

**Wisconsin Contractors Institute**  
N16 W23217 Stone Ridge Drive  
Suite 290  
Waukesha, WI 53188

We have enclosed the following courses for you:

<u>Course Name</u>	<u>Course Hours</u>	<u>Price</u>
SPS 384 Plumbing	3	
ADA Requirements	6	
Water Heaters Systems	4	
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<b>Total</b>	<b>13</b>	<b>\$99</b>

Here are the 2 steps required to complete the courses:

1. **Read the enclosed courses** and fill out the answer sheets found in the booklets.
2. **Submit your exams.** You can mail the answer sheets and payment to Wisconsin Contractors Institute, N16W23217 Stone Ridge Dr., Suite 290, Waukesha, WI 53188. (Or you can fax or email the answer sheets to us: 888-246-9280; [wcecu@gmail.com](mailto:wcecu@gmail.com))

If you have any other questions, please feel free to give us a call at 262-409-4282.

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# **Wisconsin Contractors Institute**

## **Continuing Education**

**ADA Requirements – Plumbing Elements**

**Course #13047 – 6 hours**

**Wisconsin Contractors Institute**  
**N16 W23217 Stone Ridge Drive, Suite 290**  
**Waukesha, WI 53188**  
[www.wciceu.com](http://www.wciceu.com)  
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## ADA PLUMBING ELEMENTS AND FACILITIES

The Department of Justice published revised regulations for Titles II and III of the Americans with Disabilities Act of 1990 "ADA" in the *Federal Register* on September 15, 2010. These regulations adopted revised, enforceable accessibility standards called the 2010 ADA Standards for Accessible Design "2010 Standards" or "Standards". The 2010 Standards set minimum requirements – both scoping and technical – for newly designed and constructed or altered State and local government facilities, public accommodations, and commercial facilities to be readily accessible to and usable by individuals with disabilities.

This course focuses on chapter 6 of the standards, which relates to plumbing elements and facilities.

### **602 Drinking Fountains**

**602.1 General.** Drinking fountains shall comply with 307 and 602.

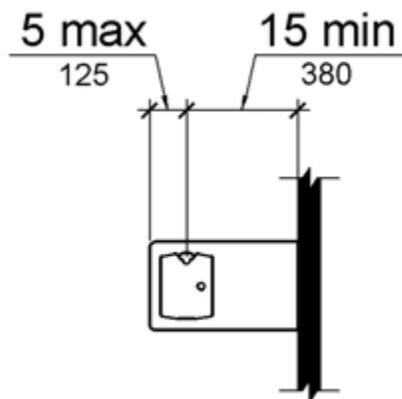
**602.2 Clear Floor Space.** Units shall have a clear floor or ground *space* complying with 305 positioned for a forward approach and centered on the unit. Knee and toe clearance complying with 306 shall be provided.

**EXCEPTION:** A parallel approach complying with 305 shall be permitted at units for *children's use* where the spout is 30 inches (760 mm) maximum above the finish floor or ground and is 3½ inches (90 mm) maximum from the front edge of the unit, including bumpers.

**602.3 Operable Parts.** *Operable parts* shall comply with 309.

**602.4 Spout Height.** Spout outlets shall be 36 inches (915 mm) maximum above the finish floor or ground.

**602.5 Spout Location.** The spout shall be located 15 inches (380 mm) minimum from the vertical support and 5 inches (125 mm) maximum from the front edge of the unit, including bumpers.



**Figure 602.5 - Drinking Fountain Spout Location**

**602.6 Water Flow.** The spout shall provide a flow of water 4 inches (100 mm) high minimum and shall be located 5 inches (125 mm) maximum from the front of the unit. The angle of the water stream shall be measured horizontally relative to the front face of the unit. Where spouts are located less than 3 inches (75 mm) of the front of the unit, the angle of the water stream shall be 30 degrees maximum. Where spouts are located between 3 inches (75 mm) and 5 inches (125 mm) maximum from the front of the unit, the angle of the water stream shall be 15 degrees maximum.

**Advisory 602.6 Water Flow.** The purpose of requiring the drinking fountain spout to produce a flow of water 4 inches (100 mm) high minimum is so that a cup can be inserted under the flow of water to provide a drink of water for an individual who, because of a disability, would otherwise be incapable of using the drinking fountain.

**602.7 Drinking Fountains for Standing Persons.** Spout outlets of drinking fountains for standing persons shall be 38 inches (965 mm) minimum and 43 inches (1090 mm) maximum above the finish floor or ground.

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**EXAM QUESTIONS:**

- 1.) For drinking fountains, the spout outlets should be \_\_\_\_\_ inches maximum above the floor.
    - a. 30
    - b. 36
    - c. 42
    - d. 48
  
  - 2.) The spout of a drinking fountain should be located \_\_\_\_\_ inches maximum for the front edge of the unit.
    - a. 5
    - b. 10
    - c. 15
    - d. 20
  
  - 3.) The spout of a water fountain shall provide a flow of water \_\_\_\_\_ inches high minimum.
    - a. 2
    - b. 3
    - c. 4
    - d. 5
  
  - 4.) The purpose of requiring the drinking fountain spout to produce a flow of water 4 inches high minimum is so that a cup can be inserted under the flow of water to provide a drink of water for an individual who, because of a disability, would otherwise be incapable of using the drinking fountain.
    - a. True
    - b. False
  
  - 5.) Spout outlets of drinking fountains for standing persons shall be \_\_\_\_\_ maximum above the floor.
    - a. 38
    - b. 40
    - c. 43
    - d. 45
- 

**603 Toilet and Bathing Rooms**

**603.1 General.** Toilet and bathing rooms shall comply with 603.

**603.2 Clearances.** Clearances shall comply with 603.2.

**603.2.1 Turning Space.** Turning *space* complying with 304 shall be provided within the room.

**603.2.2 Overlap.** Required clear floor *spaces*, clearance at fixtures, and turning *space* shall be permitted to overlap.

**603.2.3 Door Swing.** Doors shall not swing into the clear floor *space* or clearance required for any fixture. Doors shall be permitted to swing into the required turning *space*.

**EXCEPTIONS: 1.** Doors to a toilet room or bathing room for a single occupant accessed only through a private office and not for *common use* or *public use* shall be permitted to swing into the clear floor *space* or clearance provided the swing of the door can be reversed to comply with 603.2.3.

**2.** Where the toilet room or bathing room is for individual use and a clear floor *space* complying with 305.3 is provided within the room beyond the arc of the door swing, doors shall be permitted to swing into the clear floor *space* or clearance required for any fixture.

**Advisory 603.2.3 Door Swing Exception 1.** At the time the door is installed, and if the door swing is reversed in the future, the door must meet all the requirements specified in 404. Additionally, the door swing cannot reduce the required width of an accessible route. Also, avoid violating other building or life safety codes when the door swing is reversed.

**603.3 Mirrors.** Mirrors located above lavatories or countertops shall be installed with the bottom edge of the reflecting surface 40 inches (1015 mm) maximum above the finish floor or ground. Mirrors not located above lavatories or countertops shall be installed with the bottom edge of the reflecting surface 35 inches (890 mm) maximum above the finish floor or ground.

**Advisory 603.3 Mirrors.** A single full-length mirror can accommodate a greater number of people, including children. In order for mirrors to be usable by people who are ambulatory and people who use wheelchairs, the top edge of mirrors should be 74 inches (1880 mm) minimum from the floor or ground.

**603.4 Coat Hooks and Shelves.** Coat hooks shall be located within one of the reach ranges specified in 308. Shelves shall be located 40 inches (1015 mm) minimum and 48 inches (1220 mm) maximum above the finish floor.

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**6.) Mirrors located above lavatories or countertops shall be installed with the bottom edge of the reflecting surface \_\_\_\_\_ inches maximum above the floor.**

- a. 10
- b. 20
- c. 30
- d. 40

**7.) Shelves shall be located \_\_\_\_\_ inches maximum above the finish floor.**

- a. 40
- b. 44
- c. 48
- d. 52

8.) Bathroom doors shall be permitted to swing into the required turning *space*.

- a. True
- b. False

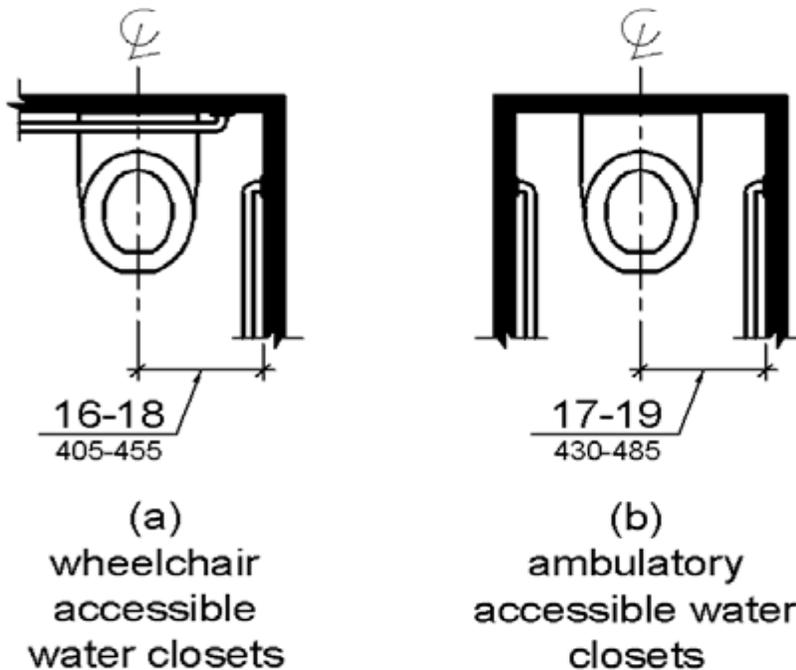
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## **604 Water Closets and Toilet Compartments**

**604.1 General.** Water closets and toilet compartments shall comply with 604.2 through 604.8.

**EXCEPTION:** Water closets and toilet compartments for *children's use* shall be permitted to comply with 604.9.

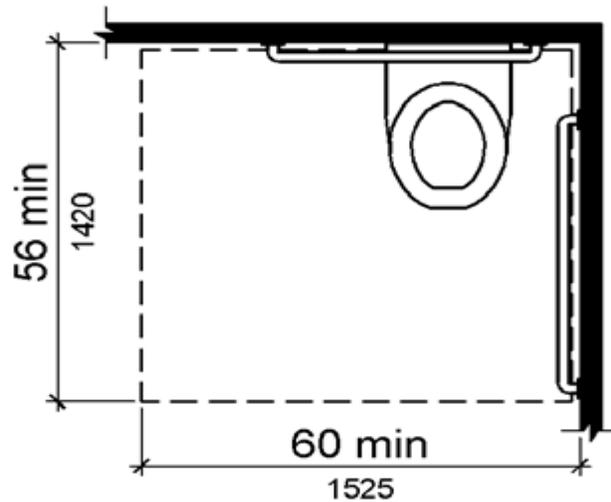
**604.2 Location.** The water closet shall be positioned with a wall or partition to the rear and to one side. The centerline of the water closet shall be 16 inches (405 mm) minimum to 18 inches (455 mm) maximum from the side wall or partition, except that the water closet shall be 17 inches (430 mm) minimum and 19 inches (485 mm) maximum from the side wall or partition in the ambulatory *accessible* toilet compartment specified in 604.8.2. Water closets shall be arranged for a left-hand or right-hand approach.



**Figure 604.2 - Water Closet Location**

**604.3 Clearance.** Clearances around water closets and in toilet compartments shall comply with 604.3.

**604.3.1 Size.** Clearance around a water closet shall be 60 inches (1525 mm) minimum measured perpendicular from the side wall and 56 inches (1420 mm) minimum measured perpendicular from the rear wall.

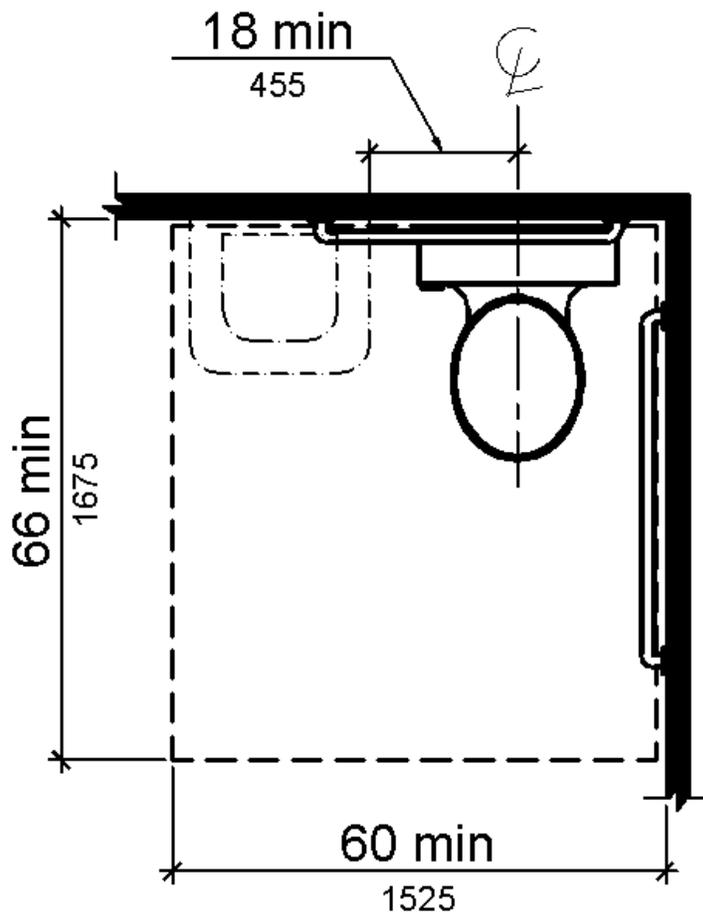


**Figure 604.3.1 - Size of Clearance at Water Closets**

**604.3.2 Overlap.** The required clearance around the water closet shall be permitted to overlap the water closet, associated grab bars, dispensers, sanitary napkin disposal units, coat hooks, shelves, *accessible* routes, clear floor *space* and clearances required at other fixtures, and the turning *space*. No other fixtures or obstructions shall be located within the required water closet clearance.

**EXCEPTION:** In *residential dwelling units*, a lavatory complying with 606 shall be permitted on the rear wall 18 inches (455 mm) minimum from the water closet centerline where the clearance at the water closet is 66 inches (1675 mm) minimum measured perpendicular from the rear wall.

**Advisory 604.3.2 Overlap.** When the door to the toilet room is placed directly in front of the water closet, the water closet cannot overlap the required maneuvering clearance for the door inside the room.



**Figure 604.3.2 (Exception) - Overlap of Water Closet Clearance in Residential Dwelling Units**

**604.4 Seats.** The seat height of a water closet above the finish floor shall be 17 inches (430 mm) minimum and 19 inches (485 mm) maximum measured to the top of the seat. Seats shall not be sprung to return to a lifted position.

**EXCEPTIONS: 1.** A water closet in a toilet room for a single occupant accessed only through a private office and not for *common use* or *public use* shall not be required to comply with 604.4.2. **2.** In *residential dwelling units*, the height of water closets shall be permitted to be 15 inches (380 mm) minimum and 19 inches (485 mm) maximum above the finish floor measured to the top of the seat.

**604.5 Grab Bars.** Grab bars for water closets shall comply with 609. Grab bars shall be provided on the side wall closest to the water closet and on the rear wall.

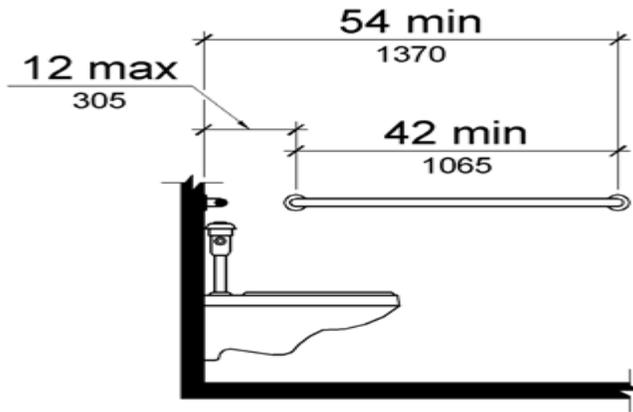
**EXCEPTIONS: 1.** Grab bars shall not be required to be installed in a toilet room for a single occupant accessed only through a private office and not for *common use* or *public use* provided that reinforcement has been installed in walls and located so as to permit the installation of grab bars complying with 604.5.

**2.** In *residential dwelling units*, grab bars shall not be required to be installed in toilet or bathrooms provided that reinforcement has been installed in walls and located so as to permit the installation of grab bars complying with 604.5.

**3.** In detention or correction *facilities*, grab bars shall not be required to be installed in housing or holding cells that are specially designed without protrusions for purposes of suicide prevention.

**Advisory 604.5 Grab Bars Exception 2.** Reinforcement must be sufficient to permit the installation of rear and side wall grab bars that fully meet all accessibility requirements including, but not limited to, required length, installation height, and structural strength.

**604.5.1 Side Wall.** The side wall grab bar shall be 42 inches (1065 mm) long minimum, located 12 inches (305 mm) maximum from the rear wall and extending 54 inches (1370 mm) minimum from the rear wall.

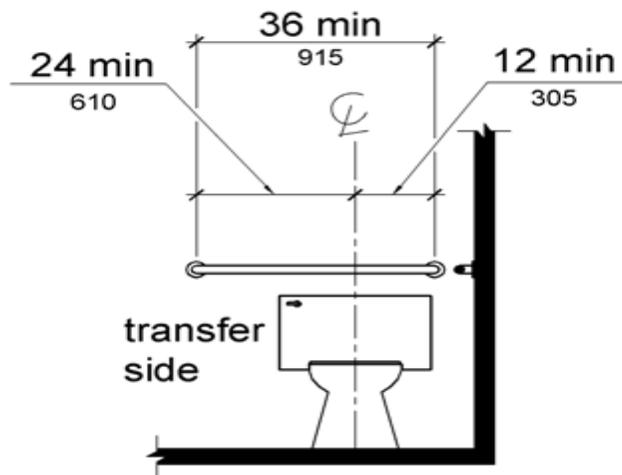


**Figure 604.5.1 - Side Wall Grab Bar at Water Closets**

**604.5.2 Rear Wall.** The rear wall grab bar shall be 36 inches (915 mm) long minimum and extend from the centerline of the water closet 12 inches (305 mm) minimum on one side and 24 inches (610 mm) minimum on the other side.

**EXCEPTIONS: 1.** The rear grab bar shall be permitted to be 24 inches (610 mm) long minimum, centered on the water closet, where wall *space* does not permit a length of 36 inches (915 mm) minimum due to the location of a recessed fixture adjacent to the water closet.

**2.** Where an *administrative authority* requires flush controls for flush valves to be located in a position that conflicts with the location of the rear grab bar, then the rear grab bar shall be permitted to be split or shifted to the open side of the toilet area.



**Figure 604.5.2 - Rear Wall Grab Bar at Water Closets**

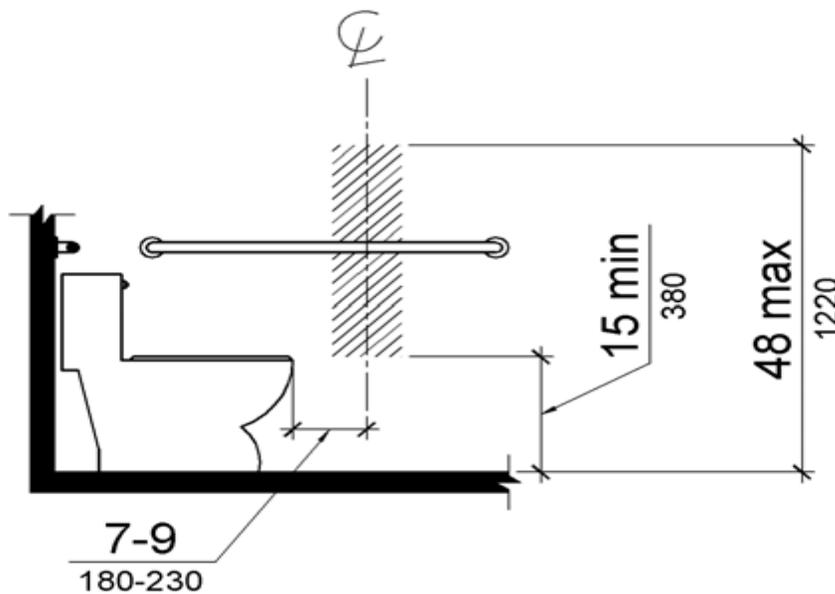
**604.6 Flush Controls.** Flush controls shall be hand operated or automatic. Hand operated flush controls shall comply with 309. Flush controls shall be located on the open side of the water closet except in ambulatory *accessible* compartments complying with 604.8.2.

**604.7 Dispensers.** Toilet paper dispensers shall comply with 309.4 and shall be 7 inches (180 mm) minimum and 9 inches (230 mm) maximum in front of the water closet measured to the centerline of the dispenser. The outlet of the dispenser shall be 15 inches (380 mm) minimum and 48 inches (1220 mm) maximum above the

finish floor and shall not be located behind grab bars. Dispensers shall not be of a type that controls delivery or that does not allow continuous paper flow.

**Advisory 604.6 Flush Controls.** If plumbing valves are located directly behind the toilet seat, flush valves and related plumbing can cause injury or imbalance when a person leans back against them. To prevent causing injury or imbalance, the plumbing can be located behind walls or to the side of the toilet; or if approved by the local authority having jurisdiction, provide a toilet seat lid.

**Advisory 604.7 Dispensers.** If toilet paper dispensers are installed above the side wall grab bar, the outlet of the toilet paper dispenser must be 48 inches (1220 mm) maximum above the finish floor and the top of the gripping surface of the grab bar must be 33 inches (840 mm) minimum and 36 inches (915 mm) maximum above the finish floor.



**Figure 604.7 - Dispenser Outlet Location**

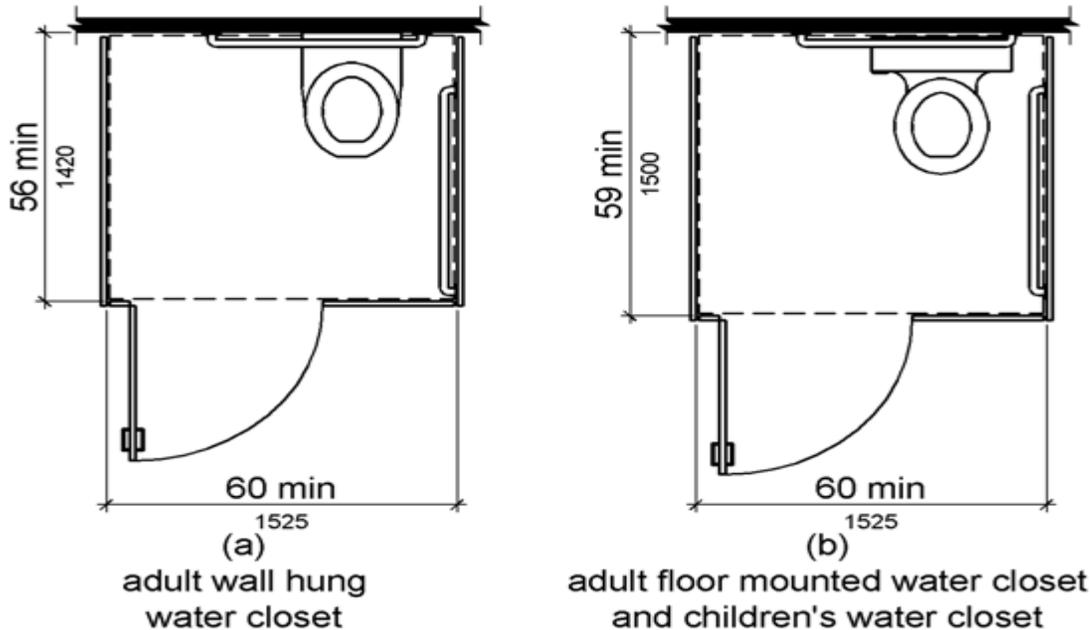
**604.8 Toilet Compartments.** Wheelchair *accessible* toilet compartments shall meet the requirements of 604.8.1 and 604.8.3. Compartments containing more than one plumbing fixture shall comply with 603. Ambulatory *accessible* compartments shall comply with 604.8.2 and 604.8.3.

**604.8.1 Wheelchair Accessible Compartments.** Wheelchair *accessible* compartments shall comply with 604.8.1.

**604.8.1.1 Size.** Wheelchair *accessible* compartments shall be 60 inches (1525 mm) wide minimum measured perpendicular to the side wall, and 56 inches (1420 mm) deep minimum for wall hung water closets and 59 inches (1500 mm) deep minimum for floor mounted water closets measured perpendicular to the rear wall. Wheelchair *accessible* compartments for *children's use* shall be 60 inches (1525 mm) wide minimum measured perpendicular to the side wall, and 59 inches (1500 mm) deep minimum for wall hung and floor mounted water closets measured perpendicular to the rear wall.

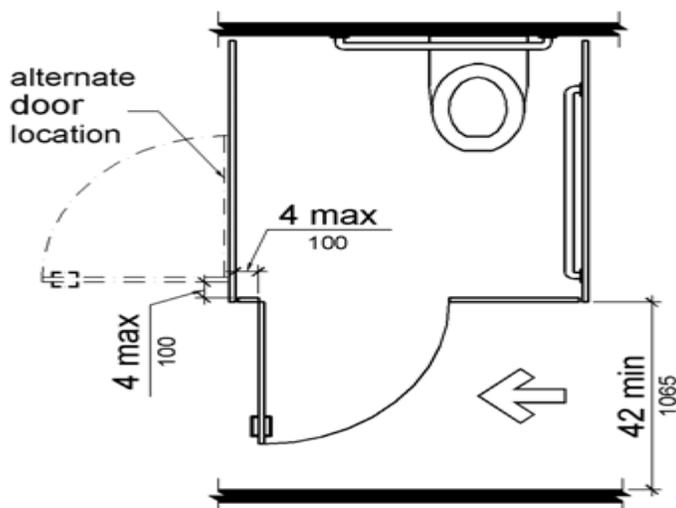
**Advisory 604.8.1.1 Size.** The minimum space required in toilet compartments is provided so that a person using a wheelchair can maneuver into position at the water closet. This space cannot be obstructed by baby changing tables or other fixtures or conveniences, except as specified at 604.3.2 (Overlap). If toilet compartments are to be used to house fixtures other than those associated with the water closet, they must be designed to exceed the minimum space requirements. Convenience fixtures such as baby changing tables must also be accessible to people with disabilities as well as to other users. Toilet compartments that are designed to meet, and not exceed,

the minimum space requirements may not provide adequate space for maneuvering into position at a baby changing table.



