

WATER DISTRIBUTION SYSTEM SPECIFICATIONS

**PUBLIC WATER SUPPLY DISTRICT NO. 6
OF CLAY COUNTY, MISSOURI**

**1061 COUCHMAN DR.
KEARNEY, MO 64060**

May 2021

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DEFINITIONS

ContractorPerson or firm responsible for the construction of Improvements.

DesignPlans sealed by Engineer and approved for construction by District and MoDNR.

DeveloperIndividual(s) or organization(s) proposing Improvements.

District.....Public Water Supply District No. 6 of Clay County, Missouri.

District EngineerAppointed engineering representative of District.

EngineerPerson or firm preparing Design.

ImprovementsPumping stations, extensions, relocations, upgrades, or any physical modification of or addition to an existing water distribution system and any related appurtenances.

MoDNR.....Missouri Department of Natural Resources.

Article I. GENERAL REQUIREMENTS

The following requirements apply to all Articles of these specifications. Additional requirements may be necessary for each individual section and additional requirements may be set forth by the District Engineer. Design, installation, and maintenance of Improvements shall be in accordance with the latest version of the District's "GUIDELINES FOR WATER DISTRIBUTION SYSTEM IMPROVEMENTS."

All Improvements shall be designed in accordance with these specifications and any applicable federal, state, and local requirements.

In cases where project specific specifications are approved by the District Engineer the project specifications shall govern.

In addition to the requirements under this specification, Improvements shall comply with the most recent MoDNR "Design Guide for Community Water Systems" requirements.

Failure to comply with these specifications, the "GUIDELINES FOR WATER DISTRIBUTION SYSTEM IMPROVEMENTS," or any other applicable documents shall result in rejection of the Improvements by the District.

Section 1.01 Standards and Conformance

Materials

Materials for use at any location in the water distribution system shall meet the requirements as set forth in this specification. Where references are made to standards such as AWWA, ANSI, ASTM, etc. it shall be understood that such references are to the latest edition of such standards. When requested by the District, Contractor shall furnish affidavits from their suppliers certifying that materials conform to stated standards before being incorporated into the work.

Where materials are specified by brand name and model, followed by the words "or approved equal," the information concerning an "approved equal" product must be submitted to the District and a written statement of approval by the District or its assigned representative must be issued before such material may be used. In all cases, approval of such alternate products shall be at the sole discretion of the District or its assigned representative.

Installation

The work covered by this specification shall consist of furnishing all specified materials with all necessary equipment, machinery, tools, and labor, and performing all work required to install and/or construct the Improvements with all directives or modifications and these specifications; all to be complete, in place, accepted, and ready for use.

Inspection, Tests, and Acceptance or Rejection of Defective Work

District staff or its representatives, independent testing laboratories, and governmental agencies with jurisdictional interests will have access to the Site and the Work for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for District's acceptance of materials or equipment to be incorporated in the work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the work.

If any work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without concurrence of District staff or its representatives, Contractor shall, if requested by District staff, uncover such work for observation. Uncovering work shall be at Contractor's expense.

Promptly after receipt of written notice from the District or its representatives of defective work, Contractor shall correct all defective work, whether or not fabricated, installed, or completed, or if the work has been rejected by the District, remove it from the project and replace it with work that is not defective. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).

Field changes shall be made only with the specific permission of the District Engineer and Engineer.

Section 1.02 Contractor Qualifications

Prior to the start of any project, to demonstrate Contractor's qualifications to perform the Work, within five (5) days of the District's request, the Contractor shall submit written evidence such as financial data, previous experience, present commitments, and three (3) projects performed within the past three (3) years, relating to construction of water distribution improvements of a similar diameter, material, and scope with project references and contacts. Among its rights regarding contract award, the District reserves the right to reject any bid based upon its sole discretion in determining the sufficiency or adequacy of the Contractor's qualifications.

Section 1.03 Site Work and Preparation

Prior to starting the various Improvements, the Contractor shall notify the District a minimum of one (1) week prior to the start of construction. After so doing, the Contractor shall clear the route of all trees, shrubs, and other objects or materials which may directly interfere with the construction. All trees, shrubs, bushes, etc., which will not interfere with the construction shall be protected from damage.

Work preparations shall include having all necessary materials and equipment at the site in working condition, and an adequate labor force at the site and completely instructed and prepared to perform the work to completion. The Contractor shall notify all utility companies or organizations of work and shall request field markings of their respective facility locations prior to starting any work.

Section 1.04 Drainage

The Contractor shall control the grading in the vicinity of the pipe trenches so that the surface of the ground will be properly sloped to prevent water from running into the excavated areas, where possible. Any water or other liquid wastes which accumulate in the excavated areas shall be promptly removed.

Section 1.05 Obstructions of Water Main

Where improvements, such as but not limited to retaining walls, tie-backs, and storm sewers greater than 24", are to be built over the water main, the main shall be placed in casing pipe as specified in Section 2.06. The determination of what will require the main to be placed in a casing pipe is at the discretion of the District Engineer.

Section 1.06 Separation of Water Main, Sewers, and Other Utilities

When buried water mains are in close proximity to non-potable pipelines, the water mains are vulnerable to contamination that can pose a risk of waterborne disease outbreaks. For example, sewers (sanitary sewer mains and sewage force mains) frequently leak and saturate the surrounding soil with sewage due to structural failure, improperly constructed joints, and subsidence or upheaval of the soil encasing the sewer. If a nearby water main is depressurized and no or negative pressure occurs, that situation is a public health hazard. The public health hazard is compounded if an existing sewer is broken during the installation or repair of the water main. Further, failure of a water main in close proximity to other pipelines may disturb their bedding and cause them to fail. To protect the public health, the following requirements shall be met. These requirements apply to horizontally directionally drilled pipe or pipe installed through other trenchless methods as well as pipe installed by conventional open-cut methods.

General

The following factors should be considered in providing adequate separation:

1. Materials and type of joints for water and sewer pipes;
2. Soil conditions;
3. Service and branch connections into the water main and sewer line;
4. Compensating variations in the horizontal and vertical separations;
5. Space for repair and alterations of water and sewer pipes; and
6. Off-setting of water mains around manholes.

Parallel installation

The water main shall be located at least ten feet horizontally from any existing or proposed line carrying non-potable fluids such as, but not limited to drains, storm sewers, sanitary sewers, combined sewers, sewer service connections, and process waste or product lines. The distance shall be measured edge to edge.

