WCI Wisconsin Contractors Institute

CONTINUING EDUCATION FOR WISCONSIN PLUMBERS

WATER SUPPLY SYSTEMS

Course #961686

Part 2 ▪ 4 Hours

WISCONSIN CONTRACTORS INSTITUTE

N16 W23217 Stone Ridge Drive, Suite 290
Waukesha, WI 53188

262-409-4282

www.wicontractorinstitute.com

This course has been approved for the following credential types: Commercial Plumbing Inspector Certification; Cross Connection Control Tester Registration; Journeyman Plumber License; Journeyman Plumber-Restricted Appliance License; Journeyman Plumber-Restricted Service License; Master Plumber License; Master Plumber-Restricted Service License; Master Plumber Restricted Appliance License; UDC-Plumbing Inspector Certification; Utility Contractor License

WATER SUPPLY SYSTEMS

What is the purpose of this course?

The purpose of this course is to set forth the requirements for the design and installation of water supply systems

Water Supply Systems

Materials

All water supply systems should be constructed of approved materials in accordance with chapter SPS 384.

General

Water quality

1. Every outlet providing water should be provided with water of the quality as specified under chapter SPS 382.70 (3) (see below) for the intended use.
2. Non–potable water may be supplied to water treatment devices or systems designed to treat water for compliance with Table 382.70–1 (see below).

Table 382.70–1 Plumbing Treatment Standards

Intended Use		Plumbing Treatment Standard
1.	Drinking, cooking, food processing, preparation and cleaning, pharmaceutical processing and medical uses	NR 811 and 812 approved sources
2.	Personal hygiene, bathing, and showering	NR 811 and 812 approved sources
3.	Automatic fire protection systems	As acceptable by local authority
4.	Swimming pool makeup water	NR 811 and 812 approved sources
5.	Swimming pool fill water	DHS 172 requirements
6.	Cooling water	pH 6–9 < 50 mg/L BOD <30 mg/L TSS Free chlorine residual 1.0–10.0 mg/L
7.	Subsurface infiltration and irrigation, using reuse as the source	<15 mg/L oil and grease <30 mg/L BOD <35 mg/L TSS <200 fecal coliform cfu/100 mL
8.	Subsurface infiltration and irrigation, using storm water and clear water as the source	<15 mg/L oil and grease <60 mg/L TSS
9.	Surface or spray irrigation using storm water and clear water as the source	<10 mg/L BOD <5 mg/L TSS
10.	Surface irrigation except food crops, vehicle washing, clothes washing, air conditioning, soil compaction, dust control, washing aggregate and making concrete	pH 6–9 <10 mg/L BOD < 5 mg/L TSS Free chlorine residual 1.0– 10.0 mg/L

Continued

11. Toilet and urinal flushing	pH 6–9 200 mg/L BOD < 5 mg/L TSS Free chlorine residual .1 mg/L – 4.0 mg/L
12. Uses not specifically listed above	Contact department for standards

Hot water required

Hot water should be provided to all plumbing fixtures, appliances and equipment used for personal washing, culinary purposes, or laundering.

Tempered water

Tempered water or hot water should be provided to lavatories, wash fountains and shower heads which are not located in dwelling units or living units. Tempered water supplied to serve multiple lavatories, wash fountains and shower heads should be provided by means of temperature–actuated mixing valves that comply with ASSE 1017.

Lavatories located in park shelters and bath houses which are not open during the period from November 15 to March 15 and which are not places of employment should not be required to be provided with hot water.

Lavatories located in waysides which are not places of employment should not be required to be provided with hot water.

PART 2 EXAM QUESTIONS

1. All water supply systems should be constructed of approved materials in accordance with chapter SPS _____.

a. 284
b. 384
c. 140
d. 1017

2. Every outlet providing water should be provided with water of the quality as specified under chapter SPS _____ for the intended use.

a. 382.70 (3)
b. 382.3
c. 384
d. 381

3. Hot water should be provided to all plumbing fixtures used for which of the following?

a. Personal washing
b. Culinary purposes
c. Laundering
d. All of the above

4. Tempered water or hot water should be provided to _____ which are not located in dwelling units or living units.

a. Lavatories
b. Wash fountains
c. Shower heads
d. All of the above

5. Tempered water supplied to serve multiple lavatories, wash fountains and shower heads should be provided by means of temperature–actuated mixing valves that comply with ASSE _____.

a. 382.40
b. 382.70–1
c. 1017
d. 1500

6. Lavatories located in park shelters which are not open during the period from _____15 to _____15 and which are not places of employment should not be required to be provided with hot water.

a. September to February
b. October to January
c. November to March
d. December to January

7. Water intended to be used for personal hygiene must meet which of the following plumbing treatment standards?

a. As acceptable by local authority
b. NR 811 and 812 approved sources
c. DHS 172 requirements
d. Contact department for standards

8. Water intended to be used as swimming pool fill water must meet which of the following plumbing treatment standards?

a. As acceptable by local authority
b. NR 811 and 812 approved sources
c. DHS 172 requirements
d. Contact department for standards

9. Water intended to be used in Automatic fire protection systems must meet which of the following plumbing treatment standards?

a. As acceptable by local authority
b. NR 811 and 812 approved sources
c. DHS 172 requirements
d. Contact department for standards

10. The pH level of cooling water should be _____?

a. 5–8
b. 1–3
c. 6–9
d. 8–10

11. There should be less than _____ mg/L of oil and grease in subsurface irrigation using storm water and clear water as the source.

a. 5
b. 10
c. 12
d. 15

12. There should be less than _____fecal coliform cfu/100 mL in subsurface infiltration and irrigation using reuse as the source.

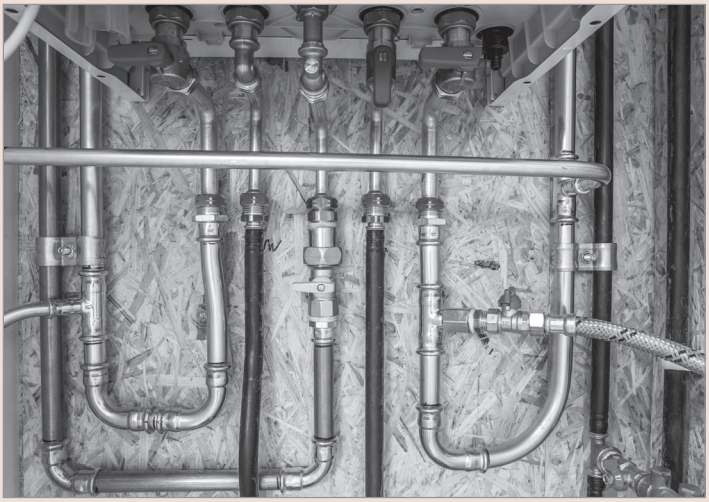
a. 100
b. 150
c. 200
d. 50

Protection

Pursuant to NR 811.07 the interconnection of 2 or more water supply systems, one system served by a public supply source and the other system served by another supply source is prohibited, unless approved in writing by the department of natural resources.

A water supply system should be designed and installed in accordance with chapter SPS

382.41 and maintained to prevent non–potable liquids, solids or gases from being introduced into the potable water supply system through cross connections.



When a connection between 2 water supply systems exists, one system having a higher degree of hazard than the other system as specified in chapter SPS 382.41, the water supply system with a lower degree of hazard should be protected as specified in chapter SPS 382.41.

When a water treatment device is provided to lower the concentration of a health–related contaminant, cross connection control should not be required to protect the water supply system downstream of the treatment device from the upstream contaminated source.

PART 2 EXAM QUESTIONS

13. True or false? The interconnection of 2 or more water supply systems, one system served by a public supply source and the other system served by another supply source is always allowable.

a. True
b. False

14. Who can approve the interconnection of 2 or more water supply systems, one system served by a public supply source and the other system served by another supply source?

a. The department of natural resources
b. An agent municipality
c. OSHA
d. Plumbing inspectors

15. A water supply system should be designed and installed in accordance with chapter SPS _____.

a. 811.07
b. 382.70
c. 382.41
d. 1017

16. True or False? A water supply system should be maintained to prevent non–potable liquids, solids or gases from being introduced into the potable water supply system through cross connections.

a. True
b. False

17. When a water treatment device is provided to lower the concentration of a health–related contaminant, cross connection control should not be required to protect the water supply system _____ of the treatment device from the upstream contaminated source.

a. Upstream
b. North
c. Downstream
d. South

Identification

Where buildings or facilities contain water supply systems where the water supply systems have different degrees of hazard, then those water supply systems should be labeled in accordance with this section.

Aboveground piping supplying water other than potable should be labeled by tags or colored bands according to Table 382.40–1a.

Note: When identifying potable water piping or valves with tags or bands, label according to Table 382.40–1a.

Valves supplying other than potable water should be identified by tags according to Table 382.40–1a.

- The tags or colored bands should be placed at intervals of not more than 25 feet. Where piping passes through a wall, floor or roof, the piping should be so identified on each side of the wall and within each compartment.
- The colored bands should be at least 3 inches wide and should bear text identifying the water or the specific use.
- Tags used to identify water outlets, valves and piping should be of metal or plastic in the shape specified in Table 382.40–1a.
- The lettering on the triangular and circular tags should be at least 1/2 inch in height.

A hose bib intended to discharge water that does not meet drinking water quality as specified in chapter SPS 382.70, should be labeled as non–potable or so identified for the specific use or uses, and should be equipped with a removable handle.

Where a building or a structure is served by 2 distribution systems, one system supplied by a public water supply and the other system supplied by a private well, each water distribution system should be identified to indicate the supply source.

