



# Saint Paul Regional Water Services

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Saint Paul, Minnesota

## STANDARDS for the Installation of Water Mains

November 3, 2014



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## **DIVISION 1000: DEFINITIONS**

### **1100 BOARD OF WATER COMMISSIONERS**

The Board of Water Commissioners of the City of Saint Paul, the governing body of Saint Paul Regional Water Services.

### **1200 CITY**

The municipality in which the project is located.

### **1300 CONTRACTOR**

The Contractor awarded the project by the City.

### **1400 ENGINEER**

The consultant Engineer or City engineering staff and/or their designated inspector assigned the engineering of the project.

### **1500 ENGINEER'S INSPECTOR**

The inspector assigned to the project by the consultant or City engineering staff to inspect installation of water mains and appurtenances.

### **1600 SAINT PAUL REGIONAL WATER SERVICES (SPRWS)**

The purveyor of the water supply used in the City and the utility that maintains the water distribution system of the City.

### **1700 SPRWS INSPECTOR**

The inspector assigned by the Saint Paul Regional Water Services as its representative to inspect construction procedures, materials used and to witness testing of the water main and appurtenances installed.

### **1800 ADMINISTRATIVE AUTHORITY**

The Board of Water Commissioners of the City of Saint Paul.

**- END OF DIVISION 1000 -**

## **DIVISION 2000: ENGINEERING DESIGN STANDARDS**

### **2100 PLAN REVIEW**

Plans and specifications shall be submitted to SPRWS in hard copy and electronic format a minimum of four weeks before a contract is advertised for bids. Electronic format shall be in accordance with current industry standards in AutoCAD or ESRI GIS format (plan view only in GIS), as may be determined appropriate by SPRWS. AutoCAD drawings shall include any customized Plot Style Tables (.ctb or .stb) or line types (.lin) and shall not require links to other drawings. Any changes in approved plans must be resubmitted for review and approval. Plans must show both plan and profile views of facility to be constructed. Fittings shall be identified and located by station or other suitable dimensions. The plan should also indicate both existing and proposed utilities located within the construction area.

### **2200 WATER MAIN DESIGN**

#### **2210 LOCATION**

Water mains shall be designed for installation in the standard water main location in a public street for which a permanent grade has been established, on the north or west side of the street at approximately one-third the full street right-of-way width (not less than 15 feet) from the property line. Refer to **Standard Plate D-1**. Public mains shall be installed in paved areas whenever possible. If a conflict exists at that location, the main shall be designed to provide the following minimum clearances: 10 feet from sanitary sewer, 5 feet from storm sewer and any other underground structure or utility. Additionally, water mains shall be designed to maintain a minimum horizontal clearance of 10 feet from trees. Trees installed after the placement of the water main shall be planted with at least 10 feet of horizontal clearance.

The water main shall also be designed to provide a minimum of 6-inches vertical clearance when crossing over any underground structure or utility and 12-inches vertical clearance when crossing under any underground structure or utility. Utility crossings will be evaluated as part of the plan review. For some crossings special construction may be required, (e.g. casing pipe, insulation, offset). Refer to **Section 2530**. Any request for exceptions to the above must be approved by SPRWS.

#### **2220 EASEMENTS**

Also see PRIVATE WATER MAIN SUPPLEMENT, page PM-1

The installation of public mains in easements will be considered only if the main represents a significant improvement to the distribution system that cannot be achieved by using public streets. Public mains in easements shall be installed in paved areas whenever possible.

A public water main may be installed in an easement within private property only if approved in advanced by SPRWS and shall be subject to the following requirements:

1. The easement area shall be 30 feet wide with the water main centered in the easement. Easements of greater width may be accepted with prior SPRWS approval. The easement shall be shown on the recorded plat for the area being developed or a dedicated easement shall be on file in the records of the County Recorder.
2. If a water main and a sanitary or storm sewer are in the same easement, the water main shall be a minimum of 15 feet from either side of the easement with a minimum 10-foot horizontal separation between sanitary sewer and water main and a minimum 5-foot horizontal separation between storm sewer and water main.
3. The easement shall be subject to the following conditions:
  - a. No change from the existing grade shown on the approved plans is permitted within the easement area after the water main is in place. Plans submitted must include the existing and proposed topography within and adjacent to the proposed easement.
  - b. Buildings, structures, material piles, trees, fences, etc. which may prevent access to the water main by SPRWS are not permitted within the easement area.
  - c. Should it be necessary that improvements or works be removed or damaged as a result of SPRWS operations, the costs of removal, replacement or modification of said works or improvements shall be borne solely by the owner.
  - d. No change of the existing surface within the easement area is permitted without SPRWS approval.
  - e. When SPRWS performs maintenance work in an easement area, surface restoration of pavement, sidewalks, shrubbery, grass, trees, etc., must be by others at no expense to SPRWS.
  - f. Additional utilities may be installed in the easement subject to SPRWS prior approval and must be constructed in accordance with separation requirements described in **Section 2210**.
4. If a service connection is to be extended beyond the normal street right-of-way line by SPRWS, a construction easement must be provided for that purpose. SPRWS will maintain only that portion of the service connection in the street right-of-way.
5. The grade throughout an easement area and the side slope shall not exceed a four to one (4:1) slope.

Where a water main easement is not in a paved area, **Standard Plate D-12** and the following shall apply:

- a. The centerline of all easements shall be identified by placing markers at either end of the easement and at 250 foot intervals or less throughout. Two (2) markers must be visible at all times from any point within the easement area. Markers shall also be placed at angle points when the easement diverges from a straight line.
- b. Markers shall have 360 degrees of visibility and shall be Rhino TriView posts with TriGrip Anchoring system, or approved equal. Markers shall be composed of a durable material which can perform in temperatures between -40° to +150°F, remain UV stable for 10 years, have a blue post with a black cap fastened to the top, and buried a minimum of 24-inches below the finished grade. A SPRWS Warning decal shall be adhered to each side of the marker; Rhino part number SD-6449K.
- c. At SPRWS sole discretion, alternate means of marking easement centerlines may be considered.

## **2230 GRADE**

The grade used to determine water main depth shall be the permanent finished street grade established by the City and shall be the grade directly over the water main. Water mains shall not be installed in ditches or other locations where there is not a street grade. However, if it is necessary to install a water main where there is not an established permanent street grade, or where the main is installed in an easement, a profile shall be taken on top of the water main during construction and on the finished ground line above the main after final grading has been completed to determine if the main is at the correct depth. The profiles shall be taken by Engineer or its representative. A copy of these profiles must be on file with SPRWS before the main is accepted for maintenance by SPRWS.

No reduction in earth cover is allowed over any main or service connection which has a previous history of freezing, unless the main or service connection is adjusted to proper depth under new finished grade as specified in **Section 2240**.

If the grade over an in-place water main or service connection 8-inch and smaller is changed to produce an earth cover of less than 7 feet or greater than 9.5 feet, the main or service connection must be adjusted to the proper depth as specified in **Section 2240**. Grade changes over in-place 12-inch and larger water mains and service connections shall be evaluated by SPRWS and shall be adjusted to proper depth if required.

## 2240 DEPTH

Depth of cover over the top of pipe shall be as follows.

<u>Pipe Size</u>	<u>Depth</u>
less than 12"	8.0 feet
12"	7.5 feet
16"	7.0 feet
20"	6.0 feet
24"	5.5 feet
30"	5.0 feet
36"	4.5 feet

Variations may be considered and approved by SPRWS. If service connections are anticipated to be installed on large diameter mains, the depth of water main cover shall be determined by SPRWS. Four (4)-inch through 16-inch pipe may be installed with 6.5 feet of cover where solid rock trench conditions are encountered. Protective measures to prevent freezing may be required depending upon conditions encountered.

## 2245 PIPE DEFLECTION

Water main design may provide for joint deflection of ductile iron pipe to produce a uniform alignment around a curve only where the curve radius is greater than 400 feet for 12-inch and smaller pipe and greater than 600 feet for 16-inch through 24-inch pipe. The design of water mains around curves of smaller radii must provide for bends to produce the required deflection.

## 2250 JOINT RESTRAINT

Joint restraint shall be accomplished by means of mechanical pipe jointing; such as mechanical joint pipe, Megalug retainer glands, or other approved methods. Rods and bands are **not** permitted. Where mechanical joint restraint is not possible, and with prior approval of SPRWS Inspector, poured concrete may be used as reaction backing at fittings. Reaction backing shall be of sufficient size to absorb all of the thrust created by maximum internal water pressures. If joint restraint is used for absorbing a portion of the thrust, the reaction backing shall be adequate to absorb all remaining thrust. The reaction backing shall be placed against undisturbed soil and the fittings are to be anchored. The fitting joints must be accessible for repair. Reaction backing must be designed by a licensed engineer and approved by SPRWS Inspector. Reaction backing is **not** allowed on hydrant installations.

## **2260 WATER MAIN VALVE LOCATIONS**

Valves shall be located at intersections on the projected property line of the intersecting street. An adequate number of valves shall be used such that no more than two blocks of main on any one residential street would be shut down at any one time. It is recommended that valves be installed at every intersection. On long continuous sections of main, valves shall be located at least every 1,000 feet. Twelve (12)-inch and larger valves shall be butterfly valves. Eight (8)-inch and smaller valves shall be gate valves. Valves shall be installed on all hydrant branches, except in locations where the hydrant can be isolated using main valves in the immediate vicinity.

## **2265 DEAD ENDS**

Dead end mains should be avoided by looping all mains. Dead end mains shall be allowed only with SPRWS prior approval. Where dead end mains are approved, a fire hydrant or approved blow-off shall be installed on the end of the main for flushing purposes. No flushing device shall be directly connected to any sewer.

## **2270 BLOW-OFFS**

Two (2)-inch blow-offs shall be installed at low points on 6-inch and 8-inch mains. Four (4)-inch blow-offs shall be installed at low points on 12-inch and 16-inch mains and 6-inch blow-offs on mains larger than 16-inches. The use of hydrants as blow-offs is permitted. SPRWS shall make the determination where blow-offs are required. Blow-offs shall be constructed near the main so they can be drained to the street by pumping. Draining the blow-off to "open-air" is an acceptable alternate to draining the blow-off to a manhole. Refer to **Standard Plates D-8** and **D-9**.

## **2275 PRESSURE TAPS**

Pressure taps on existing water mains shall be performed only by SPRWS with all excavation, compaction, backfilling and material or equipment handling performed by Contractor.

## **2280 AIR VENTS**

Air vents or hydrants shall be installed at high points on each valved section of main. SPRWS shall make the determination where air vents are required. Air vents that have less than 7 feet of cover shall be insulated from the corporation valve to the curb stop valve. Refer to **Standard Plate D-7** for installation details.

## **2285 CATHODIC PROTECTION SYSTEMS**

The level of cathodic protection required on a water main will be determined by SPRWS. Soil boring reports and soil resistivity testing will aid in the determination of appropriate system requirements, such will be indicated on project plans.

## **2300 WATER SERVICE CONNECTIONS**

Water service connections shall be designed and installed in accordance with **Standard Plate D-13**. Water service connection taps shall be performed by SPRWS except on new mains installed by Contractor. Such new mains may be tapped by Contractor in accordance with **Section 2320**.

Wherever possible, service connections shall be located at the center of residential lots and shall not be located within driveways nor within 10 feet of trees, culverts, catch basins, utility poles or other obstructions.

Tapping saddles are required for 1-inch services tapped on 4-inch or smaller ductile or cast iron pipe. Tapping saddles are **not** permitted for 1-inch services tapped on 6-inch or larger ductile or cast iron pipe.

All maintenance, repair or reconstruction of existing water services shall be performed by SPRWS.

### **2310 SERVICE CONNECTIONS INSTALLED FROM EXISTING MAINS**

Service connections installed from existing mains shall be installed 10 feet from sanitary sewer services.

#### *In street right-of-way*

Excavation for service connection piping in public street right-of-way shall be performed by SPRWS, unless otherwise approved in advance by SPRWS. Service connection installation shall be performed by SPRWS.

#### *In easements*

Service connection piping in easements may be installed by Contractor with the tap performed by SPRWS. However, 2-inch and smaller water service connection piping in public easements owned by the City may be installed by SPRWS, if requested by the City.

### **2320 SERVICE CONNECTIONS INSTALLED FROM NEW MAINS**

Service connection piping from new mains may be installed by Contractor, if so desired by the host City or SPRWS, as prescribed below.

Excavation for service connection piping from new mains shall be performed by the excavator of the new main.

Water services shall be installed and tested independent of the water main and in accordance with **Section 5320**.

#### *Water service in common trench with sanitary sewer service*

Service connection piping from new mains in public street rights-of-way or easements may be installed in the same trench as the sewer service subject to requirements of Minnesota Administrative Rules (MAR) 4715.1710 and the following:

1. Water services shall be located a minimum of 3 feet laterally from the sewer service.
2. The bottom of the water service pipe at all points shall be at least 12-inches above the top of the sewer service line at its highest point. Where this condition cannot be met, the sewer pipe material shall be ductile iron or D.R. 18 PVC.
3. Water service pipes shall be installed on a solid shelf of undisturbed soil excavated at one side of the common trench. The water service pipe shall be of one piece. Where this is not feasible, the number of joints in the service pipe shall be kept to a minimum and the joints shall be brazed.
4. Sewer service pipes shall be tested as described in MAR 4715.2820 or by methods acceptable to the Administrative Authority.

Water service in separate trench from sanitary sewer service

Service connection piping from new mains in public street rights-of-way or easements may be installed in a trench separate from the sewer service subject to the conditions below.

1. Service connection piping may be installed by Contractor only if installed and tested in conjunction with the new main.
2. Service connections shall be located a minimum of 10 feet from the sewer service.
3. Service connections installed by SPRWS from new main installed by Contractor will not be installed until the main has been pressure tested and approved by SPRWS Inspector.

**2330 SERVICE CONNECTION VALVE LOCATIONS**

General

1. Unless approved in advance by SPRWS, service valve boxes shall not be located in a sidewalk, driveway or ditch section.
2. Service valve boxes shall be set flush with the finished ground elevation.

Service Connection Valves in Street Right-of-Way

Generally, 4-inch and larger service valves shall be placed 2 feet from the water main. Two (2)-inch and smaller curb stop valves shall be placed 7 feet out from right-of-way line. Service connection shall be extended to right-of-way line or through utility easement.

Service Connection Valves in Easements

Valves on 4-inch and larger services shall be placed 2 feet from the water main. Valves on 2-inch and smaller services shall be placed within 4 feet of the water main. If the easement is paved, the valve may be located in accordance with the requirements for service connection valves in street right-of-way.

## **2340 SERVICE CONNECTION DEPTH**

Service connections shall be installed with 8 feet of cover as per the established grade from the main to the property line or, if applicable, to the utility easement line. When solid rock conditions are encountered, water services may be installed with 6.5 feet of cover. At this depth, the need for insulation will be determined by SPRWS Inspector.

If the grade over the service is ever changed so that the resulting cover is out of compliance with **Section 2230**, it shall be the City's responsibility to arrange for and pay all costs associated with the adjustment of the water service.

## **2350 SERVICE CONNECTION MATERIAL**

Two (2)-inch and smaller service connections shall be copper pipe. Four (4)-inch and larger service connections shall be ductile iron pipe. Refer to **Section 3100**.

## **2400 HYDRANTS**

Approved hydrants are Waterous Company WB-67 Pacer and Mueller Company Super Centurian 200. Refer to **Section 3400**.

## **2410 LOCATION AND SPACING**

Hydrants shall be located at each street intersection. The spacing between hydrants shall not be less than 300 feet or more than 600 feet unless approved by SPRWS. Hydrants not at an intersection shall be located at a property line (lot line) which is perpendicular to the street right-of-way. Hydrants shall be a minimum of 4 feet behind the curb but not closer than 7 feet to the street right-of-way line. Hydrants shall be placed on same side of the street as the main and only in areas which are adjacent to and directly accessible from paved roads, parking lots or driveways. Guard posts shall be required for hydrant protection in hazardous traffic areas as determined by Engineer or SPRWS Inspector. Refer to **Standard Plate D-3** for design details.

Hydrants are intended primarily for the purpose of fire protection and may only be placed in areas that are directly accessible to firefighting equipment. Proposed hydrant location shall be submitted to the local Fire Marshal for review and approval.

## **2500 GENERAL**

### **2510 CASING PIPE**

Casing pipe (or carrier pipe) shall be used as required when crossing under railroads, light rail or state and county highways. Casing shall also be used when crossing under any obstruction which may cause future water main maintenance problems. The casing shall meet all requirements of the agency granting the crossing permit. Refer to **Standard Plate D-6** for additional requirements.

Where a casing pipe is required, further information as to the size, thickness, coatings, cathodic protection, and the saddles required is available from SPRWS. These requirements vary depending on the type, size and depth of pipe, and the particular facility being crossed. Details for the installation must be submitted to SPRWS for approval prior to construction.

## **2520 INSULATION**

The design and use of insulation must be submitted to SPRWS for approval prior to construction. Insulation shall have a minimum compressive strength of 40 psi and shall be Dow Styrofoam HI brand plastic foam or approved equal. Insulation shall be a minimum of 4-inches in thickness. A uniform bedding material of sand shall be used around the insulation to provide uniform loading on the insulation. If SPRWS Inspector determines the bedding procedures are not adequate to properly support sheet insulation, an additional treated wood shell will be required. Any open-cell or preformed insulation shall be sealed and waterproofed by the application of a cold-applied, self-adhering, butyl-rubber protective material equal to Servi-Wrap P-400 as manufactured by the Grace Company or approved equal. Dow HI40 or HI60 plastic foam and any other approved high-density, closed-cell, plastic-shell insulation shall not be sealed when furnished in sheet form.

The following procedures and requirements shall be used as minimum guidelines for placement of insulation:

1. Where a water service or main passes within 3 feet above or below a storm sewer, insulation shall be placed between the water pipe and the storm pipe.
2. Where a water service or main is offset over a storm sewer, insulation shall be placed both over the top of the water pipe and between the water pipe and the storm sewer. Refer to **Standard Plates D-10 and D-5**.
3. Where a water main or service is within 4 feet of a catch basin, manhole or other outlet that is subject to cold, insulation shall be placed between the structure and the water pipe.

Insulation shall be placed parallel to the water pipe and 2 feet beyond either side of the water pipe and shall also extend 2 feet beyond either side of the storm sewer for situations 1 and 2 above. For situation 3 above, the insulation shall extend 2 feet beyond either side of the water pipe and 2 feet beyond either side of the structure.

Greater insulation thickness and/or greater extension of insulation limits may be required by SPRWS after evaluation of the following factors: depth of cover if below ground, size of water pipe and frost generating structure, angle at which storm sewer crosses water pipe, minimum flow expected in the water pipe, insulating value of the material and effects of moisture. Further information on the design or material for insulation can be obtained from SPRWS. Insulation will not be permitted to augment cover on static water lines.

## 2530 UTILITY CROSSING AND UNDERMINING

Offset or replacement of water pipe may be required at utility crossings or when pipe is undermined.

### 1. Utility Crossings

Where a utility crosses a water pipe and SPRWS believes offset of the water pipe may be required, Contractor shall expose the top of the water pipe and Engineer shall provide SPRWS Inspector with the following design information at least 3 days prior to scheduling of the offset:

- a. Size and type of utility
- b. Bottom of utility elevation
- c. Top of water pipe elevation
- d. Finished ground elevation

Separation requirements:

#### 12-inch and smaller water pipes

If separation between top of water pipe and bottom of utility is 8 inches or less, water pipe shall be offset.

#### 16-inch and larger water pipes

If separation between top of water pipe and bottom of utility is 4 inches or less, water pipe shall be offset.

For all sizes of water pipe where there is 4 inches to 8 inches of separation between the top of the water pipe and the bottom of the utility, concrete piers (City Mix No. 3A46) may be used to support the sewer over the water pipe in lieu of offsetting the water pipe. Piers shall be viewed by, and are subject to approval by, Engineer and SPRWS Inspector prior to construction. The method of support for water pipes larger than 12-inches shall be submitted to SPRWS Inspector for approval not less than 10 working days before the water pipe is exposed.

Any water pipe having less than 3 feet of separation from a catch basin, manhole or other structure subject to cold will be reviewed in the field and may require offset or insulation, as determined by SPRWS Inspector. Refer to **Section 4570** for offset requirements.

### 2. Undermining

Where utility work causes in-place cast iron water pipe to be undermined, the following requirements shall apply:

#### 8-inch and smaller

Replace cast iron pipe with ductile iron pipe the width of the trench plus 2 feet on both sides of the trench.

12-inch

Replace cast iron pipe with ductile iron pipe when more than 5 feet of pipe is undermined.

16-inch and larger

Action required will be determined by SPRWS on a case-by-case basis.

If the undermining conditions do not require replacement of the undermined water pipe, Contractor shall provide suspension support of the water pipe until its entire length is supported by properly compacted soils.

