

# Hastings Water Main Design Manual

Version: 2019-1



Review and Approved by Hastings Utility Engineer

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Date *9/25/2019*

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# Water System Design Manual Distribution List

<b>City and Utility Staff:</b>	<b>Date Submitted for Review</b>
City of Hastings Engineering (City Engineer)	9 / 9 / 2019
City of Hastings Fire Department (Fire Chief)	9 / 9 / 2019
Hastings Utilities Engineering (Director of Engineering)	8 / 12 / 2019
Hastings Water Department (Water Superintendent)	8 / 12 / 2019

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# Hastings Water System Description

The Hastings Water System is unique as compared to most water systems operated in the South Central Nebraska. The water system does not have water storage as the system relies on constant pump pressure to provide potable water. Several wells are fitted with standby power, looped feed with 2 or more electrical power substations, and /or provided remote pressure sensors that provide reliability in the event electrical power is lost. Hastings Utilities also operates the electrical generation and distribution system that affords additional electrical reliability. The water system pressure is monitored at the North Denver Station, 24 hours a day.

The water system is not chlorinated. Cleaning and disinfection of water mains and fittings are critical. Several design conditions as noted within this document has been adapted to address these issues. Consultants doing work involving the Hastings Water System shall specifically educate themselves on this issues. Assuming Hastings is like all other water systems has the potential to create a health and safety hazard.

The water system has the ability to raise the water pressure to 100 – 120 psi that affords additional fire flow capacity. This ability to increase pressure is only allowed because elevated water storage is not provided. With elevated water storage, the height of the water tower would limit the water pressure in the water system without overflowing.

Because the water system pressure can be increased, it allows smaller mains to flow more water. Since 1884 the fire flow demand requirements have risen as building codes and fire codes have improved requiring increased fire flow capacity. The use of 4 and 6 inch diameter water mains installed in the early 20<sup>th</sup> century do not meet current fire flow requirements. The increase in water pressure during fire flow events provides some increase in fire-fighting capacity however, the increase in water pressure requires the design of water system components to address this higher working pressure. When pressure is increased within the water system and especially during fire flow events the water velocity also increases. This increases in water velocity has the potential to magnify water hammer transition pressures. Typical fire flow water pressures demonstrated by modeling show water velocity of 7.5 to 10 fps are typically produced. This is near the limit of laminar flow. Sufficient surge pressure capacity of all water mains and fittings are required. The specifications shall be followed to ensure any water components installed will be compatible with the water system operation.

Transient water pressure from one pipe material to another shall be considered in the design. This is especially critical when transient water pressure flows from a rigid pipe into a flexible pipe.

The design capacity of the water system is intended to meet the peak hour demand and maximum day demand plus a 4,000 gpm fire flow. This is assuming 3,000 gpm of well capacity is not available due to testing, repairs, or out of service (firm pumping capacity).

The following are requirements to be followed for the design all Hastings Water System Improvements and extensions. Consultants, Developers, Hastings Utilities and others persons preparing plans and specifications shall adhere to these requirements. Only best practice as required for the specific

operational requirements of the Hastings Water System shall be provided for the design and construction of any water system components.

Be mindful the Hastings Water System provides the public with potable water and water for firefighting. Any non-compliance to safety and good engineering practice can lead to sickness, death, and / or property damage. The design of the Water System shall not be taken lightly or haphazardly.

## Section 1: General

### 1.1 Standards and Guidelines

Hastings Water System facilities shall be designed and constructed in conformance with this manual and the most current edition of the following standards.

1. *Recommended Standards for Water Works, Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers (Ten State Standards).*
2. Requirements and Standards of the Nebraska Department of Health and Human Services (NDHHS or DHHS) and Nebraska Department of Environmental Quality (NDEQ).
3. *American Water Works Association Standards (AWWA).*
4. City of Hastings Nebraska Plumbing Code.
5. Hastings Utilities (HU) Water Main Specification and HU Standard Details (see Appendix A).
6. University of South California (USC) Cross-Connection Control Guidelines.

Where a conflict occurs between the above standards and as noted within these documents, the most restrictive requirement shall apply. Hastings Utilities Engineer (Utility Engineer) shall be consulted on all conflicts and shall be responsible for the appropriate resolution.

### 1.2 Definitions

Hastings Utilities Engineer (Utility Engineer or Engineer): Utility Engineer shall be the current Hastings Utilities staff professional engineer on record or Hastings Coordinating Engineer.

Structures: Structures include buildings, foundations, drainage structures, bridges, culverts, loading docks, etc. It does not include single metal post signage such as a stop sign, parking lots, parking aprons, paving, sidewalks, moveable items, fences other than masonry or block fences, etc.

Property Owner: Shall include the property owner, the developer, and / or consultant representing the development of a water main improvement or extension project.

Consultant: Is any special consultant, consultant firm or engineer retained by a developer or the city to design water main and water system improvement.

Streets and Roadways: Streets and roadways include all streets and roadways under the jurisdiction of State of Nebraska Department of Transportation, Adams County, City of Hastings, and privately held streets.

### 1.3 Abbreviations

<i>AWWA</i> :	American Water Works Association
<i>DIP</i> :	Ductile Iron Pipe
<i>DIPRA</i> :	Ductile Iron Pipe Research Association
<i>PVC</i> (Pipe):	Polyvinyl Chloride Pipe (AWWA C900)
<i>PVCO</i> (Pipe):	Molecular Oriented Polyvinyl Chloride Pipe (AWWA C909)
<i>HDPE</i> (Pipe):	High Density Polyethylene Pipe (AWWA C906)
<i>PE</i> (Pipe):	Polyethylene Pipe (AWWA C901)
<i>FH</i> :	Fire Hydrant
<i>VB</i> :	Valve Box
<i>PIV</i> :	Position Indicator Valve

*HU:* Hastings Utilities / Utilities Department of the City of Hastings, NE  
*City:* City of Hastings, NE  
*NDHHS:* Nebraska Department of Health and Human Services  
*Engineer:* Hastings Utility Engineer, Professional Engineer or other designated engineer  
*ROW:* Right of Way

#### **1.4 Approvals**

1. All plans and specifications shall be reviewed, approved and stamped by a Nebraska Professional Engineer.
2. All Plans and Specifications shall also be reviewed and approved by the Utility Engineer.
3. For transmission and water treatment piping projects the plans and specifications shall also be approved by the Nebraska Department of Health and Human Services.
4. Hastings Utilities has an agreement with NDHHS for the professional review of water main improvements. The developer or consultant may utilize this approval process in lieu of submitting plans and specifications to NDHHS.
5. When a water main or appurtenance is located in City right-of-way the City Engineer shall approve the placement of these improvements as it relates to transportation systems present and future. Provide a location on the cover sheet signature and date noting approval by the City Engineer.
6. When a water main or appurtenance is located in the Adams County right-of-way the Adams County Highway Superintendent shall approve the placement of these improvements as it relates to transportation systems present and future. Provide a location on the cover sheet signature and date noting approval by the County Highway Superintendent.
7. When a water main or appurtenance is located in the State of Nebraska right-of-way, the Nebraska Department of Transportation shall approve the placement of these improvements as it relates to transportation systems present and future. Provide a location on the cover sheet signature and date noting approval by the Nebraska Department of Transportation

#### **1.5 Professional Liability**

Whenever a project is designed by a consultant for the city or consultant for a developer the consultant shall provide professional liability insurance for each water system improvement or extension project. The insurance shall name City of Hastings, NE / Hastings Utilities as additionally insured. This shall include all water related consultant activities including but not limited to studies, reports, filings, applications, preparation of plans and specifications, inspections, surveying, and other related activities.

Provide the following insurance coverage for all consultants providing design/engineering/surveying services/or consulting services):

Limits of at least:       \$1,000,000 per occurrence; \$1,000,000 aggregate

Policy shall provide for a retroactive date prior to the starting date of services for which this agreement applies. Policy shall not exclude bodily injury, property damage, or pollution liability. Coverage shall remain in force for a minimum of 3 years following substantial completion of construction through either policy renewal or the purchase of an Extended Reporting Provision. Contractor agrees to waive its rights of recovery. Subcontractor's insurer shall endorse the policy to waive subrogation against Owner and their respective agents, officers, directors and employees

Filing of this insurance shall be submitted to City of Hastings / Hastings Utilities prior to commencing work. The insurance shall remain enforce during the study, design, construction, and warranty periods of the project.

#### **1.6 Drawing and Specification Format**

All drawings shall be provided to the Utility Engineer in the most current version of AutoCAD. All specifications, letters, written communication and other contract documents shall be provided in the most current version of Microsoft Word. Spreadsheets shall be provided in the most current version of Microsoft Excel.

All plans shall be prepared in accordance to the standard drawing details located in Appendix B.

Pipe and fitting quantities to be determined from Tyler Pipe Fittings until detailed shop drawings of installed items are submitted. Please see Appendix C for a complete table of fittings.

Use of email to address questions with the Utility Engineer is strongly encouraged.

#### **1.7 Proprietary Design**

Whenever a consultant provides design service, prepares plans and specifications, or other related studies and reports it shall be understood the service and materials provided are for public use and are not proprietary. Reuse of details and other information allowed by the City of Hastings and Hastings Utilities without restriction

## **Section 2: Water Main Design Parameters**

### **2.1 Water Pressure System – Design Parameters**

The water system is currently operated as a single pressure system servicing the entire City of Hastings and additional wholesale customers. The normal operating pressure range is 55 psi to 65 psi with a full range of 40 psi to 120 psi maximum. The system currently has expanded to the limits of a single pressure system. For development outside of the existing system a pressure and flow analysis must be conducted to determine the actual flow and pressure range. When determined necessary, additional pressure zones may need to be constructed.

### **2.2 Main Size and Use Restriction**

Minimum water main size is 8 inch diameter for residential and 10 inch for commercial and industrial. Main sizes that are used include 8, 10, 12, 16, 24, 30, 36, 42, and 48 inch diameter pipes. Pipe sizes of 14, 18, and 20 are not recommend unless special conditions warrant and approved by Utility Engineer. Hastings Utility does not maintain spare or repair parts for these pipe sizes. The Utility Engineer will determine the size of the water main to be installed. The size shall reflect the minimum sizes required for the zoning and potential future zoning. It shall also adhere to the master water main plan maintained by Hastings Utilities.

**2.2.1** PVC or HDPE water main, is not allowed to be installed in industrial or potentially contaminated areas. The Utility Engineer will determine if the installation of a water main will be located in an industrial or contaminated areas or has the potential to be zoned industrial.

**2.2.2** Use of HDPE must include capacity calculation to provide equivalent flow as compared to DIP or PVC. Typically, one nominal pipe size increase is required.

### **2.3 Modeling Analysis - Network Grid**

Water mains to transport water across the water system, commonly are 10 or 12 inch mains laid on ¼ mile lines supported with 16-30 inch mains which surround and bisect the city. For additional details see the most current version of the Hastings Water System planning map. This can be obtained by contacting Hastings Utilities Engineering Department.

### **2.4 Location**

Future water main extensions shall be placed in public rights-of-way or in dedicated easements. The water main shall be constructed to the outer limits of the development to provide for future extension of the water system and adjacent properties. For additional information, coordinate with the Utility Engineer on water system development plans.

Water mains shall be located in a way to best conform to the layout of the existing facilities. When practical water mains shall be placed in street terraces see attached Typical Utility Locations on all Street ROW's for more details (Appendix D).

Where no pattern of water mains has been established, mains shall be generally installed 7 feet from the property line, which lies to the south and east of the road centerline.

## **2.5 Easements**

Permanent easements are required for all public water mains not located within the public street right-of-way. The normal easement width is no less than fifteen feet (15') wide minus (–) seven and one-half feet (7.5') either side of the centerline of the water main, preferable width is twenty feet (20').

The fifteen feet (15') wide water easement applies to all mains for a maximum depth of six feet (6') as measured from the top of the main. Additional easement shall be obtained to account for bury depths greater than 6.0 feet to top of pipe. The amount of easement shall be approved by the Utility Engineer.

Where a water main is located near buildings or other structures, the easement must provide a minimum of ten feet (10') lateral clearance between the outside of the water main and the structure. If clearance is not obtained then approval from the Utility Engineer shall be required.

Please note the Community Municipal System (CMS) (aka Hastings East Industrial Park) has a 5 feet easement on both sides of the water main. All new water main installations in the CMS area shall obtain additional easement to provide a fifteen feet (15') wide easement minus (–) seven and one-half feet (7.5') either side of the centerline of the water main.

Please note requirements as noted in Section 1.4 for approvals in right-of-ways.

All temporary dead-end water mains shall be terminated with a fire hydrant assembly. Avoid all dead-end mains by providing hydraulic looping. The construction of all dead-end mains must be approved by Utility Engineer.

## **2.6 Bury Depth**

Minimum depth of cover for all water mains is 5 feet to top of pipe. When an adjustment in depth is required to pass below another utility, the length of the deeper water main shall be kept to a minimum by using bends to achieve the desired offset. Obtain approval by the Utility Engineer to determine if the proposed method is acceptable. Please note the required sanitary separation of all water mains crossing sanitary and storm sewers.

Maximum depth of water main shall be 8 feet to top of pipe without prior approval by the Utility Engineer.

## **2.7 Thrust Restraint**

All water mains, fittings, and valves consisting of 8 to 24 inch requiring thrust restraint shall be provided with foster adaptors in lieu of thrust blocks where applicable. This restraint system is cheaper and safer to install as compared to use of uncoated “reddi-rod” assemblies. The use of foster adaptors or other approved restraint systems in lieu of “reddi-rod” is a safety issue for personal working on water mains. Restraint systems may include the use of “mega-lug” or equal systems. Provide restrained joint pipe when applicable. This includes all water mains installed in casings. Use of restraining gasket is consider to be an acceptable restrained joint system for specific applications. These applications shall be prior

approved by Utility Engineer. Typically restraining gaskets are used for DIP installed in steel casing. Fused HDPE is considered restrained.

Provide swivel connections on fire hydrants. Refer to details in Appendix A.

When construction drawings require thrust blocks in addition to restrained joint coupling, both means of restraint are to be installed (Appendix A).

The Utility Engineer shall approve all thrust restraint systems employed. When necessary a thrust calculation shall be provided to the Utility Engineer to insure the restraining system is appropriate for the operating conditions.

## **2.8 Cleaning and Hydrostatic Testing**

Disinfection and bacteriological test shall be performed in conformance with AWWA requirements and additional details as noted below. Hydrostatic testing shall be performed in conformance with AWWA and Ten State Standard. A pig launcher and blow off systems shall be designed and installed on the pipe for cleaning and noted on the drawings. A cleaning sequence shall be prepared to insure the proper placement of the pig launchers and blow off structures.

Pipe cleaning and disinfection shall conform to the following Hastings Utilities Technical Specifications (see also current revision as noted in the standard specifications).

### **“Sterilization, Flushing and Pressure Testing of Water Mains”**

*“Procedures for the disinfection of the water mains shall be in accordance with the latest revision of AWWA C651. Specifically each segment of completed water main to be disinfected shall not exceed a length greater than 1,000 LF unless otherwise approved by the Engineer.*

*All costs associated with disinfection, flushing and pressure testing of the water mains and appurtenances shall be considered subsidiary to the main installation.*

*To aid in the cleaning and disinfection of the water main the contractor shall comply with the following:*

- 1. All water main materials shall be shipped in plastic wrap or provided removal plugs to limit contamination during shipping. Water main pipe shall be shipped with a tarp or cover to protect the pipe end (windward end) during transport.*
- 2. Onsite storage of water main materials shall be placed on skids or blocks to limit contamination while in storage. Provide minimum of 4 inches elevation above the ground line and not located in areas that may become flooded.*
- 3. Tarps or plastic wrap shall be provided to secure the open end of the pipe and water materials from contamination during site storage. Contractor shall limit site storage to amounts that can be installed in a timely manner to limit contamination.*
- 4. Each section of pipe, all fittings and other water main assemblies shall be thoroughly inspected for presence of dirt, oil film(s), and debris prior to installation. Contractor shall remove and clean all visible contamination.*

5. *During installation the open end of the water main or assembly shall be fitted with a plug to limit contamination. This shall be used at all times. For periods where construction will be delayed for more than 1 hour a tight fitting plug shall be installed that will prevent water intrusion at a pressure of at least 10 feet of hydraulic head.*
6. *The use of pipe gasket lube shall be limited to Blue Lube manufactured by Whitlam Plumb-Pro or equal. The use of yellow gasket grease is not permitted or allowed to be stored on site. Pipe gasket lube shall be NSF Standard 14 and 61 certified for potable use. Care shall be taken to limit the amount of pipe gasket lube applied as this will aid in cleanup of the water main and assemblies.*
7. *Use of granular chlorine or chlorine tabs will not be permitted. Use of swabbing with chlorine prior to installation is recommended but not required.*
8. *As noted on the drawings a pig launching assembly shall be installed. Foam and / or polyethylene bristle pigs shall be provided by the contractor to aid in cleaning. Contractor shall provide at no cost all cleaning pigs and installation of the cleaning pigs.*
9. *A written plan for providing cleaning, disinfection and sampling shall be provided to the engineer for approval before main installation begins. A walk thru of the project prior to main installation shall be conducted with the contractor foreman to review disinfection procedures.*

### **Flush Water Disposal**

*The contractor shall provide all piping, hoses, ditches and other conveyance devices to properly dispose of the water from the water mains. The following procedures shall be used:*

1. *Flush water containing chlorine in excess of 1 mg/l shall be directed to the sanitary sewer at rates that do not exceed the capacity of the receiving sanitary sewer. In the event a sanitary sewer is not available the contractor shall provide, install, and operate appropriate de-chlorination equipment. Plan and procedures for de-chlorination shall be approved by the engineer prior to commencing work.*
2. *Waters containing 1 mg/l or less of free residual chlorine to be flushed from the main shall be directed to appropriate storm sewers, ditches or other drainage ways. Disposal of flushed water shall be the responsibility of the contractor. Erosion caused by flushing activities shall be repaired by the contractor. Repair of right of ways and private property shall be completed to the satisfaction of the property owner or controlling authority.*

### **Water Main Disinfection and Flushing**

*Water main disinfection and flushing shall be completed in a timely manner. As noted above a written plan shall be prepared and provided to the engineer for approval. The plan shall limit the amount of time water is allowed to be placed in the main prior to disinfection procedures are applied. The following terms and conditions shall be used with respect to disinfection and flushing of water mains:*

**Step 1. Pre-flushing (By HU Forces):** Once the water main has been installed and all appropriate control valves placed into service, the water main shall then be flushed with potable water. This shall be done at a minimum velocity of 5 fps or maximum achievable with normal system water pressure. Pre-flushing of the water main shall be conducted for a sufficient period of time until the water is clear and then an additional five (5) pipe volumes of water shall be discharged. See above for flush water disposal requirements. Hastings Utilities forces shall be responsible for the operation of all Hastings water valves.

**Step 2. Hydrostatic Pressure Testing (By Contractor):** Immediately after pre-flushing of the main (within 1 hour) the water mains shall be hydrostatically tested. Hydrostatic testing shall be in accordance with the latest revision of AWWA C600 Section 4 or AWWA C605 Section 7 as deemed appropriate. Hydrostatic testing shall be performed at a pressure of 140 psi (965 kPa) minimum to 150 psi (1035 kPa) maximum, with an maximum drop in pressure of 2 psi (14 kPa) over a two hour period. All defective materials or improperly installed materials shall be repaired or replaced as deemed appropriate by the engineer. The hydrostatic pressure test shall be repeated after all repairs are completed and until satisfactory results are obtained.

**Step 3. Aggressive Main Cleaning (Pigging) (By Contractor):** Immediately after hydrostatic testing is satisfactorily completed (within 1 hour) the water mains shall be aggressively pigged using foam or polyethylene bristle pigs as deemed appropriate by the pig manufacturer and contractor experience. Pig selection shall be based upon the type and size of main installed. Every effort shall be made to aggressively clean all sections of the water main. Pigs of appropriate size shall be launched into the water main and pushed through the main using water system pressure. Multiple pigs shall be launched until water flushed with the pig is clear. An additional 2 pigs shall then be launch to insure all debris has been removed. See above for flush water disposal requirements. Hastings Utilities forces shall be responsible for the operation of all Hastings water valves.

**Step 4. Initial Disinfection (By Contractor):** Immediately after the water main has been aggressively cleaned (within 1 hour), the water main shall be disinfected with chlorine. Sufficient amounts of chlorine shall be used to provide a minimum of 25 mg/l to a maximum of 100 mg/l of free chlorine residual for a minimum contact time of 24 hours and no more than 36 hours. Chlorine shall be added to each section of main using a continuous-feed method. The contractor shall provide, install, and operate all chlorination equipment. Chlorine material and placement is the responsibility of the contractor. No additional compensation is provided. Hastings Utilities forces shall be responsible for the operation of all Hastings water valves.

**Step 5. Flushing (By HU Forces):** Once the water main has been disinfected the water main shall be flushed. Flushing of the water main shall be conducted for a sufficient period of time to remove all traces of chlorine. A field chlorine test shall be conducted to confirm all chlorine has been removed. See above for flush water disposal requirements and specifically for waters containing chlorine. Once the chlorine is removed flush an additional five (5) pipe volumes. Hastings Utilities forces shall be responsible for the operation of all Hastings water valves.

**Step 6. Bacteriological Sampling (By HU Forces):** Once the water main has been flushed of disinfectant samples for coliforms and heterotrophic bacteria (a.k.a. HPC or plate count) shall be collected. The water

shall be tested for chlorine residual to insure that all chlorine has been removed. The water samples shall be collected from a service tap. The contractor at his expense shall excavate a location in which Hastings Utilities Forces will install a 1 inch service saddle and polyethylene water service to allow for sampling. The water main shall not be aggressively flushed during the sample collection. The water main is deemed to be clean once two sets of samples are collected 24 hours apart and show no evidence of coliforms (zero coliforms) or heterotrophic bacteria (a.k.a. HPC or plate count) greater than 500 colony forming units per ml (500 cfu/ml).

All samples will be collected by HU forces and delivered to the testing lab. The Nebraska Health Department in Grand Island, NE or Servi-Tech Labs in Hastings, NE shall be used for the testing of these samples. Coli-Alert procedures shall be used for the testing of coliforms.

During each sampling event coliform and heterotrophic bacteria samples shall be collected at a point where system water enters the project. These samples are collected to insure the water used for cleaning of the mains is potable.

**Step 7. Re-cleaning of the water main (By Contractor):** If the water main after testing and flushing as noted above has not been successfully cleaned, then it shall be re-cleaned beginning with Step 3 as noted above. Selection of the pig type and construction shall be reviewed with the engineer for approval. All water used after initial Step 6 as noted above shall be metered using estimated flow rates as determined by Hastings Utilities. This water shall be purchased by the contractor at current residential (Urban) water rates. Expense of all retesting of the water main for coliforms and heterotrophic bacteria (a.k.a. HPC or plate count) shall be the responsibility of the contractor.

**Step 8. Surfactant Cleaning (by Contractor):** If deemed necessary by the contractor the water main may be cleaned using a National Sanitation Foundation (NSF) approved surfactant equal to a Johnson Screens NW-400. Application rate of the surfactant shall be as per manufactures recommendation. NW-400 shall be injected at a rate of 1 gallon per 1500 to 2000 gallons of water. Additionally the main shall be provided chlorine at a minimum rate of 25 mg/l and a maximum of 100 mg/l of free available chlorine. The surfactant and chlorine shall be allowed to be in contact with the pipe interior for a minimum of 24 hours and a maximum of 96 hours. Flushing of the surfactant and chlorine shall be deemed complete when there is not chlorine residual present.

Type and size of cleaning pigs shall be specified and noted in the specifications. The plans shall note a minimum number of pigs to be passed through the main before bacteriology testing is performed. This requirement is necessary to insure the contractor aggressively cleans the water main before beginning flushing and testing before a main is clean will allow biofilm to grow making the cleaning more difficult. Following the procedure as noted above has been shown to reduce the efforts to clean a water main.

The design of the water main shall consider the ability to flush the main. It may require installing flushing hydrants or blow off structures. Provide a minimum of 2.5 fps for flushing velocity unless existing water system capacity is a limiting factor. A flushing velocity of 5.0 fps is preferred.

*When deemed appropriate by the Utility Engineer ice pigging shall be provided. If ice pigging is necessary to satisfactorily clean a main, a construction and operation sequence plan shall be developed. This shall include disposal of the wastewater.”*

**2.9 Water Main Pressure Class Ratings**

Water main pressure class ratings shall comply as a minimum for the following pipe materials.

<u>Pipe Material</u>	<u>Pressure Class Rating</u>
Ductile Iron Pipe (DIP)	Class 52; 4 to 48 inch (Class 50 may be used if not directly tapped for a service)
Ductile Iron Pipe (DIP) Pressure Class	Pressure Class 350; 4 to 24 inch
Poly Vinyl Chloride (PVC)	Pressure Class 200 (DR-14); 4 to 24 inch
Molecular Oriented Polyvinyl Chloride (PVCO)	Pressure Class 200; 4 to 24 inch
High Density Polyethylene Pipe (HDPE)	DR-11 for Open trench Construction and DR-9 for boring applications; 4 to 24 inch

**2.10 Water Main Tracer Wire and Marking Tape**

All water mains shall be installed with tracer wire and marking tape. All water mains shall have a tracer wire buried beside the invert of the pipe. A tracer wire locating station will be supplied to the Contractor by HU. The tracer wire furnished by HU will be a 12 or 14 Gauge AWG solid, Protrace HF-CCS PE30 or equal 30 Mil (0.8 mm) HMW-HDPE coated copper wire. The color will be blue. The wire shall be continuous and unspliced from tracer wire locating station to tracer wire locating station. The tracer wire shall be electrically intrinsic with reference to the water distribution system.

All water main and water service lines of 4" (100 mm) diameter or greater shall have warning tape buried 12" (300 mm) to 24" (600 mm) above the top of the pipe. The warning tape will be inscribed with the message "CAUTION BURIED WATER LINE". The warning tape will be a minimum of 3" (75 mm) in width. The warning tape will be a minimum 4 mils (0.1 mm) in thickness. The warning tape will be blue in color and furnished to Contractor by HU. Installation of tracer wire and warning tape will be subsidiary to bid.

**2.11 Water Main Air Vent Placement**

The design and placement of the water main shall consider the potential entrapment of air. Whenever possible the water main shall be laid to grade to allow venting of trapped air. When this is not possible a service tap shall be specified to vent the air. If possible this service tap should be placed to allow for future use. Provide a minimum 1 inch service tap. If the tap cannot be used the service line shall be removed, valve capped and shut off once it is no longer needed. The location of the tap shall be recorded.

If a permanent air vent is required the placement, type, and size shall be approved by Utility Engineer before the project design is finalized. Adequate protection of the air vent shall be provide. Installation of permanent air vents are not recommended and shall be avoided.

## **2.12 Pipe Lubrication**

The use of yellow pipe lubrication is strictly prohibited. The specification shall require only “Blue lube” pipe lubrication or approved equal.

This design requirement is specified because the excess use of yellow lube has been shown to leave a film of grease inside the water main. This grease film is difficult to remove and provides a surface to retain microbiological contamination and other contaminates.

## **Section 3: Water Service Lines**

### **3.1 Tapping Restrictions**

Taps for customer service piping may be installed on water mains except for those mains designated as transmission mains. See Water System Planning map for more details. All service taps shall be made by Hastings Utilities. Service tap sizes include 1, 1 ½, 2, 4, 6, 8, 10, and 12 inches. Corporation stops are required for 1 to 2 inch taps. All taps shall utilize a tapping saddle. Minimum tap size is 1 inch, reducers can be used to create a smaller service. Refer to Appendix A for service and service saddle connection details.

### **3.2 Connection to Facilities with Private Water Supply - Backflow Prevention Required**

Any system connected to city water while having an additional source such as private well is required to have a backflow preventer at the service connection or approved cross-connection control plan approved by Utility Engineer. An approved cross-connection control plan shall be in conformance with NDHHS Title 129, use cross-connection control guidelines and Hastings City Code chapter 30 Article VII. See section 6 for additional details.

Connection of water services to a facility shall not occur until it is fully documented the facility is compliant with the City of Hastings' Backflow Prevent Code and Plumbing Code. See Section 7 for additional cross-connection control requirements.

### **3.3 Subdivision**

All platted lots of a proposed subdivision are to front on and have a separate water service to a public water main without crossing any adjacent properties. If a need for a long service line where property lines are crossed, it must be prior approved by Utility Engineer.

### **3.4 Multi-family Structures**

Apartments, duplexes, triplexes, etc., do not need to be individually metered or have separate service lines if the complex is owned by one person.

For apartments, duplexes, triplexes, etc., with multiple owners, then individual meters and services are required for each living unit.

### **3.5 Water Service Line Construction**

It is the responsibility of the owner to coordinate with the Utility Engineer to install service lines from the main to the property line (location of stop-box), before paving or other roadway materials are installed. This includes all residential, commercial, and industrial areas. Service line installation shall be limited to areas that will be developed in a timely basis. Care shall be taken to limit the installation of services lines that are not utilized within 2 years of installation. All water service construction must follow the City of Hastings Plumbing Code. Provide tracer wire and warning tape on all water services installed.

With regards to water main design it is noted the water and sewer service lines are owned by the property owner. Hastings Utilities will attempt to locate water and sewer services as a courtesy for a ONE CALL but does NOT guarantee the accuracy of the water service line locates.

Water service line material and construction shall conform to the following Hastings Utilities Technical Specification (see also current revision as noted in the specifications).

**“Water Services and Service Line Connections”**

*“Plastic water service lines of not more than 2 inches (50 mm) in diameter may be used for residences in lieu of copper service lines, subject to the following:*

- a. Plastic tubing used for water service lines shall meet AWWA C901 Polyethylene pipe, SDR-9 PE3408 ASTM D2737, Pressure Class 200 PSI (1400 kPa) or AWWA C904-06 PEX pipe, SDR-9 ASTM F876 (PEX 1006) Pressure Class 200 PSI (1400 kPa). It shall be O.D. based on sizes 3/4 inch (20 mm) thru 2” (50 mm) conforming to the outside diameter of copper tubing.*
  - b. Fittings for plastic water service lines used for plastic water piping shall be of brass pack joints and shall conform to AWWA Standard ASTM B62-Index 115-85-5-5. No plastic fittings or brass flared will be allowed.*
  - c. Installation of plastic water service lines shall have a tracer wire attached to the water main tracer wire with connector supplied by HU, installed by Contractor subsidiary to bid. The wire shall be taped to the service prior to backfilling.*
  - d. Grounding. Grounding of electric services when plastic water services are installed: In the event a metal underground water pipe in direct contact with the earth for 10 feet (3 m) or more is not available on the premises, supplemental electrodes shall be provided. One shall be a rod or pipe electrode as specified in NEC 250-83, and the others shall be as mandated in NEC 250-81. The interior metal water system shall be bonded to the service equipment enclosure.*
  - e. For replacement services the interior metal piping system shall remain bonded to the service equipment. If there is not a ground rod already in use, an 8 foot rod (2.4 m) shall be driven and connected to the service equipment. The grounding electrode system shall comply with NEC 250-81 and 250-84.*
  - f. The city electrical inspector shall approve the installation after being satisfied that there is appropriate grounding.*
  - g. The owner shall pay an additional fee in accordance with the prevailing council fee resolution, for having the plumbing and electrical inspectors make the foregoing inspections.*
- 2) Polyvinyl Chloride Water Service Lines. For installation of 4", 6", and 8" (100 mm, 150 mm, and 200 mm) diameter service lines, the Contractor may use polyvinyl chloride pipe (PVC) or molecularly oriented PVC (PCVO) as specified herewithin. The PVC pipe shall comply with specification 4.101 (c).*
- a. All PVC water service pipe shall have a minimum pressure class of 200. All pipe connections shall be bell and socket or by mechanical joint when connecting PVC to cast iron/ductile iron pipe and fittings.*
  - b. All fittings and transitions shall conform to specification 4.102 of this document.*

- c. *All taps to PVC pipe of auxiliary service lines of two inches in diameter or smaller shall utilize tapping saddles.*
  - d. *Installation of plastic water service lines shall have a tracer wire attached to the water main tracer wire with connector supplied by HU, installed by Contractor subsidiary to bid. The wire shall be taped to the service prior to backfilling.*
  - e. *Grounding of electric services shall be in accordance to specification 4.108 Water Services; paragraphs 2(d) and 2(e) of this document.*
  - f. *The installation of PVC water service shall conform to specification 4.108 Water Services; paragraphs 2(f) and 2(g) of this document.*
  - g. *All water services lines of 8" or greater shall conform to specification 4.101, 4.102, 4.205, and other related and applicable specifications as noted within these documents.*
- 3) *Corporation Stops. Corporation stops shall be furnished and installed by Hastings Utilities through the permit system (Section 2, 2.011). This will include taps up to and including 2-inch diameter. Any Service larger than 2 inch will require ductile iron water main fittings.*
- All taps require a service saddle to be installed or otherwise noted within these specifications. The Contractor shall provide the service saddle and shall properly fasten the saddle to the main. Hastings Utilities shall provide the corporation stop as noted above. Provide an 18-8 ASTM F593 Type 304 stainless steel full body saddle equal to a Ford FS303 x Pipe O.D. x OS-CC4. Provide all saddles to accept tapered corporation valves of 1" to 2" as noted on the drawings. Provide saddles with flush body tapered Buna-N ASTM D200 rubber gaskets.*
- All HDPE water main taps require an Electrofusion fitting, Transition Saddle (Corp Saddle). The Contractor shall provide the transition saddle and shall properly fasten the saddle to the main. Hastings Utilities shall provide the corporation stop as noted above. Electrofusion Transition Saddle shall have a manufacturing standard of ASTM F1055. The Contractor shall provide Electrofusion Transition Saddle equal to Georg Fischer Central Plastics Company with brass 360 alloy outlet materials, and stainless 304 compression ring, and CC Threads or approved equal.*
- 4) *Curb Stop and Box. This item shall consist of one (1) curb stop and one (1) curb box. Curb stops shall be Mueller No. H-15155 or Ford B44 Series, unless otherwise specified, and shall be of the same nominal size as the service line to which they are connected. Curb stops shall be of heavy cast bronze construction and shall be Minneapolis pattern type. Curb boxes shall be extension type, cast iron, adjustable for length, and have Minneapolis pattern base. Lids shall have the word "WATER" cast in them and shall have a provision for being securely held in place.*
- 5) *All water services shall be constructed and installed by the Contractor at a minimum depth of 5'-0" or as by City code and as indicated on the drawings. Any work to be done on the customer side of the curb stop, except for connecting the service line to the curb stop, shall be done by a licensed plumber. All service line work to be completed between the main and curb stop may be done without the services of a licensed plumber. This work shall be deemed to be done by a water main contractor. All service line work to be done by a water main contractor shall be limited to*

*the work as indicated on the drawings and within these contract documents or as directed by the Engineer.*

*The water main contractor shall secure and obtain a plumbing permit for each water service to be installed or worked on. All plumbing permits shall be obtained before the actual service line work is to begin.”*

### **3.6 Water Service Line Sizing**

Long service lines may require upsizing to achieve desired flow as a result of line losses. The final decision and responsibility of service line and meter size is to be determined by the property owner.