**Figure 604.8.1.1 - Size of Wheelchair Accessible Toilet Compartment**

**604.8.1.2 Doors.** Toilet compartment doors, including door hardware, shall comply with 404 except that if the approach is to the latch side of the compartment door, clearance between the door side of the compartment and any obstruction shall be 42 inches (1065 mm) minimum. Doors shall be located in the front partition or in the side wall or partition farthest from the water closet. Where located in the front partition, the door opening shall be 4 inches (100 mm) maximum from the side wall or partition farthest from the water closet. Where located in the side wall or partition, the door opening shall be 4 inches (100 mm) maximum from the front partition. The door shall be self-closing. A door pull complying with 404.2.7 shall be placed on both sides of the door near the latch. Toilet compartment doors shall not swing into the minimum required compartment area.



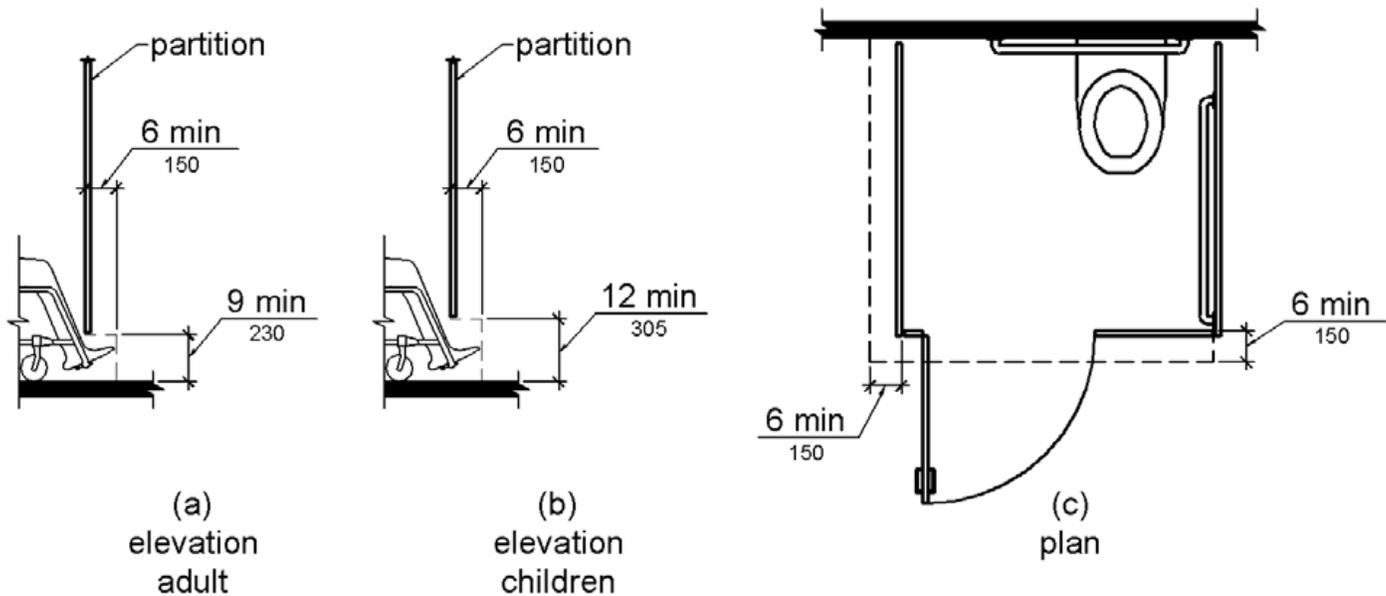
**Figure 604.8.1.2 - Wheelchair Accessible Toilet Compartment Doors**

**604.8.1.3 Approach.** Compartments shall be arranged for left-hand or right-hand approach to the water closet.

**604.8.1.4 Toe Clearance.** The front partition and at least one side partition shall provide a toe clearance of 9 inches (230 mm) minimum above the finish floor and 6 inches (150 mm) deep minimum beyond the

compartment-side face of the partition, exclusive of partition support members. Compartments for *children's use* shall provide a toe clearance of 12 inches (305 mm) minimum above the finish floor.

**EXCEPTION:** Toe clearance at the front partition is not required in a compartment greater than 62 inches (1575 mm) deep with a wall-hung water closet or 65 inches (1650 mm) deep with a floor-mounted water closet. Toe clearance at the side partition is not required in a compartment greater than 66 inches (1675 mm) wide. Toe clearance at the front partition is not required in a compartment for *children's use* that is greater than 65 inches (1650 mm) deep.



**Figure 604.8.1.4 - Wheelchair Accessible Toilet Compartment Toe Clearance**

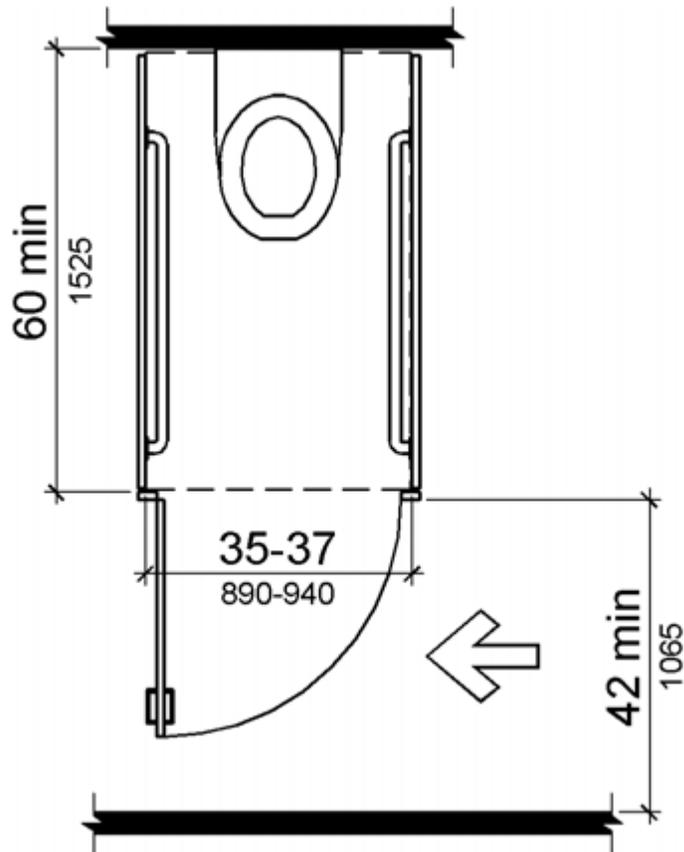
**604.8.1.5 Grab Bars.** Grab bars shall comply with 609. A side-wall grab bar complying with 604.5.1 shall be provided and shall be located on the wall closest to the water closet. In addition, a rear-wall grab bar complying with 604.5.2 shall be provided.

**604.8.2 Ambulatory Accessible Compartments.** Ambulatory *accessible* compartments shall comply with 604.8.2.

**604.8.2.1 Size.** Ambulatory *accessible* compartments shall have a depth of 60 inches (1525 mm) minimum and a width of 35 inches (890 mm) minimum and 37 inches (940 mm) maximum.

**604.8.2.2 Doors.** Toilet compartment doors, including door hardware, shall comply with 404, except that if the approach is to the latch side of the compartment door, clearance between the door side of the compartment and any obstruction shall be 42 inches (1065 mm) minimum. The door shall be self-closing. A door pull complying with 404.2.7 shall be placed on both sides of the door near the latch. Toilet compartment doors shall not swing into the minimum required compartment area.

**604.8.2.3 Grab Bars.** Grab bars shall comply with 609. A side-wall grab bar complying with 604.5.1 shall be provided on both sides of the compartment.



**Figure 604.8.2 - Ambulatory Accessible Toilet Compartment**

**604.8.3 Coat Hooks and Shelves.** Coat hooks shall be located within one of the reach ranges specified in 308. Shelves shall be located 40 inches (1015 mm) minimum and 48 inches (1220 mm) maximum above the finish floor.

**604.9 Water Closets and Toilet Compartments for Children's Use.** Water closets and toilet compartments for *children's use* shall comply with 604.9.

**Advisory 604.9 Water Closets and Toilet Compartments for Children's Use.** The requirements in 604.9 are to be followed where the exception for children's water closets in 604.1 is used. The following table provides additional guidance in applying the specifications for water closets for children according to the age group served and reflects the differences in the size, stature, and reach ranges of children ages 3 through 12. The specifications chosen should correspond to the age of the primary user group. The specifications of one age group should be applied consistently in the installation of a water closet and related elements.

<b>Advisory Specifications for Water Closets Serving Children Ages 3 through 12</b>			
	<b>Ages 3 &amp; 4</b>	<b>Ages 5 - 8</b>	<b>Ages 9 -12</b>
Water Closet Centerline	12 inches	12 to 15 inches	15 to 18 inches
Toilet Seat Height	11 to 12 inches	12 to 15 inches	15 to 17 inches
Grab Bar Height	18 to 20 inches	20 to 25 inches	25 to 27 inches
Dispenser Height	14 inches	14 to 17 inches	17 to 19 inches

**604.9.1 Location.** The water closet shall be located with a wall or partition to the rear and to one side. The centerline of the water closet shall be 12 inches (305 mm) minimum and 18 inches (455 mm) maximum from the side wall or partition, except that the water closet shall be 17 inches (430 mm) minimum and 19 inches (485 mm) maximum from the side wall or partition in the ambulatory *accessible* toilet compartment specified in 604.8.2. Compartments shall be arranged for left-hand or right-hand approach to the water closet.

**604.9.2 Clearance.** Clearance around a water closet shall comply with 604.3.

**604.9.3 Height.** The height of water closets shall be 11 inches (280 mm) minimum and 17 inches (430 mm) maximum measured to the top of the seat. Seats shall not be sprung to return to a lifted position.

**604.9.4 Grab Bars.** Grab bars for water closets shall comply with 604.5.

**604.9.5 Flush Controls.** Flush controls shall be hand operated or automatic. Hand operated flush controls shall comply with 309.2 and 309.4 and shall be installed 36 inches (915 mm) maximum above the finish floor. Flush controls shall be located on the open side of the water closet except in ambulatory *accessible* compartments complying with 604.8.2.

**604.9.6 Dispensers.** Toilet paper dispensers shall comply with 309.4 and shall be 7 inches (180 mm) minimum and 9 inches (230 mm) maximum in front of the water closet measured to the centerline of the dispenser. The outlet of the dispenser shall be 14 inches (355 mm) minimum and 19 inches (485 mm) maximum above the finish floor. There shall be a clearance of 1½ inches (38 mm) minimum below the grab bar. Dispensers shall not be of a type that controls delivery or that does not allow continuous paper flow.

**604.9.7 Toilet Compartments.** Toilet compartments shall comply with 604.8.

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9.) For a wheelchair accessible water closet, the centerline of the water closet shall be \_\_\_\_\_ inches minimum.

- a. 16
- b. 17
- c. 18
- d. 19

10.) For an ambulatory accessible water closet, the centerline of the water closet shall be \_\_\_\_\_ inches maximum.

- a. 16
- b. 17
- c. 18
- d. 19

11.) Clearance around a water closet shall be \_\_\_\_\_ inches minimum measured perpendicular from the side wall.

- a. 56
- b. 60
- c. 64
- d. 68

12.) When the door to the toilet room is placed directly in front of the water closet, the water closet cannot overlap the required maneuvering clearance for the door inside the room.

- a. True

- b. False
- 13.) **Seats in a water closet are required to be sprung to return to a lifted position.**  
a. True  
b. False
- 14.) **The seat height of a water closet above the finish floor shall be \_\_\_ inches minimum.**  
a. 16  
b. 17  
c. 18  
d. 20
- 15.) **Grab bars shall be provided on the side wall closest to the water closet and on the rear wall.**  
a. True  
b. False
- 16.) **The side wall grab bar shall be located \_\_\_ inches maximum from the rear wall.**  
a. 12  
b. 36  
c. 42  
d. 54
- 17.) **The side wall grab bar shall be \_\_\_ inches long minimum.**  
a. 12  
b. 36  
c. 42  
d. 54
- 18.) **The rear wall grab bar shall be \_\_\_\_\_ inches long minimum.**  
a. 12  
b. 24  
c. 36  
d. 48
- 19.) **The rear grab bar shall be permitted to be 24 inches long minimum, centered on the water closet, where wall *space* does not permit a length of 36 inches minimum due to the location of a recessed fixture adjacent to the water closet.**  
a. True  
b. False
- 20.) **Flush controls shall be hand operated or automatic.**  
a. True  
b. False
- 21.) **Toilet paper dispensers shall be \_\_\_ inches minimum in front of the water closet measured to the centerline of the dispenser.**  
a. 6  
b. 7  
c. 8  
d. 10

- 22.) If toilet paper dispensers are installed above the side wall grab bar, the outlet of the toilet paper dispenser must be \_\_\_ inches maximum above the floor.
- 33
  - 36
  - 42
  - 48
- 23.) Wheelchair *accessible* compartments shall be \_\_\_ inches wide minimum measured perpendicular to the side wall.
- 56
  - 60
  - 64
  - 68
- 24.) The minimum space required in toilet compartments is provided so that a person using a wheelchair can maneuver into position at the water closet.
- True
  - False
- 25.) Wheelchair *accessible* compartments for *children's use* shall be 59 inches deep \_\_\_\_\_ for wall hung and floor mounted water closets measured perpendicular to the rear wall.
- Minimum
  - Maximum
  - Both a & b
  - None of the above
- 26.) Water closet doors shall be located in the front partition or in the side wall or partition closest to the water closet.
- True
  - False
- 27.) Where located in the side wall or partition, the water closet door opening shall be \_\_\_ inches maximum from the front partition.
- 2
  - 3
  - 4
  - 5
- 28.) The front partition and at least one side partition for adults shall provide a toe clearance of \_\_\_ inches minimum above the floor.
- 6
  - 9
  - 12
  - 15
- 29.) Ambulatory *accessible* toilet compartments shall have a depth of 35 inches minimum.
- True
  - False
- 30.) Shelves shall be located 40 inches minimum and 48 inches maximum above the finish floor.

- a. True
- b. False

- 31.) According to the advisory specifications for children ages 3 and 4, the grab bar height should be \_\_\_\_\_.
- a. 18 to 20 inches
  - b. 20 to 25 inches
  - c. 25 to 27 inches
  - d. None of the above
- 32.) According to the advisory specifications for children ages 9 through 12, the toilet seat height should be \_\_\_\_\_.
- a. 11 to 12 inches
  - b. 12 to 15 inches
  - c. 15 to 17 inches
  - d. 18 to 20 inches
- 33.) According to the advisory specifications for children 5 through 8, the dispenser height should be \_\_\_\_\_.
- a. 12 to 15 inches
  - b. 14 to 17 inches
  - c. 17 to 19 inches
  - d. None of the above
- 34.) The height of water closets shall be 11 inches minimum and 17 inches maximum measured to the top of the seat.
- a. True
  - b. False
- 35.) Hand operated flush controls shall be installed \_\_\_\_ inches maximum above the finish floor.
- a. 36
  - b. 40
  - c. 44
  - d. 48
- 36.) The outlet of the toilet paper dispenser shall be \_\_\_\_\_ inches maximum above the finish floor.
- a. 14
  - b. 16
  - c. 19
  - d. 24

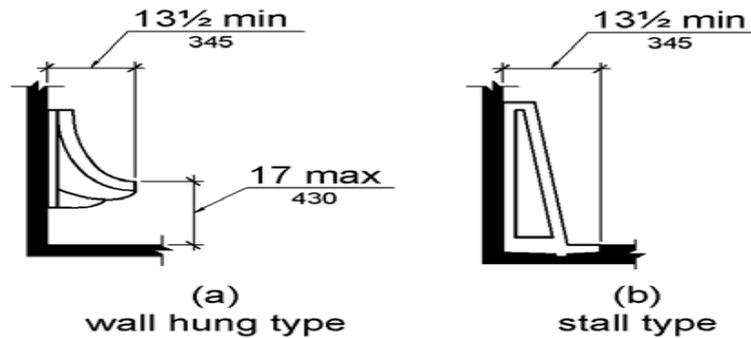
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## **605 Urinals**

**605.1 General.** Urinals shall comply with 605.

**Advisory 605.1 General.** Stall-type urinals provide greater accessibility for a broader range of persons, including people of short stature.

**605.2 Height and Depth.** Urinals shall be the stall-type or the wall-hung type with the rim 17 inches (430 mm) maximum above the finish floor or ground. Urinals shall be 13½ inches (345 mm) deep minimum measured from the outer face of the urinal rim to the back of the fixture.



**Figure 605.2 - Height and Depth of Urinals**

**605.3 Clear Floor Space.** A clear floor or ground *space* complying with 305 positioned for forward approach shall be provided.

**605.4 Flush Controls.** Flush controls shall be hand operated or automatic. Hand operated flush controls shall comply with 309.

37.) **Urinals shall be the stall-type or the wall-hung type with the rim \_\_\_\_ inches maximum above the finish floor or ground.**

- a. 13
- b. 15
- c. 17
- d. 19

38.) **Urinals shall be 12 inches deep minimum measured from the outer face of the urinal rim to the back of the fixture.**

- a. True
- b. False

39.) **Flush controls for urinals shall be hand operated or automatic.**

- a. True
- b. False

## **606 Lavatories and Sinks**

**606.1 General.** Lavatories and sinks shall comply with 606.

**Advisory 606.1 General.** If soap and towel dispensers are provided, they must be located within the reach ranges specified in 308. Locate soap and towel dispensers so that they are conveniently usable by a person at the accessible lavatory.

**606.2 Clear Floor Space.** A clear floor *space* complying with 305, positioned for a forward approach, and knee and toe clearance complying with 306 shall be provided.

- EXCEPTIONS: 1.** A parallel approach complying with 305 shall be permitted to a kitchen sink in a *space* where a cook top or conventional range is not provided and to wet bars.
- 2.** A lavatory in a toilet room or bathing *facility* for a single occupant accessed only through a private office and not for *common use* or *public use* shall not be required to provide knee and toe clearance complying with 306.
- 3.** In *residential dwelling units*, cabinetry shall be permitted under lavatories and kitchen sinks provided that all of the following conditions are met:(a) the cabinetry can be removed without removal or replacement of the fixture;(b) the finish floor extends under the cabinetry; and(c) the walls behind and surrounding the cabinetry are finished.
- 4.** A knee clearance of 24 inches (610 mm) minimum above the finish floor or ground shall be permitted at lavatories and sinks used primarily by children 6 through 12 years where the rim or counter surface is 31 inches (785 mm) maximum above the finish floor or ground.
- 5.** A parallel approach complying with 305 shall be permitted to lavatories and sinks used primarily by children 5 years and younger.
- 6.** The dip of the overflow shall not be considered in determining knee and toe clearances.
- 7.** No more than one bowl of a multi-bowl sink shall be required to provide knee and toe clearance complying with 306.

**606.3 Height.** Lavatories and sinks shall be installed with the front of the higher of the rim or counter surface 34 inches (865 mm) maximum above the finish floor or ground.

- EXCEPTIONS: 1.** A lavatory in a toilet or bathing *facility* for a single occupant accessed only through a private office and not for *common use* or *public use* shall not be required to comply with 606.3.
- 2.** In *residential dwelling unit* kitchens, sinks that are adjustable to variable heights, 29 inches (735 mm) minimum and 36 inches (915 mm) maximum, shall be permitted where rough-in plumbing permits connections of supply and drain pipes for sinks mounted at the height of 29 inches (735 mm).

**606.4 Faucets.** Controls for faucets shall comply with 309. Hand-operated metering faucets shall remain open for 10 seconds minimum.

**606.5 Exposed Pipes and Surfaces.** Water supply and drain pipes under lavatories and sinks shall be insulated or otherwise configured to protect against contact. There shall be no sharp or abrasive surfaces under lavatories and sinks.

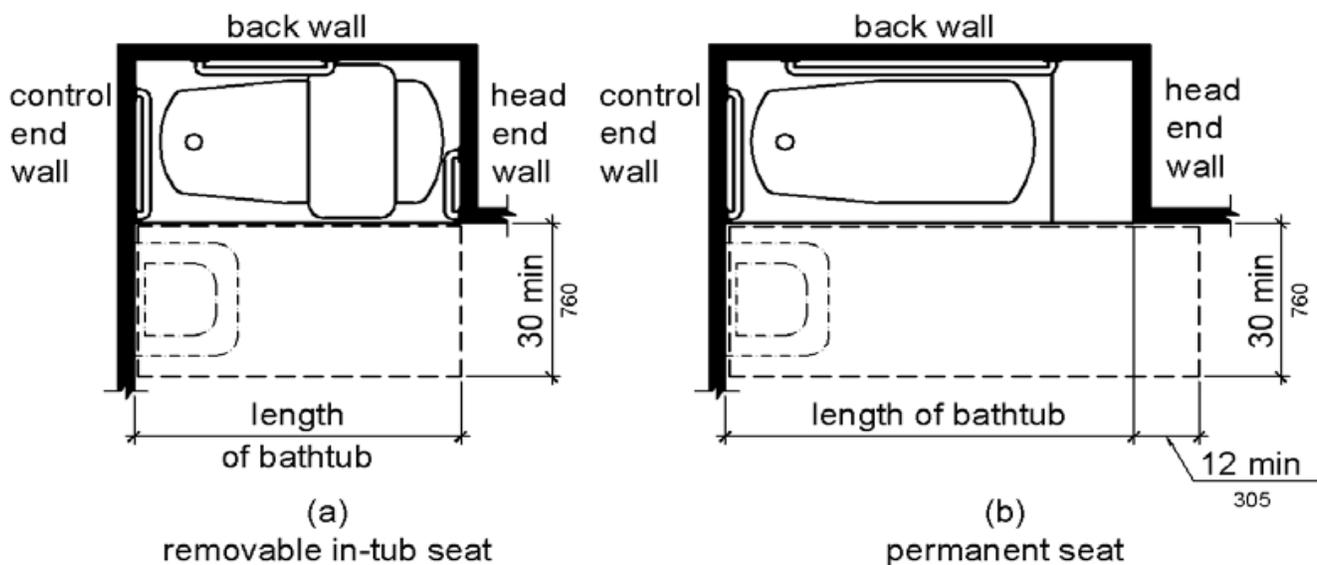
- 
- 40.) Lavatories and sinks shall be installed with the front of the higher of the rim or counter surface \_\_\_\_ inches maximum above the floor.**
- 30
  - 34
  - 38
  - 42
- 41.) In residential dwelling unit kitchens, sinks that are adjustable to variable heights, 29 inches minimum and 36 inches maximum, shall be permitted where rough-in plumbing permits connections of supply and drain pipes for sinks mounted at the height of 29 inches.**
- True
  - False
- 42.) Hand-operated metering faucets shall remain open for \_\_\_\_ seconds minimum.**
- 10
  - 15
  - 20
  - 30

- 43.) **Water supply and drain pipes under lavatories and sinks shall be insulated or otherwise configured to protect against contact.**
- a. True
  - b. False

## **607 Bathtubs**

**607.1 General.** Bathtubs shall comply with 607.

**607.2 Clearance.** Clearance in front of bathtubs shall extend the length of the bathtub and shall be 30 inches (760 mm) wide minimum. A lavatory complying with 606 shall be permitted at the control end of the clearance. Where a permanent seat is provided at the head end of the bathtub, the clearance shall extend 12 inches (305 mm) minimum beyond the wall at the head end of the bathtub.



**Figure 607.2 - Clearance for Bathtubs**

**607.3 Seat.** A permanent seat at the head end of the bathtub or a removable in-tub seat shall be provided. Seats shall comply with 610.

**607.4 Grab Bars.** Grab bars for bathtubs shall comply with 609 and shall be provided in accordance with 607.4.1 or 607.4.2.

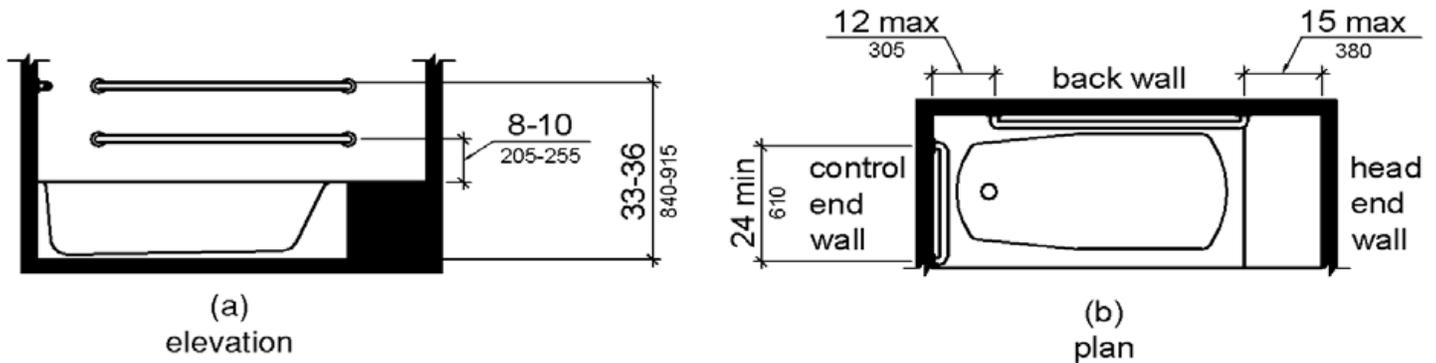
**EXCEPTIONS: 1.** Grab bars shall not be required to be installed in a bathtub located in a bathing facility for a single occupant accessed only through a private office and not for *common use* or *public use* provided that reinforcement has been installed in walls and located so as to permit the installation of grab bars complying with 607.4.

**2.** In *residential dwelling units*, grab bars shall not be required to be installed in bathtubs located in bathing facilities provided that reinforcement has been installed in walls and located so as to permit the installation of grab bars complying with 607.4.

**607.4.1 Bathtubs with Permanent Seats.** For bathtubs with permanent seats, grab bars shall be provided in accordance with 607.4.1.

**607.4.1.1 Back Wall.** Two grab bars shall be installed on the back wall, one located in accordance with 609.4 and the other located 8 inches (205 mm) minimum and 10 inches (255 mm) maximum above the rim of the bathtub. Each grab bar shall be installed 15 inches (380 mm) maximum from the head end wall and 12 inches (305 mm) maximum from the control end wall.

**607.4.1.2 Control End Wall.** A grab bar 24 inches (610 mm) long minimum shall be installed on the control end wall at the front edge of the bathtub.



