

# DISTRIBUTION SYSTEM PIPING AND APPURTENANCES

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## 8.0 GENERAL

Water distribution systems shall be designed to maintain treated water quality. Special consideration should be given to distribution main sizing, providing for design of multidirectional flow, adequate valving for distribution system control, and provisions for adequate flushing. Systems should be designed to maximize turnover and to minimize residence times.

## 8.1 MATERIALS

### 8.1.1 Standards and materials selection

- a. All materials including pipe, fittings, valves and fire hydrants shall conform to the latest standards issued by the AWWA and ANSI/NSF, where such standards exist, and be acceptable to the reviewing authority.
- b. In the absence of such standards, materials meeting applicable Product Standards and acceptable to the reviewing authority may be selected.

- c. Special attention shall be given to selecting pipe materials which will protect against both internal and external pipe corrosion.
- d. Pipes and pipe fittings containing more than 8% lead shall not be used. All products shall comply with ANSI/NSF standards.
- e. All materials used for the rehabilitation of watermains shall meet ANSI/NSF standards.

### **8.1.2 Permeation by organic compounds**

Where distribution systems are installed in areas of groundwater contaminated by organic compounds,

- a. pipe and joint materials which do not allow permeation of the organic compounds shall be used.
- b. non-permeable materials shall be used for all portions of the system including, pipe, joint materials, hydrant leads, and service connections.

### **8.1.3 Used materials**

Water mains which have been used previously for conveying potable water may be reused provided they meet the above standards and have been restored practically to their original condition.

### **8.1.4 Joints**

Packing and jointing materials used in the joints of pipe shall meet the standards of AWWA and the reviewing authority. Pipe having mechanical joints or slip-on joints with rubber gaskets is preferred. Gaskets containing lead shall not be used. Repairs to lead-joint pipe shall be made using alternative methods. Manufacturer approved transition joints shall be used between dissimilar piping materials.

## **8.2 SYSTEM DESIGN**

### **8.2.1 Pressure**

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 pressure of 20 psi (140 kPa) at ground level at all points in the distribution system under all conditions of flow. The normal working

pressure in the distribution system should be approximately 60 to 80 psi (410 - 550 kPa) and not less than 35 psi (240 kPa).

### **8.2.2 Diameter**

The minimum size of water main which provides for fire protection and serving fire hydrants shall be six-inch diameter. Larger size mains will be required if necessary to allow the withdrawal of the required fire flow while maintaining the minimum residual pressure specified in Section [8.1.1](#).

The minimum size of water main in the distribution system where fire protection is not to be provided should be a minimum of three (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.

### **8.2.3 Fire protection**

When fire protection is to be provided, system design should be such that fire flows and facilities are in accordance with the requirements of the State Insurance Services Office.

### **8.2.4 Dead ends**

a. Dead ends shall be minimized by making appropriate tie-ins whenever practical, in order to provide increased reliability of service and reduce head loss.

b Dead end mains shall be equipped with a means to provide adequate flushing. Flushing devices should be sized to provide flows which will give a velocity of at least 2.5 feet per second in the water main being flushed. They may be provided with a fire hydrant if flow and pressure are sufficient. No flushing device shall be directly connected to any sewer.

## **8.3 VALVES**

A sufficient number of valves shall be provided on water mains to minimize inconvenience and sanitary hazards during repairs. Valves should be located at not more than 500 foot intervals in commercial districts and at not more than one block or 800 foot intervals in commercial districts and at not more than one block or 800 foot intervals in other districts. Where systems serve widely scattered customers and

where future development is not expected, the valve spacing should not exceed one mile.

## **8.4 HYDRANTS**

### **8.4.1 Location and spacing**

- a. Fire hydrants should be provided at each street intersection and at intermediate points between intersections as recommended by the State Insurance Services Office. Generally, fire hydrant spacing ranges from 350 to 600 feet depending on the area being served.
- b. Water mains not designed to carry fire-flows shall not have fire hydrants connected to them. It is recommended that flushing hydrants be provided on these systems. Flushing devices should be sized to provide flows which will give a velocity of at least 2.5 feet per second in the water main being flushed. No flushing device shall be directly connected to any sewer.

### **8.4.2 Valves and nozzles**

Fire hydrants should have a bottom valve size of at least five inches, one 4-1/2 inch pumper nozzle and two 2-1/2 inch nozzles.

