

CITY OF KIRKWOOD WATER DEPARTMENT

SPECIFICATIONS FOR THE CONSTRUCTION OF WATER MAINS AND FIRE SERVICES **OPEN TRENCH METHOD**

GENERAL

These Specifications describe requirements for the installation of water mains and fire services from the tap to the vault. If any discrepancy occurs, these Specifications shall take precedence over any Drawings.

All materials and methods of construction shall meet the requirements of the City of Kirkwood Water Department. Unless specified herein, installation shall comply with American Water Works Association Standards.

All references to Standard Specifications shall be considered to be the most recent revision of such Standard Specifications in effect at the time of project initiation.

The verification of the location of all underground facilities, structures and utilities shall be the responsibility of the Contractor.

Fire services shall be appropriately sized by the developer's or Contractor's engineer.

These Specifications are subject to revision by the Water Department without notice.

MATERIALS OF CONSTRUCTION

All materials shall be new, unused, undamaged and clean when installed.

Pipe

PVCO (molecularly oriented polyvinyl chloride) pipe shall be pressure class 235, slip-joint, meeting AWWA standard C909. Pipe shall conform to requirements of NSF 61 and shall be UL or FM listed. PVCO Pipe shall be manufactured by J M Eagle or approved equal.

1. Joints: Push-on type with rubber gaskets.
 - a. PVC pipe shall have outside diameter equal to ductile iron pipe. Rubber gaskets shall meet ASTM Specification F477 and shall properly match bell configuration.
 - b. For all PVC pipe, additives, and fillers, including but not limited to stabilizers, antioxidants, lubricants, colorants, etc. shall not exceed ten (10) parts by weight per one hundred (100) parts of the resin in the compound. Manufacturers will be required to certify that their pipe compound meets this requirement as well as cell classification.
 - c. All pipe shall be furnished with a painted ring or other acceptable marking suitable for determining whether or not the pipe has been properly inserted into the coupling. Each pipe shall be clearly marked with the nominal diameter, manufacturer's name, class pressure rating and identification code.

RJ C900 PVC Pipe shall be manufactured by one of the following:

1. North American Pipe Company, Certa-Lok
2. Diamond Plastics, Lok-21

RJC900 pipe shall be pressure class 235, restrained joint, meeting AWWA standard C900. Pipe shall conform to requirements of NSF 61 and shall be UL or FM listed.

1. Joints: Self-restrained with rubber gaskets.
 - a. PVC pipe shall have outside diameter equal to ductile iron pipe. Self-restrained joints shall meet ASTM Specification D3139. Rubber gaskets shall meet ASTM Specification F477 and shall properly match bell configuration.
 - b. For all PVC pipe, additives, and fillers, including but not limited to stabilizers, antioxidants, lubricants, colorants, etc. shall not exceed ten (10) parts by weight per one hundred (100) parts of the resin in the compound. Manufacturers will be required to certify that their pipe compound meets this requirement as well as cell classification.
 - c. All pipe shall be furnished with a painted ring or other acceptable marking suitable for determining whether or not the pipe has been properly inserted into the coupling. Each pipe shall be clearly marked with the nominal diameter, manufacturer's name, class pressure rating and identification code.

Ductile iron pipe shall be class 52, slip-joint meeting AWWA standard C151. Pipe shall be cement lined in accordance with AWWA standard C104. Joints shall be push-on type with rubber gasket in accordance with AWWA standard C111.

Ductile Iron Pipe shall be manufactured by one of the following:

1. American Cast Iron Pipe Company.
2. U.S. Pipe and Foundry Company.

Gaskets

Elastomeric gaskets shall comply with ASTM F477 and shall properly match bell configuration.

Polyethylene Encasement

Polyethylene encasement meeting AWWA C105 shall be used on all **ductile** iron pipe, valves and fittings, and any other materials subject to corrosion. Encasement shall be in tube form, shall have natural (**clear**) **color**, and shall have a minimum thickness of 12 mils. Flat tube width shall correspond to the diameter of pipe being laid. Polyethylene sheets shall be used for odd shaped appurtenances. Black-colored encasement shall not be permitted.

