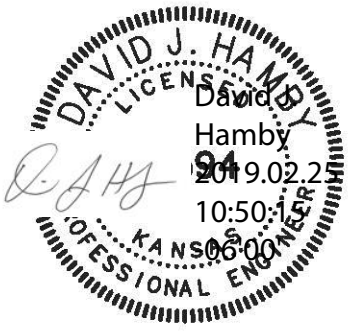
CITY OF

OTTAWA

KANSAS

# Waterline Construction Specifications

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# *CITY OF OTTAWA*

## Water Distribution Construction Specifications

## 1. WATERLINES

The purpose of this specification is to govern the furnishing of all materials, labor, equipment, tools, superintendence, and the 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 Provisions and Covenants, and as provided for in the Special Provisions.

Iron and Steel products must be produced in the United States and certifications of such production must be provided to the Owner prior to installation.

## 2. MATERIALS

This section governs materials for water mains having a diameter of two inches (50 mm) through 16 inches (400 mm).

### A. Ductile-Iron

1. Pipe: Unless indicated otherwise on the construction plans, all 6 inch (150 mm) pipe and larger shall be Class 50 ductile-iron; 4-inch (100 mm) pipe shall be Class 51 ductile-iron complete with all accessories and conforming to ANSI A21.51, AWWA C151, ASTM A536, and Grade 60-42.10. (2 inch (50 mm) pipe shall be PVC).

2. Joints: Unless otherwise specified, shall be of the push-on type conforming to ANSI A21.11/AWWA C111, except gaskets shall be neoprene or synthetic rubber. Natural rubber will not be acceptable. Gaskets shall be certified as suitable for chlorinated potable water in accordance with ANSI/NSF61.

3. 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 (2.4 MPa) 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”.

4. Polyethylene Encasement: Buried ductile iron piping and fittings shall be encased in polyethylene conforming to ASTM D1248, Type 1, Class C, Grade E-1.

**B. Polyvinyl Chloride Pipe (PVC) – 4 Inch to 16 Inch (100 mm to 400 mm):**

1. Pipe: PVC pipe shall meet the requirements of ASTM D1784, Cell Classification 12454-B, for PVC compounds, and ANSI/AWWA C900/905 with cast iron pipe O.D., for PVC pipe. All plastic pipe shall be product certified to meet NSF Standard 61 by an accredited third-party certifier for NSF Standard 61.

2. Pipe wall thickness shall be a Dimension Ratio (DR) of 18 pressure rated at 235 psi (Pressure Class 150) as defined in ANSI/AWWA C900/905.

3. Fittings: Where fittings are required, cast or ductile-iron fittings shall be used.

4. Joints: 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. Gaskets shall be certified as suitable for chlorinated potable water in accordance with ANSI/NSF61.

## 3. VALVES AND VALVE BOXES

**A. Gate Valves:**

The type, size, and location of valves shall be as shown on the Plans. Except as modified or provided herein, all gate valves in pipe lines shall be 200 psi, (1.4 MPa) iron body, gate valves with non-rising stems. Gate valves shall be resilient-seated conforming with all applicable requirements of ANSI/AWWA C500 AND C509. Gate Valves shall be manufactured by Clow, Waterous, Mueller, or an approved equal.

**B. Valve Ends:**

Valve ends shall be of the mechanical joint type, conforming to ANSI A21.11/AWWA C111 except where flanged ends are required on the plans.

The end flanges of flanged gate valves shall conform in dimensions and drilling to ANSI B16.1 for cast-iron flanges and flanged fittings, Class 125, unless explicitly provided otherwise on the plans and Special provisions. The laying lengths of the flanged valves shall conform to the dimensions of ANSI B16.10.

**C. Bonnet Thrust Plates:**

The bonnet shall have a removable thrust plate to permit the removal and replacement of the valve stem and "O" ring seal while the valve is in service.

**D. Tapping Valves:**

The size and location of the tapping valves shall be shown on the plans. The valves shall be 200 psi (1.4 MPa), iron body, or resilient-seated gate valves with non-rising stem 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. Stem Seals and Coatings:**

**1.** All valves shall be provided with stem seals of the "O" ring type. Two "O" rings shall be used with at least one "O" ring inserted above the thrust collar. The packing plate shall be attached to the valve bonnet by not less than three (3) bolts and one (1) "O" ring below the thrust collar.

**2.** All exterior surfaces of each valve shall be cleaned and painted in the shop with two (2) coats of asphalt varnish conforming to Federal Specifications TT-V-51-E or be epoxy coated. The interior surfaces of resilient-seated gate valves shall have a protective coating of fusion-bonded, non-toxic epoxy which is safe for potable water and is NSF61 product certified.

**F. Air-Release Valves:**

Air-Release valves shall be designed to vent accumulated air automatically and comply with all applicable requirements of ANSI/AWWA C512. Internal components shall be stainless steel with NPT inlet and outlet configurations. The outlet orifice shall be properly sized to facilitate operating pressures up to 150 psi.

The open end of the relief pipe (vent pipe) shall be extended at least 1 ft. (0.3 m) above grade and provided with a screened, downward-facing elbow.

Air release Valves shall be a minimum two inch ARI Valve or an approved equal.

**G. Combination Air Valves:**

No combination valves shall be allowed in water mains.

**H. Valve Operation:**

All valves shall be equipped with a 2-inch (5.02 cm) square wrench nut and ***the direction of rotation to open the valve shall be to the right (clockwise)*** unless otherwise noted in the Special Provisions.

**I. Extension Stems:**

When the distance from the top of the valve cover to the valve operating nut exceeds four (4) feet (1.2 m), each buried valve shall be provided with an extension stem and operating nut to conform with the Standard Drawings.

**J. Valve Boxes, Bases, Lids, and Covers:**

**1. Valve Boxes:**

Valve boxes shall be by Tyler Manufacturing #564 SVB; 5 ¼ or an approved equal. Valve box lids shall have "Water" cast in the lid.

**2. Valve Box Adapters:**

Valve box adapters shall be installed in each valve box and shall be Valve Box Adaptor II manufactured by Adapter Inc., 319NS or an approved equal.

## 4. FIRE HYDRANTS

**A. General:**

Fire hydrants shall be dry barrel, standard compression, two-piece standpipe, break-away design conforming to AWWA C502 and shall comply with the type that follows or as noted in the Special Provisions.

**1.** One 4 ½ inch (114 mm) pumper nozzle, two 2 ½ inch (63.5 mm) hose nozzles, 5 ¼ inch (133 mm) minimum mechanical valve ***opening right*** and 6 inch (150 mm) mechanical inlet connection.

**2.** Hydrants shall be Clow Medallion or Mueller Super Centurion 200 A-423; and be the same as the fire hydrants in use by the owning authority or as noted in the Special Provisions.

**B. Nut Dimensions:**

Operating stem and nozzle cap nuts shall be 1 ¼ inch point to flat pentagon.

**C. Nozzle Threads and Caps:**

Hydrant nozzles shall meet NFPA standard thread requirements. All nozzle caps shall be equipped with chains attached to the hydrant.

**D. Bury Depth:**

The bury length of hydrant barrel shall be four (4) feet.

## 5. SPECIALS

**A. General:**

Air release, meter, and pressure-reducing valve vaults shall be precast concrete conforming to ASTM C478. Access lid castings shall be as noted in the Special Provisions or as shown on the Plans.

Vaults which, by their special nature, must be cast in place shall conform to the Plans and Concrete Specifications.

**B. Tapping Sleeves:**

Tapping sleeves shall be standard mechanical joint type for ductile iron pipe and shall comply with all applicable requirements of ANSI A21.10/AWWA C110 for ductile iron fittings. Tapping Sleeve body, flange, bolts and nuts shall be Grade 304 stainless steel. Tapping sleeves shall be furnished with a flanged outlet conforming in dimensions and drilling to ANSI B16.1, Class 125.

## 6. 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 embedment for Ductile Iron and PVC pipelines shall be clean CA-5 (KDOT Latest Ed.) or ¼" chips. In no case will sand or any other product that will damage a water pump's impeller be allowed for bedding or fill. Crushed rock with sharp edges which could cause significant scratching or abrasion of the pipe or damage to the polyethylene tube protection shall not be used.

## 7. LOCATION WIRE

Location wire shall be Copperhead Blue, #12 AWG THHN, high tensile strength, and taped to plastic pipe water main. Wire shall be brought up on the outside of the valve box to above the final grade if in dirt and inside to center of top of valve box if in concrete.

## 8. CONCRETE

**A.** This specification is intended primarily for concrete thrust blocks, encasements and vaults. Concrete for all driveway, sidewalk, roadway pavement and/or curb and gutter replacement shall conform to the requirements of the Specifications related to SIDEWALKS AND DRIVEWAYS, ASPHALT SIDEWALKS AND DRIVEWAYS, PAVING and the Standard Drawings.

**B.** 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 (24.6 L) of water per 100 pounds (45.4 kg) of cement in the mix.

**4.** Ready-mixed concrete shall be used unless otherwise permitted by the City 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.

## 9. CASING PIPE

Casing pipe shall be used where required at railroad and 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.

## 10. CONSTRUCTION DETAILS

**Grading and Excavation:**

**A.** Excavation and trenching work shall include the necessary clearing, grubbing, and preparation of the site; removal and disposal of all debris; excavation and trenching as required; the handling, storage, transportation and disposal of all excavated material; all necessary sheeting, shoring, and protection work;

preparation of subgrades; pumping and dewatering as necessary or required; protection of adjacent property; and other appurtenant work.

**B.** Excavation and trenching work shall be performed in a safe and proper manner with suitable precautions being taken against all hazards.

The Contractor shall explore and expose any and all obstructions in advance of excavation so that minor changes in grade and alignment may be made.

In paralleling present water and gas mains, the Contractor shall protect all service connections and shall arrange to furnish service to the consumers with minimum interruption.

