

ARTICLE V
STANDARD SPECIFICATIONS
for
WATER MAIN CONSTRUCTION

- V.1 General
- V.2 Materials and Equipment
- V.3 Installation of Ductile Iron Water Main
- V.4 Laying of Pipe
- V.5 Setting Hydrants
- V.6 Anchorage
- V.7 Hydrostatic Tests
- V.8 Backfilling
- V.9 Removal, Restoration, and Maintenance of Surface
- V.10 Sterilization of Mains
- V.11 Standard Drawings

ARTICLE V

STANDARD SPECIFICATIONS

for

WATER MAIN CONSTRUCTION

V.1 GENERAL

- A. The work covered by this Article V of the specification consists in furnishing all labor, equipment, supplies and materials, and in performing all operations in connection with the construction of Ductile Iron Pipe water main and related appurtenances in accordance with the Recommended standards for Water Works, 1997 Edition (commonly referred to as 'The 10 State Standards'). The following recognized standards [State of Nebraska, Department of Roads 1985 Standard Specifications for Highway Construction (NDOR), the American Water Works Association Standards (AWWA), American Standards for Testing and Materials (ASTM), American Association of State Highway and Transportation Officials (AASHTO), etc. or the latest revisions thereof] shall apply except as here in after provided. All specifications included in this Article V will pertain except that special notations on the plans, in the Special Provisions or in the General Provisions shall have precedence.
- B. The Contractor shall make all connections to existing mains as indicated on the plans. Only City of Norfolk Water Division personnel shall operate valves that are part of the City's water system, (this includes all valves that isolate this construction from the existing system). The Contractor shall give the City's Water Division 48 hour notice prior to their needing the valve(s) operated. The Contractor is also prohibited from operating fire hydrants without direct permission from the City Water Division.

V.2 MATERIALS AND EQUIPMENT

- A. Unless otherwise specified on plans or in the Special Provisions all materials furnished for work on this contract shall be new materials. No salvaged or revised materials shall be furnished.
- B. All pipe shall be ductile iron manufactured in accordance with the requirements of AWWA Standard C151/A21.51. The pipe thickness shall be designed in accordance with AWWA Standard C150/A21.50. All pipe will have a cement mortar lining in accordance with AWWA Standard C104/A21.4, and the joints shall conform to AWWA Standard C111/A21.11 for mechanical and push-on joints. Unless otherwise specified all pipe shall be Class 52. Bidders shall state in their proposal the brand and type of pipe that they propose to furnish.

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- C. All mechanical joint fittings shall be of the long radius type as tabulated in manufacturer's catalogue and manufactured in accordance with the requirements of AWWA Standard C104/A21.4. Unless otherwise specified all fittings shall be Class D.
- D. Cement mortar lining for pipe and fittings shall conform to AWWA Standard C104/A21.4 and unless otherwise specified all pipe and fittings furnished under this contract shall be cement mortar lined.
- E. All concrete entering into the work unless otherwise specified shall be sand-gravel concrete as specified by the NDOR Specifications for ABX Concrete.
- F. All fire hydrants shall conform to AWWA Standard C502. Hydrant size and type will be as noted on the proposal. Unless otherwise specified, they shall be 5 1/2 foot bury set at the established finish grade. All nozzles shall be bronze with National Standard hose coupling threads. Each hydrant shall be furnished with a 6-inch auxiliary gate valve and roadway box with proper valve box adaptor 11. The valve shall be connected to the hydrant and the main with hub inlets and two short sections of pipe. The minimum length of the section of pipe between the valve and the hydrant shall be three (3') feet.
- G. All two-way hydrants shall be 4 1/2" or 5 1/4" main valve opening and shall be Mueller Super Centurion 250 No. A-420 or A-422, American Darling B-84B, or approved equal.
- H. All steamer hydrants shall be Mueller Super Centurium 250 No. A-423 or American Darling B-84B, or approved equal.
- I. All gate valves furnished under these specifications shall meet or exceed the requirements of the AWWA Standard C500 for gate valves for Ordinary Water Works Service, and of the type and size shown on the plans and in the proposal. All valves shall be Mueller Model #2360-20, Clow Model #F-6100, American Darling Series 2500, or approved equal. Unless otherwise stated on the plans, in the special provisions, or on the bid proposal all valves shall be valves that open to the left (counterclockwise).
- J. The roadway box shall be Tyler cast iron valve boxes, two-piece 666-S. The cost of furnishing and setting roadway boxes shall be included in the price of the valves. All valve boxes will be installed with the appropriate valve box adaptor 11.
- K. All tapping valves furnished under these specifications shall meet or exceed the requirements of the AWWA Standard C500 for gate valves for Ordinary Water Works Service and of the type and size shown on the proposal. All valves shall be either American Flow Control series 2500 4" to 36", Mueller a-2360-16 4" to 12" and the 2361-16 14" to 36" or clow model F6114 or approved equal. Unless otherwise stated on the plans in the special provisions or on the bid proposal all valves shall be valves that open to the left (counterclockwise).

- L. All tapping tees shall be Smith Blair 664 or Ford FTSC with epoxy coating and stainless steel bolts, or approved equal.
- M. All tapping for use on cast iron and ductile pipe shall be a Mueller DB2A series with a double allow strap design with AWWA taper (C.C.) thread or approved equal. Corporation stops shall be of all bronze or brass construction with tapered thread inlet and furnished with union couplings for copper tubing connections unless otherwise specified on the plans or Special Provisions. Corporation stops shall be Mueller No. H15020, Ford No. F-600, Ford No. FB 1000 and Mueller P-15013, Ford No. F1000 and Mueller P-15008, or approved equal.
- N. Service lines shall be soft tempered "type K" copper service tubing unless otherwise specified on the plans or in the Special Provisions. It shall be installed with a horizontal "gooseneck" bend at the corporation stop to provide for expansion, contraction and settlement.
- O. Curb stops shall be of all bronze or brass construction of the inverted key-round way type for copper services unless otherwise noted in the Special Provisions. Curb stops shall be of the following:

3/4"	Mueller OriSeal No. H-15201	Ford B-22-333
1"	Mueller OriSeal No. H-15201	Ford B-22-444
1 1/4"	Mueller OriSeal No. H-15201	Ford B-22-555
1 1/2"	Mueller OriSeal No. H-15201	Ford B-22-666
2"	Mueller OriSeal No. H-15201	Ford B-22-777

 or approved equal.
- P. Curb stop boxes shall be furnished with an extension of the type with a stationary rod arch pattern base. The service box cap shall have the word "Water" cast on it. They shall be Mueller No. H-10334, Ford EA2 series with 1" upper section, McDonald 5607 series, or approved equal.

V.3 INSTALLATION OF DUCTILE IRON WATER MAINS

- A. Ductile iron pipe, fittings, valves, hydrants, and accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such materials be dropped. Pipe handled on skid ways shall not be skidded or rolled against pipe already on the ground. In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench.
- B. Pipe shall be so handled that the coating and lining will not be damaged. If, however, any part of the coating or lining is damaged, the repair shall be made by the Contractor at his expense in a manner satisfactory to the Engineer.
- C. The water main shall be laid and maintained to the required lines and grades with fittings, valves, and hydrants at the required locations; spigots centered in bells; and all valves and hydrants stems

plumb. Bell holes shall be provided at each joint to permit the jointing to be made properly. A valve box shall be provided for every valve unless otherwise noted on the plans or in the Special Provisions. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the wrench nut of the valve, with the box cover flush with the surface of the finished pavement or such other level as may be directed.

