



## ***DESIGN and CONSTRUCTION MANUAL for MUPB UTILITIES***

### **SECTION 5: CONSTRUCTION OF WATER FACILITIES**

#### **5.1. PURPOSE**

The purpose of this SECTION is to outline requirements for construction, inspection, and final acceptance of potable water mains and appurtenances, water service connections, and public fire protections systems.

#### **5.2. REQUIREMENTS**

Water system improvements shall be installed in public rights-of-way or upon MUPB approval, in a utility easement granted to MUPB. All easement information must be submitted as outlined in Section 1 and 2 of this MANUAL. Water mains shall not be closer than ten feet (10) to all permanent structures.

Dead end water mains shall be minimized by looping of water mains with multiple feed points. Where dead ends occur, they shall terminate with a fire hydrant, flushing hydrant, or automatic flush valve.

The CONTRACTOR shall install a waterline marker post at the ends of all water lines, including water mains and water service connections, so as to identify the termination point of the line. The location posts shall be blue in color and marked so as to identify the line as a water pipe.

##### **5.2.1 WATER MAINS**

Water mains are those pipes used to distribute potable water to water service connections and public fire hydrants and are owned or under the control of MUPB. Water mains must be sized to meet current water consumption and projected average and maximum daily demands, including fire flow demand, if required.

Mains serving fire hydrants shall be minimum 6-inch diameter.

Mains without hydrants shall be minimum 3-inch diameter. Any departure from minimum requirements shall be justified by hydraulic analysis and future water use, and can be considered only in special circumstances.

##### **5.2.2. SYSTEM PRESSURES**

Minimum system pressure for all normal operating conditions shall be 30 psi. Water lines should be hydraulically capable of a flow velocity of 2.5 ft/s while maintaining a pressure of at least 20 psi.

All water mains, including those not designed to provide fire protection, shall be sized after a hydraulic analysis based on flow demands and pressure requirements. The system shall be designed to maintain a minimum normal



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operating pressure of 30 psi at ground level at all points in the distribution system under all normal conditions of flow. **The normal working pressure in the water distribution system shall not be less than 30 psi and should be approximately 60 to 80 psi.**

When static pressure exceeds 90 psi, pressure reducing devices shall be provided on mains or as part of the meter setting on individual service lines in the distribution system.

### **5.2.3. WATER SERVICE LINES**

Water service lines are those water lines that tap off the water main and provide water service to a specific property, utility customer or water user.

The normal working pressure in the distribution system at the service connection should be approximately 60-80 psi and shall not be less than 30 psi under peak demand flow conditions. Peak demand is defined as the maximum customer water usage rate, expressed in gallons per minute (gpm), in the pressure zone of interest during a 24-hour (diurnal) time period.

All water service lines shall be designed and sized to maintain a minimum 30 psi pressure at peak design flow. Water service lines for single residences shall be at least 3/4 inch in diameter. When two residences are served by one service line a minimum of a 1" line shall be installed.

All water service lines shall be covered with a minimum of 36" to top of pipe within city and a minimum cover of 42" within KYTC ROW or county ROW.

Water line plans shall show individual meter locations. All double water service lines across streets from the main shall be a minimum 1" PE Tubing and encased in 2" PVC pipe in gravel bedding. Single meter services shall be 3/4" PE Tubing encased in 2" PVC piping. The service line shall have a shutoff valve at the meter box and corporation stop at the main and turned on. MUPB will set the meter when a customer applies for service. All non-metal tubing shall have a coated solid copper 12-gauge tracer wire shall be taped to the casing pipes for all street crossings.

### **5.2.4. WATER LINE LOCATION**

The water main shall be constructed to a depth providing a minimum cover of 36" to top of pipe within city and a minimum cover of 42" within KYTC ROW or county ROW.

Water mains and water service lines shall be separated from sanitary sewer mains. Water lines shall be constructed with a lateral separation of 10 feet or more from any gravity sanitary or force main measured edge to edge where practical. If not practical a variance may be requested to allow the water pipe to be installed closer



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to the gravity sanitary or force main provided the water pipe is laid in a separate trench or undisturbed shelf located on one side of the sewer with the bottom of the pipe at least 18 inches above the top of the gravity sanitary or combined sewer pipe.

Water lines crossing gravity sanitary sewer or force main sewers shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sanitary sewer main with preference to the water main located above the sanitary sewer.

A plan for a water line that would propose a section of line be laid within a 200-foot radius of an underground storage tank as defined in KRS 224.60-100 or a petroleum storage tank as defined in KRS 224.60-115, shall provide that all water lines within the 200-foot radius shall be ductile iron pipe with appropriate gaskets or other non-permeable pipe approved by the cabinet. Any future replacement of an existing water line within a 200-foot radius of a storage tank, whether or not plans are submitted to KDOW, shall also meet this requirement.

Non-permeable materials shall be used for all portions of the piping system present within a 200-foot radius of an area of known soil contamination by organic compounds, including hydrant leads and service connections.

### **5.3. PIPE MATERIAL**

Water mains shall be constructed of ductile iron or polyvinyl chloride (PVC) pipe unless otherwise approved by MUPB. HDPE (directionally drilled) pipe may be used for stream or river crossings where approved by MUPB.

#### **5.3.1. DUCTILE IRON PIPE, FITTINGS & JOINTS**

Ductile iron shall conform to the latest AWWA Specifications C151 (ANSI A21-51). Pressure class shall be Class 350.

The interior of the pipe shall be cement-mortar lined in accordance with AWWA C104 (ANSI A21.40). The exterior of the pipe shall be bituminous coated in accordance with AWWA C151 (ANSI A21.51) for pipe and AWWA C 110 (ANSI A21.10) for fittings.