**2540 SAFETY REGULATIONS**

Safety laws and regulations governing construction in the project shall be followed, including but not limited to, OSHA Standards for excavations, trenching and shoring (Federal Register Part 1926, Subpart P). Refer to **Section 4410** for excavation safety requirements.

**2550 APPROVED EQUAL**

Material specifications must be submitted to SPRWS Engineering Division for review and approval on any material requested to be substituted as approved equal.

**2560 ABANDONMENT OF EXISTING PIPE**

Pipe can only be abandoned with the approval of SPRWS. All abandon pipe must be capped or bulk-headed and traceable. Tracer wire connection materials and methods (Sections 3160 and 4640) are subject to prior approval by SPRWS Inspector. All connections shall be coated with a urethane coating (e.g. CRC Seal Coat No. 18410) or approved equal.

**- END OF DIVISION 2000 -**

## DIVISION 3000: MATERIALS

### 3100 PIPE AND APPURTENANCES

#### 3110 DUCTILE IRON PIPE

Ductile iron pipe used in the work shall be equal in quality to that manufactured by the United States Pipe and Foundry Company, the American Cast Iron Pipe Company, James B. Clow and Sons or Griffin Pipe and Foundry or approved equal. The pipe shall conform to the latest revision of AWWA Standard C151 for centrifugally cast pipe, Grade 60-42-10, and shall be gauged full length.

The minimum allowable pipe wall thickness shall be as follows:

Size	Thickness Class	Wall Thickness
4"	53	0.32"
6"	53	0.34"
8"	52	0.33"
12"	52	0.37"
Larger	52	Varies Per ANSI/AWWA C150

Ductile iron water pipe shall be cement-mortar lined and shall conform to the latest revision of ANSI/AWWA C104/A21.4.

#### 3120 PLASTIC PIPE

Plastic pipe shall be used only with SPRWS prior approval.

##### Molecularly Oriented Polyvinyl Chloride (PVCO)

PVCO pipe shall be pressure class 200 and conform to the latest revision of ANSI/AWWA C909. Only sizes 4-inch through 24-inch are allowed. Only iron fittings are allowed.

##### High Density Polyethylene (HDPE)

HDPE pipe shall be pressure class 200, PE 3408, SDR-9, with ductile iron pipe sizes (DIPS) and shall conform to the latest revisions of ANSI/AWWA C906, ASTM F714 and NSF 61. Only sizes 2-inch through 24-inch are allowed.

#### 3130 STEEL PIPE

The use of cement mortar-lined steel water pipe may be permitted in special cases such as on bridges where weight is a factor. Steel pipe shall conform to the latest revision of AWWA C200. Cement mortar lining for steel pipe shall conform to the latest revision of AWWA C205. Certain uses of steel water pipe may require special exterior coatings or cathodic protection. Additional information concerning acceptable uses for steel water pipe is available from SPRWS Engineering Division.

## 3140 PIPE FITTINGS

Cor-Blue corrosion-resistant, high-strength, low-alloy steel Cor-Ten tee head bolts and nuts shall be furnished and installed on mechanical joint fittings according to the latest revision of ANSI/AWWA C111/A21.11. Bolts shall feature a baked on ceramic filled fluorocarbon resin.

### Fittings for Ductile or Cast Iron Pipe

Mechanical joint fittings shall be used with both mechanical joint and push-on joint pipe and shall conform to the latest revision of AWWA C110. Fittings and sleeves, regardless of size, shall have a minimum rated working pressure of 250 psi.

For fittings 4-inches to 24-inches, compact ductile iron fittings with a minimum working pressure of 350 psi and conforming to the latest revision of AWWA Standard C153 may be installed.

Fittings manufactured by U.S. Pipe, American D.I. Pipe, Union Foundry, Tyler, Clow, Star and Trinity Valley are acceptable. Those proposing to furnish equal quality fittings must first obtain written approval from SPRWS.

Mechanical joint restraints shall be ductile iron and shall conform to the latest revision of ANSI/AWWA C111/A21.11. Restraints shall be hexagonal in shape with a full-bodied, solid, outer ring. Lightweight, compact glands and glands with ear-type retainer lugs are **not** acceptable. Mechanical joint restraints shall have a minimum rated working pressure of 250 psi.

Set screws for retainer glands shall be corrosion-resistant high-strength low-alloy steel or approved equal. Series 1100 MEGALUG as manufactured by EBBA Iron, Inc. or approved equal will be considered acceptable for use on ductile iron pipe. Series 110000X Oversize MEGALUG as manufactured by EBAA Iron, Inc. or approved equal will be considered acceptable for use on cast or grey iron pipe.

### Fittings for Plastic Pipe

Fittings for PVC pressure systems shall be ductile iron and shall conform to the latest revision of ANSI/AWWA C110/A21.10.

Mechanical joint restraints shall be used to transition from the plastic pipe to the fittings. Series 2000PV mechanical restraints, as manufactured by EBAA Iron, Inc. or approved equal, will be considered acceptable for use on PVC plastic pipe. At locations where bends are required pre-cast thrust blocks shall be installed.

Fittings for HDPE pressure systems shall be fusible HDPE material. No ductile iron fittings will be allowed unless needed to transition to existing iron pipe or hydrants. Fusible HDPE mechanical joint adaptors shall be used for connecting to iron fittings or iron pipe.

### 3150 TAPPING SLEEVES

Tapping sleeves for use in tapping cast iron, ductile iron and PVC pipe water main shall be stainless steel with stainless steel flanges. (e.g. JCM model 432 or Ford Fast) or approved equal. Sleeves shall be adaptable to properly fit and seal class A, B, C and D pit cast iron, ductile iron and PVC pipe in the following Outside Diameter sizes:

<b>Nominal Pipe Size</b>	<b>Required Outside Diameter Range</b>
4"	4.80" – 5.00"
6"	6.90" – 7.10"
8"	9.05" – 9.30"
12"	13.20" – 13.50"
16"	17.40" – 17.80"
20"	21.60" – 22.06"
24"	25.80" – 26.32"
30"	31.74" – 32.74"
36"	37.96" – 39.16"

Tapping sleeve gaskets shall provide sealing across the full pipe circumference and the full area of the sleeve. Bolts and nuts shall be stainless steel.

Taps larger than 2 inches on iron pipes require the use of a tapping sleeve, and 1.5 and 2 inch taps require a tapping saddle. All taps on plastic pipe require the use of a tapping sleeve.

For 16-inch and larger mains, fusion-bonded, epoxy-coated, fabricated steel sleeves are permitted. Such sleeves shall be complete with stainless steel or high-strength low-alloy bolts and hexagonal nuts and a broad cross-section ring gasket. Alternate sleeves shall be JCM model 412, Ford style FTSC or approved equal.

Service connection fittings for HDPE pressure systems shall be HDPE electro-fusion type fittings with a minimum working pressure rating of 200 psi. Service saddles shall be self-tapping and sealing. Double-strapped ductile iron body service saddles may NOT be used in lieu of electro-fusion type.

### 3160 CONDUCTIVITY

#### Ductile Iron

Joints shall be provided with an electrical bond capable of carrying 600 amps for an extended period of time to provide integral electrical thawing capability and a continuous circuit for tracing capabilities.

Mechanical joints shall have rubber gaskets conforming to the latest revision of ANSI/AWWA C111/A21.11. Copper straps or cable bonding shall be used to obtain conductivity. If mechanical joint retainer glands are used, copper straps are optional. Push on joints shall be jumpered with copper straps, either factory or field welded. All coating, rust or foreign material must be removed prior to assembly to permit proper electrical contact. The use of wedges or gaskets with embedded copper clips is **not** permitted.

#### Tracer Wire for Plastic Pipe

Tracer wire used in pipe bursting and directional drilling applications shall be 3/16 braided stainless steel or 7 x 7 Stranded Copper Clad Steel having a 30 volt maximum rating, a 4,700 lb break load, and wire coating shall be HDPE with a thickness of 0.045". Wire to be Copperhead Soloshot Xtreme Strength 7x7 stranded PBX-50 or approved equal.

For all other plastic pipe applications, tracer wire shall be No. 10 AWG, direct burial copper XLP wire or copper clad steel with 30 mil HDPE insulation and min. 450 lb. break load. Copperhead #10 High Strength 1030B-HS, Copperhead #10 Superflex 1030B-SF or approved equal.

Direct bury wire connections shall include 3-way lockable connectors and mainline to lateral lug connectors specifically manufactured for use in underground trace wire installation. Connectors shall be dielectric silicon filled and shall be installed in a manner so as to minimize uninsulated wire exposure. Brundy type KS15, DryConn 3-way Direct Bury Lug #3WB-01, or approved equal.

#### Trace Wire Termination Points

All tracer wire termination points must utilize an approved trace wire access box. A minimum of 2 feet of excess/slack wire is required in all access boxes after meeting final grade.

The box for in-ground tracer wire termination shall be an H20 rated utility box, Bingham & Taylor P525 or approved equal. The box covers for in-ground tracer wire termination boxes shall be cast iron with the legend "WATER".

Tracer wire termination boxes for hydrants shall be blue Little Fink test stations, manufactured by Cott Manufacturing, Copperhead T3 Test station T3-75-F, or approved equal. The mounting bracket shall be a 14 gauge, stainless steel properly affixed to the hydrant grade flange (affixing with tape or plastic ties shall not be acceptable).

### **3170 POLYETHYLENE ENCASEMENT**

Polyethylene encasement shall be by the tube method and shall conform to the latest revision of ANSI/AWWA C105/A21.5. Polyethylene encasement shall be composed of 8-mil linear low-density virgin polyethylene film or 4-mil cross laminated high-density virgin polyethylene film. All polyethylene encasements shall be fitted appropriately for the size of the main.

## **3200 VALVES**

### **3210 GATE VALVES 4-INCH THROUGH 8-INCH**

Gate valves shall be resilient-seated, nonrising stem (NRS), suitable for buried service and shall conform to the latest revision of ANSI/AWWA C509, with the following specific options:

1. Valves shall be right-hand opening (clockwise) with red wrench nut.
2. Stem seals shall be O-ring type.
3. Bolting materials shall be stainless steel with hexagonal heads and shall have the mechanical strength requirements of ASTM A307.
4. Gate valves shall have mechanical joint valve ends. Tapping valves shall have full-size cutter diameter with tapping valve ends.

### **3220 BUTTERFLY VALVES 12 INCH AND LARGER**

Butterfly valves shall be mechanical joint end valves, class 150B, rubber-seated, suitable for buried service, and shall conform to the latest revision of ANSI/AWWA C504, with the following specific options:

1. Valves shall be right-hand opening (clockwise) with red wrench nut, installed facing vertically upward for key operation.
2. Mating seat surface shall be 18.8 stainless steel or ASTM A436 Type 1 (Ny-resist). Sprayed or plated mating seat surfaces are **not** acceptable.
3. Shaft seals shall be O-ring type.
4. Actuator components between the Input and the Stop Limiting devices shall be capable of withstanding a wrench nut input torque of 450 ft-lbs.
5. Valve operators shall be designed to hold the disc in any intermediate position between fully opened and fully closed without creeping or fluttering.

### **3230 VALVE BOXES**

Valve boxes shall be screw type Tyler Series 6860, or equal, with a 5¼- inch inside diameter and be extendable from 48-inches to 102-inches. Drop lids shall be marked "WATER." Valve box parts shall be labeled and cast with raised letters identifying manufacturer, series number, part number and country where cast. Risers shall be compatible with and shall properly fit Series 6860 Valve Box Top Sections. Risers shall accommodate standard 5¼-inch drop lids.

Valve boxes must be installed with a valve box aligner, as shown in **Standard Plate D-2**.

### **3300 SERVICE AND LAWN SPRINKLER CONNECTIONS**

Service and lawn sprinkler connection materials shall be suitable for use and perform properly at a minimum operating pressure of 150 psi.

#### **3310 CURB STOP VALVES**

Curb stop valves for copper service connections 2-inch and smaller shall be without drain and shall be:

- Mueller Mark II H-15154, Minneapolis thread, or
- Mueller 300 ball valve, B-25154, Minneapolis thread, or
- Ford B22, Minneapolis thread.

Curb stop valves for lawn sprinklers and air vents shall be of like materials as required for service connections, but shall have a drain (wasting valve).

#### **3320 CURB STOP BOXES**

Curb stop boxes shall be Mueller Co. H-10316, H-10336, A.Y. McDonald Mfg. Co. 5628, 5628-B, 5630, 5631, 5631-B, or approved equal. Parts from different manufacturers may be interchanged, provided they are compatible with each other. Curb stop boxes and accessories shall be coated with an asphalt-based paint.

Curb stop boxes shall telescope one foot to an extended length of 96-inches. Upper sections shall be of 2-inch I.D. steel pipe. Base sections and lids shall be cast of heavy, high-grade iron. Lids shall have a 2-inch brass pentagon plug, printed with the word "Water" in raised letters.

A brass Minneapolis thread centering ring from the curb stop manufacturer may be installed, if available.

In cases where the curb stop boxes are situated in asphalt or concrete paved areas, a Ford Type A single lid cover or equal shall be installed a minimum of 2-inches and not more than 4- inches over the curb stop with the lid placement ¼-inch below finished grade. The pitch of the lid should match the pitch of the paved surface. Covers shall be marked "WATER" for identification purposes. Refer to **Standard Plate D-14**.

#### **3330 COPPER MAINS AND SERVICE PIPES**

Copper service tubing shall be seamless copper tubing suitable for underground water services. The tubing shall conform to the latest revision of ASTM B88, Type "K" soft.

#### **3340 SERVICE CONNECTION SADDLES**

Service saddle bodies shall be of ductile iron or stainless steel with synthetic rubber gaskets and with threads suitable for use with standard CC (AWWA Taper Thread) Mueller corporation valves. Saddles must have a minimum of two bands, and bands shall be bronze or stainless steel. Nuts and bolts shall be of the same material as the bands.

### 3350 SERVICE COUPLINGS

Couplings at the property line shall be two-part Mueller 15405, Mueller 15400 or equal. Soft soldered joints are not permitted.

### 3360 CORPORATION VALVES

Corporation valves shall be Muller 300 Ball Type B-25000 or Ford Corp FB600. Corporation valve inlets shall be threaded with standard AWWA/CC Taper. Inlet threads shall be protected in shipment by a plastic coating or other equally satisfactory means. Corporation valve outlets shall be threaded for use with flared copper tubing unless otherwise specified.

### 3400 FIRE HYDRANTS

Fire hydrants shall conform to the latest revision of ANSI/AWWA C502 for Dry-Barrel Fire Hydrants, except as follows:

1. Fire hydrants shall open in a clockwise direction. Acceptable hydrants are the Waterous Company WB-67-250 Pacer and the Mueller Company Super Centurian 200.

All hydrants shall be provided with nozzle cap chains, the nozzle caps shall be standard nozzle caps with a 1½” (point-to-flat) pentagon nut. Nozzles shall be mechanically attached and not leaded in place.

Fire hydrant requirements vary based on municipality; the contractor shall supply the appropriate hydrant depending on which municipality the work to be done is located in:

<b>Municipality</b>	<b>Nozzle</b>	<b>Thread</b>	<b>Color</b>
Saint Paul	(1) - 4” Storz connection (1) - 4.5” Pumper	St Paul Standard <sup>1</sup>	Red
Maplewood	(1) - 4” Storz connection (2) - 2.5” Discharge	National Standard	Yellow
West Saint Paul	(1) - 4.5” Pumper <sup>2</sup> (2) - 2.5” Discharge	St Paul Standard <sup>1</sup>	Red
Mendota Mendota Heights Lilydale Falcon Heights Lauderdale Sunfish Lake	(1) - 4” Storz connection (2) - 2.5” Discharge	St Paul Standard <sup>1</sup>	Red

<sup>1</sup>: Hydrant threads shall conform to **Standard Plate D-4**

<sup>2</sup>: There are to be no Storz Connections allowed

### 3500 SALVAGED MATERIALS

Certain salvaged materials may be reconditioned and reused subject to approval of Engineer and SPRWS Inspector. If salvaged material is so approved, it shall be reconditioned, cleaned and recoated to the satisfaction of SPRWS Inspector. Only materials removed as part of the water main improvement project and within the improvement project boundaries will be considered for reuse.

### 3600 METRIC EQUIVALENTS

The following SI Unit sizes of pipe may be used in place of English FSS Unit sizes:

2 inch – 50 mm	16 inch – 400 mm
4 inch – 100 mm	20 inch – 500 mm
6 inch – 150 mm	24 inch – 600 mm
8 inch – 200 mm	30 inch – 750 mm
12 inch – 300 mm	36 inch – 900 mm

### 3700 CATHODIC PROTECTION SYSTEM

Cathodic protection materials shall be new and shall remain in original sealed packaging until installation.

#### 3710 GALVANIC MAGNESIUM ANODE

Contractor shall supply high potential magnesium galvanic anodes. Anodes shall conform to ASTM B843 and shall be composed of 6% aluminum, 3% zinc alloy, 1% manganese and the remainder magnesium. The magnesium anode shall be prepackaged in a cloth bag containing a low resistivity backfill, shall consist of 75% hydrated Gypsum, 20% bentonite and 5% sodium sulfate. A minimum of ten feet of AWG No. 12 copper wire with TW insulation shall be attached to the anode. Anodes shall be SuperMAG High-Potential Magnesium anodes as produced by Galvotec Alloys, Inc, or approved equal.

#### 3720 TEST STATIONS

##### Test Station Wiring

Wires utilized for test stations shall be solid single conductor copper wire type THHN insulation, No. 10 AWG.

##### Test Station Panel Boards

Test station panel boards shall be made of 4-inch x 4-inch x ¼ -inch fabric reinforced Micarta. Five double-nutted plated brass studs shall be installed on the panel boards, as shown in **Standard Plate D-15**. Tinned copper ring terminals shall be soldered to the ends of wires terminated in the test station. All panel boards shall accommodate a shunt.

##### Test Station Shunts

Shunts for all sacrificial anode test stations shall be 0.01 ohm, 6 ampere capacity, manganin wire type, unless otherwise specified.

### Test Station Box

The box for test stations shall be an H20 rated utility box, Bingham & Taylor P525 or approved equal. The box covers for insulating test stations shall be cast iron with the legend "CP TEST".

### Test Station Reference Electrode

The reference electrode shall be composed of Copper-Copper Sulfate and shall have an AWG No. 12 lead wire with 600 volt, black THWN insulation.

## **3730 JOINT BONDING**

Wires for joint bonds shall be stranded single conductor copper wire Type HMW/PE insulation No. 8 AWG.

## **3740 ISOLATION JOINTS**

Isolation joints shall be installed where new cathodically protected pipe meets existing iron pipe. Such joints shall consist of 3 feet of matched size C-900 PVC pipe. Connections to iron pipe shall be made consistent with these standards. A test station shall be installed shall be installed at each isolation joint.

To be used in lieu of Isolation Joints, only as approved by SPRWS.

## **3750 INSULATING FLANGE**

Insulating flange gaskets shall be neoprene-faced phenolic. Sleeves shall be full length and of a material indicated by the manufacturer as suitable for domestic water. Flange bolts, nuts and washers shall be stainless steel. Contractor shall provide two sets of 1/8 inch laminated phenolic insulating washers. Insulating sleeves shall be spiral wound Mylar, 1/32 inch thick.

Underground dielectric insulating flanges shall be covered with Trenton Primer and #1 Wax Tape or approved equal. Overwrap shall be plasticized PVC tape with natural and synthetic rubber adhesive.

## **3760 EXOTHERMIC WELDS**

Cable connections to pipe and fittings shall be made with exothermic weld kits specifically designed by the manufacturer for welding the type of materials. Connections to ductile iron and cast iron pipe or fittings shall use the weld metal and mold for exothermic connections to cast iron pipe. The mold and weld metal shall be supplied by the same manufacturer. Weld metal shall be type XF manufactured by Thermoweld or approved equal. All welds shall be made with copper wire sleeves.

All exposed wires and welds shall be protected with an adhesive rubber Thermite Weld Cap, or approved equal.

**3770 BITUMASTIC COATING**

Bitumastic Coating shall be TE Mastic, as manufactured by Tapecoat Company, Bitumastic 50, or approved equal. Holidays in the protective coating shall be repaired in the field as directed.

**- END OF DIVISION 3000 -**

## **DIVISION 4000: INSTALLATION OF PIPE AND APPURTENANCES**

### **4100 GENERAL INFORMATION**

The latest revision of ANSI/AWWA C600 shall apply.

No valve, hydrant or other control on either the existing or new water system shall be operated for any purpose by Contractor. Valves shall only be operated by or under the direction of SPRWS Inspector. No section of water main will be placed in permanent service by SPRWS until that section of main and appurtenances has been inspected, tested and disinfected to the approval of SPRWS Inspector.

### **4110 PRECONSTRUCTION REQUIREMENTS**

#### *Preconstruction Meeting*

A preconstruction meeting attended by Contractor, Engineer and SPRWS Inspector is required prior to start of construction. If water facilities are proposed for installation in or across a state or county highway, the state or county highway maintenance Engineer shall be invited to the meeting. Representatives of utility companies having facilities within the project area shall also be invited to the meeting.

