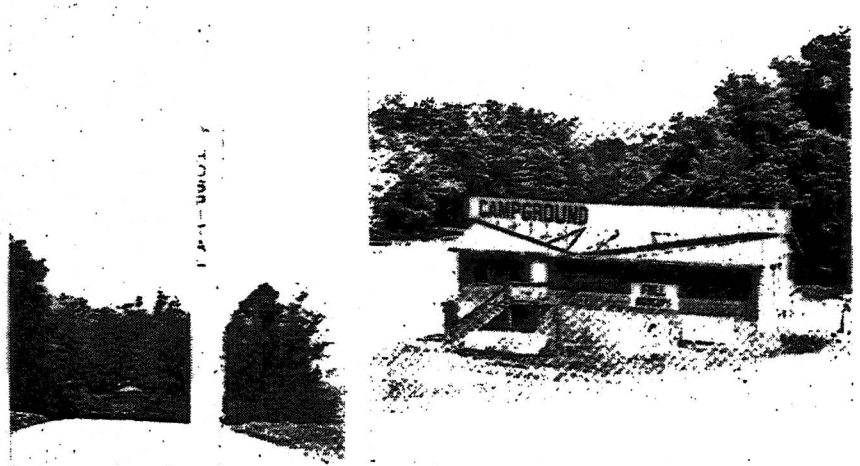


Standards for Non-Community Public Water-Supplies 1982.



STANDARDS FOR NON-COMMUNITY
PUBLIC WATER SUPPLIES, 1982

PUB000979

Missouri Department of Natural Resources
Division of Environmental Quality

Acknowledgement

The information appearing in this manual was compiled from Guidelines for Design of Small Public Water Systems, Office of Public Water Supply Ohio Environmental Protection Agency and Recommended Standards for Water Works - 1982 Edition, A Report of the Committee of the Great Lakes - Upper Mississippi River Board of Sanitary Engineers.

FORWARD

This publication has been prepared as a guide for professional engineers, and water supply specialists engaged in the design or development of non-community public water supply systems using groundwater as a source. The objective here is to assure that new or substantially modified public water system facilities such as those for factories, motels, office buildings, restaurants, campgrounds and the like will be capable of supplying water in compliance with applicable regulations.

Its purpose is to present the requirements and procedures necessary to develop an approved water supply system where connection to an existing public water system cannot be made at reasonable cost. Standards and guidelines for design are included.

THE DESIGN OF WATER SYSTEMS USING SURFACE WATER AS A SOURCE IS BEYOND THE SCOPE OF THIS MANUAL. Water supplies utilizing surface water must submit to the department plans and specifications prepared by an engineer for review and issuance of a written approval prior to initiating construction.

The requirements, criteria and procedures described in this publication represent current practices of the Missouri Department of Natural Resources. They are subject to change whenever, in the judgement of the Department, such a change will be more effective in fulfilling its responsibility under the law.

NOTE: For sewerage, a similar publication entitled, "A Guide For the Design of Small Sewerage Works" may be obtained from the Water Pollution Control Program, Department of Natural Resources.

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PART 1

1.0 Legal Requirements

1.1 Definitions

1.1.1 "Public Water System": A system for the provision to the public of piped water for human consumption, if such system has at least fifteen (15) service connections or regularly serves an average of at least twenty-five (25) individuals daily at least sixty (60) days out of the year. Such system includes: any collection, treatment, storage or distribution facilities used in connection with such system. A public water system is either a "community water system" or a "non-community water system".

1.1.2 "Community Water System": A public water system which serves at least fifteen (15) service connections and is operated on a year-round basis or regularly serves at least twenty-five (25) residents on a year-round basis.

1.1.3 "Non-Community Water System": A public water system that is not a community water system, which has at least fifteen (15) service connections or regularly serves an average of at least twenty-five (25) individuals daily at least sixty (60) days out of the year.

1.2 Statutory Requirements

1.2.1 Portions of Chapter 640 Revised Statutes of Missouri read as follows:

*640.115. Information to be furnished-approval of supplies-system changes to conform to rules.-1 Every municipal corporation, private corporation, company, partnership, federal establishment, state establishment or individual supplying or authorized to supply drinking water to the public within the state shall file with the Department of Natural Resources a certified copy of the plans and surveys of the waterworks with a description of the methods of purification and of the source from which the supply of water is derived, and no source of supply shall be used without a written permit of approval from the Department of Natural Resources, or water dispensed to the public without first obtaining such written permit of approval.

2. Construction, extension or alteration of a public water system shall be in accordance with the rules and regulations of the Department of Natural Resources.

1.3 Regulatory Requirements

1.3.1 Portions of Section 10 CSR 60-3.010 of the Missouri Public Drinking Water Regulations reads as follows:

(2) Non-community water system requirements

(A) A supplier of water which operates a non-community public water supply must apply in writing to the department for a permit to dispense water to the public. Non-community public water supply systems must--

1. Present evidence to the department of the ability to produce water meeting applicable maximum contaminant levels; and

2. Present evidence of reliable water system operation, consistent with the type of treatment and the degree of automatic control provided.

(B) Each supplier of water must notify the department, in advance, of the intent to construct a new or expand an existing water system.

1. Water supplies utilizing surface water must submit to the department plans and specifications prepared by an engineer for review and issuance of a written approval prior to initiating construction.

2. Water supplies utilizing ground water

A. may, at the discretion of the department, be required to submit plans and specifications for approval;

B. shall be constructed in accordance with the department's "Standards for Non-Community Public Water Supplies, 1982"; and

C. must file with the department within sixty (60) days of completion, a record of construction for all new or modified wells on forms provided by the department.

(3) Permits to dispense water are effective until revoked. The department may modify or revoke a permit to dispense water subject to the appeal provisions of section 640.130.4, RSMo (1978), upon a finding that any of the following events have occurred:

(A) The holder of a permit ceases to function as a public water supply;

(B) The holder of a permit fails to correct an operating deficiency or comply with these regulations within a reasonable time after receipt of notice from the department; or

(e) The department determines that an emergency condition exists in a water supply which endangers, or could be expected to endanger, the health of a person or persons consuming affected water.

PART 2

2.0 GENERAL

Connection to an existing approved system shall be given primary consideration. A ground water system may be developed if connection to an existing system is impractical. A system using hauled water from a public water system may be considered only if a supply from an existing system or a ground water system cannot be developed.

