

CITY OF ST. CHARLES, MISSOURI

SPECIFICATIONS FOR WATER MAIN AND WATER SERVICE CONSTRUCTION, EXTENSIONS, AND/OR ALTERATIONS



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STATE OF MISSOURI
PROFESSIONAL ENGINEER
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**CITY OF ST. CHARLES, MISSOURI
SPECIFICATIONS FOR WATER MAIN AND WATER SERVICE CONSTRUCTION,
EXTENSIONS, AND/OR ALTERATIONS**

A. Authority:

The specifications as drawn and approved by the Board of Public Works Department of the City of St. Charles, Missouri, shall be enforced and no part thereof altered without approval of, the Director of Public Works or their duly appointed representative.

B. Intent and Definitions:

1. Intent: The intent of these specifications is to specify the type and quality of all water main materials, the method and procedure of construction, the inspections and testing methods, and the terms of acceptance by the City of St. Charles of any water main work or extension on any main or mains, that are or will be an active part of, or connected to (without RPZ backflow prevention and metering), the water system of the City of St. Charles, Missouri.

2. Definitions:

City: City of St. Charles, Missouri

Public Works: Public Works Department of the City of St. Charles, Missouri

Water Division: Water Division of the Public Works Department of the City of St. Charles, Missouri

Engineer: The Director of Public Works/City Engineer of St. Charles, Missouri or their duly authorized representative.

Inspector: The engineering or technical inspector or inspectors authorized by the City or Engineer, limited in each case to the particular duties entrusted to him or them.

Contractor: Any person or firm licensed by the City of St. Charles doing any type of work on a water Main or Water Service.

Owner: Any person owning right to or sponsoring any work pertaining to water main work, such as a land owner or developer.

Minimum Design Standards for Community Water Systems: The minimum design standard to be followed for designing any improvement, addition, or alteration to a community water system in the state of Missouri, issued by MODNR.

AWWA: American Water Works Association

ASTM: American Society for Testing and Materials

AASHTO: American Association of State Highway & Transportation Officials

ANSI: American National Standards Institute

MODNR: Missouri Department of Natural Resources

RPZ: Reduced Pressure Zone Dual Check Backflow Prevention Assembly

C. Responsibilities of Contractor and Owner:

1. The Owner shall provide the location of three (3) horizontal and vertical control points referenced to repeatable field monumentation. The Contractor shall be responsible for the proper location and grade of the proposed extension. Property corners are to be accurately located, and labeled laths shall be provided at key lot corners, particularly at intersections and curves. The main shall not be located solely

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from street centerline markers. In new subdivisions, the street must be to final subgrade or grade (including the areas behind the curb), or the cuts and fills must be marked on laths adjacent to grade stakes.

Possible problems with sanitary sewers, manholes, storm sewer, and drop inlets must be marked and sizes and depths indicated. Failure to provide the above requirements will result in suspension of the work.

Any property corners damaged by the installation of the water main must be replaced by the contractor at the contractor's expense.

2. The Contractor shall employ skilled workmen under the supervision of a foreman, experienced in water main construction or a plumber licensed by the City of St. Charles to install the main. The labor provided by the Contractor shall be directed to be of a workman like character with respect to the methods of construction and quality of completed work. The Contractor shall not needlessly encumber the premises or adjacent property or streets with materials and/or equipment. The Inspector may suspend the work until, in their opinion, skilled personnel are provided.
3. The Contractor shall be responsible for any failure of the main extension and for maintenance of backfilled areas for two years after completion of the work. The completion date shall be established by the Engineer, based on the report of the inspector.
4. In new developments, the developer shall be responsible for providing necessary easements, and, after completion of the work, for transferring ownership of the mains to the City. Failure to provide these documents will result in a refusal of the Water Division to make service connections.
5. The Contractor shall be responsible for the reconstruction of existing field entrances onto private property, back to their original, usable condition. The field entrances shall be graded to match existing surface grades and grading of the drainage swale up to, and away from, the culverts shall provide positive drainage. The ground surface shall be seeded or sodded and maintained as specified herein.
6. Ductile Iron Pipe Only: The Contractor shall be responsible for providing a plan, designed in accordance with the Ductile Iron Pipe Research Association, indicating the extent of the use of restraining gaskets for the water main pipe in each direction from fittings, bends, tunnel sections and taps. In addition to the restraining gaskets for the pipe, supplementary thrust blocks shall be constructed, as indicated on the drawings, between the pipe and the trench wall. Restraining gaskets shall be used for the entire length of the water main constructed in tunnels.

Where the use of restraining gaskets in the push-on joints is insufficient to provide adequate thrust restraint, the Contractor is responsible for submitting plans for more substantial concrete thrust blocking capable of properly restraining the water main and its appurtenances.

7. The Contractor is responsible for submitting shop drawings for review and approval - indicating the proposed layout assembly for the Combination Air Valves. Shop drawings shall indicate the manufacturer's name, types of material to be used, and sizes of all fittings, valves, piping, manhole riser, manhole lid, manhole frame and cover, & steps; combination air valve size, manufacturer, and indication that the air valve is for operating pressures between 40 psi and 150 psi.
8. The Contractor is responsible for submitting shop drawings for the review and approval - indicating the proposed layout assembly for the Blow-Off Valves. Shop drawings shall indicate the materials to be used and sizes of all fittings, valves and piping.
9. The Contractor shall be responsible for submitting to the Engineer, for review and approval, certifications that materials being used meet the requirements as specified herein. Certifications shall be in writing from the manufacturer or in the form of published manufacturer's catalog data indicating the model to be used, the size, and all pertinent strength and material data. Items requiring certification shall include: precast manhole risers, precast manhole lids, cast iron manhole frames and covers, cast iron manhole steps, combination air valves, gate valves, valve boxes, tapping sleeves, tapping valves, fire hydrants, all piping (water main & storm sewer culvert), pipe coatings, tunnel casing pipe, casing spacers, casing end

seals, geotextile filter fabric, polyethylene encasement, grout, concrete mix, and flowable fill.

10. The Contractor is responsible for submitting a tunnel and tunnel shaft construction and monitoring plan for review and approval. Prior to beginning any tunnel or shaft excavation, the Contractor shall submit a Certificate of Design prepared by and bearing the seal of a MO professional registered engineer, licensed in the State of Missouri, for initial tunnel support and shaft support systems. The monitoring plan shall outline the Contractor's proposed methodology for monitoring any potential ground heave or settlement created during the tunnel construction. The contractor is solely responsible for all job site safety.
11. The Contractor shall be responsible for the field location of all existing utilities within the limits of the construction of this project. Utilities as indicated on the drawings have been located based upon best available information. Contractor shall be responsible for exercising extreme caution during the advance trenching operations and while supporting the utilities lines within the open trench. The Contractor shall bear the cost of repairs to utilities or appurtenances damaged resulting from any act, omission, neglect, or misconduct in their manner or method of excavating work.
12. The Contractor shall not enter upon private property for any purpose without obtaining written permission from the Owner. The Contractor shall be responsible for the preservation of all public and private property, trees, shrubs, fences, etc., along and adjacent to the work, and shall use every precaution to prevent damage or injury thereto. The contractor shall not injure, remove, cut, or destroy trees, shrubs, or flower beds which are outside of the easement or right-of-way unless specifically authorized to do so by the City of St. Charles, in compliance with the Construction Documents. The contractor shall be responsible during prosecution of the work for all damage or injury to persons or to property of any character resulting from any act, omission, neglect, or misconduct in their manner or method of executing said work satisfactorily, from their non-execution of said work, or defective work or materials.
13. The Contractor is responsible for producing an as-built set of plans and submitting them to the Engineer within 2 weeks of completing the project. The as-built plans shall include the following: the size, type and manufacturer information of material used, dimensions to locate all fittings and valve boxes, pipeline distance between fittings, alignment of pipe in relation to existing structures, and all changes/deviations from the plans. Proper dimensioning for valves and fittings will show two offset distances from the centerlines of rights-of-way or roadways.
14. Under no circumstances shall water blow offs or meter pits be installed in a sidewalk, driveway or any hard surface without prior approval from Water Division.