## Section 4 Fire Flow Capacity, Fire Hydrants, and Fire Service Lines

### 4.1 Design Fire Flow Capacity - Zoning

All new water main installations must be designed to provide the following minimum fire flow rates:

Geographic Region (Zoning)	Minimum Fire Flow in gallons per minute (gpm)
<b>Residential</b>	<b>1,500</b>
<b>Commercial</b>	<b>2,500</b>
<b>Industrial</b>	<b>3,500</b>

It is recognized that during the design of water main installation or replacement the above noted fire flow may not be met because surrounding mains do not provide sufficient capacity. The minimum main sizes or greater as note in Section 2 shall be installed. As noted, the Utility Engineer will make the final determination of main size if additional capacity is needed to meet expected water supply demands. Refer to the current water main transmission plan for required hydraulic looping and location of transmission or feeder mains.

#### 4.1.1 Fire Flow Rate – High Risk Occupancy

Special consideration for high population occupancy located in residential areas such as schools, churches, auditoriums, colleges, and day care facilities, are to be provided a minimum of 2500 gpm or as determined by the developer.

#### 4.1.2 Fire Flow Rate – Heavy Industrial

Industrial areas having special needs and high fire flow requirements greater than 3,500 gpm shall have fire flow plan developed. This fire flow plan shall be approved by the Utility Engineer, Hastings Building Department, and Hastings Fire Department prior to water main design begins.

### 4.2 Fire Hydrant Location

#### 4.2.1 Fire Hydrant Location - Residential

In residential zoning, fire hydrants shall be spaced every other block and otherwise determined by the Utility Engineer. Fire hydrants in residential areas shall not exceed more than 780 feet and placed on a grid pattern to maximize coverage from multiple hydrants. Fire Hydrants are to be located 6 feet from the property line between the street and sidewalk, approximately 2 feet off the sidewalk. See attached fire hydrant location summary for more details (Appendix D).

#### 4.2.2 Fire Hydrant Location - Rural

For non-developed (rural) areas the average distance between hydrants is typically 1000 feet with no distance being greater than 1500 feet. Whenever possible the fire hydrant should be placed near a property corner,  $\frac{1}{4}$  and  $\frac{1}{2}$  section lines, and at every roadway or street intersection. Placement of the

fire hydrant shall be located to avoid third party damage. Typically the fire hydrant is placed 2 feet off the property line / right-of-way.

#### **4.2.3 Fire Hydrant Location – Commercial and Industrial**

In commercial and industrial zoning, spacing shall be located at every intersection when possible with a distance between hydrants of not to exceed 500 feet. Locate hydrants near access points to industrial facilities. Fire Hydrants are to be located 6 feet from the property line between the street and sidewalk, approximately 2 feet off the sidewalk. See attached fire hydrant location summary for more details (Appendix D).

#### **4.2.4 Fire Hydrant Location – Cul-de-sac**

Fire hydrants placed to serve a cul-de-sac shall be located on the end of the main (bulb of the cul-de-sac) and on the property line between two lots to avoid driveway conflicts. It is required to have at least one fire hydrant in each cul-de-sac, there may be more depending on the size of cul-de-sac and the required hydrant coverage as noted above.

Avoid installation of dead end hydrants by looping through the cul-de-sac by providing hydraulic looping.

#### **4.2.5 Flushing Hydrants**

Fire hydrants installed solely for testing purposes shall be removed once testing is completed. If the flushing hydrants is to remain in place for the duration of a winter season, the fire hydrant must be installed a minimum of 3 feet behind the proposed curb and gutter.

#### **4.3 Fire Hydrant Operating Clearance**

A minimum of 3-foot radius clear space measured from the circumference of the fire hydrant must be upheld around all fire hydrants. Any item such as light poles, posts, fences, structures, and other items which hinder the accessibility to immediately access the hydrant shall not be placed or installed near the fire hydrants.

All fire hydrants in rural areas with the potential to have minimal vegetative maintenance areas shall be fitted with weed seal mats and other indicators such as signage posts.

#### **4.4 Storz Hydrant Connections**

All new fire hydrants shall be fitted with Storz connections. The HU Water Department shall install the Storz connection before the fire hydrant is placed into service.

## **Section 5: Water Valves**

### **5.1 Water Valve Construction**

All water valves installed on pipes 4 to 12 inches in diameter a resilient seated gate valve is the only acceptable valve. For valves 16 inches through 30 inch in diameter provide a bevel gear gate valve with resilient seats. Butterfly valves are not acceptable. All valves shall be installed with valve boxes and valve stem extensions.

### **5.2 Water Service Valves**

Water valves and curb stops for domestic services are to be installed at the property line for 1 inch to 2 inch taps. Any tap 4 inches and larger requires the water valve to be at the service tap located on the main and not the property line.

### **5.3 Fire Hydrant Auxiliary Valves**

Auxiliary valves are required on all fire hydrant leads. Valve size shall match hydrant lead.

### **5.4 Post Indicator Valve (PIV)**

All PIVs are privately owned, a main service valve is required before the PIV. Domestic service line tap can be placed on a fire service line before the PIV. Wall indicator valves are not allowed.

### **5.5 Uni-directional Flushing**

The water main feeding the fire hydrant is required to be provided with main line valves in order to allow for uni-directional flushing of the water main for distances not to exceed 1,000 feet or every intersection. Utility Engineer will review and approve of all valve placement plans. See attached Typical Fire Hydrant Detail Plan in Appendix A.

The design of the water main and appurtenances project shall be developed to allow for sectional testing and cleaning. The design shall also address the uni-directional flushing and if possible flushing from 2 directions. Connection of the water main extension project shall consider pressure, volume, and impact on upstream users. This shall be a consideration when developing a cleaning and flushing plan.

### **5.6 Valve Marking and Signage**

All valves installed in rural or low vegetative maintenance areas are required to have weed seal mats installed around the valve riser and indicator posts identifying the location.

### **5.7 Mainline Valve Placement within roadways and intersections**

Placement of valves (Valve Box) shall avoid the travel lane whenever possible. If it is necessary to install the valve in a traffic lane it shall be placed in the center of the driving lane when practical.

Placement of valves in sidewalks shall be placed within the center of the sidewalk whenever possible.

Placement of the valves shall consider vehicular traffic, pedestrian traffic, and handicap traffic to avoid conflicts and potential tripping hazards if frost heave and settlement occurs.

## **Section 6: Water Meters**

### **6.1 Domestic Water Meters**

Hastings Utilities furnishes all water meters for the service connection which are paid for by the owner. The meter shall be installed by a City of Hastings Licensed Plumber. The property owner owns the meter while Hastings Utilities is responsible for maintaining it.

When a water meter installation is to be housed in an un-accessible enclosure or location provide for remote reading. For meter pit installations see attached Appendix A for standard water meter pit details. The use of water meter pits shall be reviewed and approved by the Utility Engineer. Please refer to City of Hastings Code Chapter 30-112 Water Meter Installation and Chapter 30 Article VIII: Backflow Prevention.

### **6.2 Master Water Meters**

Master meters are allowed for main line metering of industrial, commercial, colleges, and single owner multifamily living complexes but are subject to approval from Utility Engineer. Metering systems shall be reviewed and approved by Utility Engineer.

All master water meters must be installed in an accessible climate controlled structure complete with ventilation and electricity. All master water meters are required to have backflow prevention assemblies installed. Additional information can be found in Hastings City Code Chapter 33-604 Article 6: Water Service and Hastings City Code Chapter 30 Article VIII Backflow Prevention.

## **Section 7: Cross-Connection Control and Backflow Prevention**

The City of Hastings' potable water system shall be protected from all cross connections by providing backflow prevention assembly in accordance with Hastings City Code Chapter 30 Article VIII: Backflow Prevention and approved by Utility Engineer.

Containment of the water service at the meter may be required if the facility to be protected cannot be properly and completely surveyed for cross-connections, has plumbing hazards, or has restrictions on access. Whenever possible the industrial and commercial processes shall be isolated with a master backflow prevention device. Duplicate backflow preventers may be required if the water service cannot be interrupted for testing of the backflow prevention device. Potable water use shall be located upstream of the master backflow preventer and downstream of the water meter. The service fixtures used within the potable water service system shall have appropriate isolation backflow preventers installed and maintained.

## **Section 8      Utility Crossings**

### **8.1      Parallel Sewer and Water Mains**

Water mains shall be separated by at least 10 feet closest distance horizontally outside of pipe to outside of pipe from any existing or proposed parallel sanitary sewer. If conditions do not allow for this and the main must be closer, it shall be prior approved by the Utility Engineer. To allow for separation of less than 10 feet, a joint-less section of main may need to be installed. See attached detail for water and sewer crossings in Appendix A. See Appendix E for NDHHS guidance on Utility crossings.

### **8.2      Sanitary Sewer Crossings**

Water mains shall be laid at such an elevation that the bottom of the water main is at least 18 inches above the top of the sanitary sewer pipe. Elbows can be used to reroute water mains around a sanitary sewer. In the instance that the bottom of the main is less than 18 inches above the top of the sanitary sewer, or the sanitary sewer is located above the water main, the sanitary sewer shall be constructed or reconstructed using a 20 feet length of PVC pressure pipe or Ductile Iron Pipe designed for sanitary sewers. The pipe must meet the requirements of the AWWA C900 DR18 with a pressure rating of 150 psi or AWWA C150, Class 52 with SewerCoat mortar lining (Aluminum Silicate) or equal. The closest sewer connection and joint to a crossing requires concrete collar. See attached detail for water and sewer crossings in Appendix A. See Appendix E for NDHHS guidance on Utility crossings.

### **8.3 Clearance from Open Structures**

All water mains shall be laid with a minimum clearance of 2 feet from subgrade structures open to the weather, such as storm sewer inlets.

All sewer and water crossings must be approved by the Utility Engineer.

### **8.4 Railroad and Highway Crossings Permits**

Plans and specifications for proposed installations on highways, county roads or railroad rights-of-ways shall be submitted to the appropriate railroad company, the Adams County Engineer, City of Hastings Engineer, or the State of Nebraska Department of Transportation for approval and issuance of any required occupancy or construction permits. When a construction or occupancy permit is required it shall be obtained in the name of City of Hastings, NE / Hastings Utilities. All required construction and occupancy permits shall be received prior to final approval of plans by the Utility Engineer. When water mains cross railroads and state highways they shall be installed within an encasement pipe (casing).

When water mains cross county roads the approving authority will advise on casing requirements. Utility Engineer will also advise on the need for casing on county roads. This additional protection may be due to utility congestion in the right-of-away, potential for third party damage, or other factors both present and future.

Water mains crossing city arterial and main thoroughfare streets may require water mains to be placed in casings as per highway crossing requirements. Water mains crossing other city streets are permitted to be constructed using open trenching and / or open boring methods. Utility Engineer will advise on

the need for casing on any city street crossing. This additional protection may be due to utility congestion in the right-of-away, potential for third party damage, or other factors both present and future.

See encasement details as found in Appendix A.

### **8.5 Hastings Airport Crossing Permits**

When water mains and appurtenances are to be constructed on the Hastings Municipal Airport the project shall be approved by FAA through its permitting process. The proposed and final construction shall be provide for inclusion in the Hastings Airport Facility Plan. Consultation with the current Hastings Airport Engineering Consultant is required to insure all proper permits and notifications are provided.

### **8.6 Railroad Crossings – Casing Requirements**

When water mains are required to be constructed under railroads a casing shall be installed. This casing shall be constructed to across the full path of the Railroad Right of Way (Edge of Right of Way to Edge of Right of Way) whenever possible. Any deviation of this requirement shall be approved by the Utility Engineer.

Casing diameter and thickness requirements for railroads crossings is found in the Appendix F.

Only DIP or HDPE pipe shall be installed in a railroad casings.

DIP requires skids to be installed on the pipe to properly support the pipe so as to limit corrosion between the DIP and the steel casing. When DIP is used a restraining gasket can be used in lieu of restrained joint. When restrained joint gaskets are used a reduction in casing size can be selected. See Appendix F for casing size requirements when using restrained joint gaskets.

The selection of the casing size shall be approved by the Utility Engineer. The Utility Engineer will evaluate the need to install communication conduits. These communication conduits are to be installed to support future phone, fiber optic, and other communication systems to benefit the development and city services.

See Appendix F for casing size requirements when HDPE is installed for the water main.

### **8.7 Highway Crossings– Casing Requirements**

When water mains are required to be constructed under state highways, major street arterials, and other designated streets a casing may be required. Casing requirements for street crossings will be determined by the Utility Engineer. Risk of pipe failure impacting property (value) and public safety will be a consideration. Potential of third party damage by maintenance of adjacent utilities will also be considered.

This casing shall be constructed to across the full path of the perpendicular state highway Right of Way (Edge of Right of Way to Edge of Right of Way) to the traverse path of the water main whenever possible. Any deviation of this requirement shall be approved by the Utility Engineer.

Casing diameter and thickness requirements for highway and street crossings is found in the Appendix F.

Only DIP or HDPE pipe shall be installed in a highway and street casings.

DIP requires skids to be installed on the pipe to properly support the pipe so as to limit corrosion between the DIP and the steel casing. When DIP is used a restraining gasket can be used in lieu of restrained joint. When restrained joint gaskets are used a reduction in casing size can be selected. See Appendix F for casing size requirements when using restrained joint gaskets.

The selection of the casing size shall be approved by the Utility Engineer. The Utility Engineer will evaluate the need to install communication conduits. These communication conduits are to be installed to support future phone, fiber optic, and other communication systems to benefit the development and city services.

See Appendix F for casing size requirements when HDPE is used for the water main.

### **8.8 Hastings Municipal Airport Runway and Taxiway Crossings– Casing Requirements**

When water mains are required to be constructed under Hastings Municipal Airport runways and taxiways a casing shall be installed. The depth of the casing shall be a minimum of 6 feet below the edge of the paving. This casing shall be constructed to cross the full path runway or taxiway plus an additional 50 feet either side. Any deviation of this requirement shall be approved by the Utility Engineer and designated engineer for the airport.

Casing diameter and thickness requirements for Hastings Municipal Airport crossing is found in the Appendix F.

Only DIP or HDPE pipe shall be installed in a Hastings Municipal Airport casings.

DIP requires skids to be installed on the pipe to properly support the pipe so as to limit corrosion between the DIP and the steel casing. When DIP is used a restraining gasket can be used in lieu of restrained joint. When restrained joint gaskets are used a reduction in casing size can be selected. See Appendix F for casing size requirements when using restrained joint gaskets.

The selection of the casing size shall be approved by the Utility Engineer. The Utility Engineer will evaluate the need to install communication conduits. These communication conduits are to be installed to support future phone, fiber optic, and other communication systems to benefit city services.

See Appendix F for casing size requirements when HDPE is used for the water main.

## **Section 9 As-Built and Final Inspection**

### **9.1 Final Inspection**

When the construction of the water main and appurtenance as completed including seeding, sodding, clean up, concrete paving, and asphalt items a final inspection with the Utility Engineer (or his representative), Consultant Engineer (or his representative) (if applicable) and the contractors foreman shall inspect all aspects of the project to make sure it is complete.

### **9.2 Project Documentation**

The contractor and / or consulting engineer when appropriate shall provide all document for the project. This shall include all as-builts, shop drawings, test reports, pay requests, change orders, and other documentation as required by the utility engineer.

As-built information shall be submitted to Hastings Utilities within 14 days of the final project inspection.

Plans: The information shall be submitted as red lined drawings and when specified on AutoCAD compatible electronic data file for incorporation into the project AutoCAD drawing.

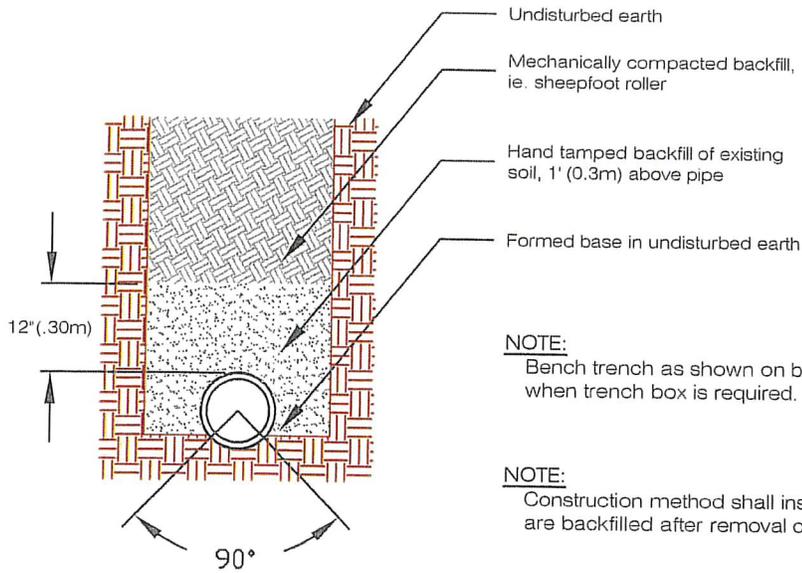
Specification: Applicable as-built information shall be submitted via track changes on a copy of the project MS Word document.

### **9.3 Substantial Completion**

The specifications for a water project shall note if the contractor is allowed to release any part of the installed water system for use by the City / HU prior to final inspection. This may be necessary for staging of related projects or the need to provide service before the project is completed. Substantial completion does not relieve the contractor or consultant of any final inspections or submittal of project documentation.

No water main or appurtenance shall be placed into service until the hydro-static testing and cleaning is completed. This requirement may be waived only when a repair is made and the main needs to be placed into service quickly or a mainline valve is installed to facilitate shut down.

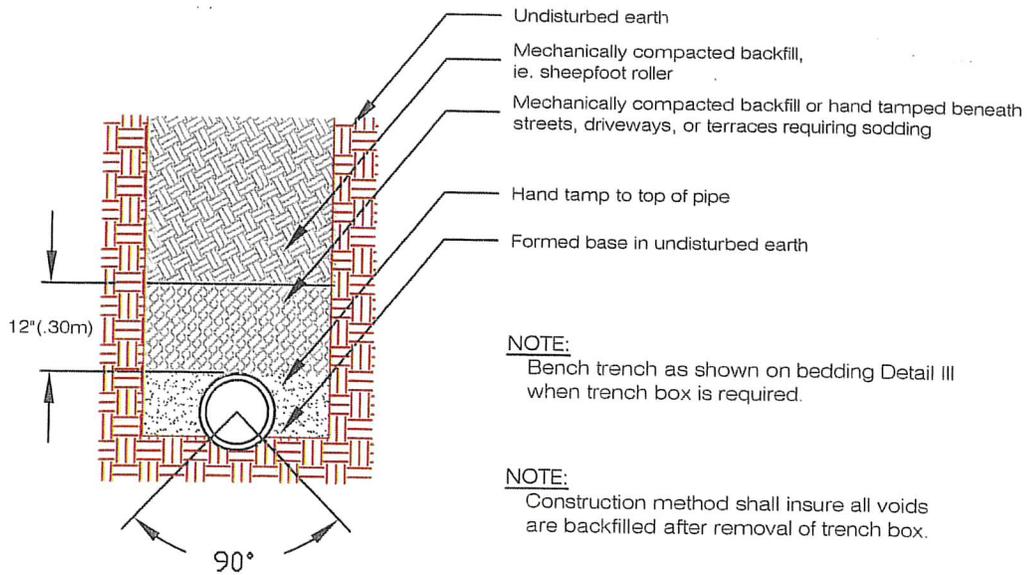
# Appendix A



**NOTE:**  
Bench trench as shown on bedding Detail III when trench box is required.

**NOTE:**  
Construction method shall insure all voids are backfilled after removal of trench box.

### TYPE I BEDDING-PVC & HDPE WATER MAIN



**NOTE:**  
Bench trench as shown on bedding Detail III when trench box is required.

**NOTE:**  
Construction method shall insure all voids are backfilled after removal of trench box.

### TYPE II BEDDING-DIP WATER MAIN

\\Hudomain\Birch\Water\Prototype\S.P.A.-1 Drawing-1.dwg

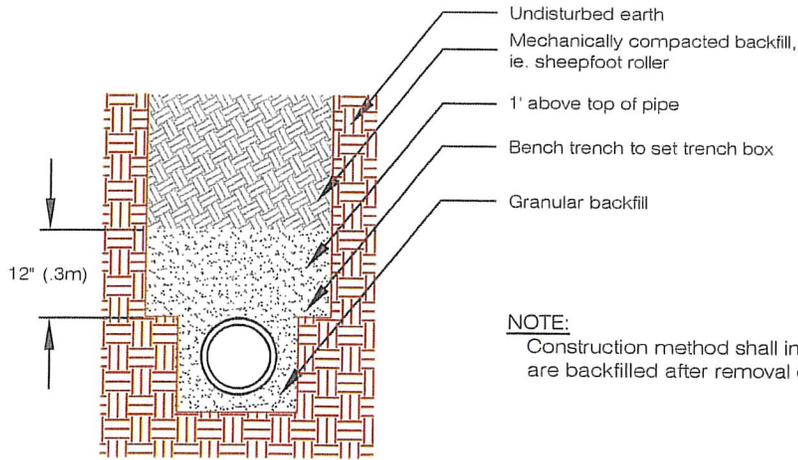
DSN: M. Sidlo	CKD:
DRN: M. Sidlo	CKD:
REVISED: Aug. '19	APP:

**Bedding for PVC, HDPE, & DIP  
Water Mains**



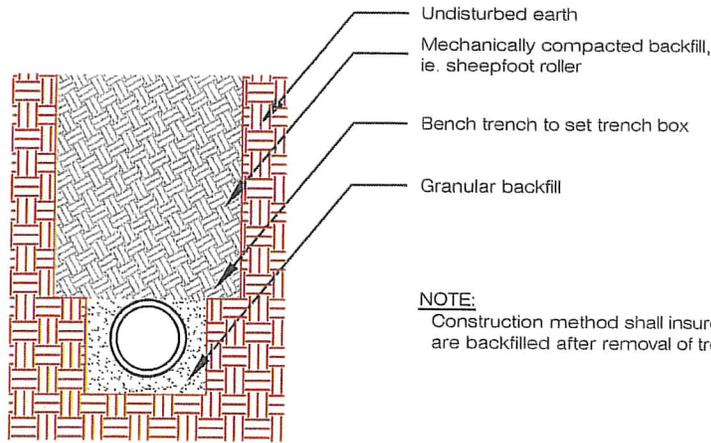
**HASTINGS UTILITIES**  
Hastings, Nebraska

NO  
**PLAN  
1A**



**NOTE:**  
Construction method shall insure all voids are backfilled after removal of trench box.

**TYPE III BEDDING-PVC, HDPE & VCP SEWER**



**NOTE:**  
Construction method shall insure all voids are backfilled after removal of trench box.

**TYPE IV BEDDING-DIP SEWER MAIN**

\\Hudomain\Birch\Water\Prototype\S.P.A.-1 Drawing-1.dwg

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DRN: M. Sidlo	CKD:
REVISED: Aug. '19	APP:

**Bedding for PVC, HDPE, VCP  
& DIP Sanitary Sewer Mains**



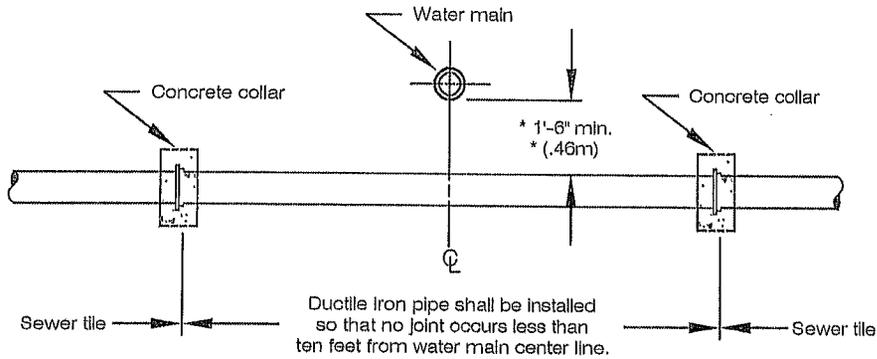
**HASTINGS UTILITIES**  
Hastings, Nebraska

NO  
**PLAN  
1B**

**\* NOTE:**  
When this distance is greater than 3'-0" (0.92m), the concrete collars duct iron pipe will not be required.

**NOTE:**  
When more that 18" (.46m) clearance exists, ductile iron pipe is not required.

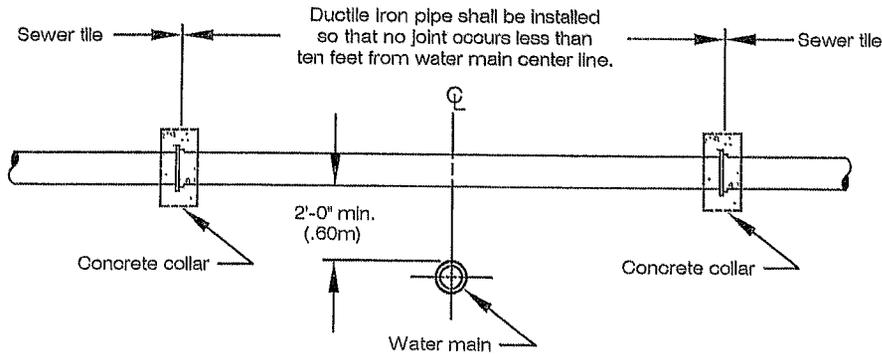
**NOTE:**  
When water and sanitary sewer mains parallel each other, there must be a minimum of 10'-0" (3.048m) separation from face to face.



Center one 20' length of water main so joints in the water main occur not less than 10' from the sewer main crossing.

**SEWER CROSSING UNDER WATER MAIN DETAIL**

Center one 20' length of water main so joints in the water main occur not less than 10' from the sewer main crossing.



**NOTE:**  
When water and sanitary sewer mains parallel each other, there must be a minimum of 10'-0" (3.04m) separation from face to face.

**SEWER CROSSING OVER WATER MAIN DETAIL**

\\Hudomain\B\lch\Water\Prototype\S.P.A.-1 Drawing-1.dwg

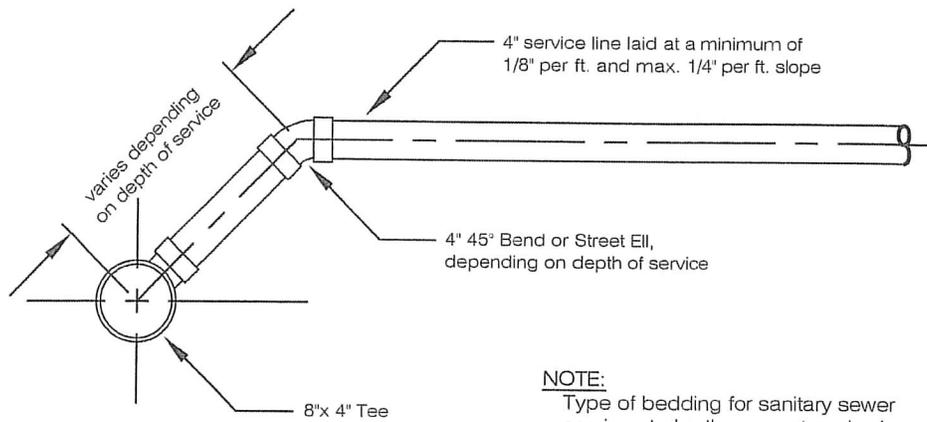
DSN: M. Sldo	OKD:
DRN: M. Sldo	CKD:
REVISED: Sept. '05	APP:

**San. Sewer Main Crossings  
Over & Under Water Mains**

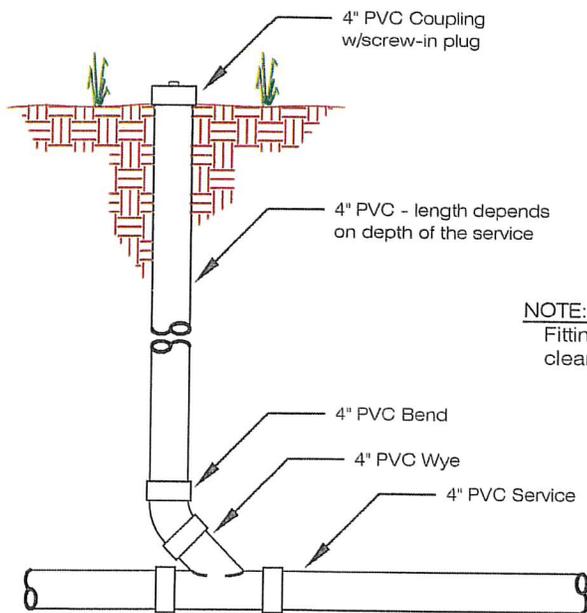


**HASTINGS UTILITIES**  
Hastings, Nebraska

NO.  
**PLAN  
1C**



**SANITARY SEWER SERVICE DETAIL**



**SAN. SEWER SERVICE CLEAN-OUT**

\\Hudomain\Birch\Water\Prototype\S.P.A.-1 Drawing-1.dwg

DSN: M. Sidlo	CKD:
DRN: M. Sidlo	CKD:
REVISED: Sept. '05	APP:

**Sanitary Sewer Service and Clean-Out Details**

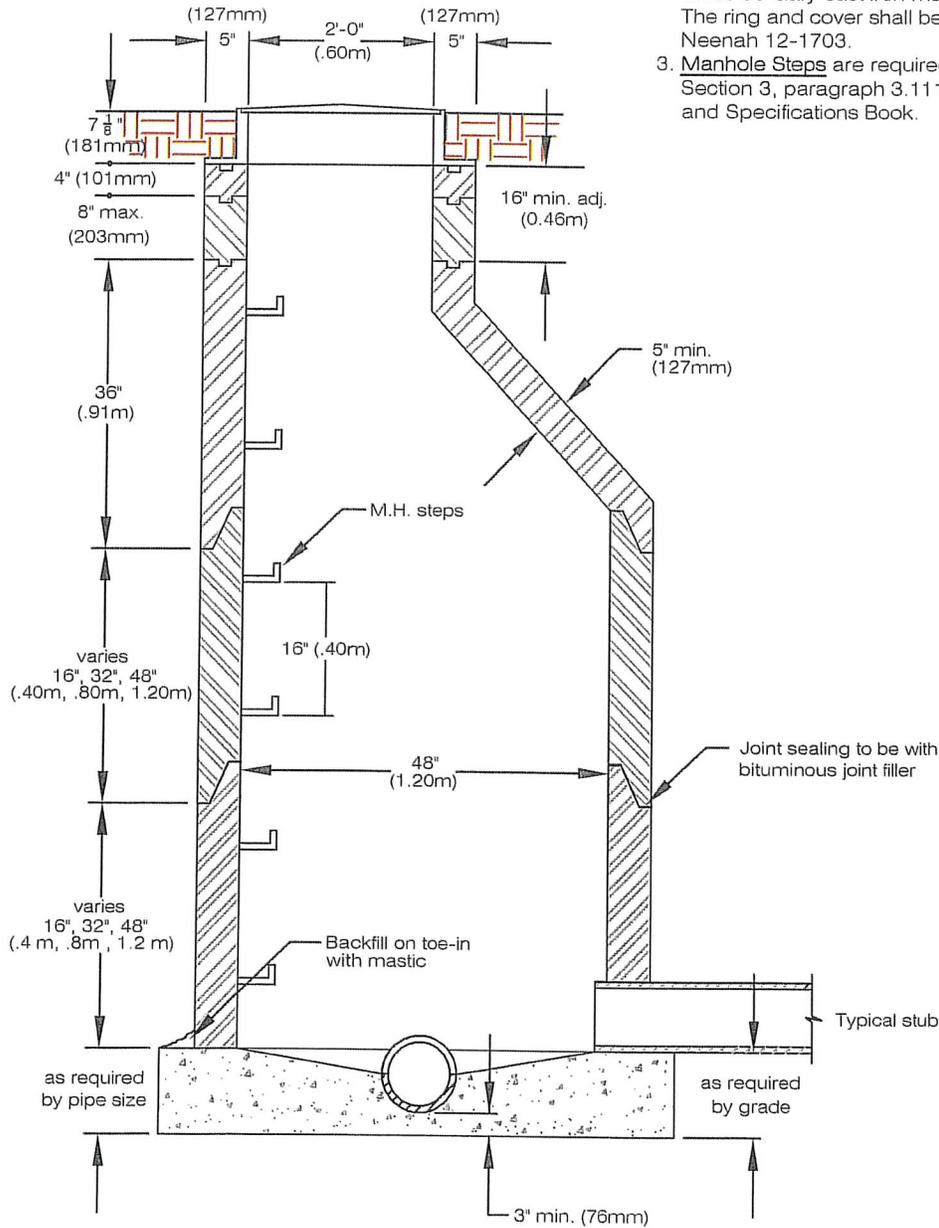


**HASTINGS UTILITIES**  
Hastings, Nebraska

NO  
**PLAN 1D**

**NOTES:**

1. Precast Sections must be made in such a manner that each section joins together in a normal configuration, otherwise section will be rejected as "unsatisfactory." The contractor will be liable and will provide a new section which is satisfactory. No sections will be used where void spots exist.
2. Manhole Ring and Cover shall be 450 lb (200 Kg) Class 35 Gary cast iron machined ring and cover. The ring and cover shall be Deter No. 1030 or Neenah 12-1703.
3. Manhole Steps are required and shall conform to Section 3, paragraph 3.111 of the current Contract and Specifications Book.



