BAND TECHNICAL PUBLICATIONS

Maintenance of Water Distribution Systems

June 1984

Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada
Canada

MAINTENANCE OF WATER DISTRIBUTION SYSTEMS

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1.0 INTRODUCTION

The primary function of a water distribution system is to deliver potable water to its users. The water must be provided in adequate quantity and at a satisfactory pressure. The secondary function of a distribution system is to furnish fire protection and this water must also be delivered in adequate quantity and at a satisfactory pressure.

Without an adequate maintenance program, however, even the best installed systems will deteriorate. Problems common to neglected systems include:

a. fire hydrants that will not produce the necessary volume and pressure;

b. undesirable taste or odours within the distribution system caused by:

   - stale water, that is dead ending mains, or

   - lack of a routine flushing program;

c. having to shut off a section of the main because of leak repair work or maintenance;

d. reduced water flow caused by incrustations lining the mains; and

e. frequent water main breaks as a result of freezing lines and services.

2.0 DEFINITIONS

Air pack: a cylinder provided with compressed air, controlled by a demand-type regulator. This air is supplied to a face piece. The safe time limit for these masks, during strenuous work, is one-half hour.

Aquifer: a geologic formation that is water bearing.

Bacteria: a group of microscopic organisms lacking chlorophyll.

Bacteriological test: a simple laboratory test conducted on a water sample to determine if it is contaminated by human or animal waste.

Calibrate: compare with a standard.

Chlorine residual test: a simple and reasonably accurate method of finding combined residual chlorine in treated water. The test equipment relies on comparison of colours between a standard solution and the sample.

Cross-connection: a connection between a distribution system and any pipes, pumps, hydrants or tanks whereby unsafe water or other contaminating materials may be discharged or drawn into the system.

Dead end: termination or end of a water main, line or pipe.

Fire hydrant: a discharge pipe with a valve and spout from which water may be drawn from the mains of a water supply.

Geophone: a stethoscopic - like device for use in detecting the sound of flowing water by amplification of sound through a diaphragm. The geophone is placed on the ground over a pipe line or on a hydrant, valve stem, or pipe.

Potable: suitable, safe or prepared for drinking (the treatment of water supplies to make them safe).

Meter: an instrument for recording the quantity of water supplied.

Reservoir: receptacle usually constructed of earthwork, masonry or steel in which large quantities of water are stored.

Split repair sleeves: provide the means to repair holes, splits, leaks or other pipe line failures quickly and strengthen the line at the point of failure.

Stuffing box: a device to prevent leakage by putting packing along a moving part of a pump.

Valve: a moveable part that controls the flow of a fluid through a pipe by opening or closing the passages. Valves are provided in a distribution system principally to isolate small areas for emergency maintenance. A gate valve is a sliding flat metal disk slightly larger than the flow opening. The basic design of the globe valve is an element, either a disk or cone (needle or tapered plug) that moves at right angles to the plane of the seat, which may be a circular ring or a female cone to accept the needle.

Water hammer: the pressure rise accompanying a sudden change in velocity of water in a pipe which may be caused by a valve suddenly closing.

3.0 SOURCES OF SUPPLY

3.1 Surface Water Supplies

Surface waters are from streams, lakes or impounding reservoirs and are generally unsafe for human consumption and require treatment.

3.2 Ground Water Supplies

Ground water sources are most often wells and in general are used only by smaller communities because of the limited quantity that can be obtained from them. One disadvantage is that the water may be excessively hard. However, an underground water supply usually requires little or no treatment because of natural purification as the water passes through underground soil formations.

Naturally clean water comes only from a clean source. Waterworks operators, therefore, should be thoroughly familiar with the catchment area for their supply.

4.0 TRANSMISSION AND DISTRIBUTION

4.1 System Maintenance and Control

A good preventive and corrective-maintenance program is necessary to:

a. prevent failure of facilities;
b. detect and eliminate weak links in the system;
c. determine the type and quantity of materials and replacement parts to be stockpiled for repairs;
d. analyze how distribution facilities stand up in actual operation as a guide for future installations;
e. maintain good public relations by making needed repairs before damage and interruption to services occur;
f. detect and eliminate safety hazards;
g. distribute work load more advantageously; and
h. reduce the cost of maintenance.

4.2 Water Mains

Because water mains are buried and rarely uncovered they cannot be regularly checked. Nevertheless, by keeping leakage and breakage records, failures or deficiencies in service can often be recognized and prevented. It is therefore important to do the following:

a. Keep up-to-date records and drawings of water distribution including locations, extensions, pipe breakage, leak surveys, pressure tests and repairs.
b. Record and mark on maps the date and location of all water quality and quantity complaints.

c. Regularly flush and clean all dead ends.

d. Maintain a measurable chlorine residual in all parts of the system at all times.

e. Disinfect all newly constructed, repaired or recently shut down mains by introducing and maintaining a 25 mg/L (25 ppm) chlorine solution in the system for at least 8 hours. Flush the system at the end of the period and collect two samples for bacteriological tests.

f. Collect at least 2 water samples every month at two separate distant points of the distribution system, for bacteria testing by provincial health or environment laboratories.

g. Collect at least one sample per week at the far end of the distribution system for colour, taste and odour examination.

h. Collect one sample every six months at the far end of the distribution system for chemical analysis.

i. Control and eliminate cross-connections of the public supply with polluted or otherwise unsafe private systems and police plumbing systems to prevent flowback or siphonage of polluted waters from fixtures and other portions of the drainage system.

j. Determine the exact location of water mains before any other roadway excavations are carried out.