At the preconstruction meeting, SPRWS will provide Contractor with a list of existing gate boxes and stop boxes in the construction area.

#### *Existing Facilities*

Contractor is responsible for the condition of existing water facilities in the construction area. Throughout construction, Contractor shall maintain access to all facilities and shall maintain all facilities in a condition no less than was found prior to construction.

Prior to construction, SPRWS will attempt to locate and repair existing valve boxes and stop boxes in the construction area. Contractor may inspect these facilities with its own forces and notify SPRWS Inspector of deficiencies.

#### *Initial Inspection*

Contractor, along with SPRWS Inspector, shall inspect all valve and stop boxes in the construction area, and any that are found to be damaged, incomplete or buried shall be noted. If Contractor fails to schedule an inspection prior to construction, any facilities found to be damaged or broken within the construction area shall be assumed to have been damaged by Contractor and Contractor shall be responsible for repairs to such facilities.

Contractor shall replace valve-housing top sections found to be broken during the initial inspection. For those top sections so identified, SPRWS Inspector will authorize Contractor to obtain replacement top sections from SPRWS Warehouse at 1900 Rice St., St. Paul, Minnesota, without charge to Contractor.

#### **4120 NOTIFICATION**

Contractor shall notify SPRWS at least 48 hours in advance of construction so that an inspector can be assigned to the project.

#### **4130 MATERIALS**

Contractor shall furnish and install only the specified materials approved by SPRWS. SPRWS will be responsible for furnishing any material required for work to be performed by SPRWS.

Materials furnished by Contractor must be inspected by SPRWS Inspector before installation. Any materials installed without prior inspection may be ordered removed for inspection and approval.

#### **4140 INTERRUPTION OF WATER SERVICE**

SPRWS Inspector or SPRWS Foreman shall notify the Engineering office of any host community in which a water main shutdown becomes necessary. Consumers affected by such operation shall be notified by SPRWS personnel a minimum of 24 hours before the operation and advised of the probable time when the service will be restored. Where larger services or commercial properties are affected by the shut-offs, a minimum of 3 days notice shall be given. After-hours work may be required if certain properties cannot be out of service during normal work hours. In the event a main must be placed out of service for more than a single 8 hour period, temporary service must be installed by SPRWS to all affected consumers at the expense of the project. For extended main shutdowns, contractor must provide SPRWS 2 weeks' prior notice for residential shutdowns, and 3 weeks' prior notice for commercial shutdowns.

#### **4150 CORROSION CONTROL**

All pipe and appurtenances shall be protected by the use of polyethylene encasement in accordance with AWWA Standards C105. If coating or corrosion control is determined necessary by SPRWS Inspector or Engineer, coatings and cathodic protection systems shall conform to the most current applicable standards. In the absence of applicable AWWA standards, coatings and cathodic protection systems shall conform to applicable recognized industry standards and codes, from organizations including, but not limited to, National Association of Corrosion Engineers (NACE), SSPC (Society of Protective Coatings), NSF, STI/SPFA, etc., subject to prior SPRWS approval.

#### **4200 HANDLING PIPE AND ACCESSORIES**

##### **4210 CARE IN HANDLING**

Pipe, fittings, valves, hydrants, appurtenances and accessories shall be unloaded at the point of delivery, hauled to and distributed at the site of the project by Contractor, unless otherwise directed by SPRWS Inspector, and they shall at all times be handled with care to avoid damage. In loading and unloading they shall be lifted by hoist, slid, or rolled on skidways in such a manner as to avoid shock. Under no circumstances shall they be dropped. Pipe handled on skidways must not be skidded or rolled against pipe already on the ground.

Additionally, plastic pipe shall be handled according to AWWA M55: PE Pipe – Design and Installation.

#### **4220 PLACEMENT OF PIPE**

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.

#### **4230 CARE OF PIPE COATING**

Pipe shall be handled in such manner that a minimum amount of damage to the coating will result. Damaged coating shall be repaired in a manner satisfactory to SPRWS Inspector.

#### **4240 PIPE STAGING**

Pipe shall be placed on the site of the work parallel with the trench alignment and with bell ends facing the direction in which the work will proceed, unless otherwise directed by SPRWS Inspector.

#### **4250 PIPE AND APPURTENANCE CLEANLINESS**

Contractor shall prevent materials from contaminating or potentially contaminating the interior of all pipes, fittings and other accessories during storage, construction, or repair, while materials are located at the construction site.

#### **4260 PIPE LINING**

Pipe with damaged lining will be rejected. No repair will be acceptable.

### **4300 ALIGNMENT AND GRADE**

#### **4310 GENERAL**

Water mains and appurtenances shall be installed only in the location and to the grade shown on construction plans approved by SPRWS. Valves, fittings and hydrants shall be installed at approved locations. Any deviation from the approved plans must be submitted to SPRWS for review and approval prior to construction.

If a water main is installed within an easement, alignment hubs must be set by a surveyor to identify the easement limits and the water main alignment. Grade stakes are required in intervals of 25 feet, or as requested by SPRWS Inspector. Alignment hubs and grade stakes shall be maintained until the installation is complete.

#### **4320 PROTECTING UNDERGROUND AND SURFACE STRUCTURES**

Temporary supports, adequate protection and maintenance of underground and surface utility structures, drains, sewers, house and service connections for both sewer and water, and other obstructions encountered in the progress of the work shall be furnished by Contractor at its

expense under the direction of Engineer, unless otherwise provided for. Adjustment of in-place, underground water facilities shall be accomplished by SPRWS unless contractual arrangements are made. Scheduling of SPRWS adjustments must be coordinated through SPRWS Inspector. Refer to **Section 2530** for utility crossings and undermining requirements.

#### **4330 OBSTRUCTIONS CAUSED BY OTHER UTILITIES**

Wherever existing utility structures, branch connections leading to main sewers or to main drains, or other conduits, ducts, pipes, or structures form obstructions to the grade and alignment of the water main to be laid, they shall be permanently supported, removed, relocated or reconstructed by Contractor through cooperation with the owner of the utility, structure or obstruction involved. In those instances where relocation or reconstruction is impractical, a deviation from the line and grade may be ordered by Engineer, if approved by SPRWS Inspector.

Wherever possible, existing utility structures and appurtenances will be located in advance of trench excavation and must be properly marked. Contractor shall not alter any existing utility lines unless it is determined by Engineer that it will be necessary in order to install the new water main. Utility lines that are damaged by Contractor shall be repaired or replaced by said utility at Contractor's expense, unless the Utility states otherwise.

Crossings of utilities or structures not shown on the construction plans shall be reviewed with Engineer and SPRWS Inspector prior to construction.

#### **4340 DEVIATION WITH ENGINEER'S CONSENT**

Construction shall not deviate from plans and specifications approved by SPRWS, except with the approval of SPRWS Inspector and the consent of Engineer. Any changes requiring revision to the plans originally approved by SPRWS must be resubmitted for approval prior to construction.

Failure to comply with this requirement shall be cause to deny acceptance of the installation until such time as remedial action is completed by Contractor and approved by SPRWS Inspector.

#### **4350 PIPE COVER**

Water mains shall be laid to the depth shown on the drawings or at such other depth as established by Engineer or SPRWS Inspector, in order to connect the new pipe to existing water mains. Refer to **Section 2240**.

#### **4400 EXCAVATION AND PREPARATION OF TRENCH**

The trench shall be dug to the alignment and depth required and only so far in advance of pipe laying as Engineer or SPRWS Inspector shall permit. The trench shall be so braced and drained that workers may work therein safely and efficiently. It is essential that the discharge from pumps be lead to natural drainage channels, drains, or to sewers.

## 4410 EXCAVATION SAFETY

Contractor shall follow OSHA Standards for excavations, trenching and shoring (Federal Register Part 1926, Subpart P). Contractor shall protect workers against cave-ins in excavations by adequate protective systems, such as trench boxes, shoring, allowable sloping or other. Contractor shall be responsible for the excavation throughout the life of the trench. Contractor shall have a duly authorized Competent Person on site. The Competent Person shall be capable of identifying hazards and taking prompt corrective measure to eliminate them. Inspections shall be in accordance with OSHA Standard Section 1926.651 (K) (1). All soils shall be classified as Type C unless otherwise determined by acceptable documented visual and manual tests. SPRWS Inspector, Engineer or SPRWS Foreman shall have the authority to require the use of a trench box or other protective systems.

### 1. Excavation requirements

#### Water service trench

Trench box with 4 shored sides, with an approximate width of 3 feet and a length of 5 feet to minimize removals. Trench box is required at the water main and at property line or boulevard stop box.

#### Water utility hole

Trench box with 4 shored sides, adjustable to an approximate width of 5 feet and a length of 7 feet. This is also required on miscellaneous holes such as valve or stop box work.

#### Hydrant excavation

Trench box with 3 shored sides, adjustable to an approximate width of 6 feet and a length of 8 feet. Hydrant trench boxes will be used in conjunction with water main trench boxes when installing hydrants from a new main.

#### Water main trench

Trench box with 2 shored sides, minimum length of 24 feet. The inside width of the trench box shall not exceed 6 feet when installing water mains 12-inch and smaller, or 8 feet inside width when installing water mains larger than 12-inch.

### 2. Trench box requirements

Trench boxes shall meet OSHA requirements and manufacturer's tabulated data requirements, as referenced on the box. A four-sided trench box is required on all excavations deeper than five (5) feet, where underground work or inspection is to be performed by SPRWS. Ladders are required and must extend three feet above the surface of the trench. Sidewalks, pavement, ducts and appurtenant structures shall not be undermined, unless a support system or another method of protection is provided. Trenches in excess of 20 feet in depth must be signed off by a registered professional engineer. Excavated material must be kept a minimum of two (2) feet from the edge of the trench. Trench boxes shall be sized to minimize removals. Contractor shall provide for protected trench ingress and egress by means of a ladder or properly sloped trench walls.

Where field conditions prohibit the use of a trench box, Contractor shall be responsible to install an excavation protection system meeting OSHA regulations.

#### **4420 WIDTH**

The trench shall be ample in width to permit the water main to be laid and jointed properly and the backfill to be placed and compacted properly. The trench shall be constructed in compliance with **Section 4410** and the maximum clear width of the trench at the bottom shall be not more than 2 feet greater than the pipe diameter.

#### **4430 PIPE FOUNDATION**

The trench, unless otherwise specified, shall have a flat bottom conforming to the grade to which the pipe is to be laid, with bearing for the full length of the pipe. Bells shall be hand dug to allow bearing along the length of the pipe. Granular bedding material for pipe bedding shall be in accordance with MN/DOT 3149.2F. Refer to **Standard Plate D-5**.

#### **4440 PIPE FOUNDATION AND BACKFILL IN POOR SOIL**

When the trench bottom uncovered at subgrade is found to be unstable or to include ashes, cinders, refuse, vegetable or other organic material, or large pieces or fragments of inorganic material, a further depth and/or width shall be excavated, or other approved means shall be adopted to assure a firm foundation for the pipe, as ordered by Engineer. The depth of excavation and backfill material used for replacement shall be as ordered by Engineer and approved by SPRWS Inspector. Protective measures required for pipe installation in corrosive soils are found in **Section 4150**.

#### **4450 PIPE FOUNDATION IN WET SOIL**

Where either SPRWS Inspector or Engineer determines that the amount of moisture in the pipe foundation soil is sufficient to require stabilization, Contractor shall stabilize the pipe foundation with 1½-inch clear river rock installed to a depth determined by the requiring entity.

#### **4460 PIPE FOUNDATION AND BACKFILL IN ROCK**

Ledge rocks, boulders and large stones shall be removed to provide at least 6-inches clearance from all parts of the pipe, and appurtenances. Adequate clearance for properly jointing the pipe shall be provided at bell holes. The pipe shall be laid on a 6-inch bed of granular material to assure the barrel of the pipe will have a uniform bearing for its full length. The trench shall be backfilled with granular material to a depth of 1 foot above the top of the pipe. Excavated rock shall be removed from the job site. Backfill material shall be compacted with hand operated equipment up to 1 foot above the pipe. Remainder of backfilling shall be performed in accordance with **Sections 4920** and **4930**.

## **4500 INSTALLATION OF PIPE**

### **4510 MANNER OF HANDLING PIPE AND ACCESSORIES**

Proper implements, tools and facilities satisfactory to SPRWS Inspector or Engineer shall be provided and used by Contractor for the completion of the work without interruption to existing service by Contractor. Pipe and fittings shall be carefully lowered into the trench piece by piece, in such manner as to prevent damage to pipe lining or pipe coating. Under no circumstances shall pipe or accessories be dropped or dumped into the trench. Any defective, damaged or unsound pipe shall be rejected. Valves should be wrapped in a protective material until installed to prevent foreign materials from damaging the valve disc or seat. Valves should be opened, operated and inspected for damage or imperfection prior to installation and any not serviceable, in the opinion of SPRWS Inspector or Engineer, shall be rejected.

### **4520 PIPE INSTALLATION CLEANLINESS**

Foreign matter or dirt shall be removed from the inside of the pipe, valves and hydrants before lowered into position in the trench, and it shall be kept clean by approved means during and after installation.

Precautions shall be taken to protect the interiors of pipes, fittings and valves against contamination. Pipe delivered for construction shall be stored and placed so as to minimize entrance of foreign material. Openings in the pipeline shall be closed with watertight plugs when pipe installation is interrupted or stopped. If water accumulates in the trench, the plugs shall remain in place until the trench is dry. Rodent resistant plugs may be used where it is determined by SPRWS Inspector or Engineer that watertight plugs are not practical.

Jointing of pipe in the trench shall be completed before work is stopped.

### **4530 CUTTING PIPE**

When it is necessary to cut pipe, the end shall be cut as nearly square as possible (no diagonal cuts) and dressed with a file or grinder. Slip joint pipe ends shall be beveled. Before assembling, a depth mark must be placed on field cut pipe to assure proper homing of the joint. When a nipple is used in conjunction with a fitting, the minimum length shall be 2 feet. When a nipple is used in conjunction with straight pipe, the minimum length shall be determined by SPRWS Inspector, but in no case shall the length be less than 2 feet.

### **4540 PIPE INSTALLATION**

Unless otherwise directed, pipe shall be laid with bell ends facing the direction in which the work will proceed, and for lines on an appreciable slope, bells shall, at the discretion of Engineer, face up-grade.

#### **4550 PERMISSIBLE DEFLECTIONS AT JOINTS**

Wherever necessary to deflect pipe from a straight line, either in the vertical or horizontal plane to avoid obstructions or for other reasons, the degree of deflection shall be as directed by Engineer and approved by SPRWS Inspector. However, in no case shall the deflection be greater than allowed in the latest revision of AWWA C600. Deflection of mechanical joint pipe shall be made after joint assembly but before bolts are tightened. Pipe deflection around curved streets shall be in accordance with **Section 2245**.

#### **4560 UNSUITABLE CONDITIONS FOR LAYING PIPE**

No pipe shall be laid in water, or when the trench or weather conditions are unsuitable for such work, except with the permission of Engineer or SPRWS Inspector.

#### **4570 OFFSETS**

Water main offsets shall be installed in accordance with **Standard Plate D-10**.

Elevation of in-place water pipes as shown on plans will **not** be accepted as a means to determine the need for an offset as they do not typically reflect actual depth. See Utility Crossings in **Section 2530** for required information.

Offset of in-place water pipe shall be performed by SPRWS, including compacting suitable material under and around the offset excavation. Contractor shall be responsible for traffic control, excavation, pipe handling, backfilling, restoration and removal of old pipe and fittings. Contractor shall provide additional workers to direct Contractor's equipment operator(s) during excavation, pipe handling and backfilling operations. Contractor shall allow SPRWS sufficient time to complete its work.

Contractor shall locate all underground utilities and shall be responsible for damage to underground utilities caused by or arising from its excavation.

#### **4600 JOINTING PIPE**

The number of joints in any section of pipe shall be kept to a minimum.

#### **4610 PREPARATION OF PIPE**

Before laying pipe, all lumps, blisters and excess asphaltic coating shall be removed from the bell and spigot ends of each pipe. The pipe shall then be wire brushed and wiped clean dry. Pipe ends shall be kept clean until joints are made.

Polyethylene encasement shall be used with all ductile iron pipe installments; as well as with all ductile iron fittings and valves used in plastic pipe installations. The encasement shall be installed such that all metallic surfaces and appurtenances of the pipe are covered with the encasement and secured using polyethylene compatible adhesive tape. All rips, tears, and other damage shall be repaired with compatible adhesive tape.

#### 4620 ASSEMBLY OF MECHANICAL JOINT PIPE

The inside of the socket and the outside of the spigot end shall be wiped clean and a thin film of gasket lubricant shall be applied to the inside gasket surface and spigot end of the pipe to improve gasket seating. Place the gland on the spigot end of the pipe with the lip extension toward the spigot end, followed by the gasket with the narrow end of the gasket toward the spigot end of the pipe. The spigot end of the pipe shall be entered into the socket with care to keep the joint clean and free of trench material. Press the gasket firmly and evenly into the gasket recess, keeping the joint straight during assembly. Push the gland toward the bell and center it around the pipe with the gland lip against the gasket. Align bolt holes and insert bolts with bolt heads behind the bell flange, and tighten opposite nuts to keep the gland square with the socket. Tighten nuts according to the following table:

<b>Bolt Diameter</b>	<b>Torque, foot pounds</b>
5/8"	45 - 60
3/4"	75 - 90
1"	85 - 90
1 1/4"	105 - 120

#### 4630 ASSEMBLY OF PUSH-ON JOINT PIPE

The inside of the socket and the outside of the spigot end shall be thoroughly cleaned to remove oil, grit, excess coating and other foreign matter. The circular rubber gasket shall be flexed inward and inserted in the gasket recess of the bell socket. A thin film of gasket lubricant shall be applied to the inside gasket surface and spigot end of the pipe. Gasket lubricant shall be as supplied by the pipe manufacturer and approved by Engineer or SPRWS Inspector. The spigot end of the pipe shall be entered into the socket with care used to keep the joint from contacting the ground. The joint shall then be completed by forcing the plain end to the bottom of the socket with a forked tool or jack-type tool or other device approved by Engineer. Pipe that is not furnished with a depth mark shall be marked before assembly to assure that the spigot end is inserted to the full depth of the joint. Field-cut pipe lengths shall be filed or ground to resemble the spigot end of such pipe as manufactured. Complete assembly instructions are available from the pipe manufacturer.

#### 4640 CONDUCTANCE OF PLASTIC PIPE

##### Molecularly Oriented Polyvinyl Chloride (PVCO)

PVCO pipe shall be installed in accordance with the latest revision of ANSI/AWWA C909.

##### Main Tracer Wire

All pipe shall be installed with one tracer wire. Tracer wire shall be continuous, not spliced, and shall be placed and stay true on the crown of the pipe and attached to the pipe every ten feet.

#### Outlet Tracer Wire

Tracer wire for service connections, hydrant branches, tees and other outlets shall be connected to the main tracer wire with a direct burial, split-bolt connector Brundy type KS15 or approved equal. All connections shall be coated with a urethane coating CRC Seal Coat No. 18410 or approved equal.

Connection to copper service pipe shall be accomplished by stripping the wire's plastic sheath, wrapping the wire a minimum of 5 wraps around the pipe and connecting it to a grounding clamp. Grounding clamp shall be direct burial (e.g. Brundy type C-11D or C-22D) or approved equal.

#### High Density Polyethylene (HDPE)

HDPE pipe shall be joined only by thermal butt fusion, socket fusion or electrofusion. HDPE pipe and transition sections shall be installed in accordance with the latest revision of ANSI/AWWA C906.

#### Main Tracer Wire

All pipe shall be installed with 2 tracer wires of HDPE stainless steel braided stranded wire, as specified in **Section 3160**. Tracer wires shall be continuous and not spliced.

All tracer wire shall be traceable at a frequency of 9.82 kHz with a 0.6W transmitter. Tracer wire shall be continuous for the length of the pipe run and shall **not** be bonded to iron fittings.

#### Hydrant Tracer Wire

Tracer wire shall daylight at each hydrant location and shall be concealed with a hydrant tracer wire test box. The tracer wire test box shall be secured to the hydrant flange using a bracket, as specified in **Section 3160**.

Connection to hydrants with plastic leads shall be accomplished by a nut and bolt connection to a copper strap CAD welded to the barrel of the hydrant. Connection materials and methods are subject to prior approval by SPRWS Inspector.

### **4650 JOINT RESTRAINT**

Tees, crosses, plugs, caps, valves, hydrants and all bends shall be securely anchored as specified in **Section 2250**.

## **4700 SETTING VALVES, VALVE BOXES, SERVICE STOPS, HYDRANTS AND FITTINGS**

### **4710 JOINTING**

Valves and pipe fittings shall be set and jointed to new pipe in the manner previously specified for cleaning, laying and jointing pipe. Main line valves shall be installed in the closed position, and hydrant valves installed in the open position unless instructed otherwise by SPRWS Inspector. Valves at the end of a line shall be restrained in accordance with **Standard Plate D-11**.