Tracer Wire

Tracer wire shall be used on all pipe. Wire shall be HDPE insulated single strand # 12 AWG continuous copper clad steel tracer wire. Wire shall part # 1230B-HS as manufactured by Copperhead Industries or approved equal. Wire splices shall be part # CH10666 as manufactured by Copperhead Industries or approved equal. Wire shall be spliced underground using only 3M Corporation Direct Bury Splice Kit No. 054007-0-9053.

Warning Tape

Blue warning tape shall be required for open trench installations. Warning tape shall be non-metallic and shall caution that a buried water line exists below.

Fittings

All fittings, which include bends, tees, crosses, plugs and caps, shall be ductile iron, mechanical joint, in accordance with AWWA standard C110 or C153, and shall be epoxy-lined in accordance with AWWA standard C116 or cement lined in accordance with AWWA standard C104. Fittings shall have a bituminous coating applied to the exterior surfaces. Unless noted otherwise, gaskets shall be SBR, styrene butadiene rubber, conforming to AWWA C111. Anchor couplings are permitted at the discretion of Kirkwood Water Department.

Provide anti-rotation, high strength, low-alloy (Cor-Ten) T-bolts with ASTM A563, Grad A heavy hex head nuts. Bolting shall conform to AWWA C111, including Appendix A.

Ductile Iron Fittings shall be manufactured by one of the following:

1. American Cast Iron Pipe Company.
2. U.S. Pipe and Foundry Company.
3. Star Pipe Company.
4. Sigma Corporation.

Pipe Couplings

Couplings shall be ductile iron, **long barrel**, mechanical joint. All T-bolts and nuts shall be thoroughly sprayed with a bituminous coating.

Repair Clamps

All repair clamps shall be full circle stainless steel with ductile iron lugs. They shall be Smith-Blair 226.

Foster Adapters

Foster adapters, where permitted, shall provide positive restraint and connect the valves and/or fittings at a linear distance not to exceed three (3) inches. Foster adapters shall be manufactured of ductile iron and be supplied with gaskets and bolts conforming to AWWA C111. Foster adapters shall be manufactured with asphaltic seal coating in accordance with AWWA C104.

Restraint Systems

All fittings, including bends, tees, crosses, fire hydrants, caps and plugs shall be restrained to PVC and C900 PVC pipe using Series 2000PV MEGALUG by EBAA Iron Inc.

All fittings, including bends, tees, crosses, fire hydrants, caps and plugs shall be restrained to ductile iron pipe using Series 1100 MEGALUG by EBAA Iron Inc.

In addition to MEGALUG joint restraints, all fittings, including bends, tees, crosses, fire hydrants, caps and plugs shall **also be restrained with concrete thrust blocks**. Tees and crosses need not be restrained to the “run” pipe.

Valves

Valves shall be ductile iron body, resilient wedge gate, non-rising stem type, O-ring seals, and mechanical joint connections (tapping valves shall be flange x mechanical joint). They shall be American Flow Control Series 2500, Clow Model 2639, Kennedy Ken-Seal II, or Mueller Cat. No. A-2360. The valves shall be suitable for cold water, non-shock, bi-directional flow operation, and working pressure of 200 PSI. They shall be of such design as to maintain the full area of the pipe through the valve when open and shall be designed to take full pressure on either face. They shall be opened by turning counter-clockwise and shall have two-inch square cast iron operating nuts with an arrow cast in the nut indicating the direction of opening. Valve shall have Type 304 stainless steel bonnet bolts and nuts and type 304 stainless steel O-ring gland bolts and nuts. Valves shall have the manufacturer's name or initials and the pressure rating cast on the body.

Valve Boxes

Valve boxes shall be provided for all valves installed. They shall have suitable bases to fit around the valve bodies without bearing on them, and shall have a minimum inside diameter of five inches. They shall be designed for the depth of trench specified. The top section shall have a flange for holding it in position. Covers shall be recessed flush with the top and marked “WATER” in raised letters. Valve boxes and covers shall be made of cast iron and all exterior and interior surfaces of valve boxes shall be shop coated with an asphalt bituminous coating. Threaded valve box tops and bottoms shall not be permitted.