All excavated material shall be piled in a manner that will not endanger the work and that will avoid obstructing sidewalks and driveways. Gutters shall be kept clear or other satisfactory provisions made for street drainage.

**C. Classification of Excavated Material:**

No classification of excavated materials will be made. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the contract work regardless of the type, character, composition, or condition thereof.

**D. Blasting:**

Prior to blasting, the Contractor shall obtain a blasting permit from the City or County office having site jurisdiction.

All existing safety regulations, laws, and ordinances on the storage, transportation, and use of explosives shall be enforced at all times.

Blasting will be permitted only when proper precautions are taken for the protection of persons, the work, private property, public utilities, and the public from damage or injury. Any damage caused by blasting will be repaired by the Contractor at his own expense.

**E. Unauthorized Excavation:**

Any part of the trench excavated below grade shall be corrected with material approved by the City Engineer placed and compacted by the Contractor.

**F. Removal of Water:**

The Contractor shall provide and maintain adequate dewatering equipment to remove and disposes of all surface and ground water entering excavation,

trenches, or other parts of the work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation or other cause will result.

All excavations for concrete structures or trenches which extend down to or below static groundwater elevations shall be dewatered by lowering and maintaining the ground water surface beneath such excavations a distance of not less than twelve (12) inches (30 cm) below the bottom of the excavation.

Surface water shall be diverted or otherwise prevented from entering excavated areas or trenches to the greatest extent practicable without causing damage to adjacent property.

The Contractor will be held responsible for the condition of any pipe or conduit which he may use for drainage purposes, and all such pipes shall be left clean and free of sediment.

**G. Sheeting and Shoring:**

Except where banks are cut back on a stable slope according to OSHA standards, excavation for structures and trenches shall be properly and substantially sheeted, braced, or shored as necessary to prevent caving or sliding, to provide protections for workmen and the work, and provide protection for existing structures and facilities. Sheeting, bracing, and shoring shall be designed and built to withstand all loads that might be caused by earth movement or pressure and shall be rigid, maintaining shape and position under all circumstances.

Trench sheeting shall not be pulled unless pipe strength is sufficient to carry trench loads based on trench width to the back of sheeting. Sheeting shall not be pulled after backfilling. When ordered by the City Engineer, wood sheeting shall be left permanently in the trench.

Where trench sheeting is left in place, such sheeting shall not be braced against the pipe, but shall be supported in a manner which will preclude concentrated loads or horizontal thrusts on the pipe. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment has been completed.

**H. Stabilization:**

Trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact under the effect of the workmen.

## I. Trench Excavation:

The Contractor shall not open more trench in advance of pipe laying than is necessary to expedite the work. One block or 300 feet (91 m), whichever is the shorter, shall be the maximum length of open trench ahead of pipe laying unless by written permission of the City Engineer. At no time shall a trench be left open overnight.

Except where tunneling or boring and jacking is specified an shown on the plans by the City Engineer, all trench excavations shall be open cut.

## J. Alignment and Grade:

The alignment and grade or elevation of the pipeline shall be as shown on the plans.

The Contractor must maintain a constant check of the pipe alignment and trench depth and will be held responsible for any deviations therefrom.

Unless otherwise shown or indicated on the plans or unless set forth by the City Engineer, the horizontal and vertical alignment of the water main shall be maintained to within the following tolerances:

| Horizontal | Vertical |
|---|---|
| 3" (7.6 cm)± | 42" to 48" (1.07 to 1.22 m) Depth of Cover |

## K. Minimum Cover:

Except where otherwise shown, trenches shall be excavated to a depth sufficient to provide a minimum depth of backfill cover over the top of the pipe as indicated above. Greater pipe cover depths may be necessary on existing pipe, conduits, drains, drainage structures, or other obstructions encountered at normal pipe grands.

Measurements of pipe cover depth shall be made vertically from the outside top of pipe to finish grade or pavement surface elevations.

## L. Limiting Trench Width:

Trenches shall be excavated to a width which will provide adequate working space and pipe clearances for proper pipe installation, jointing, and embedment. However, the limiting trench widths below an elevation six (6) inches (15 cm) above the top of the installed pipe shall be as follows:

**Ductile-Iron Pipe**

| Pipe Size | Minimum Trench Width In Earth | Maximum Trench Width In Earth | Minimum Clearance In Rock |
|---|---|---|---|
| 4" (100 mm) | 18" (45 cm) | 30" (75 cm) | 12" (30 cm) |
| 6" (150 mm) | 24" (60 cm) | 30" (75 cm) | 12" (30 cm) |
| 8" (200 cm) | 26" (65 cm) | 32" (80 cm) | 12" (30 cm) |
| 10" (250 cm) | 28" (70 cm) | 34" (85 cm) | 12" (30 cm) |
| 12" (300 cm) | 28" (70 cm) | 34" (85 cm) | 12" (30 cm) |

When PVC pipe is used, the minimum trench width shall be equal to the outside diameter of the pipe plus six (6) inches (15 cm) on each side of the pipe.

Where necessary to reduce earth load on trench banks to prevent sliding and caving, banks may be cut back on slopes which shall not extend lower than one (1) foot (30 cm) above the top of the pipe.

**M. Unauthorized Trench Widths:**

When, for any reason, the width of the lower portion of the trench as excavated at any point exceed the maximum permitted in the foregoing tables, with pipe of adequate strength, special pipe embedment, or arch concrete encasement, as required by loading conditions and as determined by the City Engineer, shall be furnished and installed by and at the Contractor's expense.

**N. Trench Bottom in Earth:**

The trench in earth shall have a flat bottom the full width of the trench and shall be excavated to the grade to which the pipe is to be laid. The bottom surface of the trench shall be graded to provide a uniform bearing and continuous support for each pipe at every point along its entire length.

**O. Bell Hole Option:**

The Contractor, at his option, may use granular material in the trench bottom in lieu of bell holes. The granular fill material shall be spread and the surface graded to provide a uniform bearing with continuous support along each section of pipe.

The granular material shall be as specified in the section entitled "BEDDING MATERIAL" and also as shown on the Standard Drawings.

**P. Rock Exploration:**

Unless shown otherwise on the Plans or noted in the Special Provisions, no rock exploration has been made. On those projects where rock exploration has been made, test holes have been drilled at locations and intervals as shown on the plans or subsurface information report to determine the approximate location and depth

of rock. Resistance to penetration was assumed to be "solid rock". This information is furnished for general-reference purposes only.

The Contractor must form his own opinion as to the character of materials which will be encountered from an inspection in the ground, from his own investigation of the test hole information, or from such other investigations as he may desire.

**Q. Trench Bottoms in Rock:**

All rock excavation shall be carried to a minimum of twelve (12) inches (30 cm) below the bottom of the pipe, and a minimum of twelve (12) inches (30 cm) on either side of the pipe. A minimum of twelve (12) inches (30 cm) of granular pipe embedment material shall required on the top, bottom and sides of the pipe to provide continuous and uniform bearing support along the entire length of the pipe. Care shall be exercised to prevent any portion of the pipe from coming to bear on solid rock or boulders.

**R. Mechanical Excavation:**

The use of mechanical equipment will not be permitted in locations where its operations would cause damage to trees, buildings, culverts, or to the existing property, utilities, or structures above or below ground. In all such locations, hand-excavating methods shall be used.

Mechanical equipment used for trench excavation shall be of the type, design, and construction and shall be so operated that the rough trench excavation bottom elevation can be controlled, that uniform trench widths and vertical sidewalls are obtained at least from the bottom of the trench, and that trench alignment will be centered in the trench with adequate clearance between the pipe and sidewalls of the trench. Undercutting the trench sidewall to obtain clearance will not be permitted.

All mechanical trenching equipment, its operating conditions, and the manner of its operations shall be subject at all times to the approval of the City Engineer.

**S. Stream Crossings:**

Stream Crossings shall be made in accordance with these specifications and as shown on the Plans.

The trench width shall be as required for proper pipe installation and the trench depth shall be a minimum of five feet of cover under a non-navigable stream or seven feet of cover under a navigable stream. Pipe encasement, where required, shall be in accordance with the Specifications and placed as indicated on the Plans.

The construction of grouted riprap for erosion prevention of ditch slopes will be required at locations shown or designated on the Plans. The rock used for riprap shall be hard, durable stone not less than four (4) inches (10 cm) thick and shall be grouted to obtain a minimum twelve (12) inch (30 cm) depth thickness.

**T. Highway and Railroad Crossings:**

The Contractor shall make highway and railroad crossings in accordance with these Specifications, the Special Provisions, and as shown on the Plans.

All construction or work performed and all operations of the Contractor, his employees, or his subcontractors within the limits of highway or railroad rights-of-way shall be in conformity with all the requirements, regulations and be under the control (through the City Engineer) of the authority owning or having jurisdiction over and control of the right-of-way.

**U. Barricades and Warning Signs:**

The Contractor shall provide and maintain in place all barricades, warning signs, lights, and other safety devices required to protect the work, divert traffic, and warn the general public of open excavations, unfilled trenches, and other areas or conditions which might be hazardous or dangerous during the daytime or at night.

## 11. INSTALLATION

**A.** 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 (1.07 m), 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, Casing Spacers shall be used. Casing Spacers shall have a minimum of (4) runners or one (1) runner for every diameter inch, whichever is greater and shall hold the carrier pipe in the center of the casing. Casing Spacers shall be Advance Products & Systems (Model CI, SI or SSI), CCI Pipeline Systems (CS or SS) or an approved equal. Casing Spacers shall be strapped to each pipe before it is placed in the casing pipe in accordance with these Specifications and as shown on the Plans. The ends of each casing pipe shall be closed with Casing End Seals and shall be sealed with synthetic

rubber, pull-over end seals with stainless steel bands, Cascade Waterworks Mfg. (Model CCES), Advance Products & Systems, Inc. (Model AC), CCI Pipeline Systems (Model ESC) or an approved equal. The closures for each casing pipe shall not be sealed until all testing of the line has been completed and accepted.