5.0 VALVES

5.1 Valving in the Distribution System

Valving in the distribution system is very important if reliable service is to be given. Valves are provided principally to isolate small areas for emergency maintenance. Thus, most

distribution valves suffer from lack of operation rather than from wear. There are no hard and fast rules as to how often valves in different parts of the system should be operated for test purposes. It is recommended, however, that the procedure outlined in 5.2.a be followed. The corrosiveness of the water, the rate of deposition of sand or other solids, and the sizes and locations of the valves all have a bearing on how often they should be operated.

Gate valves are widely used (see Figures 1 and 2). Among their advantages are:

a. long and satisfactory usage,

b. no head loss when open wide,

c. rugged strength, and

d. resistance to leakage and high pressure.

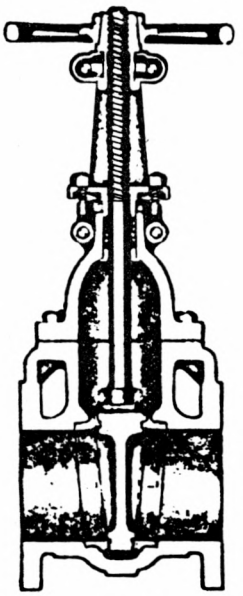
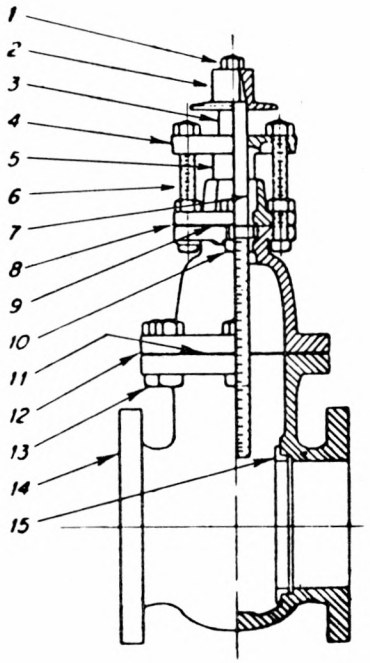


Fig. 1. Rising stem gate valve. (Courtesy of Crane Co.)



(1) Nut for wrench nut;
(2) Wrench nut;
(3) Stem;
(4) Gland flange or follower;
(5) Gland;
(6) Gland bolts and nuts;
(7) Stem packing;
(8) Stuffing box;
(9) Stuffing-box gasket;
(10) Stuffing-box bolts and nuts or studs and nuts;
(11) Bonnet gasket;
(12) Bonnet;
(13) Bolts, bolt-studs, and nuts for bonnet;
(14) Body;
(15) Seat ring (body).

(From AWWA C500-59T, JAWWA, July, 1959, p. 939.)

Fig. 2. Double-disk gate valve with nonrising stem, flanged end.

5.2 Valve Inspection Program

The procedures for a proper valve inspection program are as follows:

a. At least twice a year operate valves in both directions, fully closed and fully opened, and note the number of turns and direction of operation. Particular care should be taken to identify valves that operate in the opposite

direction to that which is standard for the system. The use of portable power-actuated valve operators is generally economically feasible for all but the smallest system. Since gate valves are constructed of different metals, corrosion can take place on the moving faces unless they are routinely flushed by regular operation. Valve blockages can sometimes be cleared by partially closing the valve, closing an adjacent downstream main valve, and opening a hydrant between the two.

b. Valves should normally be left open but any valves required to be closed should be carefully noted.

c. Operate a badly corroded valve several times, and if necessary, induce flow by opening a hydrant to flush out valve seats.

d. Note the condition of the valve packing, stem, stem nut and gearing.

e. Check valve boxes or vaults for dirt deposits. Clean out and raise, lower or replace as necessary.

f. Know the location and operating condition of every valve in the system. (This should be detailed on a map of the reserve.)

g. Very little can be done to maintain buried valves without excavation. (All valves should operate in the same direction, if possible, to avoid damage when an overeager helper tries to open the valve in the wrong direction).

h. Regularly inspect all valves and valve boxes adjacent to or part of construction projects to ensure that all conditions are satisfactory.

i. Valve boxes must be adequately protected from vandalism.

6.0 FIRE HYDRANTS

6.1 Operation

Hydrants are frequently the only portion of the distribution system actually seen by the public and therefore should be kept in good condition and painted (see Figure 3).

The modern hydrant is designed to be opened and closed without the use of excessive force. Excessive leverage may damage the hydrant, therefore:

a. Check direction of opening as marked on the hydrant cover.

b. To OPEN, turn the operating nut until the valve hits the stop in the opening direction. DO NOT FORCE THE HYDRANT IN THE OPENING DIRECTION BEYOND FULL OPEN as indicated by sudden resistance to turning. If water does not flow when the hydrant is open, it is probably due to a closed valve upstream from the hydrant.

c. Open and close hydrants slowly to prevent water hammer (air lock) in the rest of the distribution system.

d. To CLOSE, turn the operating nut until the valve closes off the flow. It is NOT NECESSARY TO CLOSE the hydrant WITH GREAT FORCE. Once the flow has stopped, loosen the operating nut in the opening direction to take the strain off the operating parts of the hydrant and to make it easier to open the hydrant when it is needed again.

e. Fire hydrants are NOT a throttling device and, therefore, ARE to be OPERATED either in the FULLY OPEN or FULLY CLOSED POSITION.

f. Drain hydrants properly to minimize the chances of contamination or freezing. In areas where a high water table floods the hydrant barrel, drains should be plugged and the hydrant pumped dry after every use. Routine pumping should be carried out at problem hydrants to ensure that no damage due to freezing takes place. (Antifreeze in the hydrant barrel may enter the water main with a drop in pressure, constituting a health hazard. Its use is not recommended). When self draining hydrants are in use, hose nozzle caps should not be replaced immediately. Allow the hydrant barrel to drain.

6.2 Inspection

It is recommended that hydrants be inspected twice a year, in spring and fall. Every time hydrants are used in extremely cold weather they should also be inspected.