#### **4720 VALVE BOXES**

Cast iron valve boxes shall be firmly supported and maintained centered and plumb over the wrench nut of the valve with the use of a valve box aligner, and valve box covers between ½-inch below flush to flush with the surface of the finished pavement. Refer to **Standard Plate D-2**. If a project will extend over more than one construction season, valve boxes on water mains already in service shall be made accessible during the winter season.

#### **4730 SERVICE CONNECTION BOXES**

Service connection stop boxes shall be firmly supported and installed plumb, with the cover flush with the boulevard surfacing.

For services 2-inch and smaller, stop boxes shall be marked with a 4-foot long, 2x2 wood timber. The timber shall extend 2 feet above grade after backfilling and shall have the service address number written on the timber. For services larger than 2-inch, an 8-foot long 4x4 wood timber shall be placed at the end of the service pipe. The timber shall extend 4 feet above grade after backfilling and shall have the service address number written on it. Metal markers are **not** permitted.

#### **4740 HYDRANT LOCATIONS**

Hydrants shall be installed at the locations shown on the approved plans and as staked in the field by Engineer. Any variance from the locations shown on the plans must be approved by Engineer and SPRWS Inspector. Refer to **Section 2410** for acceptable hydrant locations.

#### **4750 HYDRANT POSITION AND ELEVATION**

Hydrants shall stand plumb. Three-nozzle hydrants shall be installed with small nozzles parallel with the curb and the pumper nozzle pointing perpendicular to the curb. Two-nozzle hydrants shall face at a 45 degree angle to the curb. Hydrants shall conform to the established grade, with nozzles at least 16-inches above the finished grade. The hydrant traffic flange shall be not less than 2-inches nor more than 4-inches above the established grade. Dishing out around hydrants is **not** allowed. Refer to **Standard Plate D-3**.

#### **4760 HYDRANT CONNECTION TO MAIN**

Hydrants shall be connected to the main with a 6-inch ductile iron branch controlled by an independent 6-inch gate valve, except as otherwise directed or shown on the plans. Refer to **Standard Plate D-3**. The preferred location of the hydrant control valve is 2 feet in front of the hydrant. If hydrants are connected to 16-inch and larger water mains, the hydrant branch shall be offset down, if necessary, to produce 8 feet of cover.

#### **4770 HYDRANT SETTING**

Hydrants shall be set as shown on **Standard Plate D-3**.

A minimum ½ cubic yard of coarse filtered aggregate shall be placed around the base of the hydrant to at least 6-inches above the hydrant weep holes. The aggregate shall be completely covered with 8 mil plastic.

Joint restraint shall be provided as necessary for thrust resistance at hydrants and hydrant valves. Blocking the hydrant is **not** permitted. Hydrant weep holes shall be plugged in areas where ground water is encountered, as directed by SPRWS Inspector. A copper tag stating that the hydrant shall be pumped out after use shall be placed on hydrants with plugged weep holes. Tags can be obtained from SPRWS.

#### **4780 PLUGGING DEAD ENDS**

Restrained mechanical joint plugs or caps shall be installed on dead end pipes, dead-end tees and dead end crosses. Where flushing the pipe cannot be accomplished by other means, a corporation valve shall be installed on the plug or cap.

#### **4800 CATHODIC PROTECTION INSTALLATION**

Contractor shall prevent electrical contact between the metallic pipe and/or fittings cathodically protected and other existing buried metal structures at time of installation of cathodic protection system.

#### **4810 GALVANIC MAGNESIUM ANODES**

Excavate a hole to a minimum of 3 inches larger than the anode diameter, and to a depth of one foot below the pipe or fittings to be protected, as shown in **Standard Plate D-15**. Excavate the lead wire trench to the depth indicated on the details shown on the plans. Do not lift or support anode by the lead wire. Anodes shall be presoaked in water (min. 2 gallons) prior to installation and plastic or paper bags shall be removed from the anode before lowering into the hole.

#### **4820 WIRES**

Wires buried in the ground shall be laid straight, without kinks, and provide a minimum cover of 24 inches. Fill material around the wires shall be free from stones, roots, or other material that might damage the insulation of the conductors. Each cable run shall be continuous in length and free of joints or splices, unless otherwise specified by SPRWS Inspector. Care shall be used during installation to avoid punctures, cuts and similar damage to the insulation. Any damage to insulation will require replacement of the entire cable length by contractor. Copper ring terminals shall be crimped and soldered to the ends of the test leads, drain wires and anode leads terminated in the test station. All wire test leads and anode leads shall extend a minimum of 18 inches above grade after connection to the test station panel board. No wire bend shall have a radius less than eight (8) times the diameter of that wire. Copper terminal rings sized for wire and stud shall be used to make all wire connections to terminal studs.

#### **4830 JOINT BONDING**

For metallic pipe, joint bond all non-welded rubber gasket joints, mechanical joints, and fusion epoxy flanged fittings to provide electrical continuity between all metallic sections of the water main to be cathodically protected.

Joint bonds shall be installed with a wire loop extended above the bonded joint. The overall length of the conductor shall permit sufficient flexibility of each fitting across the joint without transferring any tensile strength to the bond cable. Cable to fitting connections shall be in conformance with these specifications. Coat all exposed surfaces of each fitting with liquid epoxy patch kit, as supplied by the pipe manufacturer.

#### **4840 ANODE TEST STATION**

Two test leads shall be connected at the nearest pipe to the test station. All connections of test lead wires to metal surfaces at the point of connection shall be cleaned by grinding or filing prior to welding the conductor. Anode test station boxes shall be installed using a concrete collar satisfactory to prevent settlement. Set the concrete collar level and flush with the top or finished grade.

#### **4850 INSULATED FLANGED JOINTS**

Insulating components of each insulation flange kit shall be cleaned of all dirt, grease, oil, and other foreign materials, immediately prior to assembly.

#### **4860 EXOTHERMIC WELDS**

Coating materials shall be removed from the surface over an area just sufficient to make the connection. The steel surface shall be cleaned to white metal by grinding or filing prior to welding the connector. Resin impregnated grinding will **not** be allowed. No connections to the structures or piping shall be buried until the SPRWS inspector has inspected the connections and given permission to backfill. Connections made in violation to this provision will be rejected. After welding, coat all bonds with bitumastic coating. Protect all exposed wires and welds with adhesive rubber cap.

#### **4870 PETROLATUM WAX TAPE**

Wire brush dirt and loose rust from substrate; apply primer by brush and work in to obtain a full film cover on substrate. Install mastic to contour all sharp edges and irregular profiles. Spirally apply tape with minimum 55% overlay smooth tape to exclude voids and seal overlaps.

### **4900 BACKFILLING AND CLEAN UP**

#### **4910 BACKFILL PROCEDURE AT PIPE ZONE**

Backfill material at the pipe zone shall be entirely free of rocks, lumps or frozen material in accordance with MN/DOT 3149.2D - Granular Backfill. Backfilling at the pipe zone shall be a two-stage procedure.

##### Stage One

Granular backfill shall be carefully deposited simultaneously on both sides of the pipe for the full width of the trench to the top of the pipe. The backfill material shall then be thoroughly compacted with hand-operated mechanical equipment before proceeding to stage two.

Stage Two

Granular backfill material shall be carefully deposited directly over the pipe to a depth of 12-inches above the top of the pipe as a protective barrier prior to backfilling above the pipe zone.

Contractor may at its option, or as required by SPRWS Inspector, leave the joints exposed for examination during the specified pressure test.

No organic material, clay or other cohesive material that is known to be corrosive, which may be excessively expansive, or which is suspected of being such material in the opinion of Engineer or SPRWS Inspector, shall be permitted at the pipe zone. Refer to **Section 4150**.

**4920 BACKFILL MATERIAL EXCLUSION ABOVE THE PIPE ZONE**

No rocks, concrete or pieces of blacktop greater than 6-inches in dimension shall be permitted within the backfilling above the pipe zone. Rocks, concrete or pieces of blacktop smaller than 6-inches may be included in backfill if amounting to less than 10 percent by volume of the material used. Corrosive soil, organic material and trash are **not** permitted in the backfill material.

**4930 BACKFILL PROCEDURE ABOVE THE PIPE ZONE**

Backfill shall be thoroughly compacted to the satisfaction of SPRWS Inspector or Engineer. For each lift during the backfill process, a 3-foot radius around each valve box, hydrant and stop box shall be thoroughly compacted with hand operated mechanical equipment. Puddling with water will not be permitted. In a city street, compaction shall conform to the local city standards and shall be subject to approval by said local authority.

**4940 CLEAN UP**

Pipeline material left on the ground, tools, temporary structures, all dirt, rubbish and excess earth and rock from excavation shall be removed from the area by Contractor. The construction site shall be left clean to the satisfaction of SPRWS Inspector and Engineer.

**- END OF DIVISION 4000 -**

## **DIVISION 5000: TESTING OF PIPE, SERVICE CONNECTIONS, AND APPURTENANCES**

Water main, service connection, and appurtenance testing shall be conducted in the following order:

1. Filling the main
2. Flushing the main
3. Hydrostatic test
4. Bacteriological test
5. Conductivity test

### **5100 FILLING AND CHLORINATION OF COMPLETED MAINS**

After the main has been installed and backfilled; it shall then be filled and disinfected slowly with water from an uncontaminated source. The velocity of the water must not exceed 1-foot per second. Air vents or hydrants at high points of each valved section shall be opened while filling.

#### **5110 PROCEDURE**

Only the chlorination methods specifically listed within this Section are approved for use. Chlorination is required for new water mains before they are placed in service. Procedure for disinfection shall be governed by the latest revision of ANSI/AWWA C651. If approved by SPRWS Inspector, a 1-inch or smaller tap may be used by Contractor for testing or chlorination. When work is complete, the corporation shall be replaced with a suitable brass plug.

#### **5120 CHLORINATION TO BE PERFORMED BY CONTRACTOR**

Labor, equipment, and tools necessary to make the required chlorination applications shall be furnished by the Contractor. Chlorination work shall be performed under the direction of SPRWS Inspector.

If the main is not placed in service within 15 days of initial chlorination, samples shall be taken to determine if re-chlorination is necessary before placing main in service.

#### **5130 CONTINUOUS FEED METHOD**

A solution of water containing at least 50 parts per million of chlorine shall be fed into the line to be treated until the line is completely filled. This solution shall be retained in the line a minimum of 24 hours at which time the residual chlorine content in the line must not be less than 25 parts per million on any part of the line. This method is recommended for installations regardless of size of pipe or length of line.

#### **5140 TABLET METHOD**

This method may be used on mains 16-inch in diameter and smaller provided the length of pipe does not exceed 1000 feet between valves. Sufficient tablets or granular equivalent to produce a solution of not less than 50 parts per million chlorine residual shall be cemented to

the top of each pipe during installation. The solution obtained shall be retained for a minimum of 24 hours at which time a residual of 25 parts per million or greater must still be present at any point along the line. This method is not recommended if trench water or foreign material has entered the main or if the water temperature is below 5°C (41°F).

Minimum number of hypochlorite tablets of 5 g required for a dose of 50 mg/l\*

<u>Pipe Lengths</u>	<u>Diameter of Pipe (in.)</u>					
	2"	4"	6"	8"	12"	16"
13' or less	1	1	2	2	5	8
18'	1	1	2	3	6	12
20'	1	1	2	3	7	14
30'	1	2	3	5	10	20
40'	1	2	4	6	14	26

\*Based on 3¼ grams available chlorine per tablet

In addition to the tablets, calcium hypochlorite granules shall be placed at the upstream end of each branch main and at 500-foot intervals throughout the main.

### **5150 SLUG METHOD**

Completely fill the main to eliminate air pockets and flush the main to remove particulates. Slowly flow a slug of water containing at least 100 mg/l chlorine through the main. The rate of flow shall be slow enough to produce a contact time of at least 3 hours between the highly chlorinated water and all parts of the main and appurtenances.

## **5200 FLUSHING THE MAIN**

### **5210 FLUSHING MAINS AFTER CHLORINATION**

The contractor shall flush the water mains after chlorination has been completed by opening hydrants and/or blow-offs. Flushing shall continue until the water chlorine content is at current system chlorine levels. A minimum velocity of 2.5 fps must be established and maintained during flushing until all excess chlorine is expelled from the main.

Contractor shall supply all hoses and fittings necessary when flushing the water main, a SPRWS inspector must be present.

The chart below is a guide for flushing water mains. The chart assumes a static pressure of 40 psi for main sizes indicated. The corresponding hose sizes and maximum hose lengths are suggested as a minimum to achieve the required GPM flow needed to obtain a flushing velocity of 2.5 fps.

Main Size	Min. GPM	Size of Flushing Hose	Main Size	Min. GPM	Size of Flushing Hose
4"	100	3"	12"	880	3"
4"	100	4"	12"	880	4"
4"	100	6"	12"	880	6"
6"	220	3"	16"	1565	4"
6"	220	4"	16"	1565	6"
6"	220	6"	20"	2450	4"
8"	390	3"	20"	2450	6"
8"	390	4"			
8"	390	6"			

**5220 DECHLORINATION**

Water expelled during any flushing procedure must be dechlorinated in accordance with the latest revision of ANSI/AWWA C650. Contractor shall provide all hoses and fittings necessary, as well as dechlorination tablets. Contractor shall select a suitable discharge location for water used while flushing.

**5300 PRESSURE AND HYDROSTATIC TESTS**

**5310 HYDROSTATIC PRESSURE TEST – MAINS AND D.I. SERVICE CONNECTIONS**

Newly laid pipe shall be subjected to a hydrostatic pressure of 150 psi or 50% over static pressure, whichever is greater, for a period of 120 minutes. Each valved section of water main shall be tested independently. Only tested and approved sections of water main may be connected to the existing distribution piping. Subjecting existing water mains, fittings or valves to full test pressures is prohibited. Pressure tests shall be performed in conformance with the latest revision of ANSI/AWWA C600. No service connection taps will be permitted until the hydrostatic pressure test and the bacteriological test have been approved. Where it is necessary to test existing mains, a pressure not exceeding 100 psi shall be established at the lowest point of elevation.

**5320 HYDROSTATIC PRESSURE TEST – COPPER MAINS AND SERVICE CONNECTIONS**

After the service connection has been laid and partially backfilled, the entire length of the service connection shall be subjected to a hydrostatic pressure of 150 psi or 50% over static pressure, whichever is greater, for a 10 minute period. No loss of pressure will be permitted. After the hydrostatic pressure test has been approved and the corporation is turned on, the nut

on the corporation shall be tightened down. Caution must be used to avoid over tightening of the nut on the corporation to avoid damaging the corporation body. The corporation shall not be disturbed after final tightening of the nut. The entire length of the service connection, for pressure testing purposes, shall be interpreted as:

- Copper services - from the corporation to the property line or easement line
- Ductile iron services - from the service connection valve to the property line or easement line

### **5330 PROCEDURE**

The specified test pressure of each valved section, as measured at the lowest available point of elevation, shall be applied by means of a pump connection to the pipe through an air vent or a blow-off in a satisfactory manner. A pump connection to a hydrant will be permitted if an air vent or blow-off is not available. Contractor shall furnish all necessary labor, material and apparatus, including pump, pipe connections, gauges, meters and required measuring devices for conducting the tests. Gauges used for pressure testing mains and services shall display the pressure in 2 psi maximum increments, shall be liquid filled, and shall be approved by SPRWS inspector. It is required that the chlorination flushing (see **Section 5100**) be completed prior to beginning the hydrostatic pressure test for mains and ductile iron services.

### **5340 EXAMINATION UNDER PRESSURE**

Joints that cannot be pressure tested shall be left uncovered until city pressure is applied. Each joint will then be carefully examined for any leaks that might occur. Joints showing visible leaks shall be re-tightened or re-gasketed until water tight. Any cracked or defective pipes, fittings, valves or hydrants discovered in consequence of this pressure test shall be removed and replaced by Contractor with sound material and the test shall be repeated until satisfactory to SPRWS Inspector.

### **5350 HYDROSTATIC TEST**

The hydrostatic test shall be performed in accordance with the latest revision of ANSI/AWWA C600, except that the allowable leakage volume shall be 33 percent of that allowed in ANSI/AWWA C600, as reflected in the formula and table below.

Testing allowance is defined as the maximum quantity of makeup water that is added into a pipeline or valved section undergoing hydrostatic pressure testing in order to maintain pressure within  $\pm 5$  psi of the specified test pressure. All visible leaks are to be repaired regardless of the allowance used for testing.

Contractor shall furnish the gauge and measuring device for the hydrostatic test. Contractor shall furnish the pump, pipe, connections, and all other necessary apparatus, and shall furnish all necessary assistance to conduct the test. The duration of each hydrostatic test shall be 120 minutes. During the test, pipe shall be subject to a pressure of 150 psi or 50% over static pressure, whichever is greater.

No pipe installation will be accepted until the leakage is less than the number of gallons per hour determined by the following formula:

$$L = \left( \frac{SD\sqrt{P}}{148,000} \right) \times .33$$

Where: L = Testing allowance (makeup water), in gallons per hour  
 S = length of pipe tested, in feet  
 D = nominal diameter of the pipe, in inches  
 P = average test pressure during the hydrostatic test, in psi

**Table of Allowable Leakage**

Allowable Leakage (L) per 2 hours  
 Per 100 feet @ P (150 psi)

Pipe Size (D)	Gallons	Ounces
4"	0.010	2.8
6"	0.017	4.2
8"	0.022	5.6
12"	0.033	8.4
16"	0.044	11.2
20"	0.055	14.2
24"	0.066	17.0
30"	0.083	21.2

**5360 VARIATION FROM PERMISSIBLE LEAKAGE**

Should any test of pipe disclose leakage greater than that specified in **Section 5350**, Contractor shall, at its own expense, locate and repair the defective joints or materials until the leakage is within the specified allowance.

**5400 BACTERIOLOGICAL TESTS**

After flushing is complete, each section of main will be shut down for a period of 16 hours. Samples of water shall then be drawn for bacteriological evaluation by SPRWS Inspector. No main shall be placed in service until this evaluation is complete and the results approved by SPRWS Inspector. In the event these test results are not acceptable, the disinfection process shall be repeated until satisfactory results are obtained. Contractor shall provide all hoses and fittings necessary to connect to a 3" or larger, male cam lock. Contractor shall select a suitable discharge location for water used while testing and flushing, as well as provide dechlorination tablets.

## **5500 ELECTRICAL CONDUCTIVITY TEST**

Electrical conductivity tests on iron pipe shall be performed by Contractor and approved by SPRWS Inspector. After the backfilling is complete and the lines are hydrostatically tested and approved, an electrical test shall be conducted through all joints to verify that adequate conductivity is maintained through the joint to permit the use of thawing equipment. This test shall be made with a thawing machine or arc welder having the necessary volt meters and amp meters to indicate the results of the test. The test shall run 5 minutes with a minimum 300 ampere current at a maximum of 30 volts. No conductivity test will be permitted through the valve stem. The main must be filled with water and the air expelled before the electrical test can be performed. Conductivity tests shall be permitted only after the hydrostatic pressure test has been approved.

## **5600 CATHODIC PROTECTION SYSTEM TESTING**

Cathodic protection systems shall be subject to testing. The contractor shall be responsible for correcting all deficiencies due to improper installation and defective equipment, in addition to performing any re-testing required.

Exothermic welds shall be tested by the contractor for adherence to the pipe and for electrical continuity between the pipe and wires.

A negative potential of at least 850 millivolts or greater (more negative) shall be measured with the cathodic protection system applied. This potential is measured with the positive lead of a voltmeter connected to the wire attached to the pipe and the negative lead attached to a saturated copper-copper sulfate reference electrode contacting electrolyte.

A minimum of 100 millivolts of cathodic polarization shift shall be measured between the structure surface and a stable reference electrode contacting the electrolyte. The formation or decay of polarization can be measured to satisfy this criterion.

## **5700 INSPECTIONS**

### ***Initial Inspection***

Where existing water facilities are situated within the project area, see Initial Inspection in **Section 4110**.

### ***Interim Inspection***

Contractor shall provide SPRWS with no less than 3-days notice prior to placing the wearing course. Following notice, SPRWS Inspector will perform an interim inspection of valve boxes to ensure they are at proper grade prior to placement of the wearing course and will provide Contractor with a list of valve boxes not at proper grade or otherwise deficient. Contractor shall repair or adjust listed valve boxes to proper grade prior to placement of wearing course.

### Final Inspection

After the mains have been completely tested and approved, Contractor shall be responsible for preparing the valve boxes, hydrants and service connection boxes for final inspection. Valve nut shall be centered and gate box shall be plumb. Where the mains have been tested and approved, and after Contractor or its subcontractors have completed final restoration (e.g. turf establishment, roadway surfacing), Contractor shall adjust to final grade and make suitable for final inspection valve boxes, service connection boxes, hydrants and appurtenances impacted by the project.