**B. Polyvinyl Chloride (PVC) 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. When cutting pipe with couplings, mark the field cut pipe end the same distance n as the mark appeared 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 instruction 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.

**C. Ductile-Iron Pipe:**

**1. Handling:**

Pipe, fittings, and accessories shall be handled in a manner that will ensure

installation in a sound, undamaged condition. Equipment, tools, and methods used in unloading, reloading, hauling, and laying pipe and fittings shall be such that the pipe, pipe coating, and fittings are not damaged. Hooks shall not be used. Under no circumstances shall pipe or accessories be dropped or dumped. Pipe and fittings on which the cement lining has been broken or loosened shall be replaced by the Contractor. where the damaged areas are small and readily accessible, the Contractor may be permitted to repair the lining with prior written approval of the Engineer.

**2. Cutting Pipe:**

Ductile-iron pipe shall be cut with either a saw or an abrasive wheel. Cutting of existing cast-iron pipe shall be done with either a saw or abrasive wheel, or when there is a free end, with mechanical pipe cutters. The cutting of pipe with a torch will not be permitted.
Cutting shall be done in a neat manner without damage to the pipe, or the cement lining. Cuts shall be smooth, straight, and at right angles to the pipe axis. After cutting , the end of the pipe shall be dressed with a file to remove all roughness and sharp corners.

**3. Cleaning:**

The interior of all pipe and fittings shall be thoroughly cleaned of foreign matter before being installed an shall be kept clean until the work has been accepted. Such surfaces shall be wire brushed, if necessary, wiped clean, and kept clean until jointing is completed.

**4. Inspection:**

Pipe and fittings shall be carefully examined for cracks and other defects immediately before installation. Spigot ends shall be examined with particular care since they are vulnerable to damage from handling. All defective, damaged, or unsound pipe and fittings shall be rejected and marked as such and removed from the site of the work.

**5. Alignment of Bell and Spigot Pipe:**

Pipelines or runs intended to be straight shall be laid straight. Deflections from a straight line or grade shall not exceed the quantities stipulated in Tables 4 and 5 of ANSI/AWWA C600.

**6. Laying Pipe:**

Pipe shall be protected from lateral displacement by pipe embedment material installed as specified. Under no circumstances shall the pipe be laid in water, and no pipe shall be laid under unsuitable trench conditions.

## 12. JOINTING

### A. Push-on Joints:

The gasket seat in the bell 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. Lubricants are to be NSF 61 product certified.

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. The gasket and packing gland shall, after proper joint cleaning, be in position on the spigot before shoving the pipe to its final position. It is important that the entering spigot is centered in and that the gland or follower ring is parallel to the face of the connecting bell. At joints where angular deflections are required, the gasket should be shoved "home" and the gland properly positioned with respect to the connecting bell with the connecting pipes in as nearly perfect alignment as practicable. The bolts shall be slightly and uniformly tightened. Then the required deflection may be made after which the bolts shall be tightened as specified hereinafter.

Immediately prior to connecting any two (2) mechanical joint piping units, the gasket shall be coated with a lubricant supplied by the pipe manufacturer and all surfaces of the bell, spigot, and gland which will come in contact with the gasket at any time during assembly shall be wired brushed, wiped clean, coated with lubricant, and the gland and gasket slipped over the spigot end of the pipe. Lubricants are to be NSF 61 product certified. The spigot shall then be inserted to the full depth of the socket unless otherwise directed.

The gasket shall then be carefully pushed into position and evenly seated in the bell. The gland shall be shoved into placed against the gasket, the bolts inserted, and the nuts tightened with the fingers until snug. Final tightening of the bolts shall be done with a ratchet torque wrench unless for a reason acceptable to the Engineer or his designee the use of a non-torque wrench is necessary.

It is essential that the gland be brought toward the pipe flange (bell face) evenly, maintaining approximately the same distance between the gland and the face of the bell at all points around its circumference. This may be done by partially

tightening the bottom bolt, then the top bolt, next the bolts on either side, and finally the remaining bolts, alternately tightening bolts 180 degrees apart. This cycle is then to be repeated until all bolts are tightened to a torque for:

| | |
|---|---|
| 5/8" bolts | 40 to 60 foot pounds |
| 3/4" bolts | 60 to 90 foot pounds |

If effective sealing is not obtained at the maximum torque specified for the side of bolt used, the joint shall be disassembled, thoroughly cleaned, and reassembled. Over stressing of bolts to compensate for poor installation practice will not be permitted.

**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 an 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. No lengths of PVC pipe less than 24" shall be used with Restrained Joint fittings.

## 13. CONNECTIONS 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 Owning authority shall be given at least 24 hours notice prior to turning off any water supply mains. The Contractor shall coordinate tie-ins with the Owning authority to minimize down time. And will not leave the site until water supply has been restored

## 14. POLYETHYLENE ENCASEMENTS

**A. Polyethylene Encasement:**

Polyethylene encasement with no less than eight (8) mil thickness, shall be installed on ductile-iron pipe and fittings.

**B. Installation:**

The polyethylene encasement shall be installed as specified in "Method A" or "Method B" below.

**1. Method A:**

Polyethylene tubing shall be approximately 2 feet (60 cm) longer than the length of pipe section to provide a one (1) foot (30 cm) overlap on each adjacent pipe section. Tube ends need not be taped in place unless Contractor is directed to do so by the City Engineer.

**2. Method B:**

Polyethylene tubing shall be one (1) foot (30 cm) shorter than the length of the pipe section with a three (3) foot (90 cm) length of polyethylene tube centered over pipe joint and lapped over the pipe section and its tubing. Tube ends need not be taped in place unless the Contractor is directed to do so by the City Engineer.

**3. Repairs:**

Any rips, punctures, or other damages to the polyethylene shall be repaired with adhesive tape or with a short length of polyethylene tube cut open, wrapped around the pipe, and secured with adhesive tape.

## 15. SETTING VALVES, FITTINGS, AND HYDRANTS

**A. 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. All valves requires 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 and have valve box adapters installed in each valve box. The valve box shaft shall not transmit shock or stress to the valve. Install valve box covers flush with the surface for the

finished area or as directed by the City Engineer.

**B. Hydrants:**

All new hydrant installations shall be as shown on the plans or Standard Drawings and shall include all necessary excavation and backfill to make the installation complete. The connection to the water main shall be anchored with Restrained Joint fittings.

Each hydrant shall be inspected before installation for directions of opening, nozzle size and threading, nozzle caps and chains, operating nut, and cap nut dimensions, tightness of pressure-containing bolting, cleanliness of inlet elbow an weep hole openings, and handling damage and cracks. Defective hydrants shall be corrected or replaced.

All hydrants shall stand plumb. The weep holes of the hydrant shall be kept clear and free to drain. The areas around each hydrant and hydrant valve shall be thoroughly compacted to prevent settlement of these areas. Use eight (8) cubic feet of three (3) inched washed rock around the base of each fire hydrant and cover with eight (8) mil plastic membrane.

Hydrants shall be set to a grade that allows their proper operation, a minimum of nineteen (19) inches from finish grade to center of nozzle. Traffic hydrants with breakaway joint must be set with the joint above the ground line. Hydrants behind curbs shall be placed with the hydrant centerline at least 24 inches (60 cm) from the back of curb. Hydrants shall be rotated so as to have the pumper nozzle facing the street or rotated to face any direction as required by the City Engineer.

## 16. THRUST RESTRAINT

**A. Hydrants:**

The back of the base elbow of each hydrant shall be braced against a sufficient area of unexcavated earth or rock with suitable restrained joints and reaction blocking as shown on the Plans or the Standard Drawings.

**B. Fittings:**

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

**C. 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 resulting thrust force and permit access to pipe and fitting joints for repairs. Use eight (8) mil plastic between concrete and fittings.

All fire hydrant and valve assemblies shall be supported on bottom with a minimum of one 3" x 16" concrete block. No poured in-place concrete shall be used under assembly.

**D. 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 City Engineer.

## 17. 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.

**A. Pipe Embedment:**

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

**B. 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 two (2) inches in greatest dimension. Masses of moist, stiff clay shall not be used. No backfill materials shall be installed on frozen surfaces, nor shall frozen materials, snow, or ice be placed in any backfill.

**2.** Whenever, in the opinion of the City 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.

**C. Placement and Compaction:**

**1.** Job-excavated materials shall be placed in uniform layers not exceeding eight (8) inches (20 cm) in uncompacted thickness. Increased layer

thickness may be permitted for noncohesive material if the Contractor demonstrates to the satisfaction of the City 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 used for backfill shall be placed in uniform layers not exceeding six (6) inches (15 cm) 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 follow the more stringent requirements of either the most current City of Ottawa standard specifications for streets, entrances, driveways and sidewalks; and/or following percent of maximum density at optimum moisture content as determined by the Standard Proctor test ASTM D698:

| Location | Cohesive Soils | Cohesion less Materials |
|---|---|---|
| Top 6 inches (15 cm) | 95% | 80% |

Flowable Fill shall be installed as required by the City. Flowable Fill shall comply with KDOT specifications, Section 843 for Low Strength mixture.

**5.** Compaction under street or highway back slopes, berms, median strips, and developed yards shall be 95% for the entire depth.

**6.** Backfill failing to meet required densities shall be removed or scarified and recompacted as necessary to achieve specified results.

## 18. DISINFECTING AND TESTING

### A. Disinfection:

After installation, the entire main shall be cleaned with a pig, flushed, disinfected by chlorination in accordance with ANSI/AWWA C651 and flushed prior to use for potable water supply purposes. The Contractor shall be required to insert a Foam Pig with a minimum density of 3 lb./$ft^3$ in the first pipe joint and pull through the entire section prior to flushing the main. Prior to chlorinating the main, flushing shall be carried out until a turbidity-free water is obtained from all points along the main. The Contractor shall disinfect the main under the supervision and inspection of the City of Ottawa. The City of Ottawa will take

chlorine samples to be tested. The Contractor shall provide at least one (1) bacteria test by an approved third party lab. Testing shall meet the requirements of Option A of Section 5.1.1.1 for AWWA C651.