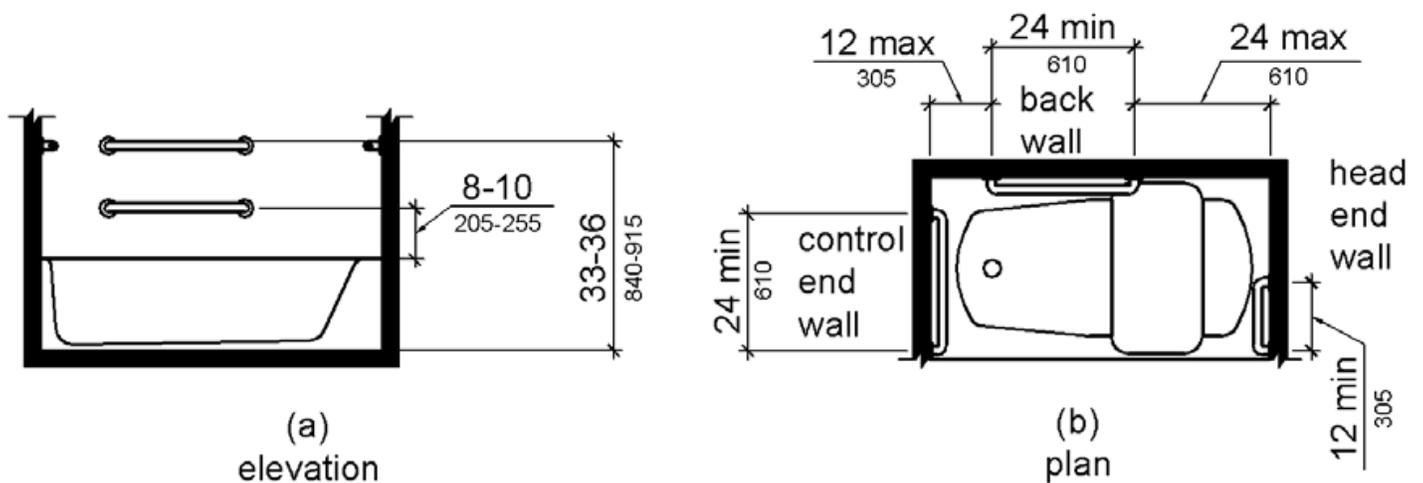
**Figure 607.4.1 - Grab Bars for Bathtubs with Permanent Seats**

**607.4.2 Bathtubs without Permanent Seats.** For bathtubs without permanent seats, grab bars shall comply with 607.4.2.

**607.4.2.1 Back Wall.** Two grab bars shall be installed on the back wall, one located in accordance with 609.4 and other located 8 inches (205 mm) minimum and 10 inches (255 mm) maximum above the rim of the bathtub. Each grab bar shall be 24 inches (610 mm) long minimum and shall be installed 24 inches (610 mm) maximum from the head end wall and 12 inches (305 mm) maximum from the control end wall.

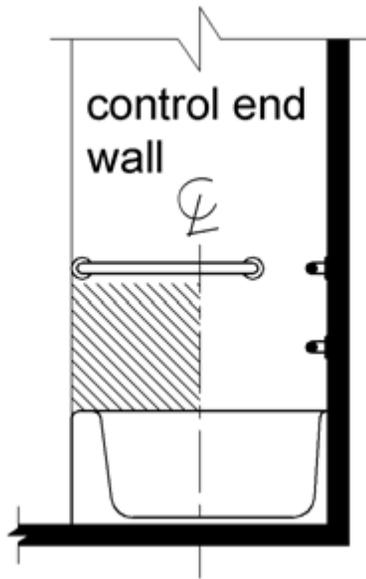
**607.4.2.2 Control End Wall.** A grab bar 24 inches (610 mm) long minimum shall be installed on the control end wall at the front edge of the bathtub.

**607.4.2.3 Head End Wall.** A grab bar 12 inches (305 mm) long minimum shall be installed on the head end wall at the front edge of the bathtub.



**Figure 607.4.2 - Grab Bars for Bathtubs with Removable In-Tub Seats**

**607.5 Controls.** Controls, other than drain stoppers, shall be located on an end wall. Controls shall be between the bathtub rim and grab bar, and between the open side of the bathtub and the centerline of the width of the bathtub. Controls shall comply with 309.4.



**Figure 607.5 - Bathtub Control Location**

**607.6 Shower Spray Unit and Water.** A shower spray unit with a hose 59 inches (1500 mm) long minimum that can be used both as a fixed-position shower head and as a hand-held shower shall be provided. The shower spray unit shall have an on/off control with a non-positive shut-off. If an adjustable-height shower head on a vertical bar is used, the bar shall be installed so as not to obstruct the use of grab bars. Bathtub shower spray units shall deliver water that is 120°F (49°C) maximum.

**Advisory 607.6 Shower Spray Unit and Water.** Ensure that hand-held shower spray units are capable of delivering water pressure substantially equivalent to fixed shower heads.

**607.7 Bathtub Enclosures.** Enclosures for bathtubs shall not obstruct controls, faucets, shower and spray units or obstruct transfer from wheelchairs onto bathtub seats or into bathtubs. Enclosures on bathtubs shall not have tracks installed on the rim of the open face of the bathtub.

- 
- 44.) **Clearance in front of bathtubs shall extend the length of the bathtub and shall be 30 inches wide minimum.**
- True
  - False
- 45.) **A grab bar \_\_\_ inches long minimum shall be installed on the control end wall at the front edge of the bathtub.**
- 12
  - 15
  - 18
  - 24
- 46.) **A grab bar 12 inches long minimum shall be installed on the control end wall at the front edge of the bathtub.**
- True
  - False

- 47.) A grab bar 12 inches long minimum shall be installed on the head end wall at the front edge of the bathtub.
- True
  - False
- 48.) Bathtub controls, other than drain stoppers, shall be located on an end wall.
- True
  - False
- 49.) A shower spray unit with a hose \_\_\_\_ inches long minimum that can be used both as a fixed-position shower head and as a hand-held shower shall be provided.
- 49
  - 59
  - 69
  - 79
- 50.) Bathtub shower spray units shall deliver water that is \_\_\_\_ °F maximum.
- 120
  - 140
  - 160
  - 212

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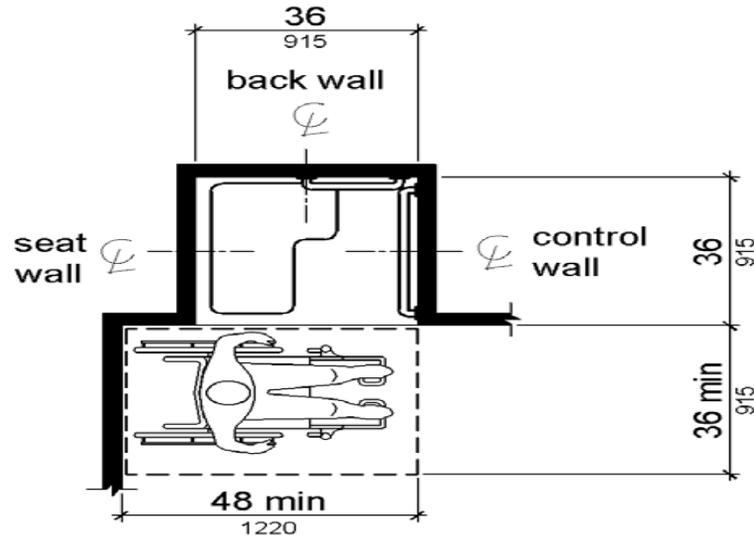
## **608 Shower Compartments**

**608.1 General.** Shower compartments shall comply with 608.

**Advisory 608.1 General.** Shower stalls that are 60 inches (1525 mm) wide and have no curb may increase the usability of a bathroom because the shower area provides additional maneuvering space.

**608.2 Size and Clearances for Shower Compartments.** Shower compartments shall have sizes and clearances complying with 608.2.

**608.2.1 Transfer Type Shower Compartments.** Transfer type shower compartments shall be 36 inches (915 mm) by 36 inches (915 mm) clear inside dimensions measured at the center points of opposing sides and shall have a 36 inch (915 mm) wide minimum entry on the face of the shower compartment. Clearance of 36 inches (915 mm) wide minimum by 48 inches (1220 mm) long minimum measured from the control wall shall be provided.



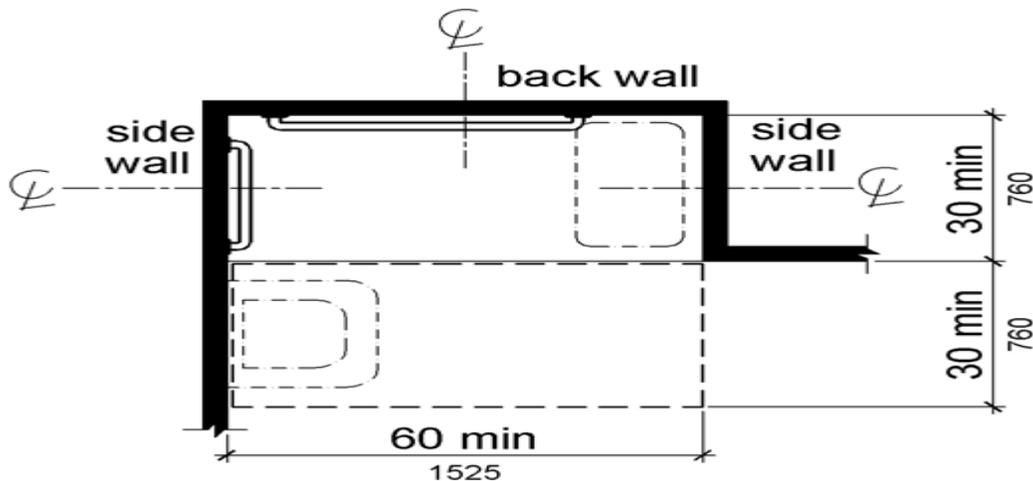
Note: inside finished dimensions measured at the center points of opposing sides

**Figure 608.2.1 - Transfer Type Shower Compartment Size and Clearance**

**608.2.2 Standard Roll-In Type Shower Compartments.** Standard roll-in type shower compartments shall be 30 inches (760 mm) wide minimum by 60 inches (1525 mm) deep minimum clear inside dimensions measured at center points of opposing sides and shall have a 60 inches (1525 mm) wide minimum entry on the face of the shower compartment.

**608.2.2.1 Clearance.** A 30 inch (760 mm) wide minimum by 60 inch (1525 mm) long minimum clearance shall be provided adjacent to the open face of the shower compartment.

**EXCEPTION:** A lavatory complying with 606 shall be permitted on one 30 inch (760 mm) wide minimum side of the clearance provided that it is not on the side of the clearance adjacent to the controls or, where provided, not on the side of the clearance adjacent to the shower seat.

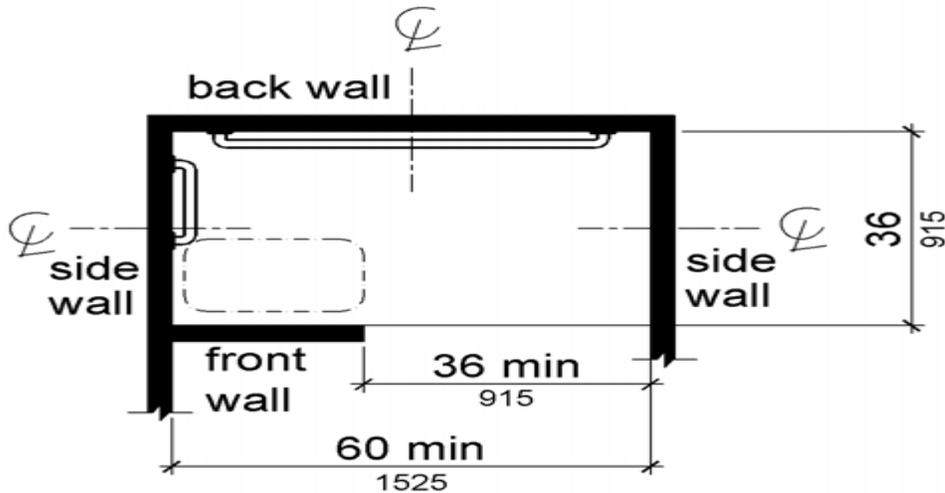


Note: inside finished dimensions measured at the center points of opposing sides

**Figure 608.2.2 - Standard Roll-In Type Shower Compartment Size and Clearance**

**608.2.3 Alternate Roll-In Type Shower Compartments.** Alternate roll-in type shower compartments shall be 36 inches (915 mm) wide and 60 inches (1525 mm) deep minimum clear inside dimensions measured at center

points of opposing sides. A 36 inch (915 mm) wide minimum entry shall be provided at one end of the long side of the compartment.



Note: inside finished dimensions measured at the center points of opposing sides

Figure 608.2.3 - Alternate Roll-In Type Shower Compartment Size and Clearance

**608.3 Grab Bars.** Grab bars shall comply with 609 and shall be provided in accordance with 608.3. Where multiple grab bars are used, required horizontal grab bars shall be installed at the same height above the finish floor.

**EXCEPTIONS: 1.** Grab bars shall not be required to be installed in a shower located in a bathing facility for a single occupant accessed only through a private office, and not for *common use* or *public use* provided that reinforcement has been installed in walls and located so as to permit the installation of grab bars complying with 608.3.

**2.** In *residential dwelling units*, grab bars shall not be required to be installed in showers located in bathing facilities provided that reinforcement has been installed in walls and located so as to permit the installation of grab bars complying with 608.3.

**608.3.1 Transfer Type Shower Compartments.** In transfer type compartments, grab bars shall be provided across the control wall and back wall to a point 18 inches (455 mm) from the control wall.

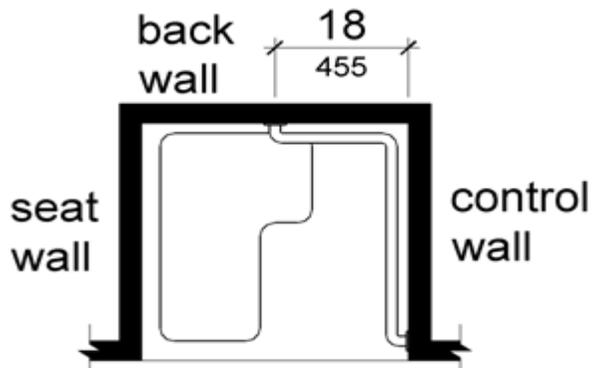
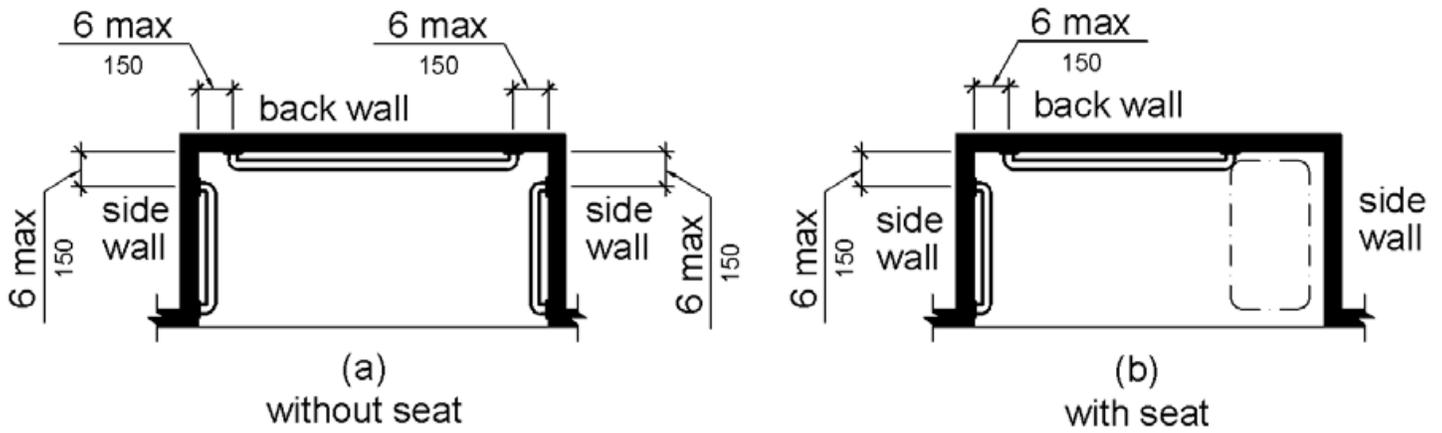


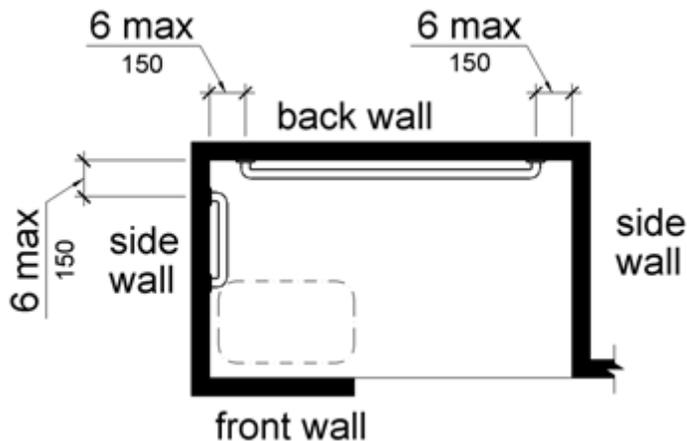
Figure 608.3.1 - Grab Bars for Transfer Type Showers

**608.3.2 Standard Roll-In Type Shower Compartments.** Where a seat is provided in standard roll-in type shower compartments, grab bars shall be provided on the back wall and the side wall opposite the seat. Grab bars shall not be provided above the seat. Where a seat is not provided in standard roll-in type shower compartments, grab bars shall be provided on three walls. Grab bars shall be installed 6 inches (150 mm) maximum from adjacent walls.



**Figure 608.3.2 - Grab Bars for Standard Roll-In Type Showers**

**608.3.3 Alternate Roll-In Type Shower Compartments.** In alternate roll-in type shower compartments, grab bars shall be provided on the back wall and the side wall farthest from the compartment entry. Grab bars shall not be provided above the seat. Grab bars shall be installed 6 inches (150 mm) maximum from adjacent walls.



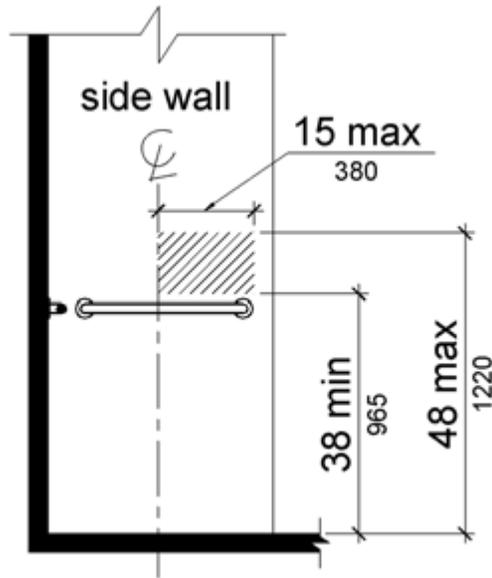
**Figure 608.3.3 - Grab Bars for Alternate Roll-In Type Showers**

**608.4 Seats.** A folding or non-folding seat shall be provided in transfer type shower compartments. A folding seat shall be provided in roll-in type showers required in *transient lodging* guest rooms with mobility features complying with 806.2. Seats shall comply with 610.

**EXCEPTION:** In *residential dwelling units*, seats shall not be required in transfer type shower compartments provided that reinforcement has been installed in walls so as to permit the installation of seats complying with 608.4.

**608.5 Controls.** Controls, faucets, and shower spray units shall comply with 309.4.

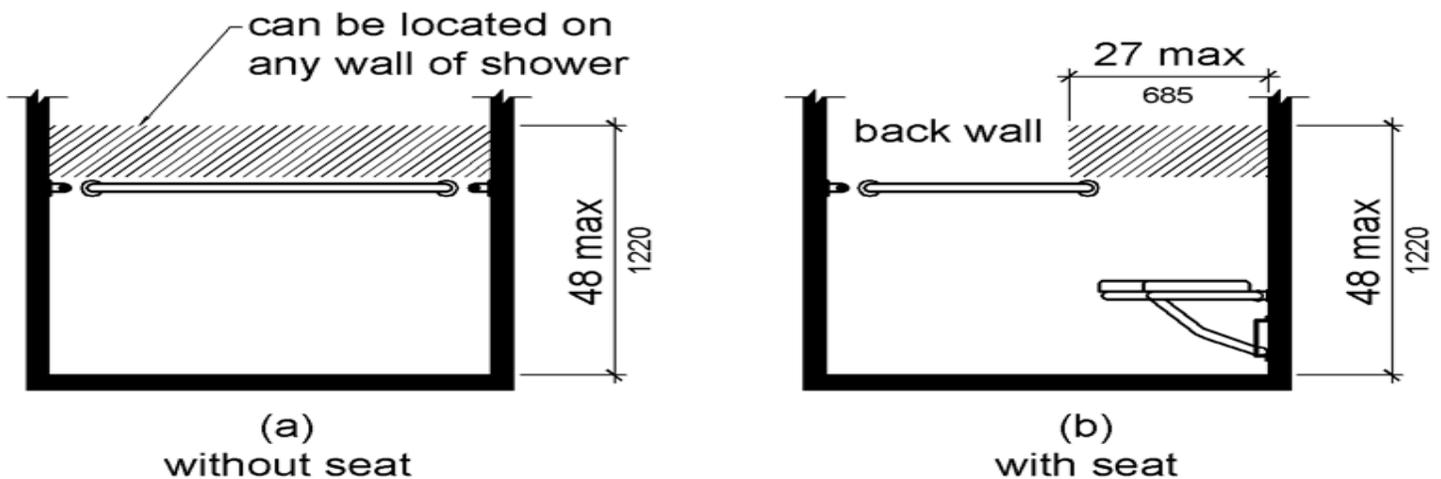
**608.5.1 Transfer Type Shower Compartments.** In transfer type shower compartments, the controls, faucets, and shower spray unit shall be installed on the side wall opposite the seat 38 inches (965 mm) minimum and 48 inches (1220 mm) maximum above the shower floor and shall be located on the control wall 15 inches (380 mm) maximum from the centerline of the seat toward the shower opening.



**Figure 608.5.1 - Transfer Type Shower Compartment Control Location**

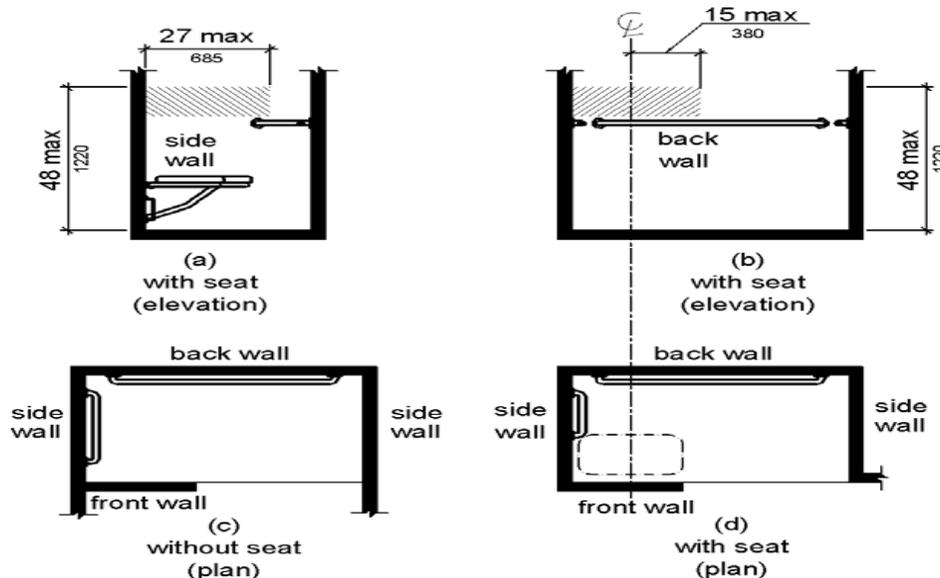
**608.5.2 Standard Roll-In Type Shower Compartments.** In standard roll-in type shower compartments, the controls, faucets, and shower spray unit shall be located above the grab bar, but no higher than 48 inches (1220 mm) above the shower floor. Where a seat is provided, the controls, faucets, and shower spray unit shall be installed on the back wall adjacent to the seat wall and shall be located 27 inches (685 mm) maximum from the seat wall.

**Advisory 608.5.2 Standard Roll-in Type Shower Compartments.** In standard roll-in type showers without seats, the shower head and operable parts can be located on any of the three walls of the shower without adversely affecting accessibility.



## Figure 608.5.2 - Standard Roll-In Type Shower Compartment Control Location

**608.5.3 Alternate Roll-In Type Shower Compartments.** In alternate roll-in type shower compartments, the controls, faucets, and shower spray unit shall be located above the grab bar, but no higher than 48 inches (1220 mm) above the shower floor. Where a seat is provided, the controls, faucets, and shower spray unit shall be located on the side wall adjacent to the seat 27 inches (685 mm) maximum from the side wall behind the seat or shall be located on the back wall opposite the seat 15 inches (380 mm) maximum, left or right, of the centerline of the seat. Where a seat is not provided, the controls, faucets, and shower spray unit shall be installed on the side wall farthest from the compartment entry.



**Figure 608.5.3 - Alternate Roll-In Type Shower Compartment Control Location**

**608.6 Shower Spray Unit and Water.** A shower spray unit with a hose 59 inches (1500 mm) long minimum that can be used both as a fixed-position shower head and as a hand-held shower shall be provided. The shower spray unit shall have an on/off control with a non-positive shut-off. If an adjustable-height shower head on a vertical bar is used, the bar shall be installed so as not to obstruct the use of grab bars. Shower spray units shall deliver water that is 120°F (49°C) maximum.

**EXCEPTION:** A fixed shower head located at 48 inches (1220 mm) maximum above the shower finish floor shall be permitted instead of a hand-held spray unit in *facilities* that are not medical care *facilities*, long-term care *facilities*, *transient lodging* guest rooms, or *residential dwelling units*.

**Advisory 608.6 Shower Spray Unit and Water.** Ensure that hand-held shower spray units are capable of delivering water pressure substantially equivalent to fixed shower heads.

**608.7 Thresholds.** Thresholds in roll-in type shower compartments shall be ½ inch (13 mm) high maximum in accordance with 303. In transfer type shower compartments, thresholds ½ inch (13 mm) high maximum shall be beveled, rounded, or vertical.

**EXCEPTION:** A threshold 2 inches (51 mm) high maximum shall be permitted in transfer type shower compartments in existing *facilities* where provision of a ½ inch (13 mm) high threshold would disturb the structural reinforcement of the floor slab.

**608.8 Shower Enclosures.** Enclosures for shower compartments shall not obstruct controls, faucets, and shower spray units or obstruct transfer from wheelchairs onto shower seats.