- D. Wherever existing utility structures or branch connections leading to them (including but not limited to sanitary sewers, storm sewers, water lines, gas lines, electrical lines, telephone lines, cable TV lines etc.) present an obstruction to the grade and alignment of the pipe, they shall be permanently supported, removed, relocated or reconstructed by the Contractor or through cooperation with the Owner of the utility, structure or obstruction involved. In instances where location or reconstruction is impractical, a deviation from line and grade will be ordered and the change shall be made in the manner directed. No deviation shall be made from the required line or grade except with the written consent of the Engineer.
- E. The Contractor shall proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures, both known and unknown, may be determined, and he shall be held responsible for the repair of such structures when broken or otherwise damaged because of carelessness on his part.
- F. Whenever, in the opinion of the Engineer, it is necessary to explore and excavate to determine the location of existing underground structures, the Contractor shall make explorations and excavations for such purposes.
- G. All pipe shall be laid to the minimum depth of cover over the water pipe of five and one-half feet (5.5') measured from the established street grade or the surface of the permanent improvement to the top of the barrels of the pipe. Deviations from this will be as shown on the plans.
- H. The trench shall be dug so that the pipe can be laid to the alignment and depth required and only so far in the advance as the Engineer shall permit. The width of the trench shall be ample to permit; the pipe to be laid and jointed properly, the backfill to be placed and compacted as specified, and the workmen to work therein safely and efficiently. Wherever necessary to prevent caving, excavations in unstable material (such as sand, gravel or sandy soil) shall be adequately sheeted and/or braced so that workmen may work therein safely and efficiently. Where sheeting and/or bracing is used the trench width shall be increased accordingly, and the sheeting and/or bracing shall also allow for the handling of specials (i.e. fire hydrants). Trench sheeting shall remain in place until the pipe has been laid, tested for defects, repaired if necessary, and the earth around it compacted to a depth of two feet over the top of the pipe. The cost of furnishing, placing, and removing the sheeting and bracing, and the leaving in place of sheeting and bracing indicated on the plans, shall be included in the price bid for the work.
- I. The Contractor shall be required, at his own expense, to keep trenches free from water during progress of the work unless otherwise indicated on the plans or in the Special Provisions. It is essential that the discharge of the trench dewatering pumps be conducted to natural drainage channels, drains or storm sewers.

- J. The trench shall be excavated to the depth required so as to provide a uniform and continuous bearing and support for the pipe on solid and undisturbed ground conforming to the required grade. Any part of the bottom of the trench excavated below the specified grade shall be corrected with approved material thoroughly compacted as directed by the Engineer. The finished subgrade shall be prepared accurately by means of hand tools.
- K. When the trench bottom at the required grade is soft and in the opinion of the Engineer, cannot support the pipe, a further depth shall be excavated as directed and refilled with approved material thoroughly compacted, or other approved means shall be adopted to assure a firm foundation for the pipe. Extra compensation shall be allowed for the extra work required.
- L. All surface materials which, in the opinion of the Engineer, are suitable for reuse in restoring the surface shall be kept separate from the general excavation material as directed by the Engineer.
- M. All excavated material shall be piled in a manner that will not endanger the work or the movement of traffic and that will avoid obstructing sidewalks and driveways. Hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, fire and police call boxes, or other utility controls shall be kept unobstructed and accessible. Gutters shall be kept clear or other satisfactory provisions made for street drainage, and natural watercourses shall not be obstructed.
- N. To protect pedestrians, direct and control vehicular traffic, and prevent damage to property, the Contractor shall provide safety devices in accordance with the Manual on Uniform Traffic Control Devices (1988 edition or the latest revision thereof). The Contractor is also responsible for maintenance of these devices including updating/changing them to accommodate the changes of the construction area. In addition, the Contractor shall enclose all material piles, equipment and pipe which may serve as obstructions to traffic (pedestrian or vehicular) by fences or barricades and when the visibility is poor, lights shall also be used.
- O. The Contractor shall carry on the work in a manner which will cause the least interruption to traffic, and may close to through traffic not more than two consecutive blocks, including the cross street(s) intersected. Where traffic must cross open trenches, the Contractor shall provide suitable bridges at street intersections and driveways.
- P. Temporary support, adequate protection and maintenance of all underground and surface structures, drains, sewers and other obstructions encountered in the progress of the work shall be furnished by the Contractor at his expense and under the direction of the Engineer. The structures which may have been disturbed shall be restored upon completion of the work.
- Q. Trees, shrubbery, fences, poles and all other property and surface structures shall be protected unless their removal is shown on the plans or authorized by the Engineer. When it is necessary to cut roots and tree branches, such cutting shall be done under the supervision and direction of the Engineer.

- R. Prior to the Contractor making connections to existing mains, or in cutting into the present system, at least 48 hours notice shall be give to the City's Water Division by the Contractor. When the water pressure must be shut off for construction purposes, the Contractor is responsible for notifying all of the affected property owners at least 48 hours prior to the time when he desires to have the water pressure shut off, and shall arrange with the Water Division to have the water shut off at that time. The Water Division shall close the necessary valves and drain the system to the best of their ability, but it is the contractor's responsibility to take care of any and all water, which may run into his trench, and he shall also hasten the work as much as possible. The Contractor shall arrange to have his men, tools, materials, pumps, etc. on the ground previous to the time of shutting off pressure to avoid all possible delay. Whenever (in the judgment of the City's Water Division) it is considered advisable to have the water shut off at night rather than in the daytime, the Contractor shall arrange to do such work during the nighttime. It shall be the contractor's responsibility to supply plenty of adequate lighting for this nighttime work.

V.4 LAYING OF PIPE

- A. Proper implements, tools and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and convenient prosecution of the work. All pipe, fittings, valves and hydrants shall be carefully lowered into the trench piece by piece by means of a derrick, ropes or other suitable tools or equipment, in such a manner as to prevent damage to water main materials and protective coatings and linings. Under no circumstances shall equipment or water main materials be dropped or dumped into the trench.
- B. The pipe and fittings shall be inspected for defects and while suspended above grade, be rung with a light hammer to detect cracks.
- C. All lumps, blisters, and excess coal-tar coating shall be removed from the bell-and-spigot end of each section of pipe. Before the pipe is laid, the outside of the spigot and the inside of the bell shall be wire-brushed, wiped clean and dried, free from oil and grease.
- D. Every precaution shall be taken to prevent foreign material from entering the pipe during laying operations. No pipe shall be laid in water or when, in the opinion of the Engineer, trench conditions are unsuitable. Methods used to accomplish this shall be approved by the Engineer. No tools, clothing, debris or other material shall be placed inside the pipe. All dead ends on new mains shall be closed with cast iron plugs or caps, with or without a blow off cock, as shown on the drawings.
- E. After placing a length of pipe in the trench, the spigot end shall be centered in the bell and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with approved backfill material tamped under it except at the bells. Pipe and fittings which do not allow a sufficient and uniform space for joints shall be removed and replaced with pipe and fittings of proper dimensions to insure such uniform space.

- F. Pipe shall be laid with bell ends facing in the direction of laying, unless directed otherwise by the Engineer. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by the Engineer.
- G. Polyethylene encasement – should be seamless, Ansi, Awwa C105/A21.5; LLDPE-8m or HDCLPE-4m

All buried ductile pipe including all straight pipe, bends, tees, adapters, closure pieces and other fittings or specials and all valves shall be provided with at least one wrap of polyethylene encasement.