\\Hudomain\Birch\Water\Prototype\S.P.A.-1 Drawing-1.dwg

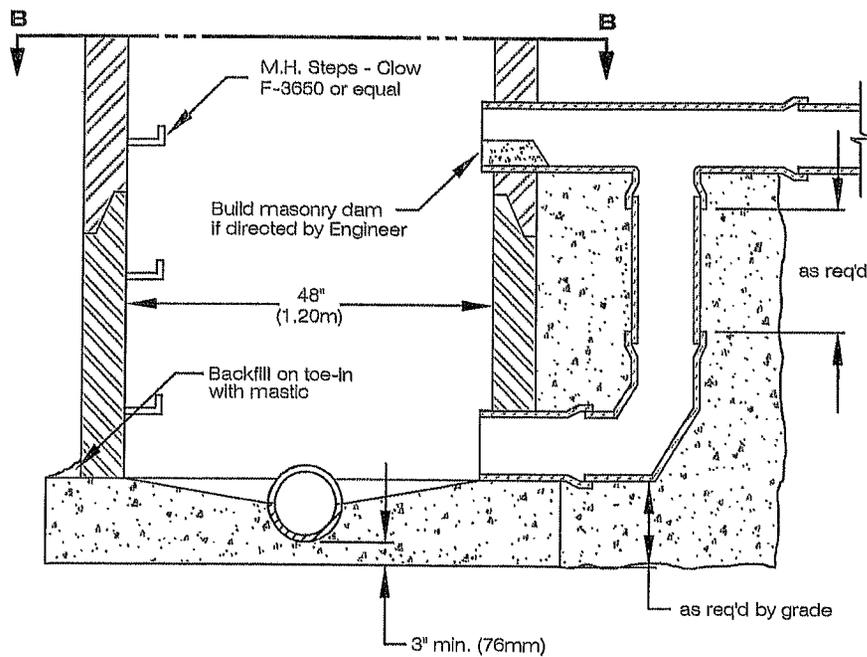
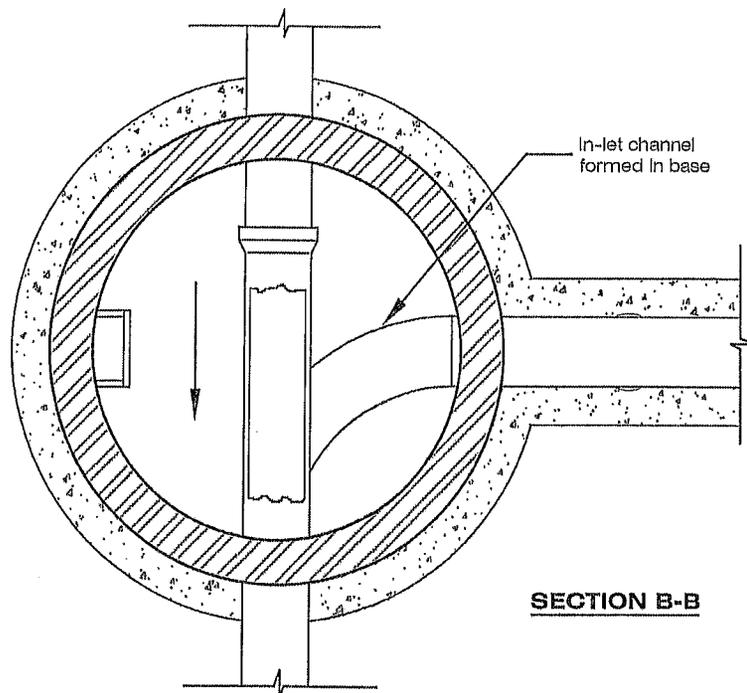
DSN:	CKD:
M. Sidlo	
DRN:	CHKD:
M. Sidlo	
REVISED:	APP:
July '19	

**Standard Sanitary Sewer  
Manhole Detail**



**HASTINGS UTILITIES**  
Hastings, Nebraska

NO  
**PLAN  
1E**



\\Hudomain\B\reh\Water\Prototype\S.P.A.-1 Drawing-1.dwg

DSN: M. Sidlo	CKD:
DRN: M. Sidlo	CKD:
REVISED: Sept. '05	APP:

**Standard Drop  
Manhole Detail**

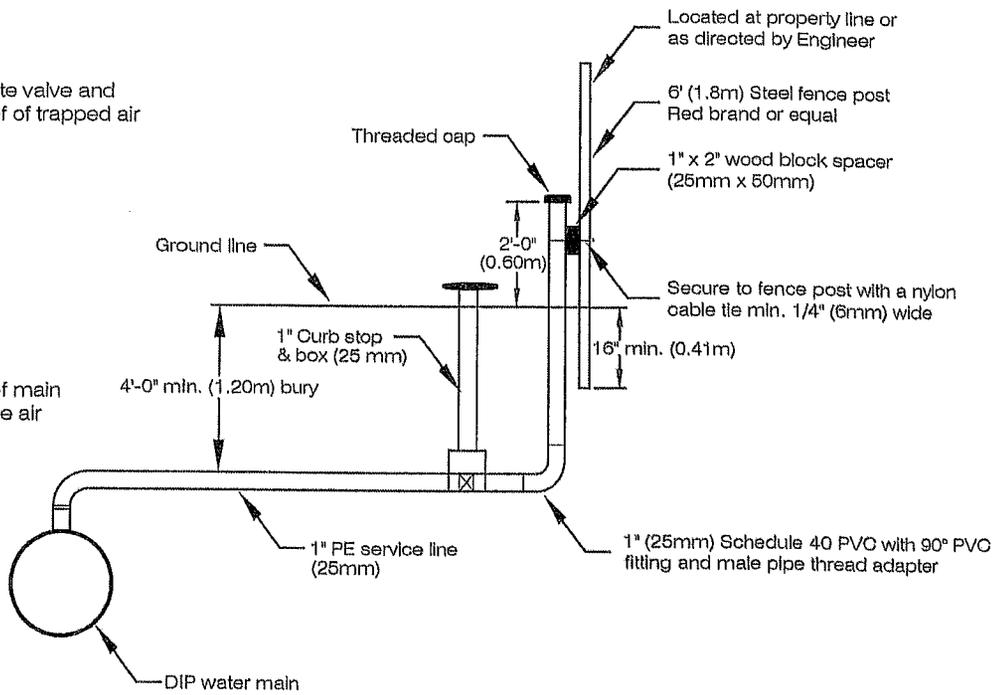


**HASTINGS UTILITIES**  
Hastings, Nebraska

NO.  
**PLAN  
1F**

**NOTE:**  
 HU to operate valve and  
 provide relief of trapped air

**NOTE:**  
 Tap on top of main  
 to remove the air



\\Hudomain\B\B\Water\Protolypa\S.P.A.-1 Drawing-1.dwg

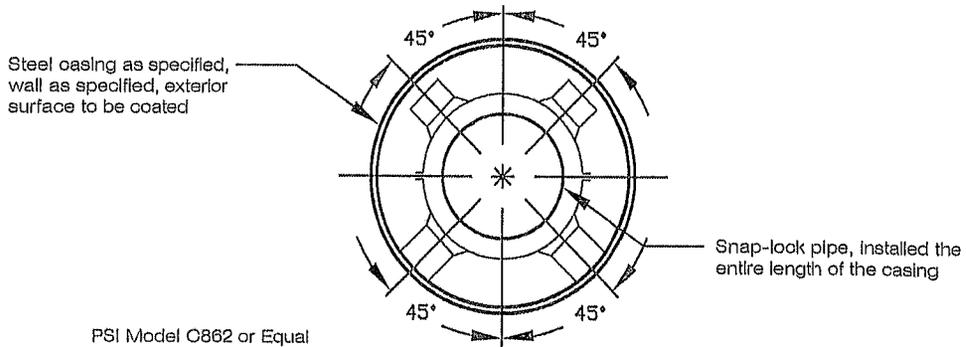
DSN: M. Siclo	CKD:
DRN: M. Siclo	CKD:
REVISED: Sept. '05	APP:

**Air Relief Detail**



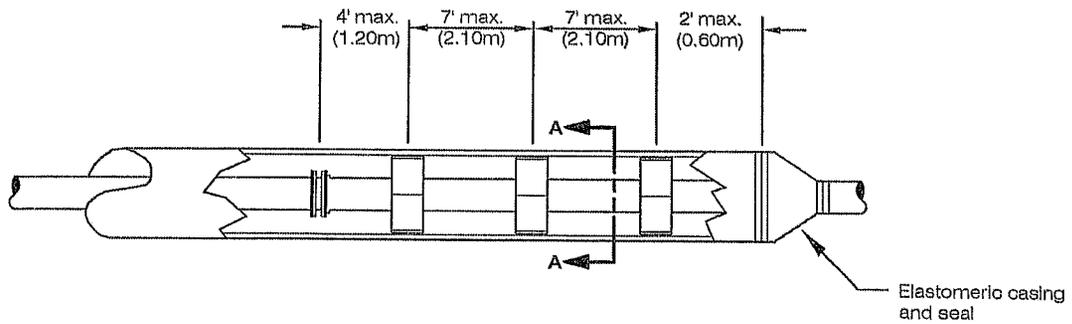
**HASTINGS UTILITIES**  
 Hastings, Nebraska

NO.  
**PLAN 1G**



**SECTION "A-A"**

**NOTE:**  
Tracer wires to be installed through tracer wire riser UNBROKEN



**NOTE:**  
One chock shall be placed not more than 2'-0" (0.60m) from each end of the casing. Subsequent chocks were placed at intervals shown within the casing pipe.

\\Hudomain\B\rah\Water\Prototype\S.P.A.-1 Drawing-1.dwg

DSN: M. Sidlo	CKD:
DRN: M. Sidlo	CKD:
REVISED: Sept. '05	APP:

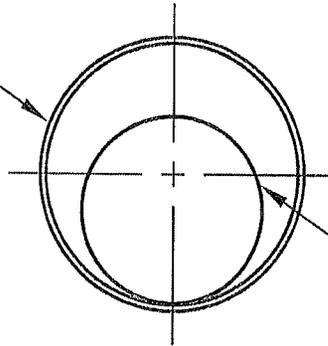
**Steel Casing Detail  
for DIP Mains**



**HASTINGS UTILITIES**  
Hastings, Nebraska

NO.  
**PLAN  
1H**

Steel casing as specified,  
wall as specified, exterior  
surface to be coated

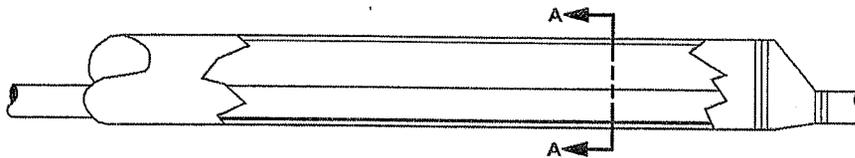


HDPE, installed the  
entire length of the casing

**SECTION "A-A"**

**NOTE:**

Tracer wires to be installed through  
tracer wire riser UNBROKEN



**NOTE:**

HDPE to lay on the flowline of casing.

\\Hudomain\Birch\Water\Prototype\S.P.A.-1 Drawing-1.dwg

DSN: M. Siclo	CKD:
DRN: M. Siclo	CKD:
REVISED: Sept. '05	APP:

**Steel Casing Detail  
for HDPE Mains**

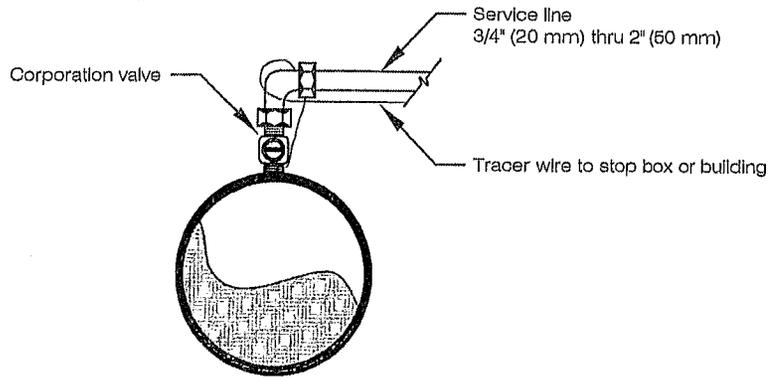


**HASTINGS UTILITIES**  
Hastings, Nebraska

NO.  
**PLAN  
1J**

**NOTE:**

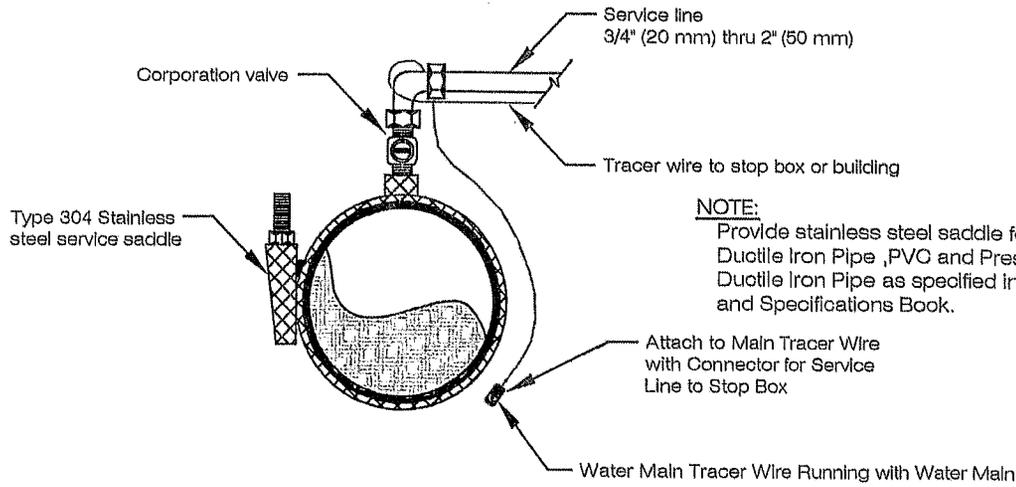
Tap corporation valve directly into  
Class 52 Ductile Iron Pipe



Existing Ductile Iron Pipe

**NOTE:**

All water services to be  
min. 5'-0" (1.52m) bury



**NOTE:**

Provide stainless steel saddle for Class 52  
Ductile Iron Pipe, PVC and Pressure Class  
Ductile Iron Pipe as specified in Contract  
and Specifications Book.

Class 52 Ductile Iron Pipe, AWWA C900 Polyvinyl Chloride Pipe, and  
Pressure Class Ductile Iron Pipe

\\Hudomain\B\ch\Water\Prototype\S.P.A.-2 Drawing-1.dwg

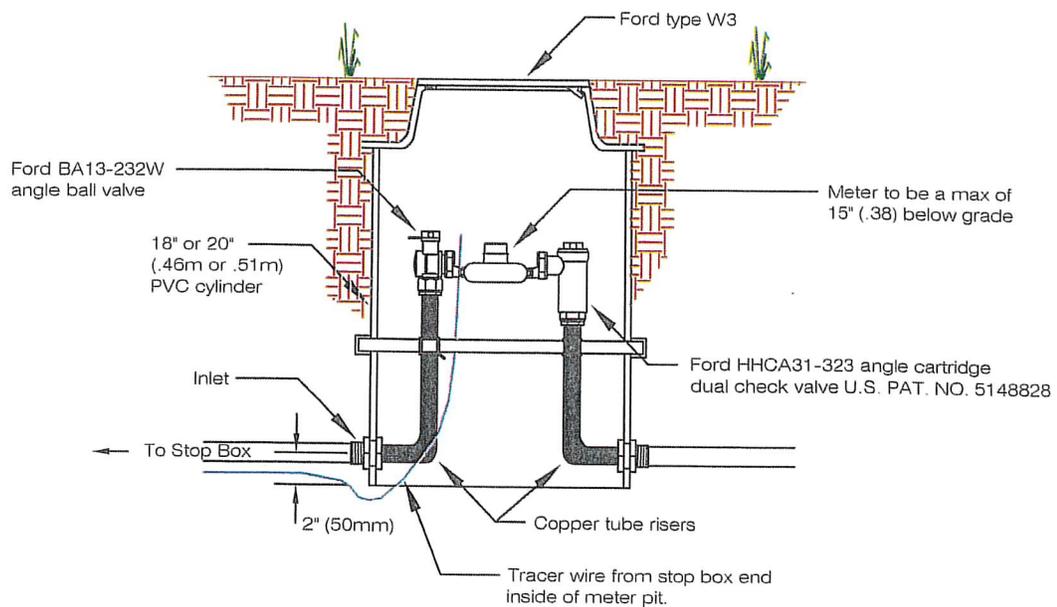
DSN: M. Stange	CKD:
DRA: J. Redding	CKD:
REVISED: June '04	APP:

**Service and Service Saddle  
Connection Details 3/4" - 2"**



**HASTINGS UTILITIES**  
Hastings, Nebraska

NO.  
**PLAN  
2A**



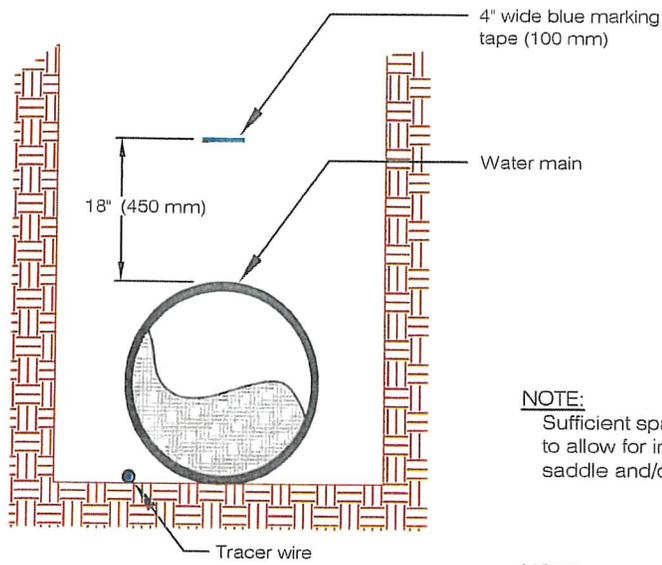
\\Hudomain\B\B\Water\Prototype\S.P.A.-2 Drawing-1.dwg

DSN:	CKD:
M. Stange	
DRN:	CKD:
J. Redding	
REVISED:	APP:
June '04	

**Standard Meter Pit  
Detail**


**HASTINGS UTILITIES**  
 Hastings, Nebraska

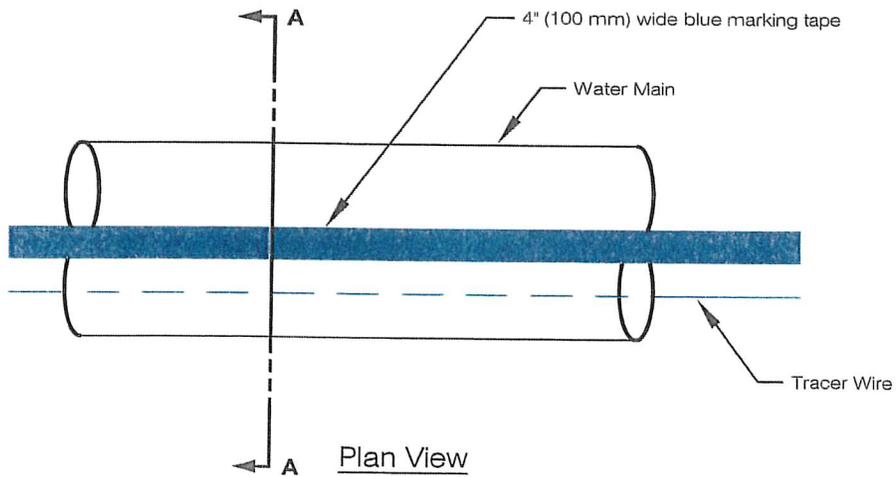
NO
<b>PLAN 2B</b>



**NOTE:**  
Sufficient space shall be provided to allow for installation of service saddle and/or tapping equipment

**NOTE:**  
Tracer wire and warning tape to be provided by Hastings Utilities (subsidiary to bid)

Section A-A



\\Hudomain\Birc\Water\Prototype\S.P.A.-2 Drawing-1.dwg

DSN: M. Stange	CKD:
DRN: J. Redding	CKD:
REVISED: June '04	APP:

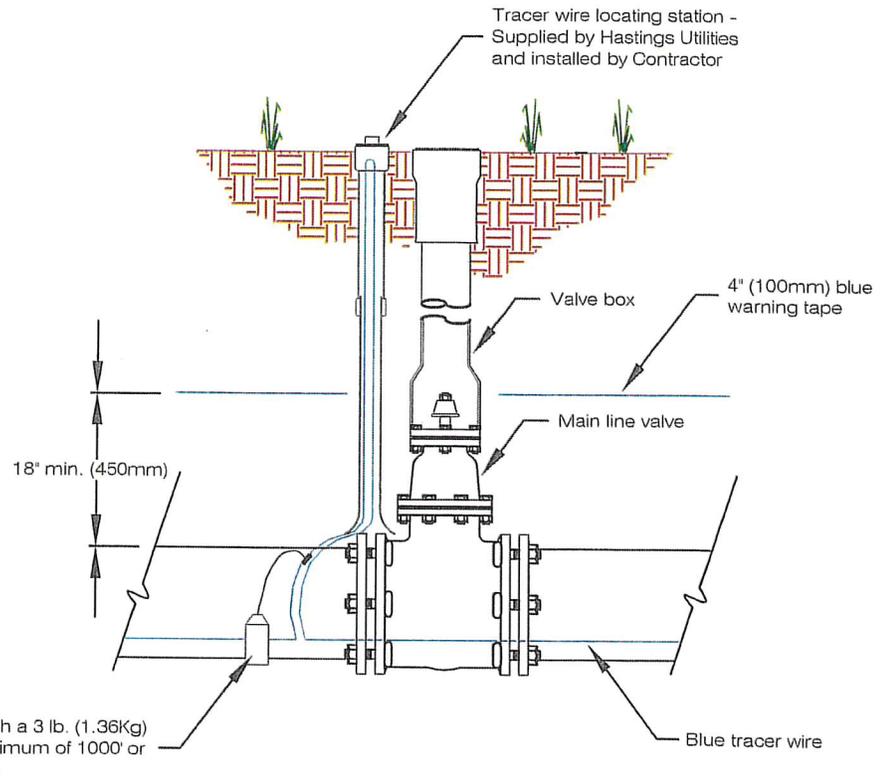
**Tracer Wire and  
Warning Tape Detail**



**HASTINGS UTILITIES**  
Hastings, Nebraska

NO.  
**PLAN  
2C**

**NOTE:**  
Tracer wires to be installed through  
tracer wire riser UNBROKEN



Plan View

\\Hudomain\B\B\Water\Prototype\S.P.A.-2 Drawing-1.dwg

DSN: M. Stange	CKD:
DRN: J. Redding	CKD:
REVISED: June '04	APP:

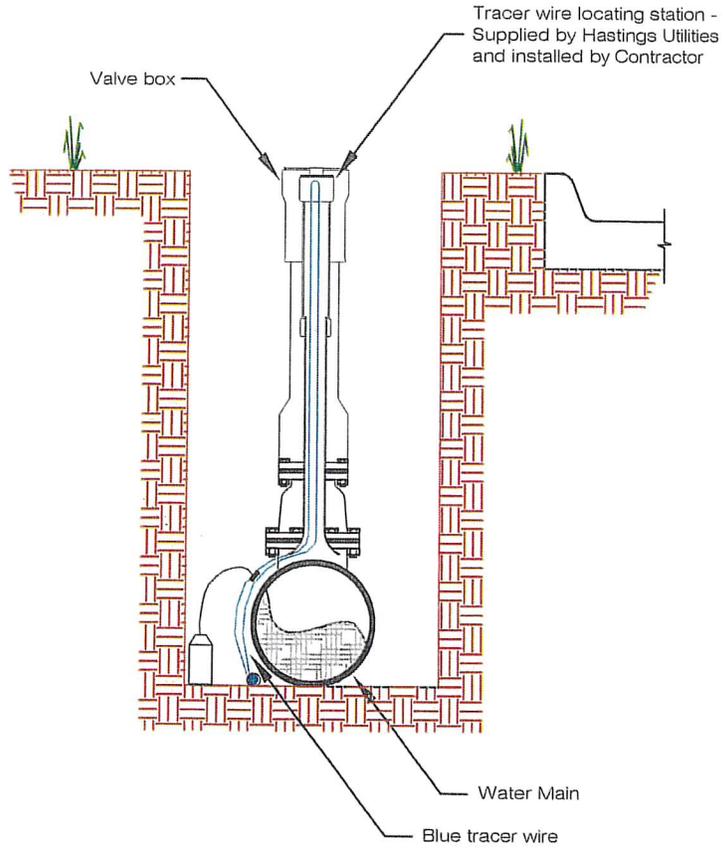
**Tracer Wire Riser Detail  
at Main Line Valve**



**HASTINGS UTILITIES**  
Hastings, Nebraska

NO.  
**PLAN  
2D**

**NOTE:**  
Tracer wires to be installed through  
tracer wire riser UNBROKEN



Section View

\\Hudomain\B\roh\Water\Prototype\S.P.A.-2 Drawing-1.dwg

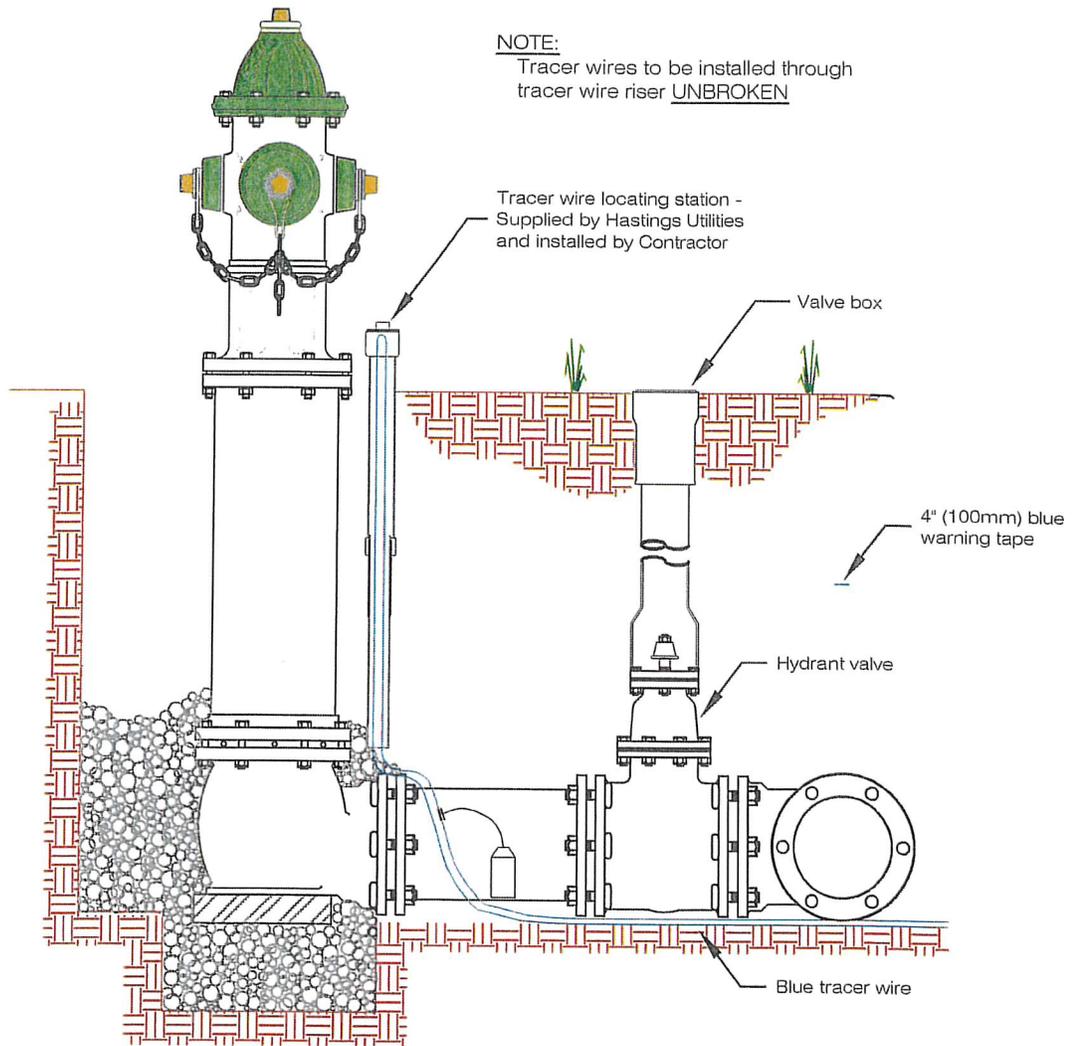
DSN: M. Stange	CKD:
DRN: J. Redding	CKD:
REVISED: June '04	APP:

**Tracer Wire Riser Detail  
at Main Line Valve**



**HASTINGS UTILITIES**  
Hastings, Nebraska

NO.  
**PLAN  
2E**



**NOTE:**  
Tracer wires to be installed through  
tracer wire riser UNBROKEN

Plan View

\\Hudomain\Birch\Water\Prototype\S.P.A.-2 Drawing-1.dwg

DSN: M. Stange	CKD:
DRN: J. Redding	CKD:
REVISED: June '04	APP:

**Tracer Wire Riser Detail  
at Fire Hydrant**



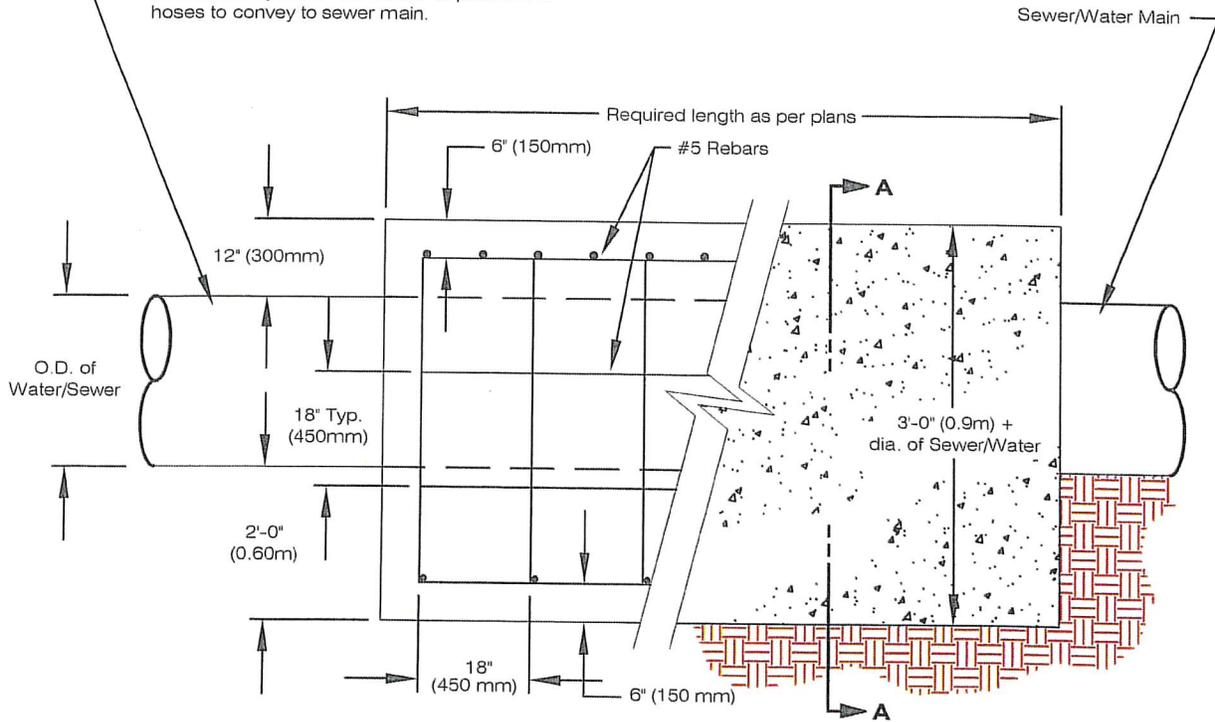
**HASTINGS UTILITIES**  
Hastings, Nebraska

NO  
**PLAN  
2F**

**NOTE:**

All concrete used for encasement shall be NDOR concrete mix 47-BM with 6 1/2 sack mix having a 28 day compressive strength of 3,200 PSI.