In cases where it is not practical to maintain a ten-foot separation, the department may allow deviation on a case by case basis, if supported by data from the design engineer. Such deviation may allow installation of the water main closer to a non-potable fluid line, provided that the water main is laid in a separate trench located as far away from the non-potable line as feasible and meets other specific construction requirements. Locating a water main on an undisturbed earth shelf located on one side of the non-potable line is not recommended and requires justification by the engineer and specific case-by-case approval of the department. In either case, an elevation shall be maintained such that the bottom of the water main is at least 18 inches above the top of the non-potable line while meeting minimum cover requirements.

In areas where the recommended separations cannot be obtained, either the waterline or the non-potable line shall be constructed of mechanical or manufactured restrained joint pipe, fusion welded pipe. Or cased in a continuous casing. Casing pipe must be a material that is approved for use as water main. Conventional poured concrete is not an acceptable encasement.

Crossings

Water mains crossing sewers, or any other lines carrying non-potable fluids shall be laid to provide a minimum vertical clear distance of 18 inches between the outside of the water main and the outside of the non-potable pipeline. This shall be the case where the water main is either above or below the non-potable pipeline. An 18 inch separation is a structural protection measure to prevent the sewer or water main from settling and breaking the other pipe. At crossings, the full length of water pipe shall be located so both joints will be as far from the non-potable pipeline as possible but in no case less than ten feet or centered on a 20-foot pipe. In areas where the recommended separations cannot be obtained either the waterline or the non-potable pipeline shall be constructed of mechanical or manufactured restrained joint pipe, fusion, welded pipe, or cased in a continuous casing that extends no less than ten feet on both sides of the crossing. Special structural support for the water and sewer pipes may be required. Casing pipe must be a material that is approved for use as water main. Conventional poured concrete is not an acceptable encasement.

Exception

Any exception from the specified separation distances in paragraphs B and C must be submitted to the department for approval.

Force mains

There shall be at least a 10 foot horizontal separation between water mains and sanitary sewer force mains or other force mains carrying non-potable fluids and they shall be in separate trenches. In areas where the recommended separations cannot be obtained, either the waterline or the non-potable line shall be constructed of mechanical

joint pipe or be jointless or fusion welded pipe. Where possible, the waterline shall also be at such an elevation that the bottom of the water main is at least 18 inches above the top of the non-potable line. Casing pipe must be a material that is approved for use as water main. Conventional poured concrete is not an acceptable encasement.

Sewer manholes

No waterline shall be located closer than 10 feet to any part of a sanitary or combined sewer manhole. Where the separation cannot be obtained, the waterline shall be constructed of mechanical or manufactured restrained joint pipe, fusion welded pipe, or cased in a continuous casing. Casing pipe must be a material that is approved for use as water main. The full length of water pipe shall be located so both joints will be as far from the manhole as possible, but in no case less than ten feet or centered on a 20 foot pipe. No water pipe shall pass through or come into contact with any part of a sanitary or combined sewer manhole.

Disposal facilities

No water main shall be located closer than 25 feet to any wastewater disposal facility, agricultural waste disposal facility, or landfill. Water mains shall be separated by a minimum of 25 feet from septic tanks and wastewater disposal areas such as cesspools, subsurface disposal fields, pit privies, land application fields, and seepage beds.

Section 1.07 Quality and Handling of Materials

All materials used for each Improvements project shall be new. Damaged or unsound pipe, fittings, and accessories of whatever nature shall be rejected and removed from the site immediately.

All pipe, fittings, valves and other accessories, shall be unloaded, stored, re-handled, and installed by methods in such a manner as to ensure their final location in a sound and undamaged condition, conforming in all respects to specified requirements. Under no circumstances shall pipe, fittings, valves, or other accessories, be dropped to the ground, or otherwise subjected to possible damage from impact or shock. Such materials shall be loaded by lifting with machine or hoist, or by skidding. Pipe handled on skidways shall not be skidded or rolled against other pipe. Under all circumstances, all materials for use shall be handled in a workman-like manner, using the necessary manpower and equipment to perform the task in accordance with the manufacturer's recommendations.

All materials shall be handled in such manner that neither the coatings nor linings are damaged. Hooks for insertion into the ends of the pipes, fittings, valves, and other accessories, shall have broad, well-padded contact surfaces, and shall be of such design and size that uniform support will be provided. Under most circumstances, damage to outside coatings are repairable, and the necessary repairs shall be properly made prior to installation. Damage to interior linings is not considered repairable, and therefore, the damaged item shall be replaced.

Proper equipment, tools, facilities, and methods satisfactory to the District, shall be provided and used by the Contractor for the safe handling of all materials. Fittings, valves, and other accessories shall be carefully lowered into the trench or excavation, piece by piece, to protect coatings and linings. Under no circumstances shall materials be dropped

or dumped into the trench. All joints shall be made as specified in Section 2.01. Each piece of pipe and all fittings, valves, etc. shall be checked and cleared of debris prior to being put in place. All gaskets shall be checked and cleaned of oil, grease, dirt, etc. before being inserted. All bolted joints shall be rechecked for operation and bolt tightness prior to installation.

All open ends of pipe, fittings, etc., shall be carefully sealed with appropriately sized mechanical joint plugs or caps at the end of each day's work to prevent entrance of animals, water, and other foreign matter. Mechanical joint plugs or caps and the appropriate gasket and gland packs shall be utilized for sealing.

Section 1.08 Work Adjacent to and/or Crossing Rights-of-Way

All work to be performed within road right-of-way shall be performed in strict accordance with the road authority's requirements and the latest version of the Manual on Uniform Traffic Control Devices as published by the Federal Highway Administration. The Contractor shall obtain the necessary permits for all work prior to starting any construction. All permits must be displayed as required with a copy provided to the District.

Crossings which must be bored shall be machine bored with installation of encasement. Boring without the concurrent installation of the encasement tube will not be permitted. Following completion of the machine bored crossing, the ends of the pipe casings shall be sealed, and all bore pit or other required excavation shall be suitably backfilled to grade. For requirements for the carrier pipe and casing pipe crossing road rights-of-way see Section 2.01 and Section 2.06, respectively.

Section 1.09 Creek Crossings

Where water mains cross creeks or other surface waters, all piping shall be HDPE piping as specified in Section 2.01. In certain cases, as determined by the District Engineer, steel casing pipe may be required as outlined in Section 2.06 of these Specifications. The determination of what constitutes a creek or other surface water and the necessity for steel casing pipe shall be made by the District Engineer.

Surface water crossings shall be in accordance with MoDNR requirements as given in Appendix B of these Specifications. Any required U.S Army Corps of Engineers permits must be acquired by the Developer with two (2) copies provided to the District. All requirements of such permits must be met by the Contractor.

Section 1.10 Staking

Staking shall be provided before the start of and during construction. Staking shall be completed by the Developer's Engineer or land surveyor and shall be completed by or directly supervised by a professional land surveyor licensed in the State of Missouri.