After Contractor has made all water facilities suitable for final inspection, Contractor shall schedule a joint inspection of all water facilities within the project with SPRWS Inspector. From this inspection, SPRWS will provide Contractor with a deficiency list showing water facilities Contractor is responsible to repair, replace or adjust. Contractor shall schedule the final inspection and complete listed repairs, replacements and adjustments in a timely manner.

### **5800 AS-BUILT DRAWINGS**

Engineer shall provide SPRWS with a complete set of as-built drawings in hard copy and electronic format within two months of completion of pipe installation.

Electronic format shall be in accordance with current industry standards in AutoCAD or ESRI GIS format (plan view only in GIS), as may be determined appropriate by SPRWS. AutoCAD drawings shall include any customized Plot Style Tables (.ctb or .stb) or line types (.lin) and shall not require links to other drawings. Any changes in approved plans must be resubmitted for review and approval. As-built drawings must show both plan and profile views of constructed facilities. Fittings shall be identified and located by station or other suitable dimensions.

**- END OF DIVISION 5000 -**

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# **STANDARDS FOR THE INSTALLATION OF WATER MAINS**

## **PRIVATE MAIN SUPPLEMENT**

The latest revision of Standards for the Installation of Water Mains, Saint Paul Regional Water Services, Saint Paul, Minnesota shall apply to all private water main installations except as herein amended. Prior to design and construction, owner must comply with requirements found in "Private Water Main Requirements." Copies of the requirements are available from SPRWS Engineering Division (651-266-6270).

### **DIVISION 1000: DEFINITIONS**

**THE PROVISIONS OF SECTION 1300, 1400 AND 1500 SHALL BE DELETED IN THEIR ENTIRETY AND THE FOLLOWING DEFINITIONS SUBSTITUTED:**

#### **1300 CONTRACTOR**

The Contractor hired by the owner of the private property served by the private water main.

#### **1400 ENGINEER**

The consultant Engineer hired by the property owner to be responsible for the engineering of the private water main.

#### **1500 ENGINEER'S INSPECTOR**

The inspector assigned to the project by the consultant Engineer to inspect the private water main installation. In the event that a consultant Engineer is not involved, the property owner shall accept this responsibility.

**THE FOLLOWING SECTION SHALL BE ADDED TO SAINT PAUL REGIONAL WATER SERVICES STANDARDS FOR THE INSTALLATION OF WATER MAINS:**

#### **1900 OWNER**

The owner of the private property where the private water main is to be installed.

**- END OF PM DIVISION 1000 -**

**DIVISION 2000: ENGINEERING DESIGN STANDARDS**

**THE PROVISIONS OF SECTION 2230 SHALL BE AMENDED AS FOLLOWS:**

**2230 GRADE**

Delete the word “street” wherever it appears in this section and delete the opening sentence, which reads:

The grade used to determine water main depth shall be the permanent finished street grade established by the City and shall be the grade directly over the water main.

Add the following sentence:

The grade used to determine water main depth shall be as determined by Engineer and as shown on the construction plan furnished to SPRWS.

**THE FOLLOWING SECTION SHALL BE ADDED TO THESE STANDARDS:**

**2315 WORK TO BE ACCOMPLISHED BY SPRWS**

Where connected to existing public mains owned by the Board of Water Commissioners, SPRWS shall construct that portion of the water main connection from the property line to the public main in the public right-of-way and perform all excavation, backfilling and restoration for any work done by SPRWS. Where connected to another existing private main, SPRWS shall install only the pressure tap, valve and box at the private main in the easement, with excavation, pipe installation, backfill and street surface restoration by Owner's Contractor. Any work performed by SPRWS shall be at Owner's expense and Owner shall make a deposit with SPRWS against such expense in advance of the work. Work to be performed by SPRWS shall be so noted on the construction plans.

**THE PROVISIONS OF SECTION 2340 SHALL BE AMENDED AS FOLLOWS:**

**2340 SERVICE CONNECTION DEPTH**

Delete the word “City's” in the second paragraph and replace it with the word “Owner's.”

**THE PROVISIONS OF SECTION 2410 SHALL BE DELETED AND THE FOLLOWING SHALL BE SUBSTITUTED:**

**2410 LOCATION AND SPACING**

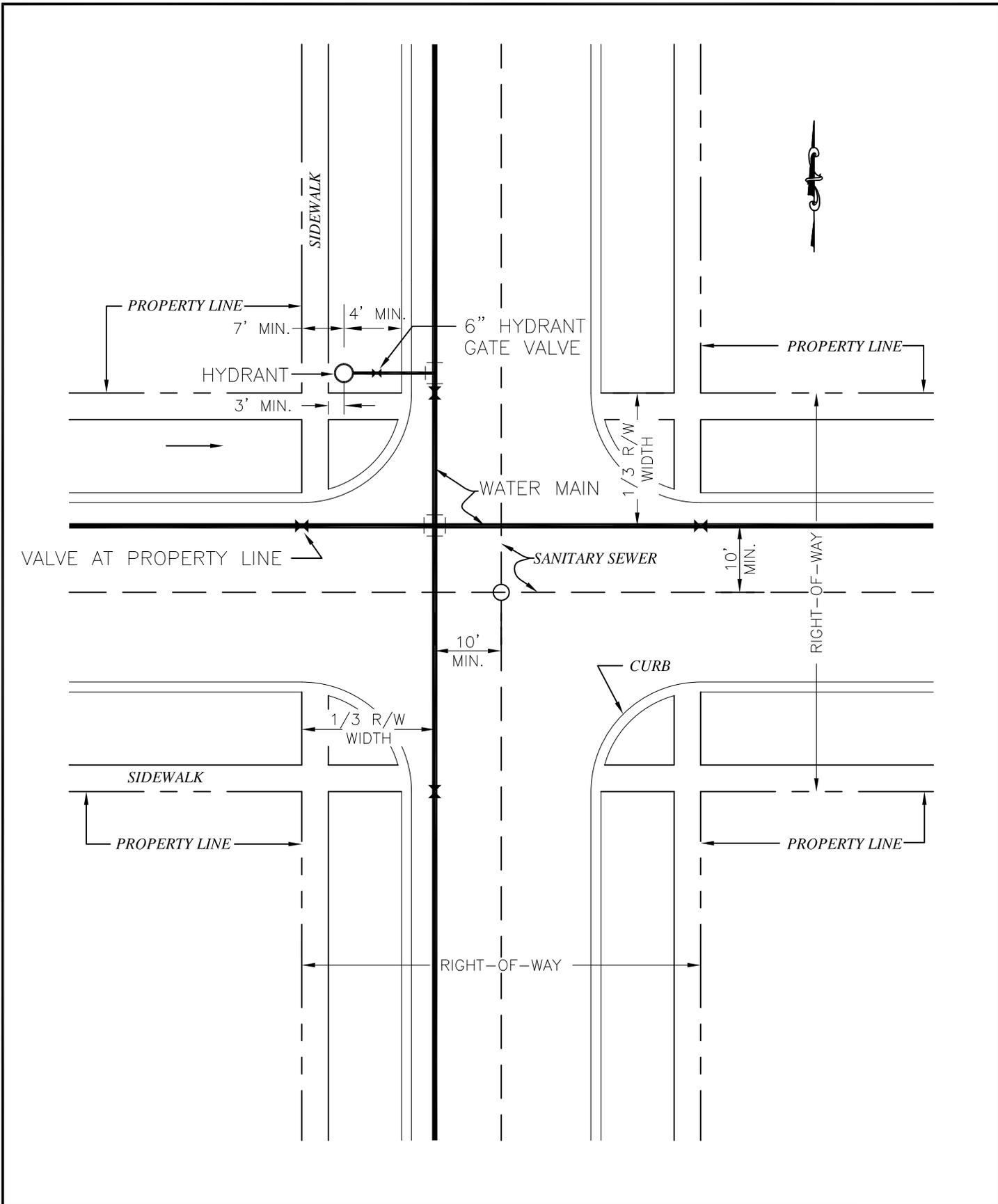
Hydrants shall be installed adjacent to a traveled roadway or parking lot as required for adequate fire protection. Hydrant spacing and location shall be reviewed by Engineer with the local City Fire Marshal.

**- END OF PM DIVISION 2000 -**

## Drawing Index

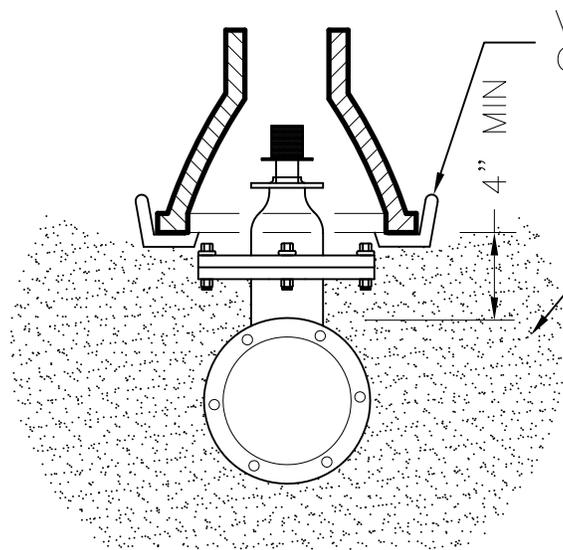
<b>Standard Plate D-1</b> .....	Typical Intersection
<b>Standard Plate D-2</b> .....	Valve Box & Installation
<b>Standard Plate D-3</b> .....	Hydrant Installation
<b>Standard Plate D-4</b> .....	Saint Paul Standard Thread Hydrant Nozzle
<b>Standard Plate D-5</b> .....	Water Main Insulation Detail
<b>Standard Plate D-6</b> .....	Typical Casing Pipe Installation
<b>Standard Plate D-7</b> .....	Air Vent Installation
<b>Standard Plate D-8</b> .....	Blow-off for 6” and 8” Mains
<b>Standard Plate D-9</b> .....	Blow-off for 12” and Larger Mains
<b>Standard Plate D-10</b> .....	Typical Water Main Offsets
<b>Standard Plate D-11 (1 of 4)</b> .....	Restrained Pipe Requirement (DIP 4.0’ – 6.0’ Cover)
<b>Standard Plate D-11 (2 of 4)</b> .....	Restrained Pipe Requirement (DIP 7.0’ – 8.0’ Cover)
<b>Standard Plate D-11 (3 of 4)</b> .....	Restrained Pipe Requirement (PVC0 4.0’ – 6.0’ Cover)
<b>Standard Plate D-11 (4 of 4)</b> .....	Restrained Pipe Requirement (PVC0 7.0’ – 8.0’ Cover)
<b>Standard Plate D-12</b> .....	Standard Easement Marker
<b>Standard Plate D-13</b> .....	Typical 1”, 1½” and 2” Service and Lawn Sprinkler Installation
<b>Standard Plate D-14</b> .....	Inset Lid Covers For Sloped Pavement
<b>Standard Plate D-15 (1 of 2)</b> .....	Cathodic Protection Anode and Test Station Installation
<b>Standard Plate D-15 (2 of 2)</b> .....	Cathodic Protection Insulating Joint/Casing Installation and Test Stations

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DR. <i>LJP</i> TR.	<b>SAINT PAUL REGIONAL WATER SERVICES</b> CITY OF ST. PAUL, MN	STANDARD
CH. <i>MGA</i>		PLATE
APPROVED <i>DJS</i>		<b>D-1</b>

**TYPICAL INTERSECTION**

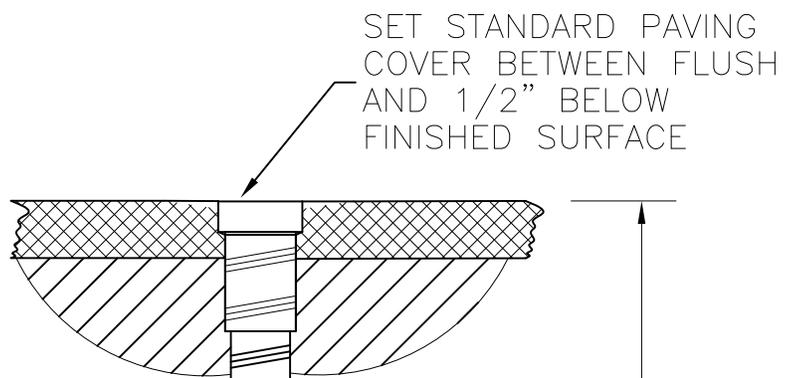


VALVE BOX BASE TO REST ON VALVE BOX ALIGNER

4" MIN

COMPACTED BACKFILL

DETAIL OF BASE SUPPORT

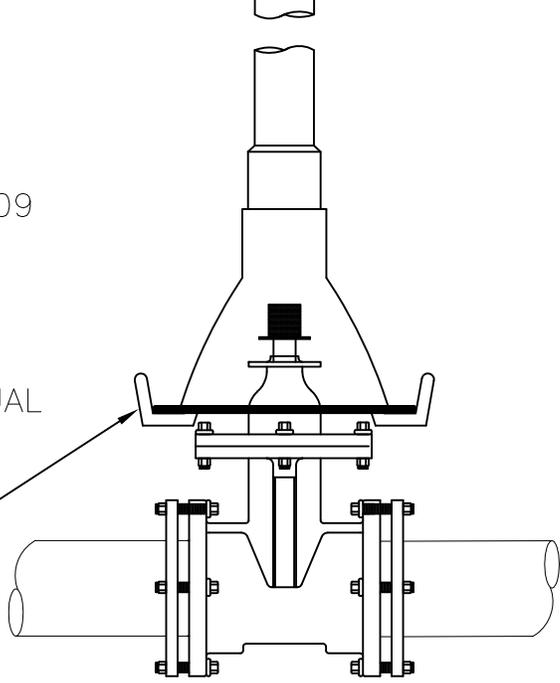


SET STANDARD PAVING COVER BETWEEN FLUSH AND 1/2" BELOW FINISHED SURFACE

GATE VALVE  
MECHANICAL JOINT  
CLOCKWISE OPENING  
CONFORMING TO AWWA C509

VALVE BOX  
TYLER SERIES 6860  
ITEM G OR APPROVED EQUAL

VALVE BOX ALIGNER



AS REQUIRED

12" PIPES AND LARGER REQUIRE BUTTERFLY VALVES

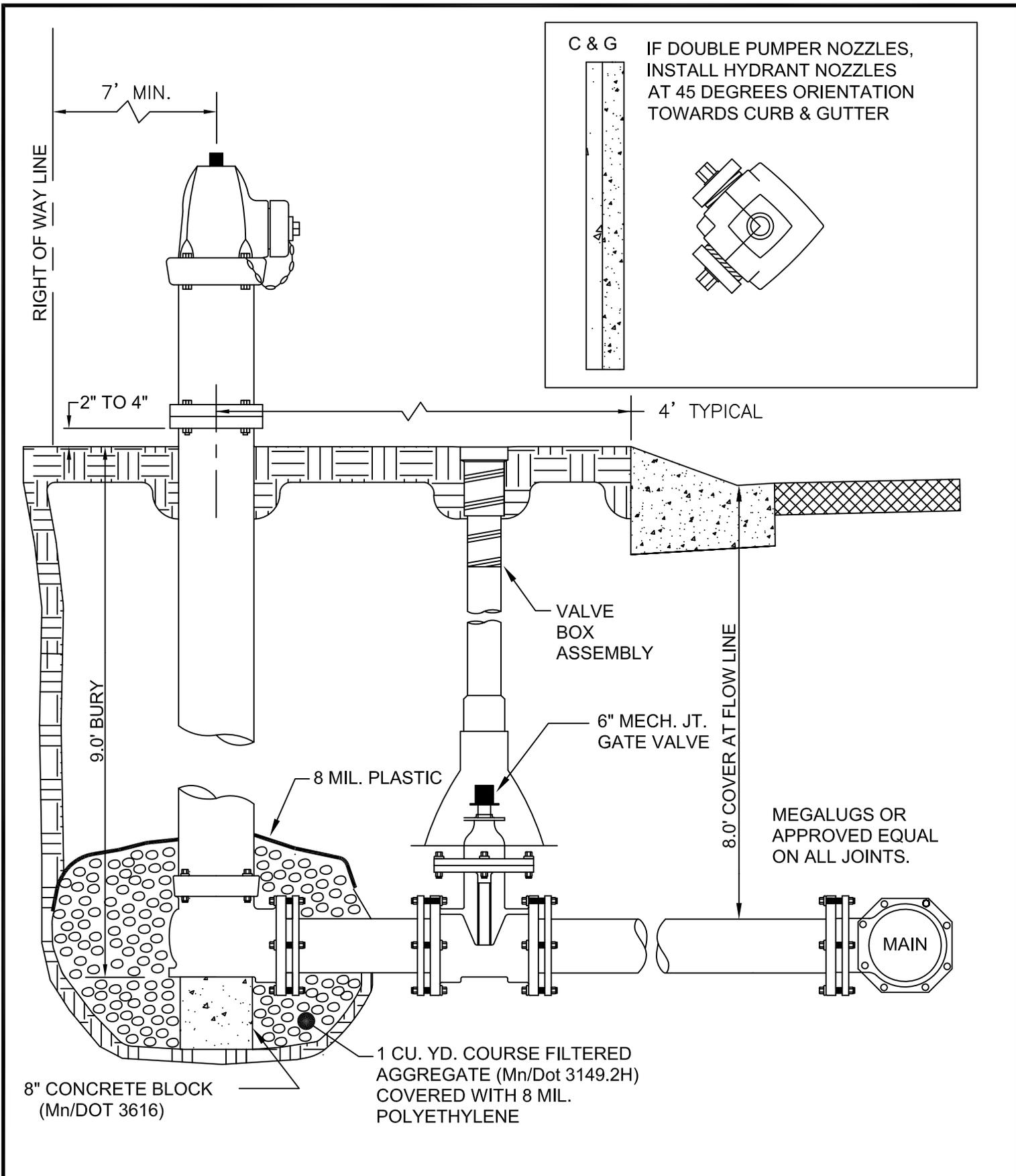
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CH. <i>VLH</i>	
APPROVED <i>DJS</i>	

SAINT PAUL REGIONAL WATER SERVICES  
ST. PAUL, MINNESOTA

VALVE BOX & INSTALLATION

STANDARD  
PLATE

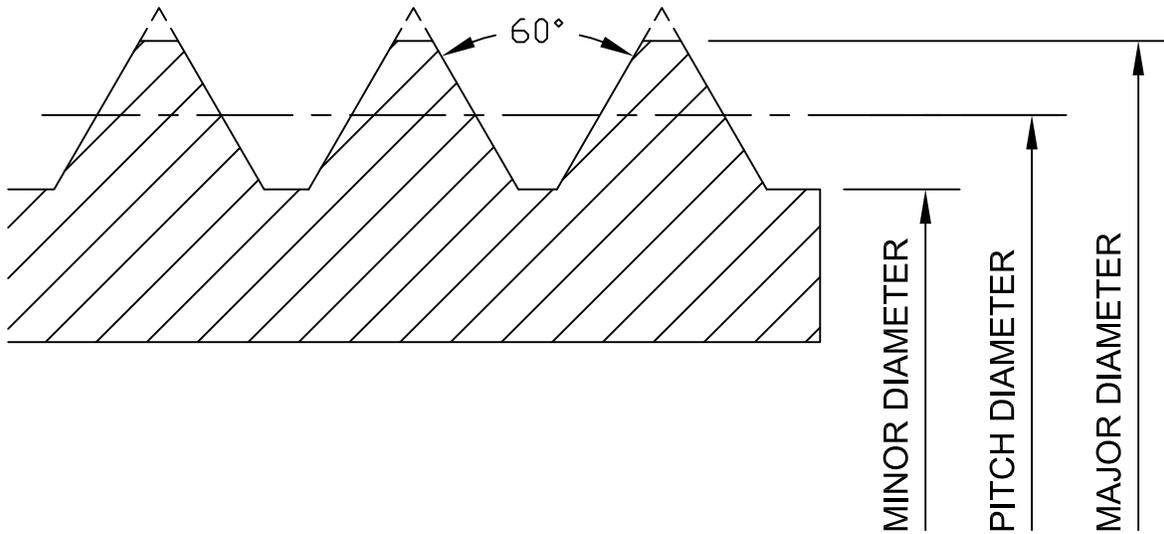
D-2



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CH. <i>MGA</i>	
APPROVED	<i>DJS</i>

