Criteria" as published by the Kansas City Metropolitan Chapter of the American Public Works Association.

Separation of Water Mains, Sanitary Sewers and Combined Sewers

General

The following factors should be considered in providing adequate separation:

- a. Materials and type of joints for water and sewer pipes;
- b. Soil conditions;
- c. Service and branch connections into the water main and sewer line;
- d. Compensating variations in the horizontal and vertical separations;
- e. Space for repair and alterations of water and sewer pipes; and
- f. Off-setting of water mains around manholes

Parallel Installation

Water mains shall be laid at least 10 feet horizontally from any existing or proposed sewer. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10-foot separation, the department may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the water main closer to a sewer, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of

the sewer and on either case, at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer. In areas where the recommended separations cannot be obtained, either the water line or the sewer line shall be constructed of mechanical joint pipe or cased in a continuous casing.

Crossings

Water mains crossing sewers shall be laid to provide a minimum vertical clear distance of 18 inches between the outside of the water main and the outside of the sewer. This shall be the case where the water main is either above or below the sewer. At crossings, the full length of water pipe shall be located so both joints will be as far from the sewer as possible but in no case less than ten feet. Special structural support for the water and sewer pipes may be required. In areas where the recommended separations cannot be obtained either the water line or the sewer line shall be constructed of mechanical joint pipe or cased in a continuous casing that extends no less than ten feet on both sides of the crossing.

Exception

Any variance from the above specified separation distances must be submitted to the Missouri Department of Natural Resources for approval.

Force Mains

There shall be at least a ten-foot horizontal separation between water mains and sanitary sewer force mains and they shall be in separate trenches. In areas where these separations cannot be obtained, either the water line or the sewer line shall be cased in a continuous casing.

Sewer Manholes

No water line shall be located closer than ten feet to any part of a sanitary or combined sewer manhole.

Disposal Facilities

No water line shall be located closer than ten feet to any on-site wastewater disposal facility, agricultural waste disposal facility, or landfill.