- 51.) **Transfer type shower compartments shall be \_\_\_\_\_ clear inside dimensions measured at the center points of opposing sides.**
- 24 inches by 24 inches
  - 30 inches by 30 inches
  - 36 inches by 36 inches
  - 42 inches by 42 inches
- 52.) **Standard roll-in type shower compartments shall have a 60 inches wide minimum entry on the face of the shower compartment.**
- True
  - False
- 53.) **In transfer type compartments, grab bars shall be provided across the control wall and back wall to a point \_\_\_\_ inches from the control wall.**
- 12 inches
  - 18 inches
  - 24 inches
  - 30 inches
- 54.) **In transfer type shower compartments, the controls, faucets, and shower spray unit shall be located on the control wall \_\_\_\_\_ inches maximum from the centerline of the seat toward the shower opening.**
- 15 inches
  - 24 inches
  - 27 inches
  - 38 inches
- 55.) **In standard roll-in type showers without seats, the shower head and operable parts can be located on any of the three walls of the shower without adversely affecting accessibility.**
- True
  - False
- 56.) **In alternate roll-in type shower compartments, the controls, faucets, and shower spray unit shall be located above the grab bar, but no higher than \_\_\_\_\_ inches above the shower floor.**
- 15 inches
  - 24 inches
  - 27 inches
  - 48 inches
- 57.) **Enclosures for shower compartments shall not obstruct controls, faucets, and shower spray units or obstruct transfer from wheelchairs onto shower seats.**
- True
  - False

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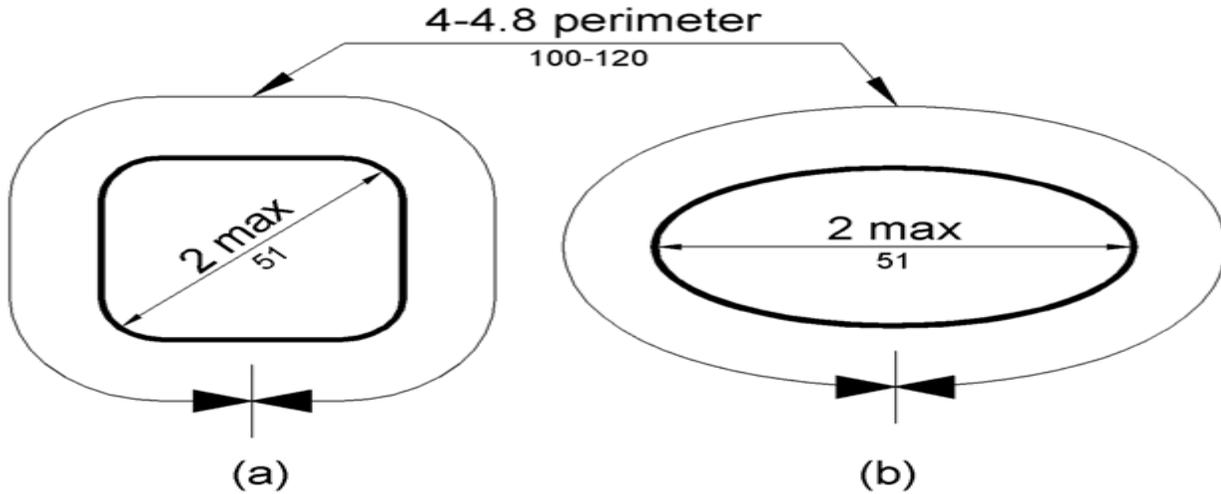
## **609 Grab Bars**

**609.1 General.** Grab bars in toilet *facilities* and bathing *facilities* shall comply with 609.

**609.2 Cross Section.** Grab bars shall have a cross section complying with 609.2.1 or 609.2.2.

**609.2.1 Circular Cross Section.** Grab bars with circular cross sections shall have an outside diameter of 1¼ inches (32 mm) minimum and 2 inches (51 mm) maximum.

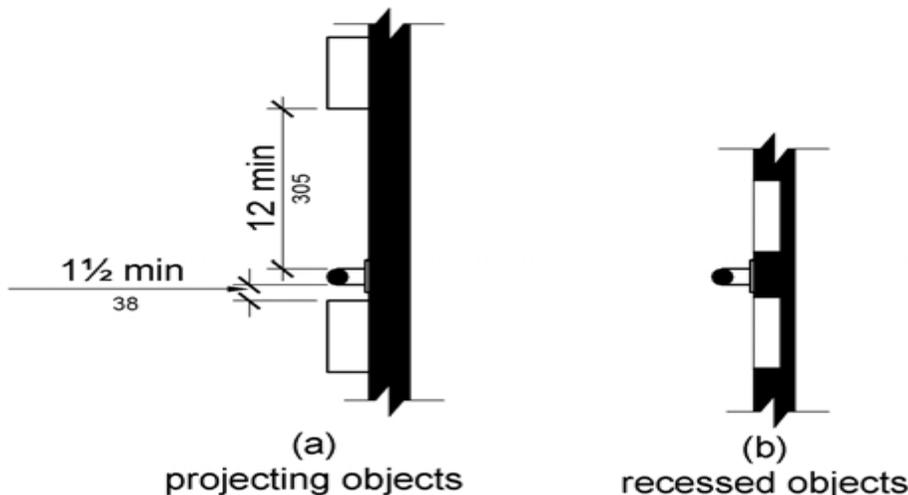
**609.2.2 Non-Circular Cross Section.** Grab bars with non-circular cross sections shall have a cross-section dimension of 2 inches (51 mm) maximum and a perimeter dimension of 4 inches (100 mm) minimum and 4.8 inches (120 mm) maximum.



**Figure 609.2.2 - Grab Bar Non-Circular Cross Section**

**609.3 Spacing.** The *space* between the wall and the grab bar shall be 1½ inches (38 mm). The *space* between the grab bar and projecting objects below and at the ends shall be 1½ inches (38 mm) minimum. The *space* between the grab bar and projecting objects above shall be 12 inches (305 mm) minimum.

**EXCEPTION:** The *space* between the grab bars and shower controls, shower fittings, and other grab bars above shall be permitted to be 1½ inches (38 mm) minimum.



**Figure 609.3 - Spacing of Grab Bars**

**609.4 Position of Grab Bars.** Grab bars shall be installed in a horizontal position, 33 inches (840 mm) minimum and 36 inches (915 mm) maximum above the finish floor measured to the top of the gripping surface, except that at water closets for *children's use* complying with 604.9, grab bars shall be installed in a horizontal position 18 inches (455 mm) minimum and 27 inches (685 mm) maximum above the finish floor measured to

the top of the gripping surface. The height of the lower grab bar on the back wall of a bathtub shall comply with 607.4.1.1 or 607.4.2.1.

**609.5 Surface Hazards.** Grab bars and any wall or other surfaces adjacent to grab bars shall be free of sharp or abrasive *elements* and shall have rounded edges.

**609.6 Fittings.** Grab bars shall not rotate within their fittings.

**609.7 Installation.** Grab bars shall be installed in any manner that provides a gripping surface at the specified locations and that does not obstruct the required clear floor *space*.

**609.8 Structural Strength.** Allowable stresses shall not be exceeded for materials used when a vertical or horizontal force of 250 pounds (1112 N) is applied at any point on the grab bar, fastener, mounting device, or supporting structure.

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**58.) Grab bars with circular cross sections shall have an outside diameter of 2 inches maximum.**

- a. True
- b. False

**59.) The *space* between the grab bar and projecting objects above shall be \_\_\_\_ inches minimum.**

- a. 2
- b. 12
- c. 24
- d. 36

**60.) Grab bars and any wall or other surfaces adjacent to grab bars shall be free of sharp or abrasive *elements* and shall have rounded edges.**

- a. True
- b. False

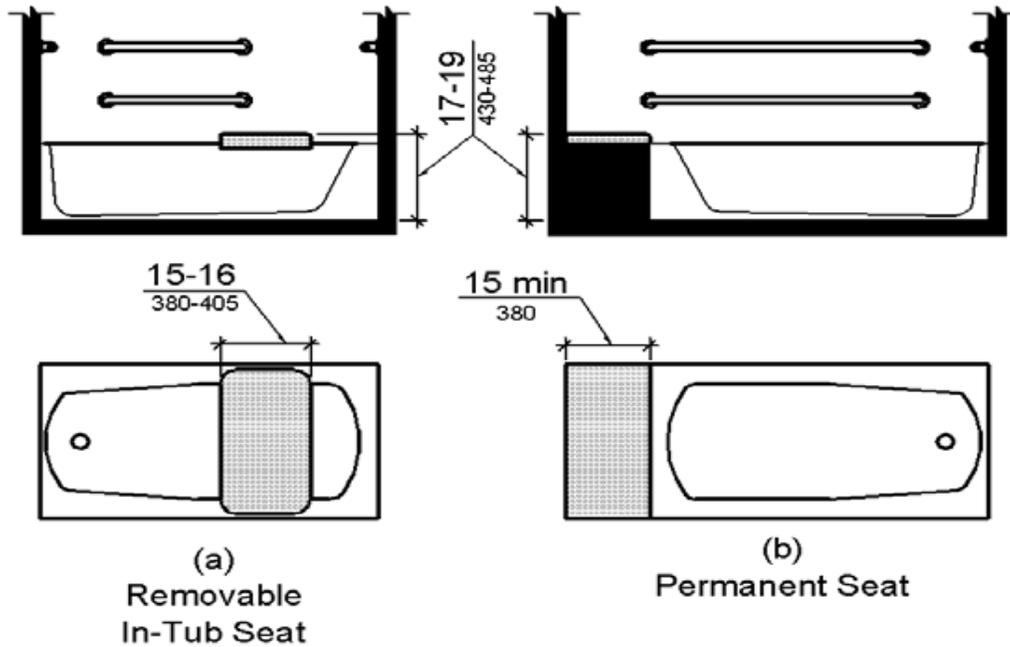
**61.) Grab bars shall rotate within their fittings.**

- a. True
- b. False

## **610 Seats**

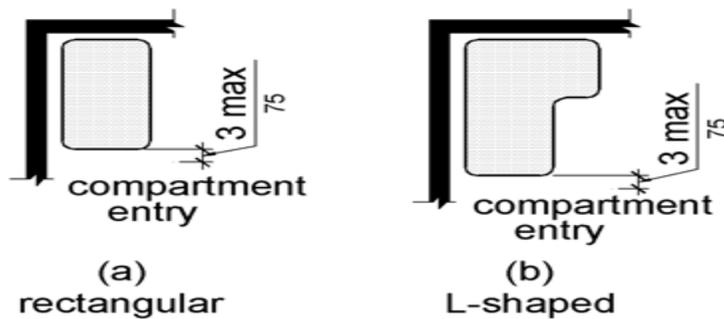
**610.1 General.** Seats in bathtubs and shower compartments shall comply with 610.

**610.2 Bathtub Seats.** The top of bathtub seats shall be 17 inches (430 mm) minimum and 19 inches (485 mm) maximum above the bathroom finish floor. The depth of a removable in-tub seat shall be 15 inches (380 mm) minimum and 16 inches (405 mm) maximum. The seat shall be capable of secure placement. Permanent seats at the head end of the bathtub shall be 15 inches (380 mm) deep minimum and shall extend from the back wall to or beyond the outer edge of the bathtub.



**Figure 610.2 - Bathtub Seats**

**610.3 Shower Compartment Seats.** Where a seat is provided in a standard roll-in shower compartment, it shall be a folding type, shall be installed on the side wall adjacent to the controls, and shall extend from the back wall to a point within 3 inches (75 mm) of the compartment entry. Where a seat is provided in an alternate roll-in type shower compartment, it shall be a folding type, shall be installed on the front wall opposite the back wall, and shall extend from the adjacent side wall to a point within 3 inches (75 mm) of the compartment entry. In transfer-type showers, the seat shall extend from the back wall to a point within 3 inches (75 mm) of the compartment entry. The top of the seat shall be 17 inches (430 mm) minimum and 19 inches (485 mm) maximum above the bathroom finish floor. Seats shall comply with 610.3.1 or 610.3.2.



**Figure 610.3 - Extent of Seat**

**610.3.1 Rectangular Seats.** The rear edge of a rectangular seat shall be 2½ inches (64 mm) maximum and the front edge 15 inches (380 mm) minimum and 16 inches (405 mm) maximum from the seat wall. The side edge of the seat shall be 1½ inches (38 mm) maximum from the adjacent wall.

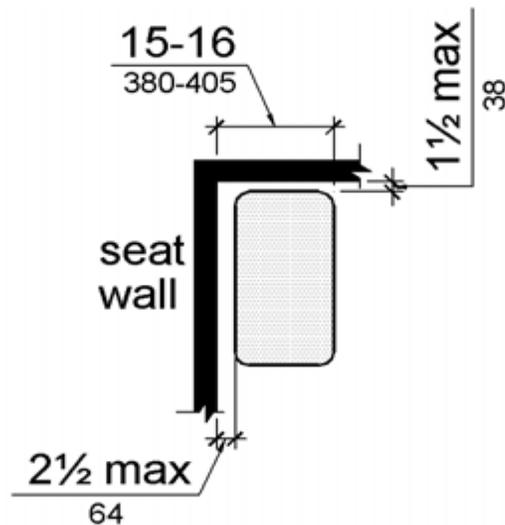


Figure 610.3.1 - Rectangular Shower Seat

**610.3.2 L-Shaped Seats.** The rear edge of an L-shaped seat shall be  $2\frac{1}{2}$  inches (64 mm) maximum and the front edge 15 inches (380 mm) minimum and 16 inches (405 mm) maximum from the seat wall. The rear edge of the “L” portion of the seat shall be  $1\frac{1}{2}$  inches (38 mm) maximum from the wall and the front edge shall be 14 inches (355 mm) minimum and 15 inches (380 mm) maximum from the wall. The end of the “L” shall be 22 inches (560 mm) minimum and 23 inches maximum (585 mm) from the main seat wall.

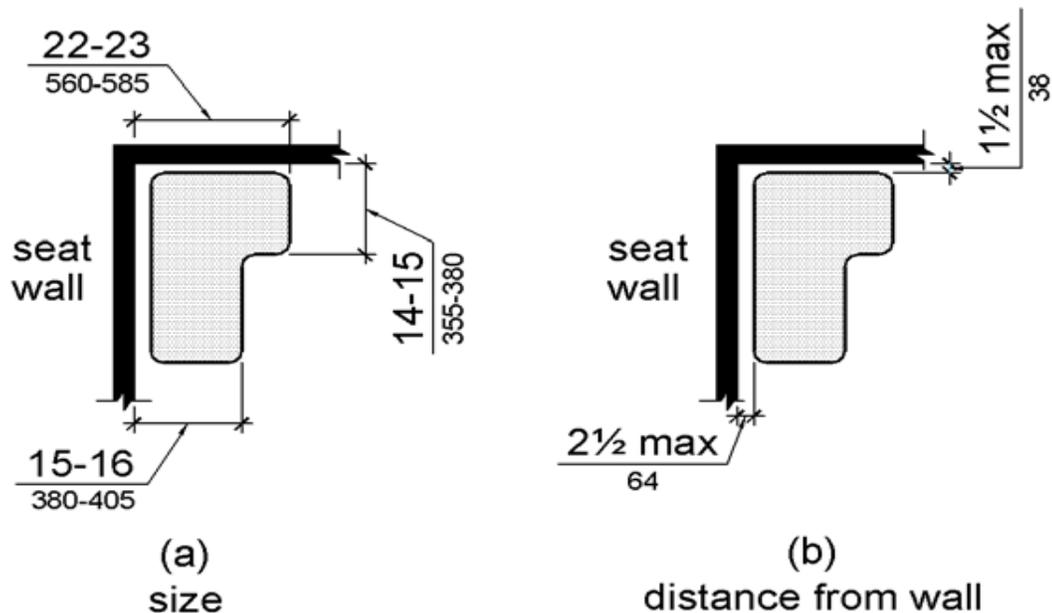


Figure 610.3.2 - L-Shaped Shower Seat

**610.4 Structural Strength.** Allowable stresses shall not be exceeded for materials used when a vertical or horizontal force of 250 pounds (1112 N) is applied at any point on the seat, fastener, mounting device, or supporting structure.

- 62.) The rear edge of a rectangular seat shall be  $2\frac{1}{2}$  inches maximum from the seat wall.
- True
  - False

- 63.) The top of bathtub seats shall be 19 inches minimum and 21 inches maximum above the bathroom finish floor.
- a. True
  - b. False

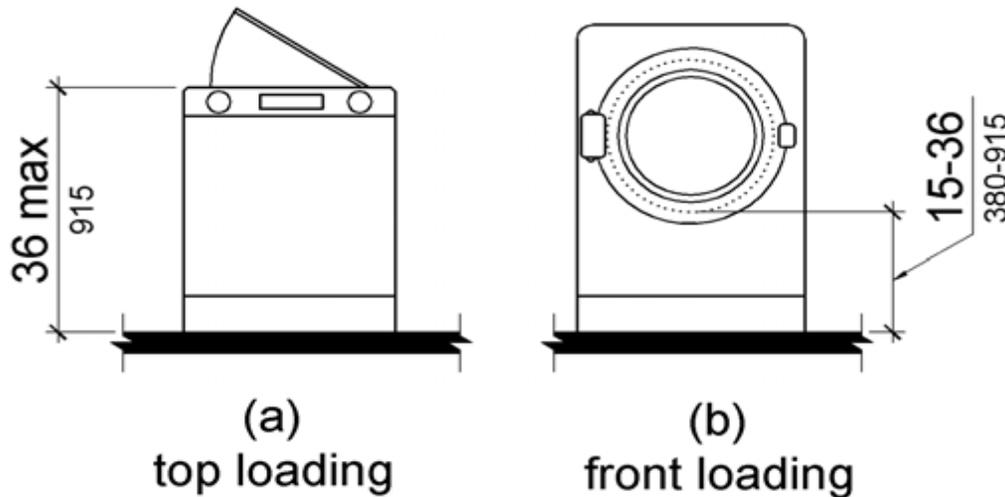
## 611 Washing Machines and Clothes Dryers

**611.1 General.** Washing machines and clothes dryers shall comply with 611.

**611.2 Clear Floor Space.** A clear floor or ground *space* complying with 305 positioned for parallel approach shall be provided. The clear floor or ground *space* shall be centered on the appliance.

**611.3 Operable Parts.** *Operable parts*, including doors, lint screens, and detergent and bleach compartments shall comply with 309.

**611.4 Height.** Top loading machines shall have the door to the laundry compartment located 36 inches (915 mm) maximum above the finish floor. Front loading machines shall have the bottom of the opening to the laundry compartment located 15 inches (380 mm) minimum and 36 inches (915 mm) maximum above the finish floor.



**Figure 611.4 - Height of Laundry Compartment Opening**

## 612 Saunas and Steam Rooms

**612.1 General.** Saunas and steam rooms shall comply with 612.

**612.2 Bench.** Where seating is provided in saunas and steam rooms, at least one bench shall comply with 903. Doors shall not swing into the clear floor *space* required by 903.2.

**EXCEPTION:** A readily removable bench shall be permitted to obstruct the turning *space* required by 612.3 and the clear floor or ground *space* required by 903.2.

**612.3 Turning Space.** A turning *space* complying with 304 shall be provided within saunas and steam rooms

**64.) Top loading machines shall have the door to the laundry compartment located \_\_\_\_ inches maximum above the finish floor.**

- a. 15 inches
- b. 24 inches
- c. 30 inches
- d. 36 inches

**65.) Front loading machines shall have the bottom of the opening to the laundry compartment located 15 inches minimum and 36 inches maximum above the finish floor.**

- a. True
  - b. False
-

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**ADA Requirements**

- |                   |                    |                    |                    |
|-------------------|--------------------|--------------------|--------------------|
| 1. T F<br>Ⓐ Ⓑ Ⓒ Ⓓ | 17. T F<br>Ⓐ Ⓑ Ⓒ Ⓓ | 33. T F<br>Ⓐ Ⓑ Ⓒ Ⓓ | 49. T F<br>Ⓐ Ⓑ Ⓒ Ⓓ |
| 2. Ⓐ Ⓑ Ⓒ Ⓓ        | 18. Ⓐ Ⓑ Ⓒ Ⓓ        | 34. Ⓐ Ⓑ Ⓒ Ⓓ        | 50. Ⓐ Ⓑ Ⓒ Ⓓ        |
| 3. Ⓐ Ⓑ Ⓒ Ⓓ        | 19. Ⓐ Ⓑ Ⓒ Ⓓ        | 35. Ⓐ Ⓑ Ⓒ Ⓓ        | 51. Ⓐ Ⓑ Ⓒ Ⓓ        |
| 4. Ⓐ Ⓑ Ⓒ Ⓓ        | 20. Ⓐ Ⓑ Ⓒ Ⓓ        | 36. Ⓐ Ⓑ Ⓒ Ⓓ        | 52. Ⓐ Ⓑ Ⓒ Ⓓ        |
| 5. Ⓐ Ⓑ Ⓒ Ⓓ        | 21. Ⓐ Ⓑ Ⓒ Ⓓ        | 37. Ⓐ Ⓑ Ⓒ Ⓓ        | 53. Ⓐ Ⓑ Ⓒ Ⓓ        |
| 6. Ⓐ Ⓑ Ⓒ Ⓓ        | 22. Ⓐ Ⓑ Ⓒ Ⓓ        | 38. Ⓐ Ⓑ Ⓒ Ⓓ        | 54. Ⓐ Ⓑ Ⓒ Ⓓ        |
| 7. Ⓐ Ⓑ Ⓒ Ⓓ        | 23. Ⓐ Ⓑ Ⓒ Ⓓ        | 39. Ⓐ Ⓑ Ⓒ Ⓓ        | 55. Ⓐ Ⓑ Ⓒ Ⓓ        |
| 8. Ⓐ Ⓑ Ⓒ Ⓓ        | 24. Ⓐ Ⓑ Ⓒ Ⓓ        | 40. Ⓐ Ⓑ Ⓒ Ⓓ        | 56. Ⓐ Ⓑ Ⓒ Ⓓ        |
| 9. Ⓐ Ⓑ Ⓒ Ⓓ        | 25. Ⓐ Ⓑ Ⓒ Ⓓ        | 41. Ⓐ Ⓑ Ⓒ Ⓓ        | 57. Ⓐ Ⓑ Ⓒ Ⓓ        |
| 10. Ⓐ Ⓑ Ⓒ Ⓓ       | 26. Ⓐ Ⓑ Ⓒ Ⓓ        | 42. Ⓐ Ⓑ Ⓒ Ⓓ        | 58. Ⓐ Ⓑ Ⓒ Ⓓ        |
| 11. Ⓐ Ⓑ Ⓒ Ⓓ       | 27. Ⓐ Ⓑ Ⓒ Ⓓ        | 43. Ⓐ Ⓑ Ⓒ Ⓓ        | 59. Ⓐ Ⓑ Ⓒ Ⓓ        |
| 12. Ⓐ Ⓑ Ⓒ Ⓓ       | 28. Ⓐ Ⓑ Ⓒ Ⓓ        | 44. Ⓐ Ⓑ Ⓒ Ⓓ        | 60. Ⓐ Ⓑ Ⓒ Ⓓ        |
| 13. Ⓐ Ⓑ Ⓒ Ⓓ       | 29. Ⓐ Ⓑ Ⓒ Ⓓ        | 45. Ⓐ Ⓑ Ⓒ Ⓓ        | 61. Ⓐ Ⓑ Ⓒ Ⓓ        |
| 14. Ⓐ Ⓑ Ⓒ Ⓓ       | 30. Ⓐ Ⓑ Ⓒ Ⓓ        | 46. Ⓐ Ⓑ Ⓒ Ⓓ        | 62. Ⓐ Ⓑ Ⓒ Ⓓ        |
| 15. Ⓐ Ⓑ Ⓒ Ⓓ       | 31. Ⓐ Ⓑ Ⓒ Ⓓ        | 47. Ⓐ Ⓑ Ⓒ Ⓓ        | 63. Ⓐ Ⓑ Ⓒ Ⓓ        |
| 16. Ⓐ Ⓑ Ⓒ Ⓓ       | 32. Ⓐ Ⓑ Ⓒ Ⓓ        | 48. Ⓐ Ⓑ Ⓒ Ⓓ        | 64. Ⓐ Ⓑ Ⓒ Ⓓ        |
|                   |                    |                    | 65. Ⓐ Ⓑ Ⓒ Ⓓ        |



# **SPS 384 Plumbing Products**

**3 Continuing Education Hours**

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## Plumbing Products – SPS 384

SPS 384.01	Scope.
SPS 384.02	Penalties.
SPS 384.03	Definitions.
SPS 384.10	Department approval.
SPS 384.11	Device listing.
SPS 384.12	Identification.
SPS 384.13	Penetrations of fire-resistive assemblies.
SPS 384.14	Chemical or biochemical treatments for private sewage systems.
SPS 384.15	Health care plumbing practices.
SPS 384.20	Plumbing fixtures, appliances and equipment.
SPS 384.25	POWTS holding, components or treatment components.
SPS 384.30	Plumbing materials.
SPS 384.40	Joints and connections.
SPS 384.50	Alternate approvals and experimental approvals.

**SPS 384.01 Scope. (1)** The provisions of this chapter govern the quality and installation of materials, fixtures, appliances, appurtenances, and equipment relating to plumbing.

**(2)** A department interpretation of the requirements in this chapter shall supersede any differing interpretation by a lower level jurisdiction. A department decision on the application of the requirements in this chapter shall supersede any differing decision by a lower level jurisdiction.

**SPS 384.02 Penalties.** Penalties for violations of this chapter shall be assessed in accordance with s. 145.12, Stats.

**SPS 384.03 Definitions.** In this chapter:

**(1)** “Health care plumbing appliance” means a plumbing appliance, the function of which is unique to health care activities.

**(2)** “Laboratory plumbing appliance” means a plumbing appliance, the function of which is unique to scientific experimentation or research activities.

**(3)** “Prefabricated plumbing” means concealed drain piping, vent piping or water supply piping or a combination of these types of piping, contained in a modular building component, which will not be visible for inspection when delivered to the final site of installation.

**SPS 384.10 Department approval.** No fixture, appliance, appurtenance, material, device or product may be sold for use in a plumbing system or may be installed in a plumbing system, unless it is of a type conforming to the standards or specifications of chs. SPS 382 and 383 and this chapter and ch. 145, Stats.

**(1) ALTERNATE OR EXPERIMENTAL PRODUCT APPROVAL.** If it is alleged that the approval of a fixture, appliance, appurtenance, material, device or product under this section would result in an adverse health effect or potentially adverse health effect on the waters of the state, the department may require an alternate or experimental product approval under s. SPS 384.50.

**(2) PRODUCT REVIEW AND APPROVAL.** (a) 1. Each type of plumbing product which falls into one of the categories specified in Table 384.10 shall be approved by the department in accordance with this subsection before the product may be sold for use in a plumbing system or installed in a plumbing system.

2. Specifications and plans or drawings for each type of product shall be submitted to the department for review. The submittal shall be accompanied by sufficient data and information to determine if the product and its performance comply with the provisions of chs. SPS 382, 383 and this chapter and ch. 145, Stats.

(b) The department may require that a submitter of a product for review have the product tested and its performance certified by an approved testing laboratory.

(c) If, upon review, the department determines that a product conforms to the provisions of chs. SPS 382, 383 and this chapter and ch. 145, Stats., the department shall issue an approval in writing. The department may impose specific conditions in granting an approval. Violations of the conditions under which an approval is granted shall constitute a violation of this chapter.

(d) If, upon review, the department determines that a product does not conform to provisions of chs. SPS 382, 383 and this chapter and ch. 145, Stats., the request for approval shall be denied in writing.

(e) The department shall review and make a determination on an application for a product approval within 40 business days of receipt of all fees, plans, drawings, specifications and other information required to complete the review.