**SAINT PAUL REGIONAL WATER SERVICES**  
 CITY OF ST. PAUL, MN  
**HYDRANT INSTALLATION**

STANDARD PLATE
<b>D-3</b>



**NIPPLE THREAD**

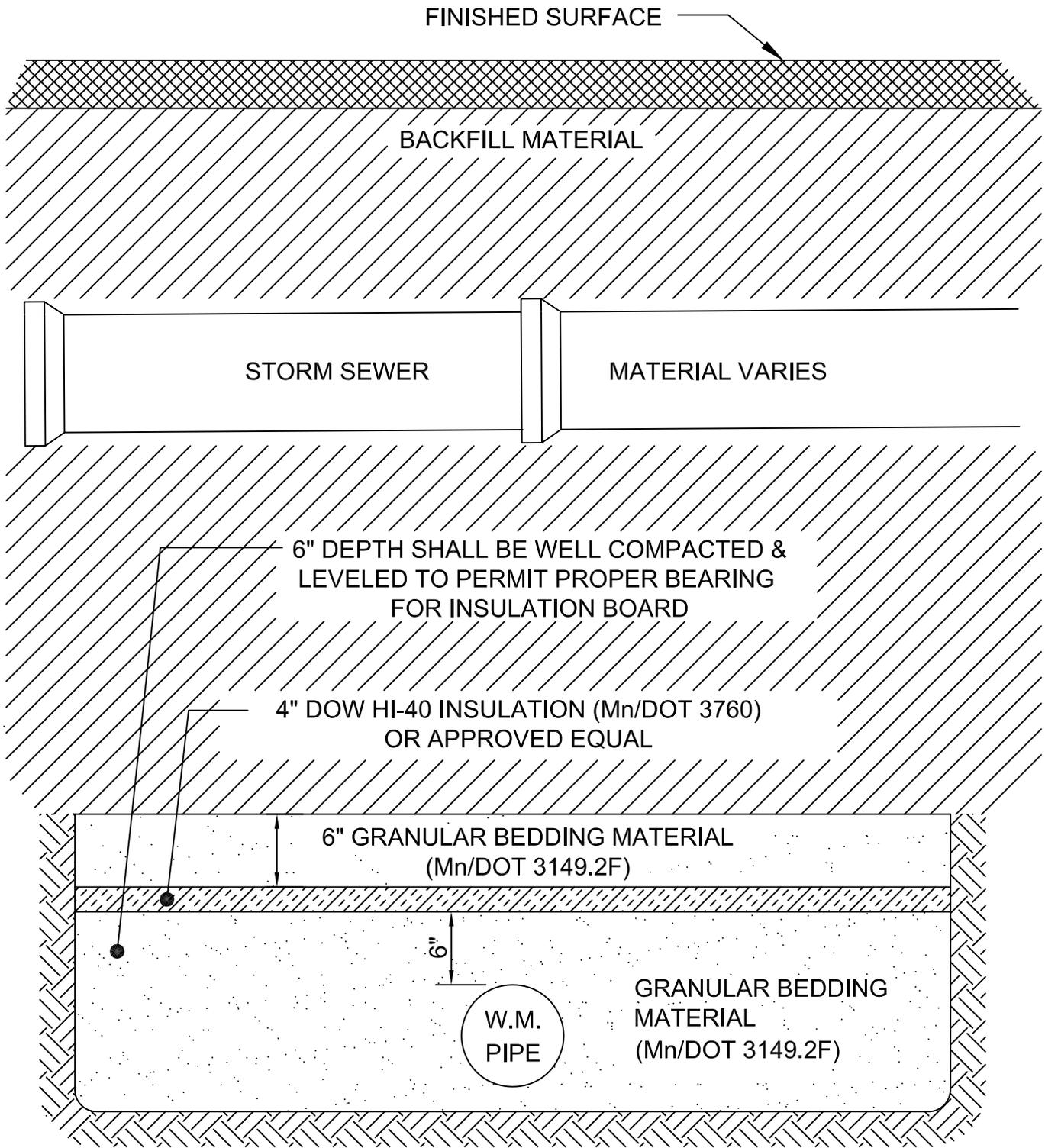
Threads Per Inch .....	6
Nom Major Diameter .....	5.531
Max Major Diameter .....	5.541
Min Major Diameter .....	4.491
Max Pitch Diameter .....	5.445
Min Pitch Diameter .....	5.427
Max Minor Diameter .....	5.337

NOTE: Waterous Company Code No. TP60517 or equivalent

DR. <i>LJP</i> TR.
CH. <i>MGA</i>
APPROVED <i>DJS</i>

SAINT PAUL REGIONAL WATER SERVICES  
CITY OF ST. PAUL, MN  
  
SAINT PAUL STANDARD THREAD

STANDARD  
PLATE  
  
D-4



STORM SEWER CROSSING WATER MAIN OR SERVICE WITH LESS THAN 3' CLEARANCE REQUIRES INSULATION PER **SECTION 2520**

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CH. *MGA*

APPROVED *DJS*

SAINT PAUL REGIONAL WATER SERVICES  
CITY OF ST. PAUL, MN

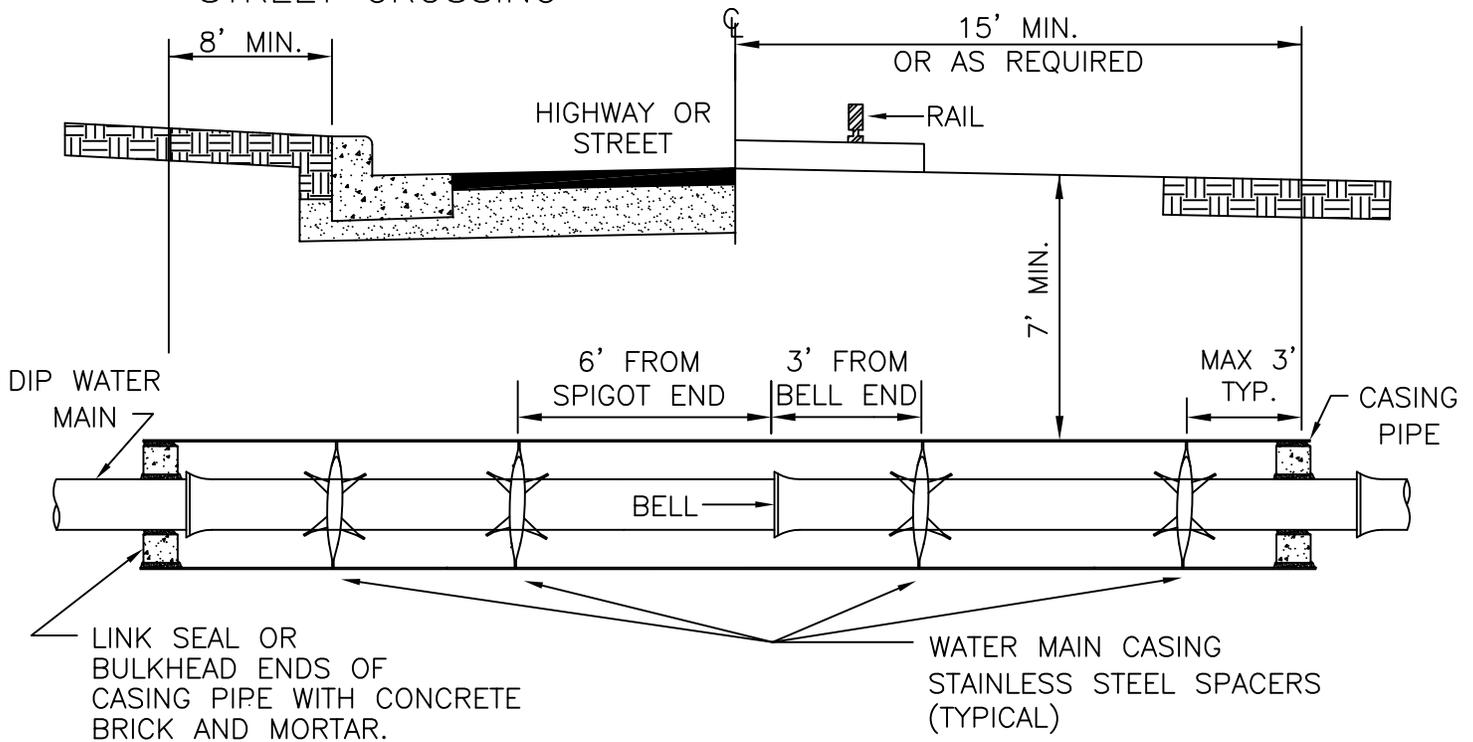
WATER MAIN INSULATION DETAIL

STANDARD PLATE

D-5

TYPICAL HIGHWAY OR STREET CROSSING

TYPICAL RAILWAY CROSSING



EVERY LENGTH OF PIPE SHALL HAVE MIN. 2 SPACERS

BELL O.D. (MJ PIPE)	SIZE OF MAIN	MINIMUM CASING SIZE	MINIMUM CASING WALL THICKNESS
11.12"	6"	18"	0.250"
13.37"	8"	20"	0.250"
17.88"	12"	24"	0.250"
22.50"	16"	30"	0.375"
27.00"	20"	36"	0.500"
31.50"	24"	42"	0.500"

- CASING SPACERS ARE REQUIRED ON WATER MAIN AND SHALL BE INCIDENTAL TO CASING UNLESS OTHERWISE SPECIFIED.
- ALL WATER MAIN IN CASING PIPE SHALL BE APPROVED RESTRAINED JOINT.
- CASING PIPE TO BE WELDED STEEL WITH A MINIMUM YIELD OF 35,000 PSI. WALL THICKNESS AND SHALL BE AS DESIGNATED BY THE PERMITTING AUTHORITY. IN NO CASE SHALL THE CASING PIPE WALL THICKNESS BE LESS THAN 0.25". STEEL CASING PIPE SHALL BE COATED INSIDE AND OUT WITH A BITUMINOUS ASPHALT COATING.
- CASING SPACERS SHALL BE STAINLESS STEEL AS MANUFACTURED BY CASCADE WATERWORKS MFG., ADVANCED PRODUCTS & SYSTEMS, INC. OR APPROVED EQUAL.

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CH. *MGA*

APPROVED  
*DJS*

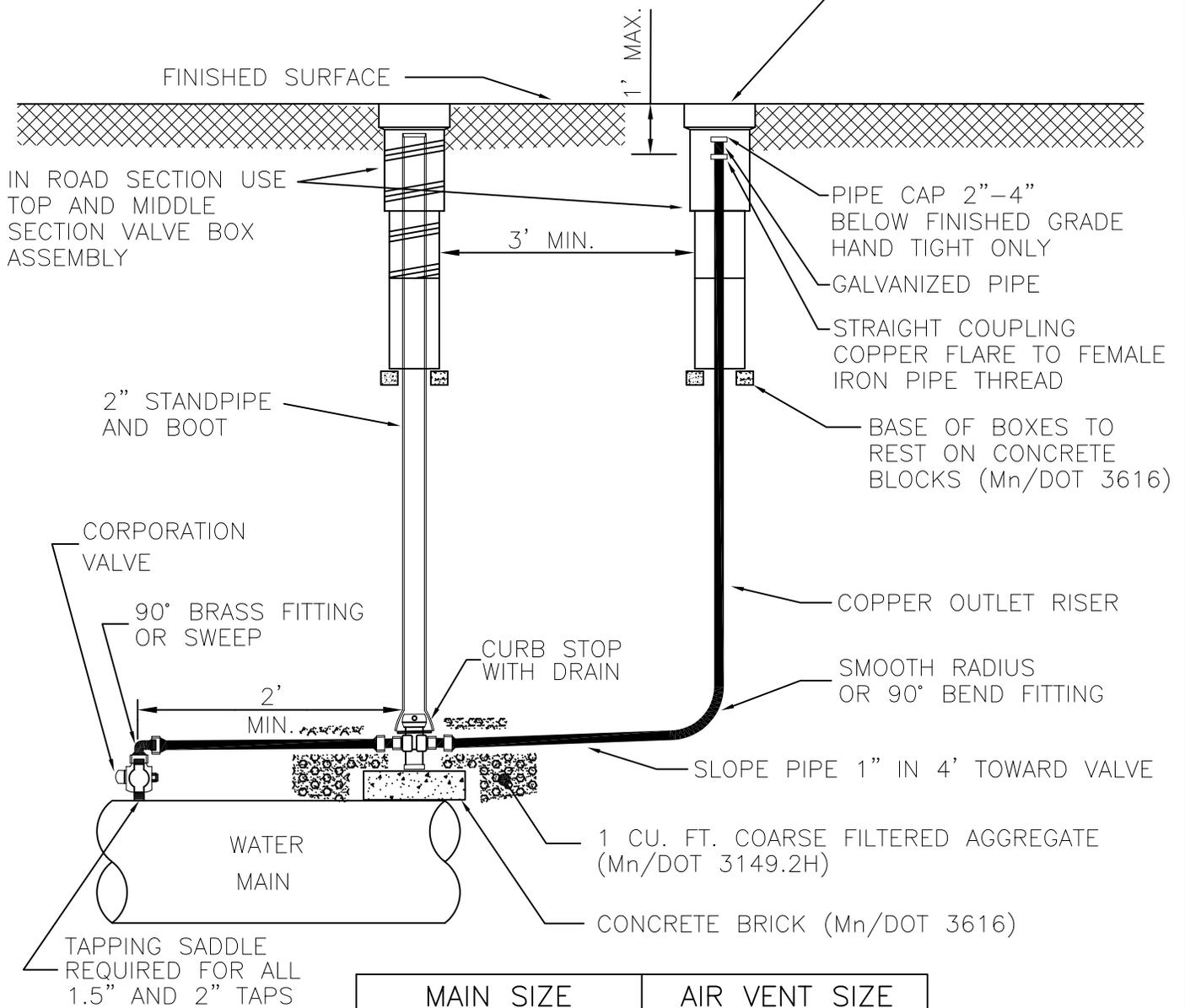
SAINT PAUL REGIONAL WATER SERVICES  
CITY OF ST. PAUL, MN

TYPICAL CASING PIPE INSTALLATION

STANDARD  
PLATE

D-6

SET STANDARD PAVING COVER BETWEEN FLUSH AND 1/2" BELOW FINISHED SURFACE (TYPICAL)



MAIN SIZE	AIR VENT SIZE
LESS THAN 12"	1"
12"	1 1/2"
16"	1 1/2"
20"	1 1/2"
GREATER THAN 20"	2"

CURB STOP VALVE MUST BE APPROVED DRAINING VALVE  
SEE SECTION 3310

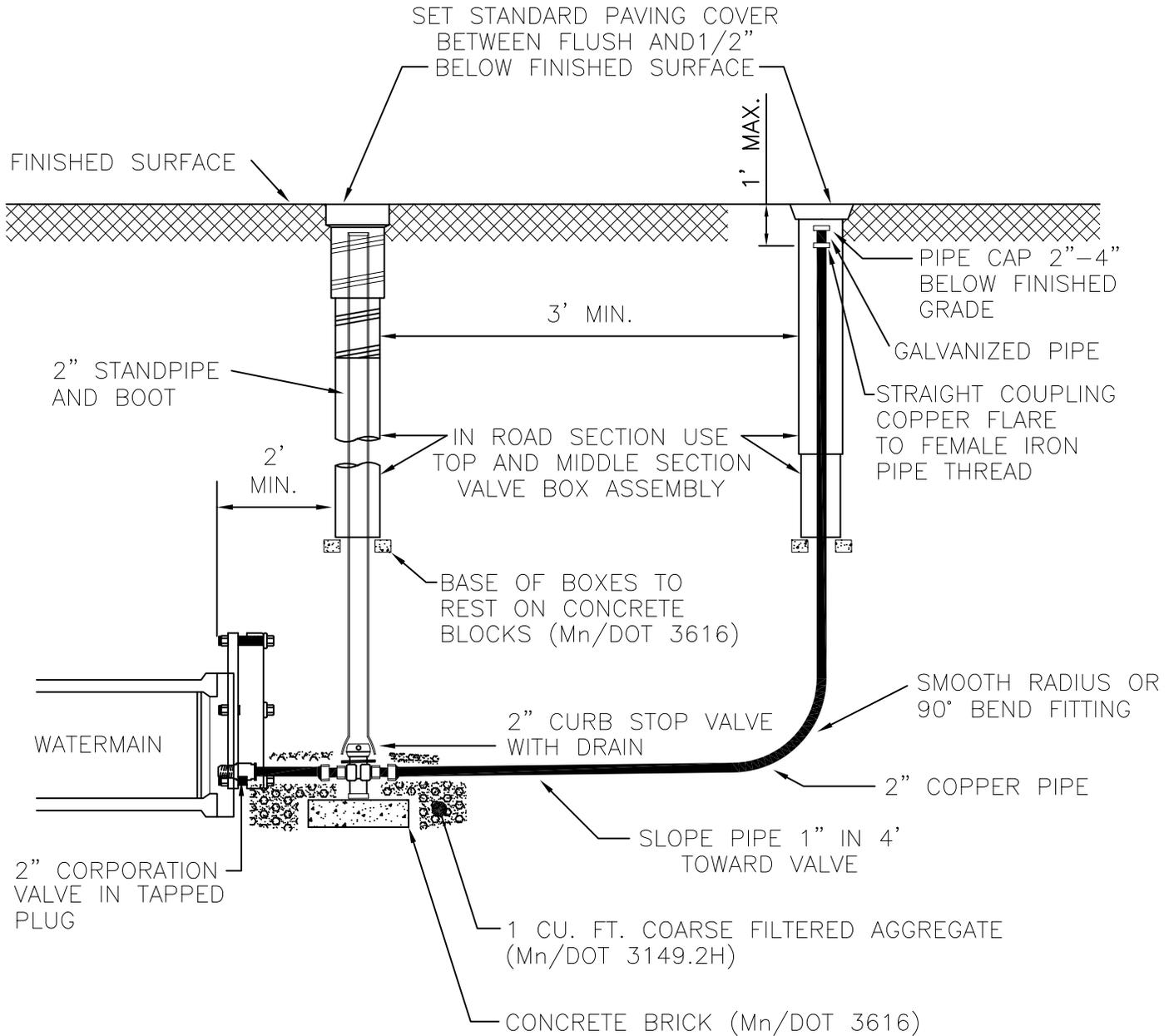
DR. *LJP* TR.  
CH. *VLT*  
APPROVED  
*DJS*

SAINT PAUL REGIONAL WATER SERVICES  
CITY OF ST. PAUL, MN

**AIR VENT INSTALLATION**

STANDARD  
PLATE

**D-7**



CURB STOP VALVE MUST BE APPROVED DRAINING VALVE PER SECTION 3310

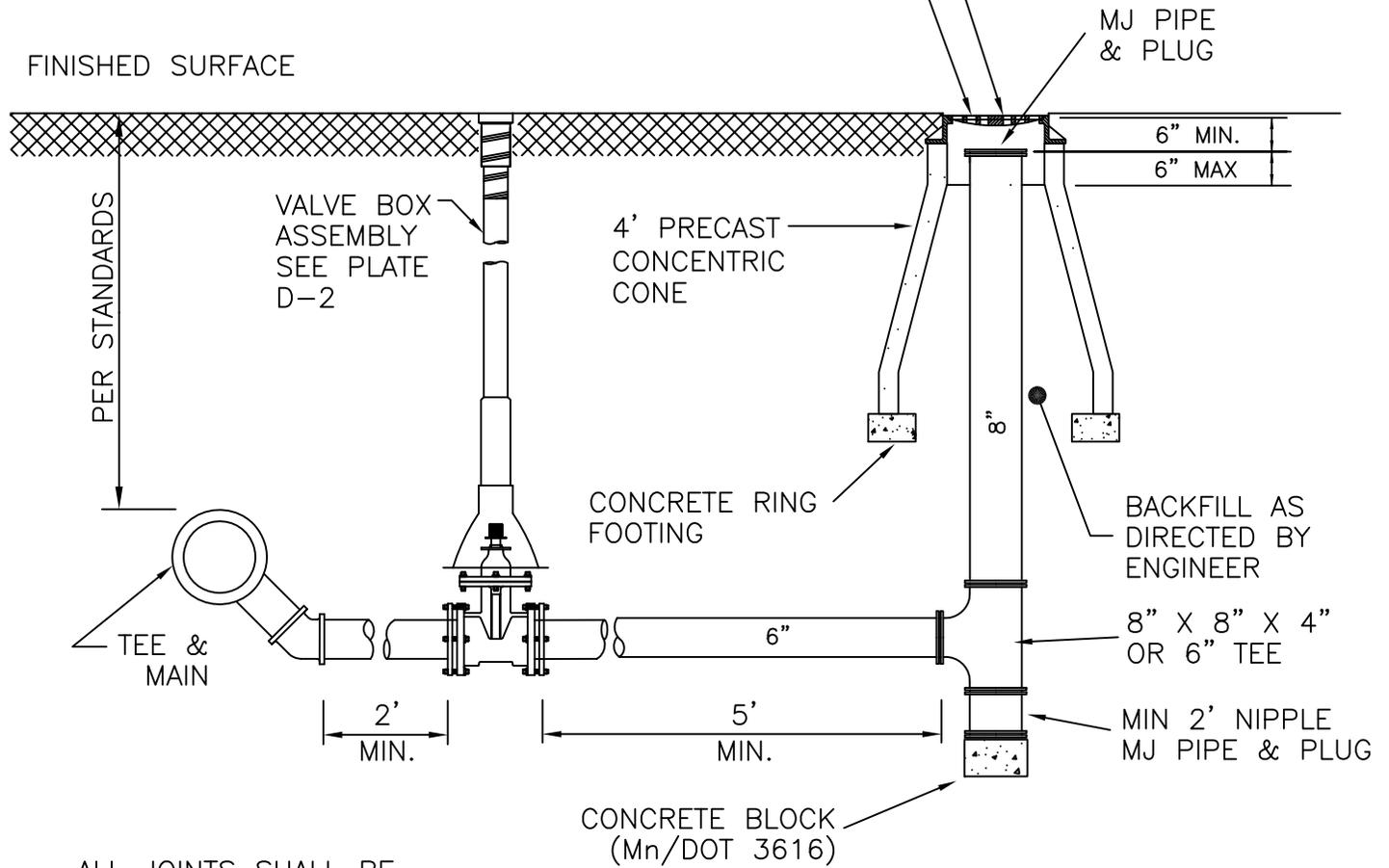
DR. <i>LJP</i> TR.
CH. <i>VLH</i>
APPROVED <i>DJS</i>