D. Materials:

The Contractor shall make satisfactory arrangements to store material and equipment after delivery and before and during construction. The City can assume no responsibility prior to the completion and final acceptance of the installation.

1. Pipe: All water main pipes, branch lines to fire hydrants, air release valve assembly piping and blow-off valve assembly piping shall meet one of the following specifications:
 - a. Ductile-Iron Pipe: AWWA C151, Class 350 psi, 4" through 12", push-on TYTON or FASTITE joints (or approved equal) with FIELDLOK or FAST-GRIP Gaskets (or approved equal) where restraint is required, cement-mortar lined, and bituminous coated. AWWA C151, Class 250 psi, 16" pipe & AWWA C151, Class 200 psi for pipes 20" and larger, with push-on TYTON or FASTITE joint (or approved equal) with FIELDLOK or FAST-GRIP Gaskets (or approved equal) where restraint is required, cement-mortar lined, and bituminous coated. The Contractor's intent to use Push-on Joints and Restraining Gaskets of other manufacturers must be submitted to the City for review prior to bid proposal submittal. Upon review of the joints and the extend of the restraint, approved equal brands may be accepted.
 - b. Ductile-Iron Pipe: AWWA C115, Class 350 psi, 4" through 12", flanged joint, cement-mortar lined, and bituminous coated.
 - c. PVC Pipe: All PVC water main material installed or that is connected within the water distribution

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system of the City of St. Charles shall meet, or exceed AWWA Specifications and meet City of St. Charles minimum specifications. The minimum specifications of PVC pipe shall be C-900, DR (dimension ratio) Series 14, and gasketed bell-end coupling for water main sizes 4" thru 12". The minimum specifications for PVC pipe shall be C-905, Dr 14 for water main sizes 16" thru 36".

2. Storm Sewer Pipe: All pipe to be used for the reconstruction of storm sewer culverts under entrance drives and field entrances shall meet one of the following specifications:
 - a. Reinforced Concrete Pipe (RCP): ASTM C76 - Specifications for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe, or Wall B designation and class III reinforcement.
3. Casing Pipe: All pipe to be used for the tunnel casing pipe shall be of the size indicated on the drawings, schedule 20 steel, continuously welded at the joints.
4. Fittings: Shall be Class 250, psi ductile iron fittings with either push-on joints or mechanical joints with megalug or equal restraint and cement and mortar lining as described and manufactured in accordance with AWWA C153 or C110.
5. Valves & Hydrants:
 - a. Tapping Sleeves and Valves: Open left, "O" ring. Tapping valves shall meet the same specifications as gate valves with mechanical, flanged or push-on (restrained) joint ends as appropriate.

Tapping sleeve sized of 4"-12" shall consist of all stainless steel, full circle two piece (wrap around style not allowed) with stainless nuts and bolts rated to a minimum 250psi. Bolt thread shall be Teflon coated to prevent galling and the washers shall be plastic lubricated; Romac "SST" Tapping Sleeve or other approved equal. Concrete thrust blocking shall be required on any tap 4" or larger.

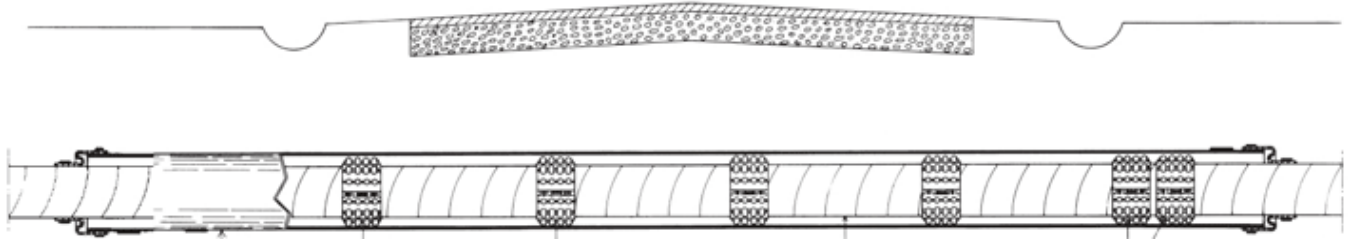
Tapping sleeves of 12" & larger, shall be ductile iron body and bonnet, with mechanical joints ends, minimum pressure rating 200psi. Concrete thrust blocking shall be required on any tap 4" or larger.
 - b. Gate Valves: All gate valves shall conform to AWWA C550 as modified herein with 250 psi working pressure and open left. Gate valves shall be resilient wedge seated with non rising stem type with O-ring stem seals. Gate valves shall be provided with mechanical joint type or flanged ends and shall be Mueller, American, Kennedy, Clow or equal. All valves shall be manufactured and tested to AWWA C509.
 - c. Valve Boxes: Valves boxes shall be a three-piece screw height adjustable type with a base which does not bear upon the top of the valve, made from cast iron and suitable for a depth of cover of at least four (4) feet. Valve boxes shall be not less than five (5) inches in diameter. Covers shall have the word WATER cast thereon and shall be heavy duty traffic rated.

All metal parts of the valve boxes, bases and covers shall be coated by dipping in bituminous varnish.
 - d. Fire Hydrant and Blowoff Hydrant: 6" Mueller Centurion 3 way 4' bury w/aux. valve, with 2-2 1/2" connections and 1-4 1/2" connection or American-Darling, 5 1/4", B-84-B, UL/FM, Kennedy K81-0, or Clow Medallion 3 Way 4' bury 2-2 1/2" connections & 1-4 1/2" connection.
6. Polyethylene Encasement: All buried ductile iron water main pipe, branch lines to all fire hydrants and blow-off valve assemblies and tunneled portions of water main shall be encased in a 12-mil layer of high density, polyethylene; clear or color coded blue, in accordance with AWWA C105 Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids. Polyethylene encasement is considered incidental to the cost of the water main pipe and pipe used for the branch lines to the fire hydrants and the blow-off valves. All polyethylene encasement shall be overlapped a minimum of 1 ft at seems and

secured with a high quality adhesive tape. All holes and tears shall be patched with high quality adhesive tape. Handling of pipe shall be done with lifting straps and non-marring equipment to preserve the integrity of the polyethylene encasement.