Polyethylene tube protection should be installed in accordance with Ansi-Awwa C105/A21.5
METHOD

- A. Preparation of pipe shall include but shall not be limited to removal of lumps of clay, mud cinders etc. prior to installation. Where ductile iron pipe is embedded or encased in concrete the polyethylene tube shall be installed over the pipe 5' either side of each end of the concrete encasement. This item will be as a separate bid item if it is to be used.
- H. The cutting of pipe for inserting valves or fittings shall be done in a neat and workmanlike manner without damage to the pipe or cement lining and so as to leave a smooth end at right angles to the axis of the pipe. The flame cutting of pipe by means of an oxyacetylene torch shall not be allowed.
- I. Whenever it is necessary to deflect joints from a straight line the amount of deflection shall not exceed 5 degrees per joint on all pipe sizes up to 12 inches and 3 degrees per joint on pipe sizes greater than 12 inches. Joints adjacent to valves and fittings shall not be deflected unless permission is obtained from the Engineer.
- J. The location at the end of each service line shall be marked by placing a 2" x 2" wood stake. The stake shall extend from four (4') feet below the water line service box to a point one (1') foot above ground level. The top two (2') feet of the stake shall be painted with one heavy coat of outside blue house paint.

V.5 SETTING HYDRANTS

- A. Hydrants shall be located as shown or as directed, and in a manner to provide complete accessibility, and also in such a manner that the possibility of damage from vehicles or injury to pedestrians will be minimized.
- B. When placed behind the curb, the fire hydrant shall be set a minimum of 6 feet from the back of curb line. When set in the lawn space between the curb and the sidewalk, or between the sidewalk and the property line, no portion of the hydrant or nozzle cap shall be within 6 inches of the sidewalk. The height of the fire hydrant shall be adjusted so that the hydrant break away flange is

within 3" at grade and such that the distance from the top of curb to the center of the outlet nozzle shall be a minimum of 18 inches. All hydrant locations and grades will be staked by the Engineer.

- C. All hydrants shall stand plumb and shall have their nozzles parallel with or at right angles to the curb face with the pumper nozzle facing the curb.
- D. Each hydrant shall be connected to the main with a 6 inch ductile iron branch controlled by an independent 6 inch gate valve (with accompanying valve box), except as otherwise directed. Hydrants shall be thoroughly cleaned before setting.
- E. A drainage pit shall be constructed as shown on the plan for each hydrant installed.

V.6 ANCHORAGE

- A. The bowl of each hydrant shall be well braced against unexcavated earth at the end of the trench with concrete backing, or it shall be tied to the pipe with suitable metal tie rods or clamps, as shown or directed by the Engineer.
- B. All plugs, caps, tees, and bends shall be provided with a reaction backing (or blocking), or movement shall be prevented by attaching suitable metal rods or clamps as shown or directed by the Engineer.
- C. Reaction backing shall be poured in place concrete. Backing shall be placed between solid ground and the fitting to be anchored; the area of bearing on the pipe and on the ground in each instance shall be that shown or directed by the Engineer. The backing shall, unless otherwise shown or directed, be so placed that the pipe and fitting joints will be accessible for repair.
- D. A metal harness of tie rods and pipe clamps of adequate strength to prevent movement may be used in place of reaction backing if approved by the Engineer. Hot dip galvanized, or otherwise rustproof treated material shall be used.

V.7 HYDROSTATIC TESTS

- A. All water mains, appenditures, fittings, valves, and hydrants shall be tested for water tightness in accordance with the Hydrostatic Testing Section of AWWA Standard C600. Deviations in this test procedure may be permitted by the Engineer, if, in his opinion, the circumstances are such as to require deviation.

Section 1: Pressure Test

After the pipe has been laid, all newly lain pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 1.5 times the working pressure at the point of testing.

(a) Test pressure restrictions. Test pressures shall:

1. Not be less than 1.25 times the working pressure at the highest point along the test section, or a minimum of 125 psi.
2. Not exceed pipe or thrust-restraint design pressures.
3. Be of at least 2-hour duration.
4. Not vary by more than \pm 5 psi (0.35 Bar) for the duration of the test.
5. All hydraulic tests shall be verified by City of Norfolk water personnel or their approved agent.
6. Not exceed twice the rated pressure of the valves of hydrants when the pressure boundary of the test section includes closed gate valves or hydrants. NOTE: Valves shall not be operated in either direction at differential pressure exceeding the rated pressure.
7. Not exceed the rated pressure of the valves when the pressure boundary of the test section includes closed, resilient-seated gate valves or butterfly valves.

(b) Pressurization. Each valved section of pipe shall be filled with water slowly and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the owner. Valves shall not be operated in together the opening or closing direction at differential pressures above the rated pressure. It is good practice to allow the system to stabilize at the test pressure before conducting the leakage test.

(c) Air removal. Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants. If permanent air vents are not located at all high points, the contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure removed and plugged or left in place at the discretion of the owner.

(d) Examination. Any exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damage or defective pipe, fittings, valves, or hydrants that are discovered following the pressure test shall be repaired or replaced with sound material, and the test shall be repeated until it is satisfactory to the owner.

Section 2: Leakage Test

The leakage test shall be conducted concurrently with the pressure test.

(a) Leakage defined. 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 (0.35 Bar) of the

specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water. Leakage shall not be measured by a drop in pressure in a test section over a period of time.

(b) Allowable leakage. No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{SD \sqrt{P}}{133,200}$$

in which L is the allowable leakage, in gallons per hour; S is the length of pipe tested, in feet; D is the nominal diameter of the pipe, in inches; and P is the average test pressure during the leakage test, in pounds per square inch gauge. In metric units,

$$L_m = \frac{SD \sqrt{P}}{2,816}$$

In which Lm is the allowable leakage, in liters per hour; S is the length of pipe tested, in meters; D is the nominal diameter of the pipe, in inches; and P is the test pressure, in Bars. These formulae are based on an allowable leakage of 11.65 gpd, per mile, per inch nominal diameter at a pressure of 150 psi.

Allowable leakage at various pressures are as shown in the following table:

Allowable Leakage per 1000 ft. (305m) of Pipeline* -- gph+

Nominal Pipe Diameter - in.