Fittings shall be Mechanical Joint, conforming to AWWA Specification C110, for short body cast iron fittings. Fittings shall be tar-coated outside and shall receive the standard cement lining on the inside as specified for the ductile iron pipe. All bolts shall be wrapped in plastic prior to thrust blocking. All fittings shall have grip rings.

Pipe joints shall be of the push-on or mechanical joint type (see MUPB approved manufacturers list), conforming to AWWA C111 (ANSI 21.11). Bells for push-on type joints shall have an annular recess in the pipe socket to accommodate a single



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rubber gasket. Plain ends shall be suitably beveled to permit easy entry into the bell. The gasket and annular recess of the socket shall be so designed and shaped that the gasket is locked in place against displacement as the joint is assembled.

All buried pipe shall have copper tracer wire taped to the line for the purpose of pipe location. See paragraph 5.20. for specifics of tracer wire requirements.

### **5.3.2. DUCTILE IRON BALL & SOCKET PIPE**

Ductile Iron Ball and Socket pipe shall be used for large stream or river crossings where directional drilled creek crossing is not utilized. The pipe material shall be ANSI A21.51 with a pressure rating of 350. The bell, ball and retainer shall be made of ANSI A21.10 ductile iron.

### **5.3.3. POLYVINYL CHLORIDE PIPE (PVC), FITTINGS AND JOINTS**

PVC water pipe shall conform, at a minimum to normal working pressure of 150 psi A21 10 per AWWA standards. The pipe furnished under ASTM F477 and joints in compliance with ASTM D3139 and shall be rated to a working pressure of at least 150 PSI at 73.4-degree Fahrenheit. Higher pressure rated PVC pipe shall be considered on a case-by-case basis and the pipe material and classification shall be determined by MUPB.

Fittings shall be Ductile Iron Mechanical Joint conforming to AWWA Specifications C110 for short body fittings. Fitting shall be tar-coated exterior, and shall receive the standard cement lining with bituminous seal coat on the interior as specified for ductile iron pipe.

Pipe joints shall be of the rubber gasketed type, conforming to ASTM D3139 and ASTM F477. All jointing material and lubricants shall be non-toxic.

All buried pipe shall have copper tracer wire taped to the line for the purpose of pipe location. See paragraph 5.20. for specifics of tracer wire requirements.

### **5.3.4. HDPE PIPE & FITTINGS**

HDPE (directionally drilled) pipe may be used for stream or river crossings where approved by MUPB. HDPE pipe shall conform, as a minimum to AWWA C906 and shall be of a pressure class to provide a 2.5 safety factor of normal working pressure. Higher pressure rated HDPE pipe shall be considered on a case-by-case basis and the pipe material and classification shall be determine by the MUPB.

Fittings shall be HDPE butt fused fittings, mechanical joint adapters, flanges, unions, grooved-couplers, transition fittings and some mechanical couplings conforming to AWWA Specifications and manufacturer recommendations. Pipe joints shall be butt fused.



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All buried pipe shall have copper tracer wire taped to the line for the purpose of pipe location. See paragraph 5.20. for specifics of tracer wire requirements.

### **5.3.5. ENCASEMENT PIPE**

Encasement pipe shall be steel, plain end, uncoated and unwrapped, have minimum yield point strength of 35,000 PSI and conform to ASTM Grade 2 of ASTM A130 Grade B without hydrostatic tests. The steel pipe shall have welded joints and be in at least 18-foot lengths.

The wall thickness of the pipe shall be a minimum of 0.375 (3/8") inches for highway crossings and for railroad crossings. Refer to MUPB Standard Details for wall thickness and diameter requirements. The diameter of the pipe shall conform to the requirements of American Railway Engineering Association for railroad crossings, and the requirements of the Kentucky Department of Transportation.

## **5.4. WATER LINE APPURTENANCES**

### **5.4.1. GATE VALVES**

All gate valves shall be mechanical joint resilient seat wedge, iron body, non-rising stem, fully bronze mounted and suitable for 200 PSI working pressure and hydrostatic tested to 400 PSI pressure. Valves shall be of standard manufacture and of the highest quality both as to material and workmanship

All gate valves shall have the name or monogram of the manufacturer, the year the valve casting was made, the size of the valve, and the working water pressure cast on the body of the valve.

Gate valves set with valve boxes shall be provided with a two-inch square operating nut and shall open by turning to the left (counterclockwise).

Gate valves for installation in meter vaults shall be flanged ANSI B16.1 Class 125 and hand wheel operated.

All valves shall conform to the latest revision of AWWA Standard for Gate Valves for Ordinary Water Works Service, AWWA C500.

### **5.4.2. TAPPING SLEEVES AND VALVES**

Tapping sleeves and valves for connection to existing water mains shall be in accordance with MUPB approved manufacturers list and be tested according to the manufacturer's recommendations.



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### **5.4.3. VALVE BOXES**

Valve boxes shall be of 5.25-inch standard cast iron, two pieces, and screw type valve box with drop cover marked "WATER". For water mains with a cover greater than 5', 8" PVC pipe may be used to raise the valve box to grade and a long valve wrench. Valve boxes shall be accurately centered over valve operating nut, and backfill thoroughly tamped about them.

Valve box bases shall not rest on the valves but shall be supported on crushed stone fill below the valve stem. They shall be set vertically and properly cut and/or adjusted so that the tops of boxes will be at grade in any paving, walk or road surface. In non-paved areas, an 18" round or 18" square concrete valve marker shall be installed around the valve box, minimum of 4" thickness.

### **5.4.4. FIRE HYDRANT**

Fire hydrants installed within MUPB distribution system shall follow the approved material list and standard details.