**1.** 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.

**2.** 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 50 mg/liter free chlorine and will be tested by the City of Ottawa.

**3.** The following table may be used to estimate the amount of chlorine (HTH) needed for chlorination. However, the contractor will be responsible maintaining the minimum chlorine residual specified in 18.A.2.

**TABLE OF DISINFECTION OF WATER MAINS**
**WITH 65% AVAILABLE HTH IN OUNCES**

| | 2" | 4" | 6" | 8" | 10" | 12" | 16" |
|---|---|---|---|---|---|---|---|
| 50' | .084 | .335 | .753 | 1.34 | 2.09 | 3.01 | 5.36 |
| 100' | .167 | .670 | 1.506 | 2.68 | 4.18 | 6.02 | 10.72 |
| 150' | .252 | 1.117 | 2.259 | 4.02 | 6.27 | 9.03 | 16.08 |
| 200' | .336 | 1.340 | 3.012 | 5.36 | 8.36 | 12.04 | 21.44 |
| 250' | .420 | 1.675 | 3.675 | 6.70 | 10.45 | 15.05 | 26.80 |
| 300' | .504 | 2.010 | 4.518 | 8.04 | 12.54 | 18.06 | 32.16 |
| 350' | .588 | 2.345 | 5.271 | 9.38 | 14.63 | 21.07 | 37.52 |
| 400' | .672 | 2.680 | 6.204 | 10.72 | 16.72 | 24.08 | 42.88 |
| 450' | .756 | 3.015 | 6.777 | 12.06 | 18.81 | 27.09 | 48.24 |
| 500' | .840 | 3.350 | 7.530 | 13.40 | 20.90 | 30.10 | 53.60 |
| 550' | .924 | 3.685 | 8.283 | 14.74 | 22.99 | 33.11 | 58.96 |
| 600' | 1.008 | 4.020 | 9.036 | 16.08 | 25.08 | 36.12 | 64.32 |
| 650' | 1.092 | 4.355 | 9.789 | 17.42 | 27.17 | 39.13 | 69.68 |
| 700' | 1.176 | 4.690 | 10.542 | 18.76 | 29.36 | 42.14 | 75.04 |
| 750' | 1.260 | 5.025 | 11.295 | 20.10 | 31.35 | 45.15 | 80.40 |
| 800' | 1.344 | 5.360 | 12.048 | 21.44 | 33.44 | 48.16 | 85.76 |
| 850' | 1.428 | 5.695 | 12.801 | 22.78 | 35.53 | 51.17 | 91.12 |
| 900' | 1.512 | 6.030 | 13.554 | 24.12 | 37.62 | 54.18 | 96.48 |
| 950' | 1.596 | 6.365 | 14.307 | 25.46 | 39.71 | 57.19 | 101.84 |
| 1000' | 1.680 | 6.700 | 15.060 | 26.80 | 41.80 | 60.20 | 107.20 |

| | |
|---|---|
| First | Find the diameter pipe to be disinfected |
| Second | Find the number of feet of pipe to be disinfected |
| Third | The answer is given in number of ounces required of 65% available chlorine (HTH) |

**4.** Mains shall be flushed prior to placing in service. The flushing water shall be disposed of without damage to public or private property. Dechlorination of water may be required.

**5.** Water bacteria samples will be taken as required by the Kansas Department of Health and Environment.

## B. Hydrostatic Testing:

All pipelines constructed under this project shall be and shall remain tight and free from leakage under all working and service conditions. Any cracked or defective pipes, fittings, or valves discovered during the tests shall be removed and replaced with sound material at the Contractor's expense.

The Contractor shall make pressure and leakage tests as specified herein under the supervision of the City Engineer or Owner. He shall provide all necessary connections between the pipeline or piping and the nearest available source of test water, test pumping equipment, pressure gauge, water measuring equipment and other equipment, water, materials, and facilities necessary for the required tests. The line test shall preferably be made in sections using either sectionalizing valves to be permanently installed or temporary plugs or valves.

Testing shall be performed after the trench has been partially backfilled. The Contractor will be permitted to make the tests after the trench is backfilled with the understanding that if required he will uncover the line to the extent necessary to find and repair all leaks or defects without any expense to the Owner.

Before applying the specified test pressure, the line to be tested shall be slowly filled with water and the air expelled from the pipe by opening valves and/or vents. If such valves are not available at high points in the line the Contractor shall tap the line at the high points and insert plugs after the test has been completed.

The specified test pressure shall be applied by means of a hand-operated force pump or other suitable device capable of maintaining the required pressure throughout the duration of the test. The pump for testing shall take suction from a reservoir of small enough volume that the amount of water loss can be measured volumetrically. Conduct test at a pressure of 150 psi (10.34 Bar). Duration of the test shall be not less than 2 hours. Maintain pressure throughout test $\pm$ 5 psi (0.35 Bar) of test pressure.

Under no circumstances shall a section of the line be tested without notifying the Engineer in advance.

The Engineer or his representative shall be present during the last hour of each pressure test. If the test for any reason fails and repair and retests are necessary, the

Contractor shall reimburse the Engineer or his representative at a pre-determined rate of compensation per hour for all subsequent tests.

After the pipeline has been installed, anchored or blocked as specified or shown on the Plans and partially backfilled, the pipeline shall be subjected to and comply with the following requirements:

**1. Anchoring and Blocking:**

Testing shall not be performed on lines having concrete blocking until the last concrete block in place has been cured for the following specified length of time.

| | |
|---|---|
| Concrete containing Type III cement | 3 days |
| Concrete containing Type II cement | 7 days |

**2. Allowable Leakage:**

Allowable Leakage: The leakage test shall be completed simultaneously with the pressure test and shall be in accordance with the Kansas Department of Health and Environment "Policies, General Considerations, and Design Requirements for Public Water Supply Systems in Kansas – Appendix C: Procedures for Pressure and Leakage Testing of Water Mains." Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 psi of the specified test pressure after the pipe has been filled with water and the air has been expelled. Allowable leakage shall be according to the following equation for DIP or PVC Piping.

$$L = \frac{SD(P)^{1/2}}{148{,}000}$$

Where

L - Total allowable leakage in one hour, gallons.
S - Length of section tested, feet.
D - Nominal pipe diameter, inches.
P - Test pressure, psi

**3. Placing Lines in Operation:**

After disinfection, flushing, and testing of the pipeline installations to the satisfaction of the Engineer, the Contractor shall assist the Owner in placing the new construction in operation.

**4. Maintenance:**

Any and all leaks which may appear within one year after acceptance of

the work by the Owner and/or which are evidenced by undue saturation of the soils at any point on the line, shall be located and repaired by the Contractor at no expense to the Owner.

**5. Measurement and Payment:**

No separate measurement or payment will be made for disinfecting and testing, but shall be considered as subsidiary to other items of the contract.

## 19. SURFACE RESTORATION

### A. Seeding and Sodding:

All unpaved areas cut by the line of trench of excavation or damaged during the work shall be seeded or sodded when specifically indicated on the plans. Seeding and sodding shall conform to the requirements of the Seeding and Sodding Specifications.

### B. 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 the Standard Sidewalks and Driveways Specifications or Asphalt Sidewalks and Driveways Specifications.

### C. Streets and Curbing:

All paved streets, shoulders and curbing areas cut by the line of trenching 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 of that removed. Paving and curb replacement shall conform to the requirements of the Paving Specifications.

## 20. SEPARATION OF WATER AND SEWER UTILITIES

### A. Gravity Sewer Lines laid Parallel to Water Lines:

When potable water pipes and gravity sewers are laid parallel to each other, the horizontal distance between them shall be not less than 10 feet (3.0 m). The distance shall be measured from edge to edge. The laying of water pipes and sanitary sewers shall be in separate trenches with undisturbed earth between them. In cases where it is not practical to maintain a 10 foot (3.0 m) separation, the contractor shall notify the City Engineer, and the City Engineer will consult with KDHE to consider equivalent protection by other methods. Equivalent protection may require the sanitary sewer construction with one of the following additional protective features: concrete encasement, vacuum sewers, or jointless pipe such as fused HDPE or cured-in-place pipe liner.

**B. Gravity Sewer Lines Crossing Water Lines:**

When a water pipe and a sanitary sewer cross and the sewer is 2 feet (0.6 m) or more (clear space) below the water pipe, no special requirements or limitations are provided herein. At all other crossings, the contractor shall notify the City Engineer, and City Engineer will consult with KDHE to consider equivalent protection by other methods. Equivalent protection may require the sanitary sewer to be constructed of one of the following materials (or approved equal) and pressure tested to assure water tightness pursuant to the most recent revision of KDHE's Minimum Standards of Design of Water Pollution Control Facilities:

**1.** Ductile iron pipe conforming to ASTM A 536 or ANSI/AWWA C151/A21.51 with minimum thickness class 50, and gasketed, push on, or mechanical joints in conformance with ANSI/AWWA C110/A21.10 or ANSI/AWWA C111/A21.11.

**2.** PVC pipe conforming to ASTM D3034 with minimum wall thickness of SDR41, ASTM F679, or ASTM F794, with gasketed push-on joints in conformance with ASTM D3212.

**3.** Reinforced concrete pipe conforming to ASTM C76 with gasketed joints in conformance with ASTM C361 or ASTM C443.

Joints in the sewer pipe must be located at least 10 feet from the edge of the crossed water pipe in order to avoid concrete encasement. Joints in the Water pipe shall be located as far as practical from the intersected Sewer main.