(f) If an approved plumbing product is modified or additional assertions of function or performance are made, the approval shall be considered null and void, unless the change is submitted to the department for review and the approval is reaffirmed.

(g) Approvals for plumbing products issued by the department prior to November 1, 1985, shall expire 30 months after the effective date of this section.

(h) Approvals for plumbing products issued by the department after November 1, 1985, shall expire at the end of the 60th month after the date of approval issuance.

**Table 384.10**  
**SUBMITTALS TO DEPARTMENT**

**Product Categories**

1. Bottled-water vending machines that are not listed by a certification body accredited by the American National Standards Institute
2. Chemical or biochemical treatments for POWTS
3. Health care plumbing appliances
4. Physical restoration processes for POWTS
5. Prefabricated holding or treatment components for POWTS
6. Prefabricated plumbing
7. Wastewater treatment devices used to meet the requirements in s. SPS 382.70
8. Water treatment devices that make a contaminant reduction claim which is not certified by a certification body accredited by the American National Standards Institute
9. Water treatment devices that are not certified to a standard which covers material safety, by a certification body accredited by the American National Standards Institute

**(3) VOLUNTARY POWTS COMPONENT REVIEW.** (a) The department may issue an approval, upon request and review, for specific methods or technologies that are proposed to be utilized as POWTS holding, treatment or dispersal components which conform to the standards or specifications referenced in chs. SPS 381, 382, 383 and this chapter, but do not require approval under sub.

(2) or s. SPS 384.50.

(b) Each request for approval shall be made on a form provided by the department.

(c) The submittal shall be accompanied by sufficient data and information to determine if the method or technology complies with the provisions of chs. SPS 381, 382 and 383, and this chapter. The submittal shall include, but not be limited to, all of the following:

1. Plans and specifications.
2. Theory of operation.
3. Testing protocol.
4. Testing data.
5. Limits of reliable operation.
6. Installation requirements and procedures.
7. Inspection checklist and worksheet.
8. Inspection requirements and procedures.
9. Operation and maintenance requirements.
10. Operation and maintenance schedule.
11. Operation and maintenance checklist and worksheet.

(d) 1. The department shall review a submittal under this sub-section with input from a technical advisory committee.

2. The members on the technical advisory committee under subd. 1. shall be appointed by the department for staggered 3-year terms and shall include representatives of at least the following groups or organizations:

- a. The department of natural resources.
- b. Local governmental unit.
- c. POWTS designer.
- d. Academic or scientific community.
- e. Plumber.
- f. Environmental group.
- g. POWTS component manufacturer.

(e) 1. After review by the technical advisory committee under par. (d) but prior to issuing an approval under par. (f), the department shall seek public comments on a submittal under this subsection.

b. The department shall include a time limit for public comment in each notice.

3. If the department receives a significant amount of public comment under subd. 2., the department may elect to recognize the specific method or technology through the rule-making process under ch. 227, Stats.

(f) 1. If, upon review, the department determines that the method or technology conforms to the provisions of chs. SPS 381, 382 and 383 and this chapter, the department shall issue an approval in writing.

2. The department may impose specific conditions in granting an approval, including a provision to provide training to POWTS installers and POWTS inspectors.

3. Violations of the conditions under which an approval is granted shall constitute a violation of this chapter.

(g) If, upon review, the department determines that the method or technology does not conform to the provisions of chs. SPS 381, 382 and 383 and this chapter, the request for approval shall be denied in writing.

(h) The department shall review and make a determination on an application for a method or technology approval within 3 months of receipt of all fees, plans, drawings, specifications and other information required to complete the review, unless the department elects to review the method or technology as part of the rule-making process under ch. 227, Stats.

(i) If an approved method or technology is modified or additional assertions of function or performance are made, the approval shall be considered null and void, unless the change is submitted to the department for review and the approval is reaffirmed.

(4) REVOCATION. The department may revoke any approval issued under this section for any false statements or misrepresentation of facts on which the approval was based, or as a result of the product's failure, or if data indicate a health hazard or threat to the waters of the state.

(5) LIMITATIONS. An approval of a plumbing product by the department may not be construed as an assumption of any responsibility for defects in design, construction or performance of any product nor for any damages that may result. All products shall be installed in accordance with the manufacturer's printed instructions and as specified in chs. SPS 382 to 384. If there is a conflict between the manufacturer's printed instructions and requirements of chs. SPS 382 to 384, the requirements of chs. SPS 382 to 384 shall take precedence.

(6) FEES. Fees for product approval review shall be submitted in accordance with s. SPS 302.66.

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## EXAM QUESTIONS

1. “\_\_\_\_\_” means a plumbing appliance, the function of which is unique to scientific experimentation or research activities.
  - a. Health care plumbing appliance
  - b. Laboratory plumbing appliance
  - c. Prefabricated plumbing
  - d. Technical plumbing
2. With regards to product approval, specifications and plans or drawings for each type of product shall be submitted to the department for review.
  - a. True
  - b. False
3. The department shall review and make a determination on an application for a product approval within \_\_\_ business days of receipt of all fees, plans, drawings, specifications and other information required to complete the review.
  - a. 10
  - b. 20
  - c. 30
  - d. 40
4. Approvals for plumbing products issued by the department prior to \_\_\_\_\_, shall expire 30 months after the effective date of this section.
  - a. November 1, 1985
  - b. November 1, 1995

- c. December 31, 1985
  - d. December 31, 1995
5. Submittal for approval may include which of the following:
- a. Theory of operation
  - b. Testing data
  - c. Inspection checklist and worksheet
  - d. All of the above
6. The members on the technical advisory committee under subd. 1. shall be appointed by the department for staggered \_\_\_\_\_ terms
- a. 1-year
  - b. 2-year
  - c. 3-year
  - d. 4-year
7. If, upon review, the department determines that the method or technology does not conform to the outlined provisions, the request for approval shall be denied \_\_\_\_\_.
- a. Via email
  - b. By verbal announcement
  - c. In writing
  - d. None of the above
8. Fees for product approval review shall be submitted in accordance with \_\_\_\_\_.
- a. ASSE 1013
  - b. s. SPS 302.66
  - c. ASTM D2235
  - d. CAN/CSA B64.1.1

**SPS 384.11 Device listing.** Cross connection control devices and water treatment devices complying with the referenced standard in Table 384.11 shall be listed by a nationally recognized listing agency acceptable to the department.

**Table 383.11  
DEVICE LISTINGS**

<b>Device</b>	<b>Reference Standard</b>
Anti-siphon Fill Valves (Ballcocks) for Gravity Water Closet Flush Tanks	ASSE 1002
Atmospheric Type Vacuum Breakers	ASSE 1001
Atmospheric Vacuum Breakers	CAN/CSA B64.1.1
Backflow Preventers for Beverage Dispensing Equipment	ASSE 1022
Backflow Preventer with Intermediate Atmospheric Vent	ASSE 1012
Backflow Prevention Devices for Hand-Held Showers	ASSE 1014
Chemical Dispensing Systems	ASSE 1055
Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies	ASSE 1015
Double Check Detector Fire Protection Backflow Prevention Assemblies	ASSE 1048

Double Check Valve Backflow Preventers	CAN/CSA B64.5
Dual Check Valve Backflow Preventers with Atmospheric Port	CAN/CSA B64.3
Hose Connection Backflow Preventers	ASSE 1052
Hose Connection Vacuum Breakers	CAN/CSA B64.2 ASSE 1011
Laboratory Faucet Backflow Preventers	ASSE 1035
Laboratory Faucet Type Vacuum Breakers	CAN/CSA B64.7
Pressure Vacuum Breakers	CAN/CSA B64.1.2
Pressure Vacuum Breaker Assembly	ASSE 1020
Pressurized Flushing Devices (Flushometers) for Plumbing Fixtures	ASSE 1037
Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers	ASSE 1013
Reduced Pressure Principle Backflow Preventers	CAN/CSA B64.4
Spill Resistant Vacuum Breakers	ASSE 1056
Vacuum Breaker Wall Hydrants, Freeze Resistant Automatic Draining Type	ASSE 1019
Residential Cation Exchange Water Softeners	NSF 44

**SPS 384.12 Identification.** Each length of pipe and each pipe fitting, trap, fixture, material, device and product to be used in plumbing shall be marked as required by the applicable standard specified by reference in this chapter or as specified by rule in this chapter.

**SPS 384.13 Penetrations of fire-resistive assemblies.** Penetrations of fire-resistive assemblies, such as walls and floor-ceiling systems, by plumbing systems or plumbing materials shall be protected in accordance with requirements of chs. SPS 361 to 366.

**SPS 384.14 Chemical or biochemical treatments for private sewage systems.** Chemical or biochemical treatments for private sewage systems shall function and perform in accordance with the assertions submitted to the department. Chemical or biochemical treatments for private sewage systems may not directly or indirectly adversely affect bacterial action in the systems, soil hydraulic conductivity in the absorption areas, or groundwater quality beneath the systems.

SPS 384.15 Health care plumbing appliances.

Health care plumbing appliances shall function and perform in accordance with the drain, vent, water supply and backflow protection requirements of ch. SPS 382.

**SPS 384.20 Plumbing fixtures, appliances and equipment. (1) DESIGN AND CONSTRUCTION.** All plumbing fixtures, appliances and equipment shall be designed and constructed to:

- a. Ensure durability, proper service and sanitation;
- b. Be free from defects;
- c. Be free from concealed fouling surfaces;
- d. Not require undue efforts in cleaning and operating; and
- e. Prevent nonpotable liquids, solids or gasses from being introduced into a potable water supply system through cross-connections.

**(2) MATERIALS.** (a) Plumbing fixtures shall have smooth surfaces that are impervious to water.

(b) All plumbing fixture fittings which are end-point devices, covered by the scope of NSF 61, section 9 and installed to supply water intended for human ingestion, shall conform to NSF 61, section 9.

**(3) WATER CONSERVING FAUCETS, SPOUTS AND PLUMBING FIXTURES.** Water conserving faucets, spouts and plumbing fixtures which meet or exceed the water conservation requirements established in par. (b) shall be installed as specified in par. (a).

(a) 1. All lavatory faucets, shower heads, urinals, urinal flushing devices, water closets and water closet flushing devices shall conform to par. (b).

2. All faucets installed on kitchen sinks of dwelling units and living units shall conform to par. (b) 4.

(b) 1. 'General.' Flow control or flow restricting devices shall be installed on the water inlet side or shall be an integral part of the faucet, spout or fixture. A flow controlling or restricting aerator shall be considered to be an integral part of a faucet or spout.

2. 'Lavatory faucet.' a. The maximum discharge rate of lavatory faucets shall be 2.2 U.S. gallons per minute at a 60 psig flowing supply pressure.

b. Lavatory faucets that are of the metering type shall allow a maximum of 0.25 U.S. gallons per metering cycle at an 80 psig flowing supply pressure.

a. 'Shower heads.' The maximum discharge rate of shower heads shall be 2.5 U.S. gallons per minute at an 80 psig flowing supply pressure.

b. 'Sink faucets.' The maximum discharge rate of sink faucets shall be 2.2 U.S. gallons per minute at 80 psig flowing supply pressure.

c. 'Urinals.' Urinals shall function properly with a maximum of one U.S. gallon per flush at an 80 psig flowing supply pressure.

d. 'Urinal flushing devices.' The flushing cycle for urinal flushing devices shall discharge a maximum of one U.S. gallon per flush per fixture use at static test pressure of 20 psig and 80 psig.

e. 'Water closets.' Water closets shall function properly with a maximum of 1.6 U.S. gallons per flush over the range of static test pressure specified in Table 384.20.

f. 'Water closet flushing devices.' The flushing cycle for water closet flushing devices shall discharge a maximum of 1.6 U.S. gallons over the range of static test pressures specified in Table 384.20.

**Table 384.20**

**STATIC TEST PRESSURES FOR WATER CLOSETS AND WATER CLOSET FLUSHING DEVICES**

Tank Type	Flushometer Type	Flushometer Type
	Siphonic	Blowout
20 to 80 psig	25 to 80 psig	35 to 80 psig

---

**EXAM QUESTIONS**

9. ASSE 1001 is the reference standard for \_\_\_\_\_.
- a. Atmospheric Type Vacuum Breakers
  - b. Atmospheric Vacuum Breakers

- c. Hose Connection Vacuum Breakers
- d. Laboratory Faucet Backflow Preventers

10. \_\_\_\_\_ is the reference standard for Chemical Dispensing Systems.

- a. ASSE 1002
- b. ASSE 1055
- c. CAN/CSA B64.3
- d. CAN/CSA B64.5

11. All plumbing fixtures, appliances and equipment shall be designed and constructed to:

- a. Ensure durability, proper service and sanitation
- b. Be free from defects
- c. Not require undue efforts in cleaning and operating
- d. All of the above

12. Materials used in plumbing fixtures shall have smooth surfaces that absorb water.

- a. True
- b. False

13. The maximum discharge rate of lavatory faucets shall be \_\_\_\_ U.S. gallons per minute at a 60 psig flowing supply pressure.

- a. 1.8
- b. 2.0
- c. 2.1
- d. 2.2

14. The maximum discharge rate of sink faucets shall be 2.2 U.S. gallons per minute at \_\_\_\_ psig flowing supply pressure.

- a. 50
- b. 60
- c. 70
- d. 80

15. Water closets shall function properly with a maximum of \_\_\_\_ U.S. gallons per flush over the range of static test pressure specified in Table 384.20.

- a. 1.2
- b. 1.4
- c. 1.5
- d. 1.6

---

**(4) GENERAL REQUIREMENTS.** (a) *Fixture outlets.* 1. The outlet passageway of a fixture shall be free from impairments and of sufficient size to insure proper discharge of the fixture contents under normal conditions.

2. The outlet connection of a fixture which directly connects to the drain system shall be an air and watertight joint.

(b) *Installation of fixtures.* 1. 'Access for cleaning.' Plumbing fixtures shall be so installed as to afford easy access for cleaning both the fixture and the area around it.

2. ‘Securing wall mounted fixtures.’ Wall mounted fixtures shall be rigidly supported by a hanger which is attached to structural members so that the load is not transmitted to the fixture drain connection or any other part of the plumbing system. The hanger for a wall mounted water closet shall conform to ASME A112.6.1M.
  3. ‘Water supply protection.’ The water supply pipes and fittings within every plumbing fixture shall be so installed as to prevent backflow.
  4. ‘Design of overflow.’ A fixture which is provided with an overflow outlet shall be designed and installed so that standing water in the fixture cannot rise in the overflow when the fixture's stopper is closed, and so that no water remains in the overflow when the fixture is empty.
  5. ‘Connection of overflows.’ The overflow from any fixture shall discharge into the drain system on the inlet or fixture side of the trap.
  6. ‘Overflows in flush tanks.’ Flush tanks shall be provided with overflows discharging to the fixture served and shall be of sufficient size to prevent flooding the tank at the maximum rate at which the tanks are supplied with water.
  7. ‘Strainers.’ All plumbing fixtures other than water closets, clinic sinks, trap standard service sinks with flush rims, urinals, standpipes and waste sinks shall be provided with strainers, cross bars or pop-up stoppers which restrict the clear opening of the waste outlet.
  8. ‘Flushometer valves.’ Flushometer valves shall be equipped with vacuum breakers which conform to ASSE 1001. Flushometer valves may not be used where the water pressure is insufficient to properly operate them. When the valve is operated, it shall complete the cycle of operation automatically, opening fully and closing positively under the water supply pressure. Each flushometer shall be provided with a means for regulating the flow through it.
  9. ‘Safing.’
    - a. The floor of all site-constructed shower stalls and shower rooms shall be protected with a safing material installed beneath the finished floor of the entire enclosure or room and upward along the sides to a minimum of 6 inches above the curb or maximum water level of the room or enclosure. The corners of the enclosure or room shall be safed to a height of 6 feet and at least 3 inches in each direction from the corners.
    - b. All floor drains or other similar fixtures shall be installed with a safing material extending a minimum of 12 inches from the fixture.
    - c. The safing material shall conform to s. SPS 384.30 (6).
    - d. The safing material shall be properly drained.
    - e. All installations directly over an unexcavated portion of a building are exempt from this subdivision.
- 

## EXAM QUESTIONS

16. True or false? The water supply pipes and fittings within every plumbing fixture shall be so installed as to prevent backflow.
  - a. True
  - b. False

17. All plumbing fixtures other than water closets, clinic sinks, trap standard service sinks with flush rims, urinals, standpipes and waste sinks shall be provided with \_\_\_\_\_, cross bars or pop-up stoppers which restrict the clear opening of the waste outlet.
- Water supply protection
  - Strainers
  - Flushometer valves
  - Safing
18. All floor drains or other similar fixtures shall be installed with a safing material extending a minimum of \_\_\_\_\_ inches from the fixture.
- 12
  - 14
  - 16
  - 18
19. The safing material shall conform to \_\_\_\_\_.
- CAN/CSA B137.9
  - AWWA C115
  - s. SPS 384.30 (6)
  - ASTM D2737
- 

**(5) PLUMBING FIXTURES AND PLUMBING APPLIANCES.** (a) *Automatic clothes washers.* Residential type automatic clothes washers shall conform to ASSE 1007.

(b) *Bathtubs.* 1. a. Enameled cast iron bathtubs shall conform to ASME A112.19.1M.

b. Porcelain enameled formed steel bathtubs shall conform to ASME A112.19.4.

c. Plastic bathtubs shall conform to ANSI Z124.1.2.

2. Bathtubs shall have waste outlets and overflows at least 1½ inches in diameter. A closing device shall be provided on the waste outlet.

3. All whirlpool piping for bathtubs shall drain by gravity to the trap serving the bathtub.

4. All waterways of the whirlpool pump for a bathtub shall drain by gravity to the trap serving the bathtub.

(c) *Bidets.* Vitreous china bidets shall conform to the material requirements in ASME A112.19.2M.

1. A bidet may not be located closer than 15 inches from its center to any side wall, partition, vanity or other obstruction, nor closer than 30 inches center to center from a water closet.

2. Bidets with submerged inlet fittings shall be protected by vacuum breakers which conform to ASSE 1001 or CAN/CSA B64.1.1.

(d) *Chemical dispensing systems.* Chemical dispensing systems shall conform to ASSE 1055.

(e) *Dishwashing machines.* 1. Residential type dishwashing machines shall conform to ASSE 1006.

2. Commercial type dishwashing machines shall conform to ASSE 1004.

- (f) *Drinking fountains.* 1. Drinking fountains and water coolers shall conform to ARI 1010 or ASME A112.19.2.
2. Drinking fountains may not be installed in toilet rooms.
  3. The water supply for drinking fountains shall be provided with an adjustable valve fitted with a loose key or an automatic self-closing valve permitting regulation of the rate of flow of water. The water supply issuing from the nozzle shall be of sufficient volume and height so that persons using the fountain need not come in direct contact with the nozzle or orifice.
  4. A drinking fountain may not have a waste outlet less than 1¼ inches in diameter.
- (g) *Floor drains.* 1. Floor drains shall be provided with removable strainers of sufficient strength to carry the anticipated loads.
2. The floor drain shall be so constructed that it can be cleaned, and the drain inlet shall be accessible at all times.
  3. Floor drains shall be of a size to efficiently serve the intended purpose. The floor drain outlet shall not be less than 2 inches in diameter.
- (h) *Food waste grinders.* 1. Residential type food waste grinders shall conform to ASSE 1008. Commercial type food waste grinders shall conform to ASSE 1009.
2. Food waste grinders shall be connected to a drain of sufficient size to serve the unit, but not less than 1 ½ inches in diameter.
  3. All food waste grinders shall be provided with an adequate supply of cold water at a sufficient flow rate to insure proper functioning of the unit.
- (i) *Laundry trays.* Each compartment of a laundry tray shall be provided with a waste outlet not less than 1 ½ inches in diameter.
- (j) *Lavatories.* 1. a. Enameled cast iron lavatories shall conform to ASME A112.19.1M.
- b. Vitreous china lavatories shall conform to ASME A112.19.2M.
  - c. Stainless steel lavatories shall conform to ASME A112.19.3.
  - d. Porcelain enameled formed steel lavatories shall conform to ASME A112.19.4.
  - e. Plastic lavatories shall conform to ANSI Z124.3.
3. Cultured marble vanity tops with an integral lavatory shall conform to ANSI Z124.3.
  4. Lavatories shall have waste outlets not less than 1¼ inches in diameter.
- (k) *POWTS design packages and POWTS components.* POWTS design packages and POWTS components shall function and perform in accordance with assertions submitted to and approved by the department under s. SPS 384.10.
- (l) *Showers.* 1. Prefabricated plastic showers and shower compartments shall conform to ANSI A124.1.2.

2. Except for combination bathtub–shower units, waste outlets serving showers shall be at least 2 inches in diameter and shall have removable strainers of sufficient strength for the anticipated loads.
  3. Where a waste outlet serves more than one shower space or shower head, the waste outlet shall be at least 2 inches in diameter and the waste outlet shall be so located and the floor so pitched that waste water from one shower does not flow over the floor area serving another shower.
  4. All shower compartments, regardless of shape, shall have a minimum finished interior of 900 square inches and shall be capable of encompassing a circle with a diameter of 30 inches. The minimum required area and dimension shall be measured in a horizontal plane 24 inches above the top of the threshold and may not extend beyond the centerline of the threshold. The minimum area and dimensions shall be maintained to a point 70 inches above the shower waste outlet with no protrusions other than the fixture valve or valves, showerheads, soap dishes, retractable seats and safety grab bars or rails.
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## EXAM QUESTIONS

20. True or false? All whirlpool piping for bathtubs shall drain by gravity to the trap serving the bathtub.
  - a. True
  - b. False
21. \_\_\_\_\_ bathtubs shall conform to ANSI Z124.1.2.
  - a. Cast iron
  - b. Porcelain
  - c. Plastic
  - d. All of the above
22. A bidet may not be located closer than \_\_\_\_ inches from its center to any side wall, partition, vanity or other obstruction, nor closer than \_\_\_\_ inches center to center from a water closet.
  - a. 15, 30
  - b. 10, 20
  - c. 15, 20
  - d. 10, 30
23. True or false? Residential type dishwashing machines and commercial type dishwashing machines shall both conform to ASSE 1006.
  - a. True
  - b. False
24. True or false? Drinking fountains may be installed in toilet rooms.
  - a. True
  - b. False
25. The floor drain outlet shall not be less than \_\_\_\_ inches in diameter.
  - a. 2
  - b. 3
  - c. 4
  - d. 5
26. \_\_\_\_\_ lavatories shall conform to ASME A112.19.2M.
  - a. Stainless steel

- b. Porcelain
- c. Plastic
- d. Vitreous china

27. All shower compartments, regardless of shape, shall have a minimum finished interior of \_\_\_\_\_ square inches and shall be capable of encompassing a circle with a diameter of 30 inches.

- a. 900
  - b. 1000
  - c. 1200
  - d. 1500
- 

(m) *Sinks*. 1. a. Enameled cast iron sinks shall conform to ASME A112.19.1M.

- b. Vitreous china sinks shall conform to ASME A112.19.2.
- c. Stainless steel sinks shall conform to ASME A112.19.3.
- d. Porcelain enameled formed steel sinks shall conform to ASME A112.19.4.
- e. Plastic sinks shall conform to ANSI Z124.6.

2. Sinks shall be provided with waste outlets not less than 1½ inches in diameter.

(n) *Urinals*. 1. a. Vitreous china urinals shall conform to ASME A112.19.2.

b. Plastic urinals shall conform to ANSI Z124.9.

2. A urinal may not be located closer than 15 inches from its center to any side wall, partition, vanity or other obstruction, nor closer than 30 inches center to center, between urinals.

- 1. Stall type urinals shall be set into the floor and the floor shall be pitched toward the fixture.
- 2. Automatic siphon urinal flush tanks may not be installed.
- 3. Pressurized flushing devices to serve urinals shall conform to ASSE 1037.

(o) *Water closets*. 1. a. Vitreous china water closets shall conform to ASME A112.19.2.

b. Plastic water closets shall conform to ANSI Z124.4.

2. Except as permitted in subd. 3., all water closets required to be provided in public buildings and places of employment shall be of an elongated bowl type, and provided with either:

- a. Hinged, open-front seats without covers; or
- b. Hinged, closed-front seats, without covers, which are encased with a continuous plastic sleeve capable of providing a clean surface for every user.

3. a. Water closets provided in day care centers, individual living units or sleeping units of residential occupancies may be of a round-bowl type with a hinged, closed front seat with or without a cover.

b. Water closets provided in prisons or correctional institutions may be of a round-bowl type, with or without a seat or cover.

4. A water closet may not be located closer than 15 inches from its center to any side wall, partition, vanity, or other obstruction, nor closer than 30 inches center to center, between water closets. There shall be at least 24 inches clearance in front of a water closet to any wall, fixture or door.

5. No person may install or maintain pan, plunger, offset washout, washout, long hopper, frostproof and other types of water closets having invisible seals or unventilated spaces or walls not thoroughly cleansed at each flushing.

6. Each water closet shall be individually equipped with a flushing device. Pressurized flushing devices shall conform to ASSE 1037. All flushing devices shall be readily accessible for maintenance and repair. Ballcocks and fill valves shall be of the anti-siphon type and shall conform to ASSE 1002. The critical level mark on the ballcock and fill valve shall be located at least one inch above the full opening of the overflow pipe.

(p) *Water heaters.* 1. Listed equipment. All water heaters shall bear the label of a listing agency acceptable to the department.

2. Design. a. All pressurized water heaters and pressurized hot water storage tanks, except those bearing the label of the American Society of Mechanical Engineers, shall be designed and constructed to withstand a minimum test pressure of 150% of the maximum allowable working pressure of the heater or tank.

b. All pressurized water heaters and pressurized hot water storage tanks shall be rated for a minimum working pressure of 125 psig.

c. A drain valve shall be installed at the lowest point of each water heater and hot water storage tank.

3. Safety devices. a. Relief valves shall be listed by the American Gas Association, Underwriters Laboratories, Inc. or American Society of Mechanical Engineers when the heat input to a water heater is less than or equal to 200,000 Btu per hour.

b. Relief valves shall be listed by the American Society of Mechanical Engineers when the heat input to a water heater exceeds 200,000 Btu per hour.

c. Pressure relief valves shall be set to open at either the maximum allowable working pressure rating of the water heater or storage tank or 150 psig, whichever is smaller.

d. Temperature and pressure relief valves shall be set to open at a maximum of 210° F and in accordance with subd. 3. c.

4. Hot water dispensers. Nonpressurized point-of-use water heaters shall conform to ASSE 1023.

(q) *Water meters.* A water meter which is used pursuant to s. SPS 383.54 (2) shall conform to AWWA C700, AWWA C701, AWWA C702, AWWA C704, AWWA C706, AWWA C707, AWWA C708, or AWWA C710.

(r) *Water treatment devices.* 1. Water softeners shall conform to NSF-44.

