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TECHNICAL SPECIFICATIONS

Water and Sewer Utilities in Close Proximity

The CONTRACTOR shall comply with the following rules which apply to installations of potable water distribution lines and wastewater collection lines, wastewater force mains and other conveyances/appurtenances identified as potential sources of contamination. Furthermore, all ratings specified shall be defined by ASTM or AWWA standards unless stated otherwise.

When new potable water distribution lines are constructed, they shall be installed no closer than nine feet in all directions to wastewater collection facilities. All separation distances shall be measured from the outside surface of each of the respective pieces.

Potable water distribution lines and wastewater collection lines or force mains that form parallel utility lines shall be installed in separate trenches.

No physical connection shall be made between a drinking water supply and a sewer line. Any appurtenance shall be designed and constructed so as to prevent any possibility of sewage entering the drinking water system.

Where the nine foot separation distance cannot be achieved, the following criteria shall apply.

A. New Waterline Installation - Parallel Lines

A.1. Where a new potable waterline parallels an existing, non-pressure or pressure rated wastewater line/force main or lateral and the licensed professional engineer licensed in the State of Texas is able to determine that the existing wastewater main or lateral is not leaking, the new potable waterline shall be located at least two feet above the existing wastewater main or lateral, measured vertically, and at least four feet away, measured horizontally, from the existing wastewater main or lateral. Every effort shall be exerted not to disturb the bedding and backfill of the existing wastewater line.

A.2. Where a new potable waterline parallels an existing pressure rated wastewater main or lateral and it cannot be determined by the licensed professional engineer if the existing line is leaking, the existing wastewater main or lateral shall be replaced with at least 150 psi pressure rated pipe. The new potable waterline shall be located at least two feet above the new wastewater line, measured vertically, and at least four feet away, measured horizontally, from the replaced wastewater main or lateral.

A.3. Where a new potable waterline parallels a new wastewater line/force main, the wastewater main or lateral shall be constructed of at least 150 psi pressure rated pipe. The new potable waterline shall be located at least two feet above the wastewater main or lateral, measured vertically, and at least four feet away, measured horizontally, from the wastewater main or lateral.
B. New Waterline Installation - Crossing Lines

B.1. Where a new potable waterline crosses an existing, non-pressure rated wastewater main or lateral, one segment of the waterline pipe shall be centered over the wastewater main or lateral such that the joints of the waterline pipe are equidistant and at least nine feet horizontally from the centerline of the wastewater main or lateral. The potable waterline shall be at least two feet above the wastewater main or lateral. Whenever possible, the crossing shall be centered between the joints of the wastewater main or lateral. If the existing wastewater main or lateral is disturbed or shows signs of leaking, it shall be replaced for at least 9 feet in both directions (18 feet total) with at least 150 psi pressure rated pipe.

B.2. Where a new potable waterline crosses an existing, pressure rated wastewater main or lateral, one segment of the waterline pipe shall be centered over the wastewater main or lateral such that the joints of the waterline pipe are equidistant and at least nine feet horizontally from the centerline of the wastewater main or lateral. The potable waterline shall be at least six inches above the wastewater main or lateral. Whenever possible, the crossing shall be centered between the joints of the wastewater main or lateral. If the existing wastewater main or lateral shows signs of leaking, it shall be replaced for at least 9 feet in both directions (18 feet total) with at least 150 psi pressure rate pipe.

B.3. Where a new potable waterline crosses a new, non-pressure rated wastewater main or lateral and the standard pipe segment length of the wastewater main or lateral is at least 18 feet, one segment of the waterline pipe shall be centered over the wastewater main or lateral such that the joints of the waterline pipe are equidistant and at least nine feet horizontally from the centerline of the wastewater main or lateral. The potable waterline shall be at least two feet above the wastewater main or lateral. Whenever possible, the crossing shall be centered between the joints of the wastewater main or lateral. The wastewater pipe shall have a minimum pipe stiffness of 115 psi at five percent deflection. The wastewater line shall be embedded in cement stabilized sand (see clause B6 of this subparagraph) for the total length of one pipe segment plus 12 inches beyond the joint on each end.

B.4. Where a new potable waterline crosses a new, non-pressure rated wastewater main or lateral and a standard length of the wastewater pipe is less than 18 feet in length, the potable water pipe segment shall be centered over the wastewater line. The materials and method of installation shall conform with one of the following options:

B.4.I. Within nine feet horizontally of either side of the waterline, the wastewater pipe and joints shall be constructed with pipe material having a minimum pressure rating of 150 psi. An absolute minimum vertical separation distance of two feet shall be provided. The wastewater main or lateral shall be located below the waterline.

B.4.II. All sections of wastewater main or lateral within nine feet horizontally of the waterline shall be encased in an 18 foot (or longer) section of pipe. Flexible encasing pipe shall have a minimum pipe stiffness of 115 psi at five percent deflection. The encasing pipe shall be centered on the
waterline and shall be at least two nominal pipe diameters larger than the wastewater main or lateral. The space around the carrier pipe shall be supported at 5 foot (or less) intervals with spacers or be filled to the springline with washed sand. Each end of the casing shall be sealed with water tight non-shrink cement grout or a manufactured water tight seal. An absolute minimum separation distance of six inches between the encasement pipe and the waterline shall be provided. The wastewater line shall be located below the waterline.

B.4.III. When a new waterline crosses under a wastewater main or lateral, the waterline will be encased as described for wastewater lines in subclause (II) above or constructed of ductile iron or steel pipe with mechanical or welded joints as appropriate. An absolute minimum separation distance of 1 foot between the waterline and the wastewater main or lateral shall be provided. Both the waterline and wastewater main or lateral must pass a pressure and leakage test as specified in AWWA C600 standards.

B.5. Where a new potable waterline crosses a new, pressure rated wastewater main or lateral, one segment of the waterline pipe shall be centered over the wastewater line such that the joints of the waterline pipe are equidistant and at least nine feet horizontally from the centerline of the wastewater main or lateral. Whenever possible, the crossing should be centered between the joints of the wastewater main or lateral. The wastewater pipe shall have a minimum pressure rating of at least 150 psi. The wastewater main or lateral shall be embedded in cement stabilized sand (see clause B6 of this subparagraph) for the total length of one pipe segment plus 12 inches beyond the joint on each end. The potable waterline shall be at least six inches above the wastewater main or lateral.

B.6. Where cement stabilized sand bedding is required, the cement stabilized sand shall have a minimum of 10 percent cement per cubic yard of cement stabilized sand mixture, based on loose dry weight volume (at least 2.5 bags of cement per cubic yard of mixture). The cement stabilized sand bedding shall be a minimum of six inches above and four inches below the wastewater main or lateral. The use of brown coloring in cement stabilized sand for wastewater main or lateral bedding is recommended for the identification of pressure rated wastewater mains during future construction.

C. Waterline and Wastewater Main or Lateral Separation.

The separation distance from a potable waterline to a manhole or cleanout shall be a minimum of nine feet. Where the nine-foot separation distance cannot be achieved, the potable waterline shall be encased in a joint of at least 150 psi pressure class pipe at least 18 feet long and two nominal sizes larger than the new conveyance. The space around the carrier pipe shall be supported at five-foot intervals with spacers or be filled to the springline with washed sand. The encasement pipe shall be centered on the crossing and both ends sealed with cement grout or manufactured seal.

D. Location of Fire Hydrants

Fire hydrants shall not be installed within nine feet vertically or horizontally of any wastewater main, wastewater lateral, or wastewater service line, regardless of construction.
E. Location of Potable or Raw Water or Suction Lines

Suction mains to pumping equipment shall not cross wastewater mains, wastewater laterals, or wastewater service lines. Raw water supply lines shall not be installed within five feet of any tile or concrete wastewater main, wastewater lateral, or wastewater service line.

F. Proximity of Septic Tank Drainfields

Waterlines shall not be installed closer than ten feet to septic tank drainfields.

Polyethylene Encasement of Ductile-Iron Piping and Appurtenances

The CONTRACTOR shall install minimum 3-millimeter polyethylene encasement around underground installations of ductile-iron pipe, ductile iron fittings, valves and other ductile iron appurtenances.

Polyethylene film shall be manufactured of virgin polyethylene material conforming to ASTM Standard Specification D-1248-78.

Polyethylene encasement shall prevent contact between the pipe and the surrounding backfill and bedding material, but is not intended to be a completely airtight and watertight enclosure. Overlaps shall be secured by the use of adhesive tape, plastic string, or any other material capable of holding the polyethylene encasement in place until backfilling operations are completed.

