

THE CITY OF

DUBUQUE

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**WATER DISTRIBUTION DIVISION
STANDARDS & SPECIFICATIONS
WATER MAINS AND APPURTENANCES**

Sub-section 15-3.00 Water Main of:

City of Dubuque

Engineering Division

Standards & Specifications

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SPECIFICATIONS FOR
CITY OF DUBUQUE, IOWA
WATER DISTRIBUTION DIVISION
STANDARDS & SPECIFICATIONS
WATER MAINS AND APPURTENANCES
2011

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	<p>I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.</p>
	<p>FOR, IIW P.C.</p> <p><i>Gary Sejkora</i> <i>8-1-11</i></p> <p>Gary Sejkora, P.E. Date License Number 8384 My license renewal date is December 31, 2012 Pages or sheets covered by this seal: Entire Specification</p>

15-3.00

WATER MAIN

15-3.01

Description: This work shall consist of furnishing all labor, materials and equipment necessary to complete the water main installation in accordance with the City-prepared or City-approved plans and these specifications.

All new water main installations shall have a minimum pipe size of eight inches (8") in diameter, except that all hydrant branches shall have a minimum pipe size of six inches (6") in diameter. Use of four inch (4") and six inch (6") diameter water main shall not be allowed except for repair of or connection to existing four inch (4") and six inch (6") mains or private water service lines.

All water main designs shall include an IDNR required investigation of potential soil and groundwater contamination from leaking underground storage tanks (LUST) within 1000 feet of the proposed water main construction and the appropriate selection of pipe and gasket materials to prevent permeation.

15-3.02

Materials

15-3.0201

Ductile-Iron Pipe

15-3.02011 Ductile-iron pipe (DIP) shall be USA manufactured and tested in accordance with AWWA Specification C151. DIP size shall be four inch (4") through 12 inch, 16 inch, 20 inch and 24 inch, unless otherwise approved by the Water Department. Wall thickness shall be as shown in the following table:

Pipe Size	Wall Thickness	Thickness Class
4"	0.29"	52
6"	0.31"	52
8"	0.33"	52
10"	0.35"	52
12"	0.37"	52
16"	0.37"	51
20"	0.39"	51
24"	0.41"	51

The weight, class, or nominal thickness and casting period shall be shown on each pipe. The manufacturer's mark, country where cast, the year in which the pipe was produced and the letters DI or "Ductile" shall be cast or stamped on the pipe.

Standard laying lengths shall be 18 or 20 feet. Random lengths are not acceptable.

15-3.02012

All ductile iron pipe shall be cement mortar lined (standard thickness) in accordance with AWWA Specification C104. All ductile iron pipe shall have an asphaltic coating approximately one (1) mil thick.

15-3.0201A **Polyvinyl Chloride Pipe**

15-3.0201A1 Requests may be made to the Water Department for polyvinyl chloride (PVC) pipe use. The request shall include the results of an IDNR required review of records for any leaking underground storage tank (LUST) site within 1000 feet of the proposed water main construction. In areas where PVC pipe use is requested and there is no IDNR information available, the requestor could be required, based on the condition and previous use of the site(s), to provide the Water Department with a Phase One Environmental Study. Upon receipt of the required information, the Water Department will determine if PVC pipe may be substituted for DIP. PVC pipe may be substituted for DIP under certain soil and ground-water conditions, where there is no environmental contamination by petroleum products or any other type of contaminants that might permeate PVC pipe or cause damage to PVC pipe. PVC pipe may not be installed within 1000 feet of property zoned commercial or industrial without prior authorization from the City Manager or the City Manager's designee. PVC pipe may be substituted for ductile iron pipe in residential areas for size eight inch (8") through 12 inch.

15.3.0201A2 PVC pipe shall be USA manufactured and tested in accordance with AWWA C900. All PVC compounds used in the production of the pipe shall comply with NSF 61 for Drinking Water Systems Components. The PVC pipe, eight inch (8") through 12 inch shall be DR 14 Class 305 with working pressure plus mechanical joint surge pressure rating of 305 psi. All fittings for PVC pipes shall be ductile iron.

All PVC pipes shall be clearly marked in accordance with AWWA C900. All materials, such as lubricant, that are used in the installation of the PVC pipe mains and may come in contact with the water being transported shall be certified to NSF Standard 61 and shall not adversely affect the potable qualities of the water.

15-3.0202 **Pipe Joints**

15-3.02021 All DIP water mains shall have push-on joints or mechanical joints with rubber gaskets per AWWA C111.
All DIP with push-on gasket type joints shall have the spigot end marked with a painted stripe to indicate when the pipe is "home".
When DIP is installed in areas of soil or groundwater contamination by organic compounds, the gaskets shall be Nitrile Buna N (acrylonitrile butadiene, NBR).

15-3.02022 PVC pipe joints shall be gasketed, push-on type conforming to AWWA C900. Gaskets shall be part of a complete pipe section and purchased as such.
All PVC pipe with push-on gasket type joints shall have the spigot end marked to indicate the proper insertion depth of the spigot into the bell.

15-3.0203 **Valve, Fitting and Hydrant Joints**

All valves and fire hydrant inlets shall have mechanical joint connections that conform to AWWA standard C111. All compact fittings for sizes four inch (4") to 24 inch inclusive shall be mechanical joint type and conform to AWWA standard C153. Alternate full body fittings shall be mechanical joint type and conform to AWWA standard C110. Mechanical joint by plain end fittings may be used where appropriate as approved by the Water Department.

15-3.0204 **Mechanical Joint (MJ) Nuts, Bolts, Gaskets, and Glands**

All mechanical joint (MJ) nuts, bolts, gaskets and glands shall conform to AWWA standard C111 and shall be USA made. Nuts and bolts shall be high strength low alloy steel and be marked to identify material and producer. The nuts and bolts shall have a ceramic filled, baked-on fluorocarbon resin coating (Cor-Blue). All glands shall be ductile iron with an asphaltic coating and marked (stamped or cast) with the manufacturer's I.D., nominal size, and the letters D.I. or the word "Ductile". When mechanical joints are installed in areas of soil or groundwater contamination by organic compounds the gaskets shall be Nitrile Buna N.

15-3.0205 **Fittings**

All fittings shall be ductile iron, have a pressure rating of 350 psi, and shall be manufactured and tested in accordance with AWWA standard C153 for compact fittings sized four inch (4") to 24 inch inclusive except that the plain end shall be beveled. Ductile iron MJ full body fittings per AWWA C110 may be used. Fittings shall be USA made only.

Swivel joint (anchoring) tees and spools are approved for appropriate connections such as to valves, fittings, and fire hydrants.