Fire Hydrants

Fire hydrants shall be per AWWA C502 and be traffic model breakaway type. Hydrants shall be 5-1/4” diameter valve opening, 3-way (one 4 1/2” diameter steamer nozzle and two 2 1/2” diameter hose nozzles), and conform to national standard thread requirements. Hydrants shall be equipped with a six-inch diameter mechanical joint shoe, open counter clockwise, and have a 1 1/2” pentagon operating nut. Fire hydrants shall be American Darling B-84-B or Mueller A423. Bury depth of hydrants shall be such that the **top** of the traffic flange shall be positioned no less than two inches and no more than six inches above finished grade.

Tapping Sleeves and Valves

Taps of four inch and larger diameter shall consist of a stainless steel tapping sleeve. The tapping sleeve shall be constructed **entirely** of stainless steel. Carbon steel or ductile iron flanges are not permitted. Approved sleeves include Ford FTSS, Mueller H-304, Power Seal 3490, Romac SST III,

or Smith-Blair 665. The tapping valve shall comply with the requirements previously described in the valve section, with the exception of tapping valves shall be flange x mechanical joint. Tapping valves shall be American Flow Control series 2500, Clow Model 2639, Kennedy Ken-Seal II, or Mueller A-2360.

PVC Casing Pipe (Exterior Piping)

When casing pipe is required for water main crossing under a sewer, pipelines shall be installed in a PVC casing pipe. The PVC casing pipe shall be RJ C900 as specified above.

Casing pipe diameter shall be such that there is a minimum of 3" clearance between the largest diameter part of the carrying pipe being installed and minimum inside diameter of the casing pipe. To facilitate the installation of the inner pipe, that pipe shall be fitted with at least three casing insulators per pipe length. The casing insulators shall be stainless steel Model 4810 as manufactured by Power Seal Pipeline Products Corporation of Wichita Falls, Texas, Advance Products & Systems Model SSI, or equal.

The ends of the casing pipes shall be sealed with rubber wrap-around end seals as manufactured by Power Seal, or equal. End seals shall be ordered for the specific size of carrier and casing pipe and shall be provided with stainless steel clamps.

Material Storage

All materials shall be stored in a safe and secure manner and in such a way as to prevent damage to the materials. **Individual** pipes, hydrants, valves and fittings may be laid directly on the ground, but in such a way as to prevent water or dirt from accumulating inside these materials. Gaskets and polyethylene encasement shall be protected from direct sunlight. Gaskets shall not be allowed to come into contact with petroleum products.

If water mains or fire hydrants are stacked, the bottom tier of pipes/hydrants shall not be laid directly on the ground, but shall be held off the ground and supported by timbers. Timbers shall also be installed between each tier, preventing contact between tiers.

Trench Excavation and Backfill

With the exception of material that is to be used for backfill purposes, all excavated material shall be **immediately** loaded and removed from the job site. Excavated material shall not be deposited on the ground unless it is to be used for backfill material.

The trench shall be excavated to a depth of at least six inches below the bottom of the pipe. The trench shall be at least twelve inches wider than the outside diameter of the pipe. The pipe shall be laid in the center of the trench so a minimum distance of six inches is maintained between the outside of the pipe and each trench wall.

Prior to placing the pipe, at least six inches of one-inch clean, crushed limestone bedding shall be placed and leveled in the bottom of the trench. The bedding shall be true and even, and shall provide a uniform and continuous bearing and support for the pipe, except that it will be permissible to disturb the backfill material near the center of each length of pipe to permit the withdrawal of pipe slings and other lifting equipment. Blocking shall never be used to support the pipe. All water main and appurtenances shall be inspected and approved by a Water Department representative prior to covering the new pipe. **Any piping or appurtenances that are covered or otherwise hidden from view prior to receiving approval from the Water Department shall be completely uncovered in order to permit a thorough inspection.**

After an inspection of the pipe is complete, one-inch clean crushed limestone shall be placed around each side of the pipe (six-inch minimum width on each side), and over the top of the pipe (minimum thickness of twelve inches when pipe is in lawn).

Trench backfill from the top of the granular bedding to the level of existing grade adjacent to the trench shall be in accordance with the policies and procedures established by the City's Public Services Department. Suitable native material previously excavated from trench and/or supplemental borrow material may be used if the trench is not located beneath pavement of any kind. Backfill shall be placed in layers of thickness within the compacting ability of the equipment used. Compaction of the trench backfill shall be performed at the proper moisture content of the backfill material to achieve the desired results, and accomplished without inundation. Backfill of native material or soil shall be thoroughly jetted.