The CONTRACTOR shall furnish and install fire hydrants were shown on the plans. Hydrants shall conform in all respects to the requirements of AWWA C502-73. Hydrant barrel shall have safety breakage feature above the ground line. All hydrants shall have 6-inch (6") mechanical joint shoe connection, two 2.5-inch (2.5") discharge nozzles and one (4.5") inch pumper nozzle with caps fitted with cap chains. Connection threads and operation nuts shall conform to National Standard Specifications as adopted by National Board of Fire underwriters.

Operation nut shall be pentagonal in shape, conform to current standard in use, and shall open by turning to the left (counterclockwise). Main valve shall have 5.25 inch (5.25") full opening and be of the compression type opening against water pressure so that the valve remains closed should the barrel be broken off.

Hydrant shall be fully bronze mounted. Main valve shall have a threaded bronze set ring assembly of such design that it is easily removable by unscrewing from a threaded bronze drain ring. Bronze drain ring shall have multiple ports providing positive automatic drainage as the main valve is opened or closed. Drainage waterway shall be completely bronze to prevent rust or corrosion.

Operating stem shall be equipped with anti-friction thrust bearing to reduce operating torque and assure easy opening. Stop shall be provided to limit stem travel. Stem threads shall be enclosed in a permanently sealed lubricant reservoir protected from weather and the waterway with O-ring seals.

Hydrants shall be designed for 250 PSI working pressure and shop tested to 500 PSI pressure with main valve both opened and closed. Under test the valve shall not leak, the automatic drain shall function and there shall be no leakage into the bonnet.



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Fire hydrants shall be located not more than 6 feet (6') nor less than 2.5 feet from the edge of existing or proposed edge of pavement unless otherwise approved by MUPB. Hydrants shall be installed with a vertical distance from the center of the pumper nozzle to the ground of at least 18 inches. All fire hydrants shall be provided with a shut-off valve on the hydrant lateral.

Fire hydrants shall be secured to the shut off valve by AWWA approved restraint joints, joint restraints or another method approved by MUPB. MUPB shall determine spacing, placement and orientation of all fire hydrants

The fire hydrants shall have the NFPA identification color on the bonnet that signifies the correct flow rate for that hydrant.

- |    |          |                 |
|----|----------|-----------------|
| a. | Red –    | 0 – 499 gpm     |
| b. | Orange – | 500 – 999 gpm   |
| c. | Green –  | 1000 – 1499 gpm |
| d. | Blue –   | 1500 and up gpm |

### **5.4.5. AIR RELEASE VALVES AND BOXES**

Air release valves shall be installed at the high point on the water main as shown on the approved standard details. They shall be connected to the main by a corporation stop with inside I.P.S. threaded outlet. The inlet pipe to the air release valve shall be seamless red brass or stainless-steel pipe with I.P.S. male threaded ends and isolation valve.

Air release valves shall be per the approved equal manufacturer list of water parts and supplies. Valve shall have a threaded inlet and be suitable for 250 PSI water working pressure. The air release valve shall be installed as shown in MUPB Standard Details.

### **5.4.6. FIRE PROTECTION LINES**

Installation of water service lines to be used for private fire protection systems (i.g. sprinkler systems) shall have a MUPB approved backflow preventer installed at the property line. Backflow Preventer shall be installed in the Fire Vault or other approved location, where the facility owner of the installed backflow preventer, can have it tested regularly and provide certified test results to MUPB.

## **5.5. TRENCH EXCAVATION**

Trenches in which pipes are to be laid shall be excavated in open cut to the depths shown on the approved plans. The minimum allowable trench width shall not be less than the outside diameter of the pipe plus twelve (12) inches. Where rock is encountered, it shall be removed to a minimum depth of six inches below the pipe bell and twelve (12) inches on either side.





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Trenches shall be kept free of water during the installation of pipe and until the pipeline has been backfilled. Backfilling shall be as specified herein.

### **5.5.1. OBSTRUCTIONS**

In cases where storm sewers, sanitary sewers, gas lines, water lines, telephone lines, and other utilities, or other underground structures are encountered, they shall not be displaced. All precautions shall be made to not damage any other utility. In the event that a utility is damaged (as defined by the owner of the said utility) all fines/repairs/damage fees associated with these damages will be incurred at the expense of CONTRACTOR/OWNER. See KY PSC rules on Natural Gas/Hazardous Liquids pipeline incidents.

The CONTRACTOR shall notify KY 811 prior to beginning construction work.

### **5.5.2. SHORING SHEETING AND BRACING**

The shoring, sheeting, and bracing of excavation shall be performed by the CONTRACTOR in compliance with applicable codes and OSHA requirements. MUPB shall not be held responsible for job site safety. Safety is the responsibility of the OWNER/CONTRACTOR.

## **5.6. PIPE BEDDING**

In all cases the foundation for pipes shall be prepared so that the entire load of the backfill on top of this pipe will be carried on the barrel of the pipe and, insofar as possible, where bell and spigot pipe are involved so that none of the load will be carried on the bells.

When undercutting and granular bedding are involved, the depth at the bottom of the bells of the pipe will be at least six inches above the bottom of the trench as excavated.

Supporting of the pipe shall be as set out hereinbefore, and in no case shall the supporting of pipe on blocks be permitted.

### **5.6.1. EARTH FOUNDATION**

Bedding material shall be free from rock and be acceptable to MUPB. In no case shall pipe be supported directly on rock. Pipe may be supported on excavated earth, if acceptable by MUPB.

### **5.6.2. ROCK FOUNDATION**

If the trench bottom is in rock, the excavation shall be undercut to a minimum depth of six inches below the bottom of the pipe. The pipe shall be laid on a bed of granular material to provide continuous support for the lower section of the pipe.





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Granular bedding shall be size No. 9 or No. 68 crushed stone as defined by KYTC-KDHSS.