### **8.4.3 Hydrant leads**

The hydrant lead shall be a minimum of six inches in diameter. Auxiliary valves shall be installed on all hydrant leads.

### **8.4.4 Hydrant drainage**

- a. Hydrant drains should be plugged. When the drains are plugged the barrels must be pumped dry after use during freezing weather.
- b. Where hydrant drains are not plugged, a gravel pocket or dry well shall be provided unless the natural soils will provide adequate drainage.
- c. Hydrant drains shall not be connected to or located within 10 feet of sanitary sewers, storm sewers, or storm drains.

## **8.5 AIR RELIEF VALVES**

### **8.5.1 Air relief valves**

At high points in water mains where air can accumulate provisions shall be made to remove the air by means of air relief valves. Automatic air relief valves shall not be used in situations where flooding of the manhole or chamber may occur.

### **8.5.2 Air relief valve piping**

- a. Use of manual air relief valves is recommended wherever possible.
- b. The open end of an air relief pipe from a manually operated valve should be extended to the top of the pit and provided with a screened, downward-facing elbow if drainage is provided for the manhole.
- c. The open end of an air relief pipe from automatic valves shall be extended to at least one foot above grade and provided with a screened, downward-facing elbow.
- d. Discharge piping from air relief valves shall not connect directly to any storm drain, storm sewer, or sanitary sewer.

## **8.6 VALVE, METER AND BLOW-OFF CHAMBERS**

Wherever possible, chambers, pits or manholes containing valves, blow-offs, meters, or other such appurtenances to a distribution system, shall not be located in areas subject to flooding or in areas of high groundwater. Such chambers or pits should drain to the ground surface, or to absorption pits underground. The chambers, pits and manholes shall not connect directly to any storm drain or sanitary sewer. Blow-offs shall not connect directly to any storm drain or sanitary sewer.

## **8.7 INSTALLATION OF WATER MAINS**

### **8.7.1 Standards**

Specifications shall incorporate the provisions of the AWWA standards and/or manufacturer's recommended installation procedures.

### **8.7.2 Bedding**

A continuous and uniform bedding shall be provided in the trench for all buried pipe. Backfill material shall be tamped in layers around the pipe

and to a sufficient height above the pipe to adequately support and protect the pipe. Stones found in the trench shall be removed for a depth of at least six inches below the bottom of the pipe.

### **8.7.3 Cover**

Water mains shall be covered with sufficient earth or other insulation to prevent freezing.

### **8.7.4 Blocking**

All tees, bends, plugs and hydrants shall be provided with reaction blocking, tie rods or joints designed to prevent movement.

### **8.7.5 Pressure and leakage testing**

Installed pipe shall be pressure tested and leakage tested in accordance with the appropriate AWWA Standards.

### **8.7.6 Disinfection**

New, cleaned and repaired water mains shall be disinfected in accordance with AWWA Standard C651. The specifications shall include detailed procedures for the adequate flushing, disinfection, and microbiological testing of all water mains. In an emergency or unusual situation, the disinfection procedure shall be discussed with the reviewing authority.

### **8.7.7 External corrosion**

- a. Provide for a system of records by which the nature and frequency of corrosion problems are recorded. On a plat map of the distribution system, show the location of each problem so that follow-up investigations and improvements can be made when a cluster of problems is identified.
- b. If needed, perform a survey to determine the existence of facilities or installations that would provide the potential for stray, direct electric currents. Also, determine whether problems are caused by the use of water pipes as grounds for the electrical system.
- c. In areas where aggressive soil conditions are suspect, or in areas where there are known aggressive soil conditions, analyses shall be performed to determine the actual aggressiveness of the soil.

d. If soils are found to be aggressive, take necessary action to protect the water main, such as by encasement of the water main in polyethylene, provision of cathodic protection (in very severe instances), or using corrosion resistant water main materials.

## **8.8 SEPARATION DISTANCES FROM CONTAMINATION SOURCES**

### **8.8.1 General**

The following factors should be considered in providing adequate separation :

- a. materials and type of joints for water and sewer pipes,
- b. soil conditions,
- c. service and branch connections into the water main and sewer line,
- d. compensating variations in the horizontal and vertical separations,
- e. space for repair and alterations of water and sewer pipes,
- f. off-setting of pipes around manholes.