Inspection should cover the following points:

a. Make an external inspection of paint, caps, chains, etc.

b. Listen for leaks -- a stethoscope type instrument called a geophone is often used with the tubing attached to a solid surface like a valve or a hydrant (see 13.3.3).

c. Operate and flush. Note the ease or difficulty of operation, and repair or replace any worn or loose parts.

d. Check the condition of the drain valve, operating nut, nozzles, caps, chains, packing and paint.

e. After operation and closure, check the interior to see if the barrel drains properly.

6.3 Maintenance

6.3.1 Lubrication

At time of inspection add #1 graphite grease or cup grease at the grease fitting in the top of the operating nut. In order to prevent hard operation, do not use excessive greasing pressure on the gun. Also grease nozzle cap threads with #1 graphite grease.

6.3.2 Removal of Internal Parts

Use the following procedure to remove internal parts:

a. Shut off water in the line leading to the hydrant.

b. Open the hydrant valve.

c. Remove bolts and nuts from the top flange.

d. Take off the domed cover.

e. Remove the operating head by continuing to turn in the open direction until the thread is turned out of the operating unit. Then carefully strip the head up over the threads.

f. Place the seat wrench over the rod making sure the square hole in the seat wrench engages the rod square. Turn to LEFT or COUNTERCLOCKWISE to unscrew the main valve and drain assembly from the main valve seat drain ring.

g. Remove seat wrench.

h. Lift out hydrant rod and all working parts for inspection or repair.

i. When a new valve ball made of leather or rubber is installed, it is necessary to install a new lead gasket between the valve ball bottom and the lock nuts to prevent leakage through the valve ball.

6.3.3 Flushing

At the time of inspection flush out the hydrant lead and the hydrant itself. If necessary flush the drains by filling the hydrant and then opening the main valve two turns to force water out of the drains under pressure. The drain valve is open during the first three turns of the operating nut.

6.3.4 Records

Record the locations and dates of repairs of all hydrants.

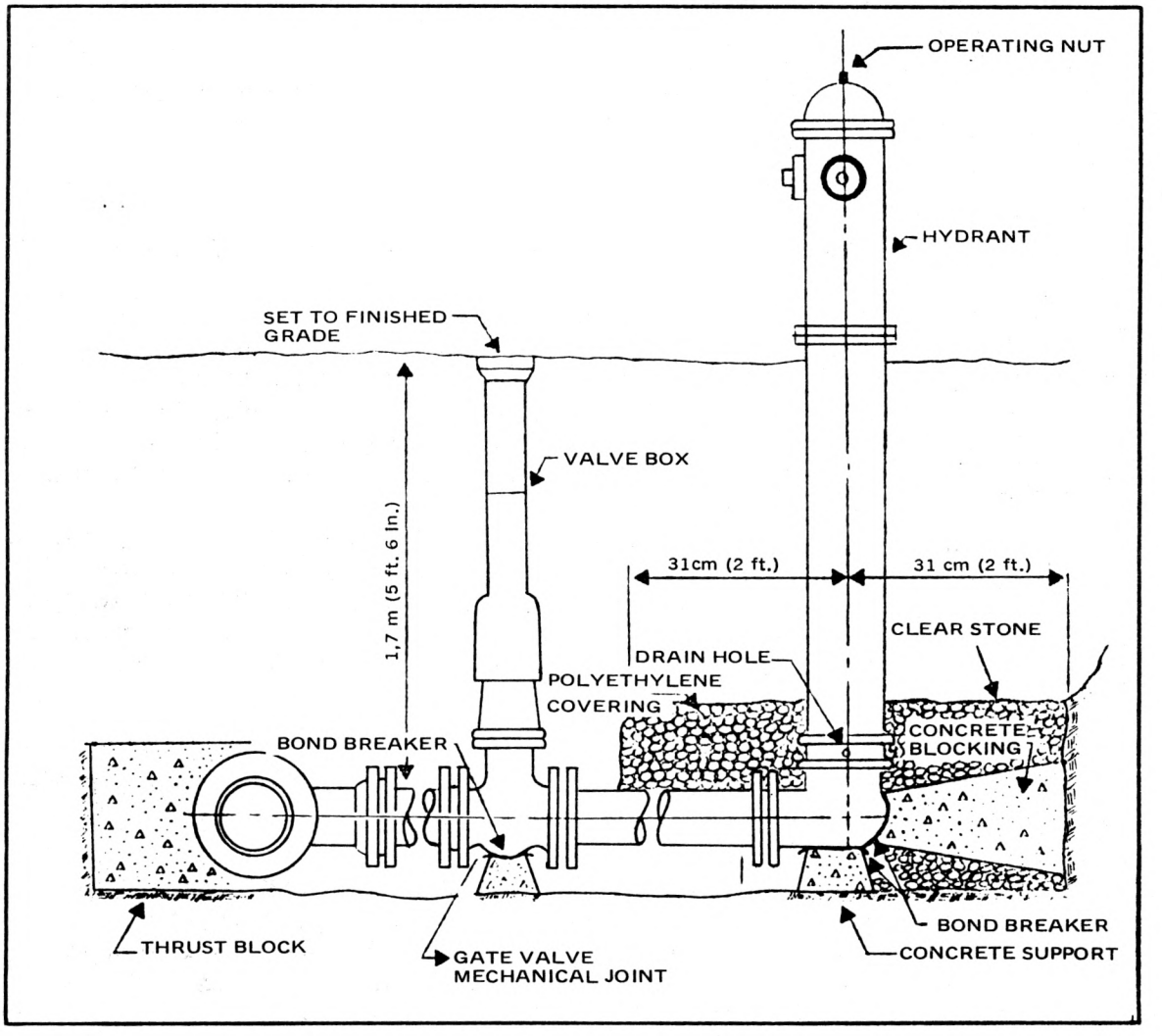


Fig. 3 Fire Hydrant

Note the accessibility of the hydrant, its ground clearance, and the degree of interference from poles or other objects. Correct if necessary. (This would be a one time check and would require the raising of a work order if correction was required.)