Ave. Test Pressure psi (Bar)	3	4	6	8	10	12	14	16	18	20	24	30	6	42	48	54
450(31)	0.48	0.64	0.95	1.27	1.59	1.91	2.23	2.55	2.87	3.18	3.82	4.78	5.73	6.69	7.64	8.60
400(28)	0.45	0.60	0.90	1.20	1.50	1.80	2.10	2.40	2.70	3.00	3.60	4.50	5.41	6.31	7.21	8.11
350(24)	0.42	0.56	0.84	1.12	1.40	1.69	1.97	2.25	2.53	2.81	3.37	4.21	5.06	5.90	6.74	7.58
300(21)	0.39	0.52	0.78	1.04	1.30	1.56	1.82	2.08	2.34	2.60	3.12	3.90	4.68	5.46	6.24	7.02
275(19)	0.37	0.50	0.75	1.00	1.24	1.49	1.74	1.99	2.24	2.49	2.99	3.73	4.48	5.23	5.98	6.72
250(17)	0.36	0.47	0.71	0.95	1.19	1.42	1.66	1.90	2.14	2.37	2.85	3.56	4.27	4.99	5.70	6.41
225(16)	0.34	0.45	0.68	0.90	1.13	1.35	1.58	1.80	2.03	2.25	2.70	3.38	4.05	4.73	5.41	6.03
200(14)	0.32	0.43	0.64	0.85	1.06	1.28	1.48	1.70	1.91	2.12	2.55	3.19	3.82	4.46	5.09	5.73
175(12)	0.30	0.40	0.59	0.80	0.99	1.19	1.39	1.59	1.79	1.98	2.38	2.98	3.58	4.17	4.77	5.36
150(10)	0.28	0.37	0.55	0.74	0.92	1.10	1.29	1.47	1.66	1.84	2.21	2.76	3.31	3.86	4.41	4.97
125(9)	0.25	0.34	0.50	0.67	0.84	1.01	1.18	1.34	1.51	1.68	2.01	2.52	3.02	3.53	4.03	4.53
100(7)	0.23	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50	1.80	2.25	2.70	3.15	3.60	4.05

* If the pipeline under test contains section of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

+ To obtain leakage in liters/hour, multiply the values in the table by 3.785.

When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gal/h/in. (0/0012 L/h/mm) of nominal valve size shall be allowed.

When hydrants are in the test section, the test shall be made against the closed hydrant.

(c) Acceptance of installation. Acceptance shall be determined on the basis of allowable leakage. If any test of pipe laid discloses leakage greater than that specified in Section 2(b), the contractor shall at his own expense, locate and make repairs as necessary until the leakage is within the specified allowance.

All visible leaks are to be repaired regardless of the amount of leakage.

V.8 BACKFILLING

- A. All backfill must be compacted to a minimum of 90 percent of the maximum dry density as determined by (AASHTO T99, ASTM D698) Standard Proctor. The Contractor shall backfill from the bottom of the trench to the top of the pipe with sand, and the balance of the trench shall be backfilled using suitable material from the excavation. The top 12 inches of backfill in locations under existing or future pavement shall be compacted to a minimum of 96 percent of the maximum density as determined by (AASHTO T99, ASTM D698) Standard Proctor.
- B. Under existing or future pavements the Engineer may require that the backfill shall be placed and compacted in lifts of eight (8") inches maximum loose thickness.
- C. The Contractor shall bring all backfill material to not more than 4% above or 2% below the optimum moisture content before backfilling as determined by (AASHTO T99, ASTM D698) Standard Proctor.
- D. Tamping machinery and equipment shall be as approved by the Engineer. Machines too light for achieving the desired compaction and those that might damage the pipe will not be approved. The method of using the machines must also be as approved by the Engineer.
- E. The Owner may hire a recognized testing laboratory to perform in-place density tests on subgrade.
- F. When in-place density tests are performed, the tests shall be performed in accordance with the procedures set forth in:

ASTM D 2167 (Rubber Balloon Method)
ASTM D 1556 (Sand Cone Method)
ASTM D 2922 (Nuclear Method)

- G. If the tests show non-compliance with the plans and specifications, the backfill shall be removed, replaced, and retested by the Contractor without extra compensation and at no extra cost to the Owner.

V.9 REMOVAL, RESTORATION, AND MAINTENANCE OF SURFACE

- A. The Contractor shall remove pavement and road surfaces as a part of the trench excavation, and the amount removed shall depend upon the width of trench specified for the installation of the pipe and the width end length of the pavement area required to be removed for the installation of gate valves, specials, manholes, or other structures.
- B. The Contractor shall use a concrete saw cutting to a depth one-half the thickness of the slab to assure the breaking of the pavement along straight lines. The face of the remaining pavement shall be vertical and undamaged.
- C. If the Contractor removes or damages pavement or surfaces beyond the limits specified above, such pavement and surfaces shall be replaced or repaired at the expense of the Contractor to the satisfaction of the Engineer.
- D. The Contractor shall replace all surface material, and shall restore paving (unless otherwise specified), curbing, sidewalk, gutters, shrubbery, fences, sod and other surfaces disturbed, to a condition equal to that before the work began, furnishing all labor and material incidental thereto. The subgrade for the new pavement must first be approved by the Engineer prior to placing concrete. No pavement shall be replaced until backfill compaction has been approved by the Engineer.
- E. Surplus material, tools and temporary structures shall be removed by the Contractor, and all dirt, rubbish, and excess earth from excavation shall be hauled away by the Contractor, and the construction site shall be left clean, to the satisfaction of the Engineer.
- F. Following the certification of completion by the Engineer, the Contractor shall maintain the surface of the unpaved trenches, curbs, sidewalks, gutters, shrubbery, fences, sod, and other surfaces disturbed for the period described in the General Provisions.
- G. All material and labor required for the maintenance of the trenches and adjacent structures shall be supplied by the Contractor and the work shall be done in a manner satisfactory to the Engineer.

V.10 STERILIZATION OF MAINS

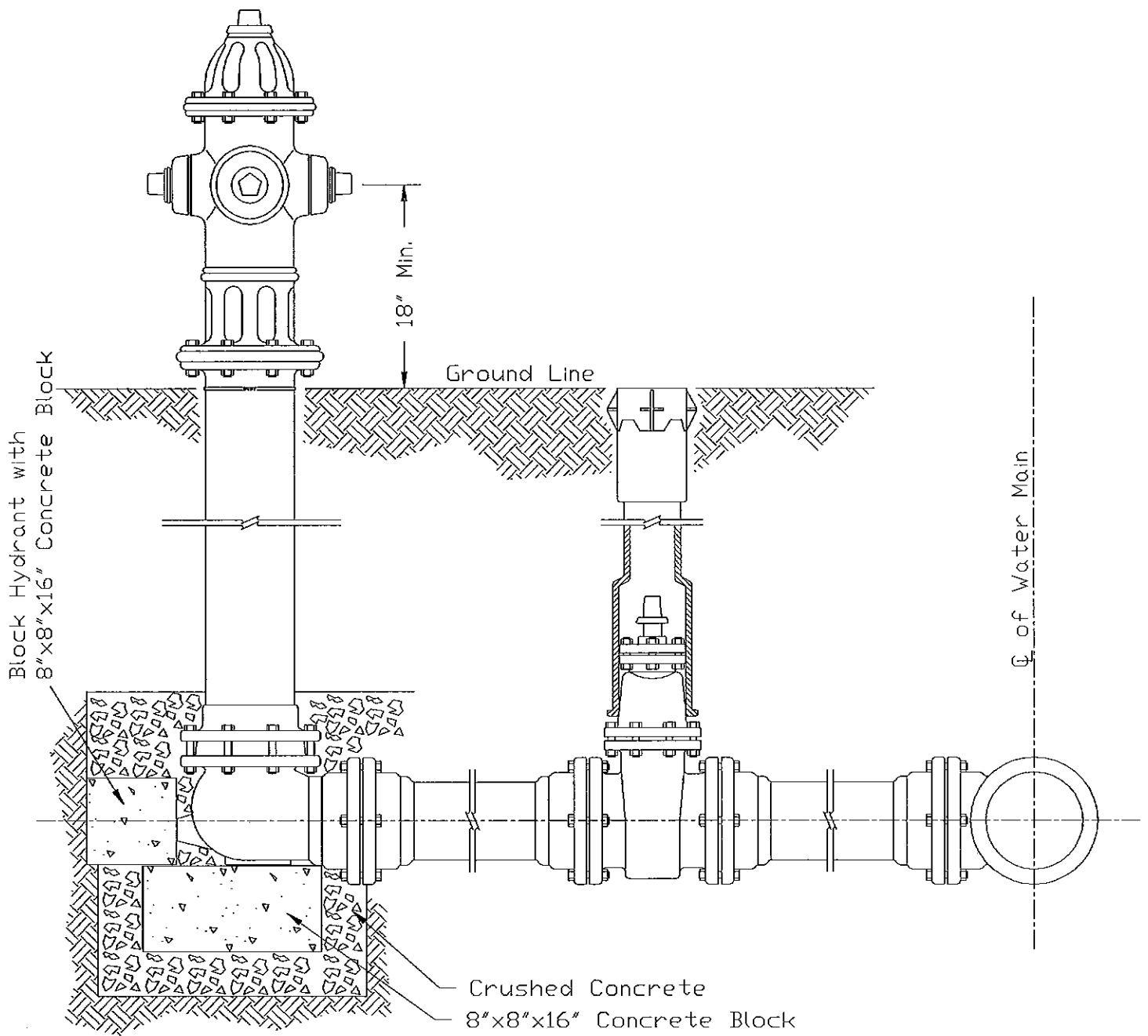
- A. Before being placed in service, all new water distribution systems, or extensions to existing systems, or any valved section of such extension, or any replacement in the existing water distribution system shall be sterilized.
- B. The Contractor shall sterilize by the use of calcium hypochlorite tablets (comparable to commercial products known as "HTH", "Perchloron", and "Maxochlor"). The tablets shall be placed at each