2.1 PROCEDURES FOR ESTABLISHING A NON-COMMUNITY PUBLIC WATER SYSTEM

2.1.1 Connect to an existing approved system.

- a. Contact existing public water system(s) within economical piping distance for connection thereto.
- b. If arrangements can be made to connect to an existing system have an engineer prepare plans for the connection and distribution system.

2.1.2 Develop an approved ground water system.

Where there is no existing public water system within economical piping distance, give consideration to the development of a ground water system:

- a. Obtain from the Department of Natural Resources, requirements, design criteria and responsibilities involved.
- b. Have a professional engineer prepare plans for the system covering well construction, treatment, storage and distribution.
- c. Submit plans to the Department of Natural Resources. Construction must not commence until the formal approval letter is received from the department.
- d. Obtain well site acceptance from an environmental engineer from appropriate regional office. See map of the Department of Natural Resources regions for address and telephone number of the appropriate regional office. (Figure 1)
- e. Drill and develop well.
- f. Arrange for collection and analysis of required well water samples after well has been drilled and developed.
- g. Test pump the well. Pump until drawdown has stabilized.
- h. Determine the treatment processes required for your proposed system based on the sample analyses.
- i. Where a well is terminated into geological formations commonly utilized for private domestic wells, chlorination with retention is required to assure safe bacteriological quality.

2.1.3 Develop an approved storage system using hauled water.

Where the above systems cannot be developed, use of a storage tank with hauled water may be considered. Consult the Department of Natural Resources.

2.2 INFORMATION REQUIRED ON PLANS

2.2.1 General location of project.

2.2.2 Site plan including

- a. Location of existing wells, isolation radius, and possible sources of contamination.
- b. Ownership of land and land use of surrounding property.
- c. Location of water mains and sewer lines.

2.2.3 Construction Details

a. Well development

1. upper terminal development
2. depth of well
3. well screen data
4. casing diameter and material
5. grouting of annular space
6. pitless adaptor data
7. housing (if any) over upper terminal
8. sampling taps
9. meters

b. Treatment devices, if applicable

1. piping diagram in sufficient detail to show flow through plant
2. details of treatment equipment including dimensions, etc.
3. water treatment plant waste disposal facilities, if applicable
4. disinfection procedures, including equipment, method, points of application, detention, safety equipment, etc.
5. other pertinent information

c. Storage

1. plant site clearwells
2. system storage

a. location

d. Distribution System

1. waterline size, material and location
2. disinfection procedures

NOTE ON SPECIFICATION: Separate specifications are not needed if all necessary information is shown on the plans.

2.3 . PLAN SUBMITTAL

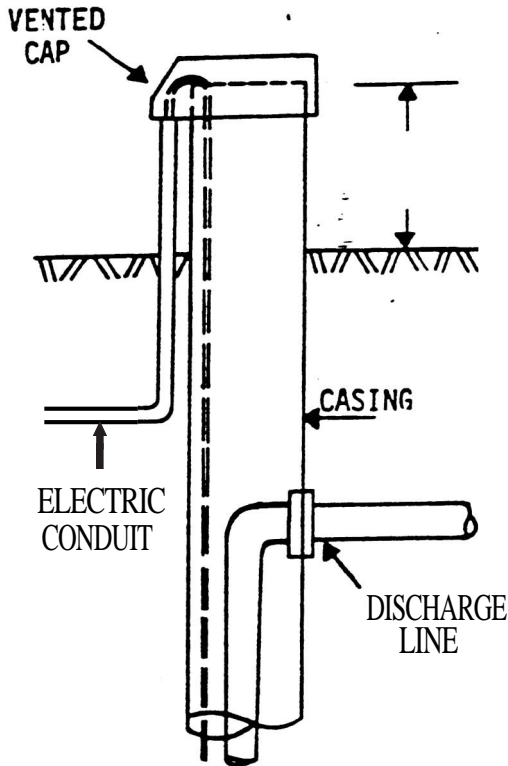
2.3.1 Provide

- a. two sets of the detailed plans and specifications submitted at least 30 working days prior to the date on which action by the Department is desired.
- b. a completed Water Supply Data Form, this form is (Figure 3) and can be obtained from the regional office.
- c. Within sixty (60) days of completion, a record of construction for all new or modified wells on the Well Development Form (Figure 2A) and Survey of Pressure Grout Sealing of Well Casing (Figure 2B) provided by the Department.

2.3.2 Where an existing well is used, the following shall be provided:

- a. A signed and notarized report attesting to proper well construction, protection and satisfactory condition of the grouting, casing capabilities and pitless installation device (Figure 3).
- b. Completed Water Supply Data Form (Figure 3) and Well Development Form (Figure 2A) provided by the Department.
- c. Copies of the chemical and radiological analyses.
- d. Treatment process, if required.

WELL DEVELOPMENT



WELL
 Aquifer _____
 Depth _____

CASING
 Size _____ Depth _____

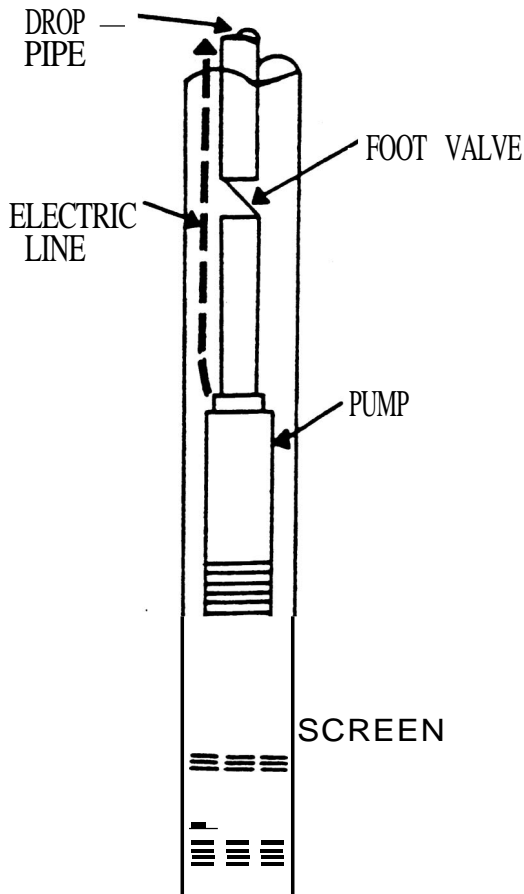
PITLESS INSTALLATION DEVICE
 Make _____
 Model _____
 Approval Type: NSF _____ WSC _____