Use the same backfill material as that specified for pipe without polyethylene wrapping, exercising care to prevent damage to the polyethylene wrapping when placing backfill. Backfill material shall be free from cinders, refuse, boulders, rocks, stones, or other material that could damage polyethylene.

Mechanically Tamped Backfill

Where specifically called for in these specifications or on the drawings, the material used in the backfill process shall be uniformly, mechanically tamped, with hand-operated pneumatic or gasoline tools in 6" to 8" loose lifts, to 95% of standard Proctor density (ASTM 698) at slightly above optimum moisture. Mechanical compaction shall extend to the finished ground surface.

Corrosion Protection of Buried Threaded Components

After buried fittings have been installed, but prior to backfilling, the CONTRACTOR shall thoroughly coat nuts and bolts of all components with corrosion inhibitor spray.
A thorough coating of corrosion inhibitor shall prevent contact between the nuts and bolt and the surrounding backfill and bedding material.

It is not intended to be cover the fitting, valve, or appurtenance body—the polyethylene wrap specified elsewhere herein is required for that purpose. The poly wrap is to protect the body of the component from corrosion, while the corrosion inhibitor is required for protection of the threaded components.

Use the same backfill material as that specified for pipe without this coating, exercising care to prevent damage to the corrosion inhibitor coating material when placing backfill. Backfill material shall be free from cinders, refuse, boulders, rocks, stones, or other material that could damage the coating.

Trench Excavation for Sanitary Sewer and Potable Water Mains

The CONTRACTOR shall perform all necessary trench excavation. Unless otherwise specified herein, trench excavation will comply with the Trench Excavation section of ASTM D-2321. There shall be no separate classification of excavation.

In general, all pipeline excavation shall be made by open cut from the surface of the ground and shall be no greater in width or depth than is necessary to permit the proper construction of the work. The sides of the trench shall be cut and maintained as nearly vertical as is feasible to a point at least 12 inches above the top of the pipeline. If the trench walls are to be sloped for trench safety purposes (where other forms of trench safety are not required), then sloping may begin at this point.

The entire foundation area in the bottom of the excavation shall be firm, stable and of uniform density. A soil is stable if it provides dependable support for the pipe and undergoes only slight volumetric change with variation in its moisture content.

Unstable soil conditions in trench bottoms shall be stabilized before laying the pipe. As a minimum, this is accomplished by over-excavating the trench bottom to remove the unstable material and bringing it back to grade with appropriate bedding material. Additional stabilization may be required, including French Drains, well points, concrete backfill, or other to be agreed upon by the ENGINEER. No additional compensation is allowed for stabilization.

Materials shall not be disturbed below grade, except soft, wet, disintegrated, or other unsuitable materials which shall be removed to a depth below grade as is directed by the ENGINEER. Any rock or other extremely hard materials under the foundation area shall be removed to a depth not less than 6" below grade.

Excavate trenches to ensure that sides will be stable under all working conditions. Slope trench walls or provide supports in conformance with all state and national standards for safety. Open only as
much trench as can be safely maintained by available equipment. Backfill all trenches as soon as practicable, but not later than the end of each working day.

Do not lay or embed pipe in standing or running water. At all times prevent flows from sewers, storm drains, runoff and surface water from entering the trench. The providing of a proper foundation will be at the CONTRACTOR'S expense. Embedment for pipe, structure foundations, or the pipeline itself shall not be laid or poured in standing or running water, or on unstable foundations.

When standing or running water from any source is present in the work areas, dewater to maintain stability of in-situ and imported materials. Maintain water level below pipe bedding and foundation to provide a stable trench bottom. Use, as appropriate, sump pumps, well points, deep wells, geofabrics, perforated underdrains, or stone blankets of enough thickness to remove and control water in the trench. Dewatering shall be considered as incidental work and will not be paid for as separate items. When excavating while depressing groundwater, ensure the groundwater is always below the bottom of cut to prevent washout from behind sheeting or sloughing of exposed trench walls. Maintain control of water in the trench before, during, and after pipe installation, and until embedment is installed and enough backfill has been placed to prevent floatation of the pipe. To preclude loss of soil support, employ dewatering methods that minimize removal of fines and the creation of voids in in-situ materials.

Control running water emanating from drainage of surface or groundwater to preclude undermining of the trench bottom or walls, the foundation, or other zones of embedment. Provide dams, cutoffs or other barriers periodically along the installation to preclude transport of water along the trench bottom. Backfill all trenches after the pipe is installed to prevent disturbance of pipe and embedment.

Use suitably graded materials in foundation or bedding layers or as drainage blankets for transport of running water to sump pits or other drains. Use well graded materials, along with perforated underdrains, to enhance transport of running water, as required. Select the gradation of the drainage materials to minimize migration of fines from surrounding materials.

Where trench walls are stable or supported, provide a width enough, but no greater than necessary, to ensure working room to properly and safely place and compact haunching and other embedment materials. The space between the pipe and trench wall must be wider than the compaction equipment used in the pipe zone. Maximum trench widths shall be as shown on the drawings. In addition to safety considerations, trench width in unsupported, unstable soils will depend on the size and stiffness of the pipe, stiffness of the embedment and in-situ soil, and depth of cover. Specially designed equipment may enable the satisfactory installation and embedment of pipe in trenches narrower than specified above. If it is determined that the use of such equipment provides an installation consistent with the requirements of this standard, minimum trench widths may be reduced, as approved by the ENGINEER.

When supports such as trench sheeting, trench jacks, trench shields or boxes are used, ensure that support of the pipe and its embedment is maintained throughout installation. Ensure that wall
sheeting is sufficiently tight to prevent washing out of the trench wall from behind the sheeting. Provide tight support of trench walls below viaducts, existing utilities, or other obstruction that restrict driving of sheeting.

Unless otherwise directed by the ENGINEER, sheeting shall not be placed in or below the pipe zone to preclude loss of support of foundation and embedment materials. When specifically allowed by the ENGINEER, sheeting may be placed in or below the pipe zone, with the top of sheeting to be cut off 1.5 feet or more above the crown of the pipe. Leave rangers, whalers, and braces in place as required to support cutoff sheeting and the trench wall in the vicinity of the pipe zone. Timber sheeting to be left in place is considered a permanent structural member and should be treated against biological degradation (for example, attack by insects or other biological forms) as necessary, and against decay if above groundwater.

Do not disturb the installed pipe and its embedment when using movable trench boxes and shields. Movable supports should not be used below the top of the pipe zone unless approved methods are used for maintaining the integrity of embedment material. Before moving supports, place and compact embedment to enough depths to ensure protection of the pipe. As supports are moved, finish placing and compacting embedment.

If the ENGINEER permits the use of sheeting or other trench wall supports below the pipe zone, ensure that pipe and foundation and embedment materials are not disturbed by support removal. Fill voids left on removal of supports and compact all materials to required densities.

If ledge rock, hard pan, shale, or other unyielding material, cobbles, rubble or debris, boulders, or stones larger than 1.5 in. (40 mm) are encountered in the trench bottom, excavate a minimum depth of 6 in. (150 mm) below the pipe bottom and replace with proper embedment material.

The CONTRACTOR shall be responsible for the satisfactory disposal of excess and unsuitable materials of any sort, and shall be responsible for backfilling, tamping, compacting, and refilling after settlement, of all excavated areas and other land, private and public, damaged or occupied by the CONTRACTOR in the performance of the contract, to as good condition as they were prior to the beginning of the work. It shall be his further responsibility to remove all surface obstruction to his work on easements or sites. He shall protect all pipes, conduits, signs, utility poles, wire, fences, building, and other public or private property improvements adjacent to or in the line of the work.

Trench backfilling as it relates to pavement repair subbase:

- Due to the varying depths of trenching and the varying types of native soils, the backfill under trenched areas that will receive pavement repair will conform to the requirements shown in the detail drawings.
- All backfill beneath trenched areas that are to receive pavement repair will be uniformly mechanically compacted in maximum 8” loose lifts to a minimum of 95% standard Proctor density at -1 to +3% of optimum moisture. The backfill material will be as shown in the detail drawings. Hand-operated pneumatic or gasoline-powered equipment will be required.
for adequate compaction around valve stacks, manholes, cleanouts, etc.

- In all trenched areas that are to receive pavement repair, the pipe will be installed in trenches with near-vertical walls employing OSHA-approved trench-safety methods (hydraulic wall jacks, trench boxes, etc.). Sloping the sides of the trench will not be allowed so that pavement repair at the top of the trench is minimized.