pipe joint in a sufficient number such that a minimum of 50-ppm available chlorine shall be present in the line. The newly laid pipe shall be filled very slowly (by the City Water Division) to avoid washing the tablets to the extremity of the pipeline.

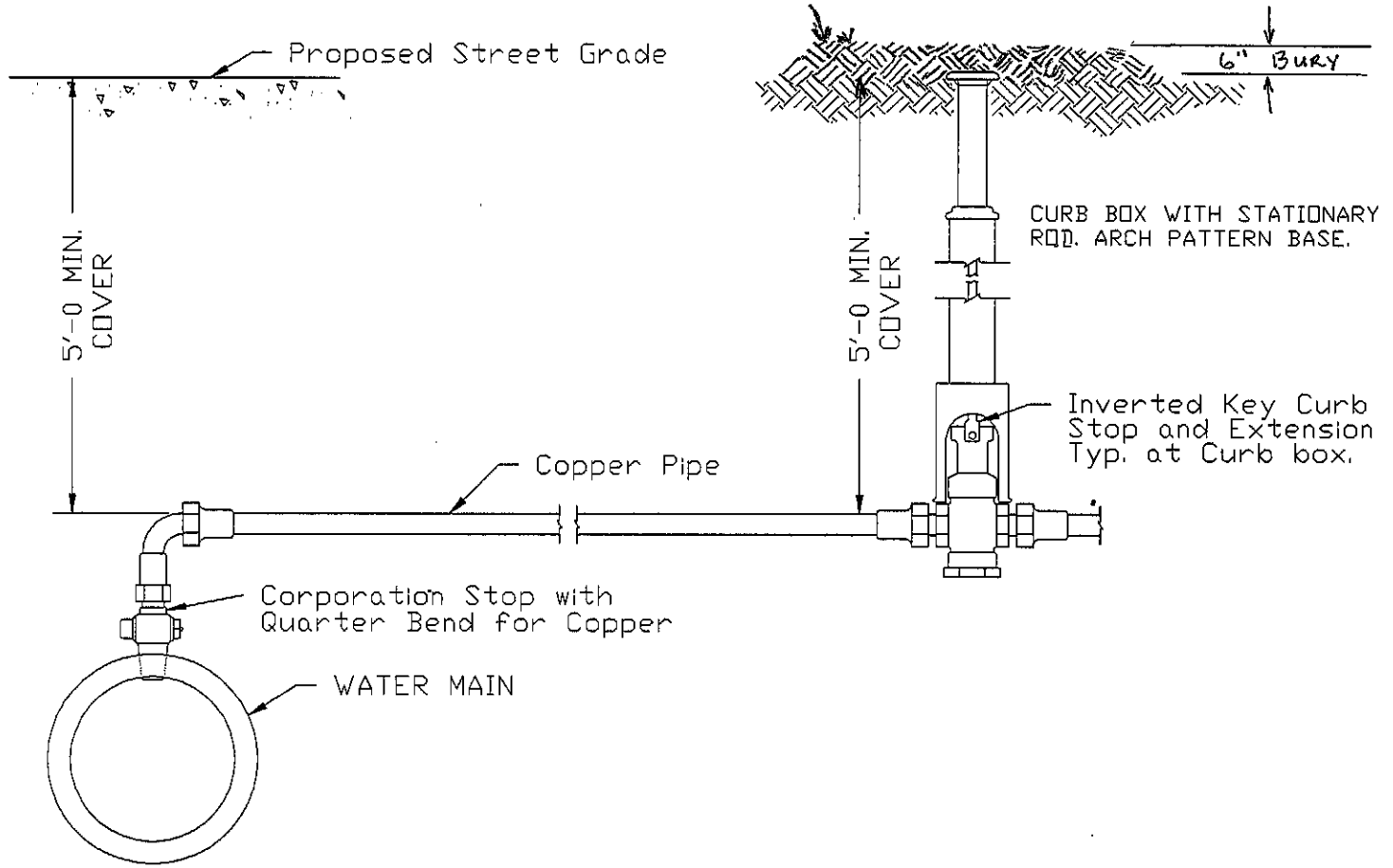
- C. The treated water shall be retained in the pipe long enough to destroy all non-spore-forming bacteria. This period shall be at least 24 hours or as directed by the Engineer. In the process of chlorinating newly laid water pipe, all valves or other appurtenances shall be operated while the pipe line is filled with the treated water. After the chlorine treated water has been retained for the required time, the chlorine residual at pipe extremities and at other representative points shall be at least 5 ppm.
- D. Following sterilizations, all treated water shall be thoroughly flushed from the newly laid pipe line at its extremities by City Water Division until the replacement water throughout its length shall, upon test, both chemically and bacteriologically, be proven equal to the water quality served the public from the existing water supply system, and approved by the Public Health Authority having jurisdiction. The bacteriological test shall at a minimum consist of two consecutive test samples taken 24 hours apart by Water Division personal, with both samples showing (testing with) Zero (0) Coliform Growth
- E. If the Contractor wishes to sterilize by a method other than the method indicated above; or it becomes necessary to re chlorinate the line; the Contractor shall submit in writing his proposed method to the Engineer for approval. The method chosen shall be in accordance with a current AWWA Standard.
- F. The furnishing of materials and the labor and all other costs incidental to testing and sterilization shall be borne by the Contractor and merged into his bid price for construction of water mains.