7. Concrete: All concrete for thrust blocks and concrete encasement work shall meet ASTM Standards C150 (type 1), C260 and C33. Concrete shall be Class A, 6 bag mix, 4-inch maximum slump, 3,000 psi compressive strength in 28 days. Concrete thrust blocking is considered incidental to the cost of the water main pipe and pipe used for the branch lines to the fire hydrants and the blow-off valves.
8. Anchors, Inserts, and Reinforcements: Only to be installed with preapproval from Water Division. All bolts shall conform to ASTM specifications A7 and A307; threads for bolts and nuts to be Class 2A and 2B, respectively. Bolts used to anchor fittings to reactions blocking shall be painted with asphaltic spray paint after installation, but before burial. Reinforcing steel bars shall be deformed, bars, intermediate grade billet steel, conforming to ASTM Standards A15 and A305. All exposed bolts, straps, rods and nuts are to be coated with asphaltic spray paint and wrapped in polywrap prior to burial.
9. Manhole Construction: The manhole construction for the Combination Air Valve Assembly housing shall consist of reinforced precast concrete riser sections manufactured in accordance with ASTM C 478 Standard Specifications for Reinforced Manhole Sections. Portland cement used shall be Type I in accordance with ASTM C 150.
10. Manhole Frames, Covers and Steps: The manhole frames, covers and steps shall conform to the requirements of the Specifications for Gray Iron Castings, ASTM A 48, manufactured of Class 30 B cast iron. The cast iron frames & covers shall be Neenah Model R-1799-0 (or approved equal), cast in the concrete manhole lid. The cast iron manhole steps shall be Neenah Model R-1981-I (or approved equal), cast in the wall of the manhole riser.
11. Manhole Lid: The concrete manhole lid shall be precast of the dimensions and reinforcing indicated on the drawings. The cast iron frame and cover and the ductile iron sleeve, for the vent pipe, shall be cast in the structure. Portland cement used shall be Type I in accordance with ASTM C150 - Specifications for Portland Cement.
12. Rock Blanket: The material to be used for rock blanket shall be crushed limestone of the weight gradation indicated on the drawings. The rock blanket is to be used for slope and surface protection where indicated and at the outlet for each of the Blow-Off Valve Assemblies.
13. Crushed Stone Bedding: The material to be used for crushed stone bedding shall be crushed limestone or screenings of the sieve size gradation as specified herein. The crushed stone bedding shall be used as bedding for all pipe.
14. Granular Backfill: The material to be used for granular backfill shall be crushed limestone or screenings of the sieve size gradation as specified herein. The granular backfill shall be used as backfill in trenches over all pipe constructed under improved surfaces.
15. Grout: Contractor is responsible for submitting a grout design mix for use to fill voids created between the exterior tunnel casing pipe wall and the undisturbed earth. Grout is considered incidental to the cost of the casing pipe.
16. Tunnel Casing Chocks (or Spacers): Three casing chocks (or spacers) per pipe joint, or approximately one every 6' along the length of the pipe, and two back-to-back at each end of the pipe, shall be used when placing the water main carrier pipe in the tunnel casing. Spacers shall be plastic Raci style installed to manufacture recommendations. Casing chocks (or spacers) shall be sufficient riser height to restrain the carrier pipe centered within the casing pipe. Illustration below:

TYPICAL ROAD CROSSING



17. Tunnel Casing End Seal: Each end of the casing pipes shall be sealed with one-piece, long life, synthetic rubber compound (neoprene), minimum of 1/8" thick. The casing end seal shall be Pipeline Seal and Insulator, Inc. (PSI) Model C, or approved equal.
18. Street Signs: Street signs indicated to be removed and replaced shall be stored and protected against damage by the Contractor until all other work in the immediate vicinity of the street sign location is complete, at which time Contractor can re-install street signs. The Contractor shall re-install street signs at the original location or as otherwise directed by the Engineer.
19. Taps and Meters: The City requires a minimum of 48 hours notice prior to any and all water taps being made. If the tap is not ready upon arrival, the contractor will be required to reschedule the water tap. The contractor is responsible for all excavation work and site restoration. The contractor is also responsible for providing a tapping saddle for all PVC, ductile & cast iron water mains. Type K copper with compression fittings will be required between City water main and meter box. 3/4" and 1" services will be placed in a 20" x 30" plastic meter box, 1 1/2" and 2" services will be placed in a 36" plastic meter box with an additional shut off on the main line before the meter setter, but outside of the box. Concrete pyramid boxes will be required within pavement and only with preapproval from the Water Division. 3" and larger meters will be set in a vault per the standard detail. Meter lids must have a 2" hole, in order to hold the radio read antenna. The City will provide the corporation and meter for 3/4", 1", 1 1/2" and 2" domestic services. Water meters shall be furnished by the City of St. Charles. Water meters shall be placed within the public right-of-way and in front of the structure/facility to which the water meter will service. No water meter shall be placed within any structure/facility and shall be set for easy access as designated by the Water Division.
20. Meter Frames & Lids: Meter frames and lids shall conform to the requirements of the Specifications for Gray Iron Castings, ASTM A 48, manufactured of Class 30 B cast iron. The frames on 3/4" and 1" meter pits shall fit and bear evenly on a 20" meter pit. The frame shall be a drop-in style lid with screw type lock and hole for the meter antenna. Double meter pits shall have two holes in the lid. All castings shall be made in the USA (contractors and/or suppliers may provide a letter and supporting documentation there is no domestically made equivalent to vary from this requirement).

Acceptable products for 3/4" & 1" meter applications:

Single meter applications: Ford A-3T, Ford A-53T, A.Y. McDonald 74M3AT, A.Y. McDonald 74M53AT, or approved equal.

For double meter pit applications: A.Y. McDonald 74M53ATT, Ford A-53TT, or approved equal.

Single meter applications in pavement or sidewalk: A.Y. McDonald A-32CH, A.Y. McDonald 74M53AT, Ford A-53T, or approved equal.

Meters in traffic areas (pyramid concrete box): Lids shall be traffic rated heavy duty and submitted for prior approval.

21. Brass: All brass shall be **lead free**, clearly marked as such, cast stamped (ie.NL, LF, etc.), meet current AWWA standards, and be Mueller, Ford, A.Y. McDonald, or approved other. Only ball style valves shall be utilized including, but not limited to, corporation valves, curb stop valves, meter setters, dual check

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valves, couplings, meters, strainers, RPZ assemblies, and tapping saddles. All brass shall be pressure rated to a minimum 150psi.

1. Meter setters: ¾" or 1" meter setters shall be constructed of Class K copper and **lead free** brass, must contain a dual check on the downstream side and an integral ball valve shutoff on the upstream side. Base connections may be either restrained compression fitting or flare nut. Standard height shall be 15".
2. Meter setters: 1 ½" & 2" meter setters shall be constructed of Class K copper and **lead free** brass, they must contain an angle cascading dual check valve, and an angle ball valve. Base connections may be either restrained compression or flare nut. Setter height shall be adequate to elevate the top of the meter dial within 18" of the water meter lid, standard height shall be 24".