15-3.0206 **Valves**

15-3.02061 **Gate Valves (4" – 24")**

All gate valves shall be resilient seat type and shall conform to AWWA C509 or C515 and may include Clow, Kennedy, Mueller, American Flow Control or approved equal with a working pressure rating of at least 250 psi, and be tested to a minimum of 500 psi. Valves shall be USA made only.

All gate valves shall be standard design, with cast iron or ductile iron body, resilient seat per AWWA C509 or C515, and non-rising stems with "o" ring stuffing box. Valve stems two inch (2") square (at base) shall be of bronze. All valves shall turn right to open, with an operating nut. All valve assembly bolts and nuts are to be stainless steel.

15-3.02062 **Butterfly Valves (16" – 24")**

Butterfly valves shall conform to AWWA C504. The butterfly valves shall be class 150B (minimum) with consideration for water main pressure testing. Butterfly valves shall be for buried service with mechanical joint connections per AWWA C111 and manual two inch (2") nut operated sealed worm gear or traveling nut actuator. All exposed valve assembly bolts and nuts shall be stainless steel. The butterfly valves shall be assembled in the USA and shall be Clow, Pratt, Mueller, DeZurik or approved equal.

15-3.02063 **Backflow Prevention**

See City of Dubuque, City Ordinance Title 13 – Public Utilities, Chapter 1: Article D. Cross Connection Control.

15-3.0207 **Valve Boxes**

Furnish and install standard slip type cast iron valve boxes on all gate and butterfly valves. Valve boxes shall have a five and one-quarter-inch (5-1/4") inside diameter, a drop lid marked "WATER", and provide at least six inches (6") of adjustment above and below the height required for the water main depth of cover. Valve boxes for four inch (4") through 12 inch, gate valves and for 16 inch through 24 inch butterfly valves shall be Tyler Union 6855 Series or USA made approved equal. A typical valve box would be the Tyler Union 666A (26T+24B+60 Ext) for four inch (4") to 12 inch gate valves at 5.5 feet of water main cover. Alternate box numbers or combinations may be required for larger gate valves and for butterfly valves and for different depths of cover.

All gate valve boxes shall be installed with a Valve Box Adaptor II by Adaptor, Inc. or approved equal. All butterfly valve boxes shall be installed with a Butterfly Valve Adaptor by Adaptor, Inc. or approved equal.

15-3.0208 **Fire Hydrants**

15-3.02081 Fire hydrants shall be manufactured and tested in accordance with AWWA standard C502. The manufacturer and model of hydrant used for water main construction is determined by the Water Department, and includes the following: Clow Medallion, Kennedy K-81D Guardian, Mueller Super Centurion or approved equal. Fire hydrants shall be USA made only.

15-3.02082 The hydrants shall have a five and one-quarter-inch (5-1/4") valve opening, with a six inch (6") mechanical joint connection for a bury depth of six feet (6'), one (1) four inch (4") pumper nozzle and two (2) two and one-half-inch (2-1/2") hose nozzles with National Standard thread. Nozzle caps shall have a tapered square operating nut. Hydrants must open to the right and have a tapered square operating nut. The operating nuts shall have a seven-eighths-inch (7/8") top and one inch (1") base. Hydrants shall have a corrosion resistant drain port in the base per AWWA C502. All hydrant assembly bolts and nuts that are underground shall be stainless steel.

15-3.02083 All six inch (6") hydrant leads shall be thickness Class 52 DIP.

15.3-0209 **Corrosion Control**

- 15-3.02091 All ductile iron water mains shall be protected from corrosion using a polyethylene encasement blue in color. Polyethylene shall be a minimum of eight (8) mils in thickness and have a minimum tensile strength of 1200 psi.
- 15-3.02092 Polyethylene installation shall conform to Methods A, B, or C as stated in AWWA C105.
- 15-3.02093 All buried valves and fittings shall be polyethylene wrapped as required for DIP water main. Do not poly wrap hydrant base/shoe.

15-3.0210 **Thrust Restraint**

- 15-3.02101 Thrust blocking concrete mix shall be Iowa DOT Class C ready mix concrete.
- 15-3.02102 Threaded steel rods shall be three-quarter-inch ($\frac{3}{4}$) in diameter. Rods, nuts, and accessories shall be made of high strength low alloy steel (HSLA i.e. Corten) or stainless steel.
- 15-3.02103 Movement can be prevented by installing wedge type retainer glands rated for use on the class of ductile iron pipe being installed. All retainer glands shall comply with AWWA standard C111. Retainer glands shall be EBAA Mega Lug or approved equal and made in the USA.
- 15-3.02104 Retainer gaskets for push-on joints in DIP may be used for thrust restraint. Retainer gaskets shall be Field Lok 350 or McWane Sure Stop 350. Nitrile rubber is required in contaminated areas.
- 15-3.02105 Joint restraint in PVC pipe water mains may be by use of wedge type retainer glands on mechanical joints, EBAA 2000 PV or approved equal. PVC push-on joints may be restrained by use of an internal joint restraint system (Eagle Loc 900 or similar) or by use of a joint harness, EBAA Series 1600 or approved equal with HSLA steel thrust rods and stainless steel assembly bolts. Joint restraint shall be USA made.
- 15-3.02106 Alternate thrust restraint products or systems for water main joints will be considered by the Water Department.

15-3.0211 **Bedding Sand**

Bedding sand or crushed limestone may be used for water main embedment and shall be free of rock larger than three-quarter-inch ($\frac{3}{4}$) and foreign materials and comply with AWWA C600 or C605, Type 5 Laying Condition plus one foot (1') above the top of the pipe. Crushed limestone gradation must have prior approval of the Water Distribution Division.

15-3.0212 **Cement**

Cement shall be of Portland Cement, complying in all respects with the requirements as set forth in the latest designation of ASTM C-150.

15-3.0213 **Crushed Stone**

Crushed stone may be required for DIP or PVC pipe embedment in wet trenches and shall be Iowa DOT special backfill per IDOT Section 4132.02 or an alternate material approved by the Water Department.

15-3.0214 **Encasement for Water Main**

15-3.02141 Water lines to be installed beneath existing or proposed structures, existing pavements, and railroad tracks shall be encased with steel pipe having welded joints, a minimum yield strength of 35,000 psi, and an inside diameter six inches (6") to eight inches (8") larger than the outside diameter of the water main bells. The thickness of the steel pipe encasement shall be determined by referencing the following table (unless other applicable requirements specify heavier casing):

Nominal Casing Diameter	Wall Thickness for Highways/Streets	Wall Thickness for Railroads
8" – 12"	0.250"	0.250"
14"	0.250"	0.281"
16"	0.250"	0.281"
18"	0.250"	0.312"
20"	0.312"	0.344"
24"	0.312"	0.406"
30"	0.375"	0.469"
36"	0.500"	0.532"
42"	0.500"	0.563"
48"	0.625"	0.625"

15-3.02142 Casing spacers of stainless steel with polyethylene glides and casing end seals (Cascade or approved equal) are required on each encasement. Spacer intervals shall comply with the manufacturer's recommendations.