### **5.6.3. SPECIAL BEDDING**

In wet, yielding, mucky locations, where pipe is in danger of sinking below grade or floating out of line or grade, or where backfill materials are of such fluid nature that such movements of the pipe might take place during the placing of the backfill, the pipe must be weighted or secured permanently in place by such means as will prove effective. When ordered by MUPB, yielding and mucky material in sub-grades shall be removed below ordinary trench depth in order to prepare a proper bed for the pipe. No. 9, No. 68 or No. 57 crushed stone or approved equal shall be used to replace poor sub-grade material and shall be classified as "Special Pipe Bedding."

## **5.7. INSTALLATION OF PIPE**

All pipes shall be laid with ends abutting a true to line and grade as shown on the plans. Supporting of pipe shall be as specified under "Pipe Bedding" specified herein and in no case, shall be supported on blocks.

Fittings for the water mains shall be provided and placed as shown on the plans. All open ends of pipes and of branches shall be sealed or plugged.

Before each piece of pipe is lowered into the trench, it shall be thoroughly cleaned and inspected for defects. Any piece of pipe or fitting which is known to be defective shall not be laid or placed in the lines. Any defective pipe or fitting discovered after the pipe is laid shall be removed and replaced with a satisfactory pipe or fitting. In case a length of pipe is cut to fit in a line, it shall be so cut as to leave a smooth and at right angles to the horizontal axis of the pipe.

Granular bedding material as specified herein, shall be used to correct irregularities in the earth trench sub-grade.

The interior of the pipe shall be maintained clean. Pipe shall be stored in a location where dirt, mud and debris cannot easily enter and contaminate the pipe. When laying of any pipe is stopped for any reason, the exposed end of such pipe shall be closed with a proper plug fitted into the pipe bell, so as to exclude earth or other material.

No backfilling (except for securing pipe in place) over pipe will be allowed until MUPB or their representative has made an inspection of the joints, alignment and grade in the section laid, but such inspection shall not relieve the CONTRACTOR of further liability in case of defective joints, misalignment caused by backfilling and other such deficiencies that are identified later.

### **5.7.1. PIPE INSTALLATION WITHIN FILL AREAS**



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Any water main to be installed in fill areas shall require the OWNER/DEVELOPER to provide inspection and testing services by a Registered Geotechnical Engineer to ensure that each lift in the proposed trench area was constructed and compacted to 95% Standard Proctor density from bottom of fill to 30" above top of pipe. Copies of all test reports shall be certified by the Geotechnical Engineer and submitted to MUPB prior to pipe installation.

### **5.8. PREVENTATIVE MEASURES AGAINST CONTAMINATION**

Precautions shall be taken to protect the interiors of pipes, fittings, and valves against contamination. Pipe delivered for construction shall be stored so as to minimize entrance of foreign material. All openings in the pipeline shall be closed with a watertight plug when laying is stopped at the close of day's work or other reasons such as rest breaks and meal periods.

The CONTRACTOR shall follow the procedures for contamination prevention below for all material delivered to the construction site.

1. All piping, valves, fittings, etc. delivered to the job site shall be stored elevated above the ground and shall be covered to protect from exposure to dust and debris.
2. All piping, fittings and valves shall be thoroughly cleaned of dust, dirt, and deposits by swabbing or other means acceptable to MUPB. Each component shall be cleaned on the same day it is to be installed.
3. All openings in the pipeline shall be closed with an approved watertight plug at the end of each day when pipe installation has stopped, or for other reasons such as rest or meal breaks.

See paragraphs 5.17, 5.18 and 5.19 for removal of contaminants from new waterlines.

### **5.9. JOINTING PIPE**

Pipe joints described herein shall be installed in accordance with the manufacturer's recommendations.

### **5.10. BACKFILLING PIPELINE TRENCHES**

All backfilling shall be accomplished in accordance with the pipe manufacturer's published recommended installation and backfilling method for the pipe being buried and with the requirements of this SECTION. Any variances must be approved in writing by MUPB.

When directed by MUPB, the CONTRACTOR shall add water to the backfill material or dry out the material when needed to attain a condition near optimum moisture content for a maximum density of the material when it is tamped. The CONTRACTOR shall obtain a



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compaction of the backfill of at least 95 percent of standard Proctor density ASTM D698 where mechanical tamping of backfill is required.

In all cases walking or working on the completed pipelines except as may be necessary in tamping or backfilling will not be permitted until the trench has been backfilled to a point one foot above the top of the pipe. The filling of the trench and the tamping of the backfill shall be carried on simultaneously on both sides of the pipe in such a manner that the completed pipeline will not be disturbed and injurious side pressures do not occur.

Whenever water lines are installed, the OWNER/DEVELOPER shall be responsible for any trench settlement which occurs within these right-of ways/easements within one year from the time of final acceptance of the work. If paving shall require replacement because of trench settlement within this time, it shall be replaced by the OWNER/DEVELOPER. Repair of settlement damage shall meet the approval of MUPB.

All backfilling shall be accomplished in accordance with the details shown on the Standard Drawings, manufacturers recommendations and the requirements of this SECTION. Any variances must be approved in writing by MUPB.

### **5.10.1. WATER MAIN TRENCH BACKFILLING**

There are three (3) types of trench backfill conditions where the method of final backfilling varies. The various types and trench situations are as follows:

1. **PIPE LAID IN ROCK OR EARTH TRENCH:** Areas not subject to vehicular traffic, no pavement including gravel.
2. **ORIGINAL GRAVEL SURFACE:** Gravel areas subject to light vehicular traffic such as residential driveways; church and commercial parking lots and entrances; and farm drives.
3. **ORIGINAL BITUMINOUS or CONCRETE SURFACE:** City, County and state roads; bituminous road shoulders; all bituminous surface areas such as residential driveways, church and commercial parking lots, and entrances.

See MUPB Standard Details (GP-001) for specific details for each case.