**Tapping Sleeves and Valves**

Tapping sleeves and valves shall be used where shown on the drawings, and the sleeve and valve are considered one unit for payment purposes.

Tapping valves shall meet AWWA specifications and requirements outlined for gate valves elsewhere herein, except that they shall be especially designed for use with tapping sleeve. They shall be complete with valve box and marker, and concrete blocking. Valves shall be flange by MJ, unless otherwise noted.

The tapping sleeve shall be of stainless-steel body, with corrosion-resistant steel alloy bolts. The outlet shall be a flat faced flange, for connection to the valve. Small and large O.D. range gaskets shall be provided. The sleeve shall be designed for a minimum of 150 psi operating pressure and 250 psi test pressure. It shall be provided in two sections, which bolt together to surround the pipe circumference, with the outlet cast as an integral portion of the sleeve.

Tapping sleeves which consist of two half-circle fabricated sections of steel, gasket lined and longitudinally crimped to allow deformation by tightening the bolts and thus provide built-in range over a variety of pipe O.D.'s may also be used, providing that the main body, neck, and bolts are constructed of Type 304 stainless steel, and designed to withstand a minimum of 150 psi working pressure and 250 psi test pressure.

The tapped plug removed from the line shall be delivered to the ENGINEER.

All metallic components shall be poly-wrapped to reduce corrosion.

**Existing Water Service Transfers (New Main to Meter)**

After the new mains covered by this contract have been installed, (including new corporation stops, service saddles, one-piece service lines, and locking curb stops for existing services), tested, sterilized and placed into service, this CONTRACTOR shall transfer existing water services where shown on the drawings to be transferred, from the new main to the existing meter.

The CONTRACTOR shall arrange the transfers at the customer's convenience. He shall uncover the existing service at the meter box, turn the existing meter stop off, and disconnect the existing service line from the meter. The existing meter and meter box will be reused unless otherwise shown on the
drawings. All existing curb stops and end of existing service line at the meters shall be removed from the meter box, and buried outside meter box.

The bid item for this work includes the corporation stop, service saddle, curb stop, and service line from the new main to the existing meter, and any pavement repair required.

**New Water Service Connections**

Connection of new services to mains shall be made utilizing all bronze double-strap service saddles. The saddle shall bolt completely around the pipe and contain rubber or neoprene gaskets. The corporation stop will be ¾” diameter minimum, brass construction, with tee-head, meeting AWWA C-800 as to threads. 1 ½” and larger stops shall be ball type. The stop shall screw into the service saddle. From the corporation stop, the CONTRACTOR will install ¾” SDR9 HDPE "poly" tubing (as shown on the drawings) with 30” minimum cover to the meter box. The service line will turn up beneath the meter box and terminate at an angle curb stop within the meter box. The angle stop shall be cast bronze, with locking lever handle. The angle stop will connect to the meter described elsewhere herein. All materials of construction in the service will be rated for a minimum of 150 psi operating pressure. Where certain services are designated on the plans as larger than 5/8" or ¾" meters, the service line size, corporation stop, saddle and all fittings will be increased to the same nominal diameter as the meter size.

All new meter service connections will be constructed and loaded to the angle stop prior to sterilizing and pressure testing the mains, so that the service lines are included in the sterilization and testing process. Each service line shall be flushed with chlorinated water prior to pressure testing at the main line.

Payment for the connection to the meter and box is included as one item on the bid schedule. "Far side" service connections include any pavement repair required therefore, but bores and encasement, if required, are separate.

All metallic components in contact with potable water shall be certified "lead free" in accordance with NSF-61 and NSF/ANSI 372.

Wherever possible, the new water service shall be placed on the uphill side of the lot.

**Gray Iron Castings**

Gray (cast or ductile) iron castings shall conform to ASTM A-48, and shall be free of blowholes, cracks, warping, and burnt-on sand, and shall be reasonably smooth. Covers shall fit properly into frames and shall seat uniformly. Angles shall be filleted and risers shall be sharp and true.

Additional specific requirements for gray iron valve boxes, fittings, valves, manhole and cleanout covers, and similar appurtenances, may also be included under other sections herein.
Existing Line Abandonment

After the new lines covered by this contract have been installed, tested, sterilized (if used for potable water applications), and placed into service, and required customer services have been transferred from existing parallel lines to the new mains, certain existing lines, where shown on the drawings, will be cut, permanently plugged (with a rubber boot and stainless steel circle clamps) and taken out of service. The abandonment of these lines is outlined on the construction drawings insofar as the piping arrangement of the existing system is known, but the existing piping arrangement is not guaranteed.

Valve Boxes

All buried valves shall have screw-type, three-piece, 5" minimum diameter, C.I. valve boxes. The three pieces shall include an upper female-threaded section with drop-in top; a male-threaded barrel bottom section; and a flared base section with minimum inside dimension at the base of 14 inches. Tyler 6860 Series with #6 base, or approved equal. The CONTRACTOR shall determine the depth of bury of the water main and the assembled box extension required. Valve boxes shall be set so as to not transfer surface impact loads to the pipe or the valve. Boxes shall be plumb, with the operating nut set in the center of the box. Each top shall be set 1" above finished grade when the surface is earthen, or flush with the surface when in pavement.

Only in the case of buried butterfly valves with a buried gearbox will the 14" base not be required. Provide a standard 8" bottom non-slotted valve box base in this situation. The weight of the box shall be transferred to compacted backfill around the valve instead of onto the valve itself.

Fire Hydrants (5-1/4" Flush Valve)

Fire hydrants shall be manufactured in strict compliance with the latest edition of AWWA C-502 for dry-barrel hydrants, 5-1/4" main valve. They shall be as follows:

a. Be of the compression type which closes with the pressure and shall be so designed as to provide for two drain ports that are an integral part of the main valve assembly and work automatically when operated.

b. Be of the dry "head" design.

c. Be designed for 150 psi, working pressure (300 psi test pressure).

d. Be so designed as to make, if possible, by means of a swivel flange, to face the nozzles in any desired position.

e. Have one 4-1/2" pumper and two 2-1/2" hose connections. CONTRACTOR shall furnish
OWNER with one hydrant wrench.

Fire hydrants shall be blocked with Class B concrete on the thrust side, care being taken not to clog the drain ports. A washed rock pea gravel sump (10 cu. ft.) shall also be provided and hydrants shall be fastened to the main line with thrust-restrained mechanical joints as shown by the drawings. Hydrants shall be mechanical joint also.

The pumper nozzle shall face the roadway. The body of the valve shall be no closer than four feet to any obstacle (except fences).

Fire hydrants shall have a bury equal to the connecting main's bury and any extension piece necessary to provide such bury and at the same time obtain 18" minimum clearance (26" maximum) between the nozzles and the ground shall be considered as being covered by the unit price bid.

The term "fire hydrant assembly" shall include all parts from the tee (including the tee) to the hydrant.

Fire hydrants shall be manufactured by Clow Valve Company, 902 South 2nd St Oskaloosa, IA 52557, 900-829-2569, https://www.clowvalve.com/

Brass Goods

All brass goods shall meet AWWA current requirements and shall be that material commonly referred to as waterworks brass. They shall be screwed or flared connections and shall meet AWWA Standard C-800.

All brass goods shall be manufactured by Ford Meter Box, 815 Miles Parkway, Pell City, AL 35125, 260-563-3171, https://www.fordmeterbox.com/

Furthermore, all brass goods shall comply with NSF-61, as well as NSF/ANSI 372 ("lead free" requirement of the Reduction of Lead in Drinking Water Act).

Gate Valves

Valve size and location shall be as shown on the drawings. Valves inside of structures or above grade shall have hand wheels. Buried valves shall be equipped with valve boxes as described elsewhere herein. Valves inside of structures or above grade shall be flanged; buried valves 2" and larger shall be mechanical joint. Buried valves smaller than 2" shall have threaded ends with brass pipe nipples in each end. All valves furnished under these specifications shall comply in all respects to AWWA specifications.

All buried valves shall be anchored in Class B concrete as per the detail drawings, so that no stress
or strain, as a result of operating the valve, will be transferred to the pipe.