Under road pavements, sidewalks, driveways and parking lots, one-inch clean backfill shall be compacted to 95 percent of maximum dry density (see "Pipe Bedding Detail Under Pavement" on drawings). In other areas, backfill shall be compacted to the degree necessary to prevent future settlement.

INSTALLATION

Pipe

Unless specified herein, installation of PVC pipe shall comply with the most recent revision of American Water Works Association Standard C605. Installation of ductile iron pipe shall comply with the most recent revision of American Water Works Association Standard C600.

Pipe and fitting joints shall not be deflected until assembled. Maximum joint deflection shall comply with the applicable AWWA standard for the type and diameter of pipe and fittings. Maximum joint deflection for ductile iron pipe is five degrees. Maximum joint deflection for PVC pipe is one degree.

Carefully examine each pipe immediately prior to installation. All visible foreign material shall be removed from the pipe immediately prior to its installation. If necessary, the Contractor shall rinse the interior surface of the pipe. Pipes shall be installed with the bell end facing the direction in which the pipe is being installed. Install pipelines to grades and alignment indicated. Provide proper facilities for lowering sections of pipe into trenches. Pipe shall not be rolled or dropped into the trench. Immediately prior to installing each pipe section, the previously installed section of pipe must be inspected to insure that no foreign material has entered the pipe since its installation. If any foreign material is discovered in the previously installed section of pipe, it shall be removed prior to installing the next pipe section. Lubricant shall be applied according to the manufacturer's instructions and shall be in accordance with AWWA C605 or C600, whichever applies. Under no circumstances shall pipe be laid in water and no pipe shall be laid when trench conditions or weather are unsuitable for such work. Full responsibility for diversion of drainage and for dewatering of trenches during construction shall be borne by the Contractor. At times when pipe laying is not in progress, watertight plugs shall close the open ends of the pipe. Foreign material shall be prevented from entering the pipe during and after installation.

Mains shall not be tapped for service line connections prior to the installation, disinfection and pressure testing of the water main, unless a tap is needed for flushing and pressure testing purposes.

Water mains shall have no less than 42 inches and no more than 48 inches of cover after finished grading. Exceptions to this rule may be made by the Water Department to provide necessary clearance from sanitary and storm sewers, and to accommodate conflicts with other utilities, including water service lines. Such approval must be obtained from the Water Department prior to any installation that deviates from these specifications.

IF, AFTER FINISHED GRADING IS COMPLETE, ANY PORTION OF THE WATER MAIN HAS MORE THAN 48 OR LESS THAN 42 INCHES OF COVER, AND THIS INSTALLATION OUTSIDE THE REQUIRED LIMITATIONS DID NOT RECEIVE PRIOR APPROVAL FROM THE WATER DEPARTMENT, THE DEVELOPER SHALL RELOCATE THAT PORTION OF WATER MAIN TO THE REQUIRED DEPTH AT HIS EXPENSE. IT IS NOT THE CITY'S RESPONSIBILITY TO APPROVE OR DISAPPROVE THE INSTALLATION OF NEW PIPE WITH REGARD TO PROPER DEPTH DURING CONSTRUCTION. IT IS THE DEVELOPER'S RESPONSIBILITY TO ENSURE THAT, AFTER FINAL LANDSCAPING HAS BEEN COMPLETED, COVER OVER THE NEW MAIN IS IN COMPLIANCE WITH THESE REQUIREMENTS.

Polyethylene Encasement

All valves and fittings, threaded rods, restraint systems, washers, nuts and all other ductile, cast or steel appurtenances shall be protected with clear polyethylene encasement. The encasement shall prevent contact between the wrapped items and the surrounding backfill and bedding material. Encasement shall be secured with duct tape.

Installation of polyethylene encasement shall be in accordance with AWWA standard C105.

Tracer Wire

Wire shall be installed directly on top of PVC pipe and shall be duct taped to the pipe every five feet. Wire shall extend to tops of **all** valve boxes with a minimum of 2 feet tucked neatly inside the box. Wire shall be spliced underground using only 3M Corporation Direct Bury Splice Kit No. 054007-0-9053.