15-3.0215 **Tracer Wire**

15-3.02151 A tracer wire shall be installed for all DIP and PVC pipe water main. The tracer wire shall be 10 gauge stranded copper wire with 30 mil polyethylene insulation in a red color.

The tracer wire shall be taped to the water mains at 15 foot intervals and looped up from the main to inside a tracer wire access box. The City must be able to successfully perform a continuity test on the tracer wire for the purpose of locating the water mains before final acceptance of the construction.

15-3.02152 Tracer wire access boxes shall be installed adjacent to fire hydrants and other locations as required by the Water Department. The tracer wire access boxes shall be Valvco Figure #TWAB or approved equal with "WATER" indicated on the lid.

15-3.0216 **Cast Couplings**

15-3.02161 Couplings may be used for connecting to existing water mains or as approved. Couplings shall be straight or transition (for large O.D. sand cast pipe) with body and glands of epoxy-coated ductile iron and stainless steel bolts and nuts. Cast couplings shall be USA made Romac Macro or Style 501, Cascade Omega, or approved equal.

15-3.0217 **Monitoring Manhole for Underwater Crossings**

15-3.02171 Monitoring manholes for underwater stream crossings shall comply with IDNR requirements. The pipe passing through the manhole shall include a valve, flanged pipe, three-quarter-inch pipe taps with saddles, and corporation stops.

15-3.02172 The monitoring manhole shall have an inside diameter of at least four feet (4') larger than the water main O.D. (e.g. five feet (5') for eight inch (8") main). The manhole construction shall comply with City sewer specifications including an integrally precast base, gasket joint sidewall, A-Lok pipe connections (two feet (2') above the base), plastic steps, cone or flat top, and cast iron frame and cover bolted to the top unit.

The valve shall be a resilient seated gate valve for mains up to 12 inch and may be a gate or butterfly valve for larger water mains. Valves shall comply with these specifications except that the ends shall have 125 pound flanges and shall have a hand wheel operator.

The piping in the manhole shall be Class 53 DIP with a flanged by plain end segment on one side of the valve and a plain end by plain end DIP segment with an EBAA or approved equal flange adapter at the valve. Flanged pipe shall be connected to water main with MJ sleeves or cast couplings.

Within the manhole on each side of the valve, a three-quarter-inch ($\frac{3}{4}$ ") tap shall be made on the top of the DIP. A tapping saddle (Smith Blair 317, Cascade, or equal), an AWWA thread inlet by internal or external thread NPT outlet corporation stop (McDonald 3128B/3148B, or equal), and brass plugs or caps shall be installed for the corporation stop outlet.

The manhole shall be drained with a two inch (2") or larger pipe to the ground surface and the end screened (SST) if possible.

Otherwise a sump shall be constructed in the base of the manhole that will allow for placement of a pump or suction line.

15-3.03 Excavation and Preparation of Trench

15-3.0301 General

The Contractor shall excavate all pipe trenches to provide a minimum cover of five and one-half feet (5-½') above the top of the water main, or as otherwise shown in the contract documents or directed by the Water Department. Whenever the Contractor excavates below the elevations required for the barrel of the pipe, the Contractor shall backfill the trench with crushed stone or sand tamped in place at no additional cost to the City.

Whenever the Water Department deems it advisable to explore or excavate ahead of the trenching to determine the location of existing underground structures, the Contractor shall make such excavations and explorations at no additional cost, unless otherwise provided in the contract documents.

If any unexpected obstruction is encountered during the progress of the work, the Water Department may order a deviation from the established elevations or alignment or make other changes necessary to overcome the obstruction. Changes in alignment will not be basis for extra payment; however, elevation changes exceeding one foot (1') will be compensated as outlined in these specifications.

Any existing structure encountered which requires temporary removal, support, or other maintenance while construction proceeds shall be adequately protected and maintained so that it is not damaged in any way.

The Contractor shall do all clearing necessary for access, stringing of pipeline materials and construction of the pipeline and appurtenant structures. In areas which are to be seeded or sodded, the Contractor shall remove and stockpile sufficient topsoil (if present) to a minimum depth of four inches (4"). Topsoil shall be free from trash, debris, and surface vegetation more than six inches (6") in height. After all other work has been completed in each area; topsoil shall be placed and graded to the satisfaction of the Water Department.

The ground shall be excavated in open trenches except where encasing or tunneling is indicated in the contract documents or is considered necessary or proper by the Water Department, to the width and depth necessary for the proper construction of the water main and appurtenances according to the contract documents.

The trench shall be dug only as far in advance of the pipe laying that is necessary to expedite the work. All work must be done in a dewatered trench and the Contractor shall provide and maintain adequate dewatering equipment to remove and dispose of all surface and ground water entering excavations, trenches or other parts of the work.

All excavated material shall be piled within the construction limits or in a location obtained by the Contractor and approved by the Water Department in a manner that will not endanger the work and that will avoid obstructing sidewalks, driveways and fire hydrants. Gutters shall be kept clear or other satisfactory provisions made for street drainage at all times.

15-3.0302 **Trench Bottom & Bedding**

15-3.03021 All DIP water mains shall be laid on four inches (4") of sand or crushed limestone that are free of rock larger than three-quarter-inch (3/4") and foreign material. The bed shall be slightly rounded to provide uniform and continuous bearing and support for the pipe at every point between bells. Bell holes shall have sufficient depth to insure an even bearing of the main body of the pipe, avoiding bearing directly on the bell joints. DIP water main may be embedded in native soil if it is granular in the opinion of the Water Department.

15-3.03022 All PVC shall be laid as required for DIP unless crushed stone is specified in the contract documents.

15-3.03023 Elevation of the bottom of the trench shall be checked before pipe laying occurs.

15-3.0303 **Trench Width**

15-3.03031 The trench width at the bottom shall be at least two feet (2') plus the outside diameter of the pipe and no more than three feet (3') plus the outside diameter of the pipe, except in rock excavation.

15-3.03032 If the Contractor creates a trench width greater than that specified the Contractor shall be required to alleviate the situation by methods approved by the Water Department. Approved methods may require the Contractor to install pipe with a greater strength than the specified pipe or to upgrade the class of bedding. No extra compensation shall be allowed for any increase in materials or construction costs created due to greater than specified trench width.

15-3.0304 **Sheeting and Bracing**

The Contractor, in order to maintain safe working conditions in compliance with the Federal Occupational Safety and Health Administration and State regulations, to confine their work within the construction limits, and to prevent the disturbing or settlement of adjacent road surfaces, curbs, foundations, structures, fences, walks, utility lines or railroad tracks, shall furnish all sheeting and bracing which may be necessary, including safety boxes. The Contractor shall be responsible for the placement of the sheeting and bracing and for its strength and sufficiency.