V.11 STANDARD DRAWINGS

Typical Fire hydrant w/ Auxiliary Gate Valve.....	Page V.15
Typical Connection to Water Main Using a Corporation Stop.....	Page V.16
Sanitary Sewer - Water Main Crossing.....	Page V.17
Storm Sewer - Water Main Crossing.....	Page V.18
Details of Anchoring.....	Page V.19 Page V.20 Page V.21
Valve Box Adaptor II.....	Page V.22



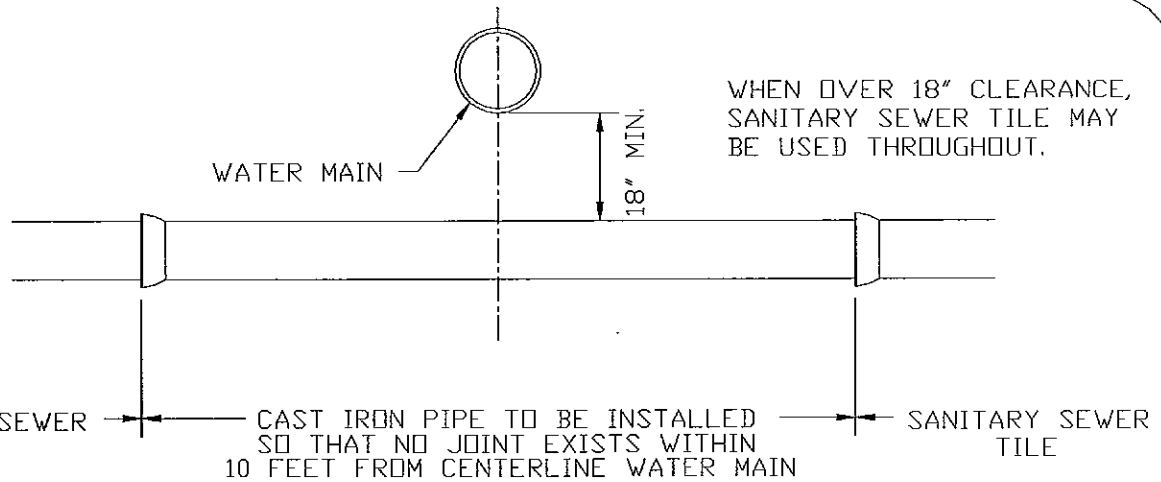
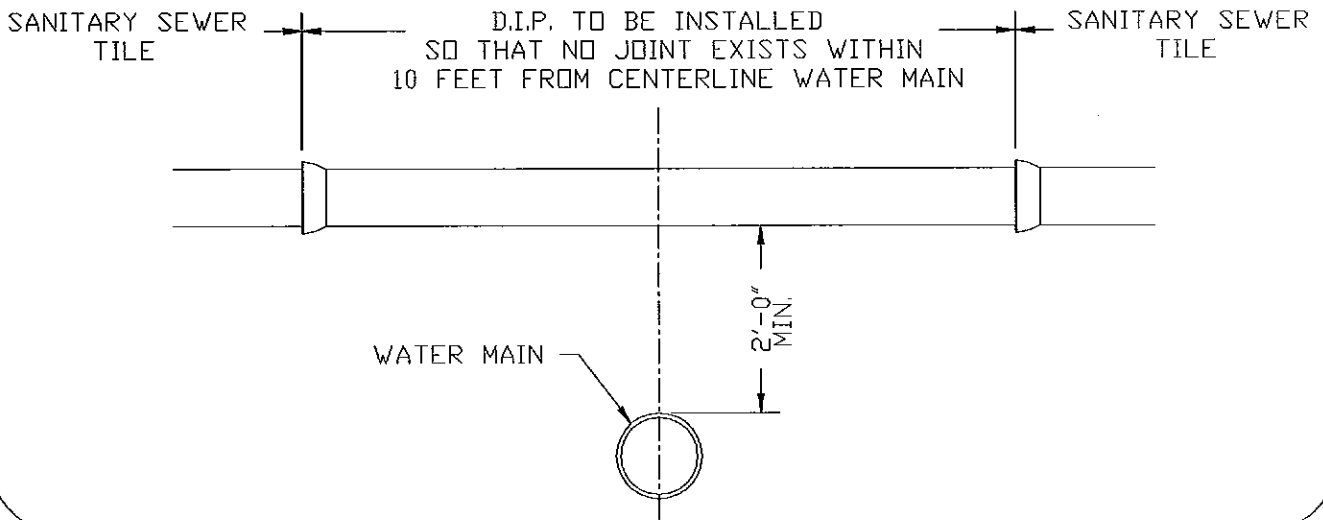
TYPICAL SETTING OF FIRE HYDRANT WITH
AUXILIARY GATE VALVE



TYPICAL CONNECTION FOR COPPER TUBING
TO WATER MAIN USING A CORPORATION STOP

SANITARY SEWER - WATER MAIN CROSSINGS

SANITARY SEWER CROSSING OVER WATER MAIN

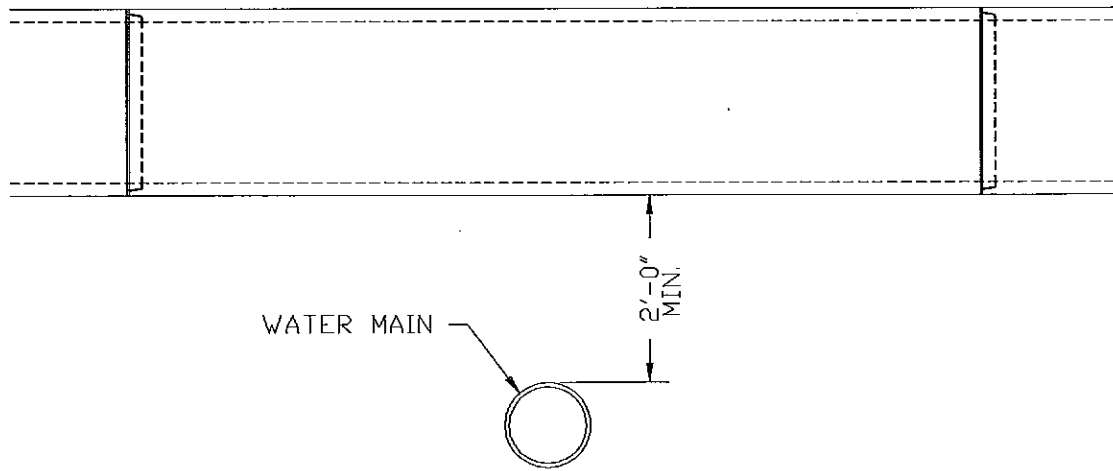


SANITARY SEWER CROSSING UNDER WATER MAIN

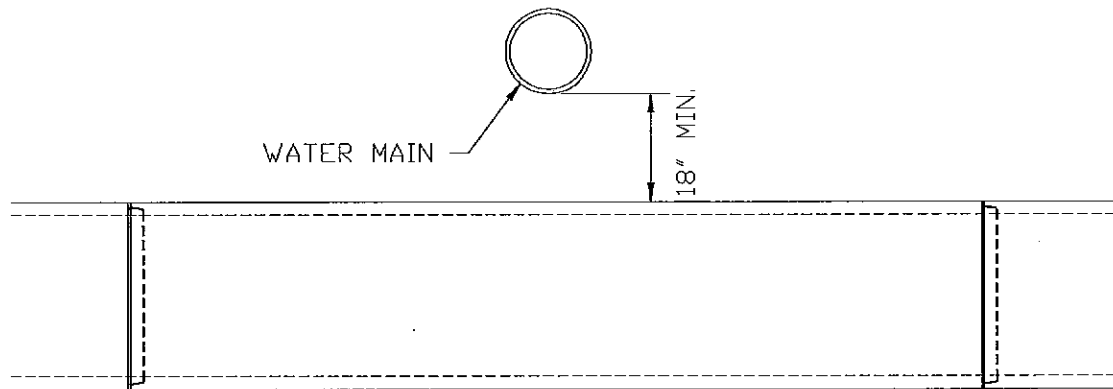
NOTE: IN ALL CASES WHERE THE WATER MAIN IS CROSSING WITHIN 2 FEET OF A SANITARY SEWER LINE (less than 2 feet above or below) THE CONTRACTOR WILL BE REQUIRED TO CENTER A 20 FOOT SECTION OF WATER MAIN OVER THE CROSSING.