All valves shall be manufactured by Clow Valve Company, 902 South 2nd St Oskaloosa, IA 52557, 900-829-2569, https://www.clowvalve.com/

This CONTRACTOR shall furnish to the OWNER a valve operating wrench for each type of valve.

a. 2" and Larger

2" and larger valves furnished under this specification shall comply in all respects to AWWA C-509 or C-515 for resilient seated gate valves. The valves shall be non-rising stem with 2" nut operator (unless handwheel is shown - handwheels to be ductile iron, if specified) and mechanical joint connections. Valve body, bonnet, stuffing box and operating nut shall be ductile iron. Wedge shall be constructed of ductile iron, fully encapsulated in synthetic rubber, except for guide and wedge nut areas. The valve shall be designed for a minimum 200 psi working pressure, 400 psi test pressure. The design shall allow 0-ring seals to be changed while the valve is in service. Valve body and bonnet shall be covered inside and out (ferrous parts only) with asphalt varnish or a fusion-bonded epoxy acceptable for use in potable water. Valve shall open to the left (counter clockwise).

b. 1-1/2" and Smaller

1-1/2" and smaller valves shall be ASTM B-62 brass, of the plug type, and manufactured from materials, which meet the various ASTM specifications applying to materials for use in waterworks service. The bronze body and bronze plug shall comply strictly with ASTM B-62 material specifications, commonly referred to as waterworks brass. The valves furnished under these specifications shall be manufactured and tested to AWWA C-800 standards. 1-1/2" and smaller valves shall be fastened to mains with all brass service saddles and brass threaded nipples, as per the detail drawings. Valve shall open to the left (counter clockwise). The handwheel shall be epoxy-coated ductile iron to prevent corrosion.

Sterilization of Potable Water Mains

All newly constructed or existing repaired water lines and appurtenances shall be sterilized for 24 hours at 50 ppm available chlorine as per AWWA C-651-99, by this CONTRACTOR before the lines are placed into service. After completion of the pipe lines, or any valved section thereof, the main shall be flushed and then chlorinated. Any of the following methods of procedure (arranged in the order of preference) shall be followed, subject to the approval of the ENGINEER:

Chlorine Gas-Water Mixture
Sodium Hypochlorite and Water Mixture
Calcium Hypochlorite and Water Mixture

The use of dry calcium hypochlorite in the pipe is not allowed. Upon completion of sterilization, all
lines shall again be flushed, until the chlorine residual at the sterilized section terminus is less than 2 ppm. One bacteriological sample per 1000 feet of new pipe shall be collected by the CONTRACTOR who shall arrange and pay for their testing at an acceptable laboratory. Written test results shall be supplied to the ENGINEER.

The following table provides an estimate of chlorine required to produce a 50 ppm concentration, per 100 feet of pipe. It is provided for field reference only, and adherence thereto does not relieve the CONTRACTOR of full responsibility for a successful test:

<table>
<thead>
<tr>
<th>Pipe Size (Inches)</th>
<th>100% Chlorine (Pounds)</th>
<th>1% Chlorine Solution (Gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0.027</td>
<td>0.33</td>
</tr>
<tr>
<td>6</td>
<td>0.061</td>
<td>0.73</td>
</tr>
<tr>
<td>8</td>
<td>0.108</td>
<td>1.30</td>
</tr>
<tr>
<td>10</td>
<td>0.170</td>
<td>2.04</td>
</tr>
<tr>
<td>12</td>
<td>0.240</td>
<td>2.88</td>
</tr>
</tbody>
</table>

Hydrostatic Testing - Water and Wastewater Pressure Mains

After backfilling mains and before pavement repairs, each section of pressure line constructed shall be tested with a hydraulic test pressure of not less than 150 psi over a continuous period of not less than four hours. The CONTRACTOR shall furnish adequate equipment to make these tests. The test pressure shall not be allowed to fall below 140 psi, at which pressure the pump will be started and the line loss measured directly by tank measurement or read off a totalizing meter. Re-pressurizing shall be done each hour, or sooner, as may be required to maintain the test pressure within the prescribed limits. The final re-pressurizing will be made at the end of the final hour of the test. Total water used will be the sum of the quantities required to re-pressurize the line to the original test pressure. 100% of the pressure mains laid will be tested. New meter service lines will be tested. Where existing service lines are reused and transferred to the new main, the connection of the corporation stop into the new main will be done before the pressure test, but the existing service line shall not be tested.

During the filling of the mains, and before applying the test pressure, all air shall be expelled from the mains.

If the test indicates a leakage in excess of a rate equal to 10 gallons per inch of diameter of the pipe per mile over a 24-hour period, then the CONTRACTOR shall be required to find the leaks and eliminate same. All known leaks shall be stopped, regardless of allowable leakage.

Tests may be combined with sterilization and shall be observed by representatives of the interested parties.
**Copper Tubing**

All copper tubing buried, whether above or below ground, shall be type "K" (soft) seamless copper, meeting current ASTM Specification B-88-62. Sweated joints and compression/grip ring joints are permissible, except that no joints will be allowed beneath foundations.

**Fittings and Blocking**

All 6" and larger cast iron, ductile iron, asbestos cement pressure and gravity pipe, and PVC pressure pipe, shall have ductile iron (not gray iron) fittings. These fittings shall conform to the American National Standard for Ductile-Iron and Gray-Iron Fittings, 3" through 48", for Water and Other Liquids, AWWA Standard C110, or the American National Standard for Ductile Iron Compact Fittings 3" through 24" for water service, AWWA C153. Ductile iron fittings shall be "Tyler", "U.S. Pipe", "American Pipe", “Sigma” or approved equal, and shall be manufactured in the USA. Each fitting shall have cast on its exterior the appropriate AWWA designation.

MJ fittings are required and shall be rated for 350 psi working pressure. Flange fittings will be rated for 250 psi minimum working pressure, and will have ANSI Class 125 flanges, unless otherwise specified.

The ductile iron fittings shall have a 1/16 inch cement-lining and asphaltic seal coat all meeting AWWA C-104.

For gravity service, the ductile fittings shall be rated for a minimum of 125 psi working pressure.

Bolts and nuts for mechanical joints or flanged ends shall be of high-strength, zinc-plated carbon steel, and shall conform to ASTM Designation A 307 (Grade B).

All buried ductile iron fittings shall be mechanical joint. All pressure fittings above ground, inside of structures, or on disturbed foundations shall be flanged.

All mechanical joint fittings shall be blocked with concrete (as shown in the detail drawings), then wrapped with polyethylene. Concrete blocking shall be placed at the time the fitting is installed.

SDR 35 PVC gravity sewer pipe shall have SDR 35 PVC gasketed push-on fittings. PVC fittings shall conform to ASTM resin specification D-1784, the dimensions shall conform to ASTM D-3034, the gasket shall conform to ASTM D-3212 and the joint material shall meet the requirements of ASTM F-477.

SDR 26 PVC pressure rated pipe (ASTM D-2241) used for gravity service shall use SDR 26 PVC gasketed fittings.

Where fittings are specified in the bid schedule to be paid by weight, payment will be based on the
weight of the fitting only, exclusive of gaskets, bolts, nuts, glands, blocking and so forth. Where fittings are not specifically itemized on the bid schedule, they are considered incidental to the other items of construction shown.

The weight of fittings listed in the bid schedule is based on “compact” fittings unless “full body” fittings are specified.

Flexible Couplings

Flexible pipe couplings 4” diameter and larger shall be of a gasketed sleeve type, with the same nominal diameter as the pipe. Each coupling shall consist of one steel middle ring, two steel followers, and two rubber-compound wedge section gaskets.

All couplings shall be secured by at least 4 bolts, and 6” and larger by a minimum of 6 bolts. Bolts shall be no less than ½” diameter, 60,000 psi ultimate strength, corrosion-resistant steel alloy. All couplings shall be designed for a minimum of 250 psi working pressure.

The couplings shall be protected from corrosion by a double wrap of polyethylene, as described elsewhere herein.

Black Iron Pipe

Black iron pipe shall not be used in this project, except for pipe tracer wire termination terminals, and encasement pipe.

Ductile-Iron Pipe

Ductile-iron pipe, 3” in diameter and larger, shall conform to the current American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water and Other Liquids, ANSI/AWWA C151/A21.51.

All ductile iron pipe shall be "Tyler", "U.S. Pipe", "American" or approved equal.

Ductile-iron thickness shall conform in all respects to the current American National Standard for the Thickness Design of Ductile-Iron Pipe, ANSI/AWWA C150/A21.50.