The installation of each reduced pressure principle backflow preventer, reduced pressure fire protection principle backflow preventer, reduced pressure detector fire protection backflow preventer, spill resistant vacuum breaker and pressure vacuum breaker should display a department assigned identification number.

The method to display the department assigned identification number should be a weather–resistant tag, securely attached to the cross connection control assembly.

The tag should contain at least the following information:

- Wisconsin Department of Safety and Professional Services
- Identification/Object Number Cross Connection Control Assembly
- Do Not Remove This Tag

The department assigned identification number should be printed in the blank area with a permanent, waterproof marker or similar indelible method.

Multipurpose piping system

A multipurpose piping system should be designed and installed in accordance with this section and NFPA 13D.

Note: Pursuant to this section, materials for multipurpose piping systems need to be acceptable under the NFPA 13D standard and chapter SPS 384.30, Table 384.30–9.

Note: Chapter SPS 321.095 of the Dwelling Code and chapter SPS 362.0903 (10) of the Commercial Building Code have information as to fire protection provisions for multipurpose piping systems.

Fire department connections are prohibited in a multipurpose piping system.

PART 2 EXAM QUESTIONS

18. What table should be used when identifying potable water piping or valves with tags or bands?

a. 1017
b. 382.7–2b c. 811.07
d. 382.40–1a

19. The tags or colored bands should be placed at intervals of not more than _____ feet.

a. 10
b. 25
c. 20
d. 5

20. The colored bands should be at least _____ inches wide.

a. 1
b. 2
c. 3
d. 4

21. The lettering on the triangular and circular tags should be at least _____inch in height.

a. 1/8
b. 1/4
c. 1/3
d. 1/2

22. A hose bib intended to discharge water that does not meet drinking water quality should be labeled as _____.

a. Potable
b. Non–potable
c. Private
d. None of the above

23. The installation of each reduced pressure principle backflow preventer should display a department assigned _____.

a. Identification Color
b. Identification Letter
c. Identification Symbol
d. Identification Number

24. The method to display the department assigned identification number should be a _____tag.

a. Weather–resistant
b. Colorful
c. Black and white
d. Large

25. A multipurpose piping system should be designed and installed in accordance with this section and NFPA_____.

a. 384.30
b. 362.0903
c. 13D
d. 382.40

26. What type of connections are prohibited in a multipurpose piping system?

a. Health care facility
b. Fire department
c. A residential dwelling
d. A state owned facility

Control Valves

Private water mains

Private water mains should be provided with control valves as specified in this section.

'Corporation cocks.' If a private water main 2 inches or less in diameter connects to a public water main, a corporation cock should be installed at the connection to the public water main. If a private water main 2–1/2 inches or larger in diameter connects to a public water main, a corporation cock should be installed not more than 8 feet from the connection to the public water main.

'Curb stops.' If a private water main connects to public water main, a curb stop should be installed in the private water main between the corporation cock and the property line. If a private water main 2–1/2 inches or larger in diameter connects to a public water main, one control valve may serve as the corporation cock and the curb stop. The control valve should be located not more than 8 feet from the connection to the public water main and should be accessible for operation.

PART 2 EXAM QUESTIONS

27. If a private water main connects to a public water main, how many inches in diameter should it be in order for a corporation cock to be installed at the connection to the public water main?

a. 1 or less
b. 2 or less
c. 3 or less
d. 4 or less

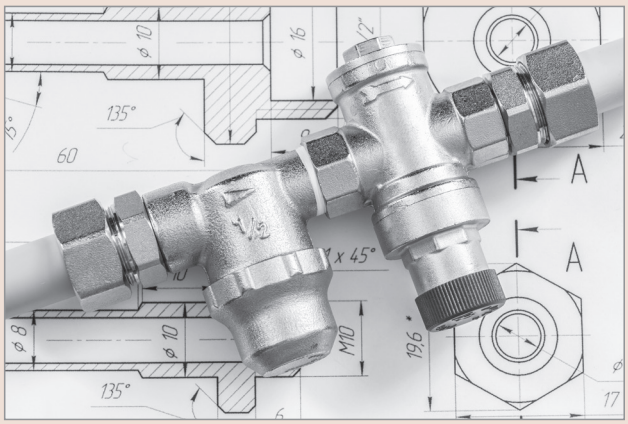
28. With regards to a water service that is 2–1/2inch or larger in diameter connecting to a public water main, what is the maximum distance from the public water main that the corporation cock should be installed?

a. 8 feet
b. 9 feet
c. 10 feet
d. 12 feet

Water services

Water services should be provided with control valves as specified in this section. 'Corporation cocks.' If a water service 2" or less in diameter connects to a public water main, a corporation cock should be installed at the connection to the public water main. If a water service 2–1/2" or larger in diameter connects to a public water main, a corporation cock should be installed not more than 8 feet from the connection to the public water main.

'Curb stops.' Except for water services serving farm buildings and farm houses, a curb stop should be installed in each water service which connects to a private water main. The curb stop should be located outside the building served by the water service. A curb stop should be installed in each water service which connects to a public water main. The curb stop should be located between the corporation cock and the property line.



If a water service 2–1/2" or larger in diameter connects to a public water main, one control valve may serve as the corporation cock and the curb stop. The control valve should be located not more than 8 feet from the connection to a public water main and should be accessible for operation.

'Building control valves.' If a water service serves a building, a building control valve should be provided in the water service as specified in this subsection.

If the water service connects to a public water supply or to a private water supply which has an external pressure tank, the building control valve should be installed inside the building and located within 3 feet of developed length from the point where the water service first enters the building. If a water meter is provided, the building control valve should be located upstream of the water meter.

PART 2 EXAM QUESTIONS

29. A curb stop should be installed in each water service which connects to a private water main, with the exception of what type of dwelling?

a. Schools and playgrounds
b. Gas stations and airports
c. Hospitals and residential facilities
d. Farm buildings and farm houses

30. True or false? A curb stop should be installed in each water service which connects to a private water main.

a. True
b. False

31. Where should the curb stop be located?

a. Between the corporation cock and the property line
b. Between the corporation cock and private water main
c. Between the corporation cock and the public water main
d. Depends on the diameter of the water source

32. When connected to a public water main, what diameter must the water service be in order to allow for a single control valve to function as both the corporation cock and curb stop?

a. 1 inch or less
b. 1–1/2 inches
c. 2 inches
d. 2–1/2 inches or more

33. When provided with a water meter, where should the building control valve be located with respects to the water meter?

a. Downstream
b. Upstream
c. Within 8 feet
d. Within 10 feet

34. True or false? When a water service connects to a public or private water supply which has an external pressure tank, the building control valve should be installed inside the building.

a. True
b. False

35. If a private water supply includes an external pressure tank, the building control valve should be installed inside the building and located within how many feet of developed length downstream from the internal pressure tank?

a. 1
b. 2
c. 3
d. 4

Water distribution systems

Control valves should be installed in water distribution systems serving public buildings as specified in this section.

If a water meter is provided, a control valve should be installed within 3 feet of developed length downstream from the outlet of the water meter. If bypass piping is provided around a water meter, a control valve should be installed in the bypass piping.

A control valve should be installed in the supply piping to each water heater and water treatment device and in the fixture supply to each plumbing fixture, plumbing appliance and piece of equipment. The control valve may be part of the bypass piping or an internal part of a water treatment device. When the valve is an internal part of the water treatment device, the device should be removable for service.

If a hot water circulation system is provided, a control valve should be installed on both the inlet and outlet piping to the circulation pump. If a hot water circulation system has 2 or more return pipe lines, a balancing control valve should be installed in each return piping line.

The water distribution system for buildings with more than 4 dwelling units or living units should be provided with control valves in such numbers and at such locations so that the water supplied to all the units within the building can be isolated into groups of 4 of less units.

Control valves should be installed in water distribution systems serving one–family and 2–family dwellings as specified in this section.

If a water meter is provided, a control valve should be installed within 3 feet of developed length downstream from the outlet of the water meter. If bypass piping is provided around a water meter, a control valve should be installed in the bypass piping.

A control valve should be installed in the supply piping to each water heater and water treatment device and in the fixture supply to each water closet, exterior hose bib, plumbing appliance and piece of equipment. When the valve is an internal part of the water treatment device, the device should be removable for service.

If a hot water circulation system is provided, a control valve should be installed on both the inlet and outlet piping to the circulation pump. If a hot water circulation system has 2 or more return pipe lines, a balancing control valve should be installed in each return piping line.

PART 2 EXAM QUESTIONS

36. If bypass piping is provided around a water meter, a control valve should be installed _____ the bypass piping.

a. In
b. Nearby
c. Away from
d. Outside of

37. True or false? The control valve may be part of the bypass piping but not as an internal part of a water treatment device.

a. True
b. False

38. When the control valve is a(n) _____ part of the water treatment device, the device should be removable for service.

a. External
b. Internal
c. Accessory
d. Unimportant

39. True or false? If a hot water circulation system is provided, a control valve should be installed on both the inlet and outlet piping to the circulation pump.

a. True
b. False

40. If a hot water circulation system has 2 or more return pipe lines, a balancing control valve should be installed how often?

a. Each return piping line
b. Every other return piping line
c. In the first and last piping line
d. No such requirement

41. The water distribution system for buildings with more than _____ dwelling units should be provided with control valves in such numbers and at such locations so that the water supplied to all the units within the building can be isolated into groups of 4 of less.

a. 2
b. 3
c. 4
d. 5

42. If a water meter is provided, where should a control valve be installed from the outlet of the water meter?

a. Downstream
b. Upstream
c. Within 3 feet
d. Within 10 feet

43. If bypass piping is provided around a water meter, a _____ valve should be installed in the bypass piping.

a. Public water main
b. Private water main
c. Bypass
d. Control

44. A control valve should be installed in the supply piping to each water heater and water treatment device and in the fixture supply which of the following:

a. Water closet
b. Exterior hose bib
c. Plumbing appliance
d. All of the above

45. True or false? When the valve is an internal part of the water treatment device, the device should be removable for service.

a. True
b. False

46. If a _____water circulation system is provided, a control valve should be installed on both the inlet and outlet piping to the circulation pump.

a. Cold
b. Hot
c. Multi
d. Single

Hot Water Supply Systems

General

Water heating systems should be sized to provide sufficient hot water to supply peak demand.