7.0 METERS

Meters shall conform to the following standards (see Figure 4):

a. All meters shall be at least 90% accurate -- this is determined by calibration at regular intervals.

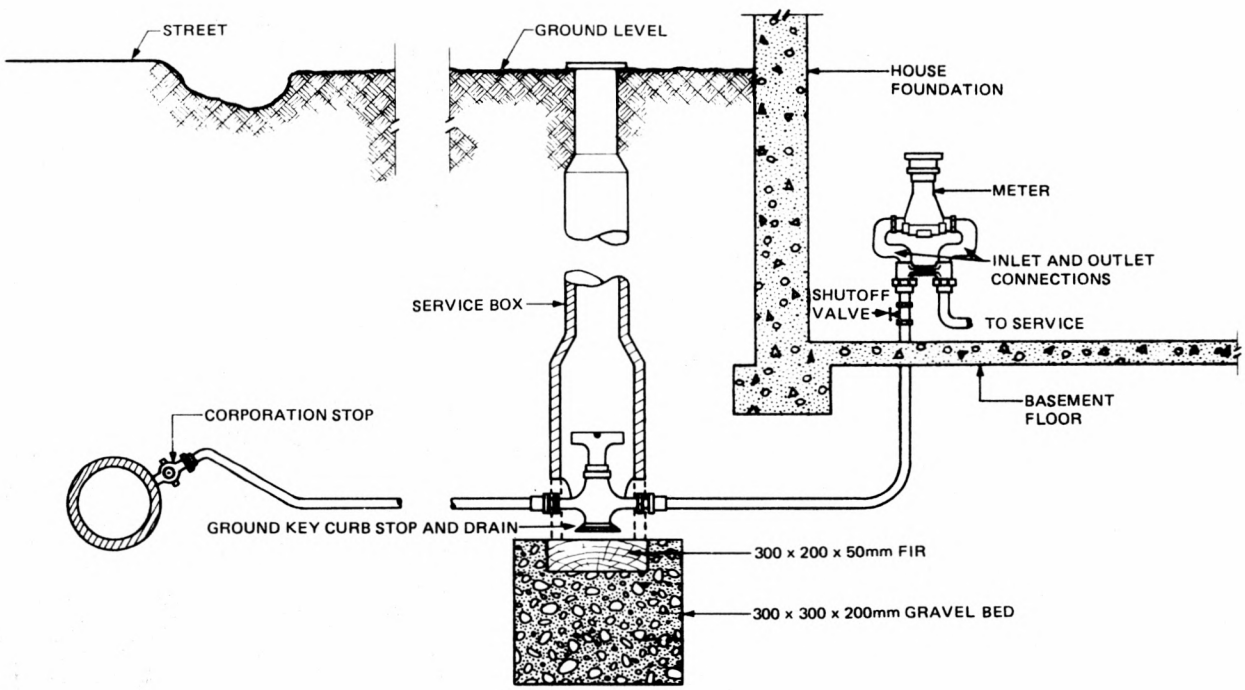


Fig. 4 Typical Meter Service Line and Water Box Installation.

b. Meters shall not leak.

c. A meter shall have no damage which impairs its operation.

d. Meter register faces shall be clean and legible.

8.0 TRUCKING

For water tank trucks follow the procedure outlined below (see Figure 5):

a. Maintain and operate trucks and hauling equipment as recommended by the manufacturer's operating manual.

b. Chlorinate every truck-load of water before distribution. Residual chlorine should not exceed 0.2 mg/L (ppm). (See BTP-MS-4 Hypochlorination O & M Guideline for determining chlorine residual).

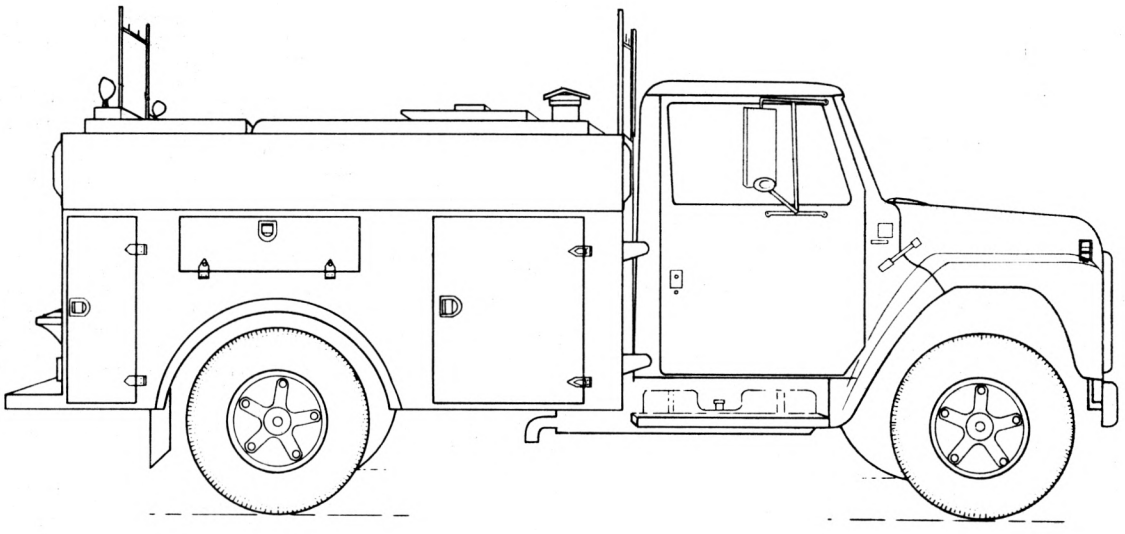


Fig. 5 Water Tank Truck

c. Close the manhole of the tank truck tightly to prevent contamination.

d. Store the tank truck in a heated garage to protect against frost.