DISCHARGE LINE
 Material _____
 Size _____
 Foot Valve: Yes _____ No _____

ELECTRICAL
 Volts _____ Hertz _____
 Phases _____
 Lightning Protection: "Yes _____ No _____

PUMP
 Make _____
 Model _____
 Capacity _____ gpm at _____ TDH
 Horsepower _____ Depth _____

SCREEN
 Type _____
 Material _____
 Length _____ Size _____



SURVEY OF PRESSURE GROUT SEALING OF WELL CASING

Name of cementing contractor _____

Name of drilling contractor _____

Date of cement casing _____

Static water level before sealing _____ Static water level after sealing _____

Was water circulated before cement grout was introduced? _____

Were crevices encountered which prevented or interfered with grouting? _____ Depth _____

Was any prepared compound pumped into well in an attempt to obtain circulation? _____

Material used _____ Amount _____

Was cement grout forced upward from bottom of casing to grout surface? _____

If not, to what elevation? _____ Who determined elevation? _____

What was the maximum pressure exerted on cement grout? _____

Total amount of cement used _____ Amount forced upward from bottom of casing _____

Amount introduced from top of ground _____

How many hours was cement grout permitted to set before plug was drilled out? _____

Give a brief narrative of cementing operation, including difficulties encountered: _____

—

+

Date _____ Reported by _____

WATER SUPPLY DATA FORM

NAME OF PROJECT _____ COUNTY _____

LOCATION - (Section, Township & Range) _____

NAME AND ADDRESS OR ULTIMATE OWNER _____

PHONE _____

NAME AND ADDRESS OF ENGINEER _____

PHONE _____

BASIS OF DESIGN

ESTIMATED NUMBER OF PROPOSED INITIAL WATER USERS (Population) _____

ANTICIPATED ULTIMATE POPULATION TO BE SERVED _____ WHEN _____

ESTIMATED WATER CONSUMPTION - AVERAGE _____ PEAK _____

DESCRIBE SOURCE OF SUPPLY (Provide capacity figures) _____

PROVIDE BRIEF DESCRIPTION OF PROPOSED FACILITIES, INCLUDING PROCESSES TO BE USED, CAPACITY OF TREATMENT FACILITIES, AREA TO BE SERVED BY DISTRIBUTION SYSTEM, ETC. _____

ESTIMATED COST OF CONSTRUCTION _____

PART 3

3.0 SOURCE

3.1 AVAILABILITY OF WELL WATER

3.1.1 The availability of an adequate well water supply is a major consideration in the selection of a well site.

3.1.2 In areas known to have groundwater problems such as inadequate quantity or unacceptable quality, acceptance of the well site may be withheld pending drilling of a test well and submission of information relative to yield and quality.

3.1.3 Information on the availability of groundwater can be obtained from the Department of Natural Resources, Division of Geology and Land Survey, Rolla, Missouri.

3.2 QUALITY OF WATER

3.2.1 Microbiological Quality

a. Disinfection of every new, modified or reconditioned ground water source

1. shall be provided after completion of work, if a substantial period elapses prior to test pumping or placement of permanent pumping equipment, and;

2. shall be provided after placement of permanent pumping equipment.

b. After disinfection, one or more consecutive, safe microbiological samples shall be taken from the well, analysis shall be made in a Department of Natural Resources approved laboratory.

3.2.2 Physical and Chemical Quality

a. Every new groundwater source shall be examined for applicable physical, chemical characteristics by tests of a representative sample in a **laboratory** certified by the **Department** of Natural Resources.

b. Samples shall be collected at the conclusion of the test pumping procedures.

c. The Department of Natural Resources will advise on methods and types of treatment required on the basis of the results of those analyses.

3.2.3 Every new, modified or reconditioned groundwater source shall be examined for radiological activity as required by the Department of Natural Resources.

3.3 . WELL SITE ACCEPTANCE

3.3.1 Requirements

The well site(s) for a non-community public water supply are to be accepted by the **regional** office of the Department of Natural Resources. **Sites** for new wells are to be accepted before the wells are **drilled**.

3.3.2 Procedures

Provide a plot plan of the area within 1000 feet of the well site, drawn to scale and showing:

- a. proposed well location to the nearest quarter-quarter section;
- b. property lines, use of adjacent properties, other wells;
- c. existing roads or highways;
- d. buildings (proposed and existing), **parking** lots, streams, ponds, lakes;
- e. sanitary sewers, septic tanks, buried fuel **tanks**, chemical storage, and any other sources or potential sources of contamination.

3.3.3 Isolation standards

- a. Unless the geology and aquifer hydraulics dictate greater or lesser distances, acceptance of the well site will be **based** on compliance with the following Radii:

<u>Source of Possible Contamination</u>	<u>Isolation Radius</u>
Sanitary sewer lines	50 ft.
Sewage treatment plants septic tanks, disposal fields	300 ft.
Chemical storage, buried fuel tanks	300 ft.
Lakes or streams	50 ft.

- b. The owner of the well should own all the land within a 50 feet isolation radius. Any use of the land within the isolation radius must have the approval of the Department of Natural Resources.

3.4 BASIS OF DESIGN

3.4.1 Requirements

- a. The estimated average daily water demand shall be determined by using either the chart (Figure 4) or historical water use data. Calculate the peak daily and hourly demands using factors not less than those shown below:

1. Peak daily demand equals average daily demand x 2.0
 2. Peak hourly demand equals average daily hourly demand x 10
- b. The primary well system must be capable of providing an adequate supply of water during normal and peak usage periods. In addition, standby or alternate sources may be required in case of emergency, pump failure, etc.

3.4.1.1 Well capacity

The capacity of the wells and pumps in a hydro pneumatic pressure system are to be at least ten times the average daily water consumption rate. Where the aquifer cannot support this withdrawal rate, a storage tank **with** high service pumping may be used to meet this peak requirement provided the wells can meet the peak daily demand.

3.4.2 Geological data

- a. shall be determined from samples **collected** at 5-foot intervals and at each pronounced change **in** formation.
- b. shall be recorded and samples submitted to the Division of Geology and Land Survey.
- c. shall be supplemented with information on accurate record of **drill** hole diameter and depths, assembled order of size and length of casing and liners, grouting depths, formations penetrated, water levels, and location of any **blast** charges.