Temperature maintenance

If the developed length of hot water distribution piping from the source of the hot water supply to a plumbing fixture or appliance exceeds 100 feet, a circulation system or self–regulating electric heating cable should be provided to maintain the temperature of the hot water within the distribution piping.

If a circulation system is used to maintain the temperature, no uncirculated hot water distribution piping may exceed 25 feet in developed length.

If a self–regulating electric heating cable is used to maintain the temperature, the cable should extend to within 25 feet of each fixture or the appliance.

Water distribution piping conveying circulated water or served by a self–regulating electric heating cable should be insulated to limit the heat loss at the external surface of the pipe insulation to a maximum of 25 BTUs per hour per square foot for above–ground piping and 35 BTUs per hour per square foot for underground piping. The maximum heat loss should be determined at a temperature differential, T, equal to the maximum water temperature minus a design ambient temperature no higher than 65°F.

Water distribution piping served by self–regulating electric heating cable should be identified as being electrically traced in accordance with chapter SPS 316.

The installation of self–regulating electric heating cable may be subcontracted by a plumber to another trade.

PART 2 EXAM QUESTIONS

47. A circulation system or self–regulating electric heating cable should be provided to maintain the temperature of the hot water within the distribution piping if the developed length of hot water distribution piping from the source of the hot water supply to a plumbing fixture or appliance exceeds how many feet?

a. 50
b. 100
c. 250
d. 500

48. If a circulation system is used to maintain the temperature, no uncirculated hot water distribution piping may exceed how many feet in developed length?

a. 25
b. 50
c. 75
d. 100

49. True or false? If a self–regulating nuclear heating cable is used to maintain the temperature, the cable should extend to within 25 feet of each fixture or the appliance.

a. True
b. False

50. For above–ground piping, water distribution piping conveying circulated water or served by a self–regulating electric heating cable should be insulated to limit the heat loss at the external surface of the pipe insulation to a maximum of how many BTUs per hour per square foot?

a. 10
b. 15
c. 20
d. 25

51. For underground piping, water distribution piping conveying circulated water or served by a self–regulating electric heating cable should be insulated to limit the heat loss at the external surface of the pipe insulation to a maximum of how many BTUs per hour per square foot?

a. 30
b. 35
c. 40
d. 45

52. True or false? The maximum heat loss should be determined at a temperature differential, T, equal to the maximum water temperature minus a design ambient temperature no higher than 65°F.

a. True
b. False

53. Water distribution piping served by self–regulating electric heating cable should be identified as being _____ traced in accordance with chapter SPS 316.

a. Electrically
b. Mechanically
c. Partially
d. Entirely

54. The installation of self–regulating electric heating cable may be subcontracted by a(n) _____ to another trade.

a. Electrician
b. Dwelling contractor
c. Plumber
d. Architect

Water heaters

All water heaters and safety devices should be designed and constructed in accordance with chapter SPS 384.20 (5) (p).

Note: Water heaters are to be installed in accordance with the requirements specified in chapters SPS 361 to 366 and chapters SPS 320 to 325 with respect to energy efficiency, enclosures and venting.

Safety devices

Water heaters should be equipped with safety devices as specified in this paragraph.

All pressurized storage–type water heaters and unfired hot water storage tanks should be equipped with one or more combination temperature and pressure relief valves. The temperature steam rating of a combination temperature and pressure relief valve or valves should equal or exceed the energy input rating in BTU per hour of the water heater. No shut off valve or other restricting device may be installed between the water heater or storage tank and the combination temperature and pressure relief valve.

All pressurized non–storage type water heaters should be provided with a pressure relief valve installed at the hot water outlet with no shut off valve between the heater and the relief valve.

Temperature and pressure relief valves should be installed so that the sensing element of the valve extends into the heater or tank and monitors the temperature in the top 6" of the heater or tank.

A vacuum relief valve should be installed in each water heater and hot water storage tank which, when measured from the bottom of the heater or tank, is located more than 20 feet above any faucet or outlet served by the heater or tank.

Every relief valve which is designed to discharge water or steam should be connected to a discharge pipe.

The discharge pipe and fittings should be made of a material acceptable for water distribution piping in accordance with chapter SPS 384.30 (4) (e) 1.

The discharge pipe and fittings should have a diameter not less than the diameter of the relief valve outlet. The discharge pipe may not be trapped. No valve may be installed in the discharge pipe.

The discharge pipe should be installed to drain by gravity flow to a floor served by a floor drain or to a receptor in accordance with chapter SPS 382.33 (8). The outlet of the discharge pipe should terminate within 6" over the floor or receptor, but not less than a distance equal to twice the diameter of the outlet pipe. The outlet of the discharge pipe may not be threaded.

The discharge pipe for a water heater should terminate within the same room or enclosure within which the water heater or hot water storage tank is located.

PART 2 EXAM QUESTIONS

55. All water heaters and safety devices should be designed and constructed in accordance with what chapter of SPS?

a. 363.50 (7) (p)
b. 384.20 (5) (p)
c. 401.67 (2) (p)
d. 422.03 (11) (p)

56. Water heaters are to be installed in accordance with the requirements specified in chapters SPS 361 to 366 and chapters SPS 320 to 325 with respect to which of the following:

a. Energy efficiency
b. Enclosures
c. Venting.
d. All of the above

57. All pressurized storage–type water heaters and unfired hot water storage tanks should be equipped with how many temperature and pressure relief valves?

a. One or more
b. None
c. Depends on the intensity of pressure
d. No such requirement

58. The temperature steam rating of a combination temperature and pressure relief valve or valves should _____ the energy input rating in BTU per hour of the water heater.

a. Balance
b. Be less than
c. Equal or exceed
d. Not exceed

59. True or false? No shut off valve or other restricting device may be installed between the water heater or storage tank and the combination temperature and pressure relief valve.

a. True
b. False

60. All pressurized non–storage type water heaters should be provided with a pressure relief valve installed at the hot water outlet with how many shut off valves between the heater and the relief valve?

a. Zero
b. One
c. Two
d. Three

61. Temperature and pressure relief valves should be installed so that the sensing element of the valve extends into the heater or tank and monitors the temperature in the top _____ of the heater or tank.

a. 2 inches
b. 4 inches
c. 6 inches
d. 8 inches

62. A vacuum relief valve should be installed in each water heater and hot water storage tank which, when measured from the bottom of the heater or tank, is located more than how many feet above any faucet or outlet served by the heater or tank?

a. 5
b. 10
c. 15
d. 20

63. True or false? A relief valve which is not intended to discharge water or steam should be connected to a discharge pipe.

a. True
b. False

64. The discharge pipe and fittings should be made of a material acceptable for water distribution piping in accordance with what chapter from SPS?

a. 379.48 (7) (e) 1
b. 384.30 (4) (e) 1
c. 395.21 (2) (e) 1
d. 406.50 (11) (e) 1

65. Which of the following is a requirement for the discharge pipe?

a. The pipe and fittings should have a diameter not less than the diameter of the relief valve outlet
b. The pipe may not be trapped
c. No valve may be installed in the discharge pipe
d. All of the above

66. The outlet of the discharge pipe should terminate within _____ over the floor or receptor, but not less than a distance equal to twice the diameter of the outlet pipe.

a. 2 inches
b. 4 inches
c. 6 inches
d. 8 inches

67. True or false? The outlet of the discharge pipe may not be threaded.

a. True
b. False

68. The discharge pipe for a water heater should terminate where, with respects to the location of the water heater or water storage tank?

a. In a different room
b. Within the same room or enclosure
c. Within 10 feet
d. At least 50 feet away

Controls

All hot water supply systems should be equipped with automatic temperature controls capable of adjustments from the lowest to the highest acceptable temperature settings for the intended use.

A separate means should be provided to terminate the energy supplied to each water heater and each hot water circulation system.

Load Factors for Water Supply Systems

Intermittent flow fixtures

The load factor for intermittent flow fixtures on water supply piping should be computed in terms of water supply fixture units as specified in Tables 382.40–1b and 382.40–2 (see below) for the corresponding fixture and use. Water supply fixture units may be converted to gallons per minute in accordance with Table 382.40–3 or 382.40–3e (see below).

Continuous flow devices

The load factor for equipment which demands a continuous flow of water should be computed on the basis of anticipated flow rate in terms of gallons per minute.