### **8.8.2 Parallel installation**

- a. Water mains shall be laid at least 10 feet horizontally from any existing or proposed gravity sewer, septic tank, or subsoil treatment system. The distance shall be measured edge to edge.
- b. In cases where it is not practical to maintain a 10 foot separation, the reviewing authority may allow deviation on a case-by-case basis, if supported by data from the design engineer.

### **8.8.3 Crossings**

- a. Water mains crossing 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 sewer. This shall be the case where the water main is either above or below the sewer with preference to the water main located above the sewer.

b. At crossings, one full length of water pipe shall be located so both joints will be as far from the sewer as possible. Special structural support for the water and sewer pipes may be required.

#### **8.8.4 Exception**

When it is impossible to obtain the minimum specified separation distances, the reviewing authority must specifically approve any variance from the requirements of Sections [8.8.2](#) and [8.8.3](#). Where sewers are being installed and Section [8.8.2](#) and [8.8.3](#) cannot be met, the following methods of installation may be used:

a. Such deviation may allow installation of the water main closer to a gravity sewer, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least 18 inches above the top of the gravity sewer.

b. the sewer materials shall be water works grade 150 psi (1.0 Mpa) pressure rated pipe meeting AWWA standards or pipe approved by the reviewing authority and shall be pressure tested to ensure water tightness.

#### **8.8.5 Force mains**

There shall be at least a 10 foot horizontal separation between water mains and sanitary sewer force mains. There shall be an 18 inch vertical separation at crossings as required in Section [8.6.3](#).

#### **8.8.6 Sewer manholes**

No water pipe shall pass through or come in contact with any part of a sewer manhole. Water main should be located at least 10 feet from sewer manholes.

#### **8.8.7 Separation of water mains from other sources of contamination**

Design engineers should exercise caution when locating water mains at or near certain sites such as sewage treatment plants or industrial complexes. On site waste disposal facility including absorption field must be located and avoided. The engineer must contact the reviewing authority to establish specific design requirements for locating water mains near any source of contamination.

## **8.9 SURFACE WATER CROSSINGS**

Surface water crossings, whether over or under water, present special problems. The reviewing authority should be consulted before final plans are prepared.

### **8.9.1 Above-water crossings**

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

### **8.9.2 Underwater crossings**

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

- a. the pipe shall be of special construction, having flexible, restrained or welded watertight joints,
- b. valves shall be provided at both ends of water crossings so that the section can be isolated for testing or repair; the valves shall be easily accessible, and not subject to flooding,
- c. permanent taps or other provisions to allow insertion of a small meter to determine leakage and obtain water samples shall be made on each side of the valve closest to the supply source.

## **8.10 CROSS-CONNECTIONS AND INTERCONNECTIONS**

### **8.10.1 Cross-connections**

There shall be no connection between the distribution system and any pipes, pumps, hydrants, or tanks whereby unsafe water or other contaminating materials may be discharged or drawn into

the system. Each water utility shall have a program conforming to state requirements to detect and eliminate cross connections.

### **8.10.2 Cooling water**

Neither steam condensate, cooling water from engine jackets, nor water used in conjunction with heat exchange devices shall be returned to the potable water supply.

### **8.10.3 Interconnections**

The approval of the reviewing authority shall be obtained for interconnections between potable water supplies. Consideration should be given to differences in water quality.

## **8.11 WATER SERVICES AND PLUMBING**

### **8.11.1 Plumbing**

Water services and plumbing shall conform to relevant local and/or state plumbing codes, or to the applicable National Plumbing Code. Solders and flux containing more than 0.2% lead and pipe and pipe fittings containing more than 8% lead shall not be used.

### **8.11.2 Booster pumps**

Individual booster pumps shall not be allowed for any individual residential service from the public water supply mains. Where permitted for other types of services, booster pumps shall be designed in accordance with Section 6.4.

## **8.12 SERVICE METERS**

Each service connection should be individually metered.

## **8.13 WATER LOADING STATIONS**

Water loading stations present special problems since the fill line may be used for filling both potable water vessels and other tanks or contaminated vessels. To prevent contamination of both the public supply and potable water vessels being filled, the following principles shall be met in the design of water loading stations:

- a. there shall be no backflow to the public water supply,
- b. the piping arrangement shall prevent contaminant being transferred from a hauling vessel to others subsequently using the station,

c. hoses shall not be contaminated by contact with the ground.

### Acceptable Water Loading Station Devices