22. Trace Wire:

1. Open-Trench Installation: direct burial #12 AWG Solid (0.0808" diameter), steel core soft drawn tracer wire, 250# average tensile break load, 30 mil high molecular-high density polyethylene jacket complying with ASTM-D-1248, 30A. Open-Trench Installation: direct burial #12 AWG Solid (0.0808" diameter), steel core soft drawn tracer wire, 250# average tensile break load, 30 mil high molecular-high density polyethylene jacket complying with ASTM-D-1248, 30volt rating. Color shall be "blue" for domestic water (potable) pipelines and "purple" for raw water (non-potable) pipelines. Manufactured by Copperhead Industries part number 1230-SF, or approved equal.
2. Directional Bore or Jacked Installation: direct burial #12 AWG Solid (0.0808"diameter), steel core hard drawn extra high strength horizontal directional drill tracer wire, 1150# average tensile break load, 45 mil high molecular-high density polyethylene jacket complying with ASTM-D-1248, 30 volt rating. Color shall be "blue" for domestic water (potable) pipelines and "purple" for raw water (non-potable) pipelines. Manufactured by Copperhead Industries part number 1245-HS, or approved equal.
3. Connectors: Splices along the continuous run of trace wire for repair of a wire break or replacement of failed segment of wire shall use 3M Brand DBR Direct Bury Splice Kit or approved equal. Approved alternatives must securely connect two or more wires, effectively moisture seal by means of a dielectric non-hardening silicone sealant, manufacturer approved for direct burial and rated for a minimum of 50V. Branch connections for laterals, turnouts, services and appurtenances shall use DryConn Direct Bury Lug Aqua, or approved equal. Approved alternatives must securely connect one or two wires to the main trace wire without cutting the main trace wire, effectively moisture seal by means of a dielectric non-hardening silicone sealant, manufacturer approved for direct burial and rated for a minimum of 50V.

E. Material Handling:

Pipe, fittings, valves, hydrants and accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such materials be dropped or rolled against pipe or fittings already on the ground.

F. Location:

1. Alignment and Grade: The water main pipe shall be laid and maintained to the required lines and grades as indicated on the drawings. All combination air valve assemblies, blow-off valves assemblies, gate valves, tapping sleeves and tapping valves, hydrants and fittings shall be placed as shown on plans. Elevations of interconnections and utilities have been shown using the best information available. Minor differences in location and grade are anticipated and need not to be indicated to the Engineer. Differences in elevation and grade of significant impact that require changes to the layout of the water main and impact cost of the project shall be submitted to the Engineer immediately for review and approval prior to continuation.

All pipes shall have a minimum of 42 inches of cover over the top of the pipe unless otherwise indicated on the drawings or as directed in writing by the Engineer. All water mains shall have a depth not to exceed 66" to the top of the main unless otherwise indicated on the drawings or as directed in writing by the Engineer. Fire hydrants shall be installed to exact bury lines as indicated on Fire Hydrant.

Fire hydrants shall be placed at the locations as indicated on the drawings or as otherwise directed in writing by the Engineer. See section P.

It shall be the responsibility of the Contractor to make sure that all valves are adjusted to finished grade level and that all valve boxes are installed so that access to the operating nut can be made without any obstruction from any foreign matter or improperly installed valve boxes. If any grade changes are made, the Contractor shall adjust the valve box(s) accordingly.

All fire hydrants shall have the hydrant steamer cap facing the street for easy access by the Fire Department. If grade changes are made, the Contractor shall adjust the fire hydrant(s) and valve(s) accordingly.

2. Dead Ends: Unless indicated otherwise on the drawings or deemed unnecessary by the Engineer, the dead end of a main shall have a fire hydrant, flushing hydrant or blow-off valve for flushing purposes.
3. Valves, Tapping Sleeves, Ells, Tees, Caps/Plugs, Hydrants and Tunneled Portions of Water Main: All valves, tapping sleeves, fittings, fire hydrants and tunneled portions of water main pipe shall have thrust restraint or reinforcement, either in the form of restraining gaskets, pipe straps or a properly designed thrust block of concrete. **In addition to the use of restraining gaskets such as FIELDLOK, supplementary concrete thrust blocks as indicated on the drawings shall be used at all valves and fittings.**
4. Water Main Near Sewers: The reconstruction of storm sewer culverts and the construction of the water main in the proximity of storm sewers as indicated on the drawings shall be, to the extent practicable, constructed to the lines and grades indicated. Contractor shall exercise all necessary precaution to use-in-place such storm sewer culverts and storm sewers as indicated on the drawings.
 - a. Parallel Installation: Unless otherwise indicated on the drawings, or as directed by the Engineer, a water main shall be laid at least 10 feet horizontally from any existing or proposed drain, sanitary and/or storm sewer line. 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.
 - b. 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.
 - c. Exception: Any variances from the specified separation distances in paragraph b and c must be submitted to the department for approval.
 - d. 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.
 - e. Sewer Manholes: No waterline shall be located closer than ten feet to any part of a sanitary or combined sewer manhole.

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

G. Excavation and Preparation of the Trench, Tunnel Shaft and Tunnel:

- 1. Size and Alignment: The trench shall be excavated to alignment, depth and width as indicated on the drawings. Width of the trench shall be so as to have a minimum width of 12 inches greater than the outside diameter of the pipe. Bell holes shall be provided at each joint to permit proper jointing.

Hand excavation shall be employed in trenching when deemed necessary by the Engineer. The Contractor shall locate the tunnel work shafts. The work shaft locations shall be subject to the approval of the Engineer. The work shafts shall be of suitable size and shape and properly equipped to carry out the necessary work.

The Contractor shall provide security fence around all work shaft areas and shall cover opening when the shaft area is not in use. If required due to the depth of the work shaft or the time tunneling operations, the contractor shall be required to provide illumination in place until permission to remove illumination is received from the Engineer.

The shaft opening shall be sealed and backfilled when no longer required.

- 2. Tunneling: Water main to be constructed in tunneled casing pipe shall be constructed at the locations indicated on the drawings or as otherwise directed by the Engineer. The initial set-up of shields and tunnel-bore or tunnel-jacking machines prior to start of excavation shall be appropriate to the configuration of the machine and to the ground conditions. The initial set-up shall permit the shield of the tunnel-bore or tunnel-jacking machinery to begin and continue the excavation within line and grade tolerances. The Contractor shall excavate in a sequence designed to maintain the face in a stable condition. The face of the excavation shall be controlled to prevent loss of ground, using methods appropriate to the ground conditions.

- 3. Bracing and Shoring:

- a. In the event of any hazardous or unstable trenching conditions, suitable bracing or shoring may be required by the Engineer. Where necessary, trenches shall be excavated to the extra width required to permit the placement of sheeting, bracing and appurtenances or sloped side walls to maintain the safety and stability of the slopes and trenches and to protect adjacent utilities and structures. All sheeting and bracing shall be removed as the water main construction progresses. Fill all voids left from the removal of the sheeting and bracing and compact with the proper type of backfill.
- b. Perform tunnel and work shaft excavation in a manner that will minimize the movement of the ground in front of and surrounding the boring or jacking and excavation, and minimize subsidence of the surface, structures, and utilities above and in the vicinity of the excavation. Support the ground in a manner to prevent loss of ground and keep the perimeters and faces of the tunnel, passages, and bottoms of shafts stable. Support the face of excavation by positive means during all shutdown periods in soft ground or mixed face tunnel shall rely solely on hydraulic pressure. The Contractor shall be responsible for monitoring ground movements associated with the work and making suitable changes in construction methods for control of ground movements and prevent damage to work and adjacent structures. Any tunnel monitoring by the Engineer will be intended to supplement the Contractor's monitoring system and does not relieve the Contractor of their responsibilities, nor place on the City responsibility for control of ground movement and protection of the work and adjacent structures. Should tunneling cause subsidence of the surface pavement, it shall be restored to pre-construction condition.