Table 382.40–1a Distribution and Service

Supply	Tag & Band Color	Tag Shape	Tag Size	Tag Legend
Potable	Green	Round	3″ diameter	Safe Water
Non-potable	Yellow	Triangle	4″ sides	Non-potable Water or Not Safe for Drinking
Reuse (Non-potable)	Purple	Triangle	4″ sides	Non-potable Water or Not Safe for Drinking or Specific Use
Device Specific	Gray	Triangle	4″ sides	Specific Use

Table 382.40–1b
Water Supply Fixture Units for Nonpublic Use Fixtures

Type of Fixture[a]	Water Supply Fixture Units (wsfu)		
	Hot	Cold	Total
Automatic Clothes Washer	1.0	1.0	1.5
Bar Sink	0.5	0.5	1.0
Bathtub, with or without Shower Head	1.5	1.5	2.0
Bidet	1.0	1.0	1.5
Dishwashing Machine	1.0		1.0
Glass Filler		0.5	0.5
Hose Bibb: 1/2 inch diameter 3/4 inch diameter		3.0 4.0	3.0 4.0
Kitchen Sink	1.0	1.0	1.5
Laundry Tray, 1 or 2 Compartment	1.0	1.0	1.5
Lavatory	0.5	0.5	1.0
Manufactured Home	––	15	15
Shower, Per Head	1.0	1.0	1.5
Water Closet, Flushometer Type		6.0	6.0
Water Closet, Gravity Type Flush Tank Bathroom Groups:		2.0	2.0
Bathtub, Lavatory and Water Closet–FM[b]	2.0	7.5	8.0
Bathtub, Lavatory and Water Closet–FT[c]	2.0	3.5	4.0
Shower Stall, Lavatory and Water Closet–FM	1.5	7.0	7.5
Shower Stall, Lavatory and Water Closet–FT	1.5	3.0	3.5

Table 382.40–2
Water Supply Fixture Units for Public Use Fixtures

Type of Fixture[a]	Water Supply Fixture Units (wsfu)		
	Hot	Cold	Total
Automatic Clothes Washer, Individual	2.0	2.0	3.0
Automatic Clothes Washer, Large Capacity	b	b	b
Autopsy Table	2.0	2.0	3.0
Bathtub, With or Without Shower Head	2.0	2.0	3.0
Coffeemaker		0.5	0.5
Dishwasher	b	b	b
Drink Dispenser		0.5	0.5
Drinking Fountain		0.25	0.25
Glass Filler		0.5	0.5
Health Care Fixtures:			
Clinic sink	2.0	7.0	7.0
Exam/treatment sink	0.5	0.5	1.0
Sitz bath	1.5	1.5	2.0
Surgeon washup	1.5	1.5	2.0
Hose Bibb:			
1/2" diameter		3.0	3.0
3/4" diameter		4.0	4.0
Icemaker		0.5	0.5
Lavatory	0.5	0.5	1.0
Shower, Per Head	2.0	2.0	3.0
Sinks:			
Bar and Fountain	1.5	1.5	2.0
Barber and Shampoo	1.5	1.5	2.0
Cup		0.5	0.5
Flushing Rim		7.0	7.0
Kitchen and Food Preparation per faucet	2.0	2.0	3.0
Laboratory	1.0	1.0	1.5
Service sink	2.0	2.0	3.0
Urinal:			
Syphon Jet		4.0	4.0
Washdown		2.0	2.0
Wall Hydrant, Hot and Cold Mix:			
1/2" diameter	2.0	2.0	3.0
3/4" diameter	3.0	3.0	4.0
Wash Fountain:			
Semicircular	1.5	1.5	2.0
Circular	2.0	2.0	3.0
Water Closet:			
Flushometer		6.5	6.5
Gravity Type Flush Tank		3.0	3.0

Table 382.40–3
Conversion of Water Supply Fixture Units to Gallons per Minute

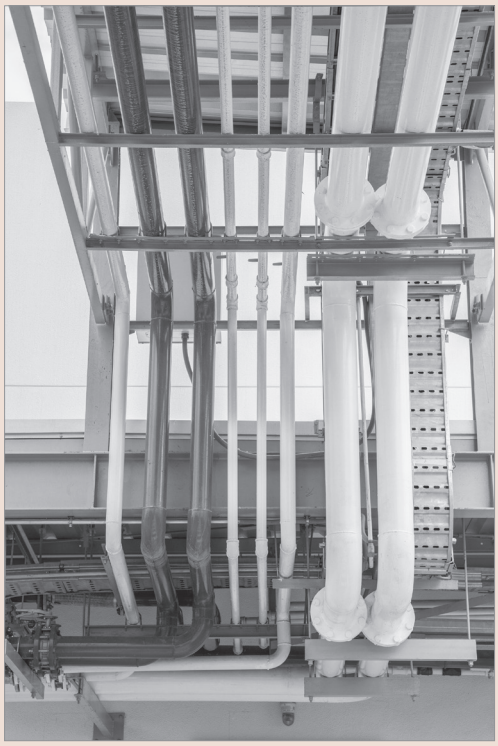
Water Supply Fixture Units	Gallons per Minute	
	Predominately Flush-ometer Type Water Closets or Syphon Jet Urinals	Predominately Flush Tank Type Water Closets or Washdown Urinals
1	–––	1
2	–––	2
3	–––	3
4	10	4
5	15	4.5
6	18	5
7	21	6
8	24	6.5
9	26	7
10	27	8
20	35	14
30	40	20
40	46	24
50	51	28
60	54	32
70	58	35
80	62	38
90	65	41
100	68	42
120	73	48
140	78	53
160	83	57
180	87	61
200	92	65
250	101	75
300	110	85
400	126	105
500	142	125
600	157	143
700	170	161
800	183	178
900	197	195
1000	208	208
1250	240	240
1500	267	267
1750	294	294
2000	321	321
2250	348	348
2500	375	375
2750	402	402
3000	432	432
4000	525	525
5000	593	593

Table 382.40–3e
Conversion of Water Supply Fixture Units to Gallons per Minute for Water Treatment Devices Serving an Individual Dwelling

Water Supply Fixture Units (WSFUs)	Gallons Per Minute (GPM)
1	1
2	2
3	3
4	4
5	4.5
6	5
7	6
8	6.5
25	7
35	8
40	9

Sizing of Water Supply Piping

The sizing of the water supply system should be based on the empirical method and limitations outlined in this section or on a detailed engineering analysis acceptable to the department.



Methodology

The determination of minimum pipe sizes should take into account the pressure losses which occur throughout the entire water supply system and the flow velocities within the water distribution system. Calculations for sizing a water distribution system should include:

- The load factor in water supply fixture units or gallons per minute on the piping;
- The minimum pressure available from the water main or pressure tank;
- The pressure loss due to the differences in elevation from the:
  - Water main or pressure tank to the building control valve;
  - Building control valve to the controlling plumbing fixture;
- The pressure losses due to flow through water heaters, water treatment devices, water meters and backflow preventers;
- The minimum flow pressure needed at the controlling plumbing fixture; and

- The pressure losses due to flow friction through piping, fittings, valves and other plumbing appurtenances. This pressure loss may be calculated in terms of equivalent lengths of piping. The equivalent length of piping to a controlling plumbing fixture, including fittings, valves and other appurtenances, may be obtained by multiplying the developed length by 1.5.

Private water mains and water services

Private water mains and water services should be designed to supply water to the water distribution systems to maintain the minimum flow pressures as specified below, but should not be less than 3/4" in diameter.

PART 2 EXAM QUESTIONS

69. The determination of minimum pipe sizes should take into account which of the following:

a. The pressure gains that occur throughout the water supply system
b. The pressure losses which occur throughout the water supply system
c. The frequency at which water flows throughout the supply system
d. The temperature of the water flowing through the supply system

70. Calculations for sizing a water distribution system should include:

a. The load factor in water supply fixture units or gallons per minute on the piping
b. The minimum pressure available from the water main or pressure tank
c. The pressure losses due to flow through water heaters, water treatment devices, water meters and backflow preventers
d. All of the above

71. What causes the pressure loss due to the differences in elevation?

a. Water main or pressure tank to the building control valve
b. Building control valve to the controlling plumbing fixture
c. A and B
d. None of the above

72. Which of the following could cause a pressure loss due to flow friction?

a. Piping
b. Fittings
c. Valves
d. All of the above

73. To calculate the pressure lost caused by the plumbing apparatus, the equivalent length of piping to a controlling plumbing fixture, including fittings, valves and other appurtenances, may be obtained by multiplying the developed length by what value?

a. 1.5
b. 2
c. 2.5
d. 3

74. Private water mains and water services should be designed to supply water to the water distribution systems to maintain the minimum flow pressures as specified below, but should not have a diameter less than how many inches?

a. 1/2
b. 3/4
c. 1
d. 1–1/4

Table 382.40–4

MAXIMUM ALLOWABLE LOAD FOR COPPER TUBING–TYPE K, ASTM B88; (C=150)

Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	Pipe Diameter (in inches)																											
	1/2"			3/4"			1"			1 1/4"			1 1/2"			2"			2 1/2"			3"			4"		
		WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU	
	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT
0.5	0.5	---	0.5	1.5	---	1.5	3.5	---	3.5	6.5	---	8.0	10.5	4.0	14.0	22.0	7.0	35.0	39.0	28.0	83.0	62.0	80.0	185	132	437	538
1	1.0	---	1.0	2.5	---	2.5	5.0	---	6.0	9.5	---	12.5	15.5	5.0	22.5	32.0	16.0	60.0	57.0	67.0	160	91.0	196	330	192	864	882
2	1.0	---	1.0	3.5	---	3.5	7.5	---	9.5	14.0	4.5	20.0	22.0	7.0	35.0	47.0	42.0	116	83.0	160	290	132	437	538	279	1611	1611
3	1.5	---	1.5	4.5	---	5.0	9.5	---	12.5	17.5	5.5	25.5	28.0	11.0	50.0	58.0	70.0	165	103	261	390	165	661	723	291	1725	1725
4	2.0	---	2.0	5.0	---	6.0	11.5	4.0	15.5	20.5	6.5	31.0	32.0	16.0	60.0	68.0	100	215	116	338	455	165	665	726	NP		
5	2.0	---	2.0	6.0	---	7.0	13.0	4.5	18.0	23.0	7.5	37.0	36.0	22.0	73.0	75.0	128	250	NP			NP					
6	2.5	---	2.5	6.5	---	8.0	14.0	4.5	20.0	25.0	8.5	42.0	40.0	30.0	86.0	NP											
7	2.5	---	2.5	7.0	---	9.0	15.5	5.0	22.5	28.0	11.0	50.0	42.0	34.0	103												
8	3.0	---	3.0	7.5	---	9.5	16.5	5.5	24.0	30.0	13.5	55.0	NP														
9	3.0	---	3.0	8.0	---	10.0	17.5	5.5	25.5	NP																	
10	3.5	---	3.5	8.5	---	10.5	18.5	6.0	27.5																		
11	3.5	---	3.5	9.0	---	11.5	19.0	6.0	28.5																		
12	3.5	---	3.5	9.5	---	12.5	NP																				
13	4.0	---	4.0	10.0	4.0	13.0																					
14	4.0	---	4.0	10.5	4.0	14.0																					
15	4.0	---	4.0	10.5	4.0	14.5																					
16	4.5	---	5.0	NP																							
17	4.5	---	5.0																								
18	4.5	---	5.0																								
19	5.0	---	6.0																								
	NP																										

NOTE: WSFU means water supply fixture units.