9.0 COLD CLIMATE WATER SYSTEMS

9.1 Inspection

Inspect the following:

a. electrical heat tapes;

b. all equipment including thermostats thoroughly before operating in low temperatures;

c. all seals, linkages, drive belts and chains of mechanical equipment;

d. all valves and hydrants in the distribution system; and

e. the insulations of heated superstructures.

9.2 Defective Parts

Replace all defective parts, for example, broken, cracked, worn, corroded, or loose parts, and malfunctioning valves.

9.3 Readjustment

Readjust all equipment for low temperature operation according to manufacturer's instructions.

9.4 Winterization

For winterization, follow the procedure outlined below:

a. Drain old lubricants and hydraulic fluids from vehicles and stationary equipment (pumps, motors etc.) and refill with low temperature ones.

b. Flush all dead-end watermains.

c. Drain all summer water systems before freeze-up.

d. Replace all wet or torn insulation material from utilidors or heated superstructures.

e. Make sure fire hydrants can be located during the winter by attaching metal rods painted red to the hydrant. The rods should be tall enough to rise above the expected snow cover.

f. Ensure a plentiful supply of chemicals for treatment plants.

g. Refill individual and bulk fuel storage tanks.

h. Provide adequate spares or essential components of mechanical and electrical equipment, for example, pump motors, drive belts, heating cables and thermostats.

9.5 Thawing

Thaw water lines as soon as freezing has been detected.

Use one of the following methods for thawing water lines:

a. Small-diameter pipes, such as service lines, of any material may be quickly thawed by pushing a flexible 11-mm or smaller plastic tube into the frozen pipe while pumping warm water into the tube (see Figure 6). Water pressure can be obtained from a nearby building, by connecting to the building plumbing. A conventional hand pump filled with warm water can also be used. There is also a commercial unit with a special fitting to attach the tube to the frozen pipe. A pulsating stream of warm water is pumped through the tube. This method is reported to be about 50% successful. Most of the failures have occurred because the thaw tube could not be inserted due to mineral build-ups, sharp

bends, and kinks in the service pipe. The success rate would be much higher if the pipes were installed with this thawing technique in mind.

b. Pipes can be thawed electrically. Refer to DRM 10-7/86.3.3 "Thawing Frozen Water Pipes with Electricity".

c. Pipes can be thawed by steam. A steam generator is used.

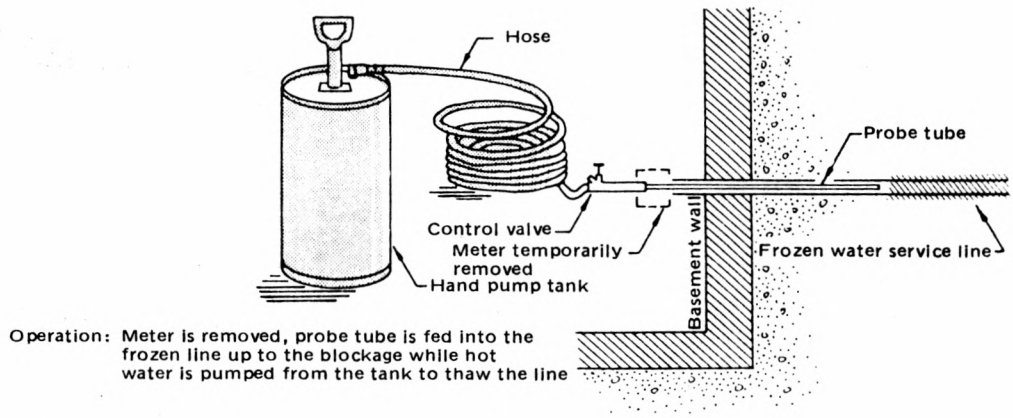


Fig. 6 Thaw Tube Thawing Method

9.6 Utilidors

For utilidors, follow the procedure outlined below:

a. inspect the insulation and replace any that is wet;

b. repair any leaks or holes in water and sewage pipes;

c. check for ground water seepage;

d. check supports for uneven settlement and heaving;

e. check and eliminate cross-connections between water and sewers; and

f. look for signs that rats and other rodents are making the utilidor their home.

10.0 SAFETY PROCEDURES - CHLORINE LEAK DETECTION

10.1 Liquid Chlorine

Liquid chlorine (chlorine gas) is seldom used on reserves. Where it is used the operator will have received training on safety procedures as liquid chlorine is very dangerous for an untrained operator to handle.

10.2 Essential Procedures

The essential procedures are as follows:

a. If you smell a leak notify your supervisor immediately.

b. Put on an air pack and have a second person with an air pack stand by.

c. Turn on the exhaust fan of the chlorine room. Check the fan discharge point and be sure that other people or equipment are not in the way. If there is a casualty, remove the person immediately and apply first aid. Shut off cylinders. If the leak is large, or if the equipment has been leaking for some time, the room will be full of gas.

d. Inform the fire department immediately, if there is any danger of fire.

AFTER the room is cleared:

a. Test for leaks using an ammonia bottle. (The ammonia must be 11% commercial grade or strong enough to cause a white smoke when the fumes mix with chlorine gas. (The bottle should be a 1L polyethylene squeeze type.)

b. When the location of the leak is found, mark it off clearly; and shut off gas supply until leak is repaired.

c. After the leak is repaired, recheck the whole system for leaks. While working on the equipment you may have jarred something and caused a leak in an area that was previously checked.

d. After you have worked on a chlorine leak a tremendous amount of chlorine may be trapped in your clothing. Therefore remove your air pack and clothes in a well ventilated area. Air your clothes and take a shower.