Any damage to the work under contract or to adjacent structures or property caused by settlement, water or earth pressures, slides, cave-ins, or other factors due to failure or lack of sheeting and bracing, or improper bracing, shall be repaired by the Contractor.

All sheeting and bracing, unless otherwise specified, shall be installed and removed from the work site at no additional compensation.

Metal sheeting or bracing may be left in place in the trench if written approval is obtained from the Water Department. Any sheeting or bracing left in place shall be cut off approximately two feet (2') below the final ground level and the cut-off portion removed.

The Contractor shall receive no compensation for sheeting and bracing left in place.

15-3.0305 **Rock Removal**

Wherever the word "rock" appears in these specifications, it shall include granite, trap, quartzite, chert, limestone, sandstone, hard shale, or slate in natural ledges or displaced masses. It shall also include rock fragments or boulders larger than one-half (1/2) cubic yard when their size, number, or location prevents them from being handled in a manner consistent with normal backhoe excavation. Material which can be removed by the use of backhoe frost teeth shall be paid for at the rate of fifty percent (50%) of the cost of rock removal.

Should rock be encountered in the excavation, it shall be removed by blasting, jackhammer, hoe-ram or otherwise. Where blasting is utilized, the excavation shall be carefully covered to prevent danger to life and property. The Contractor, prior to blasting, shall secure a City permit and any additional insurance required. No blasting shall be done by the Contractor until the necessary cross-sections of the top of the rock have been taken.

If, in the event rock excavation is a separate bid item, the following basis of payment will be used. The measurements for rock will be a width equal to 12 inches greater than the outside diameter of the pipe to be installed. Measurement for depth will be six inches (6") below the bottom of the outside of the pipe. No allowance will be made for rock excavation in excess of the above limits.

If rock is not anticipated or is not a separate bid item, but is encountered, payment will be made at \$50.00 (or as otherwise approved by the Water Department) per cubic yard as measured above.

Before pipe laying occurs, all irregularities of the rock are to be filled with suitable granular material compacted into place and the bottom of the trench brought to the proper elevation. Furnishing and placing of the granular material shall be paid for at the unit price for bedding stone, if indicated in the contract documents.

15-3.0306 **Dewatering**

All water entering the excavations or other parts of the work shall be removed until all the work has been completed. Sanitary sewers shall not be used for the disposal of trench water.

15-3.04 **Installation and Backfilling**

15-3.0401 **Inspection, Handling, and Storage**

All pipes and appurtenances are subject to inspection by the Water Department at the point of delivery. Material found to be defective due to manufacture or damage in shipment shall be rejected and removed from the job site.

All pipe, fittings, valves, hydrants, and accessories shall be loaded and unloaded by lifting with hoists or skidding to avoid shock or damage.

Materials, if stored, shall be kept safe from damage. The interior of all pipe, fittings, and other appurtenances shall be kept free from dirt and foreign matter at all times.

15-3.0402 **Line and Elevation**

Unless otherwise indicated in the contract documents, it is anticipated that the Design Engineer will provide the Contractor with line and elevation stakes set on the natural ground surface. It shall be the Contractor's responsibility to transfer the line and elevation to the bottom of the trench.

It shall be the Contractor's responsibility to protect the original line and elevation stakes set by the Design Engineer. Should the stakes become destroyed or damaged; the cost of their replacement will be at the Contractor's expense.

15-3.0403 **Pipe Laying and Assembly**

Laying of pipes shall commence at the lowest point so the spigot ends point downhill. Proper methods shall be used for handling and placing pipe to prevent damage to materials and coatings and linings and to avoid unnecessary disturbance of bedding surface in trench bottoms.

Each pipe shall be laid on an even, firm bed so that no uneven strain will come on any pipe, and particular care shall be exercised to prevent the pipe from bearing on the joints. Bell holes for bell-and-spigot pipe shall be dug at each joint. The bell end of all pipes shall be laid up-grade. Wood or concrete blocks or bricks shall not be used to support the pipe or to adjust the final elevation of the pipe.

The interior of the water main shall, as the work progresses, be cleared of all dirt, jointing material, and superfluous materials. Pipe shall be joined in strict accordance with the manufacturer's recommendations.

On 24 inch pipe, pressure must be applied to each pipe as it is laid by a winch and cable or other mechanical means to insure that the spigot is home in the socket.

When pipe laying is suspended for any reason, watertight plugs or caps shall be placed in/on the end of the pipe. Open ends of pipes and fittings shall be effectively sealed.

Before laying any ductile iron pipe, all lumps, or blisters from excess asphaltic coating shall be removed from the bell and spigot end of each pipe.

The outside of the spigot and the inside of the bell shall then be wiped clean and dry. The pipe ends shall be kept clean until all joints are made. The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat manner without damage to the DIP or PVC pipe or cement lining in DIP and so as to leave a smooth end at right angles to the axis of the pipe. Pipe ends shall be rounded or beveled per the manufacturer. The flame cutting of DIP by means of an acetylene torch will not be allowed.

Pipe shall be handled properly. Materials must at all times be handled with care to prevent damage. Under no circumstances will pipe be dropped or damaged. Hook ends shall not be used for installing or removing pipe. Equipment forks shall not be inserted into the pipe for lifting or moving activities.

The gasket and/or gasket seat inside the bell shall be wiped clean with a cloth. The gasket shall be placed in the DIP bell according to the manufacturer's direction.

15-3.04031 The embedment requirement for PVC water mains shall be in accordance with AWWA Standard C605 for "Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipes and Fittings for Water". Embedment shall be Type 5 plus 12 inches of granular material above the top of the pipe.

15-3.0404 **Backfill Around Pipe**

The Contractor, unless otherwise approved by the Water Department, shall not backfill water mains until elevations, alignment, and the pipe joints have been checked and inspected by the Water Department or designee.

Unless otherwise approved, all trenches and excavations shall be backfilled as soon as is practically possible, and the work shall be prosecuted expeditiously.

15-3.04041 All water main, as soon as laid, shall have the space between the pipe and the sides of the trench filled and thoroughly compacted by hand in six inch (6") lifts up to a level of 12 inches above the top of the pipe with sand or crushed limestone unless other material is required. Haunching and initial backfilling from the bottom of the pipe to one foot (1') above the pipe shall be carefully placed and compacted to provide side support to the pipe. Haunching and initial backfill from the bottom of the pipe to 12 inches above the top of the pipe may be placed with native soil if it is granular in the opinion of the Water Department.

15-3.0405 **Backfill General**

All backfill material shall be subject to the prior approval of the Water Department. If the material excavated constitutes unsuitable backfill, in the opinion of the Water Department, the Contractor shall provide, unless otherwise stated, acceptable backfill material, or dry and replace the unacceptable material at their expense. No frozen material shall be used for backfilling.