GPM means gallons per minute.

FM means predominately flushometer type water closets or syphon jet urinals. FT means predominately flush tank type water closets or wash down urinals. NP means not permitted, velocities exceed 8 feet per second.

For using this table, round the calculated pressure loss due to friction to the next higher number shown.

SPS 382.40 (7) (f) and (g) specifies minimum sizes for water distribution piping.

Table 382.40–5

MAXIMUM ALLOWABLE LOAD FOR COPPER TUBING–TYPE L, ASTM B88; (C=150)

Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	Pipe Diameter (in inches)																											
	1/2"			3/4"			1"			1 1/4"			1 1/2"			2"			2 1/2"			3"			4"		
		WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU	
	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT
0.5	0.5	---	0.5	2.0	---	2.0	4.0	---	4.0	7.0	---	9.0	11.0	4.0	15.0	23.0	7.5	37.0	40.0	30.0	86.0	65.0	90.0	200	136	462	561
1	1.0	---	1.0	2.5	---	2.5	5.5	---	6.5	10.0	4.0	13.0	16.0	5.0	23.0	33.0	17.5	63.0	59.0	72.0	170	94.0	211	345	198	909	923
2	1.5	---	1.5	4.0	---	4.0	8.5	---	10.5	14.5	4.5	20.5	23.0	7.5	37.0	48.0	44.0	120	86.0	175	305	137	468	566	288	1694	1694
3	2.0	---	2.0	5.0	---	6.0	10.5	4.0	14.0	18.5	6.0	27.5	29.0	12.5	52.0	60.0	75.0	175	107	283	410	169	698	752	298	1792	1792
4	2.0	---	2.0	6.0	---	7.0	12.0	4.0	16.5	21.5	7.0	33.0	34.0	18.5	66.0	70.0	108	225	119	356	469	NP			NP		
5	2.5	---	2.5	6.5	---	8.0	14.0	4.5	20.0	24.0	8.0	40.0	38.0	26.0	80.0	77.0	136	260	NP								
6	2.5	---	2.5	7.5	---	9.5	15.5	5.0	22.5	26.0	9.0	45.0	42.0	33.0	100	NP											
7	3.0	---	3.0	8.0	---	10.0	16.5	5.5	24.0	29.0	12.5	52.0	44.0	37.0	107												
8	3.0	---	3.0	8.5	---	10.5	18.0	6.0	26.5	31.0	15.0	58.0	NP														
9	3.5	---	3.5	9.5	---	12.5	19.0	6.0	28.0	NP																	
10	3.5	---	3.5	10.0	4.0	13.0	20.0	6.5	30.0																		
11	4.0	---	4.0	10.5	4.0	14.0	20.5	6.5	31.0																		
12	4.0	---	4.0	11.0	4.0	15.0	NP																				
13	4.0	---	4.0	11.5	4.0	15.5																					
14	4.5	---	5.0	12.0	4.0	16.5																					
15	4.5	---	5.0	NP																							
16	5.0	---	6.0																								
17	5.0	---	6.0																								
18	5.0	---	6.0																								
19	5.0	---	6.0																								
20	5.5	---	6.5																								
	NP																										

NOTE: WSFU means water supply fixture units.

GPM means gallons per minute.

FM means predominately flushometer type water closets or syphon jet urinals.

FT means predominately flush tank type water closets or wash down urinals. NP means not permitted, velocities exceed 8 feet per second.

For using this table, round the calculated pressure loss due to friction to the next higher number shown.

SPS 382.40 (7) (f) and (g) specifies minimum sizes for water distribution piping.

Table 382.40–6

MAXIMUM ALLOWABLE LOAD FOR COPPER TUBING–TYPE M, ASTM B88; (C=150)

Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	Pipe Diameter (in inches)																											
	1/2"			3/4"			1"			1 1/4"			1 1/2"			2"			2 1/2"			3"			4"		
		WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU	
	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT
0.5	0.5	---	0.5	2.0	---	2.0	4.0	---	4.0	7.0	---	9.0	11.5	4.0	15.5	23.0	7.5	37.0	42.0	33.0	100	67.0	96.0	210	139	481	577
1	1.0	---	1.0	3.0	---	3.0	6.0	---	7.0	10.5	4.0	14.0	16.5	5.5	24.0	34.0	18.5	66.0	61.0	77.0	180	97.0	227	360	202	945	953
2	1.5	---	1.5	4.5	---	5.0	9.0	---	11.5	15.5	5.0	22.5	24.0	8.0	40.0	50.0	48.0	128	88.0	184	315	141	493	588	294	1750	1750
3	2.0	---	2.0	5.5	---	6.5	11.5	4.0	15.5	19.5	6.5	29.0	30.0	13.5	55.0	62.0	80.0	185	110	300	425	174	731	776	303	1835	1835
4	2.5	---	2.5	6.5	---	8.0	13.0	4.5	18.0	22.0	7.0	35.0	35.0	20.0	70.0	73.0	120	240	121	374	484	NP			NP		
5	2.5	---	2.5	7.5	---	9.5	15.0	5.0	21.5	25.0	8.5	42.0	40.0	30.0	86.0	79.0	144	270	NP								
6	3.0	---	3.0	8.0	---	10.0	16.5	5.5	24.0	28.0	11.0	50.0	44.0	36.0	106	NP											
7	3.5	---	3.5	9.0	---	11.5	18.0	6.0	26.5	30.0	13.5	55.0	45.0	39.0	112												
8	3.5	---	3.5	9.5	---	12.5	19.5	6.5	29.0	32.0	17.0	62.0	NP														
9	4.0	---	4.0	10.0	4.0	13.0	20.5	6.5	31.0	NP																	
10	4.0	---	4.0	11.0	4.0	15.0	21.5	7.0	34.0																		
11	4.5	---	5.0	11.5	4.0	15.5	NP																				
12	4.5	---	5.0	12.0	4.0	16.5																					
13	5.0	---	6.0	12.5	4.5	17.5																					
14	5.0	---	6.0	12.5	4.5	18.0																					
15	5.0	---	6.0	NP																							
16	5.5	---	6.5																								
17	5.5	---	6.5																								
18	5.5	---	6.5																								
19	6.0	---	7.0																								
20	6.0	---	7.0																								
21	6.0	---	7.5																								
	NP																										

NOTE: WSFU means water supply fixture units.

GPM means gallons per minute.

FM means predominately flushometer type water closets or syphon jet urinals. FT means predominately flush tank type water closets or wash down urinals. NP means not permitted, velocities exceed 8 feet per second.

For using this table, round the calculated pressure loss due to friction to the next higher number shown.

SPS 382.40 (7) (f) and (g) specifies minimum sizes for water distribution piping.

Table 382.40–7

MAXIMUM ALLOWABLE LOAD FOR GALVANIZED STEEL PIPE, SCHEDULE 40, ASTM A53; (C=150)

Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	Pipe Diameter (in inches)																											
	1/2"			3/4"			1"			1 1/4"			1 1/2"			2"			2 1/2"			3"			4"		
		WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU	
	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT
0.5	0.5	---	0.5	1.5	---	1.5	3.5	---	3.5	7.0	---	9.0	11.0	4.0	15.0	21.0	7.0	32.0	34.0	18.5	66.0	60.0	75.0	175	123	381	490
1	1.0	---	1.0	2.5	---	2.5	5.0	---	6.0	10.5	4.0	14.0	16.0	5.0	23.0	31.0	15.0	57.0	49.0	46.0	124	87.0	180	310	179	769	805
2	1.5	---	1.5	4.0	---	4.0	7.5	---	9.5	15.5	5.0	22.5	23.0	7.5	37.0	45.0	38.0	110	72.0	116	235	127	406	511	260	1435	1435
3	2.0	---	2.0	5.0	---	6.0	9.0	---	11.5	19.0	6.0	28.0	29.0	12.5	52.0	56.0	65.0	155	89.0	188	320	158	607	683	317	1966	1966
4	2.5	---	2.5	5.5	---	6.5	11.0	4.0	15.0	22.0	7.0	35.0	34.0	18.5	66.0	65.0	90	200	104	266	395	184	809	837	NP		
5	3.0	---	3.0	6.5	---	8.0	12.0	4.0	16.5	25.0	8.5	42.0	38.0	26.0	80.0	74.0	124	245	118	350	465	NP					
6	3.0	---	3.0	7.0	---	9.0	13.5	4.5	19.0	28.0	11.0	50.0	42.0	33.0	100	81.0	152	280	119	358	471						
7	3.5	---	3.5	7.5	---	9.5	14.5	4.5	20.5	30.0	13.5	55.0	46.0	40.0	113	83.0	163	293	NP								
8	4.0	---	4.0	8.0	---	10.0	16.0	5.0	23.0	33.0	17.5	63.0	49.0	46.0	124	NP											
9	4.0	---	4.0	9.0	---	11.5	17.0	5.5	25.0	35.0	20.0	70.0	50.0	49.0	131												
10	4.5	---	5.0	9.5	---	12.5	18.0	6.0	26.5	37.0	24.0	76.0	NP														
11	4.5	---	5.0	10.0	4.0	13.0	19.0	6.0	28.0	37.0	24.0	77.0															
12	5.0	---	6.0	10.5	4.0	14.0	19.5	6.5	29.0	NP																	
13	5.0	---	6.0	11.0	4.0	15.0	20.5	6.5	31.0																		
14	5.0	---	6.0	11.0	4.0	15.0	21.5	7.0	33.0																		
15	5.5	---	6.5	11.5	4.0	15.5	NP																				
16	5.5	---	6.5	12.0	4.0	16.5																					
17	6.0	---	7.0	12.5	4.5	17.5																					
18	6.0	---	7.0	13.0	4.5	18.0																					
19	6.0	---	7.0	13.0	4.5	18.5																					
20	6.5	---	8.0	NP																							
21	6.5	---	8.0																								
22	7.0	---	9.0																								
23	7.0	---	9.0																								
24	7.0	---	9.0																								
25	7.5	---	9.5																								
	NP																										

NOTE: WSFU means water supply fixture units.