For depths of cover less than or equal to 20 feet the following shall determine the pipe pressure class:
<table>
<thead>
<tr>
<th>Pipe Diameter</th>
<th>Pressure Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>4” to 16”</td>
<td>350</td>
</tr>
<tr>
<td>18” to 20”</td>
<td>300</td>
</tr>
<tr>
<td>24” to 30”</td>
<td>250</td>
</tr>
<tr>
<td>36” to 64”</td>
<td>200</td>
</tr>
</tbody>
</table>

When the depth of cover is to exceed 20 feet Pressure Class 350 shall be used for all diameters. The ENGINEER will indicate such areas on the drawings.

All ductile-iron pressure pipe shall be furnished with one of the following types of joints, as described in the drawings or bid schedule:

<table>
<thead>
<tr>
<th>Type Joint</th>
<th>AWWA Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Push-on (buried pipe)</td>
<td>AWWA C111</td>
</tr>
<tr>
<td>Mechanical Joint (buried pipe)</td>
<td>AWWA C111</td>
</tr>
<tr>
<td>Flanged Ends (required above ground)</td>
<td>AWWA C110</td>
</tr>
</tbody>
</table>

Bolts and nuts for mechanical joints or flanged ends shall be of a high-strength low-alloy corrosion-resistant steel and shall conform to AWWA C111-95.

All screwed flanges shall be ductile iron.

All ductile iron pipe used for conveying sewer flow shall be ceramic-epoxy lined on the inside and shall be standard lined with an asphalt seal coat in accordance with AWWA Standard C-104. Ceramic-epoxy lining shall be P401 as manufactured by Induron Coatings, Inc., 3333 Richard Arrington Jr. Blvd. N., Birmingham, Alabama 35234, 1-888-773-2401, or approved equal. It shall be applied to the pipe by a factory-certified applicator.

All other ductile-iron pipe shall be standard cement-mortar lined inside, with asphalt seal-coat inside and out, in accordance with AWWA Standard C-104.

All ductile-iron pipe, fittings, valves and appurtenances shall receive polyethylene encasement as specified elsewhere herein.

**Polyvinyl Chloride (PVC) Pipe for Potable Water Mains and Wastewater Force Mains**

Plastic pipe shall be manufactured from material meeting the requirements of ASTM D-1784, 12454B compounds. The finished pipe shall conform to ASTM D-2241, the gasket joint to ASTM D-3139 and the gaskets to ASTM F-477. Each joint shall bear the seal of approval of NSF, indicating that the pipe is suitable for conveying potable water. The pipe shall bear markings on each joint showing the pressure rating, type, grade and manufacturer's run or lot. Manufacturer's certificate of test and compliance shall be furnished on all PVC pipe.
Any plastic pipe field inspected and found not to conform as to wall thickness or diameter shall be rejected, and all pipe of the same run or lot number shall be rejected and replaced with acceptable pipe at the CONTRACTOR'S expense. Field tests will be made on random samples of pipe.

14" through 36" PVC shall conform to Unibell PVC Pipe Association specification Uni-B-11 and shall have the pressure rating and DR specified on the drawings and/or bid schedule. Pipe shall have cast iron O.D. and rubber gasket joints.

6" through 12" PVC shall be either Class 160 SDR 26 gasket-joint, Class 200 SDR 21 gasket joint, or AWWA C-900 DR 18 or DR 25, whichever is specified in the drawings and/or the Bid Schedule. Where AWWA C-900 pipe is specified, it shall have cast iron equivalent O.D., and be listed by Underwriters Laboratories as well as NSF. It shall be furnished in 20' lengths, with rubber gasket joints.

3" and 4" PVC shall be Class 200 SDR 21, as shown on the drawings and/or bid schedule and shall be gasket joint. 2-1/2" and smaller PVC shall be Class 200, rubber-ring gasket joint, SDR 21, with integral bell.

All physical and chemical tests shall be made at 73 degrees Fahrenheit. These tests shall include, but are not limited to, quick burst test, sustained pressure test, acetone immersion test, vice test, and drop impact test as set forth in applicable ASTM and NSF Standards.

Plastic pipe delivered to the project well in advance of its installation shall be protected from excessive warpage, discoloration, and heat deformation. Pipe shall not be strung for laying more than thirty days in advance of the laying time. Ends of plastic pipe shall be protected so that same shall not be scratched or abraded prior to installation. Any damaged ends shall be removed prior to installation.

Pipe may be cut by using a medium tooth saw and miter box. Fine emery cloth or sandpaper shall be used to remove burrs.

No male threaded PVC pipe will be allowed. Solvent-weld pipe shall be adequately snaked to allow for expansion or contraction.

Casing Spacers

Casing spacers shall be used to install the carrier pipe inside the encasement pipe. Casing spacers shall fasten tightly onto the carrier pipe so that when the carrier pipe is being installed the spacers will not move along the pipeline. Casing spacers shall be doubled on each end of the encasement.

Each casing spacer shall be capable of providing support for the carrier pipe in service at a maximum spacing of 10'. Calculations shall be provided to the ENGINEER by the casing spacer manufacturer showing that the casing spacer will support the service load at the recommended spacing, including a
factor of safety of two (2). Casing spacers used under this specification shall meet or exceed the
specifications described herein as projection-type casing spacers.

Projection-type casing spacers shall be constructed of preformed sections of high density
polyethylene. The flexible sections shall be joined around the pipe to provide a minimum of 16
plastic projections per spacer section. Projection-type casing spacers shall be "RACI" Type F/G
spacers, manufactured by Recon Pipe Corporation of Vernon, British Columbia, telephone (604)
545-2227, or equivalent.

Carrier Pipe

The carrier pipe installed inside the encasement pipe shall be of the same material as the main line,
unless noted otherwise on the drawings.

On bell-and-spigot carrier pipes, the carrier pipe bells shall not rest on the encasement pipe flow line.
Casing spacers, as per the detail drawings, shall be provided to properly position the pipe in the
casings, protect the bells, and prevent carrier pipe floatation. The lengths of main line pipe joints
may be adjusted to cause the minimum number of carrier pipe joints to occur inside the encasement
pipe.

Bores

No State or Federal highway, or railroad, shall be open cut. All crossings of these facilities, and any
others so shown on the drawings, shall only be by methods approved by TxDOT, without damage to
them, or disturbing their use. Such methods shall be done in strict compliance with the terms and
conditions of Highway and/or Railroad Permits issued to the OWNER.

The OWNER shall furnish copies of the permits to the CONTRACTOR and it shall be this
CONTRACTOR'S responsibility to place each bore at the location specified by the OWNER'S
permit. Any permit revisions caused by bore mis-location will be at the CONTRACTOR'S expense.

Bores shall be for the length of the crossings as shown by the OWNER'S permits.

Bores shall not be made without adequate advance notification (minimum 48 hours) to the respective
permitted facility owner's representative.

Bore diameters shall not be more than 3" greater than the encasement pipe O.D. or, 3" greater than
the carrier pipe joint O.D. where the permit does not require encasement.

All bores under state or federal roadways shall be “dry” bores with encasement as shown in the
drawings. Driveway bores within state right-of-way may be “wet” bores without encasement.
The Texas Department of Transportation and/or respective railroad may impose additional requirements, which will be outlined in the OWNER'S permits and are considered a portion of this contract.

Encasement Pipe

Where lines are shown on the drawings to be installed in bores and encased, the drawings set forth a bore and encasement pipe size for each carrier pipe.

Encasement pipe shall be steel, of the configuration and wall thickness shown on the drawings, or in the OWNER'S permits. Joints shall be securely welded, and the encasement shall be installed to the straightest alignment feasible.

The exterior of the pipe shall be protected from corrosion with a bituminous coating.

End seals constructed of minimum ¼” Neoprene sheets and stainless steel circle clamps (applied to connect the Neoprene sheets to the pipe and to the casing) shall be used to prevent soil from washing into the annual space between the pipe and the casing. Install on both ends of casing. End seals shall not be installed if any water is in the casing.

Backfill - Structural and General Area

All structural and general-area backfill material shall be either stockpiled over-excavation material (if suitable), or "select material" as defined elsewhere. It shall not be the "grassed-off" overburden stripped from the site. Suitable material shall be stable, easily compacted, unfrozen and reasonably dry soil. Broken concrete larger than 3” in diameter, and large rocks, trees, trash, or other lumpy materials shall not be used in the backfill. Materials of a perishable, spongy, or otherwise improper nature shall not be used in backfilling.