Warning Tape

Warning tape shall be installed directly over the pipe and 12 inches above the pipe.

Fittings

All fittings including bends, tees, crosses, valves, fire hydrants, caps and plugs installed on PVC pipe shall include EBAA Iron MEGALUG joint restraints series 2000PV. All fittings, including bends, tees, crosses, fire hydrants, caps and plugs installed on ductile iron pipe shall include EBAA Iron MEGALUG joint restraints series 1100.

Thrust Blocks

Thrust blocks shall be installed in accordance with the details and table shown in Kirkwood's Water System Standard Drawings.

Concrete thrust blocks shall be installed at all bends, tees, tapping sleeves, hydrants and changes in alignment of the water main. Blocks shall be adequately sized for the degree of bend, diameter of bend, and anticipated system pressure. This is **in addition to** the installation of EBAA Iron

MEGALUG joint restraints. Thrust blocks shall have a compressive strength of not less than 2000 psi after 28 days.

Blocks shall distribute the thrust forces to the soil structure in such a manner that joint separation will not occur. The blocks shall be so located as to contain the resultant thrust force in such a way that the pipe and fitting joints will be accessible for repair. Final approval of thrust block sizing and installation shall be at the discretion of the Water Department.

Valves

Valves shall be installed in a horizontal position with the operating nut vertical.

Valve Boxes

A valve box shall be installed above each valve. Valve boxes shall be installed such that the top of the box is no more than ¼ inch below street pavement, flush with sidewalk pavement, or when in lawns, flush with the **dirt** surface. Valve boxes shall never pose a trip hazard or a potential threat of damage to lawn mowers.

Tapping Sleeves and Valves

Immediately prior to installation, the following surfaces shall be sprayed with household bleach until thoroughly wet:

1. The interior of the tapping sleeve branch
2. The interior of the tapping valve, including both sides of the gate
3. The pilot drill bit and the shell cutter of the tap machine

Corporation Stops

Corporation stops shall be installed only after the water main has been installed and has been placed into service. They shall be installed on the water main at 10 o'clock or two o'clock positions on the water main diameter. Corporation stops shall be attached to PVC water main with service saddles and shall be direct tapped to ductile and cast iron pipe.

Connections between the service line and the corporation stop shall be supported with blocking, with the uppermost layer of blocking being of wood.

Curb Boxes

Curb boxes shall be installed vertically and shall be perfectly centered over the curb stop valve.

Curb boxes shall be installed such that the top of the box is flush with the **dirt** surface. Curb boxes shall never pose a trip hazard or a potential threat of damage to lawn mowers.

Service Line Transfers

When the Contractor connects any existing water service to the new tap, he **must** coordinate with Water Department personnel to enable Department personnel to remove the water meter from the service line **before** the new corporation stop is turned on. Once the meter is removed, the Contractor shall turn the corporation stop fully on. Department personnel will flush the service line

into the meter box and replace the meter. **If the Contractor fails to properly coordinate this process with Department personnel, and failure to do so causes plugging of the resident's plumbing fixtures, the Contractor shall be responsible for cleaning and/or replacing the resident's fixtures.**

Fire Service Vaults

Vaults shall be adequately sized to contain:

1. pipe tee that splits the fire and domestic services;
2. double or single detector check valve; including OS&Y valves on both ends;
3. detector meter, valves, and double or single check valve on detector meter bypass;
4. collapsible fitting;
5. domestic meter (if 1 ½" or larger), valves at both ends, bypass line;
6. any and all appurtenances required by the Fire Department.

Vaults shall have a rectangular opening in the top and shall have two square cast iron frames and lids with no predrilled holes.

Domestic water meters 1" diameter or smaller shall not be installed within the main fire service vault, but shall be installed in a standard residential meter box located in the immediate vicinity of the main fire service vault.

Backflow Prevention Devices/Detector Meters

Backflow prevention devices for fire services **may** be installed in the fire service vault. Backflow prevention devices installed in the fire service vault shall be double detector check valves. If the backflow prevention device is installed inside the building, a single detector check valve shall be installed in the fire service vault. Single detector check valves shall not be installed in pyramid vaults, but shall be installed in vaults large enough to contain the detector check valve, both OS&Y valves, and collapsible fitting. Detector meters on both double and single detector check valves shall be purchased from the City and installed by the Contractor.