**SAINT PAUL REGIONAL WATER SERVICES**  
 CITY OF ST. PAUL, MN  
**BLOW-OFF FOR**  
**6" AND 8" MAINS**

STANDARD  
 PLATE  
**D-8**

SET STANDARD MANHOLE COVER  
BETWEEN FLUSH AND 1/2" BELOW  
FINISHED SURFACE (TYPICAL)

"WATER" SHALL BE PERMANENTLY  
MARKED ON THE TOP OF COVER



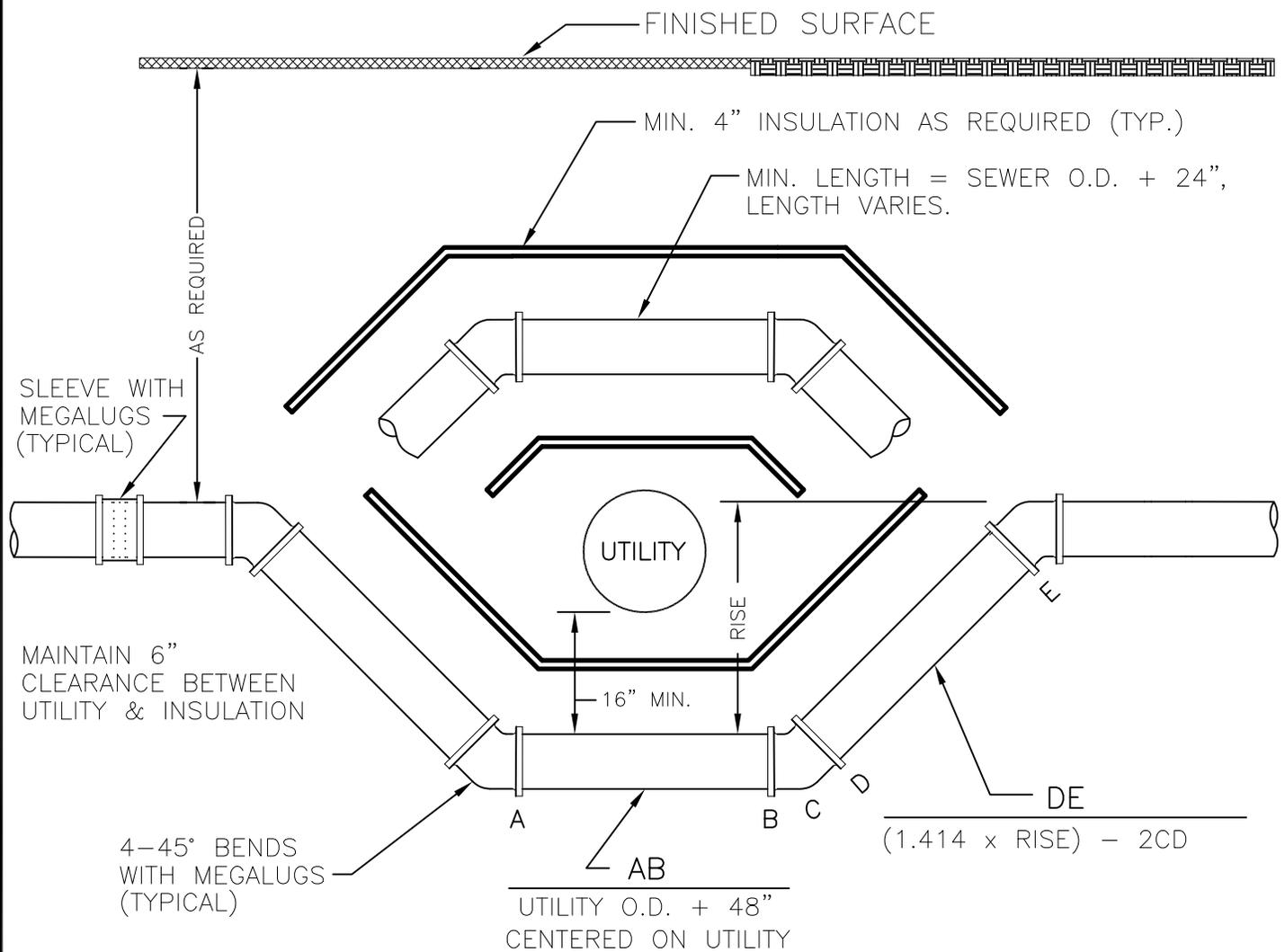
ALL JOINTS SHALL BE  
APPROVED RESTRAINED JOINT

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CH. <i>VLH</i>	
APPROVED <i>DJS</i>	

**SAINT PAUL REGIONAL WATER SERVICES**  
CITY OF ST. PAUL, MN

**BLOW-OFF FOR 12" & LARGER MAINS**

STANDARD PLATE
<b>D-9</b>



WM SIZE	CD (STD. CIP)	CD (COMPACT DIP)
6"	5"	3"
8"	5.5"	3.5"
12"	7.5"	5.5"
16"	8"	5.5"

FOR RESTRAINED PIPE LENGTHS SEE PLATE D-11

DR. *LJP* TR.

CH. *MGA*

APPROVED  
*DJS*

**SAINT PAUL REGIONAL WATER SERVICES**  
CITY OF ST. PAUL, MN

**TYPICAL WATER MAIN OFFSETS**

STANDARD  
PLATE

**D-10**

# DUCTILE IRON PIPE (DIP) WRAPPED IN POLYETHYLENE

## MINIMUM FEET OF RESTRAINED PIPE REQUIRED

PIPE SIZE	4.0' COVER				5.0' COVER				6.0' COVER			
	22.5°	45°	90°	DEAD END	22.5°	45°	90°	DEAD END	22.5°	45°	90°	DEAD END
4"					3	4	14	40	3	5	12	33
6"					4	8	20	56	4	7	17	47
8"					5	11	26	73	5	9	22	62
12"					8	15	36	104	6	13	30	88
16"	11	23	56	164	10	19	46	134	8	16	39	114
20"	14	28	67	199	11	23	55	164	10	20	47	139
24"	16	32	77	232	13	27	64	192	11	23	55	164
30"	19	38	92	280	16	32	77	232	14	28	66	199
36"	21	44	105	325	18	37	89	271	16	32	77	233
42"	24	49	117	367	20	42	100	307	18	36	87	265
48"	24	54	129	407	22	46	110	343	20	40	96	296



NOT ALLOWED

THE TABLE WAS DEVELOPED FROM CRITERIA IDENTIFIED IN THE  
*EBBA IRON INC.* RESTRAINED LENGTH CALCULATOR.  
THE TABLE ASSUMES 150 PSI, MH. GRANULAR SOILS AND TYPE 4  
TRENCH CONDITIONS. FOR REDUCERS, REFER TO THE RESTRAINED  
LENGTH CALCULATOR. FOR TEE'S, USE LENGTHS FOR 90° BENDS.

DR. <i>LJP</i> TR. CH. <i>MGA</i> APPROVED <i>DJS</i>	<b>SAINT PAUL REGIONAL WATER SERVICES</b> CITY OF ST. PAUL, MN  <b>RESTRAINED PIPE REQUIREMENT</b> DIP 4.0' - 6.0' EARTH COVER	STANDARD PLATE  <b>D-11</b> 1 of 4
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# DUCTILE IRON PIPE (DIP) WRAPPED IN POLYETHYLENE

MINIMUM FEET OF RESTRAINED PIPE REQUIRED

PIPE SIZE	7.0' COVER				8.0' COVER			
	22.5°	45°	90°	DEAD END	22.5°	45°	90°	DEAD END
4"	2	5	10	29	2	4	9	25
6"	3	6	14	41	3	6	13	36
8"	4	8	19	53	4	7	17	47
12"	6	11	26	76	5	10	23	67
16"	7	14	34	99	6	13	30	87
20"	9	17	41	121	8	16	37	107
24"	10	20	48	142	9	18	43	126
30"	12	24	58	173	11	22	52	154
36"	14	28	68	204	12	25	61	181
42"	16	32	77	232	14	29	69	207
48"	17	36	85	261	16	32	77	233

THE TABLE WAS DEVELOPED FROM CRITERIA IDENTIFIED IN THE **EBBA IRON INC.** RESTRAINED LENGTH CALCULATOR.  
 THE TABLE ASSUMES 150 PSI, MH. GRANULAR SOILS AND TYPE 4 TRENCH CONDITIONS. FOR REDUCERS, REFER TO THE RESTRAINED LENGTH CALCULATOR. FOR TEE'S, USE LENGTHS FOR 90° BENDS.

DR. *LJP* TR.

CH. *MGA*

APPROVED  
*DJS*

**SAINT PAUL REGIONAL WATER SERVICES**  
CITY OF SAINT PAUL, MN

**RESTRAINED PIPE REQUIREMENT**  
DIP 7.0' - 8.0' EARTH COVER

STANDARD  
PLATE

**D-11**

2 of 4

# PVCO PIPE

## MINIMUM FEET OF RESTRAINED PIPE REQUIRED

PIPE SIZE	4.0' COVER				5.0' COVER				6.0' COVER			
	22.5°	45°	90°	DEAD END	22.5°	45°	90°	DEAD END	22.5°	45°	90°	DEAD END
4"	/				3	5	12	26	2	4	10	21
6"	/				4	7	17	36	3	6	14	30
8"	/				5	9	22	47	4	8	18	40
12"	/				6	13	30	67	5	11	26	56
16"	10	20	47	106	8	16	39	87	7	14	33	73
20"	12	24	57	129	10	20	47	106	8	17	40	90
24"	13	28	66	151	11	23	55	124	10	20	47	105
30"	16	33	78	182	13	27	65	150	12	24	56	128



NOT ALLOWED

THE TABLE WAS DEVELOPED FROM CRITERIA IDENTIFIED IN THE *EBBA IRON INC.* RESTRAINED LENGTH CALCULATOR. THE TABLE ASSUMES 150 PSI, MH. GRANULAR SOILS AND TYPE 4 TRENCH CONDITIONS. FOR REDUCERS, REFER TO THE RESTRAINED LENGTH CALCULATOR. FOR TEE'S, USE LENGTHS FOR 90° BENDS.

DR. *LJP* TR.

CH. *MGA*

APPROVED

*DJS*

SAINT PAUL REGIONAL WATER SERVICES  
CITY OF ST. PAUL, MN

**RESTRAINED PIPE REQUIREMENT**

PVCO PIPE 4.0' - 6.0' EARTH COVER

STANDARD  
PLATE

**D-11**

3 of 4

# PVCO PIPE

## MINIMUM FEET OF RESTRAINED PIPE REQUIRED

PIPE SIZE	7.0' COVER				8.0' COVER			
	22.5°	45°	90°	DEAD END	22.5°	45°	90°	DEAD END
4"	2	4	9	19	2	3	8	16
6"	3	5	12	26	3	5	11	23
8"	4	7	16	34	3	6	14	30
12"	5	10	22	49	4	8	20	43
16"	6	12	29	63	5	11	25	56
20"	7	15	35	78	7	13	31	68
24"	9	17	41	91	8	15	36	81
30"	10	21	49	111	9	18	44	98

THE TABLE WAS DEVELOPED FROM CRITERIA IDENTIFIED IN THE **EBBA IRON INC.** RESTRAINED LENGTH CALCULATOR. THE TABLE ASSUMES 150 PSI, MH. GRANULAR SOILS AND TYPE 4 TRENCH CONDITIONS. FOR REDUCERS, REFER TO THE RESTRAINED LENGTH CALCULATOR. FOR TEE'S, USE LENGTHS FOR 90° BENDS.

DR. *LJP* TR.

CH. *MGA*

APPROVED  
*DJS*

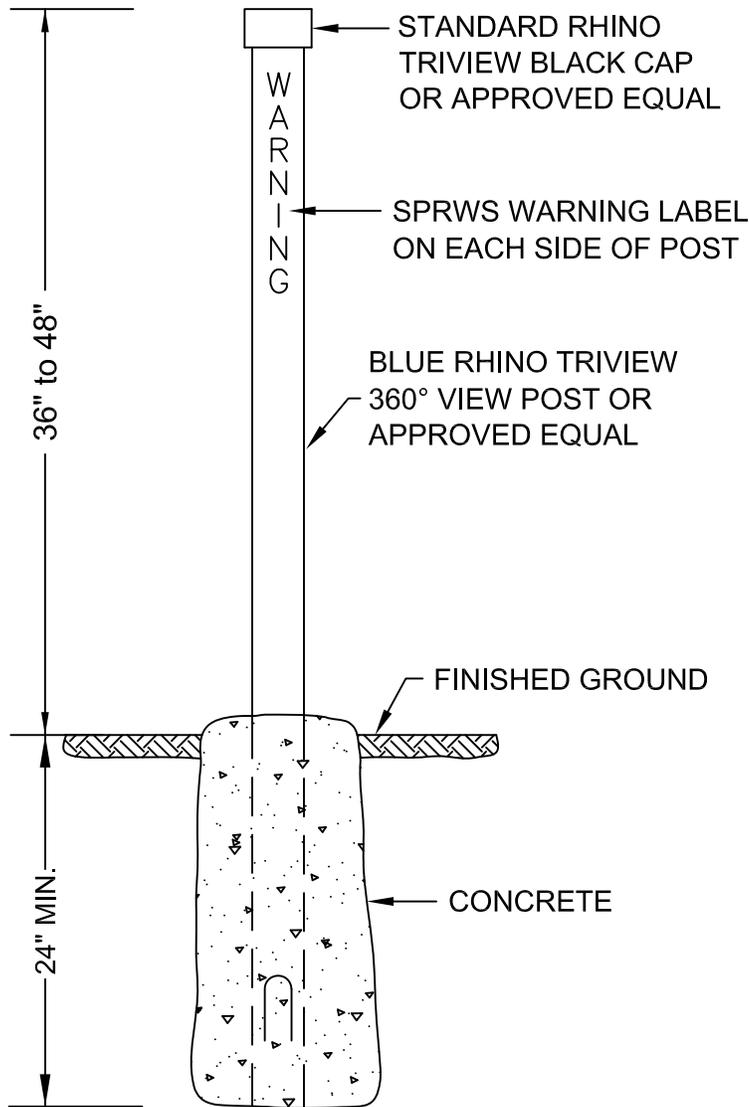
**SAINT PAUL REGIONAL WATER SERVICES**  
CITY OF SAINT PAUL, MN

**RESTRAINED PIPE REQUIREMENT**  
PVCO PIPE 7.0' - 8.0' EARTH COVER

STANDARD  
PLATE

**D-11**

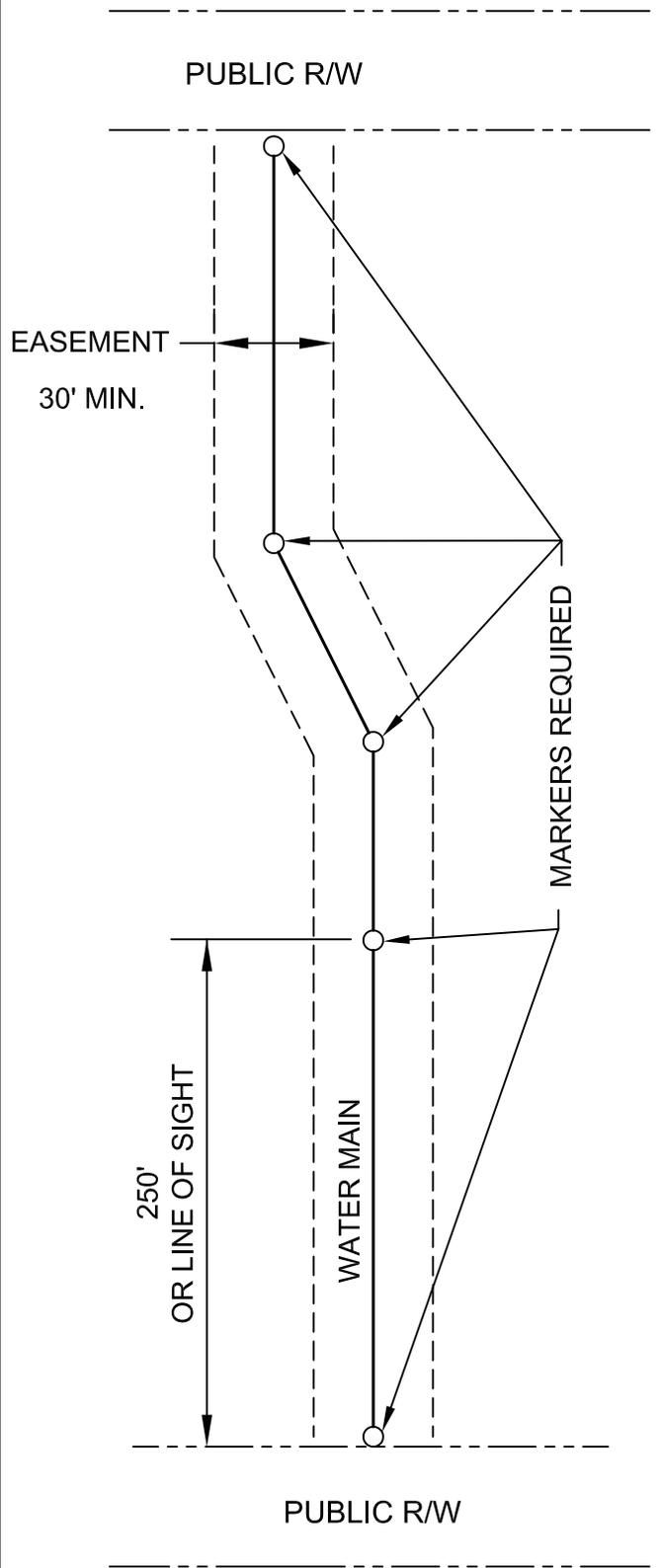
4 of 4



**MARKER DETAIL**

HEIGHT, MATERIAL, COLOR AND ANCHORING METHOD OF MARKER MAY BE ADJUSTED BY SPRWS INSPECTOR AS FIELD CONDITIONS REQUIRE

SEE SECTION 2220-5 FOR MORE INFORMATION ON MARKER REQUIREMENTS



**TYPICAL LOCATION**

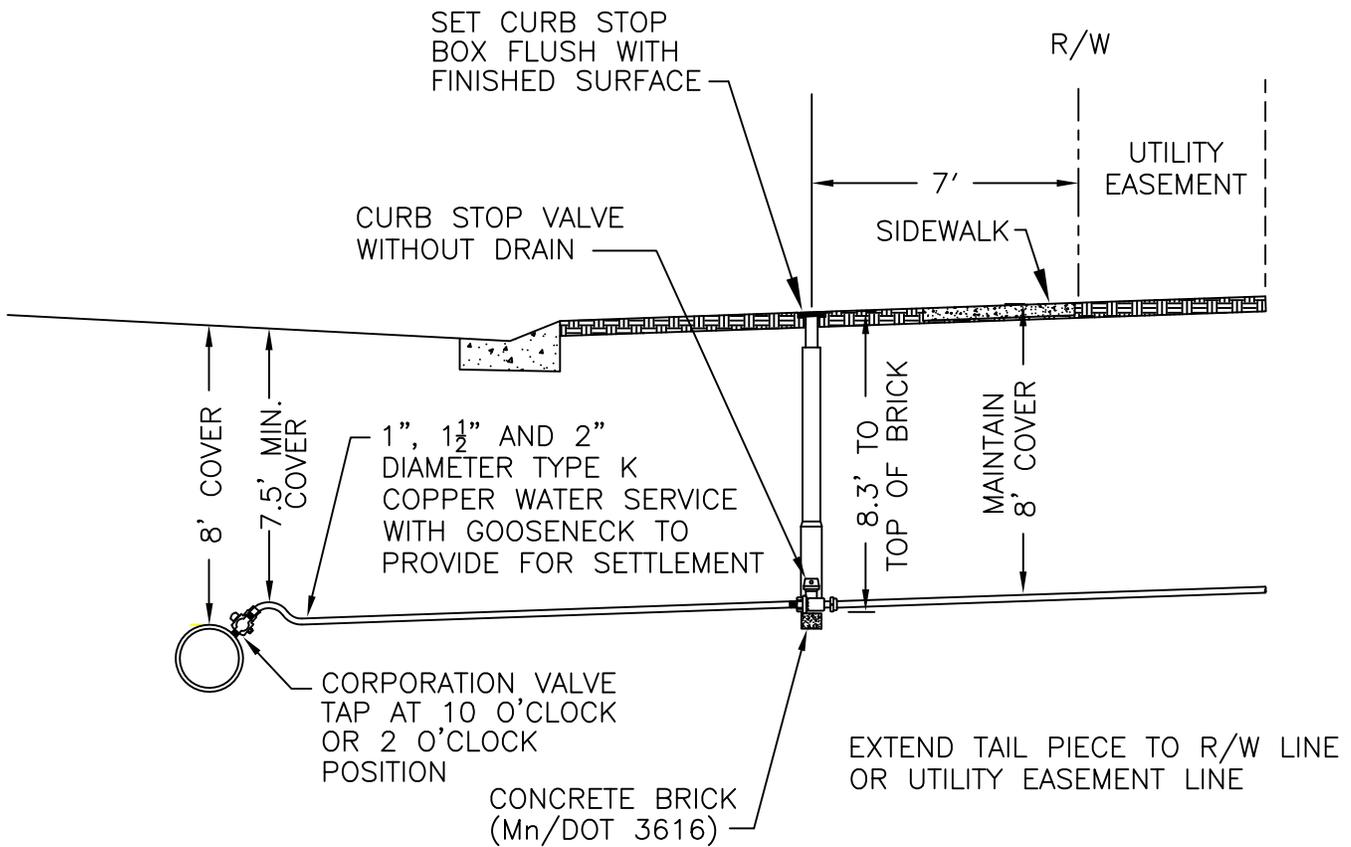
DR. <i>LJP</i>	TR.
CH. <i>VLH</i>	
APPROVED <i>DJS</i>	

SAINT PAUL REGIONAL WATER SERVICES  
CITY OF ST. PAUL, MN

**STANDARD EASEMENT MARKER**

STANDARD  
PLATE

**D-12**



REFER TO SECTION 3300 FOR ADDITIONAL REQUIREMENTS

LIQUID TEFLON OR TEFLON TAPE REQUIRED AT ALL THREADED FITTINGS.