All excavations shall be backfilled to finished grades, shapes, and configurations as shown on the drawings. Finish backfill, after consolidation, shall not have a variance of over one inch in ten feet when measured with a straight edge perpendicular to the slope. Any subsequent settlement or erosion of finished areas shall be brought back to the final grade and configuration with additional material as required, so that upon the completion of the construction of the project, and for the twelve-month maintenance period, all areas shall retain their final grade and shape.

Where suitable material for backfilling does not exist on the job site, the CONTRACTOR shall furnish such material from off the job site at his expense.

Backfill underneath pavements, sidewalks, foundations, or similar surfaces shall be mechanically compacted to minimum 95% standard proctor density (ASTM D-698), within -1 to +3 percentage points of optimum moisture, unless specifically noted otherwise. Filled areas not beneath these
surfaces shall be firmly compacted and smooth, suitable for the intended use. Backfill against structural walls shall be compacted in accordance with the applicable soil investigation report, if same is provided, or to minimum 90% standard proctor at -1 to +3 percentage points of optimum moisture where no such report is provided.

Structural excavations shall be backfilled as soon as is practical. Structures requiring less than six feet vertical fill may be backfilled after seven days curing time for the concrete. Structures requiring more than six feet vertical fill may be backfilled after fourteen days curing time for the concrete.

Exercise extreme caution in the backfill process to prevent displacement of or damage to the adjacent structures.

**Installation and Backfill of Buried Pipe**

CONTRACTOR shall comply with the "Materials", "Installation", and "Inspection, Handling and Storage" sections of ASTM D-2321, except as modified herein.

Excavation shall be as described elsewhere in these specifications and as shown on the drawings.

Install foundation and bedding as shown in the drawings and as specified herein, according to conditions in the trench bottom. Provide a firm, stable, and uniform bedding for the pipe barrel and any protruding features of its joint. Provide a minimum 4" thickness of bedding unless a greater thickness is specified.

When rock or unyielding material is present in the trench bottom, increase the thickness of bedding material to 6" minimum.

Where the trench bottom is unstable or shows a "quick" tendency, excavate all unstable material as a minimum, and replace with a foundation of material per Table I. Place and compact this foundation material in accordance with the drawings. Control of quick and unstable trench bottom conditions may also be accomplished with the use of appropriate geofabrics applied to the satisfaction of the ENGINEER and in strict accordance with the manufacturer's recommendations. For severe conditions, the ENGINEER may require a special foundation such as piles, sheeting, or concrete mats. Correction of unstable trench bottom shall not result in increased cost to OWNER.

Minimize localized loadings and differential settlement wherever the pipe crosses other utilities or subsurface structures. Provide a cushion of bedding material between the pipe and any such point of localized loading.

If the trench bottom is excavated below intended grade, fill the over-excavation with compatible foundation or bedding material and compact to a density not less than the minimum densities given in the drawings.
If trench sidewalls slough off during any part of excavating or installing the pipe, remove all sloughed and loose material from the trench.

All pipeline excavation made in one day shall have the pipe installed and backfilled the same day. Excavation of trench days ahead of pipe laying will not be permitted.

Excavations for pipeline appurtenances shall be backfilled as soon as is feasible.

Place pipe and fittings in the trench with the invert conforming to the required elevations, slopes, and alignment. Ensure uniform pipe support. In special cases where the pipe is to be installed to a curved alignment, maintain angular joint deflection or pipe bending radius, or both, as indicated in the drawings.

Adjustment in grade shall be made by scraping away or filling in along the full length of the pipe with approved bedding material, properly compacted, and not by wedging, blocking up the conduit, or supporting the conduit on mounds of earth.

The width of trench excavation is set forth in the drawings and shall not be exceeded in the area from the bottom of the trench to a point 12" above the top of the pipe.

Pipe shall be laid with the bell pointing away from the last joint. Pipe sockets and barrels shall always be clean and free from dirt.

Comply with manufacturer's recommendations for assembly of joint components, lubrication, and making of joints. When pipe laying is interrupted, secure piping against movement and seal open ends to prevent the entrance of water, mud, or foreign material.

Mark, or verify that pipe ends are marked, to indicate insertion stop position, and ensure that pipe is inserted into pipe or fitting bells to this mark. Push spigot into bell using methods recommended by the manufacturer, keeping pipe true to line and grade. Protect the end of the pipe during homing and do not use excessive force that may result in over-assembled joints or dislodged gaskets. If full entry is not achieved, disassemble, and clean the joint and reassemble. Use only lubricant supplied or recommended for use by the pipe manufacturer.

When making solvent cement joints, follow recommendations of both the pipe and solvent cement manufacturer. If full entry is not achieved, disassemble, or remove and replace the joint. Allow freshly made joints to set for the recommended time before moving, burying, or otherwise disturbing the pipe.

When the pipe joint has been checked for line and grade, the bedding material shall be applied to the springline of the pipe or as set forth in the drawings, and compacted by hand tamps or hand-held mechanical tamps, taking care not to damage or displace the pipe.
On pressure lines, all gasket joint or mechanical joint dead ends, fittings, flush valves, fire hydrants and offsets shall have Class D concrete thrust reaction blocking placed to provide for pressure reaction, as set forth in the drawings.

Where specifically called for on the drawings, additional joint restraints shall be provided.

All pipe shall then be further embedded and backfilled as set forth in the drawings and/or as described herein.

On highway right-of-way, backfill methods shall conform to the OWNER'S permits or as set forth herein and in the drawings, whichever is more restrictive.

All embedment material shall be per Table I. It shall not be the "grassed-off" overburden stripped from the site, but may be trench "tailings", provided these meet the requirements of Table I.

Where suitable embedment material, and/or suitable material for backfilling does not exist on the job site, the CONTRACTOR shall furnish such material from off the job site at his expense, and also dispose of the unsuitable material removed from the trench off of the job site, at his expense.

Place embedment materials by methods that will not disturb or damage the pipe. Work in and tamp the haunching material in the area between the bedding and the underside of the pipe before placing and compacting the remainder of the embedment in the pipe zone. Follow compaction requirements in the drawings for density requirements. Do not permit compaction equipment to contact and damage the pipe. Use compaction equipment and techniques that are compatible with materials used and location in the trench. Before using heavy compaction or construction equipment directly over the pipe, place enough backfill to prevent damage, excessive deflections, or other disturbance of the pipe. See minimum cover requirements elsewhere herein. Pipe embedment shall be compacted in maximum 8" loose lifts.

All excavations shall be backfilled to finished grades, shapes, and configurations as shown on the drawings. Finish backfill, after consolidation, shall not have a variance of over one inch in ten feet when measured with a straight edge perpendicular to the slope. Any subsequent settlement of finished areas shall be brought back to the final grade and configuration with additional material as required, so that upon the completion of the construction of the project, and for the twelve-month maintenance period, all areas shall have their final grade and shape. The CONTRACTOR, during the life of this contract, shall be responsible for so maintaining the trench and trench backfill as to permit safe passage for vehicles and pedestrians over the same. During inclement weather, he shall be responsible for removing any vehicle or livestock which may become stuck, stalled, or stranded in a trench, or in trench backfill, and shall utilize every available means to keep trenches and trench backfill across public thoroughfares and driveways safe and passable at all times.

Initial backfill, i.e., that backfill material used to a point at least 6 inches above the top of the pipe, shall be the same material as the embedment material. Unless otherwise noted on the drawings, the final backfill may be the native material removed from the trench, except that rock removed from the
trench must be reduced to a size no larger than 3" maximum dimension before reuse. Broken concrete larger than 3" in maximum dimension, trees, or other lumpy materials, or materials frozen, or of a perishable, spongy, or otherwise improper nature shall never be used in the backfill.

Consolidation of cohesionless material by watering (jetting or puddling) shall only be used under controlled conditions when approved by the ENGINEER. At all times, conform to the lift thicknesses and minimum density requirements in the drawings.

To preclude damage to the pipe and disturbance to pipe embedment, a minimum depth of backfill above the pipe should be maintained before allowing vehicles or heavy construction equipment to traverse the pipe trench. For embedment materials installed to the minimum densities required in the drawings, provide cover (that is, depth of backfill above top of pipe) of at least 30 in. (0.8 m) or one pipe diameter (whichever is larger) before allowing vehicles or construction equipment to traverse the trench surface.

All pressure conduits shall have a minimum cover as follows: 3" diameter and smaller - 30"; 4" thru 8" - 36"; and 10" and larger - 42", as measured from the natural ground surface to the top of the pipe. Pressure pipe buried in unstratified rock may be raised 6" upon authorization from the ENGINEER. Notwithstanding the above, all pipe must be buried a minimum of 36" below all highway and railroad borrow ditches.