Stakes shall be placed to indicate the road right-of-way and the limits of easements at a maximum spacing of 100 feet. The stakes shall be placed along the centerline of the proposed water main or on a fixed offset at intervals not to exceed 100 feet. Stakes shall be placed for all fittings, valves, fire hydrants and other appurtenances. All stakes shall be clearly marked to identify each appurtenance as well as centerline, station, offset, easement,

etc. For valves, fire hydrants and temporary blowoff assemblies, the stakes shall have the final grade noted on them such that all valve boxes, fire hydrants and blowoff assemblies can be set to the proper height to accommodate the final grading.

Cuts shall be marked on the laths placed as stakes. The cuts shown shall be the distance from the existing ground surface to the outside bottom of the water main.

Section 1.11 Granular Material

Where required per these Specifications, Granular Material shall be:

Sieve Size	Percent Passing
¾ inch	100%
½ inch	90-100%
#4	0-15%
#8	0-5%

Material shall be compacted to 95% per Standard Proctor Test Method (ASTM D698). The Contractor shall provide at the Contractor's cost independent third-party compaction testing by a testing firm agreeable to the District.

Section 1.12 Trench Excavation and Backfilling

Trenches for water mains shall have a minimum width of the pipe O.D. plus 12 inches. The finished cover over water mains shall be a minimum of 3'-6" and a maximum of 6'-0".

For PVC pipe, the trench depth shall be excavated 6" deeper than the proposed bottom of the pipe to allow for 6" of Granular Material bedding. The PVC pipe shall also have the Granular Material placed to a level 6" above the top of the pipe with care taken to fill all void spaces beneath the pipe. The Granular Material shall be placed as shown on Detail A of these specifications.

Backfill for all pipes under roadways or parking lots shall consist of Granular Material carefully placed to avoid future settlement from 6" above the top of the pipe to the finished grade or as specified by the governing road authority.

For pipes not under roadways or parking lots, the backfill shall be soil meeting ASTM D2487 soil classification groups GW, GP, SW, SP, GM, GC, SM, and SC free of stones larger than 6" in any length, debris, waste, frozen materials, vegetation and other deleterious matter. The liquid limit and plasticity index shall not exceed 45 and 25, respectively, for the silt and clay materials.

Backfill of all pipe shall be well compacted by mechanical means. Any completed areas that show settlement shall be promptly re-backfilled with compacted clean earth, as specified above, or compacted Granular Material as required for the initial backfill.

Section 1.13 Site Clean Up and Restoration

After work is completed, the site of all Improvements shall be cleared of all construction material and other debris. The entire work area shall be left in an orderly and acceptable condition.

Grading shall provide proper drainage and all installation sites shall be left in a neat, clean and acceptable condition. All walkways, driveways, roads, streets, etc. shall be cleaned and replaced to their original condition. All water mains shall be left with the proper amount of cover as stated in Section 1.12.

For all Improvements in easements the site shall be restored to a condition equal to, or better than, its condition before the work was started.

All Best Management Practices shall be according to the appropriate local, state or federal authorities' requirements.

Section 1.14 As-Built Drawings

Legibly mark to record actual construction:

1. Depths of various elements of sewer pipe and manholes in relation to survey datum.
2. Horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvements.
3. Location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure.
4. Field changes of dimension and detail.
5. Changes made by Change Order or Field Order.
6. Details not on original contract drawings.

Article II. WATER MAINS

Section 2.01 Pipe and Fittings

Materials - General

All pipe for water mains shall be 4" (inches) in diameter or larger and shall be PVC as specified further in this Section. Gaskets shall be made of SBR rubber. If soil is found to be contaminated by petroleum products or other contaminants, District approval must be given for determination of an acceptable pipe material before work may continue. Regardless of pipe material chosen, Nitrile gaskets shall be used in soils suspected of petroleum product contamination.

Plastic Pipe – Ductile Iron O.D.

The pipe shall be produced according to AWWA C900 specification for PVC pipe. The pipe shall be produced by an extrusion process using resin complying with ASTM Specifications D1784. Unless designated otherwise on the plans, the pipe shall conform to all the requirements of Specifications AWWA C900-81 with a standard dimension ratio of DR of 18 (235 psi) for barrel, bell or coupling. All pipe shall bear the AWWA seal of approval and designation. Certificates of compliance with these specs shall be furnished upon request.

Only elastomeric ring seals are to be used for joining pipes. Thrust blocks will be necessary at bends, tees, and reducers.

The elastomeric gaskets for plastic pressure pipe shall conform with the requirements of ASTM F477. The joint shall have been tested and approved by the National Sanitation Foundation and certification of said approval shall be submitted.

Prior to use, Engineer shall be given opportunity for examination and testing. Any pipe found to be injured, damaged or to have defects shall be removed. The pipe shall then be delivered along the line in which the pipe is to be laid. The pipe shall be handled in a manner as recommended by the manufacturer so that minimum damage results.

Joint Restrainers

All water main materials are to be restrained at all joints, valves, hydrants, couplings, and fittings. Restrained joint pipe shall be C900 PVC DR18. Acceptable products are North American Specialty Products Certa-LOK Restrained Joint PVC Pressure Piping System, North American Specialty Products Certa-LOK Yelomine, JM Eagle Eagle Loc, or approved equal. Restrained joint pipe shall meet the ASTM D22-41 Standard Specifications for Poly Vinyl Chloride (PVC), Pressure Rated pipe (SDR Series). At tees and crosses, all valves shall be installed utilizing anchor couplings. If pipe used does not have integral restraining system, use a pipe restraining system as called out below:

Restrainer for PVC pipe joints, that are without an integral restraining system, shall be EBAA Split Serrated Restraint Harness.

The split serrated restraint harness for PVC pipe bells consists of two split serrated rings and fastened together into a harness by thrust rods.

Restrainer for fittings, valves, hydrants, and/or couplings shall be EBAA Iron Series 2000 Megalug.

Restrained Joint PVC Pipe

Where restrained joint PVC is indicated on plan sheets, pipe shall be North American Specially Products Certa-LOK Tapered Bell Restrained Joint PVC Pressure Piping System, Aquamine, or approved equal. Restrained joint pipe shall meet the ASTM D22-41 Standard Specifications for Poly Vinyl Chloride (PVC), Pressure Rated pipe (SDR Series).”

Installation of pipe shall follow manufacturer’s recommended procedure and is to be in accordance with Missouri Department of Natural Resources guidelines.