WATER USAGE

SUGGESTED GUIDE

<u>Place</u>	<u>Gallons Per Day</u>
Assembly Halls	2 per seat
Bowling Alleys (no food service)	75 per lane
Churches (small)	3-5 per sanctuary seat
Churches (large with kitchen)	5-7 per sanctuary seat
Country Clubs	50 per member
Dance Halls	2 per person
Drive-In Theaters	5 per car space
Factories (no showers)	25 per employee
Factories (with showers)	35 per employee
Food Service Operations	
Ordinary Restaurant (no 24-hour)	35 per seat
24-hour Restaurant	50 per seat
Banquet Rooms	5 per seat
Restaurant along Freeway	100 per seat
Tavern (very little food service)	35 per seat
Curb Service (drive-in)	50 per car space
Vending Machine Restaurants	100 per seat
Hospitals (no resident personnel)	300 per bed
Institutions (residents)	100 per person
Laundries (coin operated)	400 per standard size machine
Motels	100 per unit
Nursing and Rest Homes	150 per patient
"	100 per resident employee
"	50 per non-resident employee
Office Buildings	20 per employee
Recreational Vehicle Parks and Camps	125 per trailer or tent space
Retail Store	20 per employee
Schools - Elementary	15 per pupil
- High and Junior High	20 per pupil
Service Stations	1000 first bay or pump island
"	500 additional bay or pump island
Shopping Centers (no food service or laundries)	0.2 per sq. ft. of floor space
Swimming Pools (average)	3-5 per swimmer
With hot water shower,	5-7 per swimmer
Travel Trailer Parks and Camps	125 per trailer or tent space
Vacation Cottages	50 per person
Youth and Recreation Camps	50 per person

FIGURE 4

3.5 GENERAL WELL CONSTRUCTION

3.5.1 Minimum protected depths

Minimum protected depths of drilled wells shall provide watertight construction to such depth as may be required by the department, to

- a. exclude contamination, and
- b. seal off formations that are, or may be, contaminated or yield undesirable water.

3.5.2 Temporary steel casing

Temporary steel casing used for construction shall be capable of withstanding the structural load imposed during its installation and removal.

3.5.3 Permanent steel casing pipe shall

- a. be new pipe meeting **AWWA** Standard A-100, ASTM or API specifications for water well construction,
- b. have minimum weights and thickness indicated in Table 1,
- c. have additional thickness and weight if minimum thickness is not considered sufficient to assure reasonable life expectancy of a well,
- d. be capable of withstanding forces to which it is subjected,
- e. be equipped with a drive-shoe when driven, and
- f. have full circumferential welds or threaded coupling joints.

3.5.4 Nonferrous casing materials

- a. Approval of the use of any nonferrous material as well casing shall be subject to special determination by the Department prior to submission of plans and specifications.
- b. Nonferrous material **proposed** as a well casing must be "resistant to the corrosiveness of the water and to the stresses to which it will be subjected **during** installation, **grouting** and operation.

3.5.5 Packers

Packers **shall** be of **material** that will not impart taste, odor, toxic substance or bacterial contamination to the well water.

3.5.6 Screens shall

- a. be constructed of materials resistant to damage by chemical action of groundwater or cleaning operations,

- b. have size of openings based on sieve analysis of **formation** and/or gravel pack materials,
- c. have sufficient diameter to provide adequate specific capacity and low aperture entrance velocity. Usually the entrance velocity should not exceed 0.1 feet per second,
- d. **be** installed so that the pumping water level remains above the screen under all operating conditions,
- e. where applicable, be designed and installed to **permit** removal or replacement without adversely affecting water-tight construction of the well, and
- f. be provided with a bottom plate or washdown bottom fitting of the same material as the screen.

3.5.7 Grouting requirements

All permanent well casing shall be surrounded by a minimum of 1 1/2 inches of grout to the depth required by the Department. All temporary construction casings shall be removed. Where removal is not possible or practical, the casing shall be withdrawn at least five feet to insure grout" contact with the native formation.

- a. Neat cement grout
 - 1. Cement **conforming** to ASTM standard C150 and water, with not more than six gallons of water per sack of cement, must be used for 1-1/2 inch openings.
 - 2. Additives may be used to increase fluidity subject to approval by the Department.
- b. Application
 - 1. Sufficient annular opening shall be provided to permit a minimum of 1 1/2 inches of grout around **permanent** casings, including couplings.
 - 2. Prior to grouting through creviced or fractured **formations**, bentonite or similar materials may be added to the annular opening, in the manner indicated for grouting.
 - 3. When the annular opening is less than four inches, grout shall be installed under pressure by means of a grout pump from the bottom of the annular opening upward in one continuous operation until the annular opening is filled.
 - 4. When the annular opening is four or more inches and less than 100 feet in depth, it may be placed by gravity through a grout pipe installed to the bottom of the annular opening in one continuous operation until the annular opening is filled.

5. After cement grouting is applied, work on the well shall be discontinued until the cement has properly set.

c. Guides

The casing must be provided with sufficient guides welded to the casing to permit unobstructed flow and uniform thickness of grout.

3.5.8 Upper terminal well construction

- a. Permanent casing for all groundwater sources shall project at least 12 inches above the pumphouse floor or concrete apron surface and at least 18 inches above final ground surface.
- b. The top of the well casing at sites subject to flooding shall terminate at least four feet above the 100 year flood level or the highest known flood elevation, whichever is higher, or as the department directs.

3.5.9 Capping requirements

- a. A welded metal plate or a threaded cap is the preferred method for capping a well.
- b. A properly fitted, firmly driven, solid wooden plug is the minimum acceptable method of capping a well until pumping equipment is installed.
- c. At all times during the progress of work, the contractor shall provide protection to prevent tampering with the well or entrance of foreign materials.

3.5.10 Well abandonment

- a. Test wells and groundwater sources which are not in use shall be sealed by such methods as necessary to restore the controlling geological conditions which existed prior to construction or as directed by the Division of Geology and Land Survey.
- b. Wells to be abandoned shall
 1. be sealed to prevent undesirable exchange of water from one aquifer to another,
 2. preferably be filled with neat cement grout,
 3. have fill materials other than cement grout or concrete, disinfected and free of foreign materials, and,
 4. when filled with cement grout or concrete, these materials shall be applied to the well hole through a pipe, tremie, or bailer.
- c. The Division of Geology and Land Survey should be informed within 60 days of well sealing completion.