- 4. Trench Excavation:

- a. Advance Open Trench: At no time shall there be more that 300 feet of trench opened in advance of the pipe laying operations and this length of open trench may be shortened by order of the Engineer when deemed necessary.

- b. De-watering: Where necessary the trench shall be de-watered prior to installation of the pipe. Discharge from any trench de-watering pumps shall be conveyed to natural drainage channels, storm sewers, or as directed by the Engineer.
- c. Disposition of Excavated Material: Stockpile excavated trenching material in the vicinity of the trench for reuse as compacted backfill material as specified herein and indicated on the drawings. Excavated material shall be placed in a manner that it will not obstruct, nor endanger the workers or the public, or obstruct walks, drives roadways or other structures.

The Contractor shall inspect all excavated material for signs of contamination with hazardous substances. If hazardous substances are suspected, the contractor is responsible for handling and disposing of such material in the proper manner and following applicable governmental regulations.

- d. Pavement Removal: Removal of pavement and road surfaces shall be at the locations and to the extent indicated on the drawings. The amount of pavement to be removed in each case depends on the type of pavement to be removed, the width of the trench, the existing joint pattern for concrete pavements and the need to perform associated improvement construction such as storm sewer culverts. The dimensions of the asphalt pavement to be removed shall not exceed the dimensions of the opening required for installation of the pipe or associated appurtenance by more than 3-inches in any direction, unless otherwise indicated on the drawings or as directed by the Engineer. The dimensions of the removal of the concrete pavement shall not exceed the joint line limits indicated on the drawings. Methods such as sawing, drilling, or chipping shall be used to ensure the breakage of pavement along straight lines. Contractor shall be responsible for issuing advance written notice to property owners of the intent to temporarily close their drives for the water main improvements. Advance notice will indicate the approximate day and the length of closure of the drive.
- e. Surface Obstruction: Trees, shrubs, fences and all other property and surface structures shall be protected during trench excavation, unless their removal is shown on the drawings, or as otherwise directed by the Engineer. Street signs indicated to be removed and replaced shall be stored by the Contractor until all other work in the immediate vicinity of the street sign location is complete. The Contractors shall re-install street signs at the original location or as otherwise directed by the Engineer.

5. Rock Excavation:

- a. Definition: Rock excavation shall include any excavation consisting of one-third cut yard or more of rock in any one line segment.
- b. Trench Width and Depth: Any trench of rock excavation shall be at least 12 inches wider than the outside diameter of the pipe and 6 inches deeper than the average depth of the trench as required by existing topography or these specifications. In the event of any required undercut, the trench subgrade shall be to proper grade by filling and compacting, with an approved material, so as to insure a uniform bed along the full length of the pipe barrel. Approved materials are clean, finely divided soil and crushed stone aggregate (95% passing a 1/2 inch screen, but not more than 10% passing a No. 200 sieve).
- c. Measurement and Payment: The measurement and payment for rock excavation classified as "Class A" per Metropolitan St. Louis Sewer District (MSD) standards shall be paid for at a rate of \$145 per cubic yard based on MSD's Standard Construction Specifications for Sewers and Drainage Facilities, 2000.

No payments for rock excavations shall be made unless the excavation is witnessed and measured by the City's inspector at the time of the excavation. All rock measurement or

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estimates to be used for payment purposes shall be made, recorded and signed in the field in the presence of the Engineer and contractor or their duly authorized representatives. It is the Contractor's responsibility to notify the City's inspector to inspect the excavation in order to receive payment for rock excavations.

H. Pipe Laying:

1. Ductile Iron: All pipe, fittings, valves and hydrants shall be carefully lowered into the trench by means of rope or mechanical equipment. Under no conditions may they be dropped or thrown. If he so desires, the inspector may hammer test all cast or ductile iron pipe before it is lowered into the trench. Ends of all pipe must be thoroughly cleaned.

Polyethylene encasement shall be installed on all pipe prior to placement into the trench. The manufacturers recommended installation instructions shall be followed.

After placing a length of pipe in a trench, the spigot end shall be centered in the bell; the pipe forced home and brought to the proper grade and alignment. The pipe shall be secured in place with proper backfill material tamped around and over it except at the bells. Bells shall be in the direction of the laying operation. Any time that the work is delayed, the open end of the line must be covered. Foreign material shall be prevented from entering the pipe while it is being placed in the trench. No debris, tools, clothing, or other materials shall be placed in the pipe at any time.

If the minimum allowable radius of the water main pipe will not permit the desired curvature, as indicated on the drawings, then a manufactured bend must be designed (specifically noting the degree of bend) and the requirements.

All joint deflections must be within the pipe manufacturer's recommendations, as are hereby included in and made a part of these specifications.

MAXIMUM DEFLECTIONS OF DUCTILE WITH PUSH ON JOINT

Size of Pipe Inches Angle (degree) 18 foot joint Deflection (inches)

6" to 12"	5 degrees	19"
16" to 24"	3 degrees	11"

No pipe or fittings shall be laid in or under water.

2. PVC Pipe: All PVC water mains which will be installed in an area where the main must be curved must be designed and installed according to the following criteria for the radius of the curvature of the main.

<u>PVC (inches)</u>	<u>Minimum Radius</u>
2"	50'
4"	100'
6"	150'
8"	200'
10"	250'
12"	300'

MAXIMUM DEFLECTIONS OF PVC PIPE, PUSH-ON JOINT

<u>Size of Pipe Inches</u>	<u>20 foot joint Deflection (inches)</u>
6"	4.0"
8"	3.0"
10"	2.5"
12"	2.0"

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Blocking is not recommended, but if it is necessary, the pipe barrel must be supported in three places.

3. Joining: All joints must be made as per manufacturers and AWWA specifications and shall be of the types specified herein.
4. Valves: Valves shall be placed at the locations indicated on the drawings or as otherwise directed by the Engineer at street, bridge, railroad, waterway crossings, dead ends and at all fire hydrants. All valves shall be protected by a valve box of five inches minimum diameter, the top of which shall be to the same grade as the existing terrain.
5. Tracing Wire:
Trace wire shall be installed in the same trench and inside bored holes and casing with pipe during pipe installation. It shall be secured to the pipe as required to insure that the wire remains adjacent to the pipe. The trace wire shall be securely bonded together at all wire joints with an approved watertight connector to provide electrical continuity, and it shall be accessible at all trace wire access points. Except for approved spliced-in repair or replacement connections, tracer wire shall be continuous and without splices from each trace wire access point.

Trace wire access points shall be accessible at all new water valve boxes, water meter boxes, blow-offs, ARVs, fire hydrants, irrigation turnouts and access manholes. Concentrations of multiple proposed valves near pipe intersections, i.e. tees or crosses, may require more than one access point assembly in each concrete valve box collar. Trace wire access points shall be within public right-of-way or public utility easements.