2. a. Except as provided in subd. 2. b., water treatment devices shall function and perform in accordance with the assertions submitted to the department under s. SPS 384.10, relating to rendering inactive or removing contaminants.

b. A water treatment device which injects a water treatment compound into a water supply system shall maintain the compound concentration in the system over the working flow rate range and pressure range of the device.

3. Except as specified in subd. 4., water treatment compounds introduced into the water supply system by a water treatment device shall be listed as an acceptable drinking water additive by a listing agency approved by the department. Listing agencies approved by the department shall include:

- a. United States environmental protection agency;
- b. United States food and drug administration; and
- c. National sanitation foundation.

4. A water supply system shall be protected from backflow when unlisted water treatment compounds, which may affect the potability of the water, are introduced into the system. The department shall determine the method of backflow protection. Water supply outlets for human use or consumption may not be installed downstream of the introduction of an unlisted water treatment compound.

5. Water treatment devices designed for contaminated water supplies shall be labeled to identify the following information:

- a. The name of the manufacturer of the device;
- b. The device's trade name; and
- c. The device's model number.

(s) *Other plumbing fixtures, appliances and equipment.* Plumbing fixtures, appliances and equipment not specifically covered in this subsection shall conform to the applicable performance standards of this chapter and chs. SPS 382 and 383.

**(6) FAUCETS, SPOUTS AND FIXTURE SUPPLY CONNECTORS.** (a) Except for circular and semi-circular wash fountains, all faucets and showerheads shall conform to ASME A112.18.1 or CAN/ CSA B125.

(b) Circular and semi-circular wash fountains shall conform to the working pressure, burst pressure, discharge rate and product marking requirements of ASME A112.18.1 or CAN/CSA B125.

(c) 1. Except as provided in subd. 2., all fixture supply connectors shall be designed and constructed to withstand a minimum pressure of 100 psig at 180°F.

2. All fixture supply connectors installed on a cold water supply serving fixtures, appliances and devices that provide <1.0 gpm at each outlet shall be designed and constructed to withstand a minimum pressure of 100 psig at 73.4°F.

(d) Hand-held showers shall conform to ASSE 1014.

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## EXAM QUESTIONS

28. \_\_\_\_\_ sinks shall conform to ANSI Z124.6.
- a. Enameled cast iron
  - b. Vitreous china
  - c. Plastic
  - d. Stainless steel

29. True or false? Automatic siphon urinal flush tanks may be installed.
- True
  - False
30. Water closets provided in \_\_\_\_\_ may be of a round-bowl type, with a hinged, closed front seat with or without a seat or cover.
- Day care centers
  - Individual living units
  - Sleeping units of residential occupancies
  - All of the above
31. All pressurized water heaters and pressurized hot water storage tanks shall be rated for a minimum working pressure of \_\_\_\_\_ psig.
- 125
  - 150
  - 175
  - 200
32. Temperature and pressure relief valves shall be set to open at a maximum of \_\_\_\_\_ ° F and in accordance with subd. 3. c.
- 180
  - 200
  - 210
  - 212
33. Water treatment devices designed for contaminated water supplies shall be labeled to identify the following information:
- The name of the manufacturer of the device
  - The device's trade name
  - The device's model number
  - All of the above
34. Except as provided in subd. 2., all fixture supply connectors shall be designed and constructed to withstand a minimum pressure of 100 psig at \_\_\_\_\_ °F.
- 160
  - 180
  - 200
  - 220
35. Hand-held showers shall conform to \_\_\_\_\_.
- ASTM D2235
  - ASTM F402
  - ASSE 1014
  - ASSE 1022

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**SPS 384.25 POWTS holding components or treatment components. (1) GENERAL.** All POWTS holding components or treatment components shall conform to the requirements of this section.

**(2) WATER TIGHTNESS.** (a) *General.* Tank assemblies, including fittings and access openings, shall be manufactured to be water tight as required under this subsection.

(b) *Concrete tanks.* 1. Where concrete tanks are required to have covers, the tanks shall meet one of the following requirements:

- a. Withstand a vacuum of at least 2 inches of mercury for 60 minutes, without loss of pressure.
- b. Hold water for one hour, without leakage after the tank has been filled with water to the top of the cover and let stand for 24 hours, then refilled to the top of the cover.

2. Concrete tanks that are not required to have a cover shall hold water for one hour, without leakage after the tank has been filled with water and let stand for 24 hours, then refilled to the highest liquid level required to be held in the tank.

(c) *Steel tanks.* 1. Steel tanks that are required to have a cover shall be capable of withstanding one of the following requirements:

- a. An internal air pressure of at least 5 psig for 15 minutes, without loss of pressure.
- b. An internal water pressure of at least 5 psig for 60 minutes, without loss of pressure.

2. Steel tanks that are not required to have a cover shall be capable of holding water after being filled to their inlet or outlet, whichever is higher, for 24 hours without loss of water.

(d) *Tanks constructed of materials other than concrete or steel.* 1. Tanks constructed of materials other than concrete or steel that are required to have a cover shall be capable of withstanding one of the following requirements:

- a. A vacuum of at least 2 inches of mercury for 60 minutes, without loss of pressure.
- b. An internal air pressure of at least 5 psig for 15 minutes, without loss of pressure.
- c. An internal water pressure of at least 5 psig for 60 minutes, without loss of pressure.

2. Tanks constructed of materials other than concrete or steel that are not required to have a cover shall be capable of holding water after being filled to their inlet or outlet, whichever is higher, for one hour without loss of water.

**(3) STRENGTH.** Tank assemblies, including fittings and access openings, shall be capable of withstanding loads and pressures that the tanks are intended to encounter and remain watertight.

**(4) PROTECTION FROM ELEMENTS.** (a) *Concrete tanks.* 1. The interior of a concrete tank assembly, including fittings and access openings, shall have a protective coating or be constructed of material, above the lowest liquid level expected in the tank, that will inhibit the deterioration of the concrete due to internal environmental effects.

2. Under subd. 1., concrete with a water cement ratio not exceeding 0.45 shall be considered resistant to deterioration due to internal environmental effects.

(b) *Steel tanks.* 1. Steel tank assemblies, including fittings and access openings, shall have a protective coating that will inhibit the deterioration of the steel due to internal and external environmental effects.

2. Steel tank assemblies, including fittings and access openings, installed underground shall be provided with cathodic protection in accordance with UL Standard 1746 or STI-P 3.

(c) *Tanks constructed of materials other than concrete or steel.* Tank assemblies, including fittings and access openings, constructed of materials other than concrete or steel shall be protected against deterioration due to internal and external environmental effects.

(5) VENTING. (a) Each tank, except camping unit transfer containers, shall be provided with a means of venting gases formed inside of the tank to the atmosphere.

(b) The tank vent shall terminate in accordance with s. SPS 382.31 (16).

(6) PIPE CONNECTION. All pipe connection openings to a tank shall be designed to allow connections in accordance with s. SPS 384.40.

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## EXAM QUESTIONS

36. True or false? Steel tanks that are not required to have a cover shall be capable of holding water after being filled to their inlet or outlet, whichever is lower, for 24 hours without loss of water.

- a. True
- b. False

37. Under subd. 1., concrete with a water cement ratio not exceeding \_\_\_\_\_ shall be considered resistant to deterioration due to internal environmental effects.

- a. 0.15
- b. 0.20
- c. 0.30
- d. 0.45

38. Camping unit transfer containers do not need to be provided with a means of venting gases formed inside of the tank to the atmosphere.

- a. True
  - b. False
- 

(7) ACCESS. (a) Each covered tank shall be provided with one or more openings of sufficient size and located in such a manner to provide a means for inspection or required servicing or maintenance of the tank.

(b) Manhole openings shall be at least 23 inches in the least dimension.

(c) Anaerobic treatment tanks located below ground shall have a manhole opening over the inlet of the most upstream compartment, in each compartment, and over all treatment apparatuses and pumps.

(d) 1. Except as provided in subd. 2., manhole openings for anaerobic treatment tanks located below ground shall extend to a distance not greater than 6 inches below finished grade.

2. Manhole openings over all anaerobic treatment apparatuses and pumps shall extend to at least 4 inches above finished grade.

(e) Servicing and maintenance openings for holding components shall comply with all of the following:

1. Extend to at least 4 inches above finished grade.

2. Be at least 23 inches in the least dimension and be located above pumps or siphons located in the holding component.

(f) Inspection openings for tanks located below ground shall extend at least to the finished grade.

(g) Inspection, servicing and maintenance openings shall terminate with a means that prevents entrance of deleterious materials.

(h) Covers located at or above ground for openings larger than 8 inches in diameter shall be provided with locking devices or other effective measures to prevent unauthorized access.

**(8) WARNING LABEL.** (a) Covers for all tank openings larger than 8 inches in diameter shall be provided with a permanent warning label indicating the dangers of entering the tank, in accordance with this subsection.

(b) The warning label shall be securely attached and made of a noncorrosive metal or plastic bearing the legend 'DO NOT ENTER WITHOUT PROPER EQUIPMENT' or 'DANGEROUS GASES EXIST IN TANK' or similar language.

(c) The label shall be rectangular in shape with minimum dimensions of 4 by 5 inches.

(d) The wording on the label shall be a minimum of ½ inch in height and be either indented or raised.

**(9) DOSING APPARATUS.** (a) Pumps for POWTS used to disperse air, treated wastewater or final effluent shall be rated by the pump manufacturer for such use.

(b) Siphons for POWTS shall be rated by the siphon manufacturer for wastewater use.

(c) All other dosing apparatus for POWTS shall be constructed of corrosive resistant materials and designed to perform as intended.

**(10) ALARM SYSTEM.** All pump and alarm controls for POWTS shall be specifically designed by the manufacturer for such use.

**(11) TANK LABEL.** (a) *Anaerobic treatment tanks.* Each treatment tank which has an anaerobic treatment compartment shall be labeled with a permanent label located near an inlet or outlet opening of the tank. The label shall be embossed, impressed, or securely attached to the tank. The label shall include all of the following information:

1. Name or trademark of the manufacturer.
2. Capacity of each compartment of the tank or the manufacturer's model number.

(b) *Aerobic treatment tanks.* 1. Each aerobic treatment tank complying with NSF Standard 40 and listed by a nationally recognized ANSI accredited third party certified listing agency acceptable to the department shall be provided with 2 label plates. The labels shall conform with all of the following:

- a. Label plates shall be inscribed to be easily read and understood, and be securely attached.
- b. One label plate shall be attached to the front of the electrical control box and the second label plate shall be attached to the aeration equipment assembly, tank, or riser at a location normally subject to access during inspection of the unit.
- c. Each label plate shall include name or trademark of the manufacturer, model number, and rated daily flow capacity of the unit.

(c) *Other treatment, holding and combination treatment—holding tanks.* Except as required in par. (a) or (b), each treatment tank and holding tank shall be labeled with a permanent label located near an inlet or outlet opening. The label shall be embossed, impressed, or securely attached to the tank. The label shall include all of the following information:

1. Name or trademark of the manufacturer.
2. Capacity of each compartment of the tank or the manufacturer's model number.

**(12) OTHER TREATMENT COMPONENTS.** A treatment component not specifically covered in this section may not be sold for use in a POWTS or may not be installed in a POWTS, unless it has received department approval and conforms to the applicable performance standards of this chapter and chs. SPS 382 and 383, and ch. 145, Stats.

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## EXAM QUESTIONS

39. Manhole openings shall be at least \_\_\_ inches in the least dimension.
- a. 23
  - b. 24
  - c. 25
  - d. 26
40. Manhole covers located at or above ground for openings larger than \_\_\_ inches in diameter shall be provided with locking devices or other effective measures to prevent unauthorized access.
- a. 2
  - b. 4
  - c. 6
  - d. 8
41. The warning label for a tank shall be \_\_\_\_\_ in shape with minimum dimensions of 4 by 5 inches.
- a. Circular
  - b. Triangular
  - c. Rectangular
  - d. Any of the above
42. Each aerobic treatment tank complying with NSF Standard 40 and listed by a nationally recognized ANSI accredited third party certified listing agency acceptable to the department shall be provided with \_\_\_ label plate(s).
- a. 1
  - b. 2
  - c. 3
  - d. 4
43. The label shall be embossed, impressed, or securely attached to the tank, and shall include the name of the manufacture and the \_\_\_\_\_.
- a. Company's phone number
  - b. Company's address
  - c. Manufacturer's model number
  - d. All of the above
-

**SPS 384.30 Plumbing materials. (1) GENERAL.** When selecting the material and determining size for a plumbing system, due consideration shall be given to the waste that will discharge to the plumbing system and to the soil, liquid and atmospheric environments where the plumbing system will be located.

- (a) The bending or offsetting of flexible or annealed pipe or tubing shall be in accordance with the applicable material standard or the instructions of the manufacturer of the pipe or tubing.
- (b) Pipe or tubing with gouges, cuts or deep scratches may not be installed.
- (c) Pipe or tubing which has been kinked may not be installed.
- (d) The bending or offsetting of rigid pipe shall be prohibited.
- (e) Nailing plates shall be installed to protect copper or plastic pipe or tubing from puncture.
- (f) Pipe and tubing for water distribution systems downstream of treatment devices designed to serve fixtures, appliances and devices that provide <1 gpm at each outlet shall be sleeved when penetrating a wall, floor or structural member.

**(2) SANITARY DRAIN AND VENT SYSTEMS AND POWTS INSPECTION AND OBSERVATION PIPING.** Sanitary drain systems and vent systems and POWTS inspection and observation piping shall be of such material and workmanship as set forth in this subsection.

- (a) *Above ground drain and vent pipe.* Except as provided in s. SPS 382.33 (2), drain pipe and vent pipe installed above ground shall conform to one of the standards listed in Table 384.30-1.
- (b) *Underground drain and vent pipe.* Except as provided in par. (d), drain pipe and vent pipe installed underground shall conform to one of the standards listed in Table 384.30-2.
- (c) *Sanitary building sewer pipe.* Sanitary building sewer pipe shall conform to one of the standards listed in Table 384.30-3.
- (d) *Treated wastewater piping.*
  1. Nonpressurized, nonperforated drain piping conveying treated wastewater from a POWTS treatment or holding component to a POWTS treatment or holding component, distribution cell or dispersal zone shall conform to one of the standards listed in Table 384.30-3.
  2. Nonpressurized perforated drain piping conveying treated wastewater in a POWTS soil treatment or dispersal component shall conform to one of the standards listed in Table 384.30-4.
  3. Pressurized perforated drain piping conveying treated wastewater in a POWTS treatment or dispersal component shall conform to one of the standards listed in Table 384.30-5 and shall be perforated in accordance with the POWTS design.
- (e) *Pressurized drain pipe.* Except as provided in par. (d) 3., pressurized drain pipe shall conform to one of the standards listed in Table 384.30-5 and shall be rated for the working pressure and temperature to which it will be subjected for a specific installation.
- (f) *Chemical drain and vent pipe.* Drain systems and vent systems for chemical wastes shall be of approved corrosion resistant material. The manufacturer of the pipe shall indicate to the department the material's suitability for the concentrations of chemicals involved.

(g) *Catch basins, interceptors and sumps.* Catch basins, interceptors and sumps shall be constructed in a watertight manner of precast reinforced concrete, reinforced monolithic concrete, cast iron, coated 12-gauge steel, vitrified clay, fiberglass, plastic or other approved materials.

(h) *Manholes.* Manholes shall be constructed in a watertight manner of precast reinforced concrete, reinforced monolithic concrete, brick or block, fiberglass or other approved materials. Fiberglass manholes may be approved for use in traffic areas if the top section of the manhole is not made of fiberglass.

(i) *Service suction lines.* A service suction line or pump discharge line serving a holding tank for cleaning purposes shall conform to one of the standards listed in Table 384.30-5. Joints and connections for suction lines shall conform to s. SPS 384.40. The use of mechanical joints shall be in accordance with the recommendations and instructions specified by the manufacturer.

(j) *POWTS inspection and observation pipe.* A POWTS inspection and observation pipe shall conform to at least one of the standards listed in Table 384.30-1.

**Table 384.30-1  
ABOVE GROUND DRAIN AND VENT PIPE AND TUBING**

<b>Material</b>	<b>Standard</b>
Acrylonitrile butadiene styrene (ABS)	ASTM D1527; ASTM D2661; ASTM F628
Brass	ASTM B43
Cast iron	ASTM A74; ASTM A888; CISPI 301
Copper	ASTM B42; ASTM B88; ASTM B306
Galvanized steel	ASTM A54
Polyvinyl chloride (PVC)	ASTM D2665; ASTM D1785; ASTM F891
Synthetic rubber hose	AHAM DW-1

**Table 384.30-2  
UNDERGROUND DRAIN AND VENT PIPE AND TUBING**

<b>Material</b>	<b>Standard</b>
Acrylonitrile butadiene styrene (ABS)	ASTM D1527; ASTM D2661; ASTM F628
Cast iron	ASTM A74; ASTM A888; CISPI 301
Copper	ASTM B42; ASTM B88
Polyvinyl chloride (PVC)	ASTM D1785; ASTM D2665; ASTM D3034; ASTM F891

**Table 384.30-3  
SANITARY BUILDING SEWER PIPE AND TUBING**

<b>Material</b>	<b>Standard</b>
Acrylonitrile butadiene styrene (ABS)	ASTMD1527; ASTM D2661; ASTM D2751;

	ASTM F628
Acrylonitrile butadiene styrene (ABS) composite	ASTM D2680
Cast iron	ASTM A74; ASTM A888; CISPI 301
Concrete	ASTM C14; ASTM C76
Copper	ASTM B42; ASTM B88
Polyvinyl chloride (PVC)	ASTM D1785; ASTM D2665; ASTM D3034; ASTM F891
PVC Corrugated Sewer Pipe With a Smooth Interior and Fittings	ASTM F949
PVC Large-Diameter Plastic Gravity Sewer Pipe and Fittings	ASTM F679
PVC Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter	ASTM F794
Type PS-46 and Type PS-1 15 PVC Plastic Gravity Flow Sewer Pipe and Fittings	ASTM F789

**Table 384.30-4**  
**PERFORATED EFFLUENT DISTRIBUTION PIPING FOR NONPRESSURIZED SOIL ABSORPTION SYSTEMS**

<b>Material</b>	<b>Standard</b>
Polyethylene (PE)	ASTM F405; ASTM F810
Polyvinyl chloride (PVC)	ASTM D2729

**Table 384.30-5**  
**PRESSURIZED DRAIN PIPE AND TUBING AND SERVICE SUCTION LINES**

<b>Material</b>	<b>Standard</b>
Acrylonitrile butadiene styrene (ABS)	ASTM D1527; ASTM D2282; ASTM D2661; ASTM F628
Brass	ASTM B43
Chlorinated Poly (Vinyl Chloride) (CPVC)	ASTM D2846; ASTM F441/F441M; ASTM F442/F442M
Concrete	ASTM C14; ASTM C76
Copper	ASTM B42; ASTM B88; ASTM B306
Ductile iron	AWWA C115; AWWA C151
Galvanized steel	ASTM A53
Polyethylene Pressure Pipe and Fitting, 4 in. through 63 in., for Water Distribution	AWWA C906
Polyethylene (PE) Pressure Pipe and Tubing, 1/2 in. through 3 in.	AWWA C901-02
Polyvinyl chloride (PVC)	ASTM D1785; ASTM D2241; ASTM D2665; AWWA C900
Stainless Steel	ANSI B36.19M; ASTM

	A269; A312/A312M; ASTM A450; A778; AWWA C220
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## EXAM QUESTIONS

44. True or false? Pipe or tubing which has been kinked may be installed.
- True
  - False
45. \_\_\_\_\_ shall be constructed in a watertight manner of precast reinforced concrete, reinforced monolithic concrete, cast iron, coated 12-gauge steel, vitrified clay, fiberglass, plastic or other approved materials.
- Catch basins
  - Interceptors
  - Sumps
  - All of the above
46. \_\_\_\_\_ is the standard for Brass, with regards to Above Ground Drain and Vent Pipe and Tubing.
- ASTM D1527
  - ASTM A53
  - ASTM B43
  - AHAM DW-1
47. Copper, with regards to Underground Drain and Vent Pipe and Tubing, is governed by standard \_\_\_\_\_.
- ASTM D2680
  - ASTM B42; ASTM B88
  - ASTM F949; ASTM F679
  - AWWA C906
48. True or false? Acrylonitrile butadiene styrene (ABS) composite complies by standard ASTM D2680 with regard to Table 384.30-3.
- True
  - False
- 

**(3) STORM AND CLEAR WATER DRAIN AND VENT SYSTEMS.** Storm and clear water drain and vent systems shall be of such material and workmanship as set forth in this subsection.

(a) *Above ground drain and vent pipe.* Drain pipe and vent pipe installed above ground and inside a building shall conform to one of the standards listed in Table 384.30-1, except black steel pipe conforming to ASTM A53 may be used for storm water conductors. Black steel conductors may not be embedded in concrete or masonry.

(b) *Underground drain and vent pipe.* Drain pipe and vent pipe installed underground shall conform to one of the standards listed in Table 384.30-2.

(c) *Storm building sewer pipe.* Storm building sewer pipe shall conform to one of the standards listed in Table 384.30-6.

(d) *Subsoil drain pipe.* Subsoil drains shall be open jointed, horizontally split, or perforated pipe conforming to one of the standards listed in Table 384.30–7.

(e) *Roof drains.* 1. Roof drains shall be provided with removable strainers of sufficient strength to carry the anticipated loads.

2. Roof drains shall be so constructed that the drains can be cleaned and the drain inlets accessible at all time.

3. Roof drains shall be sized in accordance with s. SPS 382.36 and the drain outlet shall not be less than 2½ inches in diameter.

(f) *Area drain inlets.* Area drain inlets shall be constructed in a watertight manner of precast concrete, reinforced monolithic concrete, brick or block, cast iron, coated 12 gauge steel, vitrified clay, fiberglass or other approved materials.

**Table 384.30–6  
STORM BUILDING SEWER PIPE AND TUBING**

<b>Material</b>	<b>Standard</b>
Acrylonitrile butadiene styrene (ABS)	ASTM D1527; ASTM D2282; ASTM D2661; ASTM F628
Acrylonitrile butadiene styrene (ABS) composite	ASTM D2680
Cast iron	ASTM A74; ASTM A888; CISPI 301
Concrete, circular	ASTM C14; ASTM C76
Concrete, elliptical	ASTM C507/C50M
Copper	ASTM B42; ASTM B88
Polyvinyl chloride (PVC)	ASTM D1785; ASTM D2665; ASTM D3034; ASTM F891
PVC Corrugated Sewer Pipe With a Smooth Interior and Fittings	ASTM F949
PVC Large-Diameter Plastic Gravity Sewer Pipe and Fittings	ASTM F679
PVC Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter	ASTM F794
Type PS-46 and Type PS-1 15 PVC Plastic Gravity Flow Sewer Pipe and Fittings	ASTM F789

(4)

**WATER SUPPLY SYSTEMS.** Water supply systems shall be of such material and workmanship as set forth in this subsection. All materials in contact with water, in a water supply system, shall be suitable for use with the water within the system. All pipes and pipe fittings for water supply systems shall be made of a material that contains a weighted average of not more than 0.25 percent [lead] in the wetted surface material.

(a) *Water quality.* A water supply system shall be resistive to corrosive action and degrading action from the water being conveyed.

(b) *Soil and groundwater.* The installation of water supply systems shall be prohibited in soil and groundwater that is contaminated with solvents, fuels, organic compounds or other detrimental materials which will cause permeation, corrosion, degradation, or structural failure of the piping material.

1. Where detrimental conditions are suspected, a chemical analysis of the soil and groundwater conditions shall be required to ascertain the acceptability of the proposed water supply system materials for the specific installation.

2. Where a detrimental condition exists, no underground water supply system may be installed until the detrimental condition can be:

- a. Eliminated and the source of the condition can be eliminated;
- b. Identified and the pipe and joining method can be proven resistant to the detrimental condition; or
- c. Avoided by choosing an alternate route that will not be affected by the detrimental condition.

(c) *Certification of plastic pipe.* Plastic pipe for a water supply system shall be certified for potable water contact by a nationally recognized listing agency acceptable to the department.

(d) *Water services and private water mains.* 1. Water service pipe and private water mains shall conform to one of the standards listed in Table 384.30–7. Pipe and tubing for water services and private water mains shall have a minimum working pressure of 150 psig at 73.4°F.

2. A local governmental unit may by ordinance restrict the types of materials for water services and private water mains which are to be located within or beneath an area subject to an easement for a highway, street or public service right-of-way. Before adopting an ordinance restricting the types of materials for water services, the local governmental unit shall submit a copy of the proposed ordinance to the department for review and approval.

3. Materials for combination water services and combination private water mains shall comply with NFPA 24 and the provisions specified in par. (d).

(e) *Water distribution pipe.* 1. Except as provided in subd. 2. or 3., water distribution pipe shall have a minimum working pressure of 100 psig at 180°F and shall conform to one of the standards listed in Table 384.30–8

2. Cold water distribution pipe installed underground shall have a minimum working pressure of 150 psig at 73.4°F and shall conform to one of the standards listed in Table 384.30–7 or 384.30–8.

3. Pipe and tubing for cold water distribution systems downstream of water treatment devices designed to serve fixtures, appliances and devices that provide <1 gpm at each outlet shall conform to one of the standards listed in Table 384.30–8 or 384.30–11, and shall have a minimum working pressure of 100 psig at 73.4°F.

4. Plastic pipe and tubing for water distribution systems downstream of water treatment devices designed to serve fixtures, appliances and devices that provide <1 gpm at each outlet shall be marked at intervals not to exceed 4 feet with the following information:

- a. The manufacturer's name.
- b. The trade designation of the pipe or tubing.
- c. The type of material.
- d. The minimum working temperature and pressure of the pipe or tubing.
- e. The mark of the certifying agency.

(f) *Used piping.* Piping which has been used for any other purpose than conveying potable water may not be used for water supply systems.