Both double and single detector check valves installed in fire service vaults shall have installed OS&Y valves at both ends. A collapsible fitting, assembled using two flange X plain end pipes, and a mechanical joint coupling connecting the two plain ends, with approx. a 1" gap between the plain ends, shall be installed by the Contractor.

Pipe penetrations shall be thoroughly grouted.

Separation of Water Mains, Sanitary and Storm Sewers

Water mains installed parallel to any sanitary sewer or storm sewer pipe line shall be installed with no less than 10 feet of horizontal separation between the outside of the water main and the outside of the sewer. Where 10 feet of separation is not possible, the entire water main located 10 feet or less from the sewer shall be mechanical joint ductile iron pipe.

Water mains crossing sanitary sewer or storm sewer pipelines shall be installed to provide no less than 18 inches of vertical clearance between the two pipelines and a full length of water main shall be installed so both joints will be as far from the sewer as possible.

No water main shall be located closer than 10 feet to any part of a sanitary sewer manhole. Where 10 feet of separation is not possible, the entire water main located 10 feet or less from the sanitary manhole shall be mechanical joint ductile iron pipe and shall be encased. Concrete encasement shall not be permitted.

If necessary, the Contractor shall install four 45° bends to achieve the minimum clearance between the water main and sanitary or storm sewers.

Fire Hydrant Installation

Hydrants shall stand plumb with pumper nozzles facing the curb. They shall be installed so the **top** of the traffic flange is no less than two inches and no more than six inches above finished grade. Hydrant supply branches shall be controlled by an independent resilient seat gate valve.

Valves shall be mechanical joint and shall be restrained to mechanical joint tees using EBAA Iron MEGALUG joint restraints series 2000PV, to allow shut-off when the hydrant is to be removed. Hydrants shall be restrained to valves using the same method. In addition to this joint restraint, thrust blocks shall be poured between the back of the hydrant bowl and undisturbed earth.

Hydrants shall be installed between the street curb and the sidewalk, 24-32 inches from back of street curb. No part of a hydrant shall protrude into the area above a sidewalk. Hydrants shall be located no closer than six feet to any driveway.

Once final landscaping has been completed, the Contractor shall remove all nozzle cap chains, thoroughly clean and remove all rust, dirt, grease and loose paint from the hydrant, and apply two coats of paint to the hydrant body by brush with a gloss finish safety yellow color oil-based alkyd enamel coating. The Contractor shall apply two coats of paint to the hydrant bonnet by brush with a gloss finish oil-based alkyd enamel coating brand Tnemec. Bonnet color to be determined by the Water Department.

<u>Size of Main</u>	<u>Color of Top</u>
6" and smaller	HB TNEME GLOSS CDY APL RED/SF
8" and 10"	HB TNEME GLOSS TANG ORGANGE/SF
12" and larger	HB TNEME GLOSS SPRMNT GRN/SFTY

Inspections

All piping and appurtenance installation shall be inspected and approved by Water Department personnel prior to backfill. **Any portion of work that is backfilled prior to inspection shall be uncovered at the Contractor's expense to enable Water Department personnel to thoroughly and adequately inspect all work.** The Contractor shall provide sufficient access and reasonable aid to the inspector to allow for thorough inspections of the work.

Disinfection

Disinfection: All piping shall be disinfected in accordance with AWWA standard C651 (latest version) prior to being placed in service. Disinfection shall be by chlorine injection method. All filling and flushing procedures which require the operation of system valves shall be performed by

Water Department personnel only. When a hydrant is not being installed along the new water main, the Contractor shall install a one-inch diameter corporation stop at the highest elevation on the new main and on top of the pipe for flushing, sampling, and pressure testing. When all testing is complete, the Contractor shall remove the tap and replace it with a bronze plug, unless it is in a suitable location to supply an existing home, in which case the Contractor may use it for such a purpose.

Chlorine Test: The Contractor shall fill the system with a chlorine solution in the presence of Water Department personnel. The chlorine solution shall be supplied at one end of the main as water is being withdrawn from the other end, resulting in Twenty-five (25) ppm or greater of free chlorine throughout the main. The solution shall remain in the pipe for twenty-four (24) hours, at which time it shall have a free chlorine residual concentration of at least ten (10) ppm throughout the main, or the process shall be repeated.