Restrained Joint pipe shall have the following:

1. DR 18, Class 235 psi pressure rating
2. Designed for permanent use

High Density Polyethylene (HDPE)

Materials

Materials used for the manufacture of polyethylene pipe and fittings shall be extra high molecular weight, high density ethylene/hexene copolymer PE 3408 polyethylene resin.

The polyethylene pipe manufacturer shall provide certification that stress regression testing has been performed on the specific product. The said certification shall include a stress life curve per ASTM D-2837. The stress regression testing shall have been done in accordance with ASTM D-2837, and the manufacturer shall provide a product supplying a minimum Hydrostatic Design Basis (HDR) of 1,600 psi, as determined in accordance with ASTM D-2837.

Further, the material shall be listed by PPI (the Plastics Pipe Institute, a division of the Society of the Plastics Industry) in PPI TR-4 with a 73o F hydrostatic design stress rating of 800 psi, and a 140o F hydrostatic design stress rating of 400 psi. The PPI listing shall be in the name of the pipe manufacturer and shall be based on ASTM D-2837 and PPI TR-3 testing and validation of samples of the pipe manufacturer's production pipe.

The manufacturer's certification shall state that the pipe was manufactured from one (1) specific resin in compliance with these specifications. The certificate shall state the specific resin used, its source, and list its compliance to these specifications.

Pipe Extrusion

The pipe shall be extruded using a melt homogenizing/plasticating extruder and "appropriate" die. The extruder screw design should be customized for the HDPE being processed. The extruded tubular melt will be vacuum, or pressure sized in downstream

cooling tanks to form round pipe to specification diameter and wall thickness with a "matte-finish" surface, per AWWA C-906.

Pipe

Pipe supplied under this specification shall have a nominal IPS (iron pipe size) OD unless otherwise specified. The pipe shall have a DR (Dimension Ratio) of 11, and a pressure rating of 200 psi.

The pipe shall be produced, from approved HDPE pipe grade resin(s), to the dimensions and tolerances specified in AWWA C-906.

Approved pipe manufacturers:

1. KWH Sclairpipe (Canada) Ltd.
2. Chevron Performance Pipe
3. CSR Polypipe
4. JM Eagle

Additionally, the pipe shall be inspected per industry accepted manufacturer standards for:

a.	Diameter	f.	Straightness
b.	Wall thickness	g.	Ovality
c.	Concentricity	h.	Toe-in
d.	Quick burst pressure and ductility	i.	Overall workmanship inspection on ID & OD
e.	Joint length	j.	Print line

The pipe manufacturer shall use Statistical Process Control (S.P.C.) manufacturing principles and procedures.

The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. The pipe shall be homogenous throughout and free of visible cracks, holes, voids, foreign inclusions, or other deleterious defects, and shall be nominally identical in color, density, melt index and other physical properties throughout.

Pipe performance:

1. The pipe will be extruded from resin meeting specifications of ASTM D-3350 with a cell classification of PE:345434C; and ASTM D-1248 pipe grade resin type III, Class C, Category 5, grade P34 polyethylene compound.
2. The pipe shall provide the long-term endurance characteristics recognized by:
 - a. Compressed pipe ring environmental stress crack resistance greater than 1,000 hours;
 - b. Slow crack growth resistance greater than 32 days;
 - c. Impact strength (toughness) greater than 42 in-lb./in notch.

Fittings

The standard HDPE fittings shall be standard commercial products manufactured by injection molding or by extrusion and machining, or, shall be fabricated from AWWA C-906 pipe conforming to this specification. All fittings shall be manufactured by the manufacturer of the pipe on each project. The fittings shall be manufactured from the same approved resin type, grade, and cell classification as the pipe itself. The fittings shall be fully pressure rated by the manufacturer to provide a working pressure equal to the pipe for 50 years of service at 73.4o F with an included 2:1 safety factor. The manufacture of the fittings shall be in accordance with good commercial practice to provide fittings homogeneous throughout and free from crack, holes, foreign inclusions, voids, or other injurious defects. The fitting shall be as uniform as commercially practicable in color, opacity, density and other physical properties. The minimum "quick-burst" strength of the fittings shall not be less than that of the pipe with which the fitting is to be used. All fittings shall be pressure tested by the pipe/fitting manufacturer to the specification and requirements of AWWA C-906. Standard fittings are tees, ells, flange adapters, reducers, transition fittings, branch and service saddles, and hot-tap tees.

Design/Pressure Class*

Pressure class (PC) ratings for pipe covered by this standard are given. The following express, commonly known as the ISO (International Organization for Standardization) equation, is used to calculate the pressure class rating:

$$PC = \frac{2}{DR - 1} \times HDB \times DF \quad (Eq 1)$$

Where:

PC = pressure class, in psig (kPa gauge).

HDB = hydrostatic design basis, in psi (kPa)...1600 psi @ 73° F for PE 3408.

DR = dimension ratio, ratio of the specified average outside diameter to the minimum specified wall thickness, both expressed in the same units.

DF = design factor; includes consideration of degree of safety and all the variables, included limited surge pressure effects, in the end application (normally "0.5" representing the industry accepted 2:1 safety factor).

Pressure Class: (matched to needs)

- | | | | |
|----|--------------------|----|--------------------|
| 1. | 50 PSI - SDR 32.5 | 6. | 130 PSI - SDR 13.5 |
| 2. | 64 PSI - SDR 26 | 7. | 160 PSI - SDR 11 |
| 3. | 80 PSI - SDR 21 | 8. | 200 PSI - SDR 9 |
| 4. | 100 PSI - SDR 17 | 9. | 267 PSI - SDR 7 |
| 5. | 110 PSI - SDR 15.5 | | |

The PC values include allowance for pressure rises above working pressure due to occasional positive pressure transients not exceeding two (2) times the nominal pressure class and recurring* pressure surges not exceeding one and one-half (1½) times the nominal pressure class.

**Note - This design procedure is different from PVC because HDPE is "Fatigue Tolerant (Ductile)" and PVC is "Fatigue Sensitive (Brittle)".*

Pipe Marking

During extrusion production, the HDPE pipe shall be continuously marked with durable printing and shall include the following information:

1. Nominal Size: 14 inches
2. Dimension Ratio: DR 11
3. Pressure Rating: 200 psi
4. Type: (Trade Name)
5. Material Classification: PE3408
6. Certification Bases: AWWA C-906
7. Blank Position for NSF/FM Use: NSF-PW
8. Pipe Test Category: C3
9. MFG. Plant Code ST. for Startex: ST
10. Extruder Number: #5
11. Date: 06 Jan 93
12. Operator Number: 55
13. Shift Letter: A
14. Resin Supplier Code: P

EXAMPLE: 14" IPS DR 11 200 PSI (Trade Name) PE 3408 AWWA C-906 NSF-PW C3
ST5 06JAN93 55A P.