GPM means gallons per minute.

FM means predominately flushometer type water closets or syphon jet urinals. FT means predominately flush tank type water closets or wash down urinals. NP means not permitted, velocities exceed 8 feet per second.

For using this table, round the calculated pressure loss due to friction to the next higher number shown.

SPS 382.40 (7) (f) and (g) specifies minimum sizes for water distribution piping.

Table 382.40–8
CHLORINATED POLYVINYL CHLORIDE TUBING, ASTM D2846 and F442, SDR 11; (C=150)

Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	Pipe Diameter (in inches)																	
	1/2"			3/4"			1"			1 1/4"			1 1/2"			2"		
		WSFU			WSFU			WSFU			WSFU			WSFU			WSFU	
	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT
0.5	0.5	---	0.5	1.5	---	1.5	3.0	---	3.0	5.0	---	6.0	8.0	---	10.0	16.0	5.0	23.0
1	0.5	---	0.5	2.0	---	2.0	4.0	---	4.0	7.5	---	9.5	11.5	4.0	15.5	23.0	7.5	37.0
2	1.0	---	1.0	3.0	---	3.0	6.0	---	7.0	10.5	4.0	14.0	16.5	5.5	24.0	34.0	18.5	66.0
3	1.5	---	1.5	4.0	---	4.0	8.0	---	10.0	13.5	4.5	19.0	21.0	7.0	32.0	42.0	33.0	100
4	1.5	---	1.5	4.5	---	5.0	9.0	---	11.5	15.5	5.0	22.5	24.0	8.0	40.0	50.0	48.0	128
5	2.0	---	2.0	5.0	---	6.0	10.5	4.0	14.0	17.5	5.5	25.5	27.0	10.0	47.0	56.0	65.0	155
6	2.0	---	2.0	6.0	---	7.0	11.5	4.0	15.5	19.5	6.5	29.0	30.0	13.5	55.0	59.0	73.0	171
7	2.0	---	2.0	6.5	---	8.0	12.5	4.5	17.5	21.5	7.0	33.0	33.0	17.5	63.0	NP		
8	2.5	---	2.5	7.0	---	9.0	13.5	4.5	19.0	23.0	7.5	37.0	34.0	19.0	68.0			
9	2.5	---	2.5	7.0	---	9.0	14.5	4.5	20.5	24.0	8.0	40.0	NP					
10	2.5	---	2.5	7.5	---	9.5	15.0	5.0	21.5	24.0	8.0	41.0						
11	3.0	---	3.0	8.0	---	10.0	16.0	5.0	23.0	NP								
12	3.0	---	3.0	8.5	---	10.5	16.5	5.5	24.0									
13	3.0	---	3.0	9.0	---	11.5	NP											
14	3.0	---	3.0	9.5	---	12.5												
15	3.5	---	3.5	95	---	12.5												
16	3.5	---	3.5	10.0	4.0	13.0												
17	3.5	---	3.5	NP														
18	4.0	---	4.0															
19	4.0	---	4.0															
20	4.0	---	4.0															
21	4.0	---	4.0															
22	4.0	---	4.0															
23	4.5	---	5.0															
	NP																	

NOTE: WSFU means water supply fixture units.

GPM means gallons per minute.

FM means predominately flushometer type water closets or syphon jet urinals. FT means predominately flush tank type water closets or wash down urinals. NP means not permitted, velocities exceed 8 feet per second.

For using this table, round the calculated pressure loss due to friction to the next higher number shown.

SPS 382.40 (7) (f) and (g) specifies minimum sizes for water distribution piping.

Table 382.40–9

MAXIMUM ALLOWABLE LOAD FOR CROSSLINKED POLYETHYLENE (PEX) TUBING, ASTM F876 and F877; (C=150)

Pressure Loss Due to Friction (in lbs. per 100 ft. of Length)	Pipe Diameter (in inches)																				
	1/2"			5/8"			3/4"			1"			1 1/4"			1 1/2"			2"		
		WSFU			WSFU			WSFU			WSFU			WSFU			WSFU			WSFU	
	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT	GPM	FM	FT
0.5	0.5	---	0.5	0.5	---	0.5	1.0	---	1.0	2.5	---	2.5	4.0	---	4.0	6.5	---	8.0	13.5	4.5	19.0
1	0.5	---	0.5	1.0	---	1.0	1.5	---	1.5	3.5	---	3.5	6.0	---	7.0	9.5	---	12.5	19.5	6.5	29.0
2	1.0	---	1.0	1.5	---	1.5	2.5	---	2.5	5.0	---	6.0	9.0	---	11.5	14.0	4.5	20.0	28.0	11.0	50.0
3	1.0	---	1.0	2.0	---	2.0	3.0	---	3.0	6.5	---	8.0	11.0	4.0	15.0	17.5	5.5	25.5	36.0	22.0	73.0
4	1.5	---	1.5	2.5	---	2.5	4.0	---	4.0	7.5	---	9.5	13.0	4.5	18.0	20.5	6.5	31.0	42.0	33.0	100
5	1.5	---	1.5	3.0	---	3.0	4.5	---	5.0	8.5	---	10.5	15.0	5.0	21.5	23.0	7.5	37.0	47.0	42.0	116
6	2.0	---	2.0	3.0	---	3.0	5.0	---	6.0	9.5	---	12.5	16.5	5.5	24.0	25.0	8.5	42.0	51.0	53.0	135
7	2.0	---	2.0	3.5	---	3.5	5.5	---	6.5	10.5	4.0	14.0	18.0	6.0	26.5	28.0	11.0	50.0	NP		
8	2.0	---	2.0	3.5	---	3.5	5.5	---	6.5	11.0	4.0	15.0	19.0	6.0	28.0	30.0	13.5	55.0			
9	2.5	---	2.5	4.0	---	4.0	6.0	---	7.0	12.0	4.0	16.5	20.5	6.5	31.0	NP					
10	2.5	---	2.5	4.0	---	4.0	6.5	---	8.0	12.5	4.5	17.5	21.5	7.0	34.0						
11	2.5	---	2.5	4.5	---	5.0	7.0	---	9.0	13.5	4.5	19.0	NP								
12	2.5	---	2.5	4.5	---	5.0	7.0	---	9.0	14.0	4.5	20.0									
13	3.0	---	3.0	5.0	---	6.0	7.5	---	9.5	14.5	4.5	20.5									
14	3.0	---	3.0	5.0	---	6.0	8.0	---	10.0	NP											
15	3.0	---	3.0	5.5	---	6.5	8.0	---	10.0												
16	3.0	---	3.0	5.5	---	6.5	8.5	---	10.5												
17	3.5	---	3.5	5.5	---	6.5	8.5	---	11.0												
18	3.5	---	3.5	6.0	---	7.0	NP														
19	3.5	---	3.5	6.0	---	7.0															
20	3.5	---	3.5	6.0	---	7.5															
21	4.0	---	4.0	NP																	
	NP																				

NOTE: WSFU means water supply fixture units.

GPM means gallons per minute

FM means predominately flushometer type water closets or syphon jet urinals.

FT means predominately flush tank type water closets or wash down urinals. NP means – not permitted, velocities exceed 8 feet per second.

For using this table, round the calculated pressure loss due to friction to the next higher number shown.

SPS 382.40 (7) (f) and (g) specifies minimum sizes for water distribution piping.

Pressure

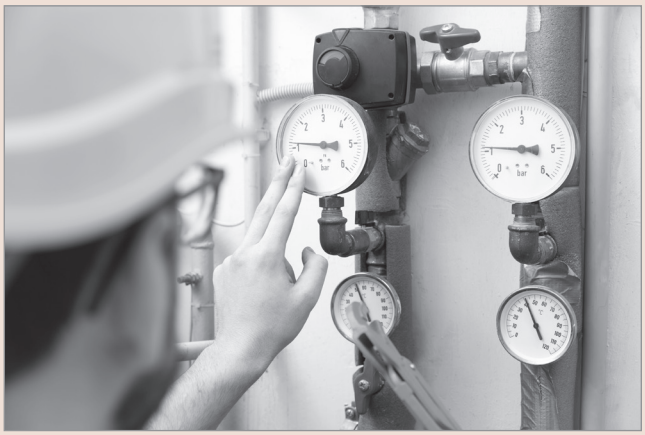
Water supply systems should be designed to provide at least 8 psig of flow pressure at the outlets of all fixture supplies.