All surplus excavated material which is not used in backfilling shall be loaded and disposed of by the Contractor at their expense.

15-3.0406 **Compaction**

15-3.04061 The compaction required in streets, alleys, sidewalks, driveways, around structures or within five feet (5') of pavement edges shall be ninety-five percent (95%) of standard Proctor density from one foot (1') above the top of the pipe to the finished surface or street base. Individual lifts shall not exceed 12 inches loose thickness. Moisture content shall be between minus one percent (1%) and plus three percent (3%) of optimum.

15-3.04062 The compaction required at all other areas shall be eighty-five percent (85%) of standard Proctor density from one foot (1') above the top of the pipe to the finished surface or street base. Individual lifts shall not exceed two feet (2').

15-3.04063 In the case where a separate item is included in the bid proposal to cover any unsuitable back fill material, the cost of the backfill shall not include any compaction. The compaction shall be included with the unit price of the pipe.

15-3.0407 **Deflection of Joints**

15-3.04071 When it is necessary to deflect ductile iron pipe from a straight line in either the horizontal or vertical plane, the amount of push-on joint deflection shall not exceed that recommended by the Ductile Iron Pipe Research Association (DIPRA), as indicated in Table 1.

The deflections listed are maximum deflections and should not be exceeded based on joint manufacturer's recommendations.

For design purposes, deflection should be limited to 80 percent (80%) of the values shown.

Mechanical joint deflections shall not exceed the recommendations of DIPRA, as indicated in Table 2.

TABLE 1 – PUSH-ON JOINT DEFLECTION

Nominal Pipe Size	Maximum Offset (Inches) For 18' Length Pipe	Approx. Radius of Curve For 18' Length Pipe
4"	19"	205'
6"	19"	205'
8"	19"	205'
10"	19"	205'
12"	19"	205'
16"	11"	340'
20"	11"	340'
24"	11"	340'

TABLE 2 – MJ DEFLECTION

Nominal Pipe Size	Maximum Offset For 18' Length Pipe	Approx. Radius of Curve For 18' Length
4"	31"	125'
6"	27"	145'
8"	20"	195'
10"	20"	195'
12"	20"	195'
16"	13.5"	285'
20"	11"	340'
24"	9"	450'

15-3.04072 The joints in PVC pipe shall not be deflected. PVC water main shall be laid straight between bends. Do not deflect PVC pipe.

15-3.0408 **Valves and Fittings**

Prior to installation, valves shall be inspected for direction of opening, number of turns to open, freedom of operation, tightness of pressure-containing bolting and test plugs, cleanliness of valve ports (especially seating surfaces), handling damage and cracks. Defective valves shall be corrected or held for inspection by the Water Department. Valves shall be closed before being installed.

- 15-3.04081 Valves, fittings, plugs and caps shall be set and joined to the pipe in the manner specified herein. Valves should be provided with special support, such as crushed stone so that the pipe will not be required to support the weight of the valve.
- 15-3.04082 A valve box shall be provided and installed for every valve, except at stream crossing monitoring manhole.
- 15-3.04083 The valve box shall not transmit shock or stress to the valve and shall be centered over the operating nut of the valve, with the box cover flush with the surface of the finished area or such other level as may be directed by the Water Department.
- 15-3.04084 A valve vault, for surface water crossing monitoring manhole designed to prevent loads onto the pipe, shall be provided when shown on the drawings or required in the contract documents.
- 15-3.04085 In no case shall valves be used to bring misaligned pipe into alignment during installation. Pipe shall be supported in such a manner as to prevent stress on the valve.
- 15-3.04086 All dead ends on new mains shall be closed with plugs or caps that are suitably restrained to prevent blowing off under test pressure. If a valve precedes the plug or cap, it shall also be restrained against blowing off. All dead ends shall be equipped with suitable flushing facilities.

15-3.0409 **Fire Hydrants**

- 15-3.04091 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. When placed behind the curb, the hydrant barrel shall be set so that no portion of the pumper or hose nozzle cap will be less than 12 inches from the back of curb unless otherwise approved by the Water Department. 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 six inches (6") of the sidewalk.
- 15-3.04092 All hydrants shall stand plumb and shall have their nozzles parallel with or at right angles to the curb, with the pumper nozzle facing the curb. Hydrants shall be set to the established elevation, with the breakaway flange two inches (2") above the ground surface, or as approved by the Water Department.
- 15-3.04093 Fire hydrants shall be placed on a concrete slab four inches (4") thick, to prevent the hydrant from settling. Fire hydrants shall be

backfilled with one inch (1") clean crushed stone to a height of three feet (3') above the bottom of trench and for the width of the trench, in accordance with AWWA C600. A layer of plastic shall be placed between the clean stone and earth backfill. Do not place poly wrap around the hydrant base/shoe connection to the lower barrel.

15-3.04010 **Thrust Restraint**

15-3.040101 Thrust restraint is required for all horizontal and vertical bends, dead ends, tees, crosses, fire hydrants, valves, reducers, etc. Project specific thrust restraint design and details shall be provided by the water main Design Engineer (P.E.) for review by the Water Department. Wood blocking will not be allowed as thrust blocking. The use of joint restraint is the preferred method of thrust restraint. The use of concrete reaction blocking shall be minimized.

Thrust restraint shall consider the pipe material, the water main appurtenance being restrained, the water main size(s), the soil type, the AWWA laying condition, the depth of bury, and a 1.5 safety factor.

15-3.040102 Concrete reaction blocking shall be placed between solid ground and the fitting to be restrained. The area of bearing on the pipe and on the undisturbed soil in each instance shall be as determined by the water main Design Engineer. The blocking shall, unless otherwise shown or directed, be so placed that the pipe and fitting joints will be accessible for repair. The concrete shall be allowed a minimum 24 hour cure time before charging the line.

15-3.040103 Metal tie rods of adequate strength to prevent movement may be used instead of concrete backing, as approved by the Water Department.

15-3.040104 Thrust restraint with metal rods and lugs or eyebolts, retainer glands, or gaskets is required on all vertical bends, fire hydrant branches, repairs, elbows, between the tee and valve on temporary stubs and other locations as determined by the water main Design Engineer.

15-3.0411 **Surface Water Crossing**

Above-Water Crossings: Above-water crossings will be considered by the Water Department only for special circumstances. If above-water crossings are permitted, the pipe shall be adequately supported and anchored; protected from vandalism, damage, and freezing; include expansion allowance as necessary; and be accessible for repair or replacement.

Underwater Crossings: Water main crossing under a waterway shall be encased with concrete equal to or greater than what is used for concrete reaction blocking or may be encased with crushed stone and protected with riprap.