Insure that sewer maintains alignment and grade during encasement operations. Provide water filled sewer or equal to restrain sewer from floating. Water provided by HU from the nearest fire hydrant. Contractor to provide the hoses to convey to sewer main.



Plan View

\\Hudomain\Birch\Water\Prototype\S.P.A.-2 Drawing-1.dwg

DSN: M. Sidlo	CKD:
DRN: M. Sidlo	CKD:
REVISED: Sept, '05	APP:

**Sanitary Sewer/Water Main  
Encasement Detail**

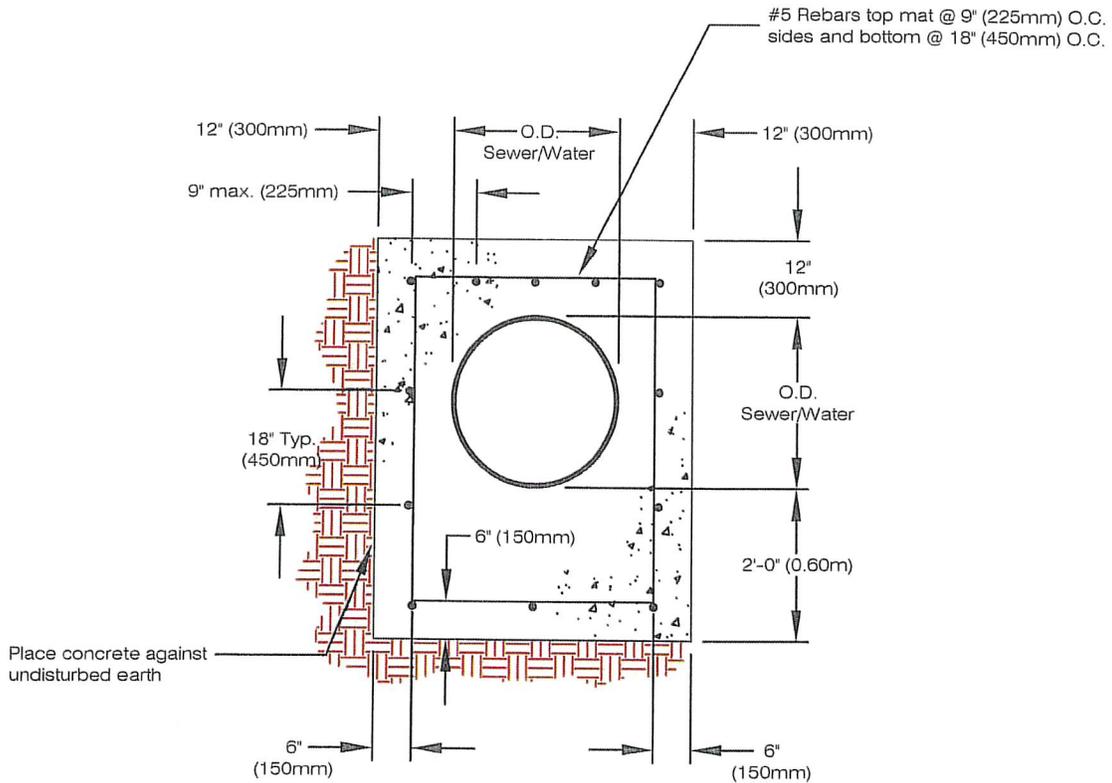


**HASTINGS UTILITIES**  
Hastings, Nebraska

NO  
**PLAN  
2G**

**NOTE:**

All concrete used for encasement shall be NDOR concrete mix 47-BM with 6 1/2 sack mix having a 28 day compressive strength of 3,200 PSI.



**Section AA**

\\Hudomain\Birch\Water\Prototype\S.P.A.-2 Drawing-1.dwg

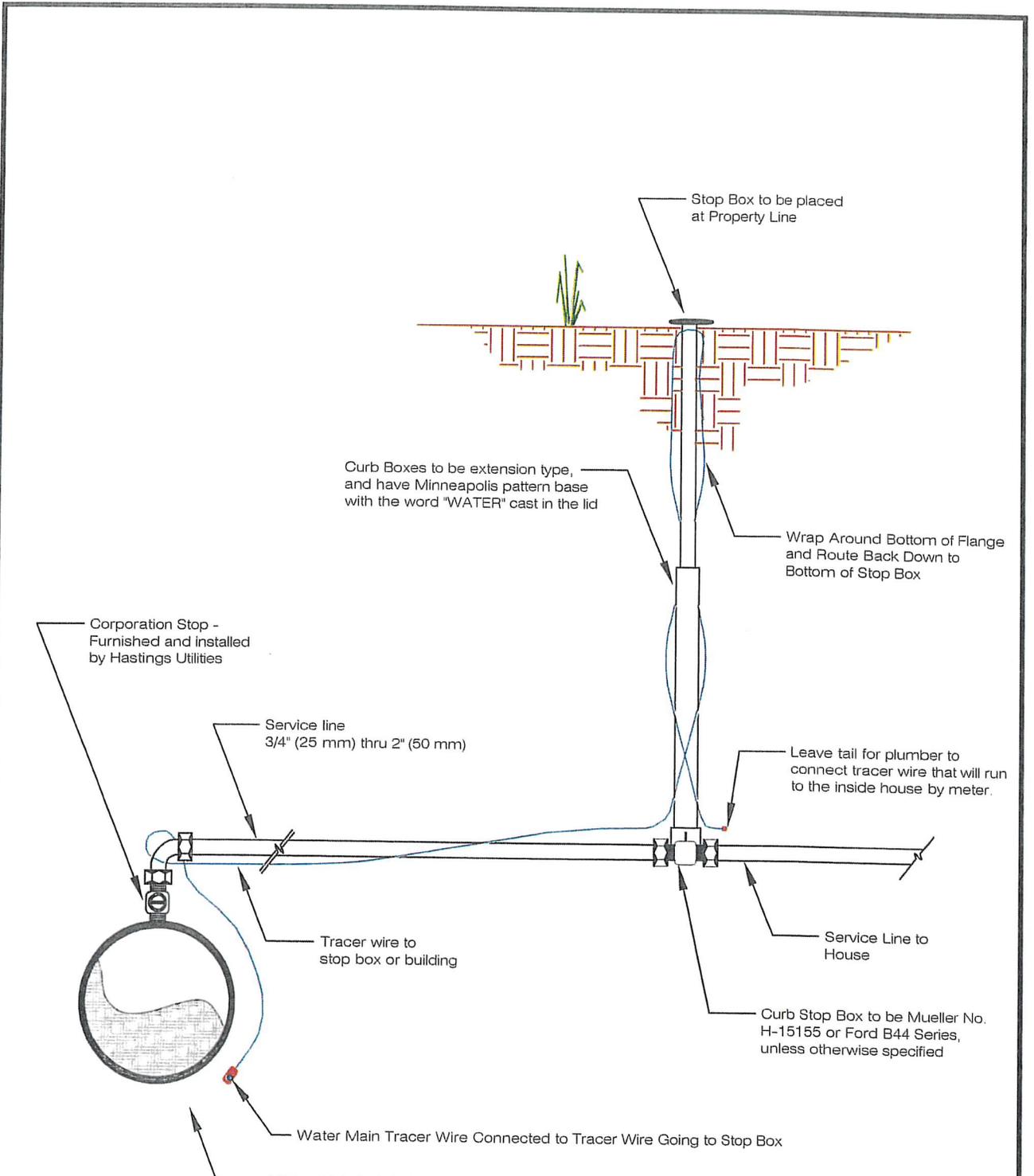
DSN: M. Sidlo	CKD:
DRN: M. Sidlo	CKD:
REVISED: Sept. '05	APP:

**Sanitary Sewer/Water Main Encasement Section Detail**



**HASTINGS UTILITIES**  
Hastings, Nebraska

NO.  
**PLAN 2H**



- NOTES:**
1. All water services to be a min. of 5'-0" (1.52m) bury.
  2. Hastings Utilities will make all water service taps.

\\Hudomain\BIRch\Water\Prototype\S.P.A.-2 Drawing-1.dwg

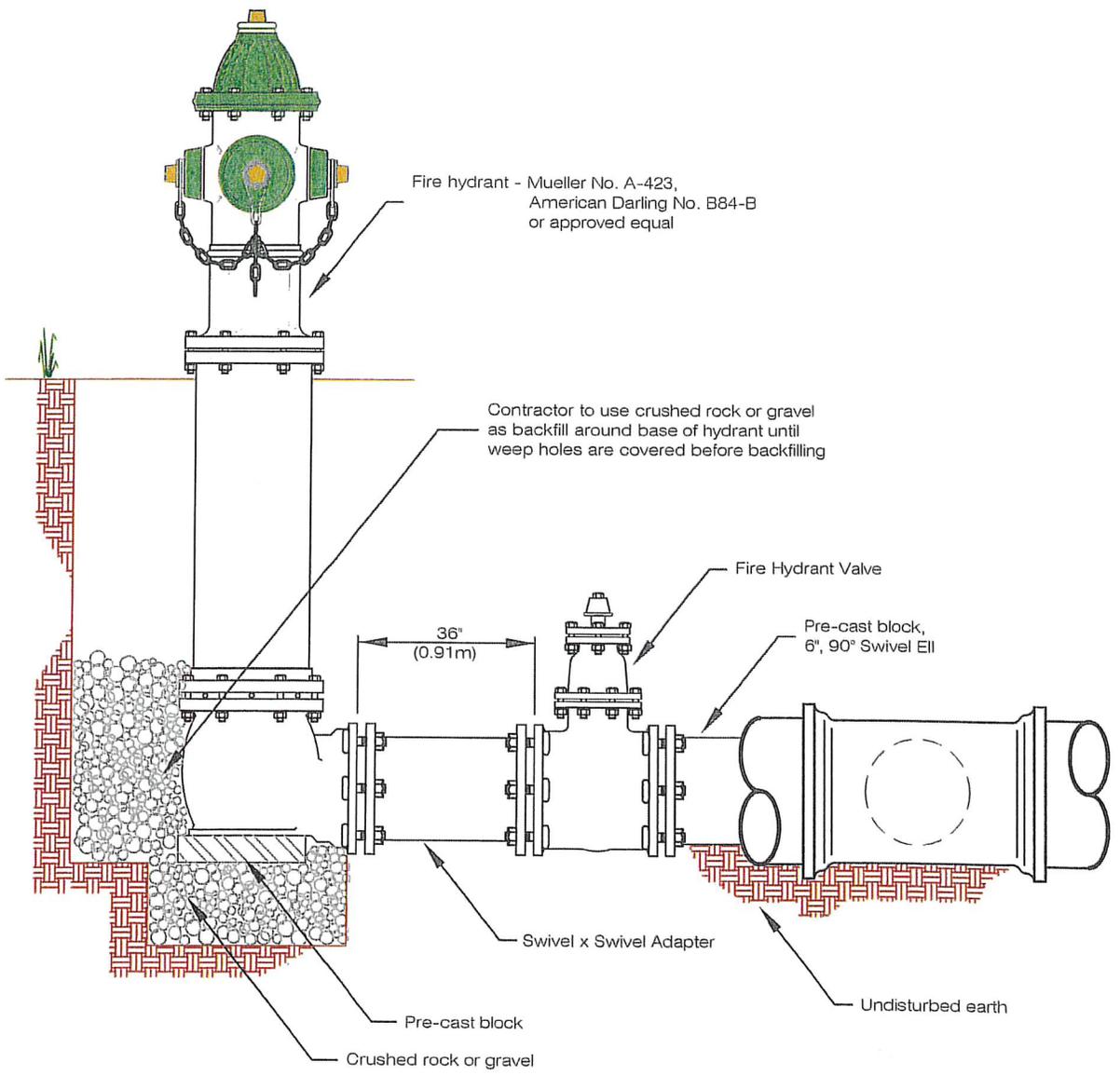
DSN: M. Sidlo	CKD:
DRN: M. Sidlo	CKD:
REVISED: February '17	APP:

**Standard  
Water Service Detail**



**HASTINGS UTILITIES**  
Hastings, Nebraska

NO.  
**PLAN  
2J**



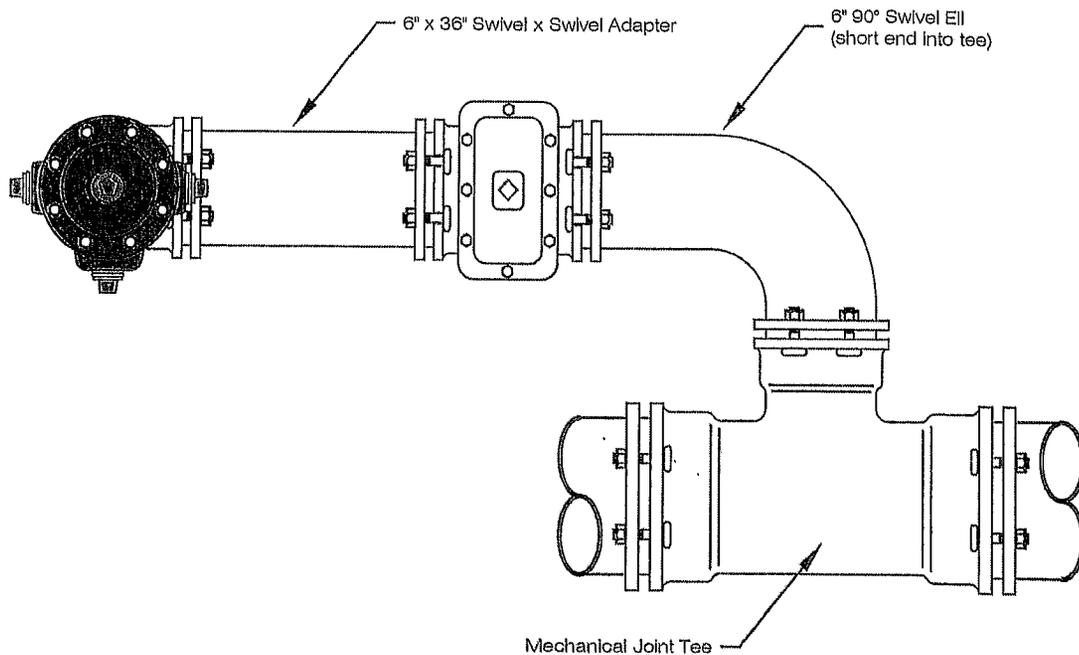
\\Hudomain\B\B\Water\Prototype\S.P.A-3 Drawing-1.dwg

DSN:	CKD:
M. Sidlo	
DRN:	CKD:
J. Runyan	
REVISED:	APP:
Jan. '06	

## Hydrant and Valve Detail

**HASTINGS UTILITIES**  
Hastings, Nebraska

NO  
**PLAN 3A**



Plan View

\\Hudomain\Biroh\Water\Prototype\S.P.A-3 Drawing-1.dwg

DSN: M. Siclo	CKD:
DRN: J. Runyan	CKD:
REVISED: Jan. '06	APP:

**Hydrant and Valve Detail  
Plan View**



**HASTINGS UTILITIES**  
Hastings, Nebraska

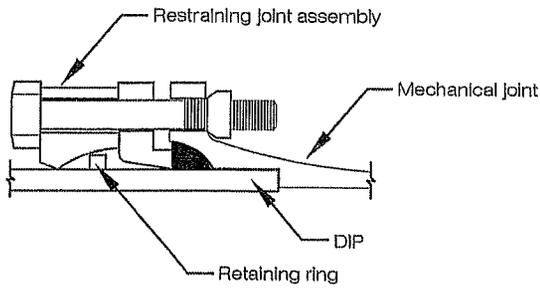
NO.  
**PLAN  
3B**

**NOTES:**

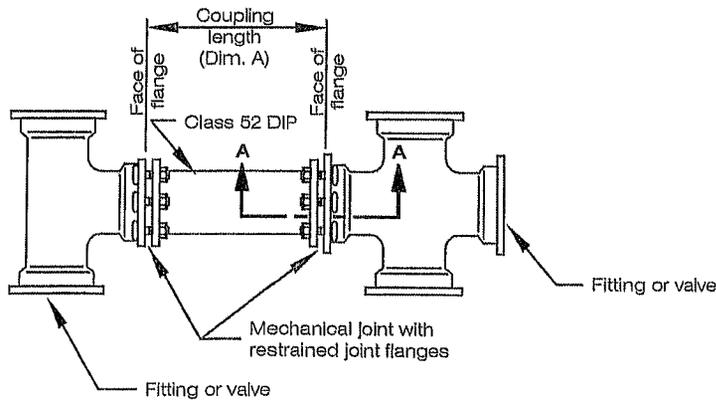
1. Use restrained joint couplings when noted on drawings and provide length as noted. If length is not noted, use the following minimum standard coupling length - Dimension A.
2. Alternate restraining joint assembly may be used with prior approval by the Engineer or as specified in the Contract and Specifications Book.

**PIPE DIA.      MIN. DIM. A**

16" (406mm)	2'-6" (.76m)
24" (609mm)	3'-0" (.91m)
30" (762mm)	3'-0" (.91m)
36" (914mm)	3'-6" (1.10m)
42" (1066mm)	3'-6" (1.10m)
48" (1219mm)	4'-0" (1.20m)



**Section A-A**



\\Hudomaln\B\roh\Water\Prototype\S.P.A.-3 Drawing-1.dwg

DSN: M. Sidlo	CHKD:
DRN: J. Runyan	CHKD:
REVISED: Jan. '06	APP:

**Restrained Joint Coupling  
Detail**

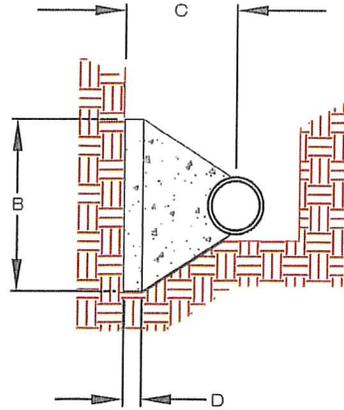


**HASTINGS UTILITIES**  
Hastings, Nebraska

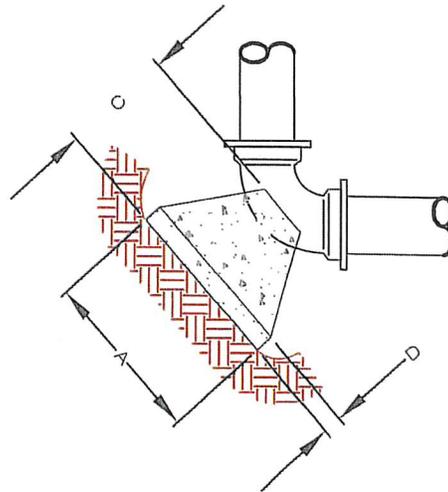
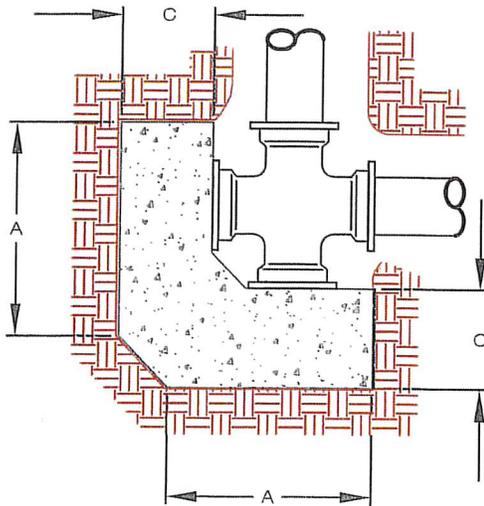
NO.  
**PLAN  
3C**

## THRUST BLOCK DIMENSIONS

PIPE SIZE INCH (mm)	A FEET (m)	B FEET (m)	C FEET (m)	D INCH (mm)
4 (101mm)	1.00 (.30m)	1.00 (.30m)	1.00 (.30m)	3 (76mm)
6 (152mm)	1.50 (.46m)	1.50 (.46m)	1.00 (.30m)	6 (152mm)
8 (203mm)	2.00 (.61m)	2.00 (.61m)	1.00 (.30m)	6 (152mm)
10 (254mm)	2.50 (.76m)	2.50 (.76m)	2.00 (.61m)	9 (228mm)
12 (304mm)	3.00 (.91m)	3.00 (.91m)	2.00 (.61m)	9 (228mm)
14 (355mm)	3.00 (.91m)	3.00 (.91m)	2.50 (.76m)	12 (304mm)
16 (406mm)	4.00 (1.20m)	3.00 (.91m)	2.50 (.76m)	12 (304mm)
18 (457mm)	4.00 (1.20m)	4.00 (1.20m)	2.50 (.76m)	12 (304mm)
20 (508mm)	4.00 (1.20m)	4.00 (1.20m)	3.00 (.91m)	16 (406mm)
24 (609mm)	4.50 (1.40m)	4.50 (1.40m)	3.00 (.91m)	16 (406mm)
30 (762mm)	4.50 (1.40m)	5.00 (1.50m)	3.50 (1.10m)	18 (457mm)
36 (914mm)	5.00 (1.50m)	5.00 (1.50m)	3.50 (1.10m)	18 (457mm)
42 (1066mm)	5.50 (1.70m)	5.50 (1.70m)	4.00 (1.20m)	24 (609mm)
48 (1219mm)	6.00 (1.80m)	6.00 (1.80m)	4.00 (1.20m)	24 (609mm)



The class of concrete to be used for thrust blocks around fittings shall be Nebraska Department of Roads Class "47B" or Type "ABX". All thrust blocks shall be cast in place and shall be considered subsidiary to the unit price of water main in the contract. All concrete shall have a minimum 28 day strength of 35000 PSI.



\\Hudomain\Blrch\Water\Prototype\S.P.A-3 Drawing-1.dwg

DSN: M. Sidlo	CKD:
DRN: J. Runyan	CKD:
REVISED: Jan. '06	APP:

### Concrete Thrust Block Details



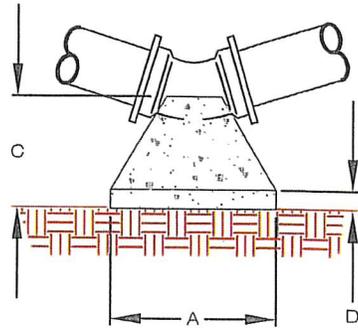
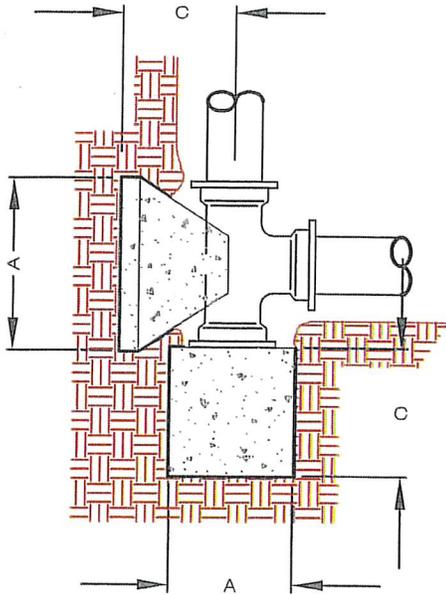
**HASTINGS UTILITIES**  
Hastings, Nebraska

NO.  
**PLAN  
3D**

## THRUST BLOCK DIMENSIONS

PIPE SIZE INCH (mm)	A FEET (m)	B FEET (m)	C FEET (m)	D INCH (mm)
4 (101mm)	1.00 (.30m)	1.00 (.30m)	1.00 (.30m)	3 (76mm)
6 (152mm)	1.50 (.46m)	1.50 (.46m)	1.00 (.30m)	6 (152mm)
8 (203mm)	2.00 (.61m)	2.00 (.61m)	1.00 (.30m)	6 (152mm)
10 (254mm)	2.50 (.76m)	2.50 (.76m)	2.00 (.61m)	9 (228mm)
12 (304mm)	3.00 (.91m)	3.00 (.91m)	2.00 (.61m)	9 (228mm)
14 (355mm)	3.00 (.91m)	3.00 (.91m)	2.50 (.76m)	12 (304mm)
16 (406mm)	4.00 (1.20m)	3.00 (.91m)	2.50 (.76m)	12 (304mm)
18 (457mm)	4.00 (1.20m)	4.00 (1.20m)	2.50 (.76m)	12 (304mm)
20 (508mm)	4.00 (1.20m)	4.00 (1.20m)	3.00 (.91m)	16 (406mm)
24 (609mm)	4.50 (1.40m)	4.50 (1.40m)	3.00 (.91m)	16 (406mm)
30 (762mm)	4.50 (1.40m)	5.00 (1.50m)	3.50 (1.10m)	18 (457mm)
36 (914mm)	5.00 (1.50m)	5.00 (1.50m)	3.50 (1.10m)	18 (457mm)
42 (1066mm)	5.50 (1.70m)	5.50 (1.70m)	4.00 (1.20m)	24 (609mm)
48 (1219mm)	6.00 (1.80m)	6.00 (1.80m)	4.00 (1.20m)	24 (609mm)

The class of concrete to be used for thrust blocks around fittings shall be Nebraska Deptment of Roads Class "47B" or Type "ABX". All thrust blocks shall be cast in place and shall be considered subsidiary to the unit price of water main in the contract. All concrete shall have a minimum 28 day strength of 35000 PSI.



\\Hudomain\B\B\Water\Prototype\S.P.A.-3 Drawing-1.dwg

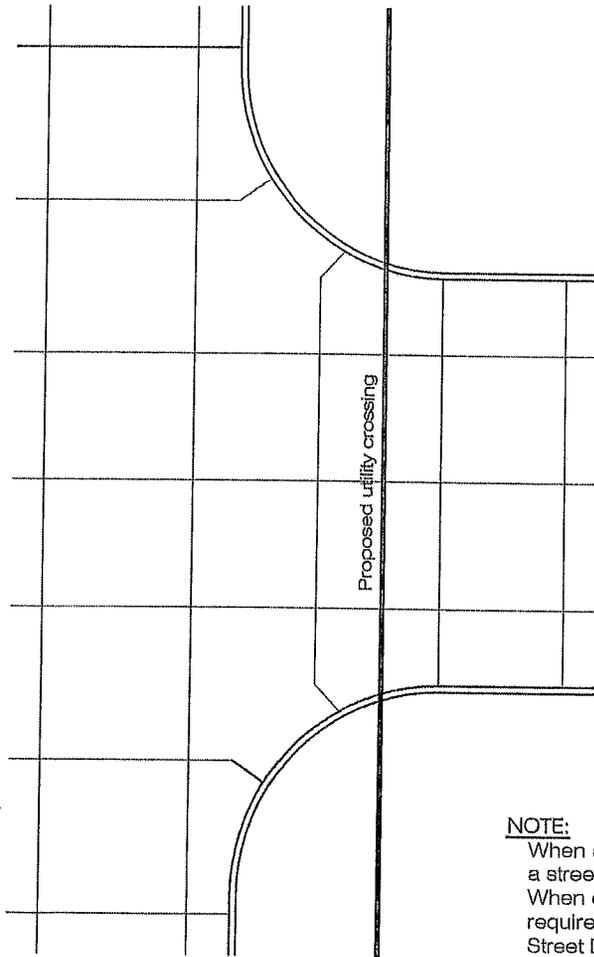
DSN: M. Sidlo	CKD:
DRN: J. Runyan	CKD:
REVISED: Jan. '06	APP:

### Concrete Thrust Block Details



**HASTINGS UTILITIES**  
Hastings, Nebraska

NID  
**PLAN  
3E**



**NOTE:**

All concrete streets are to be 47B or 47B-PHE high-early concrete.

**NOTE:**

When a new utility main crosses in the center of a street panel, the entire panel will be removed. When crossing is at a joint, two saw cuts will be required, or as directed by the City of Hastings Street Department.