10.3 Emergency Procedures

If the leak is a serious one which cannot easily be repaired, the following steps should be taken:

a. Protect yourself at all times during the emergency so as not to be overcome by the leaking gas. Do not re-enter the room in which the chlorine is leaking. Keep the air pack ready, because chlorine gas escaping through the vent may collect in low areas. This is especially important in rainy or cloudy weather or at night.

b. Alert the police department. They will have to alert residents downwind who may be in the path of the gas. An evacuation may be necessary.

c. Contact the supplier or manufacturer of the chlorine. The suppliers operate an emergency telephone service providing assistance 24 hours a day.

11.0 SAFETY RULES

11.1 General Safety Rules

Always keep in mind the following safety rules:

a. Wipe up grease and oil immediately; salt or sand icy walks.

b. Pick up all tools, clean them, and return them to their storage area.

c. Do not enter a manhole or an empty tank without a hard hat, a safety harness, an air pack, or without a second person as stand-by.

d. When it is necessary to use tools in an empty tank or manhole, etc., lower them in a pail on a rope and remove in the same way. Brooms and shovels can also be transported by rope.

e. When handling a hose under pressure, do not try to climb up or down a ladder or over a railing.

f. When washing down the floor of any tank wear hip wader rubber boots with good treaded soles -- do not wear rubber boots with worn soles and heels.

g. Wear a hard hat when working below ground level, around equipment, or anywhere where there is a risk of receiving a blow on the head.

h. Do not hang clothes on electrical disconnect handles, light switches, or control panel knobs.

i. Replace all manhole covers and trap doors to wells. Close after using; if it is necessary to leave them open, protect them with guardrails.

j. Check the ventilation of any enclosed or underground areas when gasoline-operated pumps are to be used.

k. Do not refill a gas engine which is in operation or which is still hot; remove spark plug from engine before cleaning out pump unit.

11.2 Servicing Rules

Always keep in mind the following safety rules:

a. Never work alone around electrical panels, disconnects or switches.

b. Never enter any crawl space under flooring until the area has been ventilated. A second person should be present.

c. Shut off all pumps and lock them out before servicing pumps and shafts of pumping stations.

d. Provide fire protection equipment and training to all water distribution maintenance workers.

e. Observe safety measures (refer to DRM 10-7/25 Maintenance Management).

12.0 ROUTINE MAINTENANCE

12.1 Pipes

Proper installation can be the best aid to maintenance. Pipes should be laid by hand on the bottom of undisturbed soil in a trench.

Leaks and breaks in the main occur most frequently in the winter caused by contractions due to cold and also from:

a. pipe walls which have become thin as a result of corrosion;

b. improper bedding allowing pipes to sag;

c. metal fatigue from vibration;

d. water hammer; and

e. construction activity adjacent to the piping.

12.2 How to Repair Water Main Breaks

Split repair sleeves are used for a circumferential water main break. For a longitudinal break, dewater the main and install a new section.

After excavation and repair, backfill carefully using granular material (see Figure 7).

For rubber joints - make sure to provide adequate blocking or strapping at bends, change of direction points, or at the end of the line.

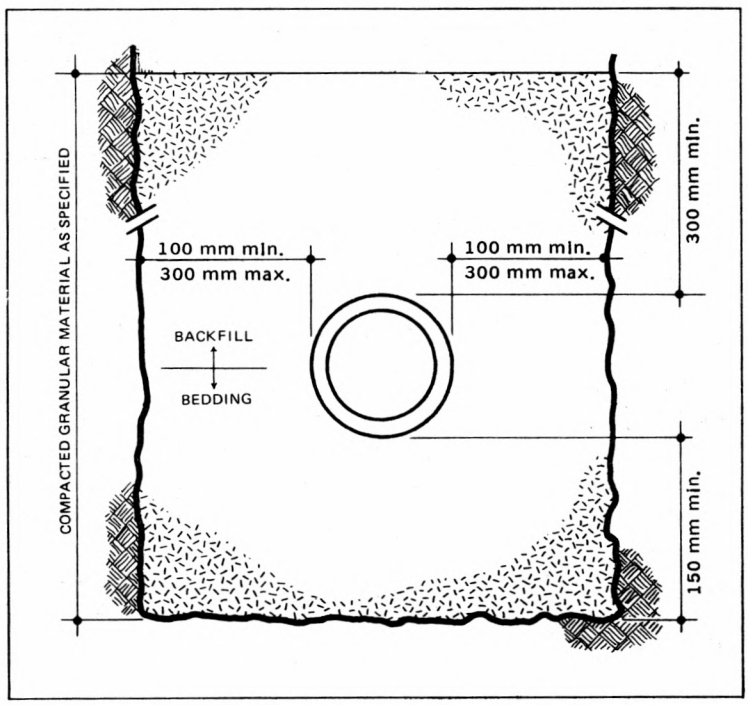


Fig. 7 Watermain Bedding

12.3 Reservoirs

Elevated storage, stand pipes and ground storage require routine inspection and maintenance to ensure they are not the source of water quality problems and excessive leakage (see Figure 8).

Stand pipes and tanks should be drained and inspected each year and metal tanks carefully inspected to ensure that severe corrosion does not proceed to the point of failure. Tanks should be cleaned and painted routinely. (Safety regulations governing work in confined spaces must be met at all times.)

Ground storage should be emptied once a year and the slime and deposits removed. (The works must be disinfected before being returned to service).