The flow pressure at the outlets of the fixture supplies serving siphonic type urinals, washdown type urinals and washdown type water closets, siphonic type flushometer water closets and campsite water supply hose connections should be at least 15 psig.

The flow pressure at the outlets of the fixture supplies serving one piece tank type water closets, pressure balance mixing valves, manufactured homes, and thermostatic mixing valves should be at least 20 psig.

The flow pressure at the outlets of the fixture supplies serving blowout type urinals and blowout type water closets should be at least 25 psig.

If the water pressure available from a water main or private water supply exceeds 80 psig, a pressure reducing valve and strainer, if a strainer is not a component of the valve, should be installed in the water distribution system.



A pressure reducing valve required as described below should be installed upstream from all plumbing fixtures and plumbing appliances and downstream from the water meter of an utility, if a meter is provided.

A pressure reducing valve should not be required to be installed in a water distribution system which supplies water directly to a water pressure booster pump.

If the pressure available from the water main or private water supply is inadequate by calculation to provide the minimum pressures specified above, a hydropneumatic pressure booster system or a water pressure booster pump should be installed to increase the supply of water.

Each water pressure booster pump should be provided with an automatic low pressure cut–off switch. The cut–off switch should be located on the inlet side of the pump and should be set to terminate the energy supplied to the pump when a positive pressure of less than 10 psig occurs.

A vacuum relief valve not less than one–half inch in diameter should be installed in each water pressure tank, if the bottom of the pressure tank is more than 20 feet above any water supply outlet served by the pressure tank.

PART 2 EXAM QUESTIONS

75. Water supply systems should be designed to provide at least how much flow pressure at the outlets of all fixture supplies?

a. 7 psig
b. 8 psig
c. 9 psig
d. 10 psig

76. The flow pressure should be at least 15 psig at the outlets for which of the following:

a. Siphonic type urinals
b. Washdown type urinals and washdown type water closets
c. Siphonic type flushometer water closets
d. All of the above

77. At the outlets, what should the water pressure for campsite water supplies be?

a. 5 psig
b. 10 psig
c. 15 psig
d. 20 psig

78. The flow pressure at the outlets of the fixture supplies serving one piece tank type water closets, pressure balance mixing valves, manufactured homes, and thermostatic mixing valves should be at least what?

a. 5 psig
b. 10 psig
c. 15 psig
d. 20 psig

79. At the outlets, what should the water pressure for fixture supplies serving blowout type urinals and blowout type water closets be?

a. 25 psig
b. 30 psig
c. 35 psig
d. 40 psig

80. A pressure reducing valve and strainer, if a strainer is not a component of the valve, should be installed in the water distribution system if the water pressure available from a water main or private water supply exceeds what?

a. 70 psig
b. 80 psig
c. 90 psig
d. 100 psig

81. True or false? A pressure reducing valve should not be required to be installed in a water distribution system which supplies water directly to a water pressure booster pump.

a. True
b. False

82. If the pressure available from the water main or private water supply is inadequate by calculation to provide the minimum pressures specified above, a hydropneumatic pressure booster system or a water pressure booster pump should be installed to _____ the supply of water.

a. Maintain
b. Manage
c. Decrease
d. Increase

83. Where should the cut–off switch be located on a water pressure booster pump?

a. Inlet side
b. Outlet side
c. Top of the pump
d. Bottom of the pump

84. True or false? The automatic low pressure switch should terminate the energy supplied to the pump when a positive pressure of less than 10 psig occurs.

a. True
b. False

85. If the bottom of the pressure tank is more than 20 feet above any water supply outlet served by the pressure tank, a vacuum relief valve should not be less than how many inches in diameter?

a. 1/4
b. 1/2
c. 3/4
c. 1

Maximum velocity

A water distribution system should be designed so that the flow velocity does not exceed 8 feet per second.

Minimum sizes

Water distribution piping 1/2" in diameter serving 2 or more plumbing fixtures may not have a load of more than 2 water supply fixture units.

Water distribution piping 1/2" in diameter serving a shower which is not individually pressure balanced or individually thermostatically blended may not serve any additional fixtures.

Minimum sizes for fixture supplies

The fixture supplies serving all plumbing fixtures, appliances and pieces of equipment should be at least 1/2″ in diameter.

Fixture supplies serving syphon jet type urinals should be at least 3/4″ in diameter.

Fixture supplies serving flushometer type water closets should be at least one inch in diameter.

Fixture supplies serving emergency eye wash or shower outlets should be not less than recommended by the manufacturer.

Maximum lengths of fixture supply connectors

Fixture supply connectors may not exceed more than 24″ in developed length upstream from a plumbing fixture or the body of a faucet.

A fixture supply connector located downstream of a water cooler, water treatment device or water heater which individually serves a faucet or outlet may not exceed more than 10 feet in developed length.

A fixture supply connector located upstream of a water treatment device serving no more than 2 fixtures or outlets may not exceed 10 feet in developed length.

Fixture supply connectors may not extend more than 10 feet in developed length upstream of a plumbing appliance.

PART 2 EXAM QUESTIONS

86. What is the maximum velocity a water distribution system should be designed to allow?

a. 2 feet per second
b. 4 feet per second
c. 6 feet per second
d. 8 feet per second

87. Water distribution piping 1/2″ in diameter serving 2 or more plumbing fixtures may not have a load of how many water supply fixture units?

a. 1
b. 2 or more
c. Depends on the water velocity
d. No such requirement

88. True or false? Water distribution piping 1/2″ in diameter serving a shower which is not individually pressure balanced or individually thermostatically blended may serve any additional fixtures.

a. True
b. False

89. What is the minimum diameter in inches for the fixture supplies serving all plumbing fixtures, appliances and pieces of equipment?

a. 1/4
b. 1/2
c. 3/4
d. 1

90. Fixture supplies serving syphon jet type urinals should be at least what diameter in inches?

a. 1/4
b. 1/2
c. 3/4
d. 1

91. Fixture supplies serving flushometer type water closets should have at least what diameter in inches?

a. 1/4
b. /2
c. 3/4
d. 1

92. From a plumbing fixture or the body of a faucet, fixture supply connectors may not exceed what length in developed length upstream?

a. 6 inches
b. 12 inches
c. 24 inches
d. 36 inches

93. A fixture supply connector located downstream of a water cooler, water treatment device or water heater which individually serves a faucet or outlet may not exceed more than how many feet in developed length?

a. 5
b. 10
c. 15
d. 20

94. A fixture supply connector located _____ of a water treatment device serving no more than 2 fixtures or outlets may not exceed 10 feet in developed length.

a. Upstream
b. Downstream
c. Within 10 feet
d. Within 20 feet

Installation

Frost protection

Adequate measures should be taken to protect all portions of the water supply system from freezing. All private water mains and water services should be installed below the predicted depths of frost specified in chapter SPS 382.30 (11) (c) 2. d., Figure 382.30–1 and Table 382.30–6, unless other protective measures from freezing are taken.

A hose bib or a hydrant that penetrates an exterior wall of a heated structure should be a frost proof and self–draining type.

Location

Exterior water supply piping may not be located in, under or above sanitary sewer manholes, or POWTS treatment, holding or dispersal components.

If a private water main or a water service crosses a sanitary sewer, the water piping within 5 feet of the point of crossing should be installed in accordance with any of the following requirements:

- The water piping should be installed at least 12 inches above the top of the sewer.
- The water piping should be installed at least 18 inches below the bottom of the sewer.
- The water or sewer piping should be installed within a waterproof sleeve made of materials as specified for sanitary building sewers in chapter SPS 384.30 (2).
- Private water mains and water services should be installed at least 5 feet horizontally from any sanitary sewer.

Note: The Department of Natural Resources has limitations for the separation of water mains and sanitary sewers.

Private water mains and water services may be installed less than 5 feet horizontally from a pressurized sanitary sewer if all of the following conditions are met:

- The bottom of the water piping is installed at least 18 inches above the pressurized sewer.
- The water piping is installed at least 3 feet horizontally from the pressurized sewer.

Private water mains and water services may be installed less than 5 feet horizontally from a non–pressurized sanitary sewer if any of the following conditions are met:

- The bottom of the water piping is installed at least 12 inches above the sewer.
- The sewer is constructed of materials listed in Table 384.30–2.
- The water service is 2 inches or less in diameter and is located more than 24 inches from the sewer.

The portion of a private water main or water service within 5 feet of developed length from the point where the water service first enters the building may be less than 12 inches above the sewer and within 24 inches of the sewer.

No private water main or water service may be installed within 6 inches of a storm sewer.

No underground water supply storage tank should be installed within 8 feet of a storage vessel containing a substance of a higher hazard than that contained in the water supply storage tank.

PART 2 EXAM QUESTIONS

95. A hose bib or a hydrant that penetrates an exterior wall of a heated structure should be frost proof and what type of draining?

a. Self–draining
b. Organic draining
c. Mechanical draining
d. Quick draining

96. Where may exterior water supply piping not be located?

a. Under or above sanitary sewer manholes
b. POWTS treatment
c. Holding or dispersal components
d. All of the above

97. If a private water main or a water service crosses a sanitary sewer, the water piping within 5 feet of the point of crossing should be installed in accordance with this requirement: at least _____ inches above the top of the sewer and at least _____ inches below the bottom of the sewer.

a. 6, 9
b. 10, 20
c. 12, 18
d. 16, 22

98. True or false? The Department of Natural Resources has limitations for the separation of water mains and sanitary sewers.

a. True
b. False

99. The portion of a private water main or water service within 5 feet of developed length from the point where the water service first enters the building may be less than _____ inches above the sewer and within _____ inches of the sewer.

a. 6, 12
b. 12, 24
c. 24, 36
d. 36, 48

100. A private water main or water service can be installed within how many inches of a storm sewer?

a. 2
b. 4
c. 6
d. 8

101. No underground water supply storage tank should be installed within how many feet of a storage vessel containing a substance of a higher hazard than that contained in the water supply storage tank?

a. 2
b. 4
c. 6
d. 8

Limitations

No private water main or water service may pass through or under a building to serve another building unless one of the following conditions are met:

- The private water main or water service serves farm buildings or farm houses, or both that are all located on one property.
- The private water main or water service serves buildings that are located on the same property and a document which indicates that the piping and distribution arrangement for the property and buildings will be recorded with the register of deeds no later than 90 days after installation.