Section 2.02 Fittings and Fitting Restraint

Materials

For restraint of unbalanced thrust for fittings, conventional thrust blocking may be used with a design based on a pressure of 200 PSI and a passive soil resistance of 2,000 PSF.

Ductile iron pipe restraints for fittings may be designed using restrained joints in the pipe and fittings. However, if such restraints are provided, calculations signed and sealed by a Missouri Registered Professional Engineer shall be provided.

Concrete for thrust blocking shall be ready mix concrete, composed of Portland cement, sand and gravel with not more than six (6) gallons of water per sack of cement. The concrete shall be a 5-1/2 sack mix with 28-day minimum compressive strength of 4,500 PSI.

All fittings shall be ductile iron, Class 350, conforming to AWWA C-153. The fittings shall be push-on joint or mechanical joints conforming to AWWA C-111 and be cement lined and seal coated in accordance with AWWA C-104. If restraints are being used in a ductile iron restraint system, U.S. Pipe TR FLEX, American Flex Ring, or Griffin Snap-Lock restrained joint pipe and fittings or approved equal shall be allowed. Mega-lug type joint restraints shall only be allowed with mechanical joint fittings.

Installation

All horizontal mechanical joint fittings 12" and smaller such as tees, bends and plugs (except for fire hydrants) shall be thrust blocked with poured concrete as shown in Detail C of these specifications. Thrust blocking for fittings larger than 12" shall be designed and detailed by Engineer.

Forms shall be provided to avoid concrete encasement of any part of mechanical joints. All form material shall be removed from the trench prior to backfilling. Pre-cast concrete block supports shall be used for all fittings installed.

Section 2.03 Not Used

Section 2.04 Buried Below Tape

Materials

Warning tape shall be installed with all water mains. The materials to be installed for this purpose shall consist of three (3) inch wide tape made of bonded layer plastic with a metallic foil core. Tape splices shall be knotted to prevent tensile pressure on the splice.

The metallic tape shall be colored blue and shall bear an imprint identifying the line below, such as; "Caution Water Main Buried Below".

Installation

The Contractor shall furnish all materials. The three (3) inch wide tape shall be installed 18" above the water main locations as the trench backfill progresses. The tape material shall be installed in accordance with the manufacturer's recommendations. The tape is to be placed in a manner such that trench backfill settlement will not place an excessive tensile stress on the material.

Contractor shall coordinate with Owner to facilitate the GPSing of all new construction.

Section 2.05 Tracer Wire

Materials

For all water mains a locator wire shall be provided and shall be a single insulated No. 12 copper wire, THNN or THWN, gasoline and oil resistant. The insulated wire shall be furnished in rolls of not less than 500 feet. Where splices are required, all splices shall be made with splice kits manufactured by 3M, Copperhead, or approved equal.

When directional drilling or boring is required, Extra High Strength (EHS), #1245B with 45 mil High Density Polyethylene (HDPE) jacket with minimum 1150# break load, shall be used.

Installation

The Contractor shall furnish all materials. The No. 12 insulated wire shall be placed along the top of the water main and taped in place with duct tape or electrical tape at a maximum of 6' intervals. All tracer wire shall be tested for continuity as called for in Section 4.06. Caution must be exercised in the initial backfilling not to move or damage the locator wire.

The wire shall be brought up the outside of each valve box from each direction and then both wires are to be threaded into the valve box through the ½” diameter hole near the top in the initial installation.

The two wires shall be spliced inside the valve box with a standard plastic or rubberized wire connector. After testing for continuity, the splices inside the box shall be made with a 3M splice kits or approved equal. Where splices become necessary outside of valve boxes, the splices shall be made initially with splice kits manufactured by 3M, Copperhead, or approved equal.

Where water mains dead end with a cap installed for a future extension, a 6’ long steel “T post” extending 3’ into the ground, with 3’ exposed shall be provided. In these cases, the locator wire shall be brought up out of the ground and securely wrapped around the “T post” and secured with electrical tape.

Install access ports at 1,000 feet max. intervals as detailed on plans. All valves, air release vaults, hydrants, flushing assemblies and blow-offs shall have access ports as well as every 1,000 feet. Access port shall be Copperhead, LP Test services or above ground posts shall be “Internal Terminal Style” with standard board with two terminals. Post shall be Rhino TriView Flex Tracing Station Model TVTI 72-BB2 or equal.

Section 2.06 Casing Pipes

Materials

Casing pipes for right-of-way crossings shall be welded steel pipe with a minimum wall thickness of ¼”, unpainted or coated, and shall have a minimum diameter as shown below and the ends of casing pipes shall be sealed with pre-formed seals or other material approved by the District. Casing pipes shall be sized and have wall thicknesses as shown in the table below.

<u>Carrier Pipe</u>	<u>Welded Steel Casing Pipe</u>	<u>Casing Pipe Thickness</u>
6”	16”	0.25”
8”	20”	0.25”
12”	24”	0.375”
16”	30”	0.375”
20”	30”	0.375”
24”	36”	0.375”
30”	42”	0.375”
36”	54”	0.5”
42”	60”	0.5”

Wherever water mains are installed in casing pipes, the pipe shall be supported with spacers. Spacers shall be RACI Type F from Public Works Marketing or approved

equal. HDPE spacers shall be Type F or Type G for carrier pipe sizes four (4) inch through 16 inch. (Maximum spacing as per manufacturer's recommendations.)

End seals shall also be required. End seals shall be synthetic rubber "wrap around" style with stainless steel band as manufactured by Advance Products and Systems, Inc. or approved equal. Carrier pipe shall be as specified in Section 2.01.

Installation

The spacers shall be carefully installed on the carrier pipe, at 6' intervals, or 3 spacers per 20' length of pipe, before it is installed in the casing pipe.

Section 2.07 Water Service Connections

Water service connections shall be made in accordance with the District's water service connection policy.

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Article III.

WATER DISTRIBUTION SYSTEM COMPONENTS

Section 3.01 Valves

Materials - General

Valves for 12" pipe and smaller shall be gate valves. Valves for 16" pipe and larger shall be butterfly valves. All valve components shall be certified in accordance with ANSI/NSF 61 and be UL listed and FM approved.

All bolts shall be stainless steel.

The valves shall open counterclockwise and have the maker's initials, pressure rating, and year in which manufactured cast on the body.