### **5.11. CONCRETE CRADLE, ANCHORS, THRUST BLOCK OR ENCASEMENT**

Concrete cradle, anchors, thrust block or encasement of water mains and/or fittings shall be placed as shown on the plans. Concrete cradle shall be utilized for areas of unsuitable subsurface. Concrete anchors shall be utilized for areas where steep slopes occur. Concrete thrust blocks shall be utilized at all fittings of pipe under pressure. Concrete encasement shall be utilized in areas of less than minimum cover (with MUPB written approval), at creek crossings and drainage crossings and when horizontal separation is not available for sewer mains.



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Concrete shall be 3,500 psi and shall be mixed sufficiently wet to permit it to flow under the pipe to form a continuous bed. In tamping concrete, care shall be taken not to disturb the grade or line of the pipe or injure the joints.

Concrete thrust block shall be utilized at all fittings for pressure piping, a polyethylene (plastic) sheet having a minimum thickness of 8 mil, shall be wrapped around the fitting to prevent the concrete from coming in contact with the fitting's bolts and nuts. Volume of concrete shall be derived from MUPB Standard Details.

Concrete encasement provides additional field supporting strength. Wherever the strength of the pipe is not sufficient to support the external loads, the encasement should be designed to provide the necessary additional strength. Concrete encasement shall completely surround the pipe and shall have a minimum thickness at any point of one fourth (1/4) of the outside diameter of the pipe or four inches (4") whichever is greater. In addition, four (4) reinforcing bars of a size selected by the MUPB shall be evenly spaced around the pipe and have a length equal to the length of the encasement.

Water mains constructed under creeks or drainage waterways shall be constructed of ductile iron pipe to a point at least twenty feet (20') beyond the edge of the creek of drainage waterway and shall be encased in concrete.

### **5.12. HIGHWAY AND RAILROAD CROSSINGS**

Steel encasement pipe for road and railroad crossings shall be bored and/or jacked in place to the elevations shown on the plans. All joints between lengths shall be solidly welded with a smooth non-obstructing joint inside. The encasement pipe shall be installed without bends. The water line pipe shall be installed after the encasement pipe is in place.

Installation of the water pipe in the encasement pipe shall be as per MUPB's recommendations and shall include manufactured casing spacers. After the water main has been installed, inspected, and tested as specified, both ends of the casing pipe shall be closed with proper fitting plug or cap in a manner acceptable to MUPB.

All street cutting, street boring, highway boring, or railroad boring permits will be the responsibility of the OWNER/CONTRACTOR. All necessary permits must be approved by KDOH and/or Railroad companies prior to construction commencing.

### **5.13. PIPELINE CLEANING (PIGGING) PROCEDURES**

After installation and prior to testing, the complete water system (including all mains, services, hydrants, blow-offs, air release valves and all other appurtenances) shall be thoroughly cleaned to remove all foreign matter. MUPB shall be notified at least 48 hours prior to cleaning activities. The cleaning of the piping system shall be accomplished by the controlled and pressurized passage through the system of a series of hydraulic or pneumatic polyurethane plugs.



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A poly-pigging plan shall be approved by MUPB and all pigging of lines must be witnessed by MUPB inspector. The poly pigs shall be removed and discharged from the system at a point near to the end of the system. The CONTRACTOR must demonstrate to MUPB that this work will be performed by experienced supervisors and personnel who have provided the cleaning service of comparable systems.

### **5.14. TESTING OF LINES**

Upon completion of the construction of water mains but prior to FINAL INSPECTION, all water mains and appurtenances shall be tested for leaks as specified herein. MUPB shall be notified at least 48 hours in advanced of the scheduled test time and, at its own discretion, have an inspector present during the performance of the test.

Where practicable, pipelines shall be tested between line valves, temporary valves, or temporary plugs in lengths of not more than 1,500 feet or between isolation valves. The CONTRACTOR may request, in writing, the testing of a section of line greater than 1,500 feet with MUPB's approval. Testing shall proceed from the source of water toward the termination of the line. The line shall be tested upon the completion of the first 1,500 feet or the first isolation valve.

#### **5.14.1. TEST RESTRICTIONS**

Water mains shall be tested at a minimum of 150 pounds per square inch in compliance with AWWA C600/C605 but not less than 1.5 times the working pressure and 1.25 times at the highest elevation at the highest elevation within the test section. The CONTRACTOR shall furnish a recording pressure gauge which shall be used for the continuous measurement and recording of test pressures and test time.

Test pressure shall not exceed pipe or thrust-restraint design pressures. The hydrostatic test shall be at least a 2-hour duration. Test pressure shall not vary by more than  $\pm 5$  psi for the duration of the test.

Valves shall not be operated in either direction at differential pressure exceeding the rated valve working pressure. For test pressures, the test setup should include provision, independent of the valve, to reduce the line pressure to the rated valve pressure on completion of the test. The valve can then be opened enough to equalize the trapped pressure with the line pressure, or fully opened if desired.

Test pressure shall not exceed the rated pressure of the valves when the pressure boundary of the test section includes closed, resilient-seated gate valves. When hydrants are in the test section, the test shall be made against closed hydrant valves. Valves and hydrants connected to MUPB system cannot be operated without MUPB personnel present.



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### **5.14.2. AIR REMOVAL**

Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants. If permanent air vents are not located at all high points, the CONTRACTOR shall install corporation stops at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation stops shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged or left in place at the discretion of MUPB.

### **5.14.3. EXAMINATION**

Any exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, valves, hydrants, or joints that are discovered following the pressure test shall be repaired or replaced with MUPB approved material, and the test shall be repeated until it is satisfactory to MUPB.

### **5.14.4. ALLOWABLE LEAKAGE**

Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 psi of the specified test pressure after the pipe has been filled with water and the air has been expelled. Leakage shall not be measured by a drop-in pressure in a test section over a period of time.