At the point of connection between ductile iron water mains, with any non-iron water main, the tracer wire shall be properly connected to the iron pipe with a cad weld or approved equivalent. Tracer wire welds shall be completely sealed with the use of an approved mastic type sealer specifically manufactured for underground use. Mastic shall be applied in a thick coat a minimum of one quarter inch (1/4") thick and shall be protected from contamination by the backfill material with the use of a plastic membrane.

Tracer wire shall be laid flat and securely affixed to the pipe at 10 foot intervals. The wire shall be protected from damage during the execution of the works. No breaks or cuts in the tracer wire or tracer wire insulation shall be permitted. At water service saddles, the tracer wire shall not be allowed to be placed between the saddle and the water main.

At all water main end caps, a minimum of 6 feet of tracer wire shall be extended beyond the end of the pipe, coiled and secured to the cap for future connections. The end of the tracer wire shall be spliced to the wire of a six pound zinc anode and is to be buried at the same elevations as the water main.

Contractor shall perform a continuity test on all trace wire in the presence of the Engineer. If the trace wire is found to be not continuous after testing, Contractor shall repair or replace the failed segment of the wire.

At all repair locations where there is existing tracer wire, the tracer wire shall be properly reconnected and spliced as outlined above.

6. Surface Water Crossings. Special detail drawings shall be submitted that are scaled and dimensioned to show the approximate bottom of the stream, the approximate elevation of the low and high-water levels, and other topographic features. The Dept. of Natural resources shall be consulted before plans are prepared. Mechanical, restrained, or fusion welded joint pipe shall be required in waterways and wet weather streams.

Above water crossings:

The pipe shall be adequately supported and anchored, protected from damage and freezing and accessible for repair or replacement. Means and methods of restraint, anchoring, and support shall be submitted to Public Works for approval.

Underwater crossings:

A. Flowing streams and water body crossings 500 feet or less in length shall have a minimum cover of four feet (48") over the pipe. When crossing water courses 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. Mechanical or restrained joint or fusion welded pipe may be used for open cut crossings, provided it is encased in a welded steel casing. Mechanical or restrained joint or fusion weld pipe shall be used for bored crossings.
2. Adequate support and anchorage shall be provided on both sides of the stream.
3. 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.
4. The valve closest to the supply source shall be in an accessible location and installed in a vault, manhole, or meter pit sized to allow the installation of leak detection equipment.
5. Permanent taps shall be provided on each side of the valve within the manhole, vault, or meter pit to allow insertion of a small meter to determine leakage and for sampling purposes.
6. Bank erosion is a major cause of stream crossing failures, and erosion protection measures such as rip rap have limited success, other methods should be explored. Stream movement and the history of bank erosion must be considered when choosing the length that the crossing pipe or casing shall extend beyond the upper edge of the stream channel. 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.
7. Large river crossings shall require specialized design and shall be considered on a case-by-case basis.

B. For lake, water body, and flood plain crossings greater than 500 feet in length, the design shall consider the ability to access and repair or replace the pipe in these crossings. Consideration shall also be given to the ability to continue service to areas served by the crossing in the event of a submerged leak or pipe break.

1. Submerged portions of pipe crossing proposed lakes shall not be buried when the submerged pipe is greater than 500 feet in length except for the transition from water to land.
2. Steel or ductile iron ball-joint river pipe or fusion welded pipe shall be used under water during normal flow conditions. Mechanical, restrained joint, or fusion welded pipe shall be used in flood plains.
3. Underwater installations shall be tested for leaks prior to installation.
4. Valves above the high water level shall be provided at both ends of water crossings so that the section can be isolated for testing or repair.
5. The valve closest to the supply source shall be in an accessible location and installed in a vault, manhole, or meter pit sized to allow the installation of leak detection equipment.
6. Permanent taps shall be provided on each side of the valve within the manhole, vault, or meter pit to allow insertion of a small meter to determine leakage and for sampling purposes.

C. Intermittent flowing streams

1. Restrained joint or thermal welded 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.
3. Adequate support and anchorage shall be provided on both sides of the waterway.

I. Anchorage/Thrust Restraint:

1. Plugs, Caps, Tees and Bends: All plugs, caps, tees and bends, unless otherwise indicated on the drawings or specified herein, shall be anchored to prevent movement by providing suitable restraining gaskets within the push-on joints, reaction blocking in the form of concrete thrust blocks or metal harness. The method of restraint must follow the recommendations of the Ductile Iron Research Association and be designed by a MO professional registered engineer. Concrete thrust blocks are required on all plugs, caps, tees, and bends.
2. All fire hydrants shall be installed using anchor couplings or similar restraints. Concrete thrust blocking shall be placed behind the fire hydrant.

3. The first section of water main, which extends from all tapping valves, shall be rodded to the tapping valve using 3/4" threadall rods and industry standard duc-lugs and washers. Concrete thrust blocking shall be placed behind the tapping valve(s). Restrained Field Loc pipe F method joints can be use in lieu of threaded rods.

J. Bedding and Backfilling:

1. Bedding Under and Around the Pipe: All pipe shall be bedded in sand or crushed stone aggregate (95% passing a 1" sieve, but not more than 10% passing a No. 200 sieve) a minimum of 6 inches above the top of the pipe and a minimum of 4 inches below the bottom of the pipe, unless otherwise directed by the Engineer.
2. Earth Backfill: For the construction of pipe in unimproved areas of lawn or turf, earth excavated from the trench shall be used to backfill from the top of the crushed stone bedding material (6-inches above the pipe) to the surface. If the excavated material in the banks of the trench is suitable, it may be used. If excavated material is not suitable for backfill, Engineer may require imported material to be used; including clean, finely divided soil or crushed stone aggregated (1" and smaller). The earth backfill shall be free from junk, debris, organic material, roots thicker than 2" and stones or rubble larger than 3" in greatest dimensions. The first lift of earth backfill shall be placed and compacted in-place by hand, in one 12- inch loose lift. Upon completion of the first lift of hand-placed fill, the balance of the trench shall be filled and mechanically compacted (90% of maximum density) to at least 3" of the proposed finished grade of the surrounding terrain. Backfill shall be free of junk, debris, brush, roots thicker than 2" stones or rubble more than 6" in greatest dimension. The top 6" of backfill shall be topsoil corresponding to that underlying original sod.
3. Improved Areas: The use of Granular Backfill for the backfilling of trenches through any improved area, such as streets, railroads, or improved drives shall be of crushed limestone or screening of a 3/4 inch minus material and shall include the restoration of these surfaces to the satisfaction of the improvement controllers or owners.

The first lift of Granular Backfill shall be placed and compacted in-place by hand, in one lift that provides a minimum of 12-inches of cover over the top of the pipe. Upon completion of the first lift of hand-placed Granular Backfill, the balance of the trench shall be filled and mechanically compacted to the bottom of the proposed pavement section in 8-inch lifts. Each subsequent 8-inch lift of Granular Backfill shall be mechanically compacted lift, using vibratory compaction equipment, to a minimum of 90-percent of the maximum modified dry density, at plus 3-percent to minus 2-percent of the optimum moisture content, in accordance with ASTM D 1557. Recommended vibratory compaction equipment shall impart at least 2,000 foot-pounds of impact energy with a frequency of 500 cycles per minutes.

Flowable fill instead of rock may be required if indicated on the plans.