STORM SEWER - WATER MAIN CROSSINGS

STORM SEWER CROSSING OVER WATER MAIN

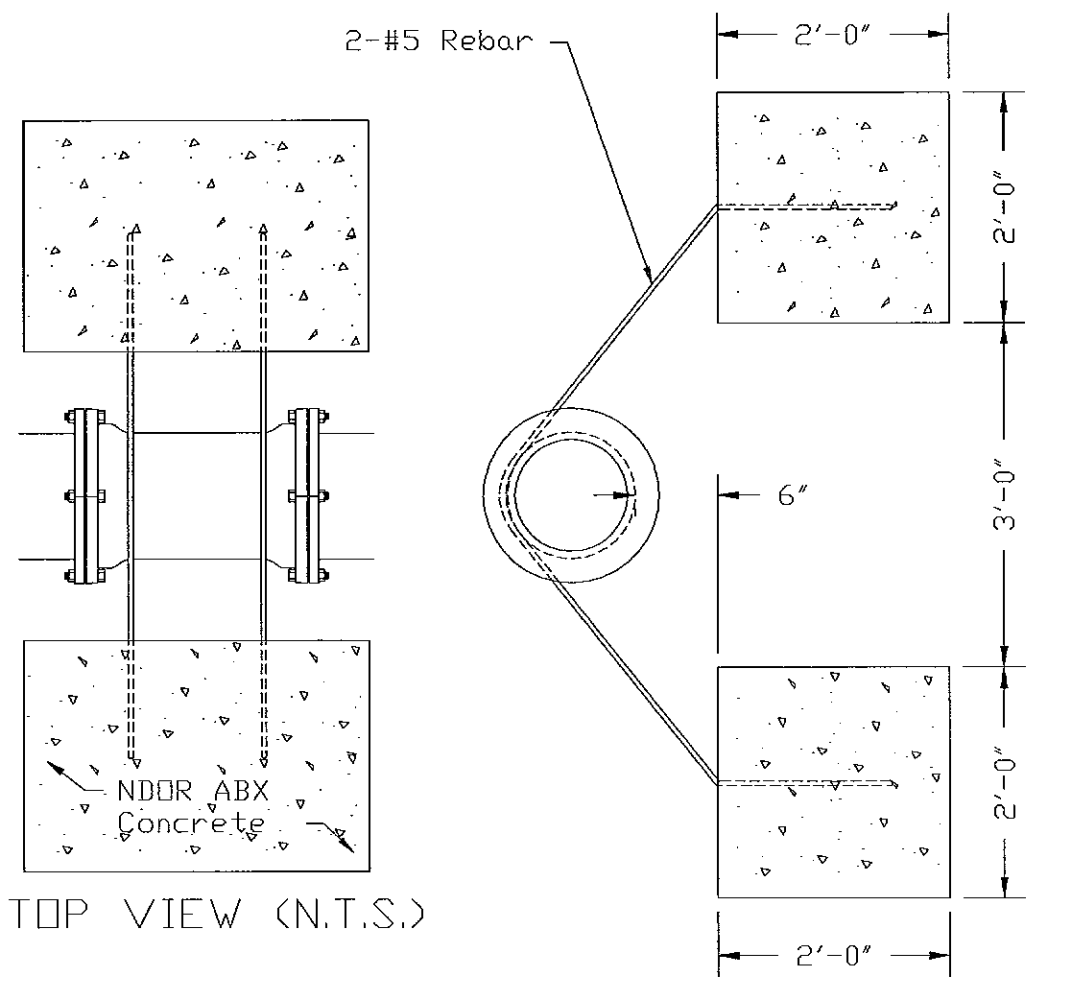


STORM SEWER CROSSING UNDER WATER MAIN



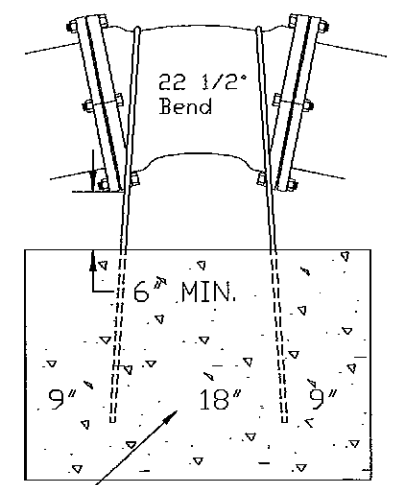
NOTE: IN ALL CASES WHERE THE WATER MAIN IS CROSSING WITHIN 2 FEET OF A SANITARY SEWER LINE (less than 2 feet above or below) THE CONTRACTOR WILL BE REQUIRED TO CENTER A 20 FOOT SECTION OF WATER MAIN OVER THE CROSSING.

DETAILS OF ANCHORING



TOP VIEW (N.T.S.)

CROSS SECTION (N.T.S.)



Anchors for 11 1/4" Bend should be 1' Wide x 1 1/2' Deep x 3' Long

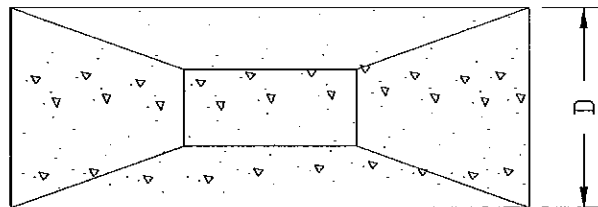
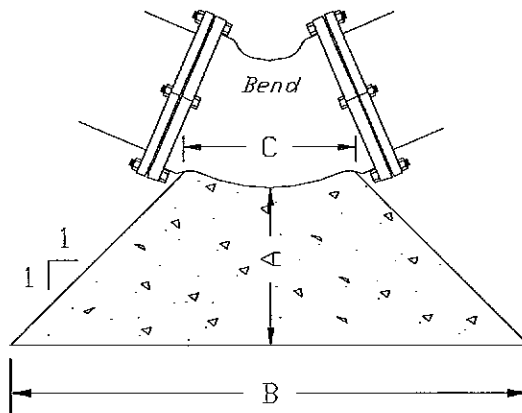
2'x 2'x 3' Anchor

PROFILE (N.T.S.)