### LAWN SPRINKLER

SAME AS SERVICE EXCEPT:

- CURB STOP VALVE WITH DRAIN
- CURB STOP BURIED WITH 2'x2'x2' CLEAN 1½" ROCK WRAPPED IN GEOTEXILE NONWOVEN FABRIC

DR. *LJP* TR.

CH. *MGA*

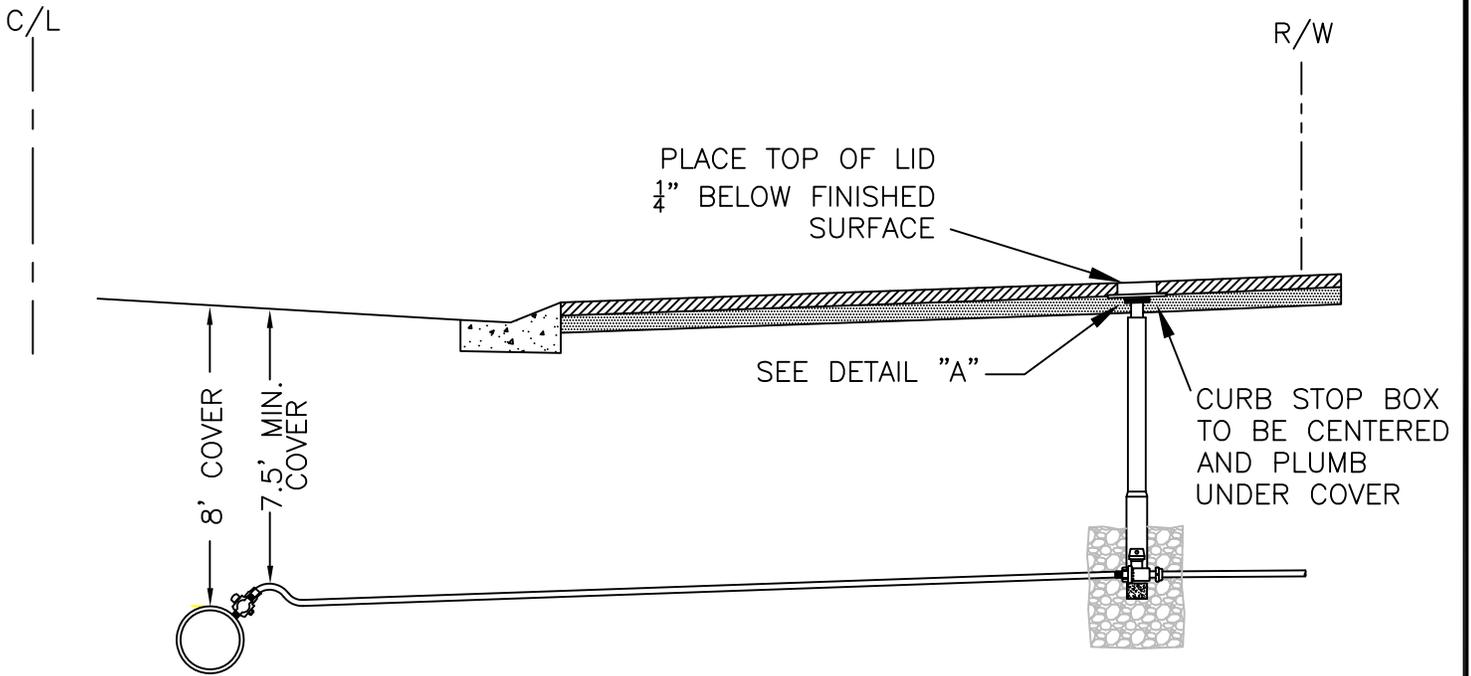
APPROVED  
*DJS*

SAINT PAUL REGIONAL WATER SERVICES  
CITY OF ST. PAUL, MN

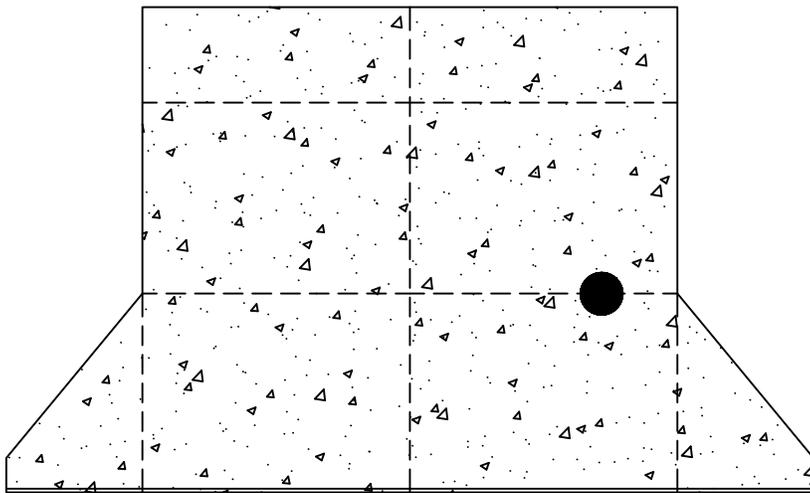
TYPICAL 1", 1-1/2" AND 2" SERVICE  
AND LAWN SPRINKLER INSTALLATION

STANDARD  
PLATE

D-13



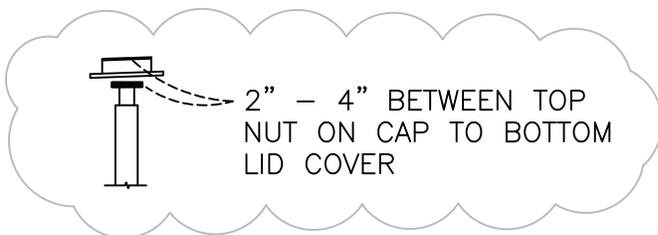
TYPICAL CONCRETE DRIVEWAY



CONTRACTOR TO  
INSTALL LID 2" - 4"  
ABOVE CURB BOX  
(SEE DETAIL "A")

SLOPE OF COVER  
TOP TO MATCH  
FINISHED GRADE

DETAIL "A"



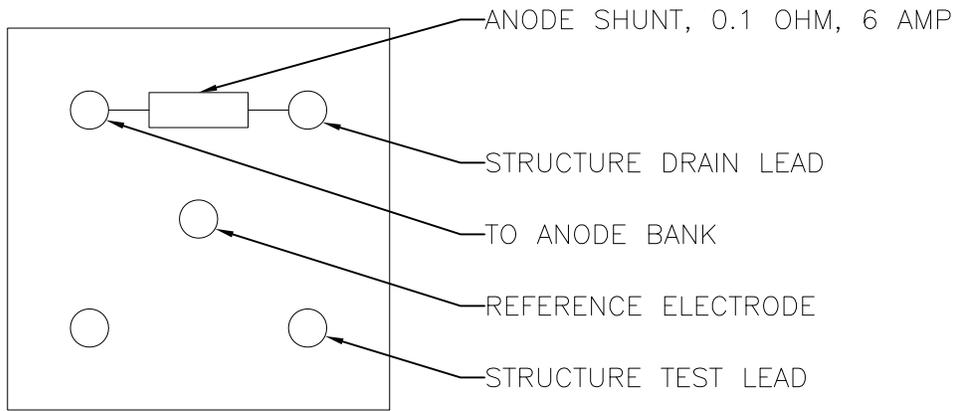
FORD TYPE "A" SINGLE LID  
COVER OR APPROVED EQUAL



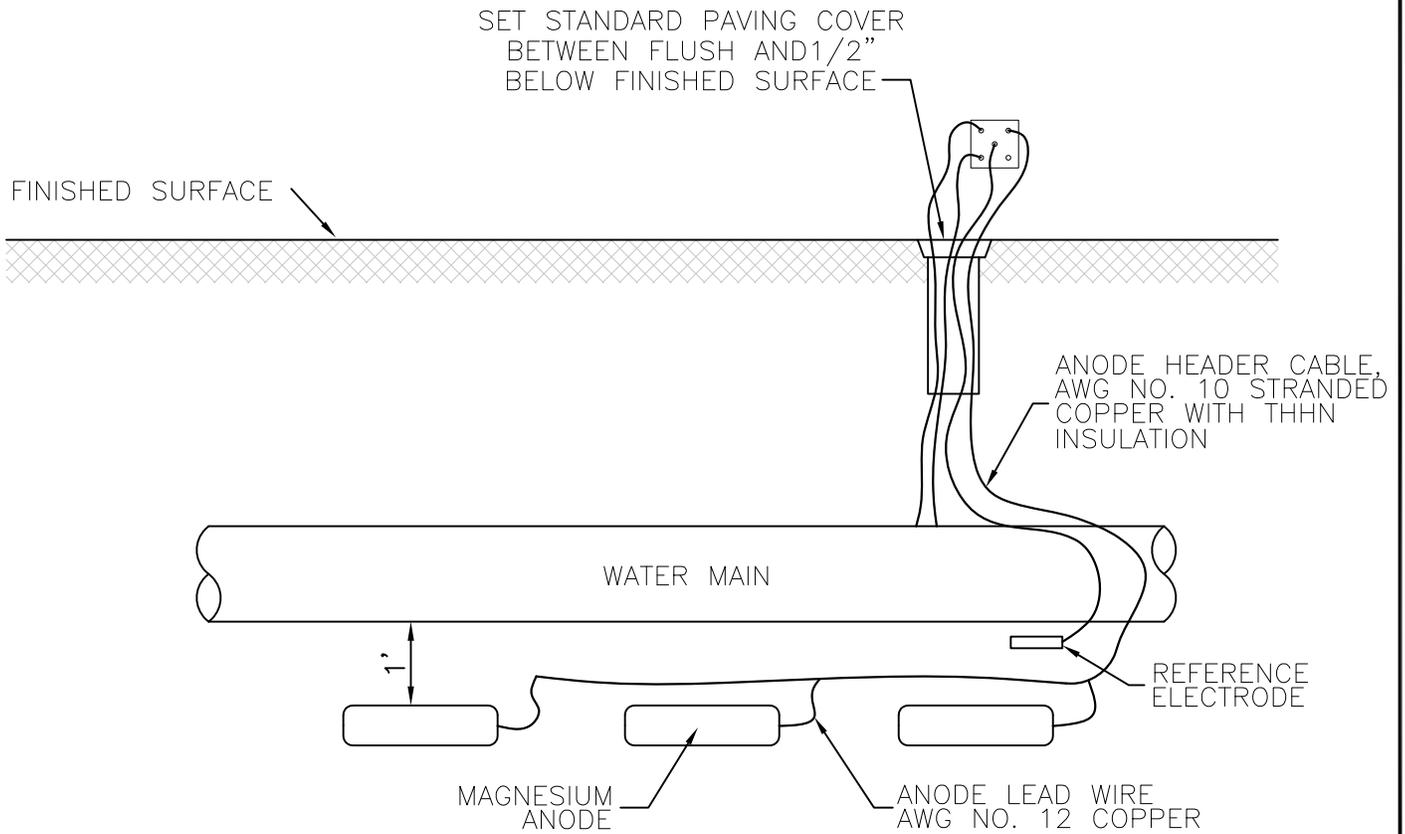
DR. <i>LJP</i>	TR.
CH. <i>MGA</i>	
APPROVED <i>DJS</i>	

<p><b>SAINT PAUL REGIONAL WATER SERVICES</b> CITY OF ST. PAUL, MN</p> <p><b>INSET LID COVERS FOR SLOPED PAVEMENT</b></p>
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<p>STANDARD PLATE</p> <p><b>D-14</b></p>
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ANODE TEST STATION CONFIGURATION



1. NUMBER OF ANODES TO BE DETERMINED BY CATHODIC PROTECTION SYSTEM DESIGN.
2. REMOVE OUTER PLASTIC WRAB JUST PRIOR TO ANODE INSTALLATION, DO NOT DAMAGE CLOTH BAG PACKAGING.
3. BACKFILL ANODES WITH NATIVE SOIL ONLY.

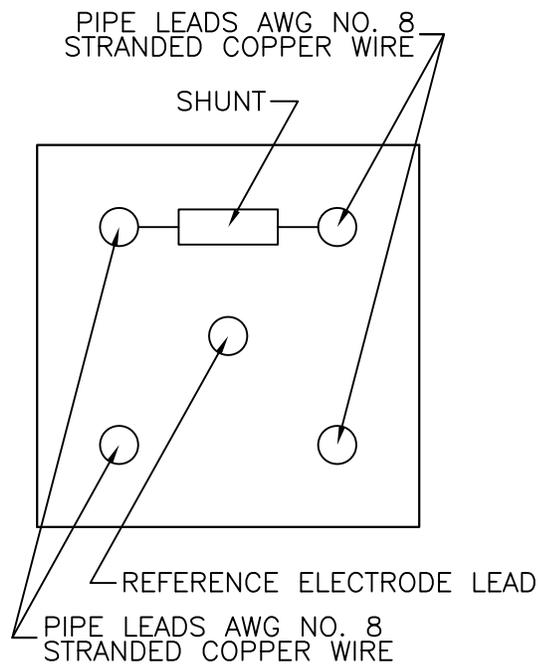
DR. <i>VLH</i> TR.
CH. ###
APPROVED ###

**SAINT PAUL REGIONAL WATER SERVICES**  
CITY OF ST. PAUL, MN

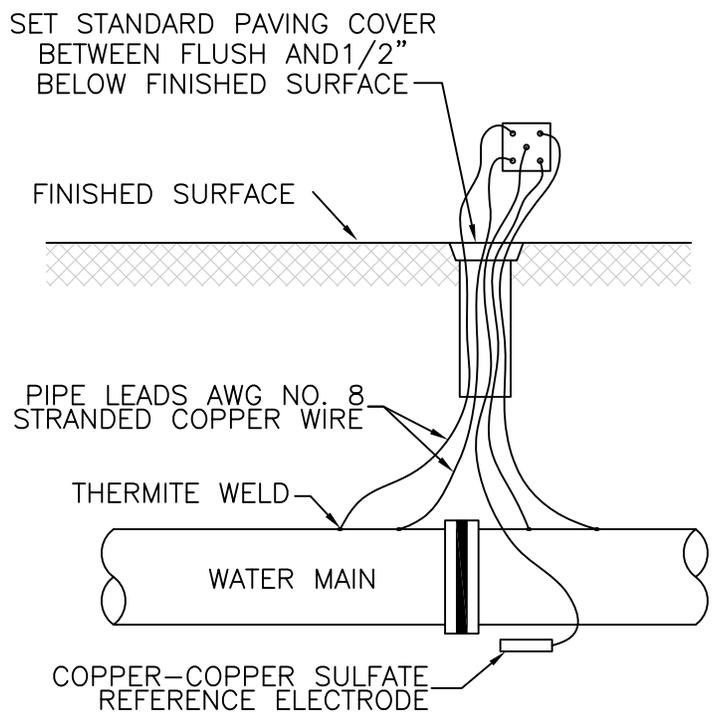
**CATHODIC PROTECTION**  
**ANODE AND TEST STATION INSTALLATION**

STANDARD  
PLATE

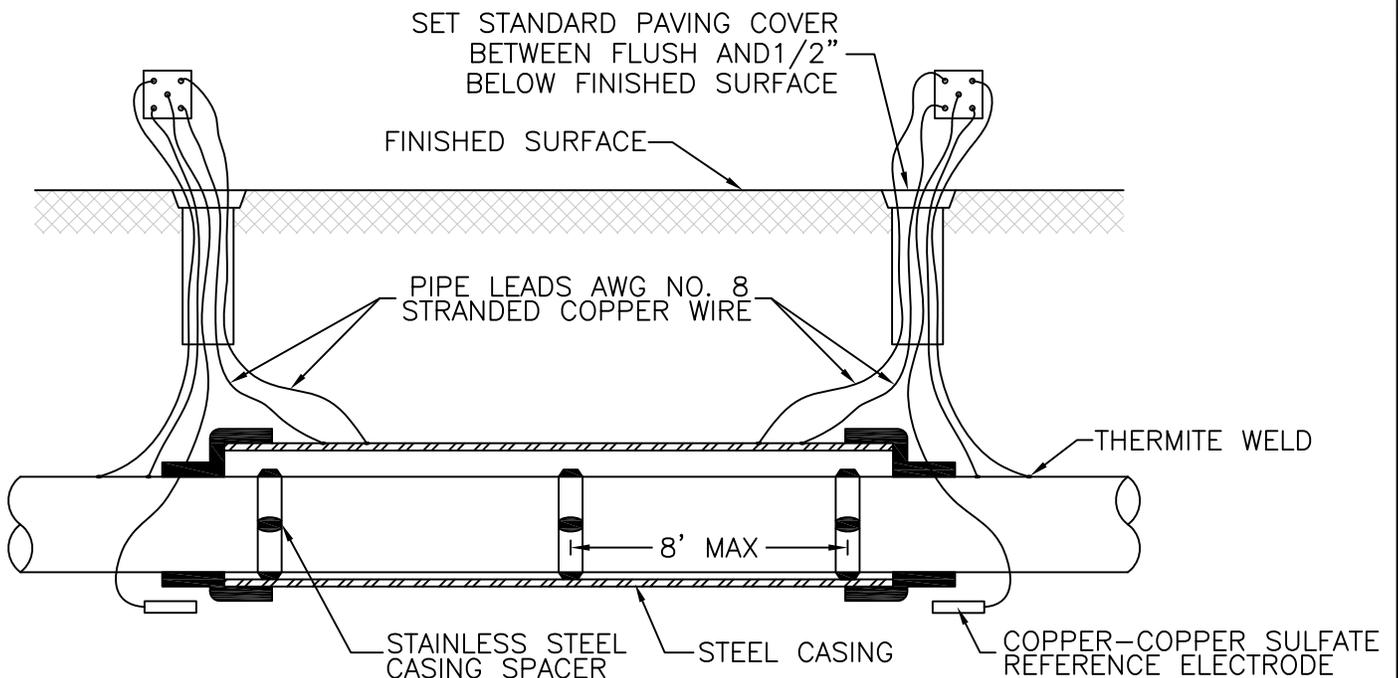
**D-15**  
1 OF 2



JOINT/CASING TEST STATION



INSULATING JOINT INSTALLATION



CASING INSTALLATION

DR. <i>VLH</i>	TR.
CH. ###	
APPROVED	###

**SAINT PAUL REGIONAL WATER SERVICES**  
 CITY OF ST. PAUL, MN  
**CATHODIC PROTECTION**  
**INSULATING JOINT/CASING INSTALLATION**  
**AND TEST STATIONS**

STANDARD  
 PLATE  
**D-15**  
 2 OF 2