Where a water main is laid across or through an area where there is an existing sanitary sewer that is not constructed of one of the above specified materials and is 2 ft. (0.6 m) or less below the water pipe, the existing sewer shall be encased in concrete with a minimum thickness of 6 inches (15.2 cm) for a 10 ft. (3.0 m) distance beyond the edges of the crossed waterline or the crossed section of sewer replaced to meet the above specified construction requirements. The above requirements shall also apply where a water main must cross under an existing sanitary sewer. In cases where it is not practical to maintain a 2 foot (0.6 m) separation, the contractor shall notify the Engineer, and the Engineer will consult with KDHE to consider equivalent protection by other methods.

**C. Pressure Sewer Lines:**

When sewer force mains run parallel to water lines, the separation distance shall be as far as practical, but at least a 10 foot (3.0 m) horizontal separation shall be maintained. There shall be at least a 2 foot (0.6m) vertical separation at crossings with water main crossing above the sewer force main. In cases where it is not practical to maintain the required vertical or horizontal separation distance

between a water line and a sanitary sewer force main, the Engineer will consult with KDHE to consider equivalent protection by other methods.

**D. Sewer Connections:**

There are to be no physical connections between any parts of the potable water system with building sewers, sanitary sewers, or wastewater treatment facilities by means of which it would be possible for sewage, even under exceptional circumstances, to reach the wells, storage reservoirs, or distribution systems.

**E. Sewer Manholes:**

No water pipe shall pass through or come in contact with any part of a sewer manhole. Required horizontal separation distances between water mains and manholes are equivalent to those for water mains and gravity sanitary sewers.

**F. Other Pollution Sources:**

It is of the utmost importance that potable water lines be protected from any source of pollution. The following shall pertain to instances where septic tanks, absorption fields, waste stabilization ponds, feedlots, or other sources of pollution are encountered.

1. A minimum distance of 25 ft. (7.6 m) shall be maintained between all potable water lines and all pollution sources, e.g., septic tanks, septic tank absorption fields, waste stabilization ponds, sewage contamination, wastewater, landfill leachate, and all CAFO facilities.

2. Under no circumstances shall a water line be extended through an area that is a real or potential source of contamination to the water line or water supply.

3. Under no conditions shall the encasement of a water line be considered as adequate protection of a water line or a water supply for the purpose of extending the water line through a real or potential source of contamination.

## 21. SEWER MANHOLES

No water pipe shall pass through, or come in contact with, any part of a sewer or a sewer manhole.

## 22. MEASUREMENTS AND PAYMENTS

This section covers the methods of measurements, and the basis of payment, for the furnishing of all labor, equipment, tools and materials, and for the performance of all related work necessary to complete any construction covered in the section entitled "WATERLINES".

## 23. GENERAL

Unless specifically altered by the Contract Special Provisions, the methods of measurement and payment will be as specified herein, and as listed in the Proposal.

## 24. ITEMS NOT LISTED IN THE PROPOSAL

There will be no measurement or separate payment for any items of work not specifically identified and listed in the Proposal and all costs pertaining thereto will be included in the Lump Sum Proposal or Contract Unit Prices for other items listed in the Proposal.

## 25. METHODS OF MEASUREMENT

The quantities of accepted work will be measured and determined as follows:

### A. Water Main - Pipe:

#### 1. Open Trenched:

Measurement of various sizes and types of water mains including fittings or bends, will be in linear feet (meters), as called for in the Proposal and/or shown on the Plans, based on field measured lengths of acceptably installed pipe, as measured along the centerline thereof. Retainer glands, thrust blocks, encasements, embedment, location wire and tape, and other subsidiary items to the pipe will not be measured separately.

#### 2. Tunneled, Bored or Jacked:

Measurement will be made in linear feet (meters) for the applicable size and type of water main tunneled, bored, of jacked as called for in the Proposal and/or as shown on the Plans, based on actual field-measured lengths of acceptable installed pipe within casing or tunnel liner, including sand fill, end seals and other subsidiary items.

### B. Valves and Valve Boxes:

Measurement will be made for the applicable size and type of valve, including valve boxes, bases, lids and covers, as determined by the quantity of valves installed.

### C. Fire Hydrants:

Measurement will be made based on the actual number of hydrants installed as called for on the Plans or as directed by the City Engineer. No measurement for payment will be made for brand piping, fittings, couplings, thrust blocks or other

appurtenant items except valves and valve boxes.

**D. Specials (Meter Vaults, Air Valves, Pressure-Relief Valves, etc.):**

Measurement for these types items will be made based on the actual number of units installed, as called for on the Plans or as directed by the City Engineer.

## 26. BASIS OF PAYMENT

Payment for the completed and accepted work shall be made by one of the following methods:

**A. Lump Sum:**

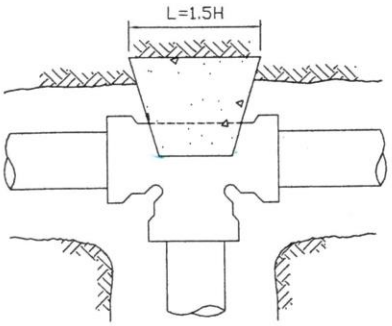
Payment will be made at the contract lump sum bid price.

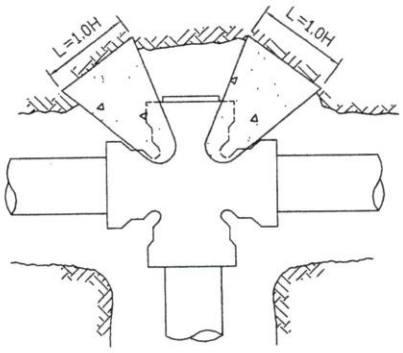
**B. Unit Price:**

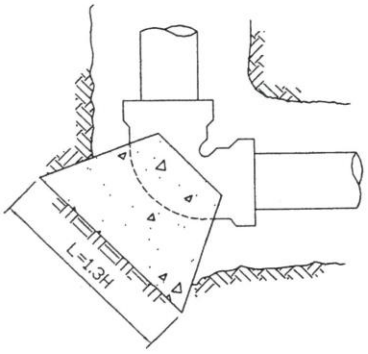
Payment will be made, based on measurement quantities, as shown in the contract unit prices.

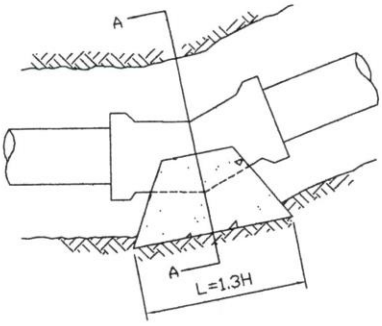
**C. Items Not Listed in the Proposal:**

There will be no measurement or separate payment for any other items of work not identified nor listed in the Proposal and all costs pertaining thereto shall be included in the lump sum or contract unit price, depending on which form is used, for other items listed in the statement of work in the Proposal.




NOTES: BLOCKS SHALL BE POURED AGAINST UNDISTURBED EARTH.
PLUGS SHALL BE INDIVIDUALLY RESTRAINED.
ALL CONCRETE USED FOR THRUST BLOCKS AND ENCASEMENT IS TO BE CLASS A CONCRETE.
NO BOLTS SHALL BE ENCASED IN CONCRETE.

## THRUST BLOCK DETAILS

| LINE SIZE | BEARING AREA IN SQUARE FEET | | | | | |
|---|---|---|---|---|---|---|
| | *TEE & VALVE | 90° ELLS | 45° ELLS | 22 1/2 ° ELLS | 11 1/4 ° ELLS | CROSS |
| 4" | 2.5 | 3.5 | 2.0 | 1.0 | 0.5 | 2.0 |
| 6" | 5.0 | 7.0 | 4.0 | 2.0 | 1.0 | 3.5 |
| 8" | 8.5 | 12.0 | 6.5 | 3.0 | 2.0 | 6.0 |
| | | | | | | |
| | | | | | | |
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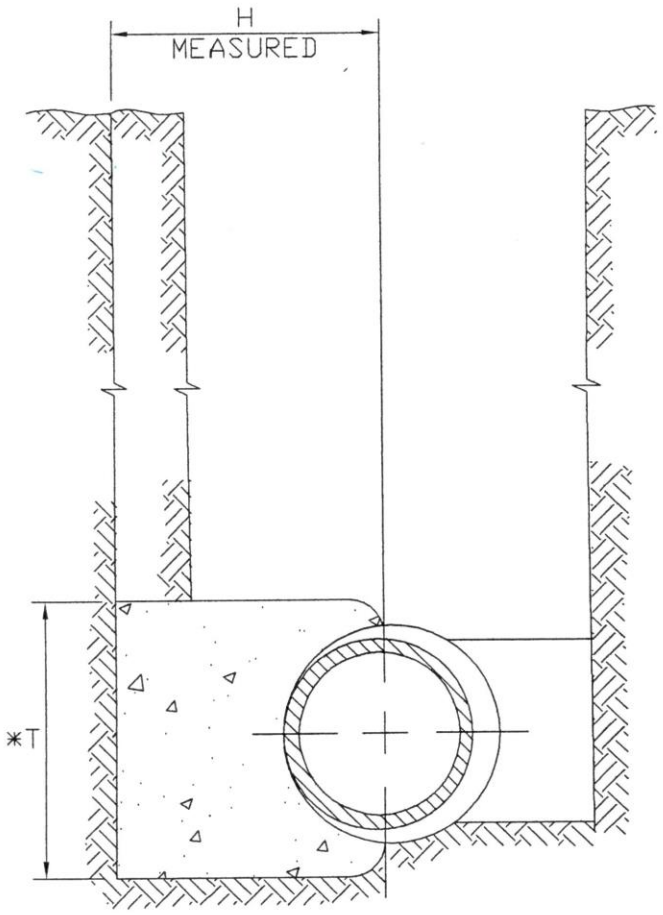
| | | | | | | |

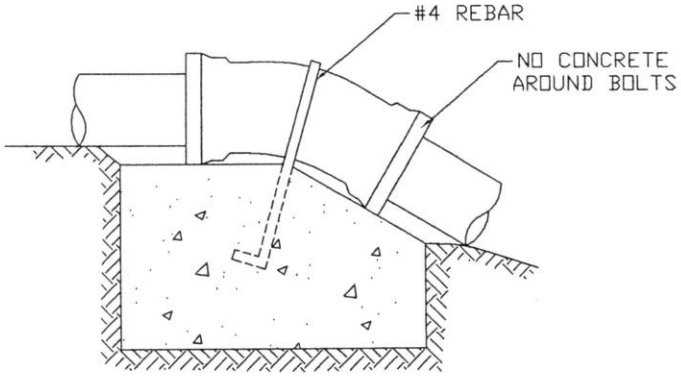
*AS INSTRUCTED BY ENGINEER




*AS REQUIRED TO OBTAIN THE MINIMUM BEARING AREA SHOWN IN THE TABLE. IN NO CASE SHALL THIS BE LESS THAN THE O.D. OF THE PIPE.