Changes in depth of cut for pressure lines, necessitated by conflicting existing underground utilities will not be a basis for additional compensation, but will be considered as incidental work. Such changes shall not reduce the specified pipe cover.

All pressure conduit crossing creeks shall be installed by directional drilling. The minimum cover shall be 48" and the maximum shall be 60".

All gravity pipelines shall have the depth of bury specified in the detail drawings.

Provide support for vertical risers as commonly found at sewer service connections, cleanouts, and drop manholes to preclude vertical or lateral movement. Prevent the direct transfer of thrust due to surface loads and settlement and ensure adequate support at points of connection to main lines.

When excavating for a service line connection, excavate material from above the top of the existing pipe before removing material from the sides of the pipe. Materials and density of service line embedment should conform to the specifications for the existing line, or with this specification, whichever is more stringent.

Secure caps and plugs to the pipe to prevent movement and resulting leakage under test and service pressures.

Use flexible water stops, resilient connectors, or other flexible systems approved by the ENGINEER to make watertight connections to manholes and other structures.
Pipe shall be protected during handling against impact shock and free fall. No cracked or damaged pipe or joint shall be installed in the line. Handle and store pipe and fittings in accordance with recommendations of the manufacturer.

If faults, caverns, or subsidence are discovered during construction, all work shall halt, and the ENGINEER will be contacted to inspect.

### TABLE I
**EMBEDMENT MATERIAL REQUIREMENTS**

<table>
<thead>
<tr>
<th>Gravity Sewer Mains</th>
<th>Particle Size Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve Size</td>
<td>% Passing</td>
</tr>
<tr>
<td>1 ½”</td>
<td>100</td>
</tr>
<tr>
<td>#4</td>
<td>5-10</td>
</tr>
<tr>
<td>#200</td>
<td>0-10</td>
</tr>
</tbody>
</table>

*Plasticity Index (P.I.) less than 12*

<table>
<thead>
<tr>
<th>Pressure Mains Smaller Than 6”</th>
<th>Particle Size Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve Size</td>
<td>% Passing</td>
</tr>
<tr>
<td>1 ½”</td>
<td>100</td>
</tr>
<tr>
<td>#4</td>
<td>50-100</td>
</tr>
<tr>
<td>#200</td>
<td>5-50</td>
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</tbody>
</table>

*Plasticity Index (P.I.) less than 25*

<table>
<thead>
<tr>
<th>Pressure Mains 6” and Larger</th>
<th>Particle Size Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve Size</td>
<td>% Passing</td>
</tr>
<tr>
<td>1 ½”</td>
<td>100</td>
</tr>
<tr>
<td>#4</td>
<td>10-100</td>
</tr>
<tr>
<td>#200</td>
<td>0-10</td>
</tr>
</tbody>
</table>

*Plasticity Index (P.I.) less than 12*

<table>
<thead>
<tr>
<th>Foundation Material (When Required)</th>
<th>Particle Size Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve Size</td>
<td>% Passing</td>
</tr>
<tr>
<td>1 ½”</td>
<td>100</td>
</tr>
<tr>
<td>#4</td>
<td>10-50</td>
</tr>
<tr>
<td>#200</td>
<td>0-5</td>
</tr>
</tbody>
</table>

*Plasticity Index (P.I.) less than 9*

**High Density Polyethylene Tubing**

All 2” and smaller water main and service connections shall be high density polyethylene (HDPE) tubing and shall conform the following specifications:
1½” and 2” pipe shall be Iron Pipe Size (IPS) conforming with ASTM D3035. The material shall be SDR 9 and shall conform with PPI TR-4 PE 4710 and ASTM D3350 Cell Class.

¾”, 1”, and 1¼” pipe shall be Copper Tubing Size (CTS) conforming with ASTM D2737. The material shall be SDR 9 and shall conform with PPI TR-4 PE 4710 and ASTM D3350 Cell Class.

HDPE pipe shall have all joints welded by means of butt-fusion providing a continuous non-gasketed pipeline, capable of hydrostatic pressure testing to 12 times its designed pressure rating.

Anchoring system shall be as shown on the drawings.

**Curb Crossing**

Where potable water lines and service lines are installed under existing or proposed concrete street curbs, markers shall be placed on the face of the curb. The mark shall be a two inch by two inch “W”. This mark shall be made by sawcut or chisel in clean, straight lines, not to disturb the surrounding curb. This mark shall be visible from the centerline of the street. This mark shall be directly above the installed line as allowed, and no mark shall be placed along the curb at a distance greater than one foot from the installed line’s location.

**Inspections**

All inspections outlined in the technical specifications or otherwise requested by the OWNER shall be conducted by the City of Bonham or approved representative.

**Tracer Wire**

All water mains and service lines shall have a blue colored tracer wire, #14 solid copper strand attached to the top center of the pipe. The wire shall have an conductor outside diameter of 0.064 inches and an outside diameter of 0.12 inches. The wire shall conform to ASTM B3 and ASTM B258. The wire shall be taped to the pipe at 3 spots per joint. Tracer wire shall be pulled up at all meter boxes and valve locations where wire shall be pulled up on the outside of base and inside of the top section as to not get tangled up on valve keys.

**Tracer Tape**

Tracer tape shall be 6” wide foil strip encased in polyethylene to prevent rusting of the foil strip. The tape used for a sewer line shall be colored green and shall be labeled “Warning – Sewer Line Below” or similar wording. The tape used for a water line shall be colored blue and shall be labeled “Warning – Water Line Below” or similar wording. The tape shall be installed no deeper than 6” below the finished ground surface.
## CONSTRUCTION STANDARDS
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WATER VALVE BURIED INSTALLATION

SCALE: N.T.S.

FURNISH AND INSTALL CLOW GATE VALVE PER CITY REQUIREMENTS
STAINLESS STEEL TAPPING SLEEVE

UNDISTURBED SOIL OR MECHANICALLY TAMPED SELECT FILL (95% MIN DENSITY)

FLAT FACE FLANGE

NEW MAIN

TAPPING VALVE FL X MJ

EDGE OF TRENCH

CONCRETE BLOCKING AS PER THRUST BLOCKING DETAIL

EXISTING GROUND

STAINLESS STEEL TAPPING SLEEVE

EXISTING MAIN

TAPPING VALVE FL X MJ

NEW MAIN

CONCRETE BLOCKING AS PER THRUST BLOCKING DETAIL

BOTH VALVE AND SLEEVE (INCLUDING NUTS, BOLTS, AND FLANGES) SHALL BE WRAPPED WITH MINIMUM 3 MIL POLY WRAP, PRIOR TO THRUST BLOCK PLACEMENT OR BACKFILL. PIPE WALL REMOVED FROM MAIN BY TAPPING SHALL BE PROVIDED TO ENGINEER.

TAPPING SLEEVE & VALVE

SCALE: N.T.S.
CLASS B 24"x24"x6" CONCRETE PAD WITH #3 REBAR @ 9" C/C 3" CLEAR ALL SIDES

ARCH PATTERN VALVE BOX BASE SHALL NOT REST ON VALVE OR MAIN

CLASS "B" 10"x10"x6" CONCRETE

UNDISTURBED GROUND

BRASS BALL VALVE CURB STOP

VALVE SIZE X 4" LONG BRASS NIPPLE T X T FEMALE CONNECTOR OR COMPRESSION FITTING

BACKFILL AS PER SPECIFICATIONS

2" & SMALLER BURIED ValVES

SCALE: N.T.S.

★ FURNISH AND INSTALL CLOW GATE VALVE PER CITY REQUIREMENTS
FORD BRONZE DOUBLE STRAP SERVICE SADDLE
LINE SIZE x 2"
BORE 2" HOLE IN NEW LINE

2" POLY TUBING (CTS)
(STIFFENERS- BOTH ENDS
FORD INSERT-55)

2" FORD COUPLING
WITH GRIP JOINT
C84-77-G

2" CLOW GATE VALVE (THxTH)
2" OPERA. NUT
VALVE BOX AND PAD NOT
SHOWN FOR CLARITY

2"x 1-1/2" BRASS BUSHING (MxF)
1-1/2" BRASS NIPPLE
EXISTING LINE

PLAN VIEW

2" FORD CORP STOP
WITH GRIP JOINT
FB1000-7-G

NEW MAIN

BRASS SERVICE SADDLE
LINE SIZE x 2"
BORE 2" HOLE IN
NEW LINE

2" CLOW GATE VALVE (THxTH)

2" FORD COUPLING
WITH GRIP JOINT
C84-77-G

2"x 1-1/2" BRASS BUSHING (MxF)

ILLUSTRATIVE SECTION VIEW

NOTE:
FOR EXISTING MAINS, CUT IN A LINE SIZE
TEE IN PLACE OF THE SERVICE SADDLE. ADAPT
BRANCH OF NEW TEE TO VALVE (NO PVC MALE
ADAPTERS.)