\\Hudomain\B\ch\Water\Prototype\S.P.A.-4 Drawing-1.dwg

DSN: M. Sidlo	CKD:
DRN: M. Sidlo	CHKD:
REVISED: June '03	APP:

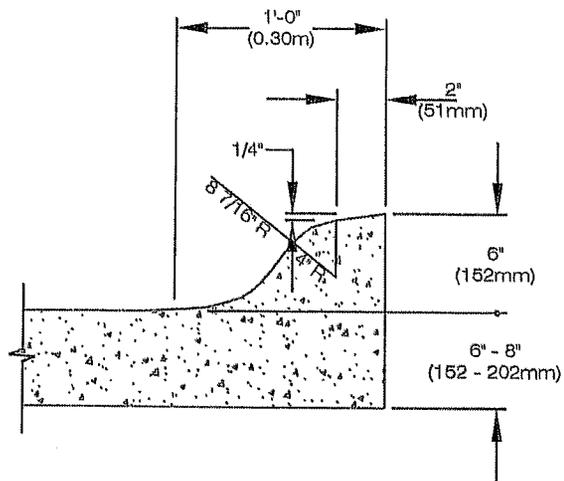
**Street Crossing  
Detail**



**HASTINGS UTILITIES**  
Hastings, Nebraska

NO  
**PLAN  
4A**





\\Hudomaln\Biroh\Water\Prototype\S.P.A.-4 Drawing-1.dwg

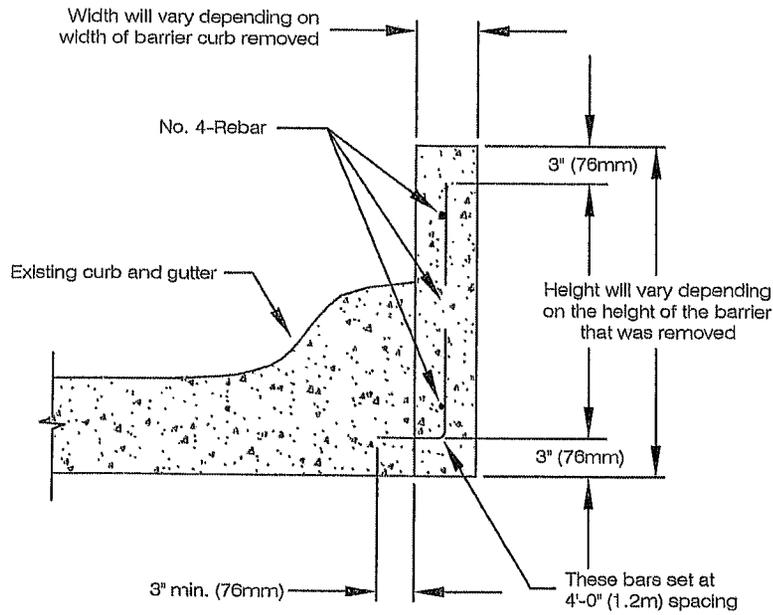
DSN:	CHK:
M. Siclo	
DRN:	CHK:
M. Siclo	
REVISED:	APP:
June '03	

**Integral Curb Detail**



**HASTINGS UTILITIES**  
Hastings, Nebraska

NO.  
**PLAN 4C**



\\Hudomain\B\rc\Water\Prototype\S.P.A.-4 Drawing-1.dwg

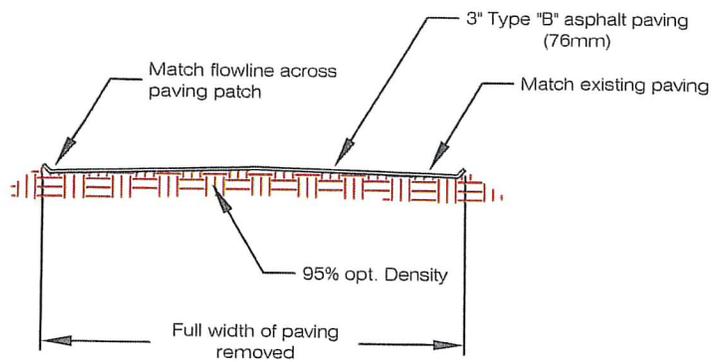
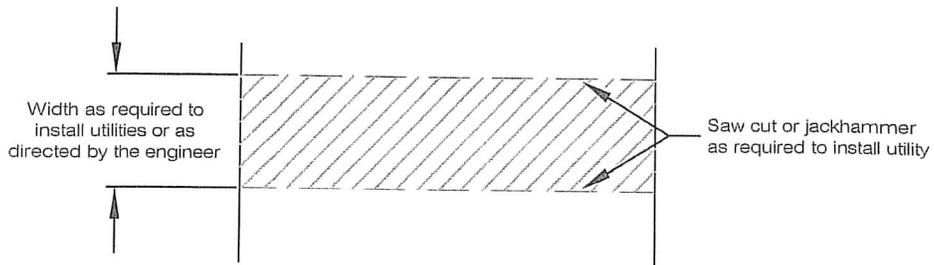
DSN: M. Siclo	CKD:
DRN: M. Siclo	CKD:
REVISED: June '03	APP:

**Retaining Wall/Barrier  
Curb Replacement Detail**



**HASTINGS UTILITIES**  
Hastings, Nebraska

NO.  
**PLAN  
4D**



\\Hudomain\Birch\Water\Prototype\S.P.A.-4 Drawing-1.dwg

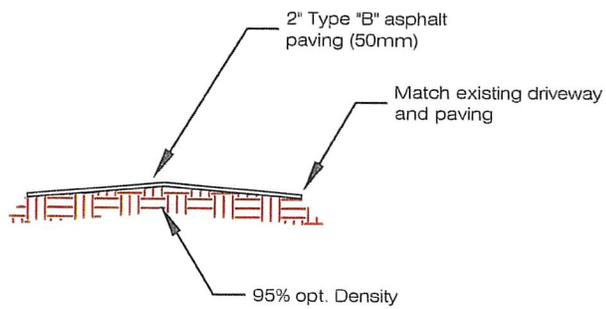
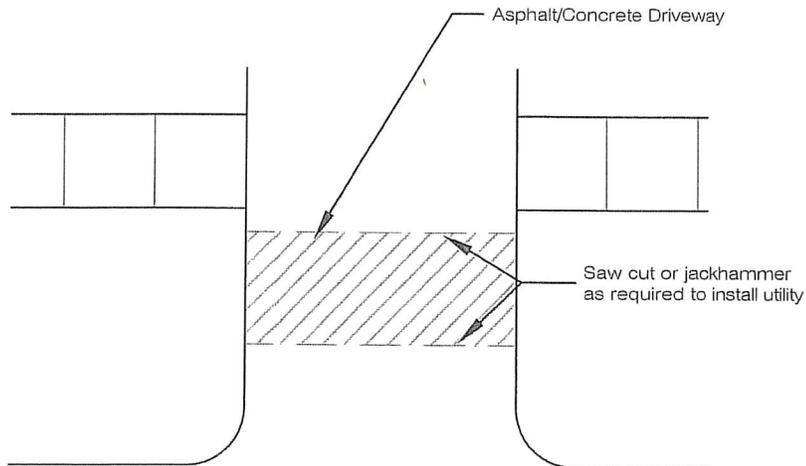
DSN: M. Sidlo	CKD:
DRN: M. Sidlo	CKD:
REVISED: June '03	APP:

**Typical Pavement Section  
and Asphalt Patch Detail**



**HASTINGS UTILITIES**  
Hastings, Nebraska

NO.  
**PLAN  
4E**



\\Hudomain\Birch\Water\Prototype\S.P.A.-4 Drawing-1.dwg

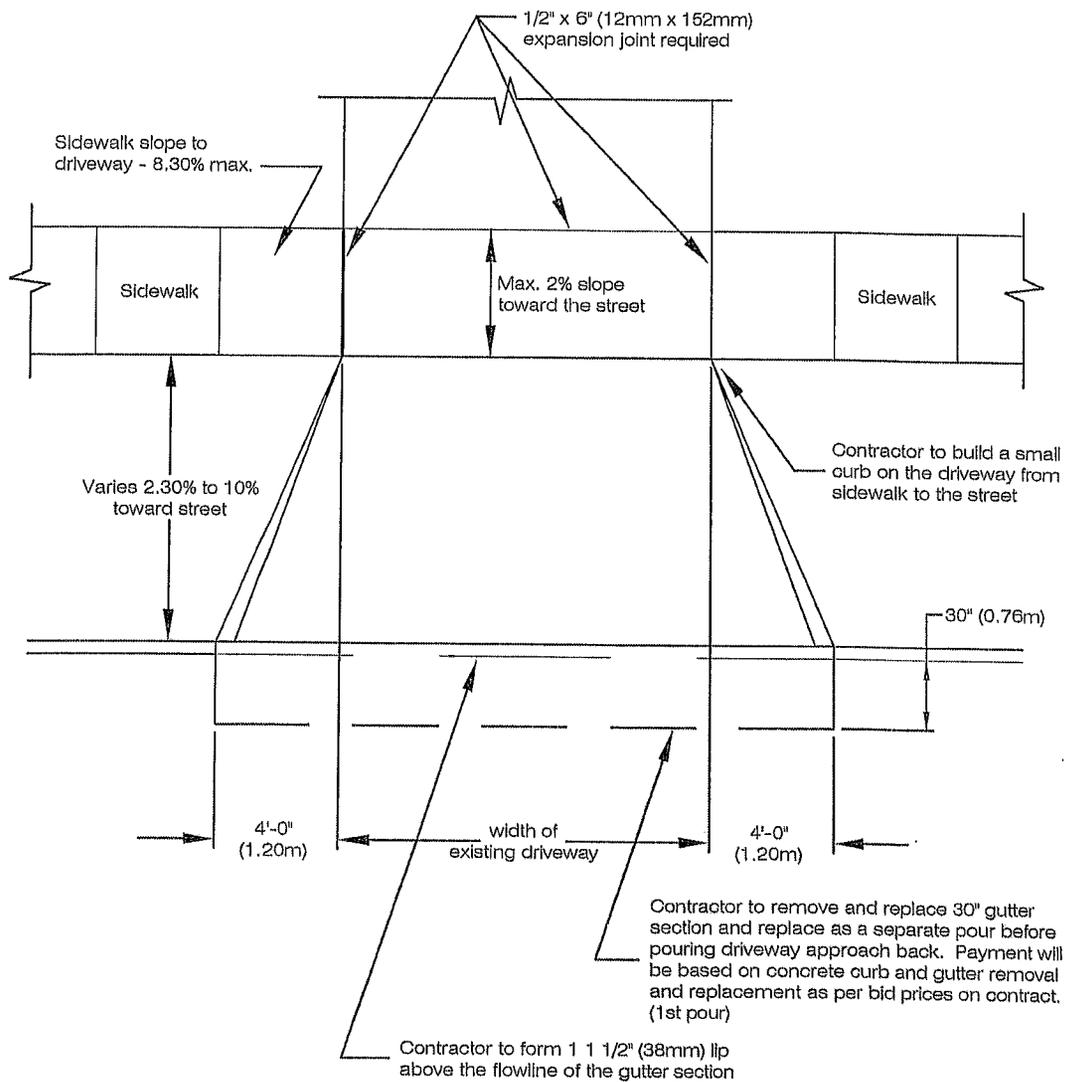
DSN: M. Sidlo	CKD:
DRN: M. Sidlo	CKD:
REVISED: June '03	APP:

**Typical Driveway Section  
Asphalt Driveway Patch Detail**



**HASTINGS UTILITIES**  
Hastings, Nebraska

NO.  
**PLAN  
4F**



**NOTES:**

1. All driveway and/or alley approaches are to be 6" (152mm) thick, 47B or 47B-PHE concrete from property line to the street.
2. Stress fracture cuts are to be spaced at a distance of 2 times the thickness of the concrete in feet, with a maximum distance of 12' (3.70m) apart and a depth of one fourth the thickness of the concrete.

\\Hudomain\B\B\Water\Prototype\S.P.A-4 Drawing-1.dwg

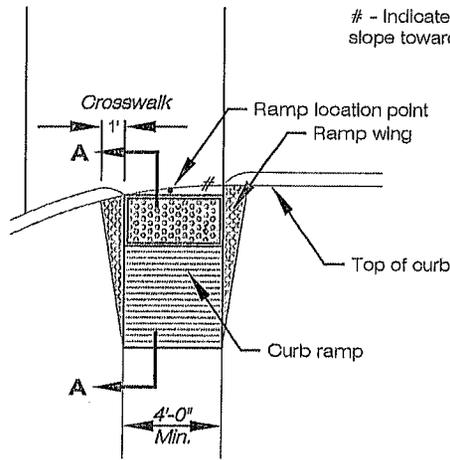
DSN: M. Sidlo	CKD:
DRN: M. Sidlo	CKD:
REVISED: June '03	APP:

**Driveway/Alley  
Approach Detail**

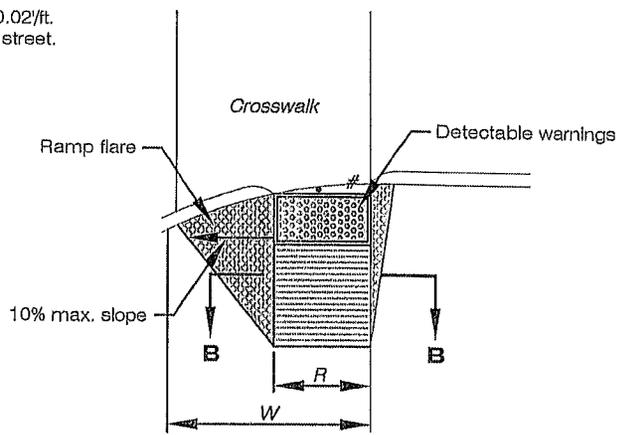


**HASTINGS UTILITIES**  
Hastings, Nebraska

No.  
**PLAN  
4G**

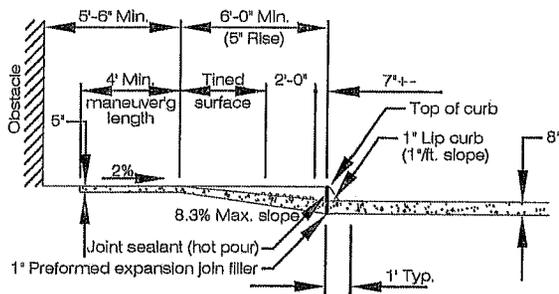


**TYPE I**

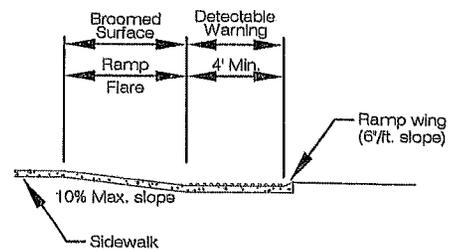


Where W is 9'-0" or less,  $R = W$   
 Where W is greater than 9'-0",  $R = 4'-0"$

**TYPE II**



**SECTION A-A**  
**TYPICAL RAMP PROFILE**



**SECTION B-B**  
**TYPICAL RAMP CROSS SECTION**

**LEGEND**

-  Detectable Warnings
-  Tined Curb Ramps
-  Broomed Ramp Wings & Flares
-  Milled Concrete

See CURB RAMP NOTES on Plan 4M for additional information

\\Hudomaln\Binh\Water\Prototype\S.P.A.-4 Drawing-1.dwg

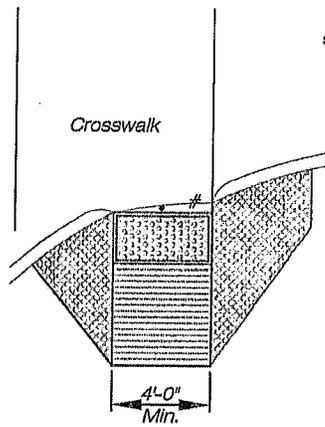
DSN: M. Sidlo	CKD:
DRN: M. Sidlo	CKD:
REVISED: June '03	APP:

**Curb Ramp & Detectable Warning Details**

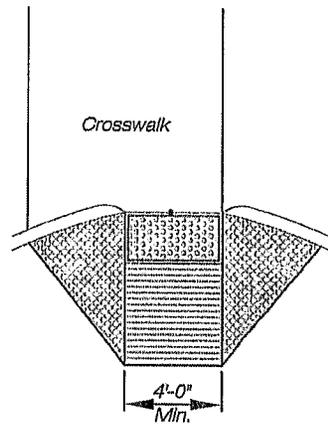


**HASTINGS UTILITIES**  
 Hastings, Nebraska

NO.  
**PLAN 4H**



# - Indicates 0.02/ft. slope towards street.



**TYPE III**

**TYPE IV**

**LEGEND**

-  Detectable Warnings
-  Tined Curb Ramps
-  Broomed Ramp Wings & Flares
-  Milled Concrete

See CURB RAMP NOTES on Plan 4M for additional information

\\Hudomain\B\rbh\Water\Prototype\S.P.A.-4 Drawing-1.dwg

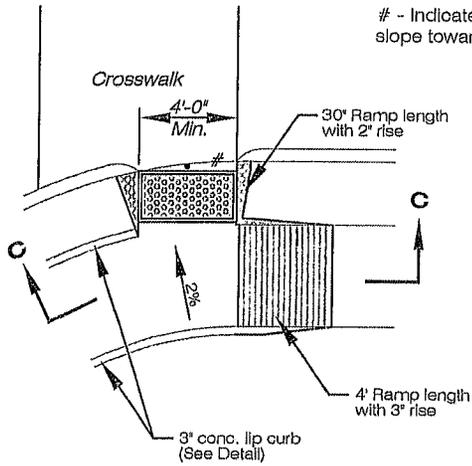
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DRN: M. Sidlo	CHKD:
REVISED: June '03	APP:

**Curb Ramp & Detectable Warning Details**

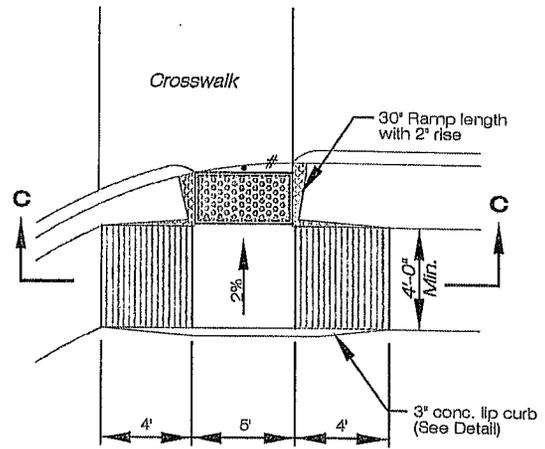


**HASTINGS UTILITIES**  
Hastings, Nebraska

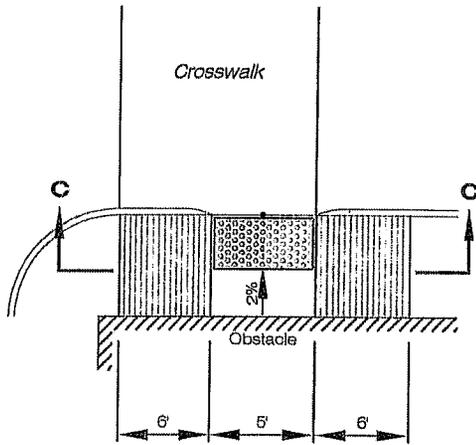
NO.  
**PLAN 4J**



**TYPE V**

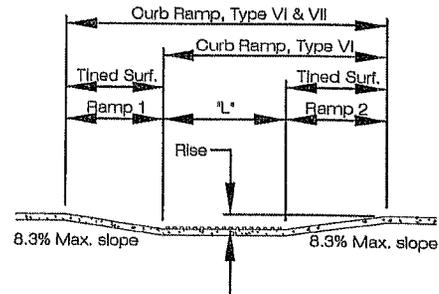


**TYPE VI**



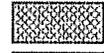
**TYPE VII**

CURB RAMP	RISE	"L"	RAMP 1	RAMP 2
Type V	3"	Var.	N/A	4'
Type VI	3"	5'	4'	4'
Type VII	5"	5'	6'	6'



**SECTION C-C  
TYPICAL RAMP CROSS SECTION**

**LEGEND**

-  Detectable Warnings
-  Tined Curb Ramps
-  Broomed Ramp Wings & Flares
-  Milled Concrete

See CURB RAMP NOTES on Plan 4M for additional information

\\Hudomain\B\Brah\Water\Prototype\S.P.A.-4 Drawing-1.dwg

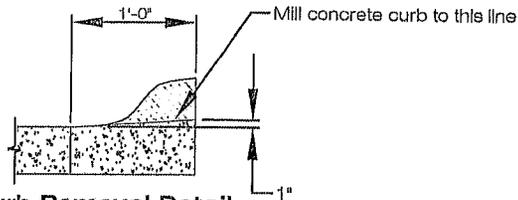
DSN: M. Siclo	CKD:
DFN: M. Siclo	CKD:
REVISED: June '03	APP:

**Curb Ramp & Detectable Warning Details**



**HASTINGS UTILITIES**  
Hastings, Nebraska

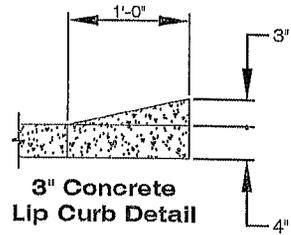
NO.  
**PLAN 4K**



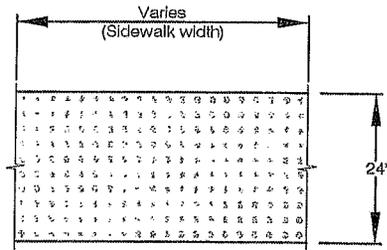
**Curb Removal Detail**

**NOTE:**

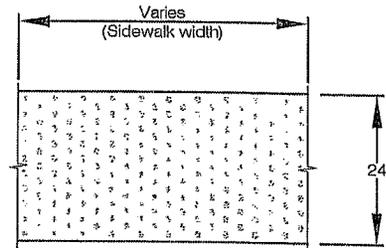
Comb. concrete curb and gutter may be removed and replaced in lieu of milling



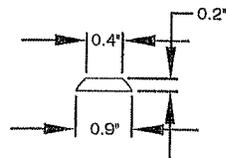
**3" Concrete Lip Curb Detail**



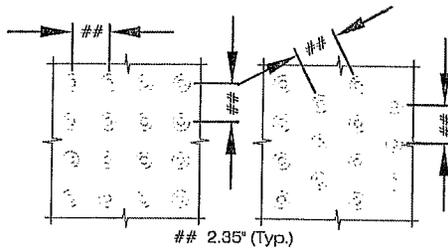
Direction of travel ↑



**DOME ALIGNMENT**



**DOME SECTION**



**DOME SPACING**

**LEGEND**

- Detectable Warnings
- Tined Curb Ramps
- Broomed Ramp Wings & Flares
- Milled Concrete

See CURB RAMP NOTES on Plan 4M for additional information

\\Hudomaln\B\roh\Water\Prototype\S.P.A.-4 Drawing-1.dwg

DSN: M. Siclo	CKD:
DRN: M. Siclo	CKD:
REVISED: June '03	APP:

**Detectable Warning Details**



**HASTINGS UTILITIES**  
Hastings, Nebraska

NO.  
**PLAN 4L**

CURB RAMP NOTES:

The normal gutter line profile shall be maintained through the area of the curb ramp.

The surface of all curb ramps shall be tined transversely to the slop of the curb ramp. The tines shall produce grooves approximately 1/8" wide and 3/16" deep on 1/2" centers. All flares and wings shall be broomed.

Care shall be taken to assure a uniform grade on the curb ramp, free of sags and short grade changes.

The ramp flares shall be constructed with a 10% slope at right angles to the slope of the curb ramp. Types II, III and IV.

The slope of sidewalks approaching curb ramps (or their flares) shall be flat enough to provide recovery areas to wheelchairs entering or existing the ramps.

The work of constructing these ramps shall be measured and paid for as a part of the work for "concrete sidewalks," concrete median surfacing" or "concrete bikeway." The work of modification of new or existing curb will not be paid for directly, but will be considered subsidiary to other items of work for which direct payment is made.

Maximum % of slopes are relative to the slope of adjacent sidewalk.

Detectable warnings shall extend the full width of the curb ramp, they shall be located so that the edge nearest the curb line is 6" to 8" from the curb line.

# Indicates 0.02/ft. slope towards the street.

\\Hudomain\Bireh\Water\Prototype\S.P.A.-4 Drawing-1.dwg

DSN: M. Sidlo	CKD:	<b>Curb Ramp &amp; Detectable Warning Notes</b>	 <b>HASTINGS UTILITIES</b>	<b>HASTINGS UTILITIES</b> Hastings, Nebraska	NO.
DRN: M. Sidlo	CKD:				<b>PLAN 4M</b>
REVISED: June '03	APP:				



# Appendix C



**SIP INDUSTRIES**  
SERAMPOR  
1960

# *SIP Industries*

*Quality Manufacturers Since 1960*



## **Utility Pipe Fittings**

[www.sipindustries.com](http://www.sipindustries.com)

Toll Free 877-921-6111

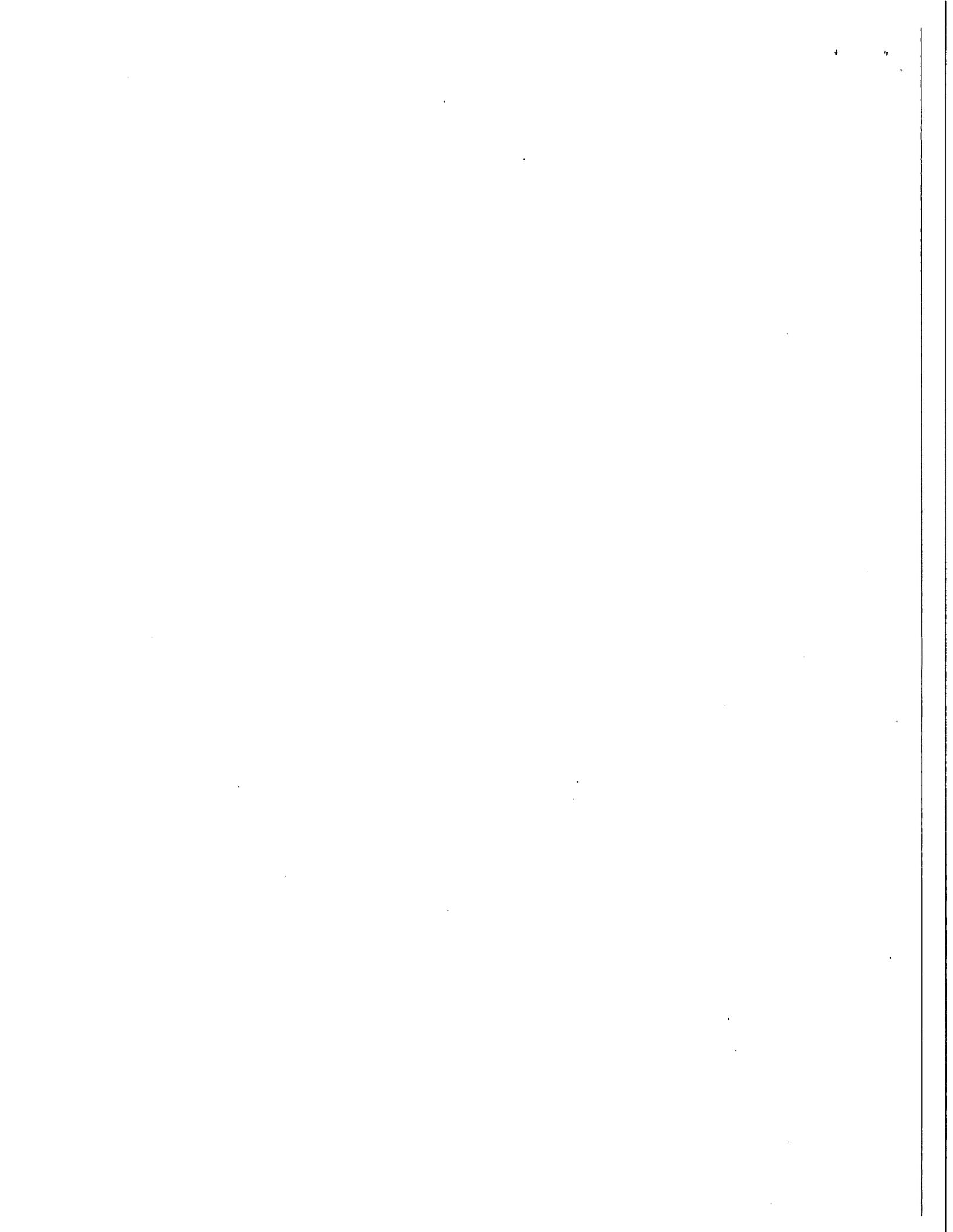


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COMPACT PUSH-ON FITTINGS ANSI/AWWA C153/A21.53	Page : 37 - 42
GENERAL NOTES	Page : 43 - 44

- All dimensions are in inches unless noted otherwise.
- All weights are approximate in pounds unless noted otherwise.

**1. Acceptance.** All sales by SIP Industries (Seller) are made pursuant to these Terms and Conditions. Submission of a purchase order to Seller, and/or acceptance of goods delivered by Seller, shall be deemed an acceptance of these Terms and Conditions by Purchaser.

**2. Entire Agreement.** These Terms and Conditions, together with Seller's price list and Purchaser's purchase order, when accepted by Seller, shall be the entire agreement between Seller and Purchaser. Neither Seller nor Purchaser is relying on any representations, warranties or agreements except as expressly provided in these Terms and Conditions and in an accepted purchase order. To the extent of any conflict between the terms of a purchase order or any other documents submitted by Purchaser, on the one hand, and these Terms and Conditions, on the other, these Terms and Conditions shall govern.

**3. Prices; FOB point of shipment.** Prices and descriptions of goods stated in Seller's price lists are subject to change without notice. All prices are FOB point of shipment, unless otherwise agreed in writing. Seller's responsibility for goods therefore ceases and title passes to the Purchaser at the point of shipment, and all claims for damages or losses in transit must be directed to the carrier.

**4. Cancellations Changes and Returns.** All cancellations, changes and returns must be accepted in writing by an authorized representative of Seller; otherwise they will not be valid and binding on Seller. Seller shall not be obligated to accept any cancellation, change or return, but if Seller does so the following terms shall apply: (i) goods must be returned to Seller's facility, in same condition in which they were accepted by Purchaser; (ii) a handling charge of twenty-five percent (25%) of the purchase price will be deducted from the credit given to Purchaser; and (iii) shipping charges, if not prepaid by Purchaser, will likewise be deducted from the credit given to Purchaser.

Unless otherwise agreed, specially-manufactured goods, including goods designed to the Purchaser's specifications, may not be cancelled or returned once work has begun to design or manufacture the goods unless an agreement is reached and confirmed in writing, including compensation to Seller for work thus far done with respect to the goods.

**5. Delays; Force Majeure.** Seller shall not be liable for any expenses, loss or damage resulting from any delay in delivery of goods or other failure of Seller's performance due to fire, floods, acts of god, strikes, labor disputes, labor shortages, riots, accidents, transportation delays or other causes beyond the reasonable control of Seller.

**6. Disclaimer regarding weights.** All stated weights are approximate and are given for shipping purposes only.

**7. Taxes.** Seller's prices do not include sales, excise or other taxes. Purchaser shall pay all such taxes. If Purchaser claims a tax exemption, Purchaser shall provide Seller with the necessary tax-exemption numbers and certificates. If Seller accepts an exemption but is later required by the taxing authority to pay taxes, Purchaser shall reimburse to Seller the amount of such taxes.

**8. Limited Warranty.** Seller warrants that goods sold and delivered by Seller to Purchaser will conform to the number and type of goods described in the accepted purchase order and that such goods will be free from defects in material and workmanship. Provided that Seller is promptly notified of a nonconformity or defect, Seller will provide a replacement or price adjustment, in Seller's discretion, not to exceed the net sales price of the defective product. Seller shall not be responsible for labor, removal or installation charges incurred in connection with the replacement of defective goods.

Purchaser shall notify Seller immediately upon discovery of a defect so that Seller may inspect the product in its installed condition. Seller shall not be responsible for defects or failures in goods of which it is not so notified; nor shall Seller be responsible for goods manufactured or sold by other parties or losses or impairments caused by such goods; nor shall Seller be responsible for defects or failure of goods due to improper installation, improper usage, normal or abnormal wear and tear, erosion or corrosion, improper storage, use or maintenance, vandalism, vehicular or other accidents, or storms or other forces beyond the control of the parties. Seller also shall not be responsible for goods that have been damaged by misuse, negligence or accident or that have been altered or repaired by any party other than Seller.

THIS IS SELLER'S SOLE WARRANTY. SELLER MAKES NO OTHER WARRANTY OF ANY KIND, EXPRESS OR IMPLIED. SELLER DOES NOT WARRANT THAT THE GOODS ARE FIT FOR ANY PARTICULAR PURPOSE. SELLER DOES NOT WARRANT THAT THE GOODS ARE MERCHANTABILITY.

**9. Limitation on Liability.** Seller shall in no event be liable for consequential or incidental damages, including lost profits, loss of use, and costs of repair; nor shall Seller be liable for exemplary or other special damages. Seller's liability for any defect, any other breach of contract or warranty, or any other claim regarding the goods shall be limited to a replacement or price adjustment for defective goods, as described above.

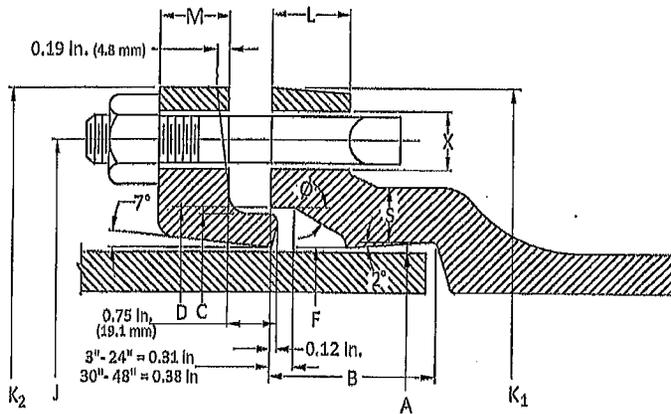
**10. Specially-manufactured goods.** If Seller has designed the goods using information provided by Purchaser, Seller shall not be responsible for design errors resulting from inaccurate or incomplete information supplied by Purchaser. If Purchaser has provided specifications or a model or sample from which a good is designed and manufactured, Seller shall not be responsible for any defect, error or inadequacy provided that the good is designed in compliance with Purchaser's specifications, model or sample.

**11. Governing law; venue.** All sales shall be governed by the law of the state of Texas. In the event that a lawsuit is filed between the parties on any claim arising out of or in connection with such sales, Seller and Purchaser agree that exclusive venue and jurisdiction shall be in the state or federal courts of Harris County, Texas.