Water main crossing a waterway with a water surface wider than 15 feet shall be of DIP with flexible restrained watertight joints and shall be installed in a stone or concrete encasement as follows:

15-3.04111 Minimum cover shall be five feet (5') below stream bed unless otherwise approved by the DNR and Water Department.

The water main shall be secured to prevent movement of the pipe and provided with easily accessible shutoff valves located outside of the floodway at each end of the crossing to allow for isolation, testing, or repair. One flanged valve shall be placed in a manhole closest to the water source for monitoring the crossing pipe.

15-3.04112 Two (2) permanent valved taps shall be placed in the DIP on each side of the flanged valve in the manhole to allow installation of a water meter to determine leakage and obtain water samples.

Stream crossings shall comply with IDNR requirements.

15-3.04113 Surface water crossings must comply with current U.S. Army Corps of Engineers Section 404 permit requirements and IDNR Flood Plain Development permit requirements. Temporary fills must consist of materials, and be placed in a manner, that will not be eroded by expected high stream flows. Temporary fills must be removed in their entirety and affected areas returned to pre-construction elevations. The areas affected by temporary fills must be re-vegetated and stabilized, as appropriate, immediately upon completion of the water main crossing of each water-body.

The water main trench cannot be constructed or backfilled in such a manner as to drain waters of the United States (e.g. backfilling with extensive stone layers, creating a French drain effect). Wetlands must be preserved and/or restored.

Surplus excavation material must be removed from the flood plain and disposed of properly.

15-3.0412 **Protection of Water Supplies**

15-3.04121 **Horizontal Separation of Water Mains from Gravity Sewers**

Water mains and sewers generally shall be separated by a distance of at least 10 feet horizontally. If such lateral separation is not possible, the bottom of the water main shall be at least 18 inches above the top of the sewer and the water main placed in a separate trench or in the same trench on a bench of undisturbed earth at a minimum horizontal separation of three feet (3') from the sewer. When it is impossible to obtain the required horizontal clearance of three feet (3') and the vertical separation of 18 inches, the sewer must be replaced with DIP meeting all requirements as set forth in these specifications for water main. However, a linear separation of at least two feet (2') shall be provided.

15-3.04122 **Separation of Water Mains from Sewage Force Mains**

Water mains shall be separated from sewage force mains by a horizontal distance of at least 10 feet unless the following

conditions exist. The force main is constructed of material meeting all requirements as set forth in these specifications for water main and the water main is laid at least four lineal feet from the sewage force main.

15-3.04123

Separation of Water Main and Sewer Crossovers

Vertical separation of water mains crossing over any sanitary sewer shall be at least 18 inches when measured from the bottom of the water main to the top of the sewer. If physical conditions prevent this separation, then the water main shall not be placed closer than 6 inches above a sewer or 18 inches below a sewer. The separation distance shall be the maximum feasible in all cases.

Where the water main crosses less than 18 inches above or crosses below a sewer, one full length of water pipe shall be located so both joints are as far as possible from the sewer. The water and sewer pipes must be adequately supported and have water tight joints. A lower permeability soil shall be used for backfill material within a 10 foot radius from the point of crossing.

15-3.04124

Separation of Sewer Manholes

No water pipe shall pass through or come in contact with any part of a sewer manhole. A minimum horizontal separation of 10 feet to the manhole exterior shall be maintained.

15-3.04125

Exceptions

Should physical conditions exist such that exceptions to Section 15-3.0412 of these specifications are necessary, the Water Department must provide a course of action that will provide equal protection to the water supply as outlined in Sections 15-3.04121, 15-3.04122, 15-3.04123 and 15-3.04124.

15-3.0413

Tapping of Water Main

15-3.04131

Any size water tap shall only be installed by employees of the Water Department. No employee will enter a trench or other excavation to install a corporation stop, saddle, make repairs, or perform other related duties until the excavation is secured by sloping, shoring, or other means recognized and in accordance with the Occupational Safety and Health Administration Standards.

The Water Department will furnish all material and labor necessary to perform water taps, and the cost of all materials and labor will be reflected in the price of the water connection permit.

15-3.4132

All service line connections to PVC water main shall be made by the Water Department in accordance with recommendations of AWWA C605. Service saddles for PVC pipe shall provide full circle support and be sized exactly to the pipe outside diameter. Sealing gaskets shall be the appropriate rubber and straps shall be stainless steel or cast brass.

15-3.0414 **Disinfecting Water Mains**

15-3.04141 **General**

The disinfecting of water mains shall be done in conformance with AWWA C 651. Precautions shall be taken to protect the interiors of pipes, fittings and valves against contamination.

All openings in the pipeline shall be closed with watertight plugs when the pipe laying is stopped at the close of the day's work or during break periods.

If dirt enters the pipe that will not be removed by flushing operations in the opinion of the Water Department, the interior of the pipe shall be cleaned by mechanical means and then swabbed with a one percent (1%) hypochlorite disinfecting solution.

15-3.0415 **Methods of Chlorination**

15-3.04151 During construction, calcium hypochlorite granules shall be placed in the upstream end of the first section of pipe, at the upstream end of each branch main, and at 500 foot intervals. The quantity of granules shall be as follows:

Pipe Diameter	Calcium Hypochlorite Granules, Oz.
4"	1.7
6"	3.8
8"	6.7
10"	10.5
12"	15.1
14" and larger	DxDx15.1

D= pipe diameter in feet

15-3.04152 Tablets may be used in place of granules. The quantity of tablets (3.25grams available chlorine per 5 gram tablet) shall be as follows:

Pipe Diameter Inches	No. 5-gram Tablets	
	18 ft. length	20 ft. length
4	1	1
6	1	1
8	2	2
10	3	3
12	4	4
16	6	7
Other Sizes	Consult	AWWA C651

The tablets may be attached to the inside top of the pipe with a food-grade adhesive applied to the broad-side of the tablet. An additional tablet shall be placed in each hydrant, hydrant branch, and appurtenance. Tablet use must provide for uniform chlorine concentrations in the water main.

15-3.04153 When installation has been completed the main shall be filled with water at a rate such that water within the main will flow at a velocity no greater than one foot (1') per second. Precautions shall be taken to assure that air pockets are eliminated. This water shall remain in the pipe for at least 24 hours. If the water temperature is less than 40° F, the water shall remain in the pipe for at least 48 hours. Valves shall be positioned so that the strong chlorine solution in the main being treated will not flow into water mains in active service.

15-3.04154 Alternate methods as described in AWWA C651 may be utilized by the Contractor and in some applications may be preferred and required by the Water Department.

15-3.0416 **Final Flushing**

After the applicable retention period, the heavily chlorinated inated water shall be flushed from the main until chlorine measurements show that the concentration in the water leaving the main is no higher than generally prevailing in the system or is acceptable for domestic use.