Only after the water main has successfully passed the hydrostatic pressure test, shall the leakage test be used to determine if the water main has passed. No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{SD\sqrt{P}}{133,200}$$

Where:

- L = Allowable leakage, in gallons per hour
- S = Length of pipe tested, in feet
- D = Nominal diameter of the pipe, in inches
- P = Average test pressure during the leakage test, in pounds per square inch (gauge)

If loss exceeds L, the CONTRACTOR shall locate and repair to MUPB's satisfaction all leaks until the pipe section will pass another leakage test.

For the pipe line to be accepted, the following will be required:

1. Pass the pressure test.



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2. Pass the leakage test, unless waived under the pressure test.
3. All evidence of leakage identified and repaired.

Should the sections under test fail to meet the requirements, the CONTRACTOR shall do all work of locating and repairing the leaks and retesting as MUPB may require.

If in the judgment of MUPB, it is impracticable to follow the foregoing procedures for any reason, modifications in the procedures shall be made as required and as acceptable to MUPB, but in any event, the CONTRACTOR shall be responsible for the ultimate tightness of the line within the above test requirements.

### **5.14.5. PRESSURE GAUGES**

Pressure gauges shall be sized accordingly to normal operating pressures (average pressures). Gauge ranges shall be no more than twice the operating pressure. Gauge assemblies shall be furnished with shutoff stops, diaphragm seals and pulsation dampers, which shall be constructed of brass or stainless steel. Gauges shall be 4-1/2-inch in diameter. Gauges shall have the following graduations:

<u>Pressure Gauges (psi)</u>			
<u>Maximum Indications</u>	<u>Figure Intervals</u>	<u>Intermediate Graduations</u>	<u>Minor Graduations</u>
15	1	0.5	0.1
30	5	1	0.2
60	5	1	0.5
100	10	5	1
160	20	5	1
200	20	10	2
300	30	10	2

### **5.15. DISINFECTION OF WATER LINES**

New potable water lines shall not be placed into service, either temporarily or permanently, until they have been thoroughly disinfected in accordance with the following requirements and to the satisfaction of MUPB and in accordance with AWWA 651 (latest revision).

MUPB will allow one of the three AWWA approved methods for disinfection/chlorination: tablet, continuous feed and slug. The tablet method gives an average chlorine dose of





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approximately 25 mg/L; the continuous feed method gives a 24-hour chlorine residual of not less than 10 mg/L; and the slug method gives a 3-hour exposure of not less than 50 mg/L free chlorine.

### **5.15.1 TABLET METHOD**

The tablet method consists of placing calcium hypochlorite granules or tablets in the water main as it is being installed and then filling the main with potable water when installation is completed. This method may be used only if the pipes and appurtenances are kept clean and dry during construction. Additional chlorine may be required due to excessive flushing.

The placement of granules shall be placed at the upstream end of the first section of pipe, at the upstream end of each branch line and at 500-foot intervals. The quantity of granules shall be:

Pipe Diameter (d)	Calcium Hypochlorite Granules	
	ounce	gram
inch		
2	0.5	12
3	1.0	27
4	1.7	48
6	3.8	108
8	6.7	190
10	10.5	298
12	15.1	428
14 and larger	$D^2 \times 15.1$	$D^2 \times 428$

The placement of a 5-gram tablet shall be placed in each section of pipe. Also, one tablet shall be placed in each hydrant, hydrant branch and other appurtenance. The tablets shall be attached with a food grade adhesive. Tablets shall be attached inside and at the top of the main, with approximately equal numbers of tablets at each end of a given pipe length. The number of 5-gram tablets required for each pipe section shall be  $0.0012 \times d^2 \times L$ ; d is the inside pipe diameter in inches and L is the length of the pipe section in feet.

Pipe Diameter (d)	Length of Pipe Section (ft)				
	13 or less	18	20	30	40
inch	Number of 5-gram tablets				
2	1	1	1	1	1
3	1	1	1	1	1
4	1	1	1	1	1
6	1	1	1	2	2
8	1	2	2	3	4
10	2	3	3	4	5
12	3	4	4	6	7



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Once construction has been completed, the main shall be filled with water at a rate to ensure that the water within the main will flow at a velocity no greater than 1 fps. Precautions shall be taken to ensure that air pockets are eliminated. This water shall remain in the pipe for 24-hours. A free chlorine residual should be found at each sampling point after the 24-hour hold period.

### **5.15.2 CONTINUOUS FEED METHOD**

The continuous-feed method consists of placing calcium hypochlorite granules in the main during construction (optional), completely filling the main to remove air pockets, flushing the completed main to remove particulates and filling the main with potable water. The potable water shall be chlorinated so that after a 24-hr holding period in the main there will be a free chlorine residual of not less than 10 mg/L.

Water shall be supplied to the water main at a constant, measured rate into the newly installed water main. At a point downstream from new water main, water-chlorine solution shall be introduced at a constant rate with a concentration of not less 25 mg/L free chlorine. The table below shows the amount of chlorine required to produce 24 mg/L concentration in 100 feet of pipe by diameter.

Pipe Diameter	100 Chlorine	1% Chlorine Solution
Inches		
4	0.013	0.16
6	0.030	0.36
8	0.054	0.65
10	0.085	1.02
12	0.120	1.44
16	0.217	2.60

Chlorine application shall not cease until the entire main is filled with heavily chlorinated water. The chlorinated water shall be retained in the main for at least 24-hour, during which time valves and hydrants in the treated section shall be operated to ensure disinfection of the appurtenances. At the end of this 24-hour period, the treated water in all portions of the main shall have a residual of not less than 10 mg/L of free chlorine.