All buried valves shall be provided with a Buffalo type valve box, Tyler 562-S or 564-S, Clay & Bailey, or approved equal. The tops of the valve boxes shall be designed with grooves to accommodate a valve box adjusting tool as provided in the tops of the above referenced Tyler valve boxes. The valve boxes shall be furnished complete with extension pieces where necessary and the top of the box shall be flush with the finished grade or pavement surface. All valve boxes shall have a ½-inch diameter hole field drilled 3-inches from the top to accommodate the water main tracer wires. Lids shall be stamped "Water".

Materials – Gate Valves

All gate valves shall be ductile iron body, resilient wedge valves, with non-rising stems, 2" operating nuts, push-on or mechanical joints, epoxy coated bodies and be manufactured in accordance with AWWA Standard C-515. The wall thickness for ductile iron valves shall meet or exceed 200 psi.

The valves shall be designed to withstand a working pressure of 200 PSI on either side of the valve unless the District Engineer determines a higher pressure class is necessary. The valves shall be American Flow Control Model AFC-2500, U.S. Pipe Metroseal 250, and Mueller A-2360 or approved equal.

Valves intended for buried service shall have 2" square operating nuts suitable for use in a standard valve box as stated herein.

Materials – Butterfly Valves

Butterfly valves shall conform to AWWA C-504 for Class 150B butterfly valves. All butterfly valves shall have a working pressure of 200 PSI unless the District Engineer determines a higher pressure class is necessary. Butterfly valves shall only be utilized on waterlines 16" and greater.

Butterfly valves shall have ductile iron bodies, be designed for buried service, have push-on joint or mechanical joint ends and have side mounted 2" square operating nuts suitable for use in a standard valve box as stated herein.

Discs shall be offset to provide an uninterrupted 360° seating edge and shall be

ductile iron per ASTM A536 Grade 65-45-12. The disc seating edge shall be solid 316 stainless steel. Sprayed mating seating surfaces are not acceptable. The disc shall be securely attached to the valve shaft utilizing a field removable/replaceable 316 stainless tangential pin locked in place with a set screw.

Valve shafts shall be type 304 stainless steel. Valve seals shall be self-compensating V-type packing with a minimum of four sealing rings. One-piece molded shaft seals and O-ring shaft seals will not be allowed.

Valve seats shall be Buna-N for water and shall be molded in and vulcanized to the valve bodies. The seats shall contain integral shaft seals protecting the valve bearings and packing from any line debris. Seats vulcanized to cartridge inserts in the valve bodies and seats on the discs are not allowed. Valve shaft bearings shall be non-metallic and permanently lubricated.

The exterior and interior of metallic surfaces of each valve shall be shop painted per AWWA C504. The interior of the bodies shall have a full rubber lining vulcanized to the valve bodies.

Each valve operator shall be sized to operate the valve at the rated working conditions of the valve. Each valve shall be assembled, adjusted, and tested as a unit per AWWA C504, by the valve manufacturer. The test pressure for leakage tests shall be 225 PSI unless the District Engineer has required a higher pressure class pipe, requiring a higher test pressure.

Installation

Prior to installation, all valves shall be checked for bolt tightness and operation. All foreign matter, dirt, and debris shall be removed from inside the valve body. The valve gate and guide shall be cleaned free of grease and dirt. After thoroughly cleaning and checking the valve for operation, the valve gate shall be opened, and the valve shall be installed in place. All valves shall have pre-cast concrete block supports, the same as for fittings as shown on Detail D of these Specifications.

Valve boxes shall be set plumb and earth or ground fill shall be tamped around the box to maintain the plumb position and the lid or cover to correspond with finished grade based on the "height" indicated on the stakes for the valves.

In general, valves shall be provided at intervals of not greater than 500 feet. Additionally, at all tee intersections, a minimum of two (2) valves shall be provided and shall be oriented as directed by the District.

Section 3.02 Tapping Sleeves and Valves

Materials

All tapping sleeves for 12" and smaller pipe shall be stainless steel with stainless steel flanges. Tapping sleeves shall be as manufactured by the Mueller Co. or M & H Valve & Fitting Co. or approved equal, for 150 psi working pressure. Sizes and number shall be as indicated on the plans. Joints shall be mechanical joint suitable for the pipe to be tapped. Outlet shall be flanged ASA B 16.1. For pipes larger than 12", the tapping sleeves shall be

ductile iron, split mechanical joint type.

Tapping valves shall be designed for leak tight attachment to the tapping sleeve and tapping machine, shall have mechanical joint by flanged joint ends, valve boxes and shall otherwise conform to Section 3.01.

When dissimilar metals are used for the tapping sleeve and valve a dielectric flange insulation kit shall be used. The kits shall consist of a full-faced neoprene and phenolic gasket with full-length insulating sleeves and single insulating washers. The gasket material shall consist of neoprene sheets, factory applied to both sides of a laminated sheet of phenolic. The operating temperature of the gasket shall be from -65°F to 175°F. The full-length sleeve shall be 1/32-inch thick phenolic and the insulating washers shall be 1/8-inch thick high strength phenolic.

Installation

The tapping sleeves shall be carefully installed on existing pipes with tightening of bolts done carefully to avoid stresses on the existing water mains. Particular care shall be used to follow the bolt tightening sequence as recommended by the manufacturer.

The tapping valve shall then be attached to the tapping sleeve with support blocks provided as shown for valves in Detail D. If the tapping sleeve and valve are dissimilar metals a dielectric flanged joint as specified above shall be used to connect the sleeve and valve. The pit for the tapping machine shall be adequate in size.

Prior to the tap being made, with the tapping valve closed, the assembly shall be air tested to a pressure of 150 PSI, using the port provided on the tapping sleeve. After the tap is completed, the "coupon" removed shall be given to the District's representative for examination. When the tap is complete, concrete thrust blocking with the same dimensions as for a tee of the same size shall be poured behind the tapping sleeve. If the pit is to be temporarily backfilled, before pipe laying continues, a mechanical joint plug shall be installed in the outlet of the tapping valve to prevent dirt or debris from entering the valve.

Section 3.03 Fire Hydrants

Materials

Fire hydrants shall have a 5-1/4" valve opening, one 4-1/2" steamer nozzle and two 2-1/2" hose nozzles and a 6" mechanical joint shoe and conform to AWWA C-502. The fire hydrants shall be Mueller Super Centurion 250, American Darling No. B-84-B,

Hydrants shall be Guardian hydrants (K81A) by Kennedy.

Post or flush type hydrants shall have one or two 2-1/2" hose nozzles, a 2-1/8" main valve opening, and a mechanical joint shoe. The post or flush type hydrants shall be manufactured by Kupferle.

All hydrants shall be delivered to the site coated with a black bituminous coating for the portions to be underground and a primer and yellow finish coat for the portions to be exposed. The types of paint and coating shall be as recommended by the fire hydrant manufacturer.