BEARING AREA = L x T

## SECTION A-A

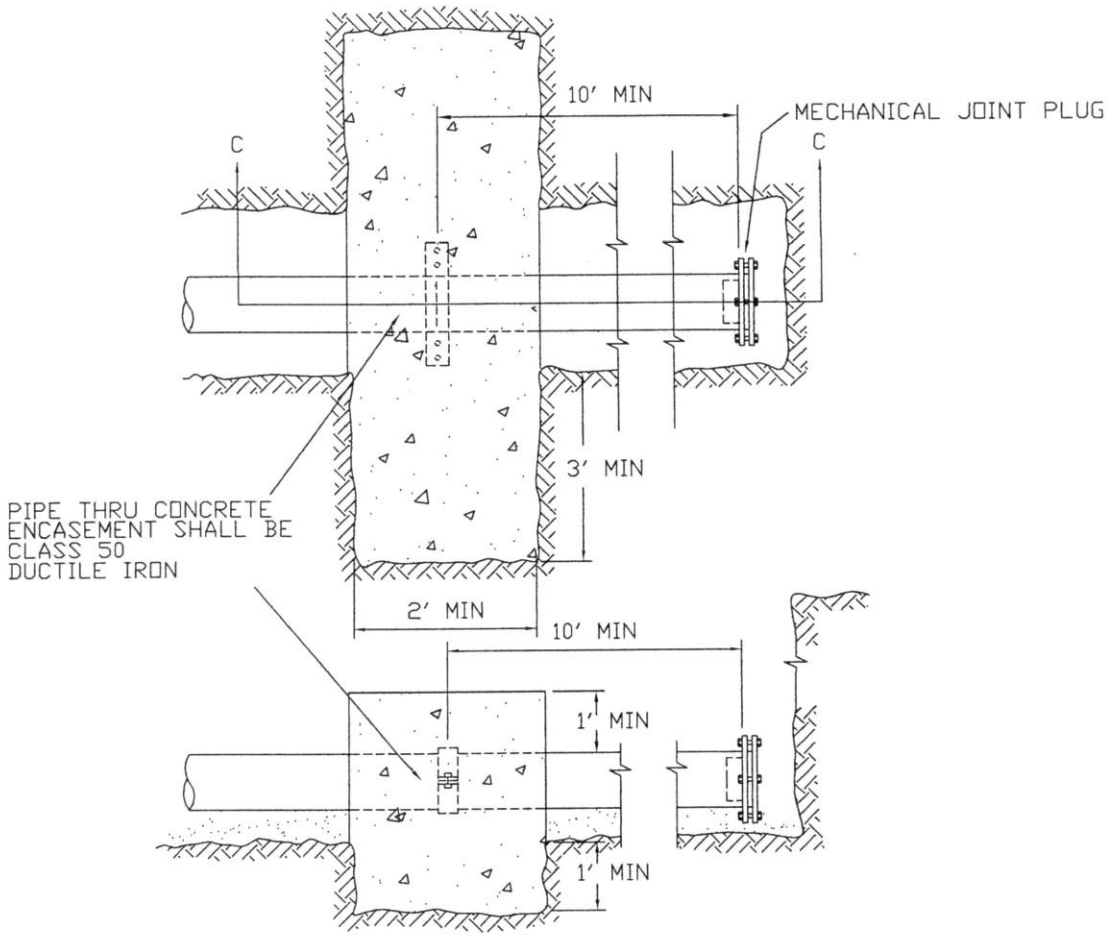



# 45° & 22-1/2° VERTICAL THRUST BLOCK DETAIL

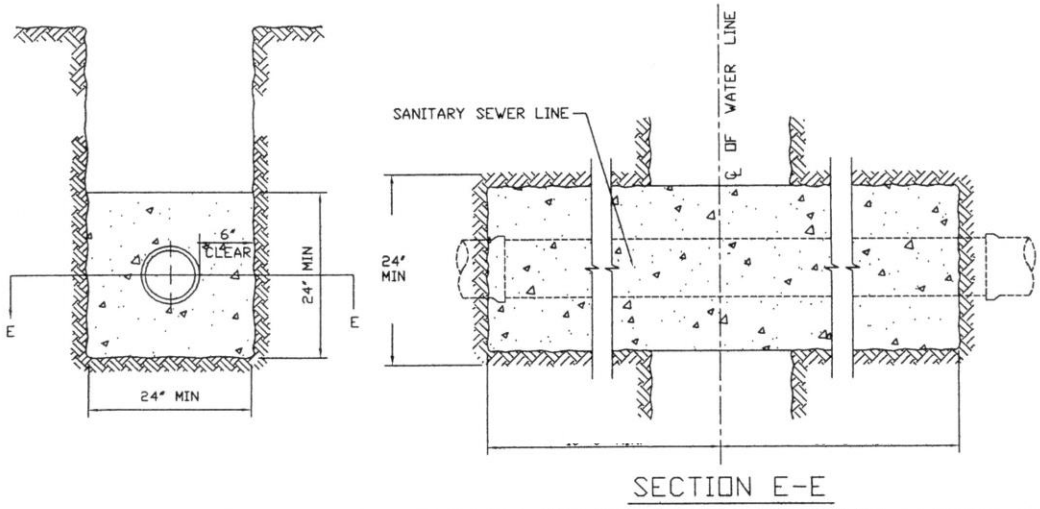
Note: Wrap all pipe bends in 8 mil plastic before adding concrete.

| BLOCK DIMENS'N | 45° & 22 1/2° VERICAL BEND | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1-1/2" | 2" | 2-1/2" | 3" | 4" | 5" | 6" | 7" |
| CU. FT. | 1.0 | 2.0 | 3.0 | 4.0 | 7.0 | 10.5 | 15.0 | 26.0 |