**Table 384.30–7**

**PIPE AND TUBING FOR WATER SERVICES AND PRIVATE WATER MAINS**

<b>Material</b>	<b>Standard</b>
Acrylonitrile butadiene styrene (ABS)	ASTM D1527; ASTM D2282
Brass	ASTM B43
Chlorinated Poly (Vinyl Chloride) (CPVC)	ASTM D2846; ASTM F441/F441M; ASTM F442/F442M
Copper	ASTM B42; ASTM B88
Crosslinked Polyethylene/ Aluminum/Crosslinked Polyethylene	CAN/CSA B137.10; ASTM F1281
Crosslinked polyethylene (PEX)	ASTM F876; ASTM F877
Ductile iron	AWWA C115; AWWA C151
Galvanized steel	ASTM A53
Polyethylene (PE)	ASTM D2239; ASTM D2737; ASTM D2104; ASTM D2447; ASTM D3035; AWWA C906; AWWA C901
Polyethylene/Aluminum/Polyethylene	CAN/CSA B137.9
Polyethylene/Aluminum/ Polyethylene (PE–AL–PE) Composite Pressure Pipe	ASTM F1282
Polyvinyl chloride (PVC)	ASTM D1785; ASTM D2241; AWWA C900
Stainless steel	ASME B36.19/B36.19M

**Table 384.30–8**

**WATER DISTRIBUTION PIPE AND TUBING**

<b>Material</b>	<b>Standard</b>
Brass	ASTM B43
Cast iron	AWWA C115
Chlorinated Poly (Vinyl Chloride) (CPVC)	ASTM D2846; ASTM F441/F441M; ASTM F442/F442M
Copper	ASTM B42; ASTM B88
Crosslinked Polyethylene/ Aluminum/Crosslinked Polyethylene	CAN/CSA B137.10; ASTM F1281
Crosslinked polyethylene (PEX)	ASTM F876; ASTM F877
Ductile iron	AWWA C115; AWWA C151
Galvanized steel	ASTM A53
Polyethylene/Aluminum/Polyethylene	CAN/CSA B137.9
Polyethylene/Aluminum/ Polyethylene (PE–AL–PE) Composite Pressure Pipe	ASTM F1282
Stainless Steel	ASME B36.19/B36.19M; ASTM A270; ASTM A450

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**EXAM QUESTIONS**

49. True or false? Black steel conductors may not be embedded in concrete or masonry.
- a. True
  - b. False
50. Roof drains shall be sized in accordance with s. SPS 382.36 and the drain outlet shall not be less than \_\_\_\_\_ inches in diameter.
- a. 2<sup>1</sup>/<sub>2</sub>
  - b. 3
  - c. 3<sup>1</sup>/<sub>2</sub>
  - d. 4
51. According to Table 384.30 6, the standard for PVC Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter is \_\_\_\_\_.
- a. ASTM F494
  - b. ASTM F679
  - c. ASTM F794
  - d. ASTM D2680
52. All pipes and pipe fittings for water supply systems shall be made of a material that contains a weighted average of not more than \_\_\_\_\_ percent [lead] in the wetted surface material.
- a. 0.10
  - b. 0.15
  - c. 0.20
  - d. 0.25
53. Pipe and tubing for water services and private water mains shall have a minimum working pressure of \_\_\_\_\_ psig at 73.4°F.
- a. 150
  - b. 200
  - c. 250
  - d. 300
54. Pipe and tubing for cold water distribution systems downstream of water treatment devices designed to serve fixtures, appliances and devices that provide <1 gpm at each outlet shall have a minimum working pressure of \_\_\_\_\_ psig at 73.4°F.
- a. 100
  - b. 150
  - c. 200
  - d. 250

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**Table 384.30–9**  
**MINIMUM BENDING RADIUS OF POLYBUTYLENE WATER DISTRIBUTION PIPE AND TUBING**

Pipe Size (inches)	Bending Radius (inches)	Tubing Size (inches)	Bending Radius (inches)
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$\frac{3}{4}$	12 $\frac{3}{4}$	$\frac{1}{4}$	4 $\frac{1}{2}$
1	15 $\frac{3}{4}$	$\frac{3}{8}$	6
1 $\frac{1}{4}$	20	$\frac{1}{2}$	7 $\frac{1}{2}$
1 $\frac{1}{2}$	23	$\frac{3}{4}$	10 $\frac{1}{2}$
2	28 $\frac{1}{2}$	1	13 $\frac{1}{2}$
		1 $\frac{1}{4}$	16 $\frac{1}{2}$
		1 $\frac{1}{2}$	19 $\frac{1}{2}$
		2	25 $\frac{1}{2}$

**(5) PIPE FITTINGS AND VALVES.** (a) *Fittings.* Pipe fittings shall conform to the pipe material standards listed in this chapter or one of the standards listed in Table 384.30–10. Threaded drain pipe fittings shall be of the recessed drainage type.

(b) *Water supply valves.* 1. Control valves for water services and private water mains shall be designed and constructed to withstand a minimum pressure of 125 psig at 73.4°F.

2. Control valves for water distribution systems shall be designed and constructed to withstand a minimum pressure of 100 psig at 180°F.

3. Except for a valve integral to a device, a control valve which serves 2 or more plumbing fixtures shall have, with the valve in a fully open position, a flow through passageway of not less than one nominal pipe size smaller than the nominal size of the piping connecting to the valve.

4. A control valve which serves 2 or more plumbing fixtures may not be a globe type valve.

(c) *Special fittings and valves.* 1. Water hammer arrestors shall conform to ASME A112.26.1 or ASSE 1010.

2. Relief valves and automatic gas shutoff devices for hot water supply systems shall conform to ANSI Z21.22.

3. Backwater valves shall conform to ASME A112.14.1, CAN/CSA B181.1 or CAN/CSA B181.2.

4. Pipe applied atmospheric type vacuum breakers shall conform to ASSE 1001, and CAN/CSA B64.1.1.

5. Water pressure reducing valves and strainers for water pressure reducing valves for domestic water supply systems shall conform to ASSE 1003.

6. Hose connection vacuum breakers shall conform to ASSE 1011 or CAN/CSA B64.2.

7. Backflow preventers with intermediate atmospheric vent shall conform to ASSE 1012 and dual check type atmospheric port backflow preventers shall conform to CAN/CSA B64.3.

8. Reduced pressure backflow preventers and reduced pressure fire protection principle backflow preventers, or backflow preventers, reduced pressure principle type (RP) shall conform with ASSE 1013 or CAN/CSA B64.4.

9. Double check backflow prevention assemblies shall conform to ASSE 1015 or CAN/CSA B64.5.

10. Individual thermostatic, pressure balancing, and combination pressure balancing and thermostatic control valves serving individual showers shall conform to ASSE 1016 or CAN/CSA B125.

11. Trap seal primer valves, water fed shall conform to ASSE 1018.
  12. Vacuum breaker wall hydrants, freeze resistant automatic draining type shall conform to ASSE 1019, types A or B.
  13. Pressure vacuum breaker assemblies shall conform to ASSE 1020 or CAN/CSA B64.1.2.
  14. Laboratory faucet backflow preventers shall conform to ASSE 1035 and laboratory faucet type vacuum breakers shall conform to CAN/CSA B64.7.
  15. Reduced pressure detector fire protection, backflow prevention assemblies shall conform to ASSE 1047.
  16. Double check detector assembly backflow preventers shall conform to ASSE 1048.
  17. Back siphonage backflow vacuum breakers shall conform to ASSE 1056.
  18. Hose connection backflow preventers shall conform to ASSE 1052.
  19. Backflow preventers for carbonated beverage machines shall conform to ASSE 1022.
  20. Dual check backflow preventers in freeze resistant types of wall hydrants shall conform to ASSE 1053.
- (d) *Pipe saddles*. Pipe saddles shall be installed in accordance with the instructions of the saddle manufacturer and conform to all of the following limitations:
1. Pipe saddles may be installed on private interceptor main sewers, building sewers, underground drain and vent pipe and tubing, and where otherwise approved by the department.
  2. A saddle for drain piping shall have a radius in accordance with s. SPS 382.30 (8) (a).
  3. The material of the saddle shall be compatible with the materials of the pipes which are to be connected to the saddle.
  4. The hole in the pipe which is to receive the saddle shall be drilled or cored to match the saddle outlet.
  5. Straps or clamps which wrap around the pipe and saddle shall be provided by the manufacturer of the saddle.
  6. Saddles shall be installed with straps or clamps which wrap around the pipe and saddle.
  7. Proper hangers or bedding shall be provided to maintain alignment between the opening in the pipe and the saddle.

**Table 384.30-10  
PIPE FITTINGS**

<b>Material</b>	<b>Standard</b>
Acrylonitrile butadiene styrene (ABS)	ASTM D2468; ASTM D3311; ASTM F409
Cast bronze	ANSI B16.15; ANSI B16.24
Cast copper alloy	ASME B16.18; ASME B16.23; ASME B16.26
Cast iron	ASME B16.4; ASME B16.12; ASME B16.1; ASME B16.45
Chlorinated polyvinyl chloride (CPVC)	ASTM F437; ASTM F438; ASTM F439
Copper	ASME B16.22; ASME B16.29

Crosslinked Polyethylene (PEX)	ASTM F1807
Ductile iron and gray iron	AWWA C110; AWWA C153; ANSI B16.42
Malleable iron	ANSI B16.3
Polyethylene (PE)	ASTM D2609; ASTM D2683; ASTM D3261
Polyvinyl Chloride (PVC)	ASTM D2464; ASTM D2466; ASTM D2467; ASTM D3311; ASTM F409; ASTM F1336; ASTM F1866
Polyvinyl Chloride (PVC) Gasketed Sewer Fittings	ASTM F1336
Stainless steel	ASTM A403
Steel	ANSI B16.5; ANSI B16.9; ANSI B16.11; ANSI B16.28
Styrene-rubber (SR)	ASTM D2852

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## EXAM QUESTIONS

55. According to table 384.30-9, if the Pipe Size is 1¼ inches, the Bending Radius should be \_\_\_ inches.
- 12 ¾
  - 15 ¾
  - 20
  - 23
56. According to Table 384.30-9, if the Tubing Size is 2 inches, the Bending Radius should be \_\_\_ inches.
- 4 ½
  - 6
  - 13 ½
  - 25 ½
57. Control valves for water services and private water mains shall be designed and constructed to withstand a minimum pressure of \_\_\_ psig at 73.4°F.
- 125
  - 150
  - 175
  - 200
58. True or false? A control valve which serves 2 or more plumbing fixtures may not be a globe type valve.
- True
  - False
59. True or false? Vacuum breaker wall hydrants, freeze resistant automatic draining type shall conform to ASSE 1019, only type A.
- True
  - False
60. Backflow preventers for carbonated beverage machines shall conform to \_\_\_\_\_.
- ASTM F1281

- b. AWWA C900
- c. ASSE 1022
- d. CAN/CSA B 137.9

**Table 384.30–1 1**

**Pipe And Tubing For Water Distribution Systems Downstream Of Treatment Devices Designed To Serve Fixtures, Appliances And Devices That Provide  $\leq 1$  Gpm At Each Outlet**

Material	Standard
Copper	ASTM B42; ASTM B88
Polyethylene (PE)	NSF 51; NSF 61
Polypropylene (PP)	NSF 51; NSF 61
Polyvinylidene fluoride (PVDF)	NSF 51; NSF 61
Polyvinyl chloride (PVC)	NSF 51; NSF 61

(6) SPECIAL MATERIALS. (a) *Sheet lead*. Sheet lead for the following uses may not weigh less than indicated in subds. 1. and 2.

- 1. Site-fabricated flashings for vent pipes, 3 pounds per square foot; and
- 2. Prefabricated flashings for vent pipes, 2½ pounds per square foot.

(b) *Traps and fixture drain connection fittings*. Copper or tubular brass traps and fixture drain connection fittings shall be at least of 20 gage material.

(c) *Sheet copper*. Sheet copper for the following uses may not weigh less than indicated in subds. 1. and 2. and shall conform to ASTM B152.

- 1. Flashing for vent pipes, 8 ounces per square foot; and
- 2. Flush tank linings, 10 ounces per square foot.

(d) *Cleanout plugs*. Cleanout plugs shall be of brass or plastic. Brass cleanout plugs shall be used with metallic piping only and shall conform to ASTM A74. Plastic cleanout plugs shall conform to the requirements of sub. (5) (a).

(e) *Flush pipes and fittings*. Flush pipes and fittings shall be of nonferrous material and shall conform to ASME A112.19.5.

(f) *Safing material*. Safing materials shall be waterproof when subjected to 2 feet of hydrostatic head when tested in accordance with ASTM C1306 or ASTM D4068. The material shall be recognized by the manufacturer for use as a safing material.

(g) *Geotextile fabrics*. Geotextile fabric used in a POWTS to prevent backfill material from entering the distribution cell shall meet the requirements listed in Table 384.30–12.

**Table 384.30–12**

**GEOTEXTILE FABRICS**

Property	Test Method	Minimum Average Roll Value
Grab Tensile, lbs.	ASTM D4632	35 lbs., minimum
Gram Elongations, %	ASTM D4632	50%, minimum

<b>Puncture, lbs.</b>	ASTM D4833	10 lbs., minimum
<b>Trapezoidal tear, lbs.</b>	ASTM D4533	11 lbs., minimum
<b>AOS, US Sieve #</b>	ASTM D4751	20 US sieve #, minimum
<b>AOS, US Sieve #</b>	ASTM D4751	70 US sieve #, minimum

(h) *Leaching chambers.* Leaching chambers for distribution cell components of POWTS or stormwater subsurface infiltration systems shall meet all of the following requirements:

1. Constructed of corrosion resistant materials.
2. Designed to prevent soil surrounding the chamber from entering the chamber.
3. Capable of withstanding pressures that the leaching chamber is intended to encounter.

(i) *Stone aggregate.* Stone aggregate which is used as a filtering medium or to create a distribution cell in a treatment or dispersal component of a POWTS or stormwater subsurface infiltration system shall meet all of the following requirements:

1. Conform to ASTM Standard C33 for coarse aggregate prior to washing.
2. Be washed to remove fine material.
3. Be ½ to 2½ inch in size.
4. Have a hardness value of at least 3 on Moh's Scale of Hardness.

(j) *Sand.* Sand that is placed as a filtering medium in a storm-water subsurface infiltration system shall conform to ASTM Standard C33 for fine aggregate.

(k) *Synthetic aggregate.* Synthetic aggregate that is used as a filtering medium or to create a distribution cell in a treatment or dispersal component of a POWTS or stormwater subsurface infiltration system shall meet all of the following requirements:

1. Be made from inert materials.
2. Be ½ inch to 2½ inches in size.
3. Be made of material that will not contaminate groundwater.
4. Be recognized by the manufacturer for use as a filtering media or a material to create a distribution cell.

## EXAM QUESTIONS

61. According to table 384.30–11, NSF 51; NSF 61 is the standard for \_\_\_\_\_.
  - a. Polyethylene
  - b. Polypropylene
  - c. Polyvinyl chloride
  - d. All of the above
  
62. Copper or tubular brass traps and fixture drain connection fittings shall be at least of \_\_\_\_ gage material.
  - a. 20
  - b. 22
  - c. 26
  - d. 30
  
63. Cleanout plugs shall be of brass or \_\_\_\_\_.
  - a. Glass
  - b. Copper

- c. Plastic
- d. Iron

64. True or false? Flush pipes and fittings shall be of nonferrous material and shall conform to ASME A112.19.5.
- a. True
  - b. False
65. According to Geotextile Fabrics, the Minimum Average Roll Value for Grab Tensile is \_\_\_ lbs.
- a. 35
  - b. 36
  - c. 38
  - d. 40
66. Leaching chambers for distribution cell components of POWTS or stormwater subsurface infiltration systems shall be \_\_\_\_\_.
- a. Constructed of corrosion resistant materials
  - b. Designed to prevent soil surrounding the chamber from entering the chamber
  - c. Capable of withstanding pressures that the leaching chamber is intended to encounter
  - d. All of the above
67. Stone aggregate which is used as a filtering medium or to create a distribution cell in a treatment or dispersal component of a POWTS shall have a hardness value of at least \_\_\_ on Moh's Scale of Hardness.
- a. 3
  - b. 4
  - c. 5
  - d. 6

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**SPS 384.40 Joints and connections. (1) GENERAL.** (a) *Tightness.* Joints and connections in the plumbing system shall be watertight and gastight as required by test or system design, whichever is greater, or as required by the adopted product standard or department approval.

(b) *Preparation of pipe ends.* Pipe ends shall be prepared in accordance with the applicable pipe standard or the pipe or fitting manufacturer's instructions.

(c) *Prohibited joints and connections.* Unless otherwise permitted in this chapter or ch. SPS 382 or 383, all of the following types of joints and connections shall be prohibited:

1. Cement or concrete joints.
2. Mastic or hot poured bituminous joints.
3. Elastomeric rolling o-rings between different diameter pipes.
4. Solvent cement joints between different types of plastic pipe other than ABS and PVC in non-pressurized systems.
5. Roll grooving of galvanized steel pipe.

**(2) ABS PLASTIC PIPE.** Joints between acrylonitrile butadiene styrene plastic pipe or fittings shall be installed in accordance with pars. (a) to (c).

(a) *Mechanical joints.* Mechanical joints shall be installed in accordance with the manufacturer's instructions.

1. 'Drain and vent systems.' Mechanical push-on joints for drain and vent systems shall conform to ASTM D3212.
2. 'Water supply systems.' Mechanical push-on joints and mechanical compression-type joints for water supply systems which use a flexible elastomeric seal shall be suitable for potable water.

(b) *Solvent cemented joints.* Solvent cemented joints shall be made in accordance with ASTM D2235 and its appendix, ASTM D2661 or ASTM F628.

1. Joint surfaces shall be clean and free of moisture.
2. Solvent cement conforming to ASTM D2235 shall be applied to all joint surfaces and the joint shall be made while the cement is wet.
3. Solvent cement shall be handled in accordance with ASTM F402.
4. Solvent cement used on pipes and fittings of a water supply system shall conform to NSF 14 and shall be certified by a nationally recognized testing agency as to conforming to NSF 14. The container for the solvent cement shall bear the certification mark of the testing agency.

(c) *Threaded joints.* Threaded joints shall only be used on pipes of schedule 80 or heavier. Threaded joints shall conform to ASME B1.20.1. The pipe shall be threaded with dies specifically designed for plastic pipe. Thread lubricant or tape approved for such use shall be applied to the male threads only.

**(3) BLACK STEEL PIPE.** Joints between black steel pipe or fittings shall be in accordance with pars. (a) to (d).

(a) *Threaded joints.* Threaded joints shall conform to ASME B1.20.1. Pipe joint compound or tape shall be used on the male threads only.

(b) *Mechanical joints.* Mechanical joints shall be installed in accordance with the manufacturer's instructions.

(c) *Caulked joints.* Caulked joints shall only be used for drain or vent piping. Caulked joints for hub and spigot piping and fittings shall be firmly packed with oakum or hemp. Molten lead shall be poured in one operation not less than one inch deep and not to extend more than  $\frac{1}{8}$  inch below the rim of the pipe, and caulked tight. Paint, varnish or other coatings may not be used on the joining material until after the joint has been tested and approved.

1. Caulked joints for drain piping shall be used only in a vertical position.
2. Caulked joints for vent piping may be used for piping in a vertical or horizontal position.

(d) *Welded joints.* Joints between black steel pipe or fittings may be welded.

**(4) BRASS PIPE.** Joints between brass pipe or fittings shall be in accordance with the provisions of pars. (a) to (d).

(a) *Brazed joints.* All joint surfaces to be brazed shall be cleaned bright by other than chemical means. Brazing filler metal conforming to AWS A5.8 or other approved material shall be used. The joining of water supply piping shall be made with lead-free materials. Solders and fluxes containing in excess of 0.2% lead shall not be used.

(b) *Mechanical joints.* Mechanical joints shall be installed in accordance with the manufacturer's instructions. Mechanical push-on joints and mechanical compression type joints for water supply systems which use flexible elastomeric seals shall be suitable for potable water.

(c) *Soldered joints.* All joint surfaces to be soldered shall be cleaned bright by other than chemical means. A nontoxic flux shall be applied to all joint surfaces. Solder conforming to ASTM B32 or other approved material shall be used. The joining of water supply piping shall be made with lead-free materials. Solders and fluxes containing in excess of 0.2% lead shall not be used.

(d) *Threaded joints.* Threaded joints shall conform to ASME B1.20.1. Pipe joint compound or tape shall be used on the male threads only.

**(5) CAST IRON PIPE.** Joints between cast iron pipe or fittings shall be installed in accordance with pars. (a) and (b).

(a) *Caulked joints.* 1. 'Drain and vent systems.' Caulked joints for hub and spigot pipe of drain and vent systems shall be firmly packed with oakum or hemp. Molten lead shall be poured in one operation not less than one inch deep and not to extend more than  $\frac{1}{8}$  inch below the rim of the pipe, and caulked tight. Paint, varnish or other coatings may not be used on the joining material until after the joint has been tested and approved.

2. 'Water supply systems.' Joints for bell and spigot pipe of water supply systems shall be firmly packed with treated paper rope. Molten lead shall be poured in one operation to a depth of  $2\frac{1}{2}$  inches.

(b) *Mechanical joints.* 1. 'Drain and vent systems.' a. Mechanical push-on joints for drain and vent systems shall have gaskets which conform to ASTM C564.

b. Mechanical sleeve joints for drain and vent systems shall have a rubber sealing sleeve conforming to ASTM C564, CISPI 310 or FM 1680. Where a stainless steel band assembly is used, the band assembly shall conform to CISPI 310 or FM 1680. Mechanical joints shall be installed in accordance with the manufacturer's instructions.

2. 'Water supply systems.' Mechanical push-on joints and mechanical compression type joints for water supply systems shall conform to AWWA C111/A21.11. Lead tipped gaskets may not be used.

(c) *Threaded joints.* Threaded joints shall conform to ASME B1.20.1. Pipe joint compound or tape shall be used on the male threads only.

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## EXAM QUESTIONS

68. Unless otherwise permitted in this chapter or ch. SPS 382 or 383, \_\_\_\_\_ are prohibited.

- a. Cement or concrete joints.
- b. Mastic or hot poured bituminous joints.
- c. Roll grooving of galvanized steel pipes
- d. All of the above

69. True or false? Solvent cement conforming to ASTM D2235 shall be applied to all joint surfaces and the joint shall be made while the cement is dry.

- a. True
- b. False

70. Threaded joints shall only be used on pipes of schedule \_\_\_\_ or heavier.

- a. 80
- b. 85
- c. 90

d. 95

71. Molten lead shall be poured in one operation not less than \_\_\_ inch(es) deep and not to extend more than  $\frac{1}{8}$  inch below the rim of the pipe, and caulked tight.
- 1
  - 1  $\frac{1}{2}$
  - 2
  - 2  $\frac{1}{2}$
72. Caulked joints for drain piping shall be used in a \_\_\_\_\_ position.
- Horizontal only
  - Vertical only
  - Horizontal or vertical
  - Perpendicular
73. Solders and fluxes containing in excess of \_\_\_% lead shall not be used.
- 0.01
  - 0.02
  - 0.10
  - 0.20
74. True or false? Pipe joint compound or tape shall be used on the male threads only.
- True
  - False

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**(6) CPVC PLASTIC PIPE.** Joints between chlorinated polyvinyl chloride plastic pipe or fittings shall be installed in accordance with the provisions of pars. (a) to (c).

(a) *Mechanical joints.* Mechanical joints shall be installed in accordance with the manufacturer's instructions. Mechanical push-on type joints which use flexible elastomeric seals shall be suitable for potable water.

(b) *Solvent cemented joints.* Solvent cemented joints shall be made in accordance with ASTM D2846 or ASTM F493.

1. Joint surfaces shall be clean and free of moisture. Cleaner, primer and cement shall be installed in accordance with the manufacturer's instructions for use of the solvent cement.
2. Solvent cement conforming to ASTM F493 shall be applied to all joint surfaces and the joint shall be made while the cement is wet.
3. Solvent cement shall be handled in accordance with ASTM F402.
4. Primer and solvent cement used on pipes and fittings of a water supply system shall conform to NSF 14 and shall be certified by a nationally recognized testing agency as to conforming to NSF 14. The containers for the primer and the solvent cement shall bear the certification mark of the testing agency.

(c) *Threaded joints.* Threaded joints shall only be used on pipes of schedule 80 or heavier. Threaded joints shall conform to ASME B1.20.1. The pipe shall be threaded with dies specifically designed for plastic pipe. Thread lubricant or tape approved for such use shall be applied to the male threads only.

**(7) CONCRETE PIPE.** (a) *Circular pipe.* Joints between circular concrete pipe or fittings shall be made by use of an elastomeric seal conforming to ASTM C443 or C990.

(b) *Elliptical pipe*. Joints between elliptical concrete pipe or fittings shall be made by use of materials conforming to ASTM C887 Type II or ASTM C990.

**(8) COPPER PIPE AND TUBING.** Joints between copper pipe, tubing or fittings shall be installed in accordance with pars. (a) to (e).

(a) *Brazed joints*. All joint surfaces to be brazed shall be cleaned bright by other than chemical means. Brazing filler metal conforming to AWS A5.8, NSF/ANSI 61, annex G, or other approved material shall be used. The joining of water supply piping shall be made with lead-free materials.

(b) *Flared joints*. Flared joints may be used on annealed tubing for water supply systems and shall be made by the use of a tool designed for that operation.

(c) *Mechanical joints*. Mechanical joints shall be installed in accordance with the manufacturer's instructions. Mechanical push-on joints and mechanical compression type joints for water supply systems which use flexible elastomeric seals shall be suitable for potable water.

(d) *Soldered joints*. All joint surfaces to be soldered shall be made in accordance with ASTM B828. Flux approved by NSF for use in potable water systems shall be applied to all joint surfaces. Solder conforming to ASTM B32, NSF/ANSI 61, annex G, or other approved material shall be used. The joining of water supply piping shall be made with lead-free materials.

(e) *Threaded joints*. Threaded joints shall conform to ASME B1.20.1. Pipe joint compound or tape shall be used on the male threads only.

**(9) DUCTILE IRON PIPE.** (a) *Mechanical joints*. Mechanical push-on joints and mechanical compression type joints for water supply systems shall conform to AWWA C111. Lead tipped gaskets may not be used.

(b) *Threaded joints*. Threaded joints shall conform to ASME B1.20.1. Pipe joint compound or tape shall be used on the male threads only.

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## EXAM QUESTIONS

75. Solvent cement shall be handled in accordance with \_\_\_\_\_.

- a. AWWA C111
- b. ASTM C923
- c. ASTM F402
- d. ASME B1.20.1

76. Joints between elliptical concrete pipe or fittings shall be made by use of materials conforming to ASTM C887 \_\_\_\_\_ or ASTM C990.

- a. Type I
- b. Type II
- c. Type III
- d. Type IV

77. True or false? With regards to mechanical joints, lead tipped gaskets may not be used.

- a. True
  - b. False
-

**(10) GALVANIZED STEEL PIPE.** Joints between galvanized steel pipe or fittings or between galvanized steel pipe and cast iron fittings shall be installed in accordance with pars. (a) to (c).

(a) *Threaded joints.* Threaded joints shall conform to ASME B1.20.1. Pipe joint compound or tape shall be used on the male threads only.

(b) *Mechanical joints.* Mechanical joints shall be installed in accordance with the manufacturer's instructions. Mechanical push-on joints and mechanical compression type joints for water supply systems which use flexible elastomeric seals shall be suitable for potable water.

(c) *Caulked joints.* Caulked joints shall only be used for drain or vent piping. Caulked joints for hub and spigot piping and fittings shall be firmly packed with oakum or hemp. Molten lead shall be poured in one operation not less than one inch deep and not to extend more than  $\frac{1}{8}$  inch below the rim of the pipe, and caulked tight. Paint, varnish or other coatings may not be used on the joining material until after the joint has been tested and approved.

1. Caulked joints for drain piping shall be used only for piping in a vertical position.
2. Caulked joints for vent piping may be used for piping in a vertical or horizontal position.