3.6 AQUIFER TYPES AND CONSTRUCTION METHODS - SPECIAL CONDITIONS

3.6.1 Sand or gravel wells

- a. If clay or hard pan is encountered above the water bearing formation, the permanent casing and grout shall extend through such materials.
- b. If a sand or gravel aquifer is overlaid only by permeable soils, the permanent casing and grout shall extend to at least 20 feet below original or final ground elevation, whichever is lower.
- c. If a temporary outer casing is used, it shall be completely withdrawn as grout is applied.

3.6.2 Gravel pack wells

- a. Gravel pack shall be well rounded particles, 95 per cent siliceous material, that are smooth and uniform, free of foreign material, properly sized, washed and then disinfected immediately prior to or during placement.
- b. Gravel pack shall be placed in one uniform continuous operation.
- c. Gravel **refill** pipes, when used, shall be Schedule 40 steel pipe incorporated within the pump foundation and terminated with screwed or welded caps at least 12 inches above the pump house floor or concrete apron.
- d. Gravel **refill** pipes located in the grouted annular opening shall be surrounded by a minimum of 1 1/2 inches of grout.
- e. Protection from leakage of grout into the gravel pack screen shall be provided.
- f. Permanent inner and outer casings shall meet requirements of Section 3.5.3.

3.6.3 Limestone or sandstone wells

The depth of the **permanent** casing will be determined from the examination of **drill** cuttings by the Division of Geology and Land Survey.

3.7 WELL PUMPS, DISCHARGE PIPING AND APPURTENANCES

3.7.1 Line shaft pumps

Wells equipped with line shaft pumps shall

- a. have the casing **firmly** connected to the pump structure or have the casing inserted into a recess extending at least one-half inch into the pump base,

- b. have the pump foundation and base designed to prevent water **from** coming into contact with the joint.

3.7.2 Submersible pumps

Where a submersible pump is used

- a. the top of the casing shall be effectively sealed against the entrance of water under all conditions of vibration or movement of conductors or cables, and
- b. the electrical cable shall be firmly attached to the riser pipe at 20 foot intervals or less.

3.7.3 Discharge piping

- a. The discharge piping shall
 - 1. be protected against the entrance of contamination,
 - 2. be equipped with a smooth nosed sampling tap located at a point where positive pressure is maintained,
 - 3. where applicable, be equipped with an air release-vacuum relief valve located upstream from the check valve, with exhaust/relief piping terminating in a downturned position at least 18 inches **above** the floor and covered with a 24 mesh corrosion resistant screen,
 - 4. be valved to permit test pumping and control of each well,
 - 5. have all exposed piping, valves and appurtenances protected against physical **damage** and freezing.
 - 6. be properly anchored to prevent movement, and
 - 7. be protected against surge or water hammer.
- b. The discharge piping should be provided with a means of pumping to waste, but shall not be directly connected to a sewer.

3.7.4 Pitless well units

- a. Pitless units shall
 - 1. be shop-fabricated from the point of connection with the well casing to the unit cap or cover,
 - 2. be threaded or welded to the well casing,
 - 3. be of watertight construction throughout,
 - 4. be of materials and weight at least equivalent and compatible to the casing,

5. have field connection to the lateral discharge from the pitless unit of threaded, flanged or mechanical joint connection, and
 6. terminate at least 18 inches above final ground elevation or four **feet** above the 100 year flood level or the highest known flood elevation, whichever is higher.
- b. **The** design of the pitless unit shall make provision for
1. access to disinfect the well,
 2. **a** properly constructed casing vent meeting the requirements of Section 3.7.5,
 3. a cover at the upper terminal of the well that will prevent the entrance of contamination,
 4. a contamination-proof entrance connection for electrical cable,
 5. an inside diameter as great as that of the well casing, up to and including casing diameters of 12 inches, to facilitate work and repair on the well, pump, or well screen, and
 6. at least one check valve within the well casing.
- c. If the connection to the casing is by field weld, the shop-assembled unit must be designed specifically for field welding to the casing. The only field welding permitted will be that needed to connect a pitless unit to the casing.

3.7.5 Casing vent

Provisions shall be **made** for venting the well casing to atmosphere. The vent shall **terminate** in a downturned position, at or above the top of the casing or pitless unit in a minimum 1 1/2 inch diameter opening covered with a 24 mesh, corrosion resistant screen. The pipe connecting the casing to the vent shall be of adequate size to provide rapid venting of the casing.

3.8 TESTING AND RECORDS

3.8.1 Yield and drawdown tests should

- a. be performed on every production well after construction or subsequent treatment and prior to placement of the permanent pump,
- b. have the test methods clearly indicated in specifications,
- c. have a test pump capacity, at maximum anticipated drawdown, at least 1.5 times the quantity anticipated, and

- d. provide for continuous pumping for at least 24 hours or until stabilized drawdown has continued for at least six hours when test pumped at 1.5 times the design pumping rate,
- e. provide the following data:
 - 1. test pump capacity-head characteristics,
 - 2. static water level,
 - 3. depth of test pump setting, and
 - 4. time of starting and ending each test cycle; and
- f. provide recordings and graphic evaluation of the following at one hour intervals or less as may be required by the Department:
 - 1. pumping rate,
 - 2. pumping water level,
 - 3. drawdown, and
 - 4. water recovery rate and levels.

Table 1
STEEL PIPE*

SIZE	DIAMETER (inches)		THICKNESS (inches)	WEIGHT PER FOOT (pounds)	
	EXTERNAL	INTERNAL		PLAIN ENDS (calculated)	WITH THREADS AND COUPLINGS (nominal)
6 in	6.625	6.065	0.280	18.97	19.18
8	8.625	7.981	0.322	28.55	29.35
10	10.750	10.020	0.365	40.48	41.85
12	10.750	12.000	0.375	49.56	51.15
14 in	14.000	13.250	0.375	54.57	57.00
16	16.000	15.250	0.375	62.58	
18	18.000	17.250	0.375	70.59	
20	20.000	19.250	0.375	78.60	
22	22.000	21.000	0.500	114.81	
24	24.000	23.000	0.500	125.49	
26	26.000	25.000	0.500	136.17	
28	28.000	27.000	0.500	146.85	
30	30.000	29.000	0.500	157.53	
32	32.000	31.000	0.500	168.21	
34	34.000	33.000	0.500	178.89	
36	36.000	35.000	0.500	189.57	

* Abstracted from American Water Works Association Standards for deep wells,
AWWA A100

PART 4

4.0 TREATMENT

4.1 GENERAL

Treatment is required when the quality of the untreated ground water makes it unacceptable by Missouri Department of Natural Resources standards and an alternate acceptable source is not reasonably available.