The environment to which the chlorinated water is to be discharged shall be inspected and if there is any question that the chlorinated discharge will cause damage to the environment, then a reducing agent shall be applied to the discharged water to neutralize the remaining residual chlorine.

Water main flushing may only be done by employees of the Water Department. The City will provide proper chlorine neutralization or may discharge to sanitary sewers.

15-3.0417 **Bacteriological Tests**

After final flushing and before the water main is placed into service, two (2) consecutive sets of acceptable samples, taken 24 hours apart, shall be collected from the new main. At least one (1) set of two (2) samples shall be taken from every 1200 feet of the new water main, plus one set from the end of the line and at least one set from each branch. Samples shall be tested for bacteriological quality in accordance with Standard Methods and shall show the absence of coliform organisms.

Samples for bacteriological analysis shall be collected in sterile containers and treated with sodium thiosulfate as required by Standard Methods. No hose or fire hydrant (if possible) shall be used for sample collection.

Employees of the water Department will collect disinfection samples and submit them for testing at no cost to the water main Contractor.

15-3.0418 **Re-disinfection**

If the initial disinfection fails to produce satisfactory bacteriological samples, the main may be reflushed and shall be resampled and tested again. If check samples show the presence of coliform organisms, then the main shall be rechlorinated by the contractor using the continuous feed or slug method or chlorinated as prescribed in AWWA C651 until satisfactory results are obtained.

15-3.0419 **Disinfection Procedures when Cutting into or Repairing Existing Mains**

15-3.04191 When an old main is opened, either by accident or design, the interior of all pipe and fittings used in making the repair or connection shall be swabbed or sprayed with one percent (1%) hypochlorite solution before they are installed.

15-3.04192 Thorough flushing is the most practical means of removing contamination introduced during repairs or connection. If valve and hydrant locations permit, flushing toward the work location from both directions is recommended. Flushing shall be started as soon as the work is completed and shall be continued until discolored water is eliminated.

15-3.04193 Two (2) bacteriological samples shall be taken after the work is finished to provide a record by which the effectiveness of the procedures used can be determined. If positive samples are recorded, daily sampling shall be continued until two (2) consecutive negative samples (24 hours apart) are recorded.

15-3.0420 Air Relief Facilities

Water mains shall be laid to avoid high points where air can accumulate. When high points occur, measures shall be taken to remove the air when the main is initially filled with water. Air relief valves shall be located at all high points where air can accumulate.

Automatic air relief valves shall not be used in situations where flooding of any manhole or chamber can occur. The open end of an automatically operated air relief valve discharge pipe shall be covered with sixteen (16) mesh or finer corrosion resistant screen and terminated in a down-turn position at least one foot (1') above ground elevation. The open end of a manually operated air-relief valve discharge pipe shall be extended to no less than six inches (6") from the top of any manhole or chamber.

15-3.0421 Chambers

Chamber, pits, and manholes containing valves, blow offs, meters, or other such appurtenances to a distribution system shall not be connected directly to any storm drain or sanitary sewer. Likewise, no device in these structures shall be connected directly to any sewer. Chambers shall drain to the ground surface, when possible, providing the chamber is not subject to flooding. Underground absorption may be used when draining to the surface cannot be provided, if conditions are suitable, otherwise a sump shall be installed.

15-3.0422 Repair and Transition Couplings

Repair and transition couplings will be utilized to join two spigot ends of watermain pipe together (see 15-3.0216).

15-3.05 Pressure Testing and Leak Detection

Pressure and leakage testing shall conform to AWWA C600 or C605. The pressure test shall consist of complete filling of the section of main under observation and pressurizing with water applied by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection, and all necessary equipment for testing shall be furnished by the Contractor. Unless otherwise specified, tests shall provide a hydrostatic pressure of a least one and one-half (1.5) times the normal operating pressure at the point of testing. The duration of the test under the specified pressure shall be at least two (2) hours. The test pressure shall not vary by more than plus or minus 5 psi for the duration of the test.

No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{SD\sqrt{P}}{148,000}$$

Where 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 psi.

Before applying the specified test pressure, all air shall be expelled from the pipe by means of taps located at the points of highest elevation or as necessary. Water main taps for air release are discourage, other suitable permanent air release means shall be utilized (i.e. fire hydrants, or permanent air release facilities as approved by the Water Department). If taps on top of the pipe are approved by the Water Department the taps are to be made by the Water Department and paid for by the Contractor.

Said taps shall afterward be tightly plugged. After the required pressure has been obtained, all exposed joints shall be carefully examined.

The Contractor shall provide suitable means of determining the quantity of water lost by leakage under the specified test pressure. No pipe installation shall be accepted until this leakage is less than 10.49 gallons per twenty-four (24) hours per inch of diameter per mile of pipe. Unless otherwise approved by the Water Department, water mains shall be tested in lengths of less than 1,000 feet. Leakage shall be defined as the quantity of water to be supplied to the newly laid pipe necessary to maintain specified leakage test pressure after the pipe has been filled with water and air expelled. Water will be made available without charge to the Contractor by the Water Department for testing the water main, in accordance with AWWA C600 and C605.

15-3.06

Completion of the Water Main Project

After water main installation is completed, it shall be the responsibility of the Contractor to ensure that all valves closed during construction are reopened and that valve boxes are raised to ground/street surface elevations.

15-3.07

Water Service

The water service items shall comply with the City of Dubuque, City Ordinances under the Utility Section, Article III, Water.

15-3.08

Method of Measurement

Unless otherwise stated in the contract documents the following shall apply:

- A. Water Main: The linear feet of each size of water main shall be the actual length measured. Deductions will be made from the measured length for valves and other appurtenances.
- B. Fittings, Valves, Hydrants, and Other Appurtenances: Each valve, hydrant, or other appurtenance will be measured as a single unit. This shall be full payment for materials, equipment, excavation, installation and all incidental work.
- C. Coupling Repair: Repair by coupling installation will be measured as a single unit. This shall be full payment for materials, equipment, excavation, installation, and all incidental work.

- D. Water Service Pipe: The linear feet of water service shall be the actual length measured. Deductions will be made from the measured length for valves and other appurtenance.
- E. Water Service Valve and Other Appurtenances: Each valve or other appurtenance will be measured as a single unit. This shall be full payment for materials, equipment, excavation, installation and all incidental work.

15-3.09

Basis of Payment

- A. General: The unit and lump sum prices stated in the contract to be paid for the respective items shall be payment in full for the completion (ready for use and operation) of all work described in the drawings and specifications.
- B. Water Main: The unit prices as bid shall include the furnishing of all labor and equipment necessary to install the water main in accordance with the plans and specifications. The work shall include all excavating, installing and joining of pipe and fittings, removal and disposal of water, backfilling, sheeting and shoring, disposal of excess excavated material, protection of existing structures and utilities, clean-up and all other operations unless specifically covered by other payment-items included in the contract.