Flowable Fill Backfill Material: The mix design shall consist of 75 pounds of cement, 2,750 pounds of sand, 18 gallons of water and 1 bag of flowable fill mixture per cubic yard of material. The Contractor shall submit a specific design mix from the selected material supplier.

Any backfill in or resurfacing of any portion of an existing street, shall be treated in the manner as prescribed in the City of St. Charles, Missouri Ordinance No. 3530, Section 1.

1. Maintenance of Backfilled Areas: Backfilled areas shall be maintained to the grade of the surrounding terrain, by the contractor for a period of two years after completion of the respective contract. Seeding shall be to the satisfaction of the adjacent property owners. Prior to final restoration and seeding, the project area shall be properly graded to insure that there are no ponding areas. No grass seed or sod shall be placed when the temperature of the surrounding air reaches 90 degrees F or above.

Watering shall be repeated as necessary to keep the seed moist until fully rooted into the subgrade (4 weeks minimum). No grass shall be accepted until fully rooted into the subgrade.

K. Disinfection/Cleaning & Testing

1. Cleaning: Prior to filling, testing, and disinfecting the installed line, the contractor shall ensure that the line is clean in conformance with ANSI/AWWA C651. To facilitate effective disinfection and minimize the chlorine dosage needed, when practicable, pre-disinfection flushing should continue until the discharge turbidity drops below 5 ntu, using measurement procedures described in AWWA Manual M12.
2. Filling and Flushing: Lines shall be filled slowly with potable water at a maximum velocity of 1 ft/sec (0.3 m/sec) while venting air. Precautions shall be taken to prevent entrapping air in the lines. After filling, lines shall be flushed at blow-offs and dead ends at a minimum velocity of 3 ft/sec (0.9 m/sec). A minimum of three changes of treated water shall be used in flushing operations. Valves shall be closed slowly to prevent excessive surges while maintaining positive pressure at all times throughout the new line. Flushing water shall be discharged without causing erosion damage, nuisance, or interruption of traffic. A special pipeline pig may be required when the required flushing velocity cannot be achieved or when needed to conserve water. The constructor shall make provisions for launching and retrieving the pig.
3. Hydrostatic Testing:
WARNING: Hydrostatic testing described in this section shall be conducted with water, or other environmentally safe, incompressible fluids, because of the inherent safety hazard potential associated with testing components and systems with compressed air or other compressed gases.
 - 3.1 General: The constructor shall provide measurement gauges and recording devices for the test, including pump, pipe, connections, and other necessary apparatus, unless otherwise specified by the purchaser, and shall provide the necessary assistance to conduct the test. Prior to testing, the constructor shall place sufficient backfill to prevent pipe movement. When local conditions require that the trenches be backfilled immediately after the pipe has been laid, the testing may be carried out after backfilling has been completed but before placement of permanent surfacing. The constructor shall ensure that thrust-blocking or other types of restraining systems will provide adequate restraint prior to pressurizing the pipeline. Refer to appropriate AWWA standards for backfilling requirements. Pressure tests will be witnessed by the Inspector. The contractor will be responsible for the cost of equipment for this test. Any defects in pipes, valves, fittings or hydrants must be immediately corrected by the contractor and successive pressure tests shall be run until satisfactory to the Engineer.
 - 3.2 Cross-connection control.
When existing water mains are used to supply test water, they should be protected from backflow contamination by temporarily installing a double check-valve assembly between the test and supply main or by other means approved by the purchaser. Prior to pressure and leakage testing, the temporary backflow protection should be removed and the main under test isolated from the supply main.
 - 3.3 Procedure: Tests shall be performed only after the pipeline has been properly filled, flushed, and purged of air. The specified test pressure shall be applied by means of an approved pumping assembly connected to the pipe in a manner satisfactory to the purchaser. The test pressure shall not exceed the design

pressure of the pipe, fittings, valves, or thrust restraints. If necessary, the test pressure shall be maintained by additional pumping for the specified time. During tests, the system and exposed pipe, fittings, valves, and hydrants shall be carefully examined for leakage. Visible leaks shall be stopped. Defective elements shall be repaired or removed and replaced and the test repeated until the test requirements have been met.

- 3.4 Test duration: The duration of the hydrostatic test shall be 2 hours.
- 3.5 Test pressure: The hydrostatic test pressure shall not be less than 1.25 times the maximum anticipated sustained working pressure at the lowest point along the test section unless the pressure exceeds the design pressure limit for any pipe, thrust restraint, valve fitting, or other appurtenance of the test section. In no case shall the test pressure exceed the design pressure limit for any pipe, thrust restraint, valve, fitting, or other appurtenance of the test section.
- 3.6 Test allowance: The testing allowance shall be defined as the quantity of water that must be supplied to the pipe section being tested to maintain a pressure within 5 psi (34 kPa) of the specified hydrostatic test pressure. No installation will be accepted if the quantity of makeup water is greater than that determined by the formula:

$$Q = \frac{LD\sqrt{P}}{148,000}$$

Where:

Q = quantity of makeup water, in gallons per hour

L = length of pipe section being tested, in ft

D = nominal diameter of the pipe, in in.

P = average test pressure during the hydrostatic test, in psi. (gauge)

In metric units,

$$Qm = \frac{LD\sqrt{P}}{795,000}$$

Where:

Qm = quantity of makeup water, in liters per hour

L = length of pipe section being tested, in meters

D = nominal diameter of the pipe, in millimeters

P = average test pressure during the leakage test, in kilopascals

These formulas are based on a testing allowance of 10.5 gpd/mi/in. (0.978 L/day/km/mm) of nominal diameter at a pressure of 150 psi (1,030 kPa).

- 3.6.1 Allowance tables: Makeup water allowances for various pipe diameters and test pressures are provided in Table 1 below.
- 3.6.2 Metal-seated valves: When testing against closed metal-seated valves, an additional allowance per closed valve of 0.0078 gph/in. (0.0012 L/hr/mm) of nominal valve size shall be allowed.

3.6.3 Hydrant: When hydrants are in the test section, the test shall be made against closed hydrant valves.

3.6.4 Visible leaks: Visible leaks shall be repaired, regardless of the amount of leakage.

4. Disinfecting

Prior to placing the installed water line in service, the new pipe and exposed sections and appurtenances of existing pipelines shall be cleaned and disinfected in accordance with ANSI/AWWA C651, unless otherwise specified. Pipelines shall be flushed following completion of disinfection procedures. Disposal or neutralization of disinfection water shall comply with applicable regulations (refer to Appendix B of ANSI/AWWA C651).