All hydrant cap threads shall be field-lubricated with an approved, food-grade grease. The hydrants shall have a minimum “bury” of four (4) feet unless the depth of the main requires a deeper bury. Refer to Detail B of these specifications.

Installation

Fire hydrants shall be installed where shown on the plans and as shown on Detail B of these Specifications. Care shall be taken to set the hydrant plumb and the 4-1/2” pumper nozzle shall face the street. Care shall also be exercised to set the fire hydrants to meet the final finished grade as indicated by the “height” given on the stake for the hydrant.

If they are installed at a dead end, a thrust block, same as for a 6” x 6” tee shall be provided to restrain the fire hydrant and care shall be taken not to encase the drain hole in the fire hydrant.

Section 3.04 Air Release Devices

Materials

For high points of water mains, air release valves shall be provided, and such valves shall be Combination Air Valves for Waterworks Service in accordance with AWWA C512. The valves shall be in concrete vaults, 72” in diameter, with cover, air vent, isolation valve and pressure gauges as approved by the District Engineer. Combination Air Valves shall be A.R.I. Model D-040-C, Combination Air Valve (Barak) or approved equal.

Installation

Where there are pronounced high spots in water mains 8” and smaller, fire hydrants shall be located at said high spots. For high spots in water mains larger than 8”, automatic air release valves shall be provided as specified above. All automatic air release devices are to be permanent and constructed per Detail G.

Article IV. TESTING

Section 4.01 Disinfection

Flushing

Water lines shall be flushed prior to disinfection at a velocity of not less than 2.5 feet per second.

Discharge point shall have adequate drainage to prevent flooding of surrounding area. Discharge point to be approved by Owner.

Chlorine Application

Continuous feed method:

This method is suitable for general application.

TABLE 2

Chlorine Required to Produce 50 milligrams per liter Concentration in 100 feet of Pipe - by Diameter

Pipe Size	100% percent Chlorine lb.	1% Chlorine Solutions gal.
4	0.027	0.33
6	0.061	0.73
8	0.108	1.30
10	0.170	2.04
12	0.240	2.88
14	0.334	4.01
16	0.436	5.24
18	0.552	6.63
24	0.981	11.78
30	1.533	18.40

Water from the existing distribution system or other approved sources of supply shall be made to flow at a constant measured rate into the newly-laid pipeline. The water shall receive a dose of chlorine, also fed at a constant measured rate. The two rates shall be proportioned so that the chlorine concentration in the water in the pipe is maintained at a minimum of 50 milligrams per liter available chlorine. To assure that this concentration is maintained, the chlorine residual should be measured at regular intervals in accordance with the procedures described in the current edition of Standard Methods and AWWA M12 - Simplified Procedures for Water Examination. Prior to the start of the disinfection process, the new source shall be flushed. Prior to the start of the disinfection process, the new source shall be flushed.

In the absence of a meter, the rate may be determined either by placing a pitot gage at the discharge or by measuring the time to fill a container of known volume.

Table 2 gives the amount of chlorine residual required for each 100 feet of pipe of various diameters. Solutions of 1 percent chlorine may be prepared with sodium hypochlorite or calcium hypochlorite. The latter solution requires approximately 1 lb. of calcium hypochlorite in 8.5 gallons of water.

During the application of the chlorine, the supply valve shall be closed to prevent the treatment dosage from flowing back into the line supplying the water. Chlorine application shall not cease until the entire main is filled with the chlorine solution. The chlorinated water shall be retained in the main for at least 24 hours, during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances. At the end of this 24-hour period, the treated water shall contain no less than 25 milligrams per liter chlorine throughout the length of the main.

Final Flushing

After the applicable retention period, the heavily chlorinated water shall be flushed from the main until the chlorine concentration in the water leaving the main is no higher than that generally prevailing in the system, or less than 1 milligram per liter. Chlorine residual determination shall be made to ascertain that the heavily chlorinated water has been removed from the pipe line. Heavily chlorinated water shall be de-chlorinated with sodium thiosulfate prior to discharge to the water course or sanitary/storm sewers. The sodium thiosulfate concentration shall be equal to 1.43 mg/L per 1 mg/L of residual chlorine concentration to be removed.

Bacteriologic Test

After final flushing, and before the water main is placed in service, a sample or samples shall be collected from the end of the line and tested for bacteriologic quality and shall show the absence of coliform organisms. If the number and frequency of samples is not prescribed by the public health authority having jurisdiction, at least one sample shall be collected from chlorinated supplies where a chlorine residual is maintained throughout the new main. From unchlorinated supplies at least two samples shall be collected at least 24 hours apart.

In the case of extremely long mains, it is desirable that samples be collected the length of the line as well as at its end.

Samples for bacteriologic analysis shall be collected in sterile bottles treated with sodium thiosulphate. No hose or fire hydrant shall be used in collection of samples. A suggested sampling tap consists of a standard corporation cock installed in the main with a copper tube gooseneck assembly. After samples have been collected the gooseneck assembly may be removed and retained for future use.

Repetition of Procedure

If the initial disinfection fails to produce satisfactory samples, disinfection shall be repeated until satisfactory samples have been obtained. When the samples are satisfactory, the main may be placed in service.

Section 4.02 Pressure Testing

Immediately following disinfection, the piping shall be pumped to a pressure (at the highest point in the project) of 150 PSI or 1.5 times the working pressure, whichever is greater, as determined by the District.

In such cases, the test pressure shall be 50 psi greater than the working pressure and two pressure tests shall be conducted. The first test shall be with the fire hydrant auxiliary valves open and be to 150 PSI. The second test shall be with the fire hydrant auxiliary valves closed and be to the higher pressure as directed by the District.

All pumping equipment and pressure gauges shall be provided by the contractor. After achieving the test pressure, the piping shall be left closed for a period of two (2) hours. At the end of this time the pressure drop shall not exceed 2 PSI.

In addition, if the pressure appears, in the judgment of the District's representative, to be continuing to drop, the test shall be continued for another two (2) hours and if any further drops occur, the test shall be considered a failure. If the pressure test fails, the contractor will be required to find and correct the source of the leakage. If this requires draining of the pipeline, when the leakage is corrected, the piping must be re-disinfected, and the pressure tested again until satisfactory results are achieved.

De-chlorination will be performed by the Contractor prior to any chlorinated waters being released into the environment. Complete de-chlorination must be achieved.

Section 4.03 Leakage Testing

Testing for leakage shall be performed on all water mains. At the completion of the pressure test, or concurrently with the pressure test, the water main shall be re-pressurized, to the test pressure, by pumping potable water into the main. The volume of water required to re-pressurize the main shall be measured. All mains shall meet leakage standards per AWWA C600. The maximum allowable leakage rate shall be calculated using the following equation:

$$L = SD(P)^{0.5} \div 148,000$$

Where:

L = allowable leakage, in gallons per hour.