### **5.15.3. SLUG FLOW**

The slug method consists of placing calcium hypochlorite granules in the main during construction; completely filling the main to eliminate air pockets; flushing the main to remove particulates; and slowly flowing through the main a slug of water dosed with chlorine to a concentration of 100 mg/L. The slow rate of flow ensures that all parts of the main and its appurtenances will be exposed to a highly chlorinated water for a period of not less than three hours.



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Downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water will have not less than 100 mg/L free chlorine. The chlorine shall be applied continuously and for a sufficient period to develop a solid column, or slug, of chlorinated water that will, as it moves through the main, expose all interior surfaces to a concentration of approximately 100 mg/L for at least three hours. As the chlorinated water flows past fittings and valves, related valves and hydrants shall be operated so as to disinfect appurtenances.

### **5.16. DECHLORINATION OF HEAVILY CHLORINATED WATER**

Dechlorination of heavily chlorinated water shall be in accordance with AWWA C651 and shall be accomplished using sodium bisulfite, sodium thiosulfate, sodium sulfite, or calcium thiosulfate solution of a concentration sufficient to remove all chlorine to a level not to exceed 0.019 mg/l. The solution shall be applied by a metering pump directly into the chlorinated water flow stream by injection into a discharge line or into the free discharge from a hydrant. The dechlorinated treated water may then be conveyed to the nearest sanitary sewer storm sewer, or local stream.

Feed System: The dechlorinating agent shall be fed from prepared carboys utilizing a metering pump or other approved metering equipment and equipped with a suitable meter and valve to adjust/monitor the feed rate.

The feed rate (gpm) of solution shall be governed by the chlorine (ppm) concentration of the water to be dechlorinated and the rate (gpm) at which it can be discharged. Constant monitoring of the chlorine residual concentration shall be made using the colorimetric method to ensure the optimum solution feed rate.

### **5.17. BACTERIOLOGICAL SAMPLES**

Following disinfection of the line, bacteriological samples shall be collected and analyzed in accordance with the requirements of Kentucky Department for Environmental Protection by MUPB. Contractor shall give 48-hour notice to MUPB to request the collection of necessary samples. When the samples have been tested and reported safe from contamination, the water line may be placed into service

Bacteriological samples shall be taken in the following manner consistent with 401 KAR 8:150:

1. Within 1,200 feet downstream of each connection point between the existing and new lines;
2. One (1) mile intervals; and
3. At each dead end, without omitting any branch line.



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### **5.18. CONNECTING TO THE WATER SYSTEM**

Unless otherwise directed by MUPB, the CONTRACTOR shall connect the new water main to the existing water system. The CONTRACTOR shall notify MUPB when the connection is to be made so that representatives of MUPB may operate existing valves and witness the connection. A minimum notice of at least 48 hours in advance of the connection shall be given to MUPB.

In cases where a wet tap must be made to connect to the existing system, the tapping sleeve, valve and box, and all other necessary material and labor shall be provided by the CONTRACTOR.

### **5.19. CUSTOMER SERVICE CONNECTIONS**

Prior to any service connections, OWNER/DEVELOPER shall have received MUPB Letter of Acceptance for the approved plan phasing, including all current punch list items. After water line has been tested and approved by MUPB, OWNER/CONTRACTOR shall install the service saddle, corporation stop, service line, meter box, setter, lid and 5' pigtail on customer side of meter. MUPB will provide meter. The meter box shall be located within 5' of property line. If development has a normal working pressure greater than 90 psi than OWNER/CONTRACTOR shall provide tandem setter and individual pressure reducing valve.

### **5.20. RESPONSIBILITY FOR MAINTENANCE**

Prior to formal acceptance of the IMPROVEMENTS by MUPB, the CONTRACTOR and/or OWNER/DEVELOPER shall be responsible for the maintenance and repair of the IMPROVEMENTS in compliance with these specifications, which shall include routine maintenance, cleaning, flushing, debris removal and general operation of water mains, booster stations and appurtenances.

After formal acceptance of the IMPROVEMENTS by MUPB, MUPB will maintain and repair the water mains and appurtenances. MUPB will maintain the water main to the outlet side of the water meter or setter.

The adopted verbiage of SECTION 2 shall be placed on all correspondence and the final plats presented to MUPB for signature.

### **5.21. PLACEMENT OF TRACING WIRE**

#### **5.21.1. Direct Burial**

Tracer wire shall be #12 AWG solid copper insulated with a 30 mil, high-density, high molecular weight polyethylene (HDPE) insulation and rated for direct burial use at 30 volts. Insulation color shall meet the APWA color code standard for identification of buried utilities. Detectable underground copper tracing wire shall be installed with all water mains lines. Tracer wire shall be attached to the top of



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the pipe with adhesive tape or other suitable devices. At each hydrant, valve, customer meter services and end of new pipe installation, the trace wire shall be daylighted and the ends connected together with waterproof connectors. For long runs of pipe, the maximum length between tracing stations (above or below grade) shall be 500 feet. Underground splicing shall be made using waterproof connectors designed for direct bury and covered with waterproof tape or wrap.

### **5.21.2. Directional Drilled**

Tracer wire shall be a #12 AWG (0.0808" diameter) fully annealed, high carbon 1055 grade steel, high strength solid copper clad steel conductor (HS-CCS), insulated with a 30 mil, high-density, high molecular weight polyethylene (HDPE) insulation, and rated for direct burial use at 30 volts. HS-CCS conductor must be at 21% conductivity for locate purposes. Break load of 452 lbs. HDPE insulation shall be RoHS compliant and utilize virgin grade material. Insulation color shall meet the APWA color code standard for identification of buried utilities. Manufacturers supplying copper clad steel tracer wire must have available detailed performance data including 5 years of underground testing in terms of durability related to damage of protective insulation and effects of potential corrosion of the specific copper clad steel used. Origin of copper clad steel manufacturer is required and steel core must be manufactured in the United States. If manufacturer has not completed 5-year corrosion testing, a 5-year warranty must be provided. Tracer wire shall be Copperhead® High Strength HS-CCS HDPE 30 mil or district pre-approved equal and made in the USA.