Table 1: Hydrostatic test makeup water allowances per 1000ft (305m) of pipeline*—gph

Avg. Test Pressure		Nominal Pipe Diameter, in. (mm)													
		4 (100)	6 (150)	8 (200)	10 (250)	12 (300)	14 (350)	16 (400)	18 (450)	20 (500)	24 (610)	30 (760)	36 (915)	42 (1,070)	48 (1,220)
450	(3102)	0.57	0.86	1.15	1.43	1.72	2.01	2.29	2.58	2.87	3.44	4.30	5.16	6.02	6.88
400	(2758)	0.54	0.81	1.08	1.35	1.62	1.89	2.16	2.43	2.70	3.24	4.05	4.86	5.68	6.49
350	(2413)	0.51	0.76	1.01	1.26	1.52	1.77	2.02	2.28	2.53	3.03	3.79	4.55	5.31	6.07
300	(2,070)	0.47	0.70	0.94	1.17	1.40	1.64	1.87	2.11	2.34	2.81	3.51	4.21	4.92	5.62
275	(1,900)	0.45	0.67	0.90	1.12	1.34	1.57	1.79	2.02	2.24	2.69	3.36	4.03	4.71	5.38
250	(1,720)	0.43	0.64	0.85	1.07	1.28	1.50	1.71	1.92	2.14	2.56	3.21	3.85	4.49	5.13
225	(1,550)	0.41	0.61	0.81	1.01	1.22	1.42	1.62	1.82	2.03	2.43	3.04	3.65	4.26	4.86
200	(1,380)	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72	1.91	2.29	2.87	3.44	4.01	4.59
175	(1,210)	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61	1.79	2.15	2.68	3.22	3.75	4.29
150	(1,030)	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99	2.48	2.98	3.48	3.97
125	(860)	0.30	0.45	0.60	0.76	0.91	1.06	1.21	1.36	1.51	1.81	2.27	2.72	3.17	3.63
100	(690)	0.27	0.41	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.62	2.03	2.43	2.84	3.24
75	(520)	0.23	0.35	0.47	0.59	0.70	0.82	0.94	1.05	1.17	1.40	1.76	2.11	2.46	2.81
50	(340)	0.19	0.29	0.38	0.48	0.57	0.67	0.76	0.86	0.96	1.15	1.43	1.72	2.01	2.29

*If the pipeline under test contains sections of various diameters, makeup water allowance will be the sum of the test allowance for each size.

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5. Final Test: After final test procedures and main is connected to the existing system, it shall be subjected to normal working pressure. If at any time within one year of contract completion, any trouble or failure in the respective line or lines occurs that can be directly attributed to faulty workmanship or defective materials, it shall be the contractor's financial responsibility.
 6. Disinfection and Laboratory Testing: All disinfection, chlorination and flushing of main will be the responsibility of the contractor. The Contractor shall keep the new pipe isolated from the existing system until satisfactory laboratory results can be obtained and proper chlorine levels are verified. All water samples shall be collected, delivered, and tested in accordance with the ANSI/AWWA C651. If, in the opinion of the on-site Inspector, the water quality discharged from the main does not meet the minimum standards for turbidity and clarity, the water sample will not be taken until the necessary actions have been taken to bring the water sample up to St. Charles Water Division's standards. Sampling and testing shall be done by a laboratory certified by the State of Missouri.
 7. Connections to Existing Mains: Under no conditions will any party or parties other than Water Division forces be allowed to make any taps or connections to an existing main without seeking permission from the City Engineer or their representative.
 8. Operation of Existing Pressurized Valves: All valves under pressure in the mains supplied by the St. Charles Water Division shall be operated only by employees of the Water Division except in cases of extreme emergency.
- L. Inspection: It shall be agreed to by all parties that the Water Division of the City of St. Charles, Missouri or their duly authorized representative shall have full authority of inspection at all times during the progress of any water main work. The inspector shall have full authority to inspect the materials and the work performed. It will be the responsibility of the contractor to notify the City of the date on which any water line(s) is to be installed so that inspections may be made by City Personnel.

The contractor shall furnish all reasonable aid and assistance required by the Engineer or their aides, for the proper inspection and examination of the work and all parts thereof.

The contractor shall regard and obey the directions and instructions of the Engineer or inspector so appointed, when the same are consistent to the content of these specifications; however, should the contractor object to any order given by any inspector he may object by written letter to the Director of Public Works of the City of St. Charles, Missouri, or their duly appointed representative.

Supervising engineers, inspectors and other properly authorized representatives of the City shall be free at all times to perform their duties, without intimidation or attempted intimidation by the contractor or by any of this employees or subcontractors. Any intimidation or attempt of intimidation shall be sufficient reason, if the City so desires, for suspension of work.

Such inspections shall not relieve the contractor or owner from any obligation to perform their work in accordance with these specifications or any approved plans and work not so constructed shall be removed and made good by the contractor or owner at their own expense, whenever ordered by the inspector without reference to any previous oversight or error in inspection.

Upon completion of any water main construction, extension and/or alternations, it shall be the responsibility of the Design Engineer of the water line construction, extension and/or alterations to furnish to the City Engineer a sealed statement of compliance certifying that all City Specifications

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have been met. Failure to comply with City Specifications will result in the City's refusal for acceptance or maintenance of said construction, extensions and/or alterations. The contractor has responsibility for the line(s) for one year after installation.

The statement of compliance shall be furnished upon completion of each phase of a project. Additional phases of the development shall not be started until the previous phase has been certified with a statement of compliance.

M. Seeding / Sodding: Refer to City Standards.

N. Restoration and clean-up: In order to obtain final acceptance by the Engineer, the work site and all other areas encroached upon by the contractor shall be returned to the conditions or near as possible, prior to construction.

On completion of contract, contractor shall remove all excess materials or supplies and shall clean up the entire working area and dress the land so as to leave neat, accessible work area. Any ditches, road or street shoulders shall be restored to their original alignment and grade.

O. Work not in bid item: All units of construction necessary for the completion of the project shall be performed at no additional cost to the City unless specifically listed as a pay item.

P. Fire Hydrant Spacing: Fire Hydrants shall be installed every 600' in residential areas and every 400' in commercial / industrial areas unless otherwise directed by the Engineer or the Fire Department.

Q. Dedication of Water Line(s) to City: any water line(s) which are to be dedicated to the City for ownership and maintenance by the City shall meet the following requirements: Before any line(s) is accepted by the City, a field inspection of the line(s) shall be made by an inspector of the City, a Water Division representative, and the contractor responsible for the installation of the line(s).

The inspector and Contractor shall field inspect each fire hydrant, fire hydrant valve, in line and blow off valve to assure that each of the items have been installed to City specifications.

Any item found not to be acceptable by the inspector shall be noted on the as built drawings. Each item shall be assigned a location by lot number or address. Upon completion of the repairs or adjustments, a re-inspection of the item(s) will be made by the inspector and Contractor.

After all inspections are made and all City specifications have been met, the inspector will submit to the Engineer the findings of the inspection(s).

After reviewing the report of the inspector and determining that all City specifications have been met, the Engineer shall initiate the necessary steps for the acceptance of the water line(s) by the City. The City has the right to accept or reject any water line(s) dedication request.

R. Governing Design Specifications: The **Minimum Design Standards for Missouri Community Water Systems** has been published by MoDNR and is effective as of Dec. 10, 2013. These standards shall be the minimum criteria for design of water systems within the City of St. Charles, MO. The new community design standards replaces the 2003 publication **Design Guide for Community Water Systems** for new construction and modification of existing systems. Where conflict should arise between these City of St. Charles "**Specifications For Water Main and Water Service Construction, Extension, and/or Alterations**" and the "**Minimum Design Standards for Community Water Systems**", the more stringent specification shall rule. If conflict is contradictory, the "**Minimum Design Standards for Community Water Systems**" specification shall be followed. The "**Minimum Design Standards for Community Water Systems**" may be found at: <http://www.dnr.mo.gov/pubs/pub2489.pdf>