S = length of pipe in test section, in feet.

D = pipe diameter, in inches.

P = average test pressure, psig.

If the volume of water put back into the main exceeds the maximum allowable leakage, as calculated by the equation above, the Contractor will be required to find and correct the source of the leakage. If this requires draining of the pipeline, when the leakage is corrected, the piping must be re-disinfected, and the leakage test shall be performed again until satisfactory results are achieved. The testing requirements for pressure and duration shall be the same as those for the pressure test.

De-chlorination will be performed by the Contractor prior to any chlorinated waters being released into the environment. Complete de-chlorination must be achieved.

Section 4.04 Flushing

After satisfactory disinfection is achieved, all piping shall be thoroughly flushed until all water discharged is visibly clear. A final chlorine residual test will then be taken and the chlorine residual must be between 0.5 - 2.5 mg/L. If the residual is too high, additional flushing shall be done until the desired residual is obtained. If the residual is too low, the entire disinfection and flushing procedure shall be repeated until the desired results are achieved. Complete de-chlorination of discharged water shall be performed by the Contractor.

Section 4.05 Bacteriological Testing

After satisfactory disinfection and pressure testing, a sample shall be taken by the Contractor in the presence of a District representative and submitted to a laboratory approved by the MoDNR and the District for bacteriological analyses. After 24 hours, a second sample shall be taken in a like manner and submitted for analyses. The two samples must be found to be "safe" by the testing laboratory, and copies of the test results must be supplied to the District. If the samples are not found to be "safe" further flushing and /or disinfection as directed by the District shall be conducted by the Contractor until "safe" samples on two consecutive days are achieved. Following successful bacteriological testing and a determination by the District that the samples are "safe", the mains may be placed into service.

If mains are not placed into service within 90 days of project completion, samples must be retaken.

Section 4.06 Final Inspection and Tracer Wire Testing

After all work is completed and all disinfection, pressure testing, flushing and bacteriological testing is complete, the Contractor shall conduct a locator wire test between all sections of the wire in the presence of a District representative. If the test is satisfactory, all splices in valve boxes shall be made permanent by means of 3-M splice kits or approved equal. If the tests fail in a section, the Contractor must find and repair any failure in the locator wires.

A final inspection shall be made by a District representative and all valves and hydrants shall be plumb and be to proper grade and all cleanup work must be satisfactorily completed. The work shall be accepted only after completion of the final inspection. Any defects found in the final inspection shall be promptly corrected by the Contractor.

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APPENDIX A – Separation from Other Utilities; Excerpt from MoDNR Design Guide

All Construction shall conform to the following taken from the “Design Guide for Community Water Systems” as published by the MoDNR and as partially reproduced below. As MoDNR’s requirements change in the future, the latest edition of their rules will apply.

8.6. Separation of Water Mains, Sanitary Sewers and Combined Sewers

8.6.1. General.

The following factors should be considered in providing adequate separation:

- a. Materials and type of joints for water and sewer pipes;
- b. Soil conditions;
- c. Service and branch connections into the water main and sewer line;
- d. Compensating variations in the horizontal and vertical separations;
- e. Space for repair and alterations of water and sewer pipes; and
- f. Off-setting of water mains around manholes.

8.6.2. Parallel installation.

Water mains shall be laid at least ten feet horizontally from any existing or proposed sewer. The distance shall be measured edge to edge. In cases where it is not practical to maintain a ten-foot separation, the department may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the water main closer to a sewer, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer and on either case, at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer. In areas where the recommended separations cannot be obtained, either the waterline or the sewer line shall be constructed of mechanical joint pipe or cased in a continuous casing.

8.6.3. Crossings.

Water mains crossing sewers shall be laid to provide a minimum vertical clear distance of 18 inches between the outside of the water main and the outside of the sewer. This shall be the case where the water main is either above or below the sewer. At crossings, the full length of water pipe shall be located so both joints will be as far from the sewer as possible but in no case less than ten feet. Special structural support for the water and sewer pipes may be required. In areas where the recommended separations cannot be obtained either the waterline or the sewer line shall be constructed of mechanical joint pipe or cased in a continuous casing that extends no less than ten feet on both sides of the crossing.

8.6.4. Exception.

Any variance from the specified separation distances in paragraphs 8.6.2. and 8.6.3. must be submitted to the department for approval.

8.6.5. Force mains.

There shall be at least a ten-foot horizontal separation between water mains and sanitary sewer force mains and they shall be in separate trenches. In areas where these separations cannot be obtained, either the waterline or the sewer line shall be cased in a continuous casing.

8.6.6. Sewer manholes.

No waterline shall be located closer than ten feet to any part of a sanitary or combined sewer manhole.

8.6.7. Disposal facilities.

No waterline shall be located closer than 25 feet to any on-site wastewater disposal facility, agricultural waste disposal facility, or landfill.

APPENDIX B – Surface Water Crossings; Excerpt from MoDNR Design Guide

All Construction shall conform to the following taken from the “Design Guide for Community Water Systems” as published by the Missouri Department of Natural Resources and as partially reproduced below. As MDNR’s requirements change in the future, the latest edition of their rules will apply.

8.7. Surface Water Crossings.

Surface water crossings, whether over or under water, present special problems. The department should be consulted before final plans are prepared. Positive joints shall be required in waterways and wet weather streams.

8.7.1. Above-water crossings.

The pipe shall be adequately supported and anchored, protected from damage and freezing and accessible for repair or replacement.

8.7.2. Underwater crossings.

a. Flowing streams.

A minimum cover of four feet shall be provided over the pipe. When crossing water courses are greater than 15 feet in width, the following shall be provided:

1. The pipe shall be of special construction, having flexible watertight joints. Steel or ductile iron ball-joint river pipe shall be used for open cut crossings. Restrained joint pipe may be used for open cut crossings, provided it is encased in a welded steel casing. Restrained joint pipe shall be used for bored crossings.

2. Valves shall be provided at both ends of water crossings so that the section can be isolated for testing or repair; the valves shall be easily accessible and should not be subject to flooding.

3. Permanent taps shall be provided on each side of the valve with a small meter to determine leakage and for sampling purposes.

4. The stream crossing pipe or casing shall extend at least 15 feet beyond the upper edge of the stream channel on each side of the stream.

b. Intermittent flowing streams.

1. Restrained joint pipe shall be used for all stream crossings.

2. The pipe shall extend at least 15 feet beyond the upper edge of the stream channel on each side of the stream.