Water distribution piping

Water distribution piping should be supported in accordance with chapter SPS 382.60. Provisions should be made to evacuate all water out of the water distribution system.

Except where parallel water meters are installed, water distribution piping should be provided to bypass a water meter 1½" or larger.

The minimum diameter of water distribution piping serving as a meter bypass should be one nominal pipe size smaller than the meter.

A bypass should be provided to serve a water treatment device. The bypass piping may be an internal part of the water treatment device.

A bypass should not be required when a water treatment device serves no more than 2 fixtures or outlets.

A bypass should be prohibited for a water treatment device installed to reduce a contaminant in order to comply with the provisions in chapter SPS 382.70 (3).

PART 2 EXAM QUESTIONS

102. In order for a private water main or water service to pass through or under a building to serve another building, the private water main or water service buildings must be located on the same property and a document indicating that the piping and distribution arrangement for the property and buildings will be recorded with the register of deeds no later than how many days after installation?

a. 30
b. 60
c. 90
d. 120

103. Water distribution piping should be supported in accordance with what chapter of SPS?

a. 382.60
b. 392.70
c. 402.89
d. 412.50

104. Provisions should be made to evacuate _____ of the water out of the water distribution system.

a. 1/3
b. 1/2
c. All
d. No such requirement

105. Except where parallel water meters are installed, water distribution piping should be provided to bypass a water meter at least how large?

a. 1/4 inch
b. 1/2 inch
c. 1 inch
d. 1–1/2 inches

106. The minimum diameter of water distribution piping serving as a meter bypass should be how many nominal pipe sizes smaller than the meter?

a. 0
b. 1
c. 2
d. 3

107. A bypass should be _____ for a water treatment device installed to reduce a contaminant in order to comply with the provisions in chapter SPS 382.70 (3).

a. Prohibited
b. Accepted
c. Established
d. Installed

Valves

All control valves installed in a water service, except a valve serving only as a corporation cock, should be accessible.

Stop–type and waste–type control valves may not be installed underground except in the following situations:

- Fire hydrants intended for firefighting.
- Two–inch and larger diameter hydrants serving municipal wastewater treatment plants.
- Emergency fixtures.

All control valves and fixture stop valves installed in a water distribution system should be accessible. Control valves for the individual plumbing fixtures and appliances within dwelling units should be accessible from within the dwelling unit.

Water hammer arrestors

All plumbing fixtures, appliances and appurtenances with 3/8" or larger inlet openings and with solenoid actuated quick closing valves should be provided with water hammer arrestors. Water hammer arrestors should be installed in the fixture supplies serving the fixtures, appliances or appurtenances. Water hammer arrestors should be accessible.

Temperature control

The water temperature to all showers in public buildings should be controlled by thermostatic or combination thermostatic–pressure balanced mixing valves or by individually controlled pressure balanced mixing valves. A thermostatic or combination thermostatic–pressure balanced mixing valve may not be bypassed.

Fittings and connections

The drilling and tapping of water supply piping should be prohibited except for:

- Corporation cocks for a water service or a private water main.
- Self–tapping valves which serve individual plumbing appliances.

PART 2 EXAM QUESTIONS

108. Stop–type and waste–type control valves may not be installed underground except in which of the following situation:

a. Fire hydrants intended for firefighting
b. Two–inch and larger diameter hydrants serving municipal wastewater treatment plants
c. Emergency fixtures
d. All of the above

109. True or false? All plumbing fixtures, appliances and appurtenances with 5/8" or larger inlet openings and with solenoid actuated quick closing valves should be provided with water hammer arrestors.

a. True
b. False

110. Water hammer arrestors should be installed in the fixture supplies serving which of the following?

a. Fixtures
b. Appliances
c. Appurtenances
d. All of the above

111. True or false? A thermostatic or combination thermostatic–pressure balanced mixing valve may be bypassed.

a. True
b. False

112. The _____ and _____ of water supply piping should be prohibited except for two exceptional situations.

a. Drilling, tapping
b. Altering, moving
c. Puncturing, shifting
d. Modifying, transforming

Flushing and disinfection of potable water supply systems

Before a newly constructed water supply system is to be put into use, the piping of the system should be filled with water and allowed to stand for at least 24 hours. After 24 hours each water outlet should be flushed beginning with the outlet closest to the building control valve and then each successive outlet in the system. The flushing at each water outlet should continue for at least one minute and until the water appears clear at the outlet.

Each portion of a water supply system which is altered or repaired should be flushed for at least one minute and until the water appears clear.

New private water mains and extensions to private water mains should be disinfected prior to use in accordance with AWWA C651 or the following method:

The pipe system should be flushed with clean water until no dirty water appears at the points of outlet.

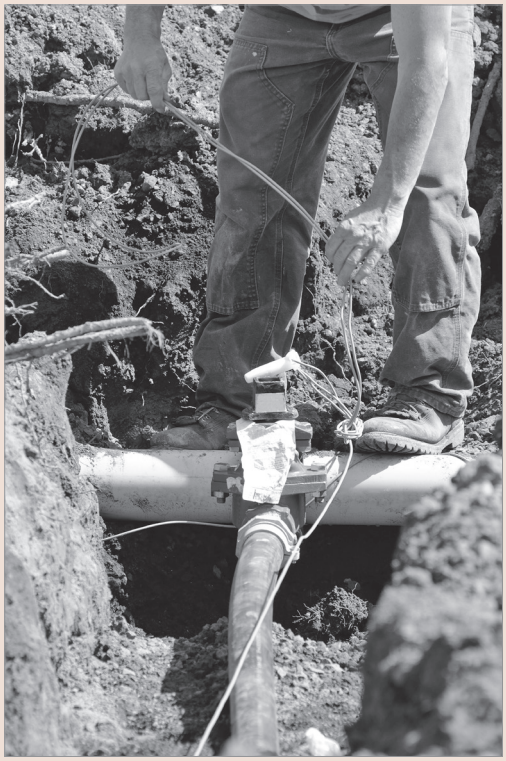
The system or part thereof should be filled with a solution of water and chlorine containing at least 50 parts per million of chlorine and the system or part thereof should be valved off and allowed to stand for 24 hours or the system or part thereof should be filled with a solution of water and chlorine containing at least 200 parts per million of chlorine and allowed to stand for 3 hours.

Following the allowed standing time, the system should be flushed with clean potable water.

The procedures should be repeated if it is shown by a bacteriological examination that contamination still exists in the system.

The department may require a water quality analysis to be done for a new or repaired water supply system. The analysis should be performed in accordance with acceptable nationally recognized laboratory practices. If the water supply system has been disinfected, water samples for the analysis may not be taken sooner than 24 hours after disinfection.

New or repaired combination water services or combination private water mains should be flushed and disinfected prior to use in accordance with NFPA 24.



Water softeners

Ion exchange water softeners used primarily for water hardness reduction that, during regeneration, discharge a brine solution should be of a demand initiated regeneration type equipped with a water meter or a sensor unless a wastewater treatment system downstream of the water softener specifically documents the reduction of chlorides.

Locating requirements

A means to locate buried non– metallic water services and private water mains connected to municipal supply systems should be provided in accordance with the options under chapter SPS 382.30 (11) (h).

Tracer wire insulation color for non–metallic, potable water pipe should be blue. Tracer wire insulation color for non–metallic, non–potable water pipe should be purple.

PART 2 EXAM QUESTIONS

113. Before a newly constructed water supply system is to be put into use, the piping of the system should be filled with water and allowed to stand for at least how many hours?

a. 12
b. 24
c. 36
d. 48

114. The flushing at each water outlet should continue until the water appears clear at the outlet and for at least how long?

a. 30 seconds
b. 1 minute
c. 2 minutes
d. 5 minutes

115. New private water mains and extensions to private water mains should be disinfected prior to use in accordance with which AWWA policy?

a. A937
b. B506
c. C651
d. D422

116. If the system or part thereof is filled with a solution of water and chlorine containing at least 50 parts per million of chlorine and the system or part thereof should be valved off and allowed to stand for how many hours?

a. 3
b. 6
c. 12
d. 24

117. If the system or part thereof is filled with a solution of water and chlorine containing at least 200 parts per million of chlorine and the system or part thereof should be valved off and allowed to stand for how many hours?

a. 3
b. 6
c. 12
d. 24

118. New or repaired combination water services or combination private water mains should be flushed and disinfected prior to use in accordance with what NFPA policy?

a. 17
b. 24
c. 58
d. 91

119. _____ exchange water softeners used primarily for water hardness reduction that, during regeneration, discharge a brine solution should be of a demand initiated regeneration type equipped with a water meter or a sensor unless a wastewater treatment system downstream of the water softener specifically documents the reduction of chlorides.

a. Ion
b. Iron
c. Chlorine
d. Chloride

120. Tracer wire insulation color for non–metallic, potable water pipe should be what color?

a. Red
b. Green
c. Purple
d. Blue