Use Copperhead High Strength Tracer Wire - Part # 1230\*-HS-\*\*

\* = Color: B=Blue Water, G=Green Sewer, P=Purple Reclaim Water R=Red Electric, N=Orange Communications, K=Black

\*\* = Spool Size: 500', 1000', 2500'

## **5.22. SECOND HAND & SALVAGED MATERIALS**

The use of second hand or salvaged materials will not be permitted unless authorized by MUPB. All materials and/or equipment specified to be salvaged from existing structures shall remain the property of the MUPB. Such materials and/or equipment shall be delivered by the CONTRACTOR and stored on sites as directed by MUPB.

## **5.23. CONTRACTOR'S GUARANTEE & UNDERSTANDING**

All work that has been rejected shall be repaired, or if it cannot be repaired satisfactorily, it shall be removed and replaced at the OWNER/DEVELOPER's expense. Defective materials shall be immediately removed from the site of the work. Work done without line and grade having been given, work done beyond the lines or not in conformity with the grades shown on the plans or as given, same as herein provided, work done without written authority and prior agreement in writing as to process, shall be done at the



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OWNER/DEVELOPER's risk and shall be considered unauthorized and, at the option of the ENGINEER and MUPB, may be ordered removed at the OWNER/DEVELOPER's expense.

### **5.24. PROTECTION OF WORK, PERSONS & PROPERTY**

During performance and up to the date of final acceptance, the OWNER/DEVELOPER shall be under the absolute obligation to protect the finished work against any damage, loss or injury. All risk of loss or damage to the work shall be borne solely by the OWNER/DEVELOPER until completion and acceptance of all work by the ENGINEER and MUPB, as evidenced by the MUPB's issuance of a Letter of Acceptance.

The OWNER/DEVELOPER shall have the full responsibility to provide and maintain all warning devices and take all precautionary measures required by law or otherwise to protect persons and property while said persons or property are approaching, leaving, or within the work site or any area adjacent to the work site. Minimum standards for safeguarding pedestrian and vehicular traffic are contained in the "Manual of Uniform Traffic Control Devices," Federal Highway Administration of the U.S. Department of Transportation, and the "Kentucky Manual of Uniform Traffic Control Devices," Kentucky Transportation Cabinet. The OWNER/DEVELOPER shall be responsible for complying with state laws and federal regulations relating to trench safety.

The OWNER/DEVELOPER shall provide normal routine maintenance on all items including booster stations, flushing and fire hydrants prior to formal acceptance. Maintenance shall be documented and provided to MUPB prior to final acceptance of improvements.

### **5.25. MATERIALS & WORKMANSHIP**

The work shall be performed according to the best modern practice with materials and construction of the highest quality and suitable for the purpose. The ENGINEER and MUPB shall judge and determine the CONTRACTOR's compliance with these requirements. The CONTRACTOR shall promptly correct or replace all work rejected by the ENGINEER or MUPB as defective or as failing to conform to the construction documents. If defective materials or workmanship found within one year of final acceptance by MUPB, as evidenced by the final Certificate of Acceptance or within such longer or shorter period as may be prescribed by law or by the terms of any other applicable special warranty on designed equipment or portions of work as required by the construction documents, the CONTRACTOR shall correct it promptly after receipt of a written notice from MUPB or the ENGINEER to do so. MUPB shall give notice promptly after discovery of such condition. The CONTRACTOR shall remove from the site all portions of the work that are defective or nonconforming which have not been corrected unless removal is waived in writing by MUPB.





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### **5.26. SUBSTITUTIONS**

Whenever materials or equipment is specified or described in this MANUAL by using the name of a proprietary item or the name of a particular supplier, the naming of the item is to be intended to establish the type, function and quality desired. Unless the name is followed by words indicating that no substitution is permitted, materials and equipment of other suppliers may be accepted by MUPB, if sufficient information is submitted by the ENGINEER to determine that the material or equipment proposed is equivalent or equal to that named. Request for review of substitute items or material and equipment will not be accepted by the MUPB from anyone other than the ENGINEER. If the ENGINEER wishes to furnish or use a substitute item of material or equipment, the ENGINEER shall make written application to the MUPB General Manager and/or Designee for acceptance thereof, certifying that the proposed substitute will perform adequately the functions and achieve the results called for by the general design, be similar and of equal substance to that specified and be suited to the same use as that specified. MUPB will be the sole judge of acceptability, and no substitute will be ordered, installed, or used without MUPB's prior written acceptance.

### **5.27. FINAL INSPECTION & ACCEPTANCE**

The CONTRACTOR shall furnish MUPB with every reasonable facility for ascertaining whether or not the work performed was according to the requirements and intent of the construction documents. Any work done or materials used without suitable inspection by MUPB may be ordered removed and replaced at the CONTRACTOR's expense. The OWNER/CONTRACTOR and MUPB shall make final inspection of all work included in the construction documents, and provisions provided in the Division of Water approval letter when practicable after the work is completed and ready for acceptance. If the work is not acceptable to MUPB at the time of such inspection, MUPB shall inform the OWNER/DEVELOPER/CONTRACTOR as to the particular defects to be remedied before final acceptance shall be made.

When the project is completed, the ENGINEER shall submit a written certification to the Division of Water that the project has been constructed and tested according to the approved construction plans and specifications, and the provisions listed in the Division of Water approval letter. The certification must be sealed, signed, and dated by a Professional Engineer licensed in the Commonwealth of Kentucky. One (1) digital and Two (2) original copy of the certification shall be submitted to MUPB General Manager and/or Designee.