**3" - 64" DUCTILE IRON MECHANICAL JOINT COMPACT FITTINGS**

**General Specifications**

- Material** : Ductile Iron per ASTM A536
- Pressure** : 350 PSI rating for 2" - 24" sizes, 250 PSI rating for 30" - 48" sizes and 150 PSI rating for 54" - 64" sizes
- Testing** : In accordance with ANSI/AWWA C153/A21.53 and UL, FM requirements
- Laying Length** : In accordance with ANSI/AWWA C153/A21.53  
(fittings not listed in ANSI/AWWA have dimensions per SIP design as noted in the catalog)
- Deflection** : 2" - 4" = 8° | 6" = 7° | 8" - 12" = 5° | 14" - 16" = 3 1/4° | 18" - 24" = 3° | 30" - 48" = 2°
- Flanges** : Flanged ends on fittings match ANSI/AWWA C115/A21.15 and ANSI B16.1 class 125 flanges
- Gaskets** : SBR in accordance with ANSI/AWWA C111/A21.11 (see fittings accessories catalog)
- T-Bolts / Nuts** : Low alloy steel in accordance with ANSI/AWWA C111/A21.11 (see fittings accessories catalog)
- Cement Lining** : In accordance with ANSI/AWWA C104/A21.4 -- size 2" - 3" single thickness and sizes 4" - 64" double thickness
- Coating** : Asphaltic seal coat inside and out in accordance with ANSI/AWWA C104/A21.4 and referenced in ANSI/AWWA C153/A21.53 and also available in Fusion-Bonded epoxy (FBE) power coated oxide red color in accordance with the ANSI/AWWA C116/A21.16
- Weight** : Are in pounds, unless noted otherwise and do not include accessories, cement lining and coating
- Dimensions** : All dimensions are in inches unless noted otherwise.
- Installations** : Per ANSI/AWWA C600 and C111 using DIP conforming to C150/C151 and PVC pipe conforming to C900/C905
- Approvals** : 3" - 24" UL Listed | 3" - 24" FM Approved | 3" and higher UL/NSF Standards 61 | 3" and higher NSF/ANSI Standards 61 Approved for Drinking Water. Please consult SIP for detail listing and approvals.



**Technical Specifications**

SIZE	A	B	C	D	F	J	K <sub>1</sub>	K <sub>2</sub>	M	S	L	Ø	X	BOLTS		
														NO.	SIZE	LENGTH
*2	2.50	2.50	3.39	3.50	2.61	4.75	6.19	6.25	0.62	0.36	0.58	28°	3/4	2	3/8	3
3	3.96	2.50	4.84	4.94	4.06	6.19	7.62	7.69	0.62	0.39	0.58	28°	3/4	4	3/8	3
4	4.80	2.50	5.92	6.02	4.90	7.50	9.06	9.12	0.75	0.39	0.60	28°	3/4	4	3/8	3 1/2
6	6.90	2.50	8.02	8.12	7.00	9.50	11.06	11.12	0.88	0.43	0.63	28°	3/4	6	3/8	3 1/2
8	9.05	2.50	10.17	10.27	9.15	11.75	13.31	13.37	1.00	0.45	0.66	28°	3/4	6	3/8	3 1/2
10	11.10	2.50	12.22	12.34	11.20	14.00	15.62	15.62	1.00	0.47	0.70	28°	3/4	8	3/8	4
12	13.20	2.50	14.32	14.44	13.30	16.25	17.88	17.88	1.00	0.49	0.73	28°	3/4	8	3/8	4
14	15.30	3.50	16.40	16.54	15.44	18.75	20.25	20.25	1.25	0.55	0.79	28°	3/4	10	3/8	4 1/2
16	17.40	3.50	18.50	18.64	17.54	21.00	22.50	22.50	1.31	0.58	0.85	28°	3/4	12	3/8	4 1/2
18	19.50	3.50	20.60	20.74	19.64	23.25	24.75	24.83	1.38	0.68	1.00	28°	3/4	12	3/8	4 1/2
20	21.60	3.50	22.70	22.84	21.74	25.50	27.00	27.08	1.44	0.69	1.02	28°	3/4	14	3/8	4 1/2
24	25.80	3.50	26.90	27.04	25.94	30.00	31.50	31.58	1.56	0.75	1.02	28°	3/4	16	3/8	5
30	32.00	4.00	33.29	33.46	32.17	36.88	39.12	39.12	2.00	0.82	1.31	20°	1 1/8	20	1	6
36	38.30	4.00	39.59	39.76	38.47	43.75	46.00	46.00	2.00	1.00	1.45	20°	1 1/8	24	1	6
42	44.50	4.00	45.79	45.96	44.67	50.62	60.00	53.12	2.00	1.25	1.45	20°	1 3/8	28	1 1/4	6 1/2
48	50.80	4.00	52.09	52.26	50.97	57.50	53.12	60.00	2.00	1.35	1.45	20°	1 3/8	32	1 1/4	6 1/2

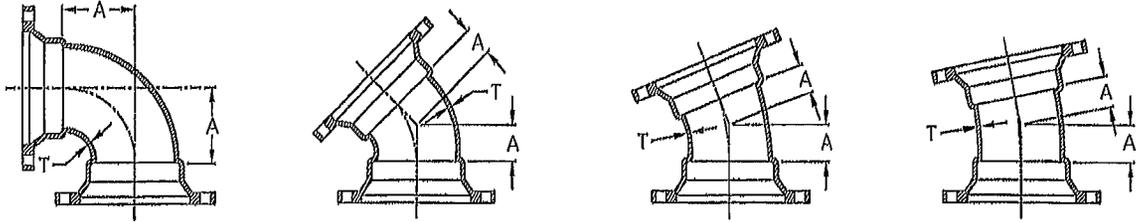
\* not included in AWWA C153

NB : Fittings & Dimensions for Size 54, 60 & 64 available on request only.

All dimensions are in inches unless noted otherwise.

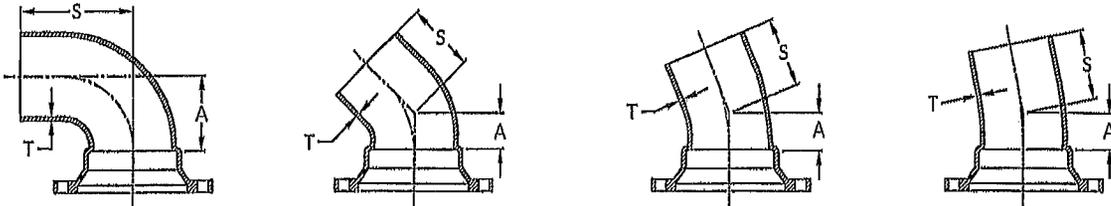
All weights are approximate in pounds unless noted otherwise.

**MIXIMUBENDS**



MJ X MJ		90° BENDS (1/4)		45° BENDS (1/4)		22.5° BENDS (1/4)		11.25° BENDS (1/4)	
SIZE	T	A	WT	A	WT	A	WT	A	WT
#2	0.30	3.25	15	1.80	14	1.00	10	1.00	9
3	0.33	3.50	19	1.50	16	1.00	15	1.00	14
4	0.34	4.00	25	2.00	22	1.50	18	1.25	16
6	0.36	5.00	39	3.00	32	2.00	31	1.50	30
8	0.38	6.50	57	3.50	46	2.50	46	1.75	42
10	0.40	7.50	89	4.50	70	3.00	64	2.00	58
12	0.42	9.00	108	5.50	86	3.50	80	2.25	67
14	0.47	11.50	210	5.00	160	3.75	136	2.50	93
16	0.50	12.50	264	5.50	202	3.75	172	2.50	148
18	0.54	14.00	335	6.00	250	4.50	255	3.00	205
20	0.57	15.00	400	7.00	305	4.50	310	3.00	245
24	0.61	16.75	565	7.50	405	4.50	412	3.00	315
30	0.66	21.50	930	10.50	780	6.75	665	4.75	600
36	0.74	24.50	1450	11.50	1135	7.75	960	5.00	820
42	0.82	29.25	2205	14.00	1610	9.00	1350	6.00	1180
48	0.90	33.25	2990	15.00	2090	10.00	1760	6.50	1475

**MIXIPLE BENDS**



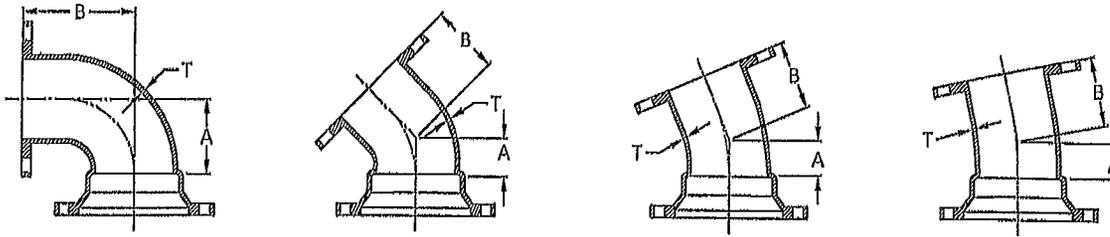
MJ X PLAIN END		90° BENDS (1/4)			45° BENDS (1/4)			22.5° BENDS (1/4)			11.25° BENDS (1/4)		
SIZE	T	A	S	WT	A	S	WT	A	S	WT	A	S	WT
3	0.33	3.25	8.50	16	1.50	7.00	13	1.00	6.50	12	1.00	6.50	12
4	0.34	4.00	9.50	22	2.00	7.50	19	1.50	7.00	18	1.25	6.25	17
6	0.36	5.00	11.50	41	3.00	8.50	34	2.00	7.50	29	1.50	7.00	27
8	0.38	6.50	12.50	58	3.50	9.00	49	2.50	8.00	43	1.75	7.25	39
10	0.40	7.50	13.00	88	4.50	10.00	69	3.00	8.50	61	2.00	7.50	52
12	0.42	9.00	14.50	114	5.50	11.00	93	3.50	9.00	79	2.25	7.75	69
14	0.47	11.50	19.50	197	5.00	13.00	146	3.75	11.25	133	2.50	10.50	118
16	0.50	12.50	20.50	248	5.50	13.50	184	3.75	11.75	166	2.50	10.50	136
18	0.54	14.00	21.00	325	6.00	13.00	235	6.00	13.00	235	6.00	13.00	235
20	0.57	15.00	22.50	390	7.00	14.00	290	7.00	14.00	300	7.00	14.00	300
24	0.61	17.00	25.00	575	7.50	14.50	390	7.50	14.50	395	7.50	14.50	400
30	0.66	22.50	30.50	865	10.50	19.50	715	6.75	15.75	600	4.75	13.75	535
36	0.74	24.50	33.50	1355	12.00	21.00	1040	7.75	16.75	865	5.00	14.00	725
42	0.82	29.25	38.25	2055	14.00	23.00	1460	9.00	18.00	1200	6.00	15.00	1030
48	0.90	33.25	42.24	2805	15.00	24.00	1905	10.00	19.00	1575	6.50	15.50	1290

\* not included in AWWA C153

All dimensions are in inches unless noted otherwise.

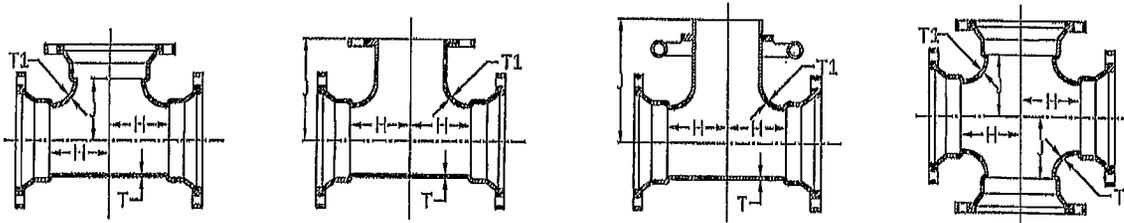
All weights are approximate in pounds unless noted otherwise.

**MJ X FLANGE BENDS\***



MJ X FLANGE	90° BENDS (¾)				45° BENDS (½)			22.5° BENDS (¼)			11.25° BENDS (1/8)		
SIZE	T	A	B	WT	A	B	WT	A	B	WT	A	B	WT
3	0.33	3.50	5.50	20	1.50	3.00	17	1.00	3.00	18	1.00	3.00	16
4	0.34	4.00	6.50	26	2.00	4.00	24	1.50	4.00	27	1.25	4.00	20
6	0.36	5.00	8.00	47	3.50	5.00	39	2.00	5.00	36	1.50	5.00	30
8	0.38	6.50	9.00	68	3.50	5.50	57	2.50	5.50	53	1.75	5.50	50
10	0.40	7.50	11.00	102	4.50	6.50	83	3.00	6.50	100	2.00	6.50	75
12	0.42	9.00	12.00	134	5.50	7.50	111	3.50	7.50	145	2.25	7.50	88
14	0.47	11.50	14.00	227	5.00	7.50	208	3.75	7.50	159	2.50	7.50	145
16	0.50	12.50	15.00	306	5.50	8.00	240	3.75	8.00	218	2.50	8.00	186
20	0.57	15.00	18.00	440	7.00	9.50	340	4.50	9.50	319	3.00	9.50	286
30	0.66	21.50	25.00	1010	10.50	15.00	805	6.75	15.00	729	4.75	15.00	686
36	0.74	24.50	28.00	1456	11.50	18.00	1175	7.75	18.00	1110	5.00	18.00	1050
42	0.82	29.25	31.00	2125	14.00	21.00	1732	9.00	21.00	1587	6.00	21.00	1595
48	0.90	33.25	34.00	2950	15.00	24.00	2285	10.00	24.00	2185	6.50	24.00	2032

**TEES: MJ X MJ, MJ X FLANGE, MJ X SWIVEL HYDRANT & CROSSES**



TEES & CROSSES			TEES MJ X MJ			TEES MJ X FE*			TEES MJ X ST*			MJ CROSSES		
SIZE	T	T1	H	J	WT	H	J	WT	H	J	WT	H	J	WT
*2 X 2	0.39	0.39	3.25	3.25	21	---	---	---	---	---	---	---	---	---
*3 X 2	0.48	0.39	3.50	3.50	45	---	---	---	---	---	---	---	---	---
3 X 3	0.33	0.33	3.00	3.00	28	3.00	5.50	30	---	---	---	3.00	3.00	35
*4 X 2	0.34	0.30	3.00	4.00	30	---	---	---	---	---	---	---	---	---
4 X 3	0.34	0.33	3.50	4.00	30	3.50	6.50	34	---	---	---	3.50	4.00	38
4 X 4	0.36	0.34	4.00	4.00	32	4.00	6.50	40	---	---	---	4.00	4.00	40
6 X 3	0.36	0.33	3.50	5.00	42	3.50	8.00	51	---	---	---	*3.50	5.00	51
6 X 4	0.36	0.34	4.00	5.00	46	4.00	8.00	58	4.00	10.00	---	4.00	5.00	57
*6 X 4 X 6	0.36	0.36	*5.00	5.00	47	---	---	---	---	---	---	---	---	---
6 X 6	0.36	0.36	5.00	5.00	56	5.00	8.00	61	5.00	10.25	66	5.00	5.00	75
*6 X 6 X 8	0.38	0.38	*6.50	6.50	63	---	---	---	---	---	---	---	---	---
*8 X 3	0.38	0.33	*4.00	6.50	55	4.00	9.00	69	---	---	---	---	---	---
8 X 4	0.38	0.34	4.00	6.50	60	4.00	9.00	74	---	---	---	4.00	6.00	68
8 X 6	0.38	0.36	5.00	6.50	72	5.00	9.00	82	5.00	11.25	87	5.00	6.00	74
*8 X 6 X 6	0.38	0.38	*5.00	6.50	65	---	---	---	---	---	---	---	---	---
*8 X 6 X 8	0.38	0.38	*6.00	6.50	87	---	---	---	---	---	---	---	---	---
8 X 8	0.40	0.38	6.50	6.50	86	6.50	9.00	93	6.50	11.50	105	6.00	6.00	105
*10 X 3	0.34	0.33	*4.00	7.50	76	---	---	---	---	---	---	---	---	---

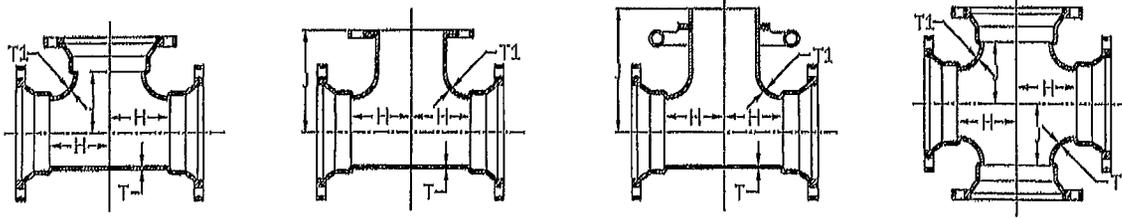
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\* not included in AWWA C153

All dimensions are in inches unless noted otherwise.

All weights are approximate in pounds unless noted otherwise.

**TEES, MJ X MJ, MJ X FLANGE, MJ X SWIVEL HYDRANT & CROSSES (Cont)**



TEES & CROSSES			TEES MJ X MJ			TEES MJ X FE			TEES MJ X ST*			MJ CROSSES		
SIZE	T	T1	H	J	WT	H	J	WT	H	J	WT	H	J	WT
10X 4	0.40	0.34	4.00	7.50	78	4.00	11.00	90	---	---	---	4.00	7.00	112
10X 6	0.40	0.36	5.00	7.50	90	5.00	11.00	109	5.00	12.75	110	5.00	7.00	119
10X 8	0.40	0.38	6.50	7.50	105	6.50	11.00	116	6.50	12.75	120	6.50	7.00	124
10X10	0.40	0.40	7.50	7.50	120	7.50	11.00	132	---	---	---	7.00	7.00	145
*12X 3	0.42	0.33	*4.00	8.75	93	---	---	---	---	---	---	---	---	---
12X 4	0.42	0.34	4.00	8.75	94	4.00	12.00	118	4.00	13.50	---	4.00	8.50	119
12X 6	0.42	0.36	5.00	8.75	110	5.00	12.00	127	5.00	13.75	127	5.00	8.50	126
12X 8	0.42	0.38	6.50	8.75	125	6.50	12.00	138	6.50	13.75	130	6.00	8.50	149
12X10	0.42	0.40	7.50	8.75	140	7.50	12.00	150	---	---	---	7.50	8.50	179
12X12	0.42	0.42	8.75	8.75	160	8.75	12.00	178	8.75	13.50	---	8.50	8.50	213
14X 4	0.47	0.34	5.50	10.50	172	5.50	14.00	163	---	---	---	*5.50	10.50	164
14X 6	0.47	0.36	6.50	10.50	182	6.50	14.00	181	6.50	15.00	212	6.50	10.50	200
14X 8	0.47	0.38	7.50	10.50	206	7.50	14.00	201	7.50	15.00	184	7.50	10.50	228
14X10	0.47	0.40	8.50	10.50	228	8.50	14.00	244	---	---	---	*8.50	10.50	225
14X12	0.47	0.42	9.50	10.50	234	9.50	14.00	282	---	---	---	*9.50	10.50	247
14X14	0.47	0.47	10.50	10.50	280	10.50	14.00	298	---	---	---	10.50	10.50	299
16X 6	0.50	0.36	6.50	11.50	228	6.50	15.00	210	6.50	16.00	256	6.50	11.50	240
16X 8	0.50	0.38	7.50	11.50	248	7.50	15.00	261	7.50	16.00	295	7.50	11.50	260
16X10	0.50	0.40	8.50	11.50	264	8.50	15.00	285	---	---	---	8.50	11.50	317
16X12	0.50	0.42	9.50	11.50	280	9.50	15.00	311	---	---	---	9.50	11.50	326
16X14	0.50	0.47	10.50	11.50	316	10.50	15.00	350	---	---	---	*10.50	11.50	336
16X16	0.50	0.50	11.50	11.50	322	11.50	15.00	372	---	---	---	11.50	11.50	385
18X 6	0.54	0.36	6.50	12.50	275	6.50	15.50	324	6.50	18.00	282	*6.50	12.50	262
18X 8	0.54	0.38	7.50	12.50	295	7.50	15.50	352	7.50	17.00	271	*7.50	12.50	285
18X10	0.54	0.40	8.50	12.50	315	8.50	15.50	---	---	---	---	*8.50	12.50	311
18X12	0.54	0.42	9.50	12.50	335	9.50	15.50	360	---	---	---	9.50	12.50	348
18X14	0.54	0.47	10.50	12.50	380	10.50	16.50	---	---	---	---	*10.50	12.50	388
18X16	0.54	0.50	11.50	12.50	405	11.50	16.50	442	---	---	---	*11.50	12.50	---
18X18	0.54	0.54	12.50	12.50	435	12.50	16.50	448	---	---	---	12.50	12.50	481
20X 6	0.57	0.36	6.50	14.00	315	6.50	17.00	365	6.50	18.50	360	*6.50	14.00	325
20X 8	0.57	0.38	8.00	14.00	345	8.00	17.00	342	8.00	18.50	380	8.00	14.00	379
20X10	0.57	0.40	9.00	14.00	370	9.00	17.00	374	---	---	---	*9.00	14.00	382
20X12	0.57	0.42	10.00	14.00	395	10.00	17.00	405	---	---	---	10.00	14.00	413
20X14	0.57	0.47	11.00	14.00	440	11.00	17.00	437	---	---	---	*11.00	14.00	456
20X16	0.57	0.50	12.00	14.00	465	12.00	18.00	478	---	---	---	*12.00	14.00	632
20X18	0.57	0.54	13.00	14.00	505	13.00	18.00	510	---	---	---	*13.00	14.00	552
20X20	0.57	0.57	14.00	14.00	535	14.00	18.00	557	---	---	---	14.00	14.00	600
24X 6	0.61	0.36	7.00	16.00	415	7.00	19.00	435	7.00	19.00	461	*7.00	16.00	425
24X 8	0.61	0.38	8.00	16.00	445	8.50	19.00	426	8.00	19.00	480	8.00	16.00	481
24X10	0.61	0.40	9.00	16.00	470	9.00	19.00	466	---	---	---	*9.00	16.00	485
24X12	0.61	0.42	10.00	16.00	500	10.00	19.00	515	---	---	---	10.00	16.00	529
24X14	0.61	0.47	11.00	16.00	550	11.00	19.00	544	---	---	---	*11.00	16.00	558
24X16	0.61	0.50	12.00	16.00	580	12.00	19.00	582	---	---	---	12.00	16.00	576
24X18	0.61	0.54	13.00	16.00	625	13.00	22.00	640	---	---	---	13.00	16.00	---
24X20	0.61	0.57	14.00	16.00	660	14.00	22.00	693	---	---	---	*14.00	16.00	817
24X24	0.61	0.61	16.00	16.00	720	16.00	22.00	790	---	---	---	*17.00	17.00	875
*30X 6	0.66	0.36	*8.00	20.00	678	8.00	23.00	805	7.50	24.50	664	8.50	20.00	670

\* not included in AWWA C153

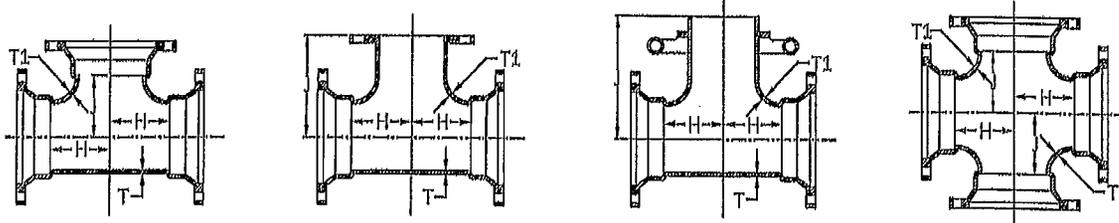
Cont

All dimensions are in inches unless noted otherwise.

All weights are approximate in pounds unless noted otherwise.

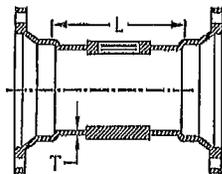
**COMPACT MJ FITTINGS**  
ANSI/AWWA C153/A21.53

**TEES: MJ X MJ, MJ X FLANGE, MJ X SWIVEL HYDRANT & CROSSES (Cont.)**



TEES & CROSSES			TEES: MJ X MJ			TEES: MJ X FE*			TEES: MJ X ST*			MJ CROSSES		
SIZE	T	T1	H	J	WT	H	J	WT	H	J	WT	H	J	WT
30X8	0.66	0.38	8.50	20.00	739	8.50	23.00	722	---	---	---	*8.50	20.00	678
30X12	0.66	0.42	10.00	20.00	830	10.00	23.00	824	---	---	---	10.00	20.00	882
30X16	0.66	0.50	12.50	20.00	959	12.50	23.00	1028	---	---	---	*12.50	20.00	885
30X18	0.66	0.54	14.00	20.00	1039	---	---	---	---	---	---	---	---	---
30X20	0.66	0.57	15.00	20.00	995	15.00	23.00	---	---	---	---	*16.00	20.00	1012
30X24	0.66	0.61	16.00	20.00	1060	16.00	25.00	1287	---	---	---	22.00	22.00	1246
30X30	0.66	0.66	20.00	20.00	1323	20.00	25.00	1292	---	---	---	22.00	22.00	1840
36 X 6	0.74	0.36	7.00	23.50	1045	8.00	26.00	1175	8.00	27.50	901	---	---	---
36 X 8	0.74	0.38	9.00	23.50	1095	---	---	---	9.00	27.50	945	---	---	---
36X16	0.74	0.50	12.50	23.50	1385	---	---	1502	---	---	---	---	---	---
36X24	0.74	0.61	16.00	23.50	1498	16.00	26.00	1949	---	---	---	16.00	23.50	1785
36X30	0.74	0.66	20.00	23.50	1555	20.00	28.00	1956	---	---	---	*26.00	26.00	---
36X36	0.74	0.74	23.50	23.50	1900	23.50	28.00	1943	---	---	---	26.00	26.00	2655
42X18	0.82	0.54	16.00	27.50	2072	---	---	---	---	---	---	---	---	---
42X24	0.82	0.61	20.00	27.50	2270	20.00	30.00	---	---	---	---	20.00	27.50	2668
42X30	0.82	0.66	22.00	29.50	2425	22.00	31.00	3163	---	---	---	22.00	29.50	2950
42X36	0.82	0.74	30.00	30.00	3000	30.00	31.00	2792	---	---	---	30.00	30.00	3607
42X42	0.82	0.82	30.00	30.00	3175	30.00	31.00	---	---	---	---	30.00	30.00	3725
48 X 6	0.90	0.36	10.00	32.00	1949	---	---	---	---	---	---	---	---	---
48X16	0.90	0.50	13.00	32.00	2657	---	---	---	---	---	---	*23.00	32.00	2623
48X24	0.90	0.61	23.00	32.00	2870	23.00	34.00	---	---	---	---	*23.00	32.00	2785
48X30	0.90	0.66	23.00	32.00	3050	23.00	34.00	2774	---	---	---	*23.00	32.00	3672
48X36	0.90	0.74	33.50	32.25	3900	33.50	34.00	3619	---	---	---	*33.50	32.25	3735
48X42	0.90	0.82	33.50	33.50	4100	33.50	34.00	3746	---	---	---	*33.50	33.50	4651
48X48	0.90	0.90	33.50	33.50	4250	33.50	34.00	3907	---	---	---	33.50	33.50	4955

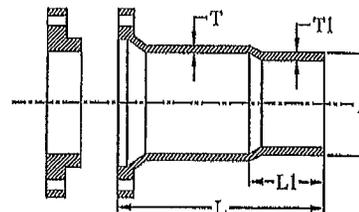
**TEES: MJ X MJ TAPPED (2 TAP)**



SIZE	T	L	TAP SIZE	WT
3	0.33	6.00	2	18
4	0.34	6.00	2	24
6	0.36	6.00	2	42
8	0.38	6.00	2	52
10	0.40	6.00	2	64
12	0.42	6.00	2	81
16	0.50	6.00	2	168
24	0.61	8.00	2	391

**CUTTING IN SLEEVE: MJ X PE**

(WITH OVER SIZE GLAND)



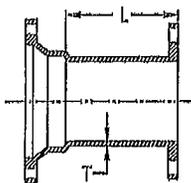
SIZE	T	T1	A	L	L1	WT
4	0.36	0.34	4.80	20.00	9.00	51
6	0.38	0.36	6.90	20.00	9.00	64
8	0.40	0.38	9.05	20.00	9.00	89
10	0.42	0.40	11.10	20.00	9.00	106
12	0.47	0.42	13.20	20.00	9.00	130
16	0.54	0.50	17.40	20.00	9.00	272

\* not included in AWWA C153

All dimensions are in inches unless noted otherwise.

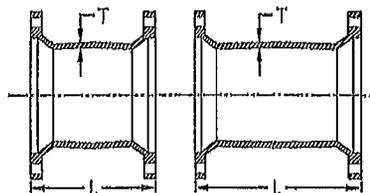
All weights are approximate in pounds unless noted otherwise.

**ADAPTER MIX FLANGE**



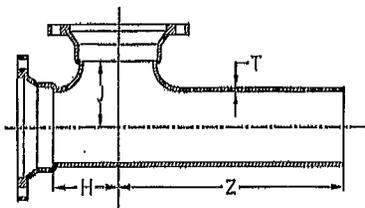
SIZE	L	T	WT
3	3.50	0.33	13
4	3.50	0.34	23
6	3.50	0.36	31
8	3.50	0.38	54
10	3.50	0.40	70
12	3.50	0.42	95
14	5.00	0.47	141
16	5.00	0.50	170
18	5.00	0.54	221
20	5.00	0.57	252
24	5.00	0.61	324
30	7.00	0.66	558
36	7.00	0.74	796
42	7.00	0.82	1190
48	7.00	0.90	1653

**MJ SLEEVES**



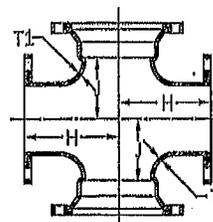
MJ SLEEVES		LONG		SHORT	
SIZE	T	L	WT	L	WT
3	0.33	12.00	17	7.50	12
4	0.34	12.00	20	7.50	15
6	0.36	12.00	29	7.50	23
8	0.38	12.00	45	7.50	31
10	0.40	12.00	61	7.50	45
12	0.42	12.00	76	7.50	56
14	0.47	15.00	128	9.50	94
16	0.50	15.00	159	9.50	118
18	0.54	15.00	200	9.00	145
20	0.57	15.00	236	9.00	173
24	0.61	15.00	306	9.00	226
30	0.66	24.00	634	15.00	472
36	0.74	24.00	889	15.00	673
42	0.82	24.00	1150	15.00	887
48	0.90	24.00	1435	15.00	1136

**TEES MIX PIPE X MJ**



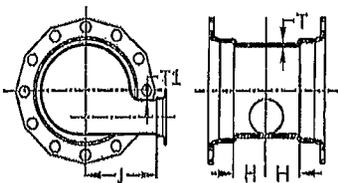
SIZE	T	H	J	Z	WT
6	0.36	5.00	5.00	12.00	59
8	0.38	6.50	6.50	12.50	80

**CROSSES MIX FLANGE**



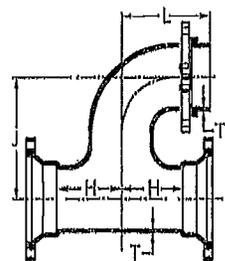
SIZE	T	T1	J	H	WT
8 X 8	0.38	0.38	9.00	6.50	133
12 X 12	0.42	0.42	12.00	8.75	260

**TEES MIX MJ TANGENTIAL**



SIZE	T	T1	J	H	WT
16 X 6	0.50	0.38	11.50	6.50	226
16 X 12	0.50	0.42	11.50	9.50	304
18 X 6	0.54	0.36	12.50	6.50	287
24 X 6	0.61	0.36	16.00	7.00	458
24 X 12	0.61	0.42	16.00	10.00	542

**TEES MIX SWIVEL PARALLEL**



SIZE	T	T1	J	H	WT	
6 X 6	0.36	0.36	12.50	8.00	10.00	85
8 X 6	0.38	0.36	13.50	9.00	11.00	109
10 X 6	0.40	0.36	14.00	11.00	13.00	127
12 X 6	0.42	0.36	16.00	12.00	14.00	240

\* not included in AWWA C153

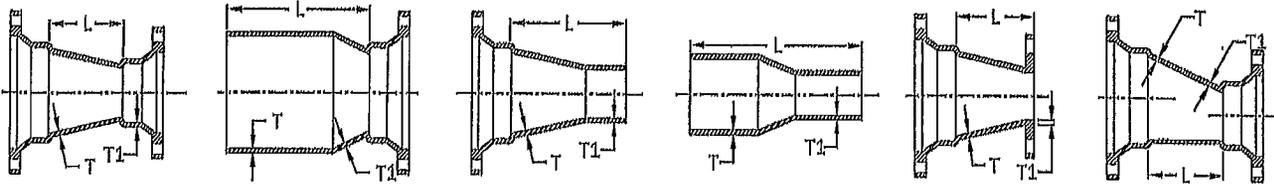
All dimensions are in inches unless noted otherwise.