# STRADDLE OR END BLOCKING

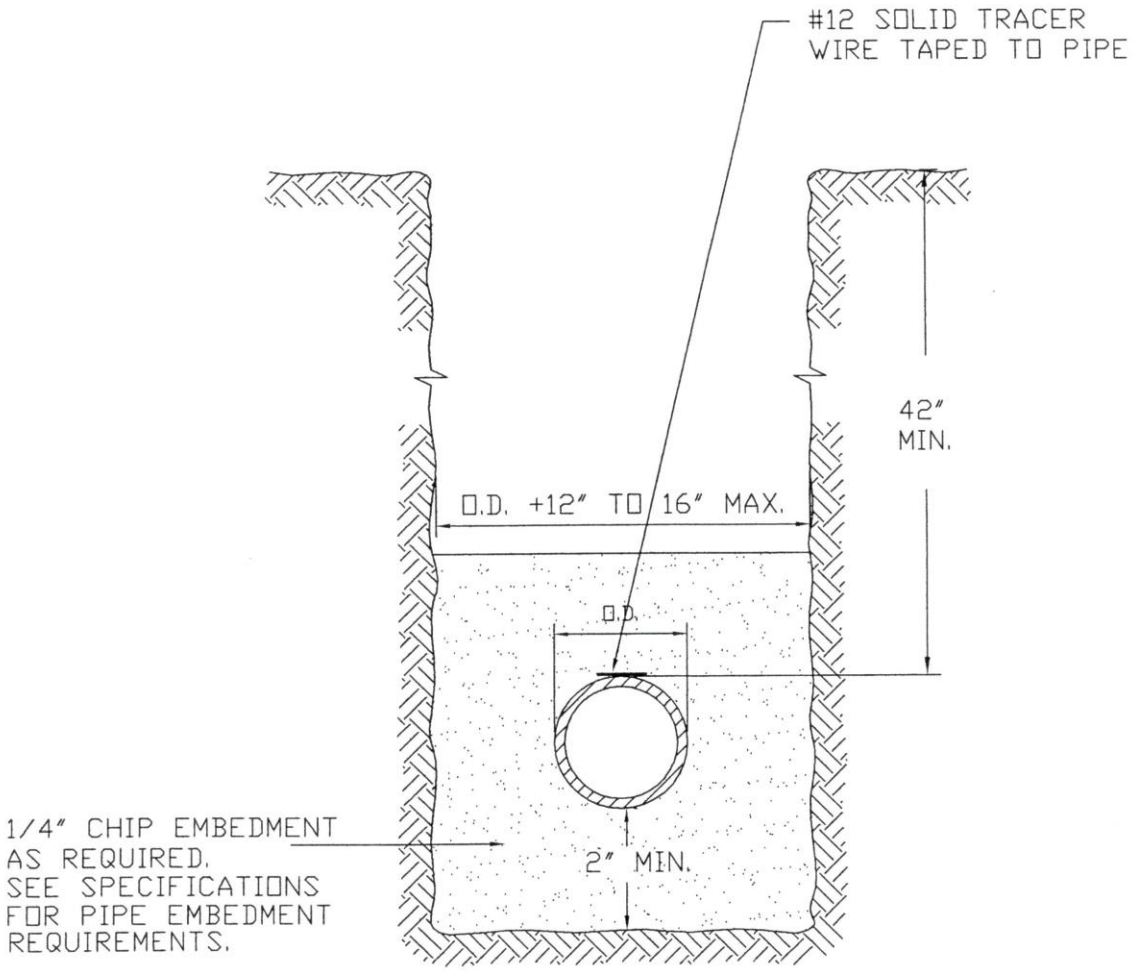



SECTION C-C

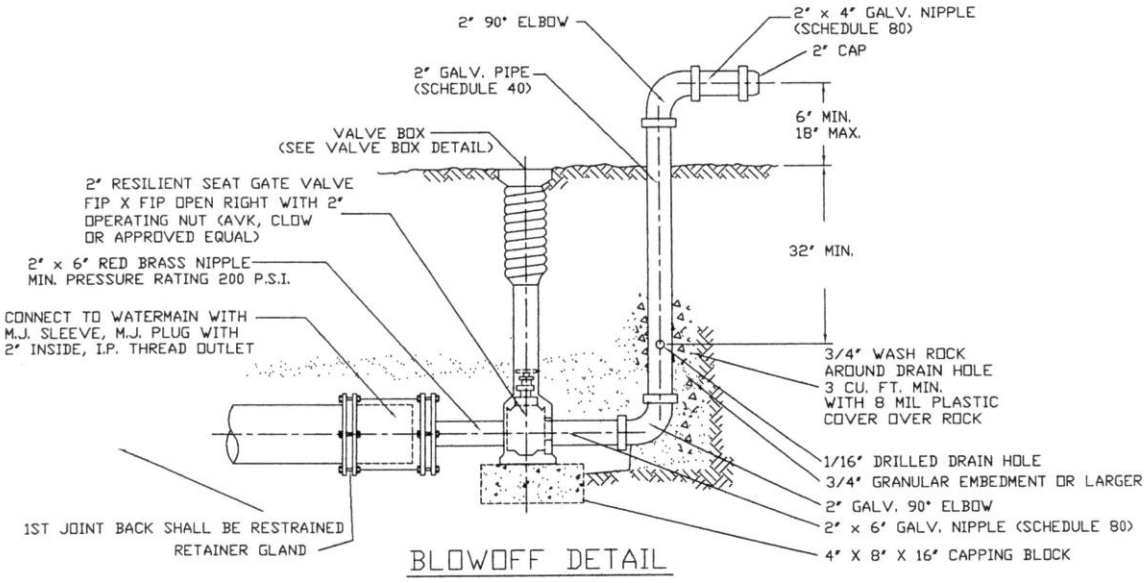



SECTION E-E

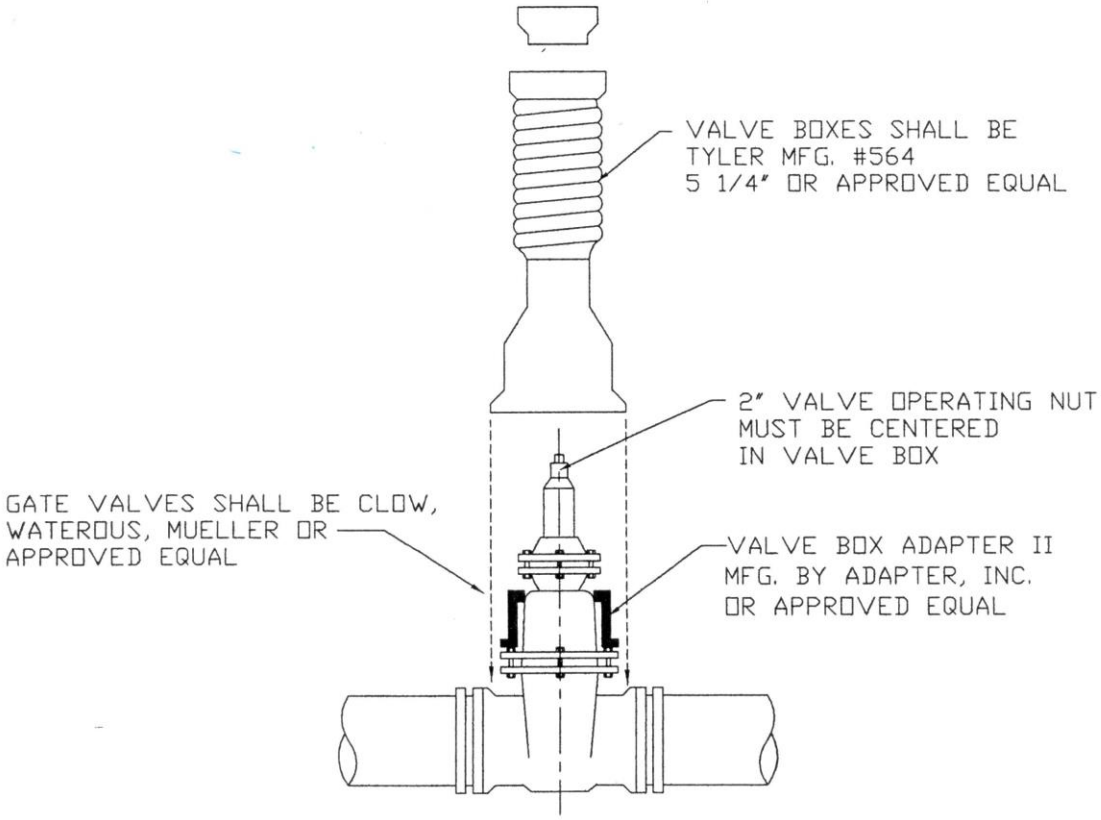
CONCRETE ENCASEMENT OF SANITARY SEWER LINE CROSSING WATER LINE



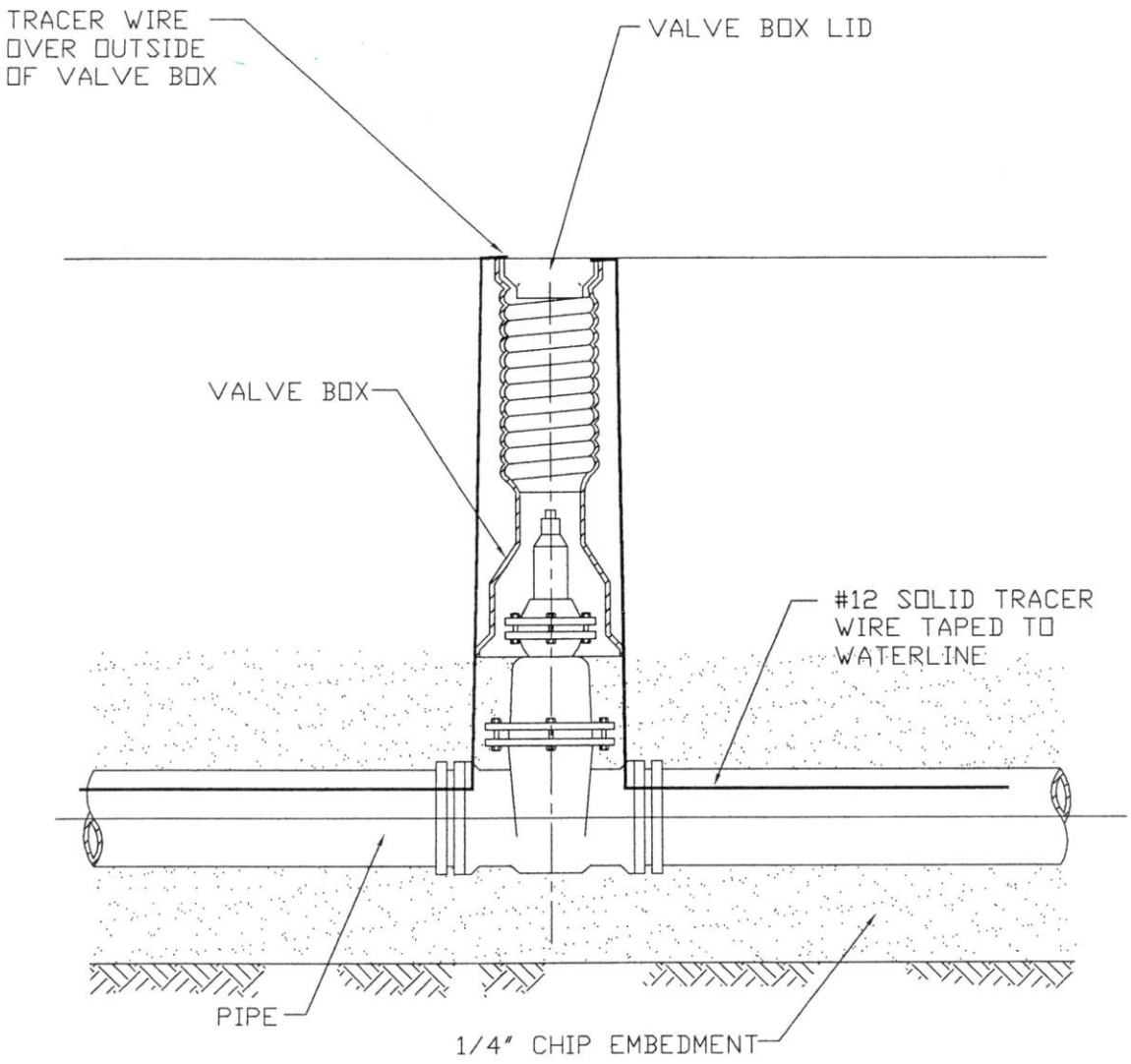

TYPICAL TRENCH SECTION



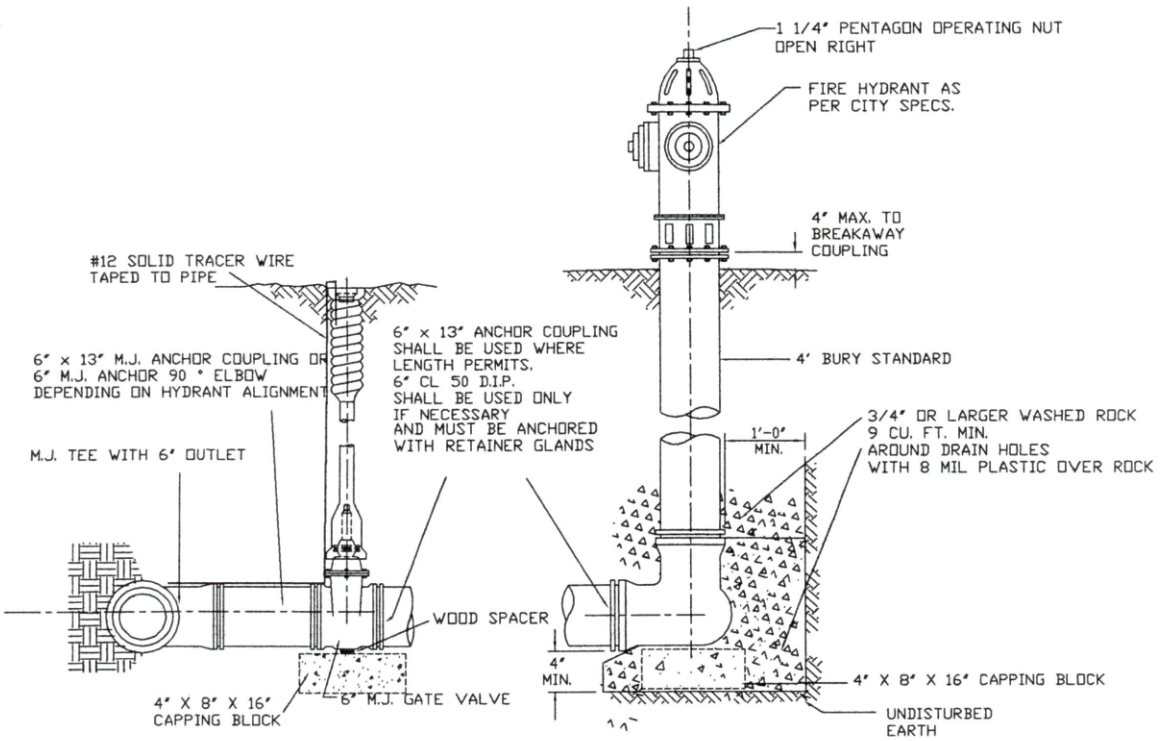

BLOWOFF DETAIL