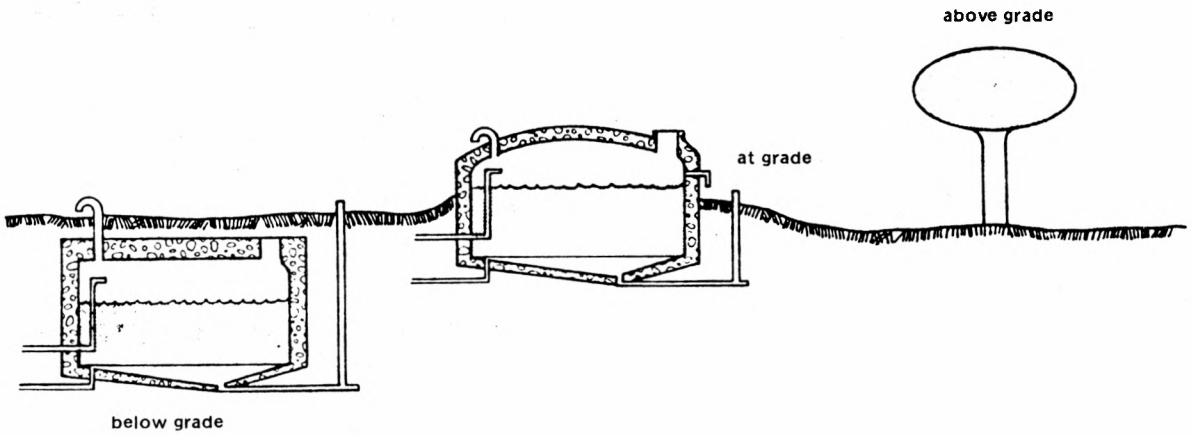


Fig. 8 Reservoirs

13.0 PROBLEM SOLVING IN DISTRIBUTION SYSTEMS

13.1 Taste, Odour and Colour Problems

Taste, odour and colour problems may be generated in the following circumstances:

a. within dead end areas where water becomes stagnant and deoxygenated (flat);

b. when turbidity and iron settle out in the mains;

c. when iron and sulphur bacteria are allowed to build up and cause offensive odours; and

d. through internal corrosive action on mains due to acidic water (low pH).

A flushing and foam swabbing program can be of some help in controlling water discoloration.

In instances where the flushing and swabbing program fails to help, outside technical aid should be called in immediately.

13.2 Bacteriological Test Result Shows Water Unsafe for Drinking

Inform your nearest National Health and Welfare Medical Services office or the local provincial department of health, "health unit" immediately. You will probably be advised to:

a. resample the raw and treated water;
b. resample the location of the bad sample; and
c. take sample from dwellings on either side of the bad sample.

On-the-spot chlorination may be necessary if internal contamination has taken place; know where you can lay your hands on such equipment in an emergency.

In most instances it will be possible, through intensive resampling, to trace the cause of the problem.

Samples must be collected immediately after the adverse results are received and delivered to the laboratory within 24 hrs., preferably at a temperature not above 10°C.

13.3 Leak Detection

13.3.1 Methods of Finding Leaks

There are two main types of leak: those that you can see and those that you can hear. Common sense

is required, for example, if you sink up to your ankles in mud in a normally dry section of ground, there must be water somewhere. Check to see if there is a water main on service nearby. Dry ground is no proof that a water leak does not exist. Water will find the easiest path to escape and sometimes this path is not the obvious one of bubbling up through the surface. This is particularly true during the winter.

13.3.2 Leaks you Can See

The leaks you can see include the following:

a. water flowing on the ground;

b. damp sections of land that don't dry up;

c. a very nice patch of green grass in the middle of a dry lawn; and

d. when it is snowing, one section of the ground does not have any snow on it (the leaking water raises the temperature of the ground slightly and melts the snow).

In the winter when the ground is frozen, the water from the leak can travel long distances to find a spot where the frost is not solid. It will then surface at that location.

13.3.3 Leaks You Can Hear

When listening for a leak keep in mind that big leaks are quiet and little leaks sound like a large water fall (Niagara). Some small leaks that don't get any bigger can be accepted; however, little leaks frequently get larger and eventually cause problems. Therefore small leaks should not be neglected for too long.

There are two methods of listening for leaks. One is to use an ordinary metal rod or stick with an ear cap on one end. You place the end of the rod or stick on any water-carrying pipe and listen.

Some people are expert at this simple procedure because they have used it often enough to be able to identify the sound of a leak as opposed to the sound of real water usage. Modern electrical amplifying equipment accomplishes the same result, by allowing more volume. It is often equipped with a meter. The equipment is moved from area to area, usually using hydrants as listening posts, until the area is located where the noise is loudest. It may be necessary to shut off services at curb boxes to limit the water movement within the area under question until the exact location of the leak is established.

The really bad leaks are the ones going into sewers or sand, carrying the water away unnoticed. If it is a bad leak, look for the general area by successively shutting down portions of the main while monitoring pumping rates. This must be done at night. Such a leak can be suspected when pumpage suddenly increases and doesn't drop below a certain level at night or on Sunday, as normally expected.

13.3.4 Repair of Leaks and Breaks

It is important to disinfect all exposed surfaces when repairing leaks and breaks

13.4 Cross Connections

13.4.1 Occurrence Of Cross Connections

The passage of polluted or unsafe water into a water supply system by backflow is known as a cross connection.

The occurrence of cross connections is not unique to any specific type of plumbing fixture or on any particular premises. The hazards may exist in homes, in public buildings, or may occur on commercial and industrial premises.

Two common types of cross connections are:

a. back flow, and
b. secondary supply systems

13.4.2 Prevention of Cross Connections

The enforcement of stringent plumbing regulations avoid the most common cross connections. Plumbing Codes applying to water supply systems are designed, in part, to ensure that active and potential cross connections do not occur. Much can be done to prevent cross connections by observing the following principles of plumbing:

a. the use of air gaps,

b. the effective installation of backflow preventers,

c. provision for fixture overflow, and

d. the use of indirect supplies.