- a. Disinfection by chlorination is recommended and may be required to assure safe bacteriological quality.
- b. **Where** a well is terminated into geological formations commonly utilized for private domestic wells, chlorination with retention is required to assure safe bacteriological quality.
- c. Upon evaluation of chemical and radiological test results, the Department shall determine **the** need for additional treatment.
- d. A separate room or building should be used for water treatment chemicals and equipment and shall be accessible only to authorized **personnel**.

4.2 CHLORINATION

4.2.1 Equipment

- a. A solution feed gas chlorinator or hypochlorinator system consisting of a solution tank and a diaphragm type pump shall be used to inject a chlorine solution into the water.
- b. Special precautions for safety and equipment design are necessary when chlorine gas is used. Consult the Department for design criteria.
- c. Liquid chemical feeders shall be such that chemical solutions cannot be siphoned into the water supply. By assuring discharge at a point of positive pressure, providing vacuum relief, providing a suitable air gap or other suitable means.

4.2.2 Chlorine solution

Chlorine solution can be prepared by one of the following methods:

- a. Mix one gallon of household bleach (5-1/2% chlorine) with 4 gallons of water in the solution tank. This will provide a solution of approximately 1% active chlorine (10,000 ppm). Three pints of commercial 15% sodium hypochlorite can be substituted for the gallon of household bleach.
- b. Dissolve one-half pound of dry calcium hypochlorite (HTH, Pittchlor, etc.) into 4-1/2 gallons of water using the solution tank. This will provide a solution of approximately 1% active chlorine.

4.2.3 Installation

Install hypochlorinator pump to operate when the well pump operates. The injection point shall be before the pressure and retention tanks. If a softener is used, the injection point should be after the softener and before the pressure and retention tanks. (Figure 5)

The pressure tank must be sized and designed to permit a full 30 minutes contact time or a separate retention tank must be provided. A pressure tank that is connected to the main line by a single pipe is considered as floating on the system. This cannot be considered as providing chlorine contact time.

The feed rate (pump setting) necessary to obtain the desired residual can be determined by experimentation using DPD (N, N **Diethyl-p-Phenylene** Diamine) chlorine test kit.

The diagrams on the next page illustrates typical chlorination installations.

4.2.4 Retention time

For bacteriological control, 30 minutes chlorine contact time shall be maintained prior to distribution.