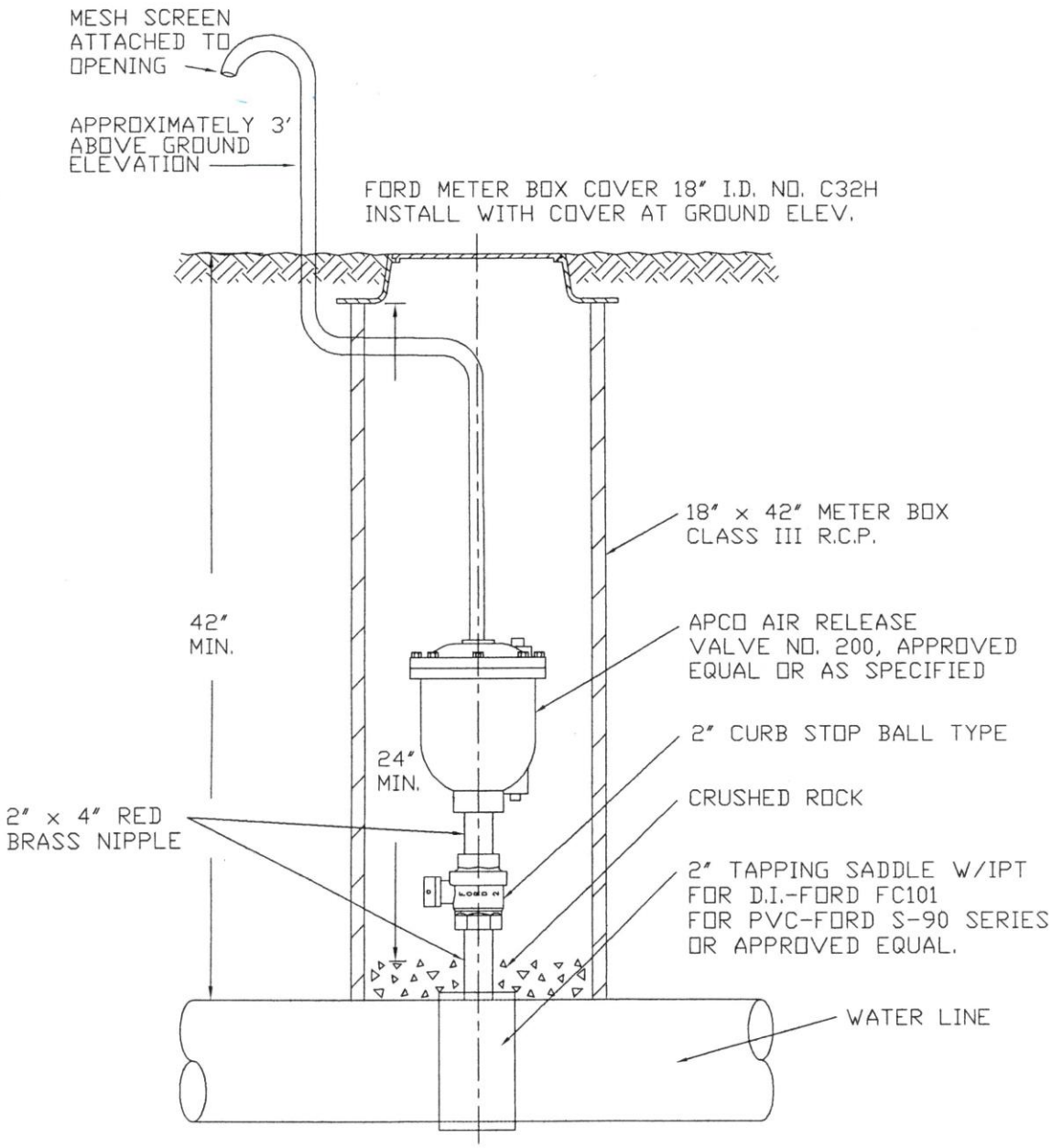

VALVE AND VALVE BOX DETAIL



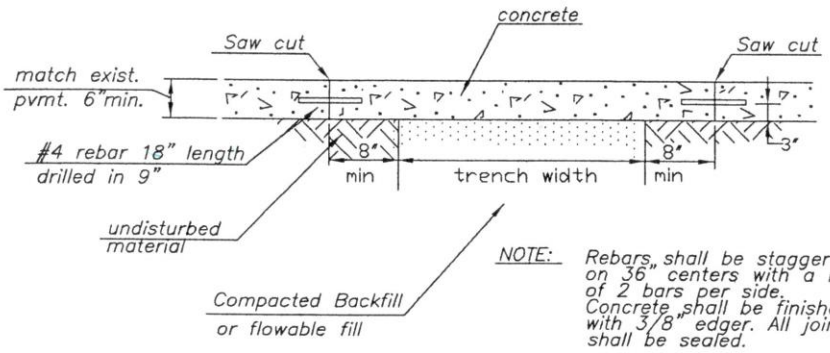

TRACER WIRE DETAIL




FIRE HYDRANT DETAIL

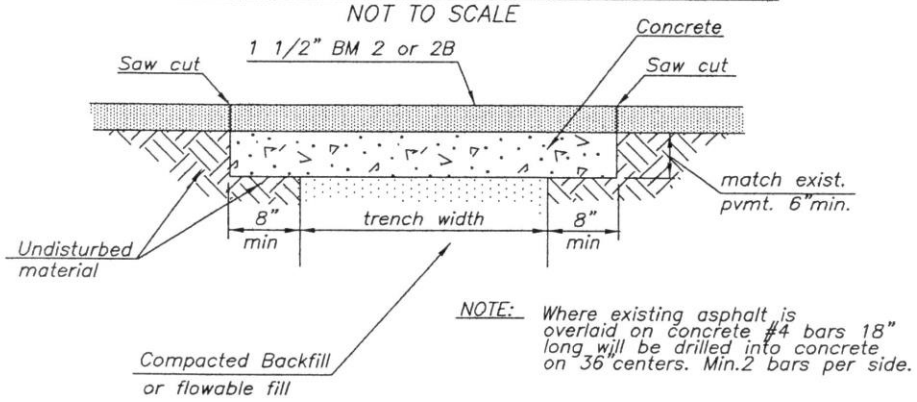



AIR RELEASE VALVE DETAIL



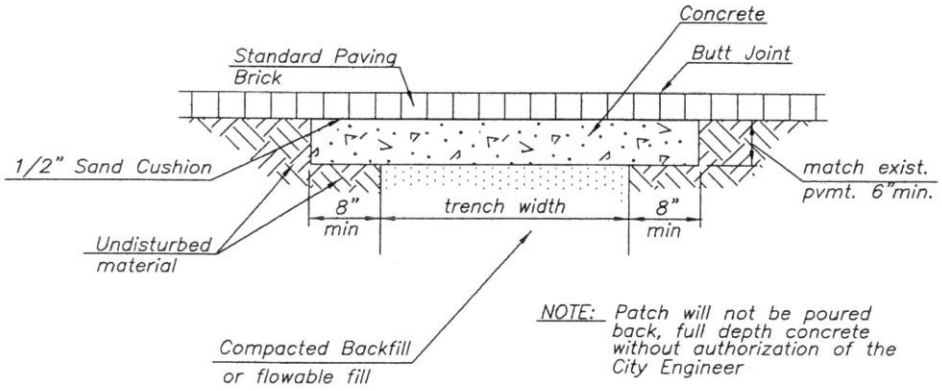

## CONCRETE PATCH REPLACEMENT

NOT TO SCALE




## ASPHALT PATCH REPLACEMENT

NOT TO SCALE




## BRICK PATCH REPLACEMENT

NOT TO SCALE