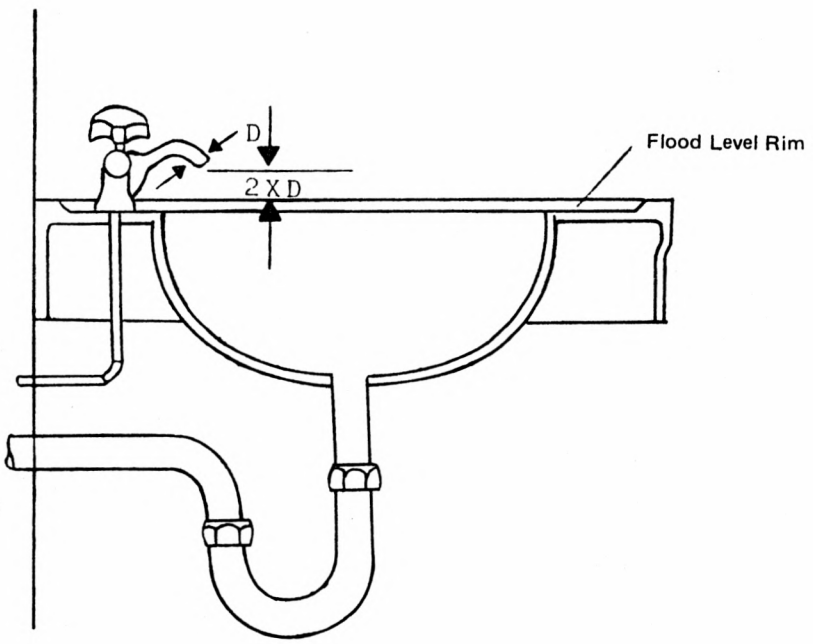


Fig. 9 Air gap on Lavatory Hand Basin

Whenever possible, there must be an air gap between the supply outlet and the flood level rim of the fixture. Unless a back flow preventer is properly installed in the distributing pipe, the orifice of the faucet or spout must be located so that the air gap complies with the most up to date provincial plumbing regulations (see Figures 9 and 10).

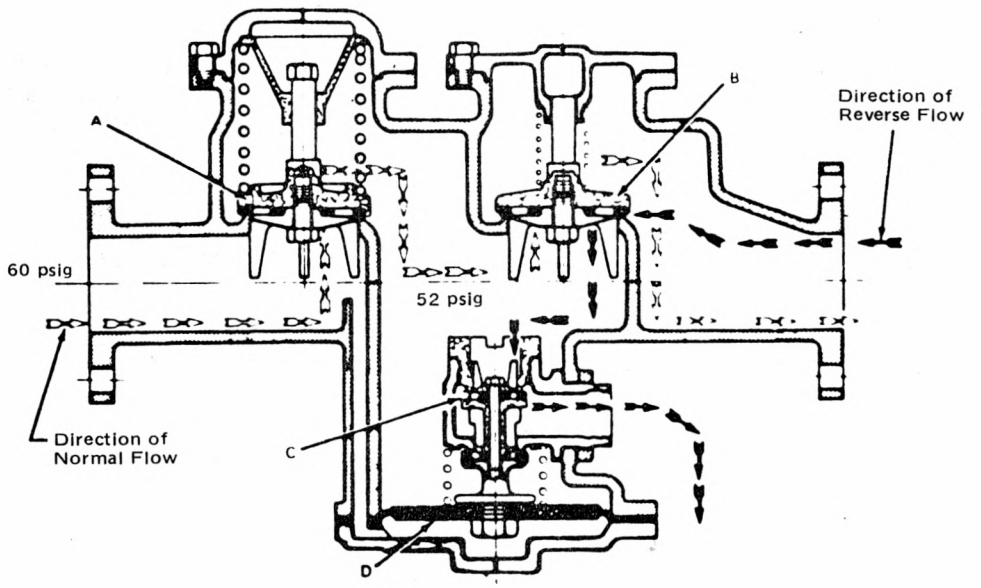


Fig. 10 Reduced Pressure Principle Backflow Preventer

The modern backflow preventer is known as the reduced-pressure-principle backflow preventer (see Figure 10). It consists of two spring-loaded check valves (A and B) with an intermediate, or reduced pressure zone draining to the atmosphere by a relief valve (C). The unit operates on the hydraulic principle that water will not flow from a zone of lower pressure to a zone of higher pressure.

13.5 PIPE THAWING

13.5.1 Freezing Problems

Since freeze-ups occur in most community systems in the colder regions of Canada, the services of thawing crews are required during the winter months. As long as a favourable balance of heat is maintained in the pipeline, freezing conditions will not develop.

Frozen services are more common than frozen mains. Less water and longer periods of no motion can cause this. Insulation protects pipes from freezing by preventing heat loss from the pipe. Another protection is to bury the pipes below the frost line.

13.5.2 Methods Used In Thawing Water Mains

Frozen water mains require the application of enough heat to melt the ice, permitting the water to resume flowing. Many methods have been used:

a. digging down to the pipe and building a fire in the trench over it (if the pipe is not plastic);

b. using gasoline or torches (if the pipe is not plastic);

c. wrapping the pipe in rags and pouring hot water on it;

d. using steam; and

e. using electricity.

Except for the use of electricity, these measures involve considerable time and inconvenience, and are often messy. Pipes may be split from extreme heat when steam or open fire are used.

13.5.3 Electrical Thawing of Water Mains And Services

The use of electricity for thawing water pipes requires caution. It demands an understanding of the inherent dangers and the electrical principles involved. Electrical thawing of frozen water pipes should be conducted only under the supervision of a licensed electrician adequately qualified to carry out these procedures. For pipe thawing, general considerations and procedures refer to DRM 10-7/86.3.3. "Thawing Frozen Water Pipes with Electricity".

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