All weights are approximate in pounds unless noted otherwise.

# COMPACT MJ FITTINGS

ANSI/AWWA C153/A21.53

## REDUCERS: MJ X MJ, PE X SMALL END MJ, LARG END MJ X PE, PE X PE, MJ X PE, MJ ECCENTRIC



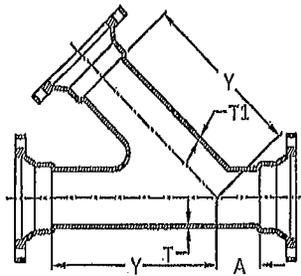
REDUCERS			MJ X MJ		PE X SEB		LEB X PE		PE X PE		MJ X FLANGE*		MJ ECCENTRIC*	
SIZE	T	T1	L	WT	L	WT	L	WT	L	WT	L	WT	L	WT
4 X 3	0.34	0.33	3.00	18	8.50	17	8.50	18	14.00	14	5.00	20	---	---
6 X 3	0.36	0.33	5.00	22	10.50	24	10.50	19	16.00	19	---	---	---	---
6 X 4	0.36	0.34	4.00	24	9.50	25	9.50	25	15.00	22	5.00	32	---	---
8 X 4	0.38	0.34	5.00	32	10.50	30	10.50	34	16.00	30	---	---	---	---
8 X 6	0.38	0.36	4.00	36	9.50	35	9.50	32	15.00	30	6.00	43	---	---
10 X 4	0.40	0.34	7.00	46	12.50	43	12.50	43	18.00	46	---	---	---	---
10 X 6	0.40	0.36	5.00	47	10.50	46	10.50	42	16.00	46	---	---	5.00	49
10 X 8	0.40	0.38	4.00	50	9.50	42	9.50	50	15.00	47	---	---	4.00	53
12 X 4	0.42	0.34	9.00	58	14.50	60	14.50	60	20.00	58	---	---	---	---
12 X 6	0.42	0.36	7.00	58	12.50	58	12.50	58	18.00	57	---	---	---	---
12 X 8	0.42	0.38	5.00	57	10.50	54	10.50	55	16.00	54	7.00	83	---	---
12 X 10	0.42	0.40	4.00	61	9.50	59	9.50	59	15.00	54	7.00	87	---	---
14 X 6	0.47	0.36	9.00	100	16.90	100	14.50	104	22.30	93	---	---	---	---
14 X 8	0.47	0.38	7.00	100	14.90	98	12.40	98	20.30	94	---	---	---	---
14 X 10	0.47	0.40	5.00	100	12.90	94	10.40	92	18.30	90	8.00	115	---	---
14 X 12	0.47	0.42	4.00	100	11.90	90	9.40	92	17.30	88	---	---	---	---
16 X 6	0.50	0.36	11.00	124	18.90	125	16.50	136	24.30	93	---	---	---	---
16 X 8	0.50	0.38	9.00	124	16.90	121	14.40	128	22.30	119	---	---	---	---
16 X 10	0.50	0.40	7.00	124	15.00	105	12.50	123	20.50	119	---	---	---	---
16 X 12	0.50	0.42	5.00	112	12.90	109	10.50	108	18.30	99	---	---	5.00	116
16 X 14	0.50	0.47	4.00	140	12.00	126	12.00	132	19.70	129	---	---	---	---
18 X 8	0.54	0.38	13.00	190	20.00	170	19.50	195	27.40	170	16.00	193	---	---
18 X 10	0.54	0.40	10.00	195	18.00	165	17.40	185	25.50	160	---	---	---	---
18 X 12	0.54	0.42	7.00	180	15.50	150	14.00	175	19.50	150	12.00	199	---	---
18 X 14	0.54	0.47	6.00	190	15.00	175	15.00	190	23.00	160	---	---	---	---
18 X 16	0.54	0.50	5.00	195	12.50	170	12.50	190	18.00	145	---	---	---	---
20 X 10	0.57	0.40	14.00	220	22.00	200	19.00	210	27.50	180	---	---	---	---
20 X 12	0.57	0.42	12.00	205	17.50	170	16.00	205	21.50	190	---	---	---	---
20 X 14	0.57	0.47	10.00	200	18.00	190	17.90	205	26.00	195	---	---	---	---
20 X 16	0.57	0.50	7.00	200	13.50	185	13.50	200	19.00	170	---	---	8.00	237
20 X 18	0.57	0.54	4.00	225	12.00	200	12.00	215	20.00	190	---	---	---	---
24 X 12	0.61	0.42	16.00	305	21.50	275	21.00	290	22.50	240	18.00	322	---	---
24 X 14	0.61	0.47	14.00	306	22.00	310	21.90	315	25.00	295	---	---	---	---
24 X 16	0.61	0.50	12.00	320	17.50	285	17.50	285	23.00	285	---	---	12.00	325
24 X 18	0.61	0.54	10.00	305	18.00	300	18.00	310	21.00	290	---	---	---	---
24 X 20	0.61	0.57	7.00	300	13.50	270	13.50	275	14.00	240	---	---	7.00	373
30 X 16	0.66	0.50	30.00	633	39.00	565	39.00	623	48.00	555	---	---	---	---
30 X 18	0.66	0.54	28.00	658	37.00	789	37.00	635	46.00	567	---	---	28.00	807
30 X 20	0.60	0.57	24.00	628	33.00	590	33.00	603	42.00	535	---	---	24.00	633
30 X 24	0.66	0.61	10.00	478	24.50	560	24.50	526	33.50	458	---	---	10.00	578
36 X 16	0.74	0.50	30.00	1016	27.00	495	---	---	---	---	---	---	---	---
36 X 18	0.74	0.54	36.00	983	37.00	595	---	---	---	---	---	---	---	---
36 X 20	0.74	0.57	36.00	975	45.00	874	45.00	950	54.00	849	---	---	---	---
36 X 24	0.74	0.61	19.00	770	33.00	746	33.00	810	42.00	709	---	---	19.00	831
36 X 30	0.74	0.66	15.50	650	24.50	725	24.50	758	33.50	657	---	---	15.50	819
42 X 24	0.82	0.61	40.00	1356	49.00	1204	49.00	1319	58.00	1067	---	---	40.00	1783
42 X 30	0.82	0.66	20.00	1083	29.00	931	29.00	1015	38.00	863	---	---	20.00	1439
42 X 36	0.82	0.74	15.50	1114	24.50	962	24.50	1013	33.50	861	---	---	15.50	1117
48 X 24	0.90	0.61	40.00	1761	---	---	---	---	---	---	---	---	40.00	1809
48 X 30	0.90	0.66	40.00	1779	49.00	1594	49.00	1711	58.00	1526	---	---	40.00	1962
48 X 36	0.90	0.74	28.00	1641	37.00	1456	37.00	1540	46.00	1355	---	---	28.00	2011
48 X 42	0.90	0.82	15.50	1426	24.50	1241	24.50	1274	33.50	1089	---	---	15.50	1475

\* not included in AWWA C153

All dimensions are in inches unless noted otherwise.

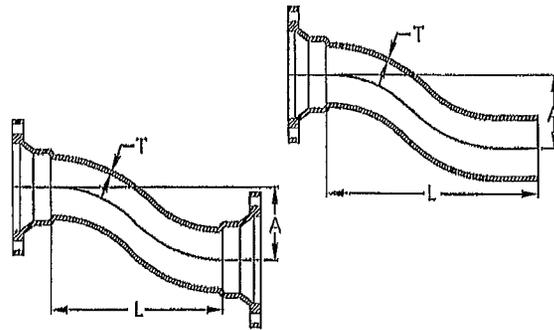
All weights are approximate in pounds unless noted otherwise.

**MULTIATERALS**



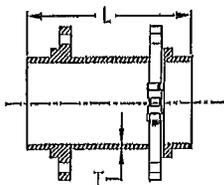
SIZE	A	Y	T	T1	WT
3 X 3	2.50	8.50	0.33	0.33	37
4 X 3	2.50	8.50	0.34	0.33	42
4 X 4	2.50	8.50	0.34	0.34	44
6 X 4	1.50	11.00	0.36	0.34	55
6 X 6	3.00	12.50	0.36	0.36	89
8 X 4	0.50	13.00	0.38	0.34	74
8 X 6	2.00	14.50	0.38	0.36	91
8 X 8	3.50	16.00	0.38	0.38	105
10 X 4	0.00	15.00	0.40	0.34	156
10 X 6	1.00	16.00	0.40	0.36	161
10 X 8	2.50	17.00	0.40	0.38	173
10 X 10	3.50	19.00	0.40	0.40	214
12 X 4	0.00	16.50	0.42	0.34	151
12 X 6	1.50	18.50	0.42	0.36	189
12 X 8	1.50	18.50	0.42	0.38	190
12 X 10	3.00	20.00	0.42	0.40	252
12 X 12	4.50	22.50	0.42	0.42	274
14 X 6	0.00	19.50	0.47	0.36	248
14 X 8	1.50	21.00	0.47	0.38	281
14 X 10	3.00	22.50	0.47	0.40	320
14 X 14	6.00	25.00	0.47	0.47	475
16 X 4	0.00	21.00	0.50	0.34	275
16 X 6	0.00	21.00	0.50	0.36	302
16 X 8	0.50	22.50	0.50	0.38	354
16 X 10	2.00	24.00	0.50	0.40	372
16 X 12	3.50	25.00	0.50	0.42	458
16 X 14	5.00	26.50	0.50	0.47	507
16 X 16	6.50	28.00	0.50	0.50	576
18 X 6	0.00	23.00	0.54	0.36	351
18 X 8	1.50	25.00	0.54	0.38	386
18 X 10	4.50	30.00	0.54	0.40	507
18 X 12	4.50	30.00	0.54	0.42	511

**MJ OFFSETS**



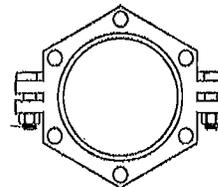
OFFSETS			MJ X MJ		MJ X RE	
SIZE	T	A	L	WT	J	WT
*3 X 6	0.33	6.00	9.00	23	---	---
*3 X 12	0.33	12.00	15.00	32	---	---
*3 X 18	0.33	18.00	21.00	42	---	---
*3 X 24	0.33	24.00	27.00	50	---	---
4 X 6	0.34	6.00	10.00	32	15.50	33
4 X 12	0.34	12.00	18.00	55	23.50	50
4 X 18	0.34	18.00	22.00	63	27.50	61
4 X 24	0.34	24.00	28.00	79	33.50	68
6 X 6	0.36	6.00	12.00	48	17.50	55
6 X 12	0.36	12.00	18.00	68	23.50	66
6 X 18	0.36	18.00	24.00	86	29.50	103
6 X 24	0.36	24.00	30.00	110	35.50	122
8 X 6	0.38	6.00	13.00	74	18.50	85
8 X 12	0.38	12.00	19.00	94	24.50	97
8 X 18	0.38	18.00	25.00	118	30.50	133
8 X 24	0.38	24.00	30.00	147	35.50	149
10 X 6	0.40	6.00	*15.00	113	20.50	127
10 X 12	0.40	12.00	21.00	144	26.50	174
10 X 18	0.40	18.00	27.00	192	32.50	202
10 X 24	0.40	24.00	33.00	244	38.50	245
12 X 6	0.42	6.00	17.00	150	22.50	132
12 X 12	0.42	12.00	23.00	192	28.50	197
12 X 18	0.42	18.00	27.00	226	32.50	273
12 X 24	0.42	24.00	35.00	272	40.50	347
*16 X 12	0.50	12.00	26.00	324	---	---
*16 X 18	0.50	18.00	36.00	406	---	---
*16 X 24	0.50	24.00	36.00	435	---	---
*20 X 12	0.57	12.00	28.00	439	---	---
*20 X 18	0.57	18.00	38.00	582	---	---

**SWIVEL X SOLID HYDRANT ADAPTER (WITH SWIVEL GLAND)**



SIZE	L	T	WT
6 X 13	13.00	0.36	48
6 X 18	18.00	0.36	58
6 X 24	24.00	0.36	63
6 X 30	30.00	0.36	65
6 X 36	36.00	0.36	77
6 X 48	48.00	0.36	98
8 X 13	13.00	0.38	55
8 X 18	18.00	0.38	69
8 X 24	24.00	0.38	85
8 X 48	48.00	0.38	147
12 X 13	13.00	0.42	118

**SWIVEL GLAND**



SIZE	WT
4	8
6	10
8	12
10	16
12	24

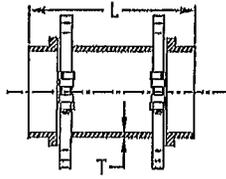
\* not included in AWWA C153

All dimensions are in inches unless noted otherwise.

All weights are approximate in pounds unless noted otherwise.

**SWIVEL X SWIVEL HYDRANT ADAPTER**

WITH TWO-SWIVEL GLANDS



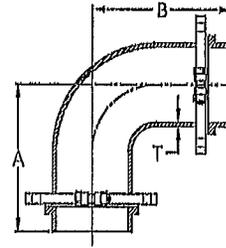
SIZE	L	T	WT
6 X 12	12.00	0.36	51
6 X 18	18.00	0.36	64
6 X 24	24.00	0.36	75

6 x 36

27

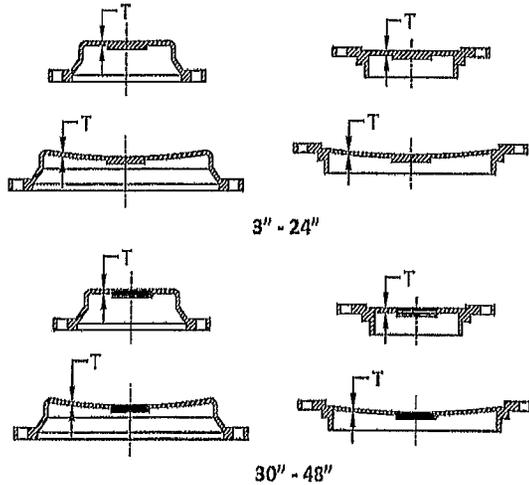
**SWIVEL X SWIVEL HYDRANT ELB**

WITH TWO-SWIVEL GLANDS



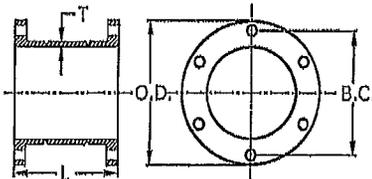
SIZE	T	A	B	WT
6	0.36	10.50	16.00	52

**SOLID AND TAPPED CAPS & PLUGS**



SIZE	T	MAX TAP	CAPS WT	PLUGS WT
*2	0.40	2	7	7
3	0.33	2	8	8
4	0.34	2	9	10
6	0.36	2	15	16
8	0.38	2	22	26
10	0.40	2	32	36
12	0.42	2	42	46
14	0.47	2	66	75
16	0.50	2	92	95
18	0.54	2	114	121
20	0.57	2	125	135
24	0.61	2	166	175
30	0.66	2 1/2	345	355
36	0.74	2 1/2	628	688
42	0.82	2 1/2	852	948
48	0.90	2 1/2	1047	1137

**HYDRANT EXTENSIONS**



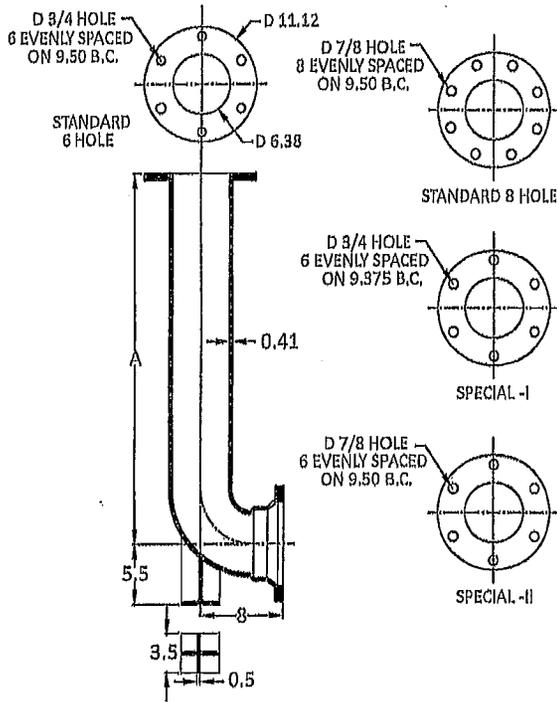
SIZE	T	L	B.C.	O.D.	FLANGE HOLES DIA	WT
6 X 4	0.56	4.00	9.50	11.12	0.75	45
6 X 6	0.56	6.00	9.50	11.12	0.75	50
6 X 8	0.56	8.00	9.50	11.12	0.75	58
6 X 10	0.56	10.00	9.50	11.12	0.75	64
6 X 12	0.56	12.00	9.50	11.12	0.75	70
6 X 14	0.56	14.00	9.50	11.12	0.75	74
6 X 16	0.56	16.00	9.50	11.12	0.75	82
6 X 18	0.56	18.00	9.50	11.12	0.75	88
6 X 20	0.56	20.00	9.50	11.12	0.75	94
6 X 22	0.56	22.00	9.50	11.12	0.75	101
6 X 24	0.56	24.00	9.50	11.12	0.75	106
6 X 26	0.56	26.00	9.50	11.12	0.75	110
6 X 28	0.56	28.00	9.50	11.12	0.75	118
6 X 30	0.56	30.00	9.50	11.12	0.75	124
6 X 36	0.56	36.00	9.50	11.12	0.75	142

\* not included in AWWA C153

All dimensions are in inches unless noted otherwise.

All weights are approximate in pounds unless noted otherwise.

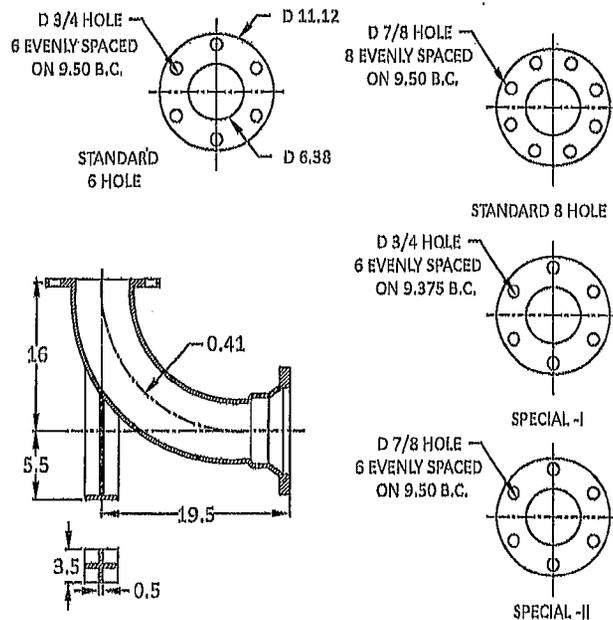
**HYDRANT BURIES**



SIZE	A	WT.
6 X 22	22.00	85
6 X 24	24.00	90
6 X 30	30.00	103
6 X 36	36.00	117
6 X 42	42.00	130
6 X 48	48.00	146
6 X 54	54.00	160

**LONG RADIUS HYDRANT BURIES**

SIZE	A	WT.
6	15.00	84



\* not included in AWWA C153

All dimensions are in inches unless noted otherwise.

All weights are approximate in pounds unless noted otherwise.

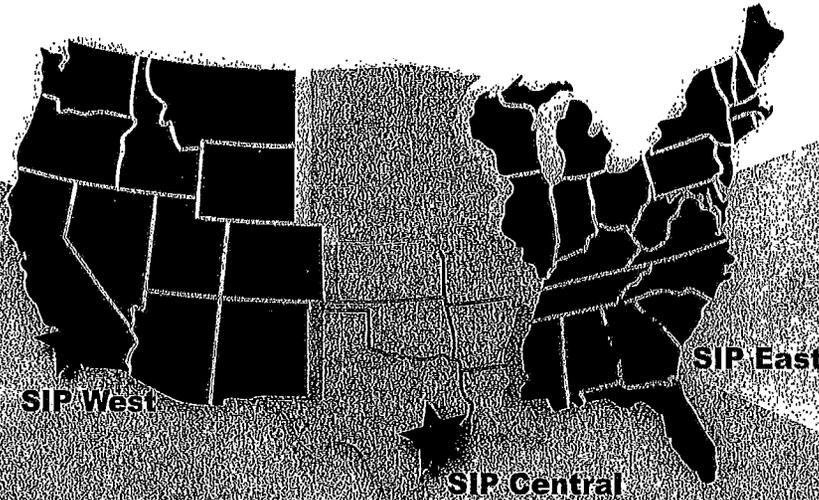






# SIP Industries

Quality Manufacturers Since 1960



## AWWA DI Fittings & Accessories

- C153 Compact MJ Fittings and Acc. 2" - 48"
- C110 Full Body MJ Fittings 2" - 48"
- C153 Push-On Fittings 4" - 24"
- C110 Flange Fittings 2" - 60"
- Stainless Steel & Blue T-Bolts
- Ductile Iron Retainer Glands
- Made In India, China & Mexico
- Cement, Fuslon Bonded Epoxy & P401 lining

## Joint Restraint System

- EZD Joint Restraint for DI Pipe 3" - 48"
- EZP Joint Restraint for PVC Pipe 3" - 36"
- PTP Pipe to Pipe Restraint 4" - 36"
- PTPDF Pipe to MJ Fittings Restraint 4" - 36"
- PTPFC Pipe to PVC Fittings Restraint 4" - 12"
- Made In China & USA
- Fusion Bonded Epoxy or Shop Coating

## Municipal Construction Castings

- Manhole Rings and Cover
- Frames and Grates
- Valve Boxes and Service Boxes
- Water Meter Covers and Boxes
- Trench Grates and Tree Grates
- Made In India & USA

## Fabrication Products for DI Pipe

- High Hub Flanges Class 150 and 250. 3" - 64"
- Threaded Bell Flanges 3" - 48"
- Anchor Flanges 3" - 60"
- Filler Flanges 4" - 30"

## Other Products and Services

- All Thread Rod
- Pipe Lube and Hydraulic Cement
- Socket Clamps and Lugs
- Flange Packs
- OEM Castings

### SIP West

8333 Almeria Avenue  
Fontana, CA 92335

### SIP Central

2900 Paffio Drive  
Houston, TX 77017

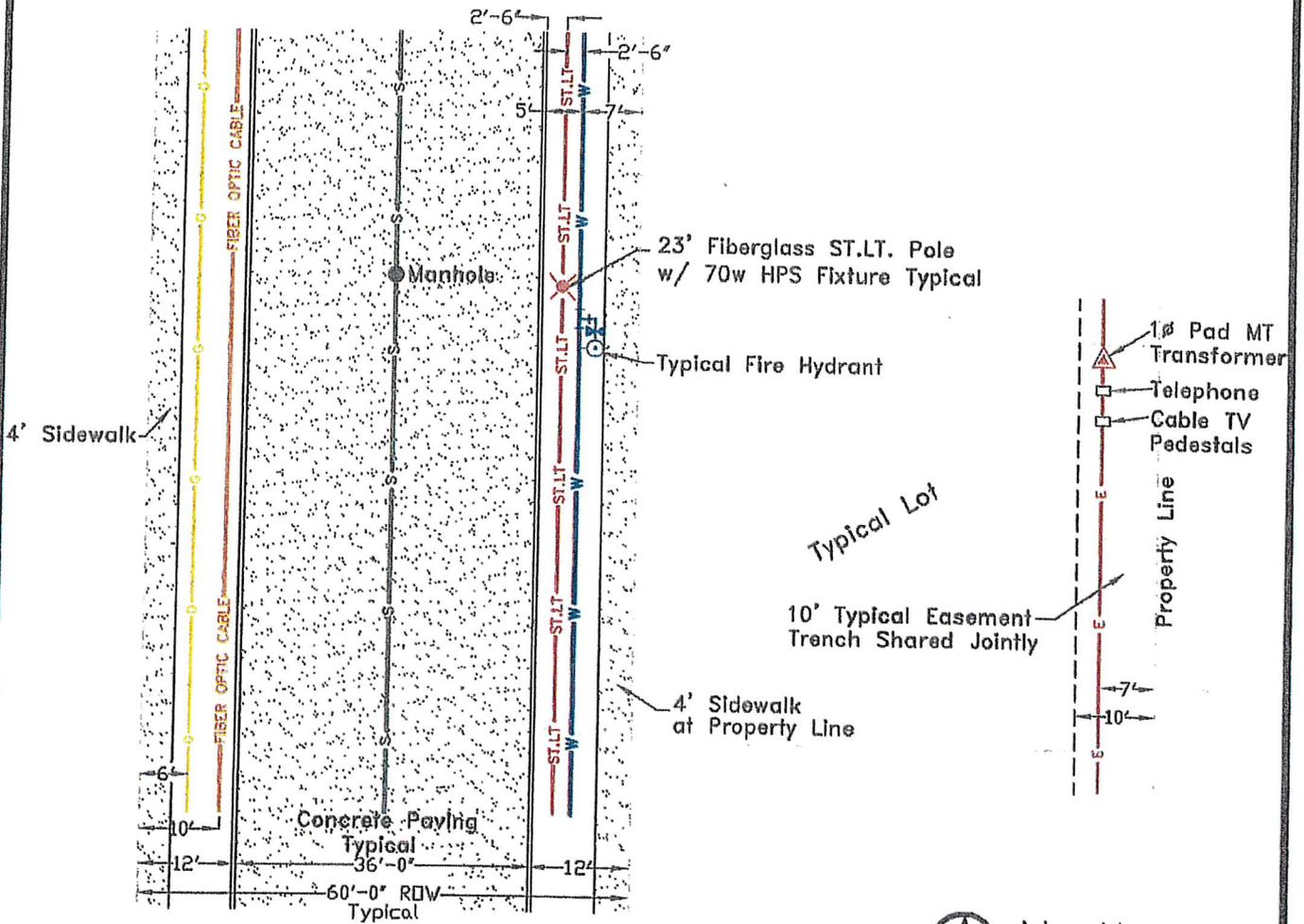
### SIP East

600 Rayloc Drive  
Atlanta, GA 30336



## Appendix D

# TYPICAL UTILITY LOCATIONS ON ALL STREET ROW'S



- G- Gas Mains are on North & West Side of Streets 6' off Property Line @ 3' Deep
- W- Water Mains are on South & East Side of Streets 7' off Property Line @ 5' Deep
- S- Sewer Mains are at Center of Streets. Depths as Needed for Gravity Flow
- E- Underground Electric are at Rear Property Line 7' off Property Line @ 4' Deep
- STLT- Underground Street Light Circuits 2'-6" Back of Curb @ 4' Deep on Either Side of Street (As Required by Design).
- FOC- Fiber Optic Cables are on North & West Side of Streets 10' off Property Line, Only if Not in Conflict with Street Light Circuit.



<b>HASTINGS UTILITIES</b> HASTINGS, NEBRASKA			
Typical Utility Locations on all Street ROW's			
<small>\\server\civ\projects\1118\Drawings\Easements\TYPICALUTILITIES.dwg</small>			
DSN: R. Sakora	SUPT	CKD:	No. 1 of 1
DRN: J.Redding	W.O. No.	CKD:	
DATE: 11/18/98	RET. No.	APP:	

No.	Revision	By	Date	Ctd	App
2	Added additional info to Street Light & Fiber Optic Notes	J.J.L.	9/21/00	R.S.	
1	Original layout of Note & Street Light	J.J.L.	8/5/99	R.S.	

## Hastings Utilities Fire Hydrant Spacing

Zoning Class	UFC Fire Flow Rate		HU Design Fire Flow		Hydrant Coverage Square Feet	Radius, Ft	Hydr. Spacing Feet		Uniform Fire Code
	GPM		GPM				Feet	Feet	
Residential	1,500		1,500		484,400	390	780	500	
Commercial	2,500		2,500		419,800	365	730	450	
Industrial	3,500		4,000		339,100	325	650	350	

Recommendation: In residential and light commercial zoning use 760 ft spacing which implies a hydrant every other intersection for nominal 390 ft block spacing

In heavy commercial and Industrial use 350 to 450 ft spacing which implies a spacing every block for nominal 390 ft block spacing. In industrial areas Fire spacing to be nominal 400 ft and located near access points with multiple approach directions.

DIP Capacity Table

DIP Water Main Capacities Class 52						
Size	Diameter (inches)	Area Sq. feet	Capacity at 5.0 fps	Capacity at 7.5 fps	1-Way Feed Nominal Capacity	2-Way Feed Nominal Capacity
4	4.22	0.097	218.0	327.0	325	650
6	6.28	0.215	482.7	724.1	750	1,500
8*	8.39	0.384	861.6	1292.4	1,250	2,500
10**	10.4	0.590	1323.9	1985.8	2,000	4,000
12	12.46	0.847	1900.3	2850.4	3,000	6,000
16	16.6	1.503	3372.9	5059.3	5,000	10,000
24	24.92	3.387	7601.1	11401.7	11,000	22,000
30	31.06	5.262	11808.2	17712.3	18,000	36,000
36	37.24	7.564	16974.7	25462.0	25,000	50,000
42	43.32	10.235	22969.9	34454.8	34,500	69,000
48	49.5	13.364	29991.1	44986.6	45,000	90,000

General Rule

Two 4" lines equal one 6" line;  
 Two 6" lines equal one 8" line;  
 two 8" lines equal one 10" line.

\* 8" Minimum Residential Main Improvement

\*\* 10" Minimum Residential Main Improvement

## Hastings Water System - Velocity Design Table

MAS 3/1/2001

### DIP Pressure Class

Pipe Dia.	Pres. Class	ID, inch	Area SF	Vel. Fps	Flow cfs	Flow gpm	Nom. 2-Way Feed	Zoning	FireFlow gpm
8	350	8.55	0.3987	7.5	2.990	1342.2	2500.0	Residential	1500
10	350	10.58	0.6105	7.5	4.579	2055.1	4000.0	Commerical	2500
12	350	12.64	0.8714	7.5	6.536	2933.4	5000.0	Ind. / Comm.	4000
16	350	16.72	1.5248	7.5	11.436	5132.7	10000.0	Dist. Trans.	4000+
24	350	24.91	3.3843	5.0	16.922	7595.0	N.A.	Major Trans.	4000+
30	350	31.02	5.2482	5.0	26.241	11777.8	N.A.	Major Trans.	4000+
36	350	34.88	6.6356	5.0	33.178	14891.3	N.A.	Major Trans.	4000+
42	350	43.24	10.1976	5.0	50.988	22885.0	N.A.	Major Trans.	4000+
48	350	49.40	13.3101	5.0	66.550	29869.8	N.A.	Major Trans.	4000+

**Working Pressure Summary** 125 psi max operating pressure at max velocity of 7.5 fps  
DIP

Pipe Dia.	Press. Class	OD, inch	ID, inch	Area SF	Net tw	Vel. Fps	Max. Op. psi	Surge psi	Working psi	Allow. Psi	Safety Factor
8	350	9.05	8.55	0.3987	0.1200	10.3	125	555.8	681	1589.2	2.00
10	350	11.1	10.58	0.6105	0.1100	7.7	125	415.5	540	1589.2	2.00
12	350	13.2	12.64	0.8714	0.1100	6.5	125	350.7	476	1589.2	2.00
16	350	17.4	16.72	1.5248	0.1900	8.5	125	458.6	584	1589.2	2.00
24	350	25.8	24.91	3.3843	0.2800	8.4	125	453.2	578	1589.2	2.01
30	350	32	31.02	5.2482	0.3400	8.2	125	442.4	567	1589.2	2.02
36	350	38.3	34.88	6.6356	0.4100	8.3	125	447.8	573	1589.2	2.01
42	350	44.5	43.24	10.1976	0.4800	8.4	125	453.2	578	1589.2	2.00
48	350	50.8	49.40	13.3101	0.5400	8.2	125	442.4	567	1589.2	2.02

**Working Pressure Summary** 115 psi max operating pressure at max velocity of 6.5 fps  
DIP

Pipe Dia.	Press. Class	OD, inch	ID, inch	Area SF	Net tw	Vel. Fps	Max. Op. psi	Surge psi	Working psi	Allow. Psi	Safety Factor
8	350	9.05	8.55	0.3987	0.1200	10.0	115	539.6	655	1589.2	2.06
10	350	11.1	10.58	0.6105	0.1100	7.5	115	404.7	520	1589.2	2.06
12	350	13.2	12.64	0.8714	0.1100	6.5	115	350.7	466	1589.2	2.00
16	350	17.4	16.72	1.5248	0.1900	8.0	115	431.7	547	1589.2	2.12
24	250	25.8	24.91	3.3843	0.2200	6.5	115	350.7	466	1589.2	2.04
30	250	32	31.02	5.2482	0.2700	6.5	115	350.7	466	1589.2	2.02
36	200	38.3	34.88	6.6356	0.2700	5.5	115	296.8	412	1589.2	2.00
42	150	44.5	43.24	10.1976	0.2600	4.5	115	242.8	358	1589.2	2.02
48	150	50.8	49.40	13.3101	0.3000	4.5	115	242.8	358	1589.2	2.04

Note: Based upon noted operating conditions the use of DIP should be limited to the operating velocities as noted with the noted pressure classes and pipe diameters.