4.2.5 Chlorine content

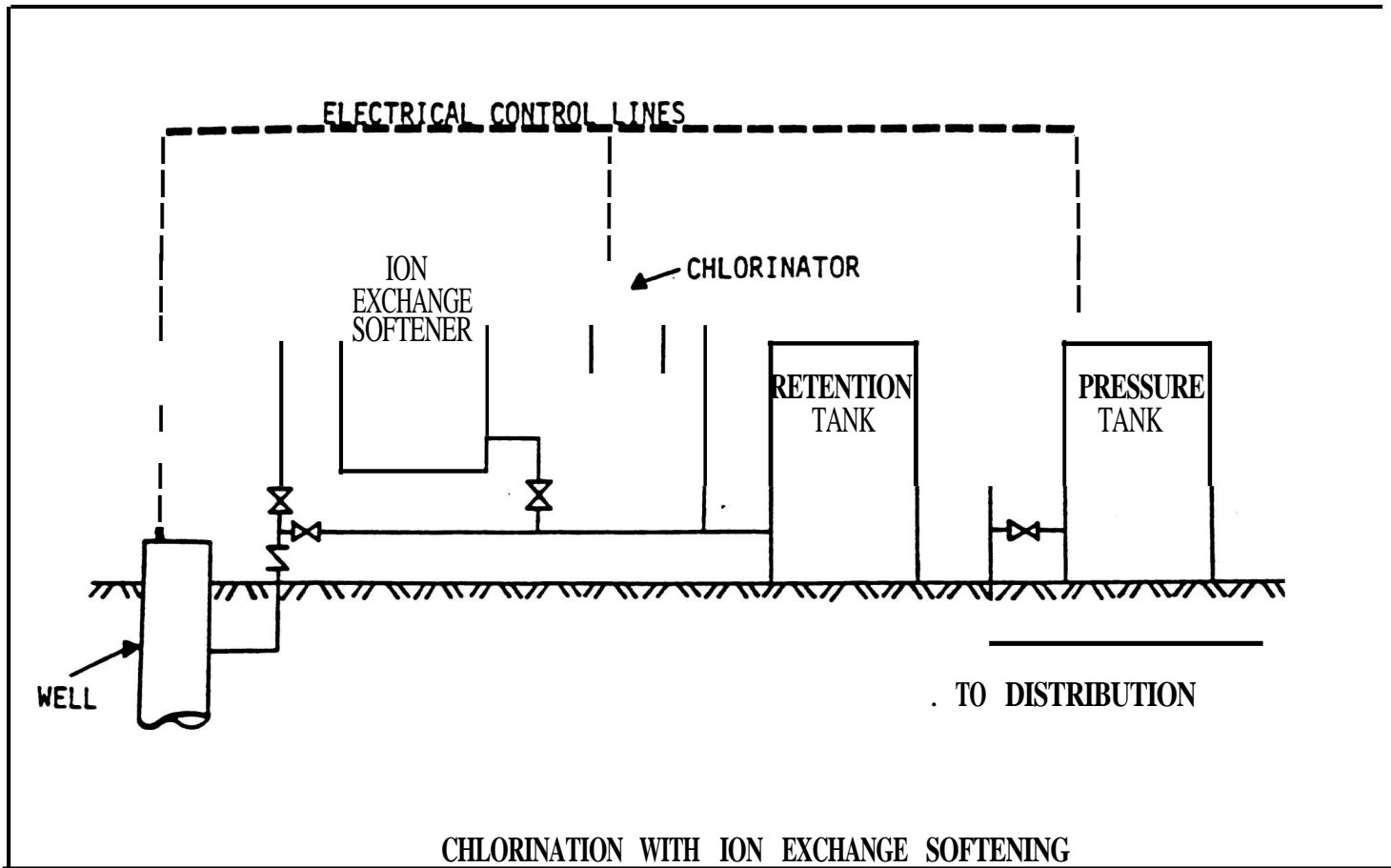
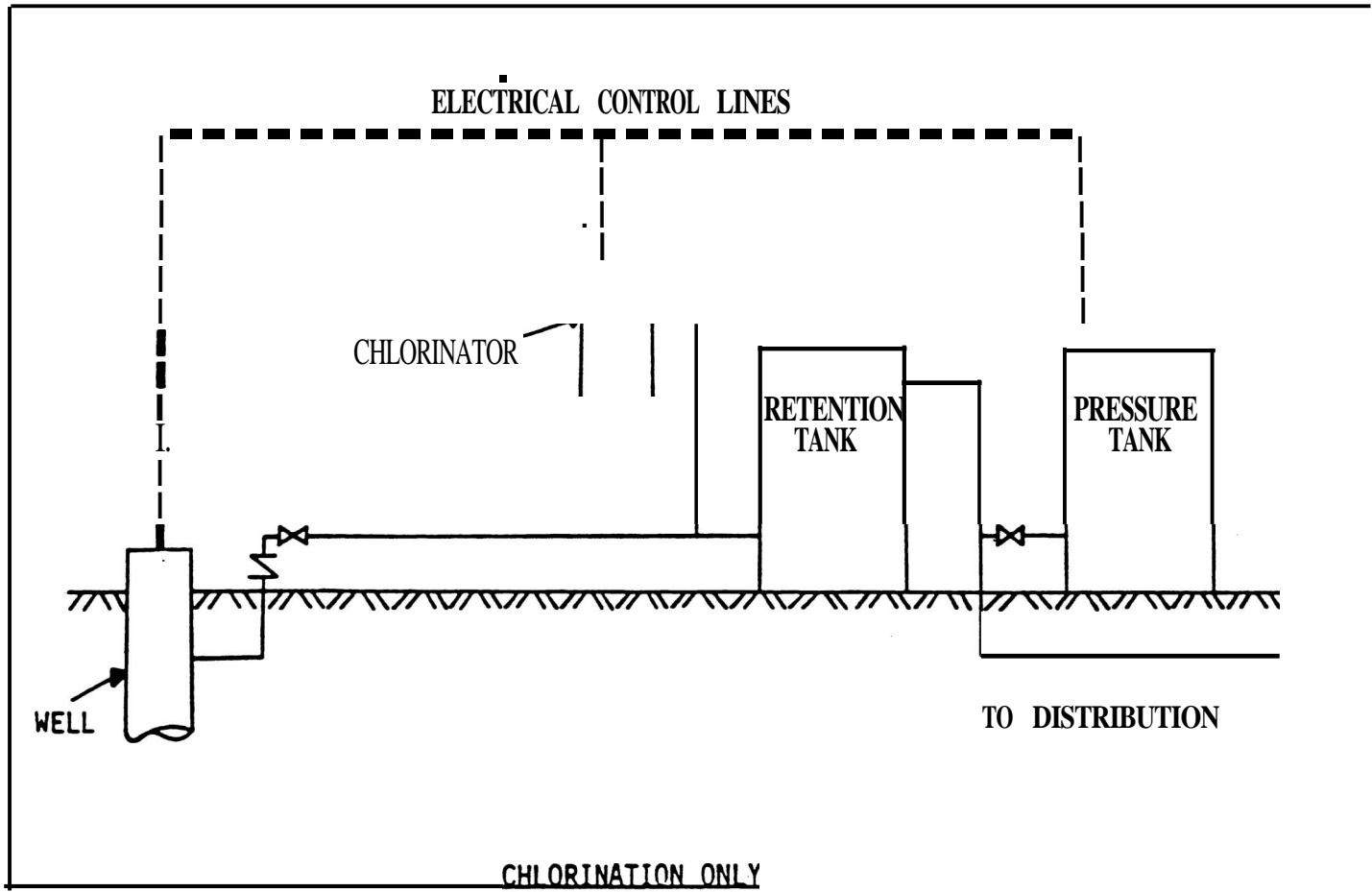
During the retention period, a minimum free chlorine residual of 1.0 mg/l shall be maintained.

In the distribution system, a minimum free chlorine residual of 0.2 mg/l shall be maintained.

Chlorine content shall be measured by the DPD method.

CAUTION:

HYPOCHLORITES ARE STRONG **OXIDANTS!** AVOID STORING OIL OR OTHER COMBUSTIBLE MATERIALS IN THE CHLORINATION AREA.



PART 5

5.0 STORAGE

5.1 GENERAL

Storage (and pumping facilities) shall be adequate to maintain a minimum of 20 psi throughout the distribution system under peak operating conditions. -

Storage may take the **form** of elevated, standpipe, hydropneumatic, ground level or clear well tankage.

Where well capacity is less than peak demand (ten times average daily demand), storage may be utilized to reduce the demand on the well. '

Storage structures shall follow current **AWWA** and **ASTM** Standards whenever applicable.

Storage structures shall be disinfected and proven bacterially safe prior to being placed into operation. A 24-hour contact period using a 50 ppm free chlorine solution is one acceptable method.

Fire flow requirements established by the State Insurance Services Office should be met where fire protection is provided.

5.2 ELEVATED AND STANDPIPE STORAGE

Elevated or standpipe storage should be provided for systems where usage exceeds 30,000 gpd. Storage at least equal to average daily demand is recommended.

5.2.1 Standards

Storage tanks shall conform to the following:

- a. The tank shall be constructed in accordance with AWWA Standards **including** D-100.
- b. The tank shall be painted in accordance with AWWA Standard D-102.
- c. The tank shall be disinfected **in** accordance **with** AWWA Standard D-105.

5.2.2 Design Criteria

- a. Head range of the elevated tank is not **to** exceed 30 feet.
- b. Tank must be provided with an overflow which is brought down to an elevation of 12" to 24" above ground surface, and discharged over a drainage inlet or splash plate.
- c. The tank should include entrance manholes with locked hatches, a screened vent and an OSHA approved access ladder.

- d. A valving arrangement must be provided to allow the tank to be removed from service.
- e. A drain must be provided.
- f. Security measures must be provided including chain link fence, air craft warning light, etc. as appropriate.
- g. A low level warning light and/or alarm must be provided.
- h. A suitable control system must be provided (i.e. telemetering).

5.3 HYDROPNEUMATIC STORAGE

Hydropneumatic storage is considered primarily as an electrical pump control mechanism and not as true storage.