Bacteriological Test: The line will then be flushed until the chlorine content at the extremity of the new system matches the chlorine concentration of the public water supply being used for flushing. To prevent any possibility of contaminated water flowing back into the existing system, all water flowing into the new main shall pass through an approved backflow device. Again, the system will be isolated for 24-hours. At the end of the required 24-hours, after being filled with system water by Water Department personnel, the City of Kirkwood's Water Department will verify that the chlorine residual is within acceptable limits. There will be no additional flushing of the system prior to completion of bacteriological sampling. Contractor shall record the size of nozzle used for flushing and length in minutes that the water main was flushed.

With the assistance of Water Department personnel, the Contractor shall then collect a minimum of 2 sets of samples at least 24 hours apart after completion of the final flushing as indicated above. Samples shall be taken at a minimum of one every 1200-feet, one on every branch, and one at the end. Two (2) consecutive acceptable bacteriological samples must be collected on every branch. The Contractor shall use a private MoDNR certified laboratory for bacteriological sampling at their expense. The Contractor shall send the samples to the MoDNR certified laboratory for the analysis of Total Coliform. Again, there will be no flushing of the system during the sampling period. Appropriate chain of custody protocol shall be followed from the collection of the sample to the laboratory. Results must be sent directly to Kirkwood Water Department. These reports shall include the free chlorine residual value, as well as results for total fecal and non-coliform bacteria. The Contractor shall be responsible for directing the flow of flushing water into a suitable storm drain. If there is the possibility that high concentrations of chlorine may enter a wetland or other body of water during the flushing operation, the Contractor shall provide for the dechlorination of all discharged water. If bacteria analyses fail to produce acceptable results, the Contractor, with the assistance of Water Department personnel, shall repeat the flushing, sampling and bacterial analyses procedure a second time. If the bacterial analysis fails to produce acceptable results the second time around, the Contractor will then be required to repeat the disinfection process. The Contractor shall be billed to cover any excess fees for laboratory use, materials, and employee wages for any bacteriological tests required beyond the second test. Following acceptable bacteria test results, the Contractor shall remove the tap and replace it with a bronze plug, unless it is in a suitable location to supply an existing home, in which case the Contractor may use it for such a purpose.

Hydrostatic Testing

Unless specified herein, all underground piping shall be tested hydrostatically by the Contractor in accordance with AWWA standard C605. Test pressure shall not be less than 1.5 times the working pressure at the point of testing, or not less than 125 PSI, whichever is greater. The duration of the test shall be a minimum of two hours. Test pressure shall not vary by more than +/-

5 PSI for the test duration. The Contractor may use a fire hydrant on the new main to conduct the pressure test, or may install a corporation stop for a test connection.

Leakage is defined as that quantity of makeup water that must be supplied to maintain, within 5 psi, the specified test pressure for the entire two-hour test duration. Pressure drops shall not be used to measure leakage. If the new main does not pass the pressure test and a leak cannot be found, it will be the Contractor's responsibility to disconnect the new main from the existing main, cap the new main at those connections, and perform another pressure test to eliminate the possibility of leakage through the valves at the connections to the existing mains.

Maximum allowable leakage shall not exceed 0.1 gallons per hour for every 10 joints in length of pipeline tested (conformance with AWWA standard C605, Table 2). All visible leaks are to be repaired, regardless of the amount of leakage. Testing and replacement of any section of pipe, valve or fitting shall be performed by the Contractor at his expense.

When a hydrant is not being installed along the new water main, the Contractor shall install a one-inch diameter corporation stop at the highest elevation on the new main and on top of the pipe for flushing, sampling, and pressure testing. Once the pressure test is completed and approved, the Contractor shall remove the corporation stop and install a brass plug.

Hydrostatic testing shall be observed by and approved by a Water Department representative.

Final Connections

If the Contractor connects the new main to an existing main **after** the new main has successfully passed the bacteriological testing, the interior of all new materials used to make the final connection shall be thoroughly sprayed with household bleach immediately prior to their installation. If the Contractor connects the new main to an existing main **after** the new main has successfully passed the pressure test, water to all portions of the new connection(s) must be turned on and the new connection(s) pressurized. These connections shall be left under full system pressure for a minimum of twenty-four (24) hours, at which time they will be inspected for leaks by Water Department personnel.