PVC Capacity Table

PVC Water Main Capacities Pressure Class 200 SDR-14						
Size	Diameter (inches)	Area Sq. feet	Capacity at 5.0 fps	1-Way Feed Nominal Capacity	2-Way Feed Nominal Capacity	
4	4.114	0.092	207.2	200	400	
6	5.914	0.191	428.1	400	800	
8	7.758	0.328	736.7	750	1,500	
10 <sup>^^</sup>	9.514	0.494	1107.9	1,100	2,200	
12	11.314	0.698	1566.8	1,500	3,000	
16 <sup>^^</sup>	15.466	1.305	2927.8	3,000	6,000	
24 <sup>*</sup>	23.736	3.073	6896.0	7,000	14,000	
30	*					
36	*					
42	*					
48	*					

\* Pipe available only in 165 psi class

\*\* Pipe size not available

<sup>^</sup> 10" Minimum Residential Main Improvement

<sup>^^</sup> 16" Minimum Commercial Main Improvement

## Hastings Water System - Velocity Design Table

MAS 3/1/2001

### PVC Pipe

Pipe Dia.	DR#	ID, inch	Area SF	Vel. Fps	Flow cfs	Flow gpm	Nom. 2-Way Feed	Zoning	FireFlow gpm
8	14	7.758	0.328267	7.5	2.462	1105.0	2000.0	Residential	1500
10	14	9.514	0.493689	7.5	3.703	1661.9	3000.0	Commercial	2500
12	14	11.314	0.698167	6.5	4.538	2036.8	4000.0	Ind. / Comm.	4000
16	14	14.914	1.213152	7.5	9.099	4083.7	7000.0	Dist. Trans.	4000+
24	18	22.934	2.86871	5.0	14.344	6437.8	N.A.	Major Trans.	4000+
30	18	28.444	4.41274	5.0	22.064	9902.9	N.A.	Major Trans.	4000+
36	21	34.652	6.54913	5.0	32.746	14697.2	N.A.	Major Trans.	4000+
42	25	40.94	9.14161	5.0	45.708	20515.1	N.A.	Major Trans.	4000+
48	25	46.736	11.91325	5.0	59.566	26735.1	N.A.	Major Trans.	4000+

**Working Pressure Summary** 125 psi max operating pressure at max velocity of 7.5 fps  
PVC

Pipe Dia.	DR#	ID, inch	Area SF	Vel. Fps	Max. Op. psi	Surge psi	Working psi	Allow. Psi	Safety Fac	Calc. DR	Req'd DR
8	14	7.758	0.328267	7.5	125	150	275	305	2.238	12.64	<b>12</b>
10	14	9.514	0.493689	7.5	125	150	275	305	2.238	12.64	<b>12</b>
12	14	11.314	0.698167	7.5	125	150	275	305	2.238	12.64	<b>12</b>
16	14	14.914	1.213152	7.5	125	150	275	305	2.238	15.55	14
24	18	22.934	2.86871	5.0	125	90	215	235	2.189	19.60	18
30	18	28.444	4.41274	5.0	125	90	215	235	2.189	19.60	18
36	21	34.652	6.54913	5.0	125	80	205	200	1.951	20.51	<b>18</b>
42	25	40.94	9.14161	5.0	125	75	200	165	1.667	21.00	<b>21</b>
48	25	46.736	11.91325	5.0	125	75	200	165	1.667	21.00	<b>21</b>

Note: PVC use based upon noted operating values may be subject to surge pressure fatigue

**Working Pressure Summary** 125 psi max operating pressure at max velocity of 6.5 fps  
**PVC**

Pipe Dia.	DR#	ID, inch	Area SF	Vel. Fps	Max. Op. psi	Surge psi	Working psi	Allow. Psi	Safety Fad	Calc. DR	Req'd DR
8	14	7.758	0.328267	6.5	125	130	255	305	2.413	13.55	14
10	14	9.514	0.493689	6.5	125	130	255	305	2.413	13.55	14
12	14	11.314	0.698167	6.5	125	130	255	305	2.413	13.55	14
16	18	14.914	1.213152	6.5	125	115	240	235	1.961	17.67	18
24	18	22.934	2.86871	6.5	125	115	240	235	1.961	17.67	18
30	18	28.444	4.41274	6.5	125	115	240	235	1.961	17.67	18
36	21	34.652	6.54913	5.0	125	80	205	200	1.951	20.51	21
42	25	40.940	9.14161	3.4	125	50	175	165	1.905	23.86	25
48	25	46.736	11.91325	3.4	125	50	175	165	1.905	23.86	25

Note: Based upon noted operating conditions the use of PVC should be limited to the operating velocities as noted when using the noted Req'd DR values and pipe diameters.

The SF for 16 inch and larger diameter PVC is calculated using a value of 2.0 as noted in AWWA C-905.

**Working Pressure Summary** 115 psi max operating pressure at max velocity of 6.5 fps  
PVC

Pipe Dia.	DR#	ID, inch	Area SF	Vel. Fps	Max. Op. psi	Surge psi	Working psi	Allow. Psi	Safety Fac	Calc. DR	Req'd DR
8	14	7.758	0.328267	6.5	115	130	245	305	2.512	14.06	14
10	14	9.514	0.493689	6.5	115	130	245	305	2.512	14.06	14
12	14	11.314	0.698167	6.5	115	130	245	305	2.512	14.06	14
16	18	14.914	1.213152	6.5	115	115	230	235	2.046	18.39	18
24	18	22.934	2.86871	6.5	115	115	230	235	2.046	18.39	18
30	18	28.444	4.41274	6.5	115	115	230	235	2.046	18.39	18
36	21	34.652	6.54913	5.0	115	80	195	200	2.051	21.51	21
42	25	40.940	9.14161	3.4	115	50	165	165	2.020	25.24	25
48	25	46.736	11.91325	3.4	115	50	165	165	2.020	25.24	25

Note: Based upon noted operating conditions the use of PVC should be limited to the operating velocities as noted when using the noted Req'd DR values and pipe diameters.

The SF for 16 inch and larger diameter PVC is calculated using a value of 2.0 as noted in AWWA C-905.

## Appendix E

NEBRASKA DEPARTMENT OF HEALTH AND HUMAN SERVICES

# GUIDANCE DOCUMENT

“This guidance document is advisory in nature but is binding on an agency until amended by such agency. A guidance document does not include internal procedural documents that only affect the internal operations of the agency and does not impose additional requirements or penalties on regulated parties or include confidential information or rules and regulations made in accordance with the Nebraska Administrative Procedure Act. If you believe that this guidance document imposes additional requirements or penalties on regulated parties, you may request a review of the document.”

Pursuant to  
Neb. Rev. Stat. § 84-901.03

**NEBRASKA**

Good Life. Great Mission.

DEPT. OF HEALTH AND HUMAN SERVICES

## WATER MAIN AND SANITARY/STORM SEWER SEPARATIONS

The Department recognizes the challenges and difficulties in designing and installing distribution mains, especially in areas fraught with existing utilities. This guide is developed to assist design engineers with sewers and water main separation design and installation. In the design and installation of water mains, design engineers must strive to achieve the separation distances required for water mains and fire hydrants from sanitary sewer, storm sewer and other potential sources of contamination as per the Recommended Standards for Water Works, 2007 Edition (RSFWW). In cases where it is **impractical** to achieve those separations required in the RSFWW, the protocols provided in this document must be followed to be considered substantial conformance by the Department.

### I. Sewer and Water Main Separations

#### A. Sanitary sewer and water main horizontal separations for parallel installations.

##### 1. Scenario 1

- a. A 10 foot radial separation is considered equivalent to the 10 foot horizontal separation requirement if the water main is above the sanitary sewer and not within 5 feet horizontally.

##### 2. Scenario 2

- a. If the horizontal separation is **greater than 8 feet but less than 10 feet**, the installation would be acceptable if the following is provided:
  - i. Engineer's professional opinion that the water quality in the water main will not be impacted based on an evaluation of the proposed installation and soil conditions; **and**
  - ii. Reasons are provided as to why it not practical to provide the 10 feet separation.

##### 3. Scenario 3

- a. If the horizontal separation is **greater than 4 feet but less than 8 feet**, the installation would be acceptable if the following is provided:
  - i. Engineer's professional opinion that the water quality in the water main will not be impacted based on an evaluation of the proposed installation and soil conditions;
  - ii. Reasons are provided as to why at least 8 feet separation cannot be provided; **and**
  - iii. The water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer **or**
  - iv. The engineer may encase either the water or sewer pipe for protection (rigid welded piping or cement/concrete-at least 4 to 6 inches thick etc.) at locations where the separation cannot be met **or**
  - v. The sewer pipe needs to be water works grade 150 psi pressure rated pipe meeting AWWA Standards and pressure tested to ensure water tightness **or**
  - vi. An alternate method of protection with approval from the Department prior to construction.

##### 4. Scenario 4

- a. **If the horizontal separation is less than 4 feet, the installation must not proceed prior to consulting and obtaining written approval from the Department.**

## B. Sanitary sewer and water main vertical separations at crossings.

### 1. Scenario 1

- a. If the water main **is above** the sanitary sewer pipe and the vertical separation is **greater than 12 inches but less than 18 inches**, the installation would be acceptable if the following is provided:
  - i. Engineer's professional opinion that the water quality in the water main will not be impacted based on an evaluation of the proposed installation and soil conditions;
  - ii. Reasons are provided as to why the 18-inch separation cannot be met; **and**
  - iii. One full length of water pipe needs to be located so that both joints will be as far from the sanitary sewer crossing as possible.

### 2. Scenario 2

- a. If the water main **is above** the sanitary sewer pipe and the vertical separation is **greater than 6 inches but less than 12 inches**, the installation would be acceptable if the following is provided:
  - i. Engineer's professional opinion that the water quality in the water main will not be impacted based on an evaluation of the proposed installation and soil conditions;
  - ii. Reasons are provided as to why at least 12 inches separation cannot be met;
  - iii. One full length of water pipe needs to be located so that both joints will be as far from the sanitary sewer crossing as possible;
  - iv. Proper support is provided to prevent settlement and breaking pipe; **and**
  - v. The engineer may encase either the water or sewer pipe for protection (rigid welded piping or cement/concrete-at least 4 to 6 inches thick etc.) for at least 12 feet on each side of the crossing with the ends sealed **or**
  - vi. The sewer pipe needs to be water works grade 150 psi pressure rated pipe meeting AWWA Standards and be pressure tested to ensure water tightness **or**
  - vii. An alternate method of protection with approval from the Department prior to construction.

### 3. Scenario 3

- a. If the water main **is below** the sanitary sewer, and the vertical separation is greater than 6 inches but less than 18 inches, the installation would be acceptable if the following is provided:
  - i. Engineer's professional opinion that the water quality in the water main will not be impacted based on an evaluation of the proposed installation and soil conditions;
  - ii. Reasons are provided as to why at least 18 inches separation cannot be met;
  - iii. One full length of water pipe needs to be located so that both joints will be as far from the sanitary sewer crossing as possible;
  - iv. Proper support is provided to prevent settlement and breaking pipe; **and**
  - v. The engineer may encase either the water or sewer pipe for protection (rigid welded piping or cement/concrete-at least 4 to 6 inches thick etc.) for at least 12 feet on each side of the crossing with the ends sealed **or**
  - vi. The sewer pipe needs to be water works grade 150 psi pressure rated pipe meeting AWWA Standards and be pressure tested to ensure water tightness **or**
  - vii. An alternate method of protection with approval from the Department prior to construction.

### 4. Scenario 4

- a. **If the vertical separation between the sewer line and the water main will be less than 6 inches, the installation must not proceed prior to consulting and obtaining written approval from the Department.**

## II. Storm sewer and water main separations

In general, the pollution hazards from a storm sewer are not as significant as a sanitary sewer since the storm sewer does not have flow in it year round. However, during rainstorm events, it may carry surface runoff which contains chemical pollutants but the pathogenic microbial impact is likely to be less than that of a sanitary sewer. For storm sewer and water main separation, the protocols provided in Sections II.A and II.B must be followed.

### A. Storm sewer and water main horizontal separations for parallel installations

#### 1. Scenario 1

- a. If the horizontal separation is **greater than 4 feet but less than 10 feet**, the installation would be acceptable if the following is provided:
  - i. Engineer's professional opinion that the water quality in the water main will not be impacted based on an evaluation of the proposed installation and soil conditions;
  - ii. Reasons are provided as to why the 10 feet separation cannot be met; **and if necessary,**
  - iii. Additional protection deemed necessary by the design engineer.

#### 2. Scenario 2

- a. **If the horizontal separation will be less than 4 feet, the installation must not proceed prior to consulting and obtaining written approval from the Department.**

### B. Storm sewer and water main vertical separations at crossings.

#### 1. Scenario 1

- a. If water main **is above** the stormy sewer pipe and the vertical separation is **greater than 6 inches but less than 18 inches**, the installation would be acceptable if the following is provided.
  - i. Engineer's professional opinion that the water quality in the water main will not be impacted based on an evaluation of the proposed installation and soil conditions;
  - ii. Reasons are provided as to why the 18-inch separation cannot be met; **and**
  - iii. One full length of water pipe need to be located so that both joints will be as far from the storm sewer crossing as possible - preference shall be given to keep joints further from any sanitary sewer than a storm sewer.

#### 2. Scenario 2

- a. If water main **is below** the storm sewer pipe and the vertical separation is **greater than 6 inches but less than 18 inches**, the installation would be acceptable if the following is provided.
  - i. Engineer's professional opinion that the water quality in the water main will not be impacted based on an evaluation of the proposed installation and soil conditions;
  - ii. Reasons are provided as to why the 18-inch separation cannot be met;
  - iii. One full length of water pipe needs to be located so that both joints will be as far from the storm sewer crossing as possible - preference shall be given to keep joints further from any sanitary sewer than a storm sewer;
  - iv. Proper support is provided to prevent settlement and breaking pipe; **and**
  - v. The engineer may encase either the water or sewer pipe for protection (rigid welded piping or cement/concrete-at least 4 to 6 inches thick etc.) for at least 12 feet on each side of the crossing with the ends sealed **or**
  - vi. The sewer pipe needs to be water works grade 150 psi pressure rated pipe meeting AWWA Standards and be pressure tested to ensure water tightness (the storm sewer pipe needs be watertight when pressure tested to at least 10 psi test pressure) **or**
  - vii. An alternate method of protection with approval from the Department prior to construction.

### 3. Scenario 3

- a. If the vertical separation between the storm sewer and the water main will be less than 6 inches, the installation must not proceed prior to consulting and obtaining written approval from the Department.

### III. Force Main Separations

At least **10 feet of horizontal separation** between water mains and sanitary sewer force mains must be provided. There must be at least **18 inches of vertical separation** at crossings between water mains and force mains and one full length of water pipe shall be located so both joints will be as far from the sewer as possible at the crossing. **Where it is impossible to meet these separation requirements for force mains, the installation must not proceed prior to consulting and obtaining written approval from the Department.**

### IV. Fire Hydrants Separations

#### A. Fire Hydrants and Sanitary Sewers Separations

1. Hydrant drains must not be connected to, or located within **10 feet of sanitary sewers**. **Where it is impossible to meet the 10 feet horizontal separation between sanitary sewer and fire hydrant drains, the installation must not proceed prior to consulting and obtaining written approval from the Department.**

#### B. Fire Hydrants and Storm Sewer Separations

1. Where it is impractical to meet the 10 feet horizontal separation requirement for storm sewer and hydrant drains, a less than 10 feet horizontal separation would be acceptable if the following is provided.
  - a. Engineer's professional opinion that the water quality in the water main will not be impacted based on an evaluation of the proposed installation and soil conditions;
  - b. Reasons are provided as to why the 10 feet horizontal separation cannot be met; **and**
  - c. At least 5 feet of horizontal separation is provided.
2. **Where it is impossible to provide at least 5 feet of horizontal separation of storm sewers to hydrant drains, the installation must not proceed prior to consulting and obtaining written approval from the Department.**

# Appendix F

**LISTING OF CASING VS PIPE DIAMETER FOR HIGHWAY CROSSINGS**  
*Thickness based upon bare steel and recommendations from NDOR and NUCA Manual No. 2*  
**RECOMMENDED CASING SIZE**

PIPE SIZE NOMINAL INCHES	O.D. OF SNAPLOCK BELL INCHES	PIPE INCHES	O.D. OF PIPE INCHES	CASING DIMENSION INCHES	PIPE TO CASING DIMENSION INCHES	BELL CLEARANCE INCHES	CASING THICKNESS INCHES
6"	12.06	6.90	18	5.30	2.72	0.250	
8"	14.75	9.05	20	5.23	2.38	0.250	
10"	16.75	11.10	24	6.14	3.31	0.312	
12"	18.63	13.20	24	5.09	2.37	0.312	
14"	22.38	15.30	30	6.98	3.44	0.375	
16"	25.31	17.40	30	5.93	1.97	0.375	
18"	27.00	19.50	36	7.75	4.00	0.500	
20"	29.13	21.60	36	6.70	2.94	0.500	
24"	35.00	25.80	42	7.60	3.00	0.500	
30"	36.00	32.00	42	4.50	2.50	0.500	
36"	42.63	38.30	48	4.23	2.06	0.625	
42"	48.64	44.50	54	4.13	2.06	0.625	
48"	55.14	50.80	60	3.98	1.81	0.625	

LISTING OF CASING VS PIPE DIAMETER FOR HIGHWAY CROSSINGS  
MINIMUM CASING SIZE

PIPE SIZE NOMINAL INCHES	O.D. OF SNAPLOCK BELL INCHES	O.D. OF PIPE INCHES	CASING DIMENSION INCHES	PIPE TO CASING DIMENSION INCHES	BELL CLEARANCE INCHES	CASING THICKNESS INCHES
6"	12.06	6.90	16	4.30	1.72	0.250
8"	14.75	9.05	18	4.23	1.38	0.250
10"	16.75	11.10	20	4.20	1.38	0.250
12"	18.63	13.20	24	5.09	2.37	0.312
14"	22.38	15.30	30	6.98	3.44	0.375
16"	25.31	17.40	30	5.93	1.97	0.375
18"	27.00	19.50	36	7.75	4.00	0.500
20"	29.13	21.60	36	6.70	2.94	0.500
24"	35.00	25.80	42	7.60	3.00	0.500
30"	36.00	32.00	42	4.50	2.50	0.500
36"	42.63	38.30	48	4.23	2.06	0.625
42"	48.64	44.50	54	4.13	2.06	0.625
48"	55.14	50.80	60	3.98	1.81	0.625

LISTING OF CASING VS PIPE DIAMETER FOR HIGHWAY CROSSINGS  
ABSOLUTE MINIMUM CASING SIZE

PIPE SIZE NOMINAL INCHES	O.D. OF SNAPLOCK BELL INCHES	O.D. OF PIPE INCHES	CASING DIMENSION INCHES	PIPE TO CASING DIMENSION INCHES	BELL CLEARANCE INCHES	CASING THICKNESS INCHES
6"	12.06	6.90	14	3.30	0.72	0.250
8"	14.75	9.05	16	3.23	0.38	0.250
10"	16.75	11.10	18	3.20	0.38	0.250
12"	18.63	13.20	20	3.15	0.44	0.250
14"	22.38	15.30	24	4.04	0.50	0.312
16"	25.31	17.40	30	5.93	1.97	0.375
18"	27.00	19.50	30	4.88	1.13	0.375
20"	29.13	21.60	30	3.83	0.06	0.375
24"	35.00	25.80	36	4.60	0.00	0.500
30"	36.00	32.00	42	4.50	2.50	0.500
36"	42.63	38.30	48	4.23	2.06	0.625
42"	48.64	44.50	54	4.13	2.06	0.625
48"	55.14	50.80	60	3.98	1.81	0.625

msexcel/watersys/casingtable.xls

Note: If different joint configurations (Outside Diameter) then choice casing diameter based upon clearance.

LISTING OF CASING VS PIPE DIAMETER FOR RAILROAD CROSSINGS UNION PACIFIC  
 Thickness based upon bare steel and recommendations from UPRR, BNSF, and NUCA Manual No. 2  
 RECOMMENDED CASING SIZE

PIPE SIZE NOMINAL INCHES	O.D. OF SNAPLOCK BELL INCHES	O.D. OF PIPE INCHES	CASING DIMENSION INCHES	PIPE TO CASING DIMENSION INCHES	BELL CLEARANCE INCHES	CASING THICKNESS INCHES
6"	12.06	6.90	18	5.24	2.66	0.312
8"	14.75	9.05	20	5.10	2.25	0.375
10"	16.75	11.10	24	6.01	3.19	0.438
12"	18.63	13.20	24	4.96	2.25	0.438
14"	22.38	15.30	30	6.85	3.31	0.500
16"	25.31	17.40	30	5.80	1.85	0.500
18"	27.00	19.50	36	7.69	3.94	0.563
20"	29.13	21.60	36	6.64	2.87	0.563
24"	35.00	25.80	42	7.54	2.94	0.563
30"	36.00	32.00	42	4.44	2.44	0.563
36"	42.63	38.30	48	4.23	2.06	0.625
42"	48.64	44.50	54	4.03	1.96	0.719
48"	55.14	50.80	60	3.82	1.65	0.781

LISTING OF CASING VS PIPE DIAMETER FOR RAILROAD CROSSINGS UNION PACIFIC  
MINIMUM CASING SIZE

PIPE SIZE NOMINAL INCHES	O.D. OF SNAPLOCK BELL INCHES	O.D. OF PIPE INCHES	CASING DIMENSION INCHES	PIPE TO CASING DIMENSION INCHES	BELL CLEARANCE INCHES	CASING THICKNESS INCHES
6"	12.06	6.90	16	4.24	1.66	0.312
8"	14.75	9.05	18	4.16	1.31	0.312
10"	16.75	11.10	20	4.08	1.25	0.375
12"	18.63	13.20	24	4.96	2.25	0.438
14"	22.38	15.30	30	6.85	3.31	0.500
16"	25.31	17.40	30	5.80	1.85	0.500
18"	27.00	19.50	30	4.75	1.00	0.500
20"	29.13	21.60	36	6.64	2.87	0.563
24"	35.00	25.80	42	7.54	2.94	0.563
30"	36.00	32.00	42	4.44	2.44	0.563
36"	42.63	38.30	48	4.23	2.06	0.625
42"	48.64	44.50	54	4.03	1.96	0.719
48"	55.14	50.80	60	3.82	1.65	0.781

LISTING OF CASING VS PIPE DIAMETER FOR RAILROAD CROSSINGS UNION PACIFIC  
ABSOLUTE MINIMUM CASING SIZE

PIPE SIZE NOMINAL INCHES	O.D. OF SNAPLOCK BELL		O.D. OF PIPE		CASING DIMENSION		PIPE TO CASING DIMENSION		BELL CLEARANCE		CASING THICKNESS	
	INCHES	INCHES	INCHES	INCHES	INCHES	INCHES	INCHES	INCHES	INCHES	INCHES	INCHES	INCHES
6"	12.06		6.90		14		3.24		0.66		0.312	
8"	14.75		9.05		16		3.16		0.31		0.312	
10"	16.75		11.10		18		3.14		0.31		0.312	
12"	18.63		13.20		20		3.03		0.31		0.375	
14"	22.38		15.30		24		3.91		0.37		0.438	
16"	25.31		17.40		30		5.80		1.85		0.500	
18"	27.00		19.50		30		4.75		1.00		0.500	
20"	29.13		21.60		36		6.64		2.87		0.563	
24"	35.00		25.80		42		7.54		2.94		0.563	
30"	36.00		32.00		42		4.44		2.44		0.563	
36"	42.63		38.30		48		4.23		2.06		0.625	
42"	48.64		44.50		54		4.03		1.96		0.719	
48"	55.14		50.80		60		3.82		1.65		0.781	

msexcel/watersys/casingtable.xls

Revised as per BNSF stds for wall thickness of 42" and 48"

Note: If different joint configurations (Outside Diameter) then choice casing diameter based upon clearance.

LISTING OF CASING VS PIPE DIAMETER FOR HASTINGS AIRPORT RUNWAY AND TAXIWAY CROSSINGS  
 Thickness based upon bare steel and recommendations from UPRR, BNSF, and NUCA Manual No. 2  
 RECOMMENDED CASING SIZE

PIPE SIZE NOMINAL INCHES	O.D. OF		PIPE INCHES	CASING		PIPE TO CASING		CASING THICKNESS INCHES
	SNAPLOCK BELL INCHES	PIPE INCHES		DIMENSION INCHES	DIMENSION INCHES	BELL CLEARANCE INCHES		
6"	12.06	6.90	18	5.24	2.66	0.312		
8"	14.75	9.05	20	5.10	2.25	0.375		
10"	16.75	11.10	24	6.01	3.19	0.438		
12"	18.63	13.20	24	4.96	2.25	0.438		
14"	22.38	15.30	30	6.85	3.31	0.500		
16"	25.31	17.40	30	5.80	1.85	0.500		
18"	27.00	19.50	36	7.69	3.94	0.563		
20"	29.13	21.60	36	6.64	2.87	0.563		
24"	35.00	25.80	42	7.54	2.94	0.563		
30"	36.00	32.00	42	4.44	2.44	0.563		
36"	42.63	38.30	48	4.23	2.06	0.625		
42"	48.64	44.50	54	4.03	1.96	0.719		
48"	55.14	50.80	60	3.82	1.65	0.781		

LISTING OF CASING VS PIPE DIAMETER FOR HASTINGS AIRPORT RUNWAY AND TAXIWAY CROSSINGS  
MINIMUM CASING SIZE

PIPE SIZE NOMINAL INCHES	O.D. OF SNAPLOCK BELL INCHES	O.D. OF PIPE INCHES	CASING DIMENSION INCHES	PIPE TO CASING DIMENSION INCHES	BELL CLEARANCE INCHES	CASING THICKNESS INCHES
6"	12.06	6.90	16	4.24	1.66	0.312
8"	14.75	9.05	18	4.16	1.31	0.312
10"	16.75	11.10	20	4.08	1.25	0.375
12"	18.63	13.20	24	4.96	2.25	0.438
14"	22.38	15.30	30	6.85	3.31	0.500
16"	25.31	17.40	30	5.80	1.85	0.500
18"	27.00	19.50	30	4.75	1.00	0.500
20"	29.13	21.60	36	6.64	2.87	0.563
24"	35.00	25.80	42	7.54	2.94	0.563
30"	36.00	32.00	42	4.44	2.44	0.563
36"	42.63	38.30	48	4.23	2.06	0.625
42"	48.64	44.50	54	4.03	1.96	0.719
48"	55.14	50.80	60	3.82	1.65	0.781

LISTING OF CASING VS PIPE DIAMETER FOR HASTINGS AIRPORT RUNWAY AND TAXIWAY CROSSINGS  
ABSOLUTE MINIMUM CASING SIZE

PIPE SIZE NOMINAL INCHES	O.D. OF SNAPLOCK BELL INCHES	O.D. OF PIPE INCHES	CASING DIMENSION INCHES	PIPE TO CASING DIMENSION INCHES	BELL CLEARANCE INCHES	CASING THICKNESS INCHES
6"	12.06	6.90	14	3.24	0.66	0.312
8"	14.75	9.05	16	3.16	0.31	0.312
10"	16.75	11.10	18	3.14	0.31	0.312
12"	18.63	13.20	20	3.03	0.31	0.375
14"	22.38	15.30	24	3.91	0.37	0.438
16"	25.31	17.40	30	5.80	1.85	0.500
18"	27.00	19.50	30	4.75	1.00	0.500
20"	29.13	21.60	36	6.64	2.87	0.563
24"	35.00	25.80	42	7.54	2.94	0.563
30"	36.00	32.00	42	4.44	2.44	0.563
36"	42.63	38.30	48	4.23	2.06	0.625
42"	48.64	44.50	54	4.03	1.96	0.719
48"	55.14	50.80	60	3.82	1.65	0.781

msexcel/watersys/casingtable.xls

Note: If different joint configurations (Outside Diameter) then choice casing diameter based upon clearance.

Casing Material Summary

Nominal Size	O.D.	Schedule	Wall	Lbs/Ft	Nominal Size	O.D.	Schedule	Wall	Lbs/Ft		
<b>12 Part II</b>	12.75	60	0.562	73.15	<b>22 Part II</b>	22	30 Ex Hvy	0.5	114.81		
		80	0.688	88.63			60	0.875	197.41		
		100	0.844	107.32			80	1.125	250.81		
		120	1	125.49			100	1.375	302.88		
		140	1.125	139.67			120	1.625	353.61		
		160	1.312	160.27			140	1.875	403		
<b>14</b>	14	10	0.25	36.71	<b>24</b>	24	160	2.125	451.06		
		20	0.312	45.61			10	0.25	63.41		
		30 Std	0.375	54.57			20 Std	0.375	94.62		
		40	0.438	63.44			20 Ex Hvy	0.5	125.49		
		40 Ex Hvy	0.5	72.09			30	0.562	140.68		
		60	0.594	85.05			40	0.688	171.29		
		80	0.75	106.13			60	0.969	238.35		
		100	0.938	130.85			80	1.219	296.58		
		120	1.094	150.9			100	1.531	367.39		
		140	1.25	170.21			120	1.812	429.39		
<b>16</b>	16	160	1.406	189.1	<b>26</b>	26	10	0.312	85.6		
		10	0.25	42.05			10 Std	0.375	102.63		
		20	0.312	52.57			20 X Hvy	0.5	136.17		
		30 Std	0.375	62.58			<b>28</b>	28	10	0.312	92.26
		40 Ex Hvy	0.5	82.77					10 Std	0.375	110.64
		60	0.656	107.5					20	0.5	146.85
		80	0.844	136.61					30	0.625	182.73
		<b>18</b>	18	100			1.031	164.82	<b>30</b>	30	10
120	1.219			192.43	10 Std	0.375	118.65				
140	1.438			223.64	20 Ex Hvy	0.5	157.53				
160	1.594			245.25	30	0.625	196.08				
10	0.25			47.39	<b>32</b>	32	10	0.312			105.59
20	0.312			58.94			10 Std	0.375			126.66
20 Std	0.375			70.59			20	0.5			168.21
30	0.438			82.15			30	0.625			209.43
<b>20</b>	20	30 Ex Hvy	0.5	93.45	<b>34</b>	34	40	0.688	230.08		
		40	0.562	104.67			10	0.312	112.25		
		60	0.75	138.17			10 Std	0.375	134.67		
		80	0.938	170.92			20	0.5	178.89		
		100	1.156	207.96			30	0.625	222.78		
		120	1.375	244.14			40	0.688	244.77		
		140	1.562	274.22			<b>36</b>	36	10	0.312	118.92
		160	1.781	308.5					Std	0.375	142.68
		10	0.25	52.73					X Hvy	0.5	189.57
		20 Std	0.375	78.6					Std	0.375	166.71
<b>22</b>	22	30 Ex Hvy	0.5	104.13	<b>42</b>	42	20 X Hvy	0.5	221.61		
		40	0.594	123.11			30	0.625	276.18		
		60	0.812	166.4			40	0.75	330.41		
		80	1.031	208.87			<b>48</b>	48	Std	0.375	190.74
		100	1.281	256.1					X Hvy	0.5	253.65
		120	1.5	296.37							
		140	1.75	341.09							
				160			1.969	379.17			
		10	0.25	58.07							
		20 Std	0.375	86.61							

**ASCE American Life Lines Alliance**  
**Guide for the design of Buried Steel Pipe**  
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Live Load transferred to pipe, lb/In<sup>2</sup>

Height of Cover feet	Highway H20	Railway E80	Airport 180
1	12.50		
2	5.56	26.39	13.14
3	4.17	23.61	12.28
4	2.78	18.40	11.27
5	1.74	16.67	10.09
6	1.39	15.63	8.79
7	1.22	12.15	7.85
8	0.69	11.11	6.93
10		7.64	6.09
12		5.56	4.76
14		4.17	3.06
16		3.47	2.29
18		2.78	1.91
20		2.08	1.53
22		1.91	1.14
24		1.74	1.05
26		1.37	
28		1.04	
30		0.69	
35			
40			

H2 loading is a 20-ton truck load with impact loading

E80 is 80,000 bl/ft railway load with impact loading

180 is 180,000 dual tandem gear assembly, 26 inch spacing between tires

and 66 inch center to center spacing with 12inch thick rigid pavement and impact loading

Box shaded in gray indicate negligible influence

Note that E80 has the highest impact on casing pipe

hence in doubt use Railway design for all application involving traffic loads