When the plans indicate the elevations at which the watermain is to be constructed, and the pipes are laid as indicated in the contract documents or to a changed flowline not lower than one foot (1') below the plan elevations, the contractor will be paid the contract price per lineal foot of water main completed.

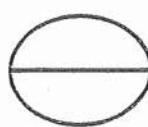
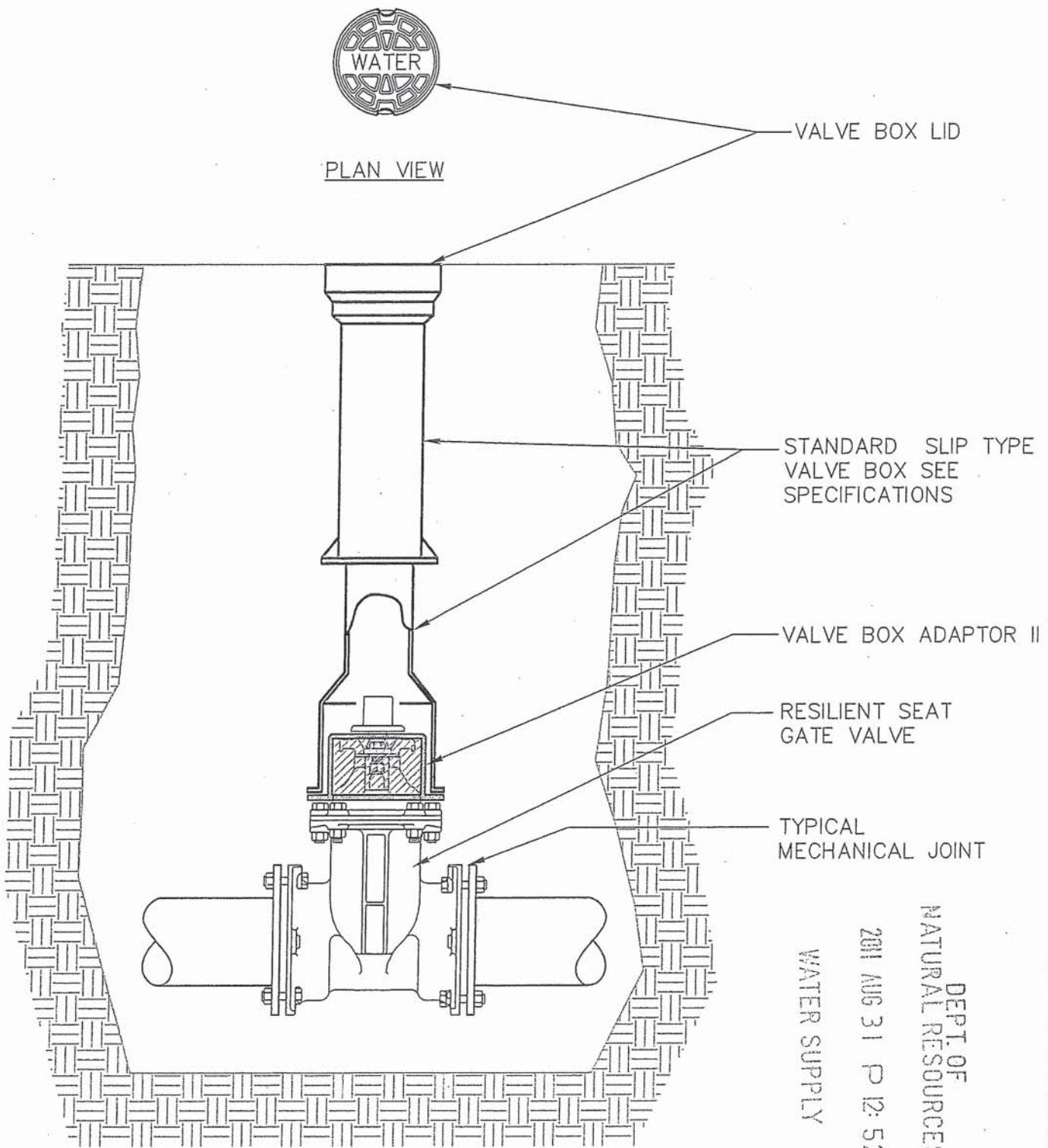
If it becomes necessary to lower the flowline by more than one foot (1'), payment for the overdepth excavation will be made as follows:

- . From the original contract price per foot shall be deducted one hundred twenty-five percent (125%) of the cost per foot of pipe, delivered to the work site. The remainder will be considered the contract "price for excavation and laying of pipe". The contract "price for excavation and laying of pipe" shall be divided by the average depth from original ground profile of the total footage of that particular size of pipe shown on the plans, and this quotient considered the "basis excavation and laying price" per foot of pipe, per foot of depth. For depth of excavation for more than one foot (1') below the plan flowline elevation, payment for overdepth excavation will be made in accordance with the following schedule:

Over-Depth Excavation	Percentage of Basic Excavation and Laying Price
1 st Foot	100%
2 nd Foot	120%
3 rd Foot	140%
4 th Foot	160%
5 th Foot	180%
6 th Foot	200%

For depth of excavation greater than six feet (6') below plan flow-line elevation, payment will be made as extra work.

- C. Encased Water Main: The length of encased water main shall be considered as the assembled length inside the pipe encasement with the unit contract price being per linear foot of encased watermain. Unless otherwise indicated in the contract documents, this shall be full payment for materials, equipment, excavation, installation and all incidental work. Excavation, regardless of nature, will not be measured or paid for separately, but shall be considered as incidental to the encased water main.
- D. Fittings, Valves, Hydrants Other Appurtenances: For construction of valves, hydrants and other water main appurtenances including tracer wire, the contractor will be paid the contract unit price each, for the item indicated, unless otherwise indicated in the contract documents.
- E. Coupling Repair: Installation of couplings will be paid the contract unit price each, for the item indicated. Unless otherwise indicated in the contract documents, this shall be full payment for materials, equipment, excavation, installation and all incidental work.
- F. Water Service Pipe: The length of water service pipe shall be considered as the assembled length with the unit contract price being per linear foot of water service pipe. Unless otherwise indicated in the contract documents this shall be full payment for materials, equipment, excavation, installation and all incidental work. Excavation, regardless of nature, will not be measured or paid for separately, but shall be considered as incidental to the water service installation.
- G. Water Service Valve Boxes and Other Appurtenances: For construction of water service valve boxes and other appurtenances, the Contractor will be paid the contract unit price each, for the item indicated. Unless otherwise indicated in the contract documents, this shall be full payment for materials, equipment, excavation, installation and all incidental work.



GATE VALVE W/BOX

NOT TO SCALE