Shutdowns of Existing Mains

When water service to existing customers must be interrupted to sections of mains to enable the Contractor to disconnect and abandon water mains, or for any other scheduled reason, the Contractor shall provide the Water Department with a 48-hour minimum notice. Water Department personnel will notify those customers to be affected by door hanger notices on the day prior to the scheduled shutdown. Scheduled shutdowns shall not begin prior to 9:00am or extend beyond 3:00 pm for residential areas. If the Contractor encounters unforeseen difficulties, he must continue working until service has been restored. When transferring individual single-family residential services to the new main, the Contractor shall be responsible for delivering notice to the occupant. Twenty-four hour notice and door hangers are not required for individual single-family residential service transfers.

Site Safety and Property Protection

The Contractor shall, at all times, conduct his operations in such a manner and employ all reasonable means to prevent damage to public and private property. Any damage to public or private property as a result of the Contractor's failure to comply with any portion of these specifications or federal, state or local regulations shall be repaired at the Contractor's expense.

The Contractor shall keep all utilities marked while excavating in their vicinity. The Contractor shall, at all times, comply with the City's Public Services Department's Excavation, Restoration and Land Disturbance Requirements.

Traffic Control

Traffic control shall comply with all applicable Federal, State and Local regulations. Adequate barricades, warning signs and lights shall be installed and maintained on a continuous basis by the Contractor. These safety devices shall be adequate to advise, warn and protect the public from any hazards arising from or otherwise associated with the Contractor's work. Flagmen shall be used when closing one lane of a two lane arterial roadway. The Contractor shall, at all times, comply with the City's Public Services Department's Excavation, Restoration and Land Disturbance Requirements.

Site Cleanliness

The Contractor shall maintain the construction site in a neat and orderly appearance. Streets, sidewalks, parking lots and curbs shall be shoveled and swept clean of mud, dirt and debris on a daily basis and washed down as necessary. All trash and waste materials shall be removed from the site on a daily basis. Any excavated material that is not to be reused shall be removed from the site **immediately**. Any excavated material that is to be reused may be stored on site, but shall not be stored in the street or on a sidewalk. Stored excavated material shall be covered with plastic at all times to prevent runoff from precipitation. Site cleanliness and the storage of materials shall, at all times, comply with the City's Public Services Department's Excavation, Restoration and Land Disturbance Requirements.

Property Restoration

The Contractor shall restore all disturbed areas as nearly as practicable to their original condition.

All disturbed grass areas shall be restored with sod. Lawn restoration shall strictly adhere to the Kirkwood Public Services Department's Excavation and Restoration Requirements.

Disturbed grass areas include not only those areas disturbed for excavation and installation of pipe and appurtenances, but also those areas disturbed by storage of materials, and operation and storage of equipment.

Any sod installed after June 15 that does not indicate substantial growth in the fall shall be replaced by the Contractor at his expense.

The Contractor shall **not** be responsible for the restoration of fencing, irrigation systems, "invisible" dog electrical fencing, retaining walls, trees, shrubs, miscellaneous plantings, planter areas and decorative items that exist **within the city's right-of-way**, unless otherwise noted on the drawings or elsewhere in these specifications.

The Contractor shall repair all downspout drains and sump pump discharge pipes damaged as a result of water main installation.

The Contractor shall restore all fencing, irrigation systems, "invisible" dog electrical fencing, retaining walls, trees, shrubs, miscellaneous plantings, planter areas and decorative items that exist outside the city's right-of-way and on private property that were damaged as a result of water main installation.

All street, driveway and sidewalk pavement repair and replacement shall strictly adhere to the Kirkwood Public Services Department's Excavation, Restoration, Land Disturbance and Pavement Repair Requirements.

Warranty

The Contractor shall guarantee materials and workmanship for a period of not less than one year from the time the main is placed into service. Any leaks that develop within the first year shall be repaired by the developer/Contractor. The Contractor is responsible for deterioration or settlement of restored areas for a period of one year after completion of all restorations.