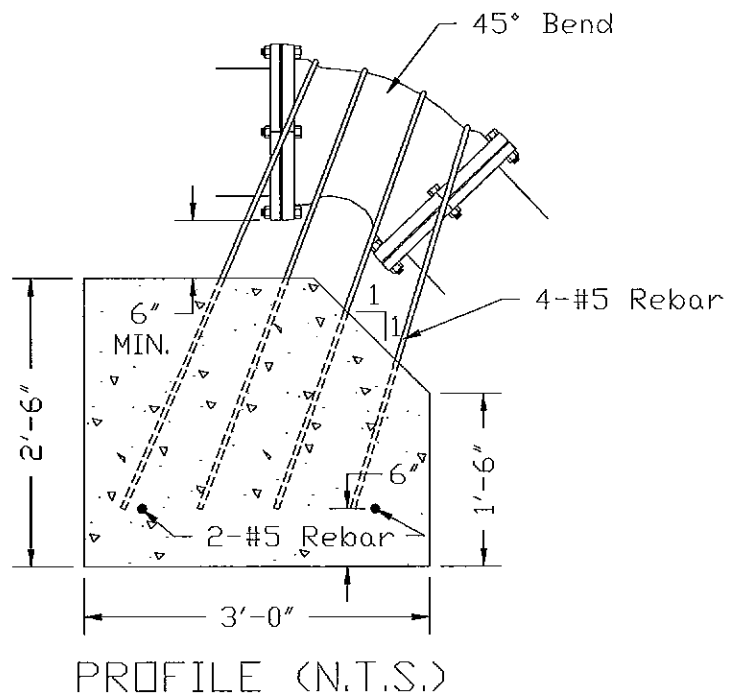
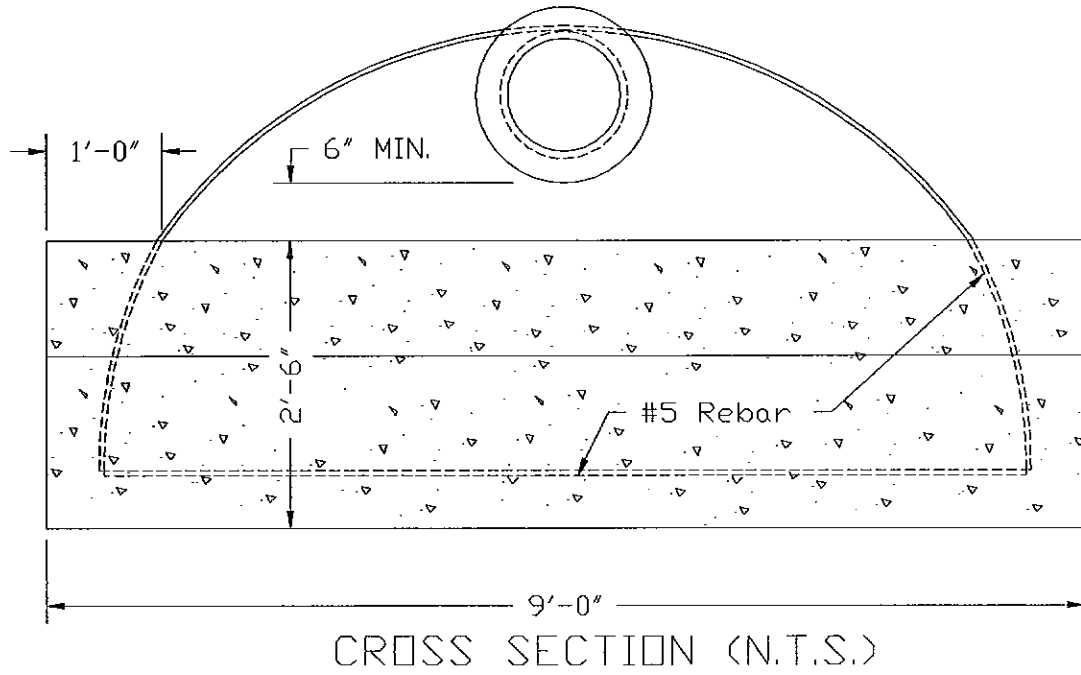
Note:
Anchors should be formed by excavating correct size in undisturbed earth.

Fittings	A	B	C	D
12"-11.25° Bend	1'	3.04'	1.04'	1'
12"-22.5° Bend	1'	3.12'	1.12'	1.3'
12"-45° Bend	1.5'	4.5'	1.5'	1.75'
12"-90° Bend	1.5'	5.37'	2.37'	2.75'
12" Plug	1'	3.1'	1.12'	3.1'
12" Tee	1'	4.5'	2.5'	3.3'
8"-11.25° Bend	1'	2.6'	.62'	.67'
8"-22.5° Bend	1'	2.75'	.75'	.75'
8"-45° Bend	1'	2.84'	.84'	1.5'
8"-90° Bend	1.5'	4.64'	1.64'	1.5'
6"-11.25° Bend	1'	2.6'	.62'	.67'
6"-22.5° Bend	1'	2.75'	.75'	.75'
6"-45° Bend	1'	2.84'	.84'	1.5'
6"-90° Bend	1.5'	4.64'	1.64'	1.5'

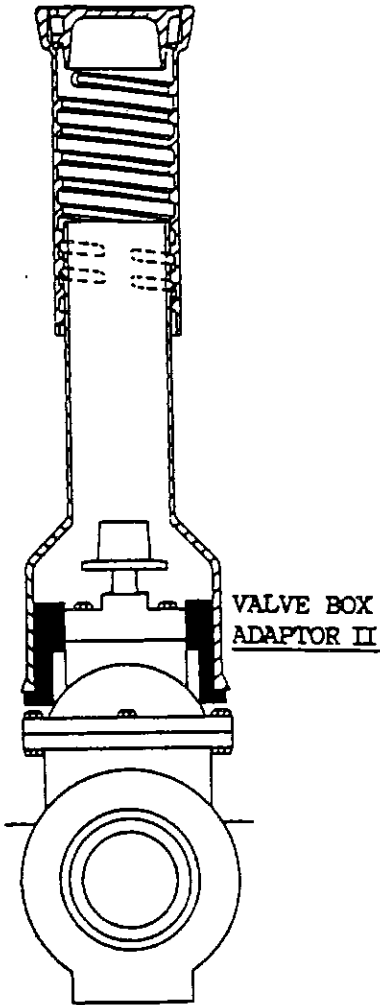
This view side view for vertical fittings & top view for horizontal fittings



This view top view for vertical fittings & side view for horizontal fittings



VALVE BOX ADAPTOR II



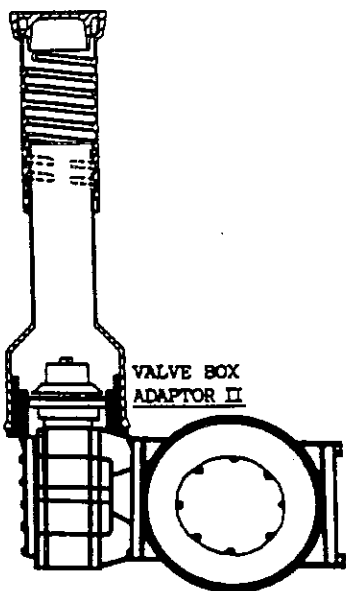
- * Maintains Proper Box Setting
- * Eliminates Settling and Shifting of the Gate Valve and Butterfly Valve Boxes
- * Seals the Valve Box on the Valve with a resilient material
- * Manufactured from Recycled Rubber
- * Cost Effective

The VALVE BOX ADAPTOR II is a proven method for the installation of a Gate Valve, Butterfly Valve Box Setting

The VALVE BOX ADAPTOR II ensures a perfect setting of the Key Box on the Valves. Eliminating the usual problems associated with backfilling, settling, shifting or an improper setting of the Key Box over the Valve

The VALVE BOX ADAPTOR II is cost effective, by omitting any future costs for excavation and resetting of the Valve Box

Manufactured for all types and sizes of Gate Valve, Butterfly Valves and Valve Boxes for water, gas and wastewater valves



PAT. PENDING