5.3.1 Standards

Hydropneumatic tanks and their installations shall conform to the following:

- a. Gross volume in gallons of the hydropneumatic tank shall be at least ten times the capacity in gpm of the largest supplying pump.
- b. Delivery volume in gallons of water from a bladder type hydropneumatic tank(s) shall be at least 3.0 times the capacity in gpm of the largest supplying pump.
- c. The tanks shall be installed above **normal** ground level. Earth mounding over **the** tank is not acceptable.
- d. Tanks less than 1000 gallons should be completely housed and heated for protection from both physical damage and freezing.
- e. Tanks shall be **provided** with a bypass to **permit** operation of the system when they are out of service.
- f. Tanks shall be provided with a drain, a pressure gauge, an air blow-off, a means of adding air, a pressure-activated off/on switch to control the supply pump, and a sight glass.
- g. Tanks of 1,000 gallons' capacity and larger **shall** be provided with a manhole.
- h. The tanks shall meet **ASME** code requirements and/or state and local laws and regulations for unfired pressure vessels.

5.4 GROUND LEVEL STORAGE

Buried tanks shall be of reinforced concrete construction.

5.4.1 Standards - General

Ground level storage tanks shall conform to the following:

- a. The top of the tank shall not be less than two feet above normal ground surface.
- b. ~~The~~ bottom of the tank shall be above the normal ground water table and the **maximum** flood level.
- c. The tank shall be constructed no closer than 50 feet to sewers, drains, **standing** water and other sources of pollution.
- d. The tank shall be watertight and constructed to prevent entry of birds, animals, insects, and excessive dust.
- e. Security shall be provided by fencing, locks and other measures as required to prevent trespassing and vandalism.
- f. The tank shall not have a direct connection to a sewer or **storm** drain.
- g. A screened vent should terminate **in** an inverted U at least 24 inches above -ground level.
- h. An access manhole should be located above the waterline of the tank. The access manhole shall be framed at least four inches above the surface of the roof and fitted with a solid, watertight, locked cover which overlaps the framed opening at least **two** inches.
- i. A screened overflow must be installed so as to have a minimum air gap of 12 inches above a splash block located at ground surface. The overflow shall not connect directly to a sewer or storm drain.
- j. Grading **shall** be carried out so that surface water drains away from the tank.

5.4.2 Standards - Fiber Glass Tanks

Fiber glass storage tank installations shall have the following exceptions and additions to the above:

- a. Tanks should be pressure tested according to manufacturer's instruction and fittings soap bubble tested before installation.
- b. Tanks shall be anchored to a concrete pad and back filled with pea gravel, with clean and free flowing 1/8"-1/2" diameter stone crushings meeting ASTM C-33, or other **backfill** material meeting manufacturer's recommendations.
- c. Combined weight of the empty tank, the concrete pad and the backfill supported on the concrete pad shall be sufficient to prevent flotation of the empty tank.

PART 6 - DRAFT

6.0 DISTRIBUTION SYSTEMS

6.1 MATERIALS

6.1.1 Standards, materials selection

Pipe fittings, valves and fire hydrants shall conform to the latest standards issued by the AWWA, if such standards exist, and be acceptable to the department. In the absence of such standards, materials meeting applicable Product Standards and acceptable to the department may be selected.

6.1.2 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.

6.1.3 Joints

Packing and jointing materials used in the joints of pipe shall meet the standards of the AWWA and the department. Pipe having mechanical joints or slip-on joints with rubber gaskets is preferred.

6.2 WATER MAIN DESIGN

6.2.1 Pressure

All water 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 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 psi and not less than 35 psi.

6.2.2 Diameter

The minimum size of watermain for providing **fire protection** and serving fire **hydrants** shall be six-inch **diameter**.

6.2.3 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.

6.2.4 Hydrants

Water mains not designed to carry fire-flows shall not have fire hydrants connected to them.

6.2.5 Dead ends

Dead ends shall be minimized by looping of all **mains** whenever practical.

6.2.6 Flushing

Where: dead-end mains occur **they** shall be provided with a fire hydrant if flow and pressure are sufficient, or with an approved flushing hydrant or blow-off for flushing purposes. 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.

6.3 VALVES

6.3.1 Sufficient valves shall be provided on water mains so that inconvenience and sanitary hazards will be minimized during repairs. Valves should be located at all branch lines.

6.4 HYDRANTS

6.4.1 Location and spacing

Hydrants should be provided as recommended by the state Insurance Services Office. Generally, hydrant spacing may range from 350 to 600 feet depending on the area being served.

6.5 INSTALLATION OF MAINS

6.5.1 Standards

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

6.5.2 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.

6.5.3 Cover

All water **mains** shall be covered with sufficient earth or other insulation to prevent freezing.

6.5.4 Blocking

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

6.5.5 Pressure and leakage testing

All types of installed pipe shall be pressure tested and leakage tested in accordance with the latest edition of **AWWA** Standard eGOD.

6.5.6 Disinfection

All new, cleaned or repaired water mains shall be disinfected in accordance with **AWWA** Standard C601. The specifications shall include detailed procedures for the adequate flushing, disinfection, and microbiological testing of all water **mains**.

6.6 SEPARATION OF WATERMAINS, SANITARY **SEWERS** AND STORM SEWERS

6.6.1 Parallel installation

Water mains shall be laid at least 10 feet horizontally from any existing or proposed sewer. The distance shall be measured edge to edge. In cases where it is not practical to maintain a ten foot separation, the reviewing authority may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation **may** allow installation of the water main closer to a sewer, provided that the water **main** is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water **main** is at least 18 inches above the top of the sewer.

6.6.2 Crossings

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. 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.

6.6.3 Exception

The department must specifically approve any variance from the requirements of Sections 6.6.1 and 6.6.2 when it is impossible to obtain the specified separation distances.

6.6.4 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 6.6.2.

6.6.5 Sewer manholes

No water pipe shall pass through or come in contact with any part of a sewer manhole.

6.7 SURFACE WATER CROSSINGS

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

6.8 CROSS-CONNECTIONS AND INTERCONNECTIONS

6.8.1

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.

6.8.2 Cooling water

Neither steam condensate nor cooling water from engine jackets or other heat exchange devices shall be returned to the potable water supply.

6.8.3 Interconnections

The approval of the Department shall be obtained for interconnections between potable water supplies.

6.9 WATER SERVICES AND PLUMBING

6.9.1 Plumbing

Water services and plumbing should conform to relevant local and/or state plumbing codes, or to the National Plumbing Code.