CONNECTION OF NEW MAIN TO 3"
AND 2" EXISTING MAINS

SCALE: N.T.S.
FORD BRONZE DOUBLE STRAP SERVICE SADDLE
LINE SIZE x 2"
BORE 2" HOLE IN NEW LINE

2" POLY TUBING (CTS)
(STIFFENERS—BOTH ENDS
FORD INSERT—55)

2" FORD COUPLING
WITH GRIP JOINT
CB4—77—G

2" CLOW GATE VALVE (THXTH)
2" OPERATING NUT
VALVE BOX AND PAD NOT
SHOWN FOR CLARITY

2"x 1-1/2" BRASS BUSHING (MxF)
1-1/2" BRASS NIPPLE

MJ RESTRAINT GLAND

EXISTING LINE

PLAN VIEW

2" FORD CORP STOP
WITH GRIP JOINT
FB1000—7—G

NEW MAIN

BRASS SERVICE SADDLE
LINE SIZE x 2"
BORE 2" HOLE IN NEW LINE

2" POLY TUBING

2" FORD COUPLING
WITH GRIP JOINT
CB4—77—G

2" CLOW GATE VALVE (THXTH)

MJ CAP TAPPED
1-1/2"

VALVE BOX

MJ RESTRAINT GLAND

EXISTING LINE

1-1/2" BRASS NIPPLE

2"x 1-1/2" BRASS BUSHING

ILLUSTRATIVE SECTION VIEW

NOTE: FOR EXISTING MAINS, CUT IN A LINE SIZE TEE IN PLACE OF THE SERVICE SADDLE. ADAPT BRANCH OF NEW TEE TO VALVE (NO PVC MALE ADAPTERS.)

CONNECTION OF NEW MAIN TO END OF 3",
2—1/2", AND 2" EXISTING MAINS

SCALE: N.T.S.
**A "W" SHALL BE CUT INTO THE CURB WHERE THE WATER SERVICE CROSSES A CURB**

**PLAN VIEW**

**PROFILE VIEW**

**WATER SERVICE CONNECTION**

SCALE: N.T.S.
5' TO BACK OF CURB OR EDGE OF PAVEMENT

1-4 1/2" CONNECTION AND 2-2 1/2" NOZZLES

CLASS "B" CONCRETE SUPPORT BLOCK
SEE TYP. WATER VALVE, CONSTRUCTION STANDARD

POURED CONCRETE THRUST BLOCK
PROTECT DRAIN OPENING. SEE CONCRETE THRUST BLOCKING SCHEDULE

POURED CONCRETE THRUST BLOCK SUPPORT BLOCK
SEE TYP. WATER VALVE, CONSTRUCTION STANDARD

PRECAST CONCRETE BLOCK OR BRICK BASE SLAB

NOTE:
CONNECTION TO PIPE, VALVE, AND HYDRANT SHALL BE MECHANICAL JOINT.
KEEP CONCRETE CLEAR OF ALL BOLTS.

TYPICAL 5 1/4" FIRE HYDRANT INSTALLATION

ALL MJ JOINTS REQUIRE MECHANICAL THRUST RESTRAINT IN ADDITION TO CONCRETE THRUST BLOCKING.

★ FURNISH AND INSTALL CLOW FIRE HYDRANT PER CITY REQUIREMENTS
BENEATH PAVED AREAS
TRENCH FINAL BACKFILL SHALL
BE EMBDENENT MATERIAL
COMPACTED IN 8" LOOSE LIFTS
TO MINIMUM 95% STD. PROCTOR
DENSITY AT -1 TO +3% OF
OPTIMUM MOISTURE.

BENEATH UNPAVED AREAS
TRENCH FINAL BACKFILL
MAY BE SUITABLE EXCAVATED
NATIVE MATERIAL, WHEEL-
ROLLED FOR COMPACTION.

UNDISTURBED GROUND
(NOTE 5 & 5A)

FOUNDATION
(MAY NOT BE REQ.)

GRADE LINE

6" MIN.

FINAL BACKFILL

INITIAL BACKFILL

SPRING LINE

6" MIN.

HAUNCHING

4" MIN.

PIPE EMBEMENT

BEDDING

STABLE FOUNDATION

ALL FOUNDATION MATERIAL AND PIPE
EMBEMENT SHALL MEET REQUIREMENTS
OF THE INSTALLATION AND BACKFILL
OF BURIED PIPE-TABLE 1 TECHNICAL
SPECIFICATION, COMPACTED TO MIN. 95%
STD. PROCTOR DENSITY. AT -1 TO +3%
OF OPTIMUM MOISTURE.

BACKFILL NOTES:

1. ON HIGHWAY RIGHT-OF-WAY, BACKFILL METHODS SHALL
   CONFORM TO THE OWNER'S PERMIT IF MORE RESTRICTIVE
   THAN NOTED ABOVE.

2. SEE "STREET, DRIVEWAY, AND SIDEWALK REPAIRS"
   STANDARD FOR WEARING SURFACE, BASE AND SUBBASE
   REQUIREMENTS FOR TRENCHES BENEATH SURFACED OR
   PAVED AREAS.

3. TRENCHES BENEATH STRUCTURES SHALL BE BACKFILLED
   SAME AS UNDER SURFACED AREAS.

4. PIPE SHALL NOT BE LAYED ON UNSTABLE FOUNDATION.
   THE CONTRACTOR SHALL REMOVE SUCH UNSUITABLE
   MATERIAL AND REPLACE IT WITH ACCEPTABLE MATERIAL.

5. FOR TRENCHING IN UNPAVED AREAS, IN THE AREA 12"
   OR MORE ABOVE THE TOP OF THE PIPE, THE EXCAVATED
   TRENCH WIDTH AND BACKSLOPE MAY VARY TO COMPLY WITH
   APPROPRIATE SAFETY PRACTICES AND REGULATIONS.

5A. IN ALL TRENCHED AREAS THAT ARE TO RECEIVE
   PAVEMENT REPAIR, THE PIPE WILL BE INSTALLED IN
   TRENCHES WITH NEAR VERTICAL WALLS EMPLOYING
   OSHA-APPROVED TRENCH SAFETY METHODS (WALL JACKS,
   TRENCH BOXES, ETC). SLOPING THE SIDES OF THE TRENCH
   WILL NOT BE ALLOWED SO THAT PAVEMENT REPAIR AT THE
   TOP OF THE TRENCH WILL BE MINIMIZED.

BACKFILL FOR SANITARY SEWER (GRAVITY AND
AND PRESSURE) AND FOR 3" OR LARGER

POTABLE WATER MAINS

SCALE: N.T.S.
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(1) These buries are applicable to gravity pipeline where no depth is specified in the plan/profile drawings, and to pressure pipelines. In addition, no pressure line shall be less than 36" deep under borrow ditches or creek bottoms. Where specified elevations are shown elsewhere for gravity lines, such as in plan/profile drawings, those grades shall govern.

**TRENCH WIDTH AND BURY**

**GRAVITY AND/OR PRESSURE LINES**

SCALE: N.T.S.
SECTION A-A

PROJECTION-TYPE CASING SPACER

STEEL ENCASEMENT PIPE

CARRIER PIPE

CASING SPACER PER SPECIFICATIONS

STEEL ENCASEMENT

TWO SPACERS REQUIRED AT EACH END OF CASING

10" MAX SPACING

FLOW

END SEALS REQUIRED ON EACH END OF CASING

CASING SPACER SHALL BE PLACED AT PIPE INSERTION MARK

CASING SPACER SHALL BE PLACED A MAXIMUM OF ONE FOOT FROM PIPE BELL

<table>
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<tr>
<th>PIPE DESCRIPTION</th>
<th>CASING NOMINAL SIZE</th>
<th>&quot;RACH:&quot; CASING SPACER PROJECTION</th>
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<th>CASING COATING</th>
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INSTALLATION IN ENCASEMENT PIPE

SCALE: N.T.S.