**(11) LEAD PIPE.** Joints between lead pipe or fittings shall be installed in accordance with pars. (a) and (b).

(a) *Burned joints.* Burned joints shall be uniformly fused together into one continuous piece. The thickness of the joint shall be at least as thick as the lead being joined. The filler metal shall be of the same material as the pipe.

(b) *Wiped joints.* A wiped joint shall be full wiped, having an exposed surface on each side of the joint not less than  $\frac{3}{4}$  inch and shall be at least  $\frac{3}{8}$  inch thick at the thickest point.

**(12) PE PLASTIC PIPE AND TUBING.** Joints between polyethylene plastic pipe, tubing or fittings shall be in accordance with pars. (a) to (c).

(a) *Flared joints.* Flared joints shall be made by use of a tool designed for that operation. Flared joints shall be made in accordance with ASTM D3140.

(b) *Heat fusion joints.* Heat fusion joints shall be made in accordance with ASTM D2657. Heat fusion joints shall be of a socket fusion type.

1. Joint surfaces to be fused shall be clean and free of moisture.
2. All joint surfaces shall be heated to the temperature recommended by the pipe or fitting manufacturer and joined.
3. The joint shall be undisturbed until cool.

(c) *Mechanical joints.* Mechanical joints may be installed in accordance with the manufacturer's instructions. Mechanical push-on joints and mechanical compression type joints which use flexible elastomeric seals shall be suitable for potable water.

**(13) PEX PLASTIC TUBING.** Joints between crosslinked polyethylene plastic pipe, tubing or fittings shall be made in accordance with the manufacturer's instructions.

**(14) PVC PLASTIC PIPE.** Joints between polyvinyl chloride plastic pipe or fittings shall be in accordance with pars. (a) to (c).

- (a) *Mechanical joints.* Mechanical joints shall be installed in accordance with the manufacturer's instructions.
1. 'Drain and vent systems.' Mechanical push-on joints for drain and vent systems shall conform to ASTM D3212.
  2. 'Water supply systems.' Mechanical push-on joints and mechanical compression type joints for water supply systems which use flexible elastomeric seals shall be suitable for potable water.
- (b) *Solvent cemented joints.* Solvent cemented joints shall be made in accordance with ASTM D2855.
1. Joint surfaces shall be clean and free of moisture. A primer conforming to ASTM F656 shall be applied to all joint surfaces.
  2. Solvent cement conforming to ASTM D2564 shall be applied to all joint surfaces and the joint shall be made while the cement is wet.
  3. Solvent cement shall be handled in accordance with ASTM F402.
  4. Primer and solvent cement used on pipes and fittings of a water supply system shall conform to NSF 14 and shall be certified by a nationally recognized testing agency as to conforming to NSF 14. The containers for the primer and the solvent cement shall bear the certification mark of the testing agency.
- (c) *Threaded joints.* Threaded joints shall only be used on pipes of schedule 80 or heavier. Threaded joints shall conform to ASME B1.20.1. The pipe shall be threaded with dies specifically designed for plastic pipe. Thread lubricant or tape approved for such use shall be applied to the male threads only.

(15) STAINLESS STEEL. Joints between stainless steel pipe or fittings shall be installed in accordance with the provisions of pars. (a) to (c).

- (a) *Mechanical joints.* Mechanical joints shall be installed in accordance with the manufacturer's instructions. Mechanical push-on type joints which use flexible elastomeric seals shall be suitable for potable water.
- (b) *Threaded joints.* Threaded joints shall conform to ANSI B1.20.1. Pipe joint compound or tape shall be used on the male threads only.
- (c) *Welded joints.* Joints between stainless steel pipe or fittings may be welded.

(16) JOINTS BETWEEN PIPE AND FITTINGS OF DIFFERENT MATERIALS. Connections between pipes of different materials shall be made with mechanical compression type joints, installed in accordance with manufacturer's instructions or as specified in pars. (a) to (e).

- (a) *Copper to cast iron.* Connections between copper pipe or tube and cast iron pipe shall be by means of either caulked joints in accordance with sub. (5) (a) or threaded fittings in accordance with sub. (5) (c).
- (b) *Copper to galvanized steel.* Connections between copper pipe or tube and galvanized steel pipe shall be by use of an adapter fitting. The copper pipe shall be soldered to the adapter in accordance with sub. (8) (d). The galvanized steel shall be threaded to the adapter in accordance with sub. (10) (a).
- (c) *Cast iron to steel or brass pipe.* Connections between cast iron pipe and galvanized or black steel or brass pipe shall be by means of:
1. Caulked joints in accordance with sub. (5) (a); or
  2. Threaded joints in accordance with sub. (5) (c).

(d) *Plastic to other materials.* 1. Connections between plastic pipe and cast iron pipe shall be by means of:

- a. Caulked joints in accordance with sub. (5) (a); or
- b. Threaded joints in accordance with sub. (5) (c).

2. Except as provided in par. (f), connections between different types of plastic pipe or between plastic pipe and other piping materials other than cast iron shall be by means of threaded joints in accordance with sub. (14) (c).

(e) *Lead to other piping materials.* Connections between lead pipe and other piping materials shall be by use of an adapter fitting conforming to s. SPS 384.30 (5) (a). The lead pipe shall be caulked or burned to the adapter fitting in accordance with sub. (11).

(f) *ABS plastic to PVC plastic.* For solvent-cemented connections between ABS and PVC piping in non-pressurized systems, all of the following shall apply:

1. Joint surfaces shall be clean and free of moisture.
2. Primer conforming to ASTM F656 shall be applied to all PVC joint surfaces.
3. Solvent conforming to ASTM D3138 shall be applied to all joint surfaces and the joint shall be made while the cement is wet.
4. Solvent shall be handled in accordance with ASTM F402.

(17) CONNECTION OF FIXTURES. Flanged fixtures which have integral traps shall be mechanically fastened to the drain piping by means of a compatible fitting. The joint between the fixture and the fitting shall be sealed with a watertight gasket or setting compound.

(18) CONNECTION OF PIPE TO CONCRETE STRUCTURES. Joints between concrete structures and piping shall be made with mechanical joints in conformance with ASTM C923, ASTM C564 or as otherwise permitted by local authority. Openings for pipe connections that are installed with mechanical joints conforming to ASTM C564 shall have an inside diameter of that required for cast iron pipe in conformance with ASTM A74.

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## EXAM QUESTIONS

78. Caulked joints for vent piping may be used for piping in a \_\_\_\_\_ position.
- a. Vertical only
  - b. Horizontal only
  - c. Vertical or horizontal
  - d. Perpendicular
79. True or false? Burned joints shall be uniformly fused together into one continuous piece.
- a. True
  - b. False
80. With regards to burned joints, the filler metal shall be of \_\_\_\_\_ as the pipe.
- a. Different material
  - b. The same material
  - c. The same class of material
  - d. Any of the above
81. A wiped joint shall be full wiped, having an exposed surface on each side of the joint not less than \_\_\_\_\_ inch(es) and shall be at least  $\frac{3}{8}$  inch thick at the thickest point.

- a.  $\frac{3}{4}$
- b. 1
- c.  $1\frac{1}{2}$
- d.  $1\frac{3}{4}$

82. Threaded joints shall conform to \_\_\_\_\_.

- a. ASTM D3188
- b. ASTM D2657
- c. ASME B1.20.1
- d. ASME B3.1.40

83. True or false? Joints between stainless steel pipe or fittings may be welded.

- a. True
- b. False

84. Primer conforming to ASTM F656 shall be applied to all \_\_\_\_\_ joint surfaces.

- a. PE
- b. PVC
- c. PEX
- d. CPVC

85. True or false? Flanged fixtures which have integral traps shall be mechanically fastened to the drain piping by means of a compatible fitting.

- a. True
- b. False

86. Openings for pipe connections that are installed with mechanical joints conforming to ASTM C564 shall have an inside diameter of that required for cast iron pipe in conformance with \_\_\_\_\_.

- a. CAN/CSA B137.10
- b. ASTM F876
- c. ASTM A74
- d. AWWA C115

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**SPS 384.50 Alternate approvals and experimental approvals. (1) GENERAL.** The provisions of chs. SPS 382 to 384 are not intended to prevent the use of a plumbing material or product not specifically addressed therein if the plumbing material or product has been approved by the department.

**(2) ALTERNATE APPROVAL.** (a) Plumbing materials or products determined by the department to comply with the intent of chs. SPS 382 to 384 and ch. 145, Stats., and not approved under s. SPS 384.10, shall be issued an alternate approval. Alternate approvals shall be issued by the department in writing.

(b) The department may require the submission of any information deemed necessary for review. Sufficient evidence shall be submitted to the department to substantiate:

1. Assertions of function and performance; and
2. Compliance with the intent of chs. SPS 382 to 384 and ch. 145, Stats.

(c) The department shall review and make a determination on an application for alternate approval within 3 months of receipt of all information and fees required to complete the review.

(d) The department may impose specific conditions in issuing an alternate approval, including an expiration date for the alternate approval. Violations of the conditions under which an alternate approval is issued shall constitute a violation of this chapter.

(e) If, upon review, the department determines that a plumbing material or product does not comply with the intent of chs. SPS 382 to 384 and ch. 145, Stats., the request for alternate approval shall be denied in writing.

**(3) EXPERIMENTAL APPROVAL.** (a) The department may allow the installation of a plumbing material or product for the purpose of proving compliance with the intent of chs. SPS 382 to 384 and ch. 145, Stats.

(b) An experimental approval shall be required for each plumbing material or product to be installed for the purpose of proving compliance with the intent of chs. SPS 382 to 384 and ch. 145, Stats. A separate experimental approval shall be obtained for each project where such a product is to be used. Experimental approvals shall be issued by the department in writing. Experimental approvals shall be denied by the department in writing.

(c) The department may require the submission of any information deemed necessary for review.

(d) The department may limit the number of applications it will accept for experimental approval of products.

(e) The department shall review and make a determination on an application for experimental approval within 6 months of receipt of all information and fees required to complete the review.

(f) The department may impose specific conditions in issuing an experimental approval. Violations of the conditions under which an experimental approval is issued shall constitute a violation of this chapter.

(g) If the department issues an experimental approval:

1. Plans detailing the installation of the plumbing material or product shall be submitted to the department in accordance with s. SPS 382.20 (4) or 383.22.
2. A copy of the experimental approval shall be attached to the submitted plans and approved plans.
3. A letter of consent from the owner of the installation shall be attached to the submitted plans and approved plans. The letter shall acknowledge that the owner has received and read a copy of the experimental approval and s. SPS 384.50.
4. The completed installation shall be inspected for compliance with the approved plans by the department. A report on the completed installation shall be written by the department.
5. A written report, from the party who was issued the experimental approval, shall be submitted to the department detailing the function and performance of the installed plumbing material or product. The report shall be completed at time intervals specified by the department, but not less than once a year.
6. On-site inspections shall be performed by the department at time intervals specified by the department, but not less than once a year. A report on the inspection shall be written by the department. The department may assess a fee for the inspection.
7. Five years after the date of the completed installation the department shall within 6 months order the removal of the plumbing material or product, issue an approval, or renew the experimental approval for another 5-year period to obtain additional information to determine the result of the experiment.

(h) If chs. SPS 382 to 384 or ch. 145, Stats., are revised to include or permit an experimental plumbing material or product to conform with the intent of chs. SPS 382 to 384 and ch. 145, Stats., the department shall waive the requirements of par. (f) as to that material or product.

**(4) MODIFICATIONS.** If a plumbing material or product with an alternate or experimental approval or the installation of an experimentally approved plumbing material or product is modified or additional assertions of

function or performance are made, the alternate or experimental approval shall be considered null and void, unless the product is resubmitted to the department for review and the approval is reaffirmed.

(5) REVOCATION. The department may revoke an alternate or experimental approval issued under this section for any false statements or misrepresentations of facts or data on which the alternate or experimental approval was based or as a result of product failure.

(6) LIMITATIONS. An alternate or experimental approval of a plumbing material or product issued by the department may not be construed as an assumption of any responsibility for defects design, construction, or performance of any plumbing material or product nor for any damages that may result.

(7) FEES. Fees for the review of a plumbing material or product under this section and any required on-site inspections shall be submitted in accordance with ch. SPS 302.

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### EXAM QUESTIONS

87. The department shall review and make a determination on an application for alternate approval within \_\_\_\_\_ of receipt of all information and fees required to complete the review.
- 14 days
  - 1 month
  - 2 months
  - 3 months
88. The department shall review and make a determination on an application for experimental approval within \_\_\_\_\_ of receipt of all information and fees required to complete the review.
- 1 month
  - 2 months
  - 3 months
  - 6 months
89. On-site inspections shall be performed by the department at time intervals specified by the department, but not less than \_\_\_\_\_.
- Every two months
  - Every three months
  - Every six months
  - Every year
90. True or false? The department may assess a fee for the inspection of an experimental approval product.
- True
  - False

## ANSWER SHEET – SPS 384 Plumbing Products Course

First Name: \_\_\_\_\_ Last Name: \_\_\_\_\_ Date: \_\_\_\_\_

Address: \_\_\_\_\_ City: \_\_\_\_\_ State: \_\_\_\_\_ ZIP: \_\_\_\_\_

WI Plumbing License #: \_\_\_\_\_

Phone: \_\_\_\_\_ Email: \_\_\_\_\_

1. a b c d	26. a b c d	51. a b c d	76. a b c d
2. a b c d	27. a b c d	52. a b c d	77. a b c d
3. a b c d	28. a b c d	53. a b c d	78. a b c d
4. a b c d	29. a b c d	54. a b c d	79. a b c d
5. a b c d	30. a b c d	55. a b c d	80. a b c d
6. a b c d	31. a b c d	56. a b c d	81. a b c d
7. a b c d	32. a b c d	57. a b c d	82. a b c d
8. a b c d	33. a b c d	58. a b c d	83. a b c d
9. a b c d	34. a b c d	59. a b c d	84. a b c d
10. a b c d	35. a b c d	60. a b c d	85. a b c d
11. a b c d	36. a b c d	61. a b c d	86. a b c d
12. a b c d	37. a b c d	62. a b c d	87. a b c d
13. a b c d	38. a b c d	63. a b c d	88. a b c d
14. a b c d	39. a b c d	64. a b c d	89. a b c d
15. a b c d	40. a b c d	65. a b c d	90. a b c d
16. a b c d	41. a b c d	66. a b c d	
17. a b c d	42. a b c d	67. a b c d	
18. a b c d	43. a b c d	68. a b c d	
19. a b c d	44. a b c d	69. a b c d	
20. a b c d	45. a b c d	70. a b c d	
21. a b c d	46. a b c d	71. a b c d	
22. a b c d	47. a b c d	72. a b c d	
23. a b c d	48. a b c d	73. a b c d	
24. a b c d	49. a b c d	74. a b c d	
25. a b c d	50. a b c d	75. a b c d	

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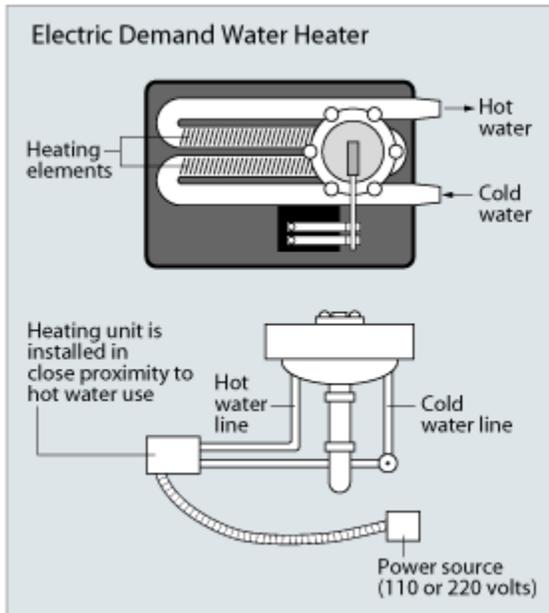
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# Demand (Tankless or Instantaneous) Water Heaters

Demand (tankless or instantaneous) water heaters provide hot water only as it is needed. They don't produce the standby energy losses associated with storage water heaters, which can save money. In the course you'll find basic information about how they work, whether a demand water heater might be right for your client's home, and what criteria to use when selecting the right model.



## How They Work

Demand water heaters heat water directly without the use of a storage tank. Therefore, they avoid the standby heat losses associated with storage water heaters. When a hot water tap is turned on, cold water travels through a pipe into the unit. Either a gas burner or an electric element heats the water. As a result, demand water heaters deliver a constant supply of hot water. You don't need to wait for a storage tank to fill up with enough hot water. However, a demand water heater's output limits the flow rate.

Typically, demand water heaters provide hot water at a rate of 2–5 gallons (7.6–15.2 liters) per minute. Gas-fired demand water heaters produce higher flow rates than electric ones. Sometimes, however, even the largest, gas-fired model cannot supply enough hot water for simultaneous, multiple uses in large households. For example, taking a shower and running the dishwasher at the same time can stretch a demand water heater to its limit. To overcome this problem, you can install two or more demand water heaters, connected in parallel for simultaneous demands of hot water. You can also install separate demand water heaters for appliances—such as a clothes washer or dishwasher—that use a lot of hot water in the home.

Other applications for demand water heaters include the following:

- Remote bathrooms or hot tubs
- Booster for appliances, such as dishwashers or clothes washers
- Booster for a solar water heating system.

Although gas-fired demand water heaters tend to have higher flow rates than electric ones, they can waste energy if they have a constantly burning pilot light. This can sometimes offset the elimination of standby energy losses when compared to a storage water heater. In a gas-fired storage water heater, the pilot light heats the

water in the tank so the energy isn't wasted. The cost of operating a pilot light in a demand water heater varies from model to model. Ask the manufacturer how much gas the pilot light uses for the model you're considering. If you purchase a model that uses a standing pilot light, you can always turn it off when it's not in use to save energy. Also consider models that have an intermittent ignition device (IID) instead of a standing pilot light. This device resembles the spark ignition device on some gas kitchen ranges and ovens.

For homes that use 41 gallons or less of hot water daily, demand water heaters can be 24%–34% more energy efficient than conventional storage tank water heaters. They can be 8%–14% more energy efficient for homes that use a lot of hot water—around 86 gallons per day. You can achieve even greater energy savings of 27%–50% if you install a demand water heater at each hot water outlet.

## Selecting a Demand Water Heater

Demand water heaters cost more than conventional storage water heaters. However, you may find that a demand water heater may have lower operating and energy costs, which could offset its higher purchase price.

Before buying or installing a demand water heater, you also need to consider the following:

- Size
- Fuel type and availability.
- Energy efficiency (energy factor)
- Estimate costs.

## Installation and Maintenance

Proper installation and maintenance of a demand water heater can optimize its energy efficiency.

Proper installation depends on many factors. These factors include fuel type, climate, local building code requirements, and safety issues, especially concerning the combustion of gas-fired water heaters.

Most tankless water heaters have a life expectancy of more than 20 years. They also have easily replaceable parts that extend their life by many more years. In contrast, storage water heaters last 10–15 years. Periodic water heater maintenance can significantly extend the water heater's life and minimize loss of efficiency. Read the owner's manual for specific maintenance recommendations.

## Sizing a Demand (Tankless or Instantaneous) Water Heater

Demand (tankless or instantaneous) water heaters are rated by the maximum temperature rise possible at a given flow rate. Therefore, to size a demand water heater, you need to determine the flow rate and the temperature rise you'll need for its application (whole house or a remote application, such as just a bathroom) in the home.

First, list the number of hot water devices you expect to use at any one time. Then, add up their flow rates (gallons per minute). This is the desired flow rate you'll want for the demand water heater. For example, let's say you expect to simultaneously run a hot water faucet with a flow rate of 0.75 gallons (2.84 liters) per minute and a shower head with a flow rate of 2.5 gallons (9.46 liters) per minute. The flow rate through the demand water heater would need to be at least 3.25 gallons (12.3 liters) per minute. To reduce flow rates, install low-flow water fixtures.

To determine temperature rise, subtract the incoming water temperature from the desired output temperature. Unless you know otherwise, assume that the incoming water temperature is 50°F (10°C). For most uses, you'll

want your water heated to 120°F (49°C). In this example, you'd need a demand water heater that produces a temperature rise of 70°F (39°C) for most uses. For dishwashers without internal heaters and other such applications, you might want your water heated at 140°F (60°C). In that case, you'll need a temperature rise of 90°F (50°C).

Most demand water heaters are rated for a variety of inlet temperatures. Typically, a 70°F (39°C) water temperature rise is possible at a flow rate of 5 gallons per minute through gas-fired demand water heaters and 2 gallons per minute through electric ones. Faster flow rates or cooler inlet temperatures can sometimes reduce the water temperature at the most distant faucet. Some types of tankless water heaters are thermostatically controlled; they can vary their output temperature according to the water flow rate and inlet temperature.

---

### **EXAM QUESTIONS:**

- 1.) Demand water heaters heat water directly without the use of a storage tank.**
  - a. True
  - b. False
  
- 2.) Typically, demand water heaters provide hot water at a rate of \_\_\_\_\_ gallons per minute.**
  - a. 1 -3
  - b. 2-5
  - c. 4-7
  - d. 6-10
  
- 3.) Electric demand water heaters produce higher flow rates than gas-fired demand water heaters.**
  - a. True
  - b. False
  
- 4.) Applications for demand waters heaters include the following:**
  - a. Hot tubs
  - b. Booster for appliances
  - c. Remote bathrooms
  - d. All of the above
  
- 5.) For homes that use \_\_\_\_\_ gallons or less of hot water daily, demand water heaters can be 24%–34% more energy efficient than conventional storage tank water heaters.**
  - a. 24
  - b. 34
  - c. 41
  - d. 86
  
- 6.) Demand water heaters cost more than conventional storage water heaters.**
  - a. True
  - b. False

- 7.) Before installing a demand water heater, the following needs to be considered.
- Size
  - Fuel type
  - Energy efficiency
  - All of the above
- 8.) Most tankless water heaters have a life expectancy of more than \_\_\_\_ years.
- 10
  - 20
  - 30
  - 40
- 9.) If you simultaneously run a hot water faucet with a flow rate of 0.50 gallons per minute and a shower head with a flow rate of 2.25 gallons per minute, what is the flow rate for a demand water heater?
- 0.50
  - 2.25
  - 2.75
  - 3.25
- 10.) Assuming the incoming water temperature is 60°F and you want the water heated to 140°F, what is the temperature rise needed for a demand water heater?
- 60°
  - 70°
  - 80°
  - 90°

---

## **Solar Water Heaters**

Solar water heaters—also called solar domestic hot water systems—can be a cost-effective way to generate hot water for the home. They can be used in any climate, and the fuel they use—sunshine—is free.

### **How They Work**

Solar water heating systems include storage tanks and solar collectors. There are two types of solar water heating systems: active, which have circulating pumps and controls, and passive, which don't.

Most solar water heaters require a well-insulated storage tank. Solar storage tanks have an additional outlet and inlet connected to and from the collector. In two-tank systems, the solar water heater preheats water before it enters the conventional water heater. In one-tank systems, the back-up heater is combined with the solar storage in one tank.

Three types of solar collectors are used for residential applications:

- **Flat-plate collector**

Glazed flat-plate collectors are insulated, weatherproofed boxes that contain a dark absorber plate under one or more glass or plastic (polymer) covers. Unglazed flat-plate collectors—typically used for solar pool heating—have a dark absorber plate, made of metal or polymer, without a cover or enclosure.

- **Integral collector-storage systems**

Also known as ICS or *batch* systems, they feature one or more black tanks or tubes in an insulated, glazed box. Cold water first passes through the solar collector, which preheats the water. The water then continues on to the conventional backup water heater, providing a reliable source of hot water. They should be installed only in mild-freeze climates because the outdoor pipes could freeze in severe, cold weather.

- **Evacuated-tube solar collectors**

They feature parallel rows of transparent glass tubes. Each tube contains a glass outer tube and metal absorber tube attached to a fin. The fin's coating absorbs solar energy but inhibits radiative heat loss. These collectors are used more frequently for U.S. commercial applications.

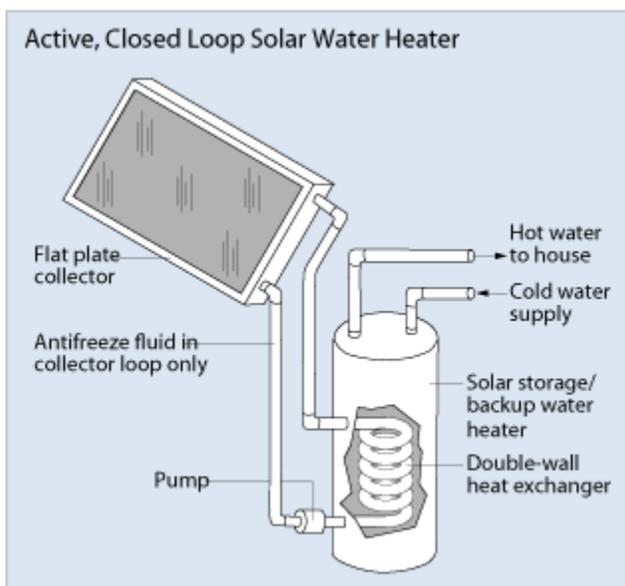
There are two types of active solar water heating systems:

- **Direct circulation systems**

Pumps circulate household water through the collectors and into the home. They work well in climates where it rarely freezes.

- **Indirect circulation systems**

Pumps circulate a non-freezing, heat-transfer fluid through the collectors and a heat exchanger. This heats the water that then flows into the home. They are popular in climates prone to freezing temperatures.



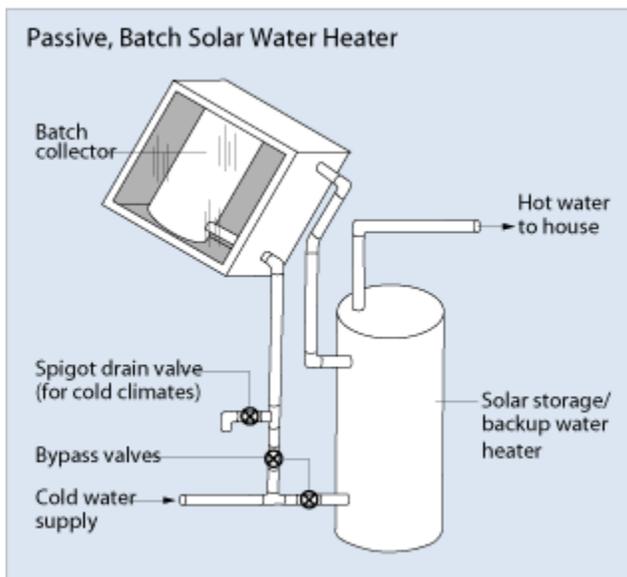
Passive solar water heating systems are typically less expensive than active systems, but they're usually not as efficient. However, passive systems can be more reliable and may last longer. There are two basic types of passive systems:

- **Integral collector-storage passive systems**

These work best in areas where temperatures rarely fall below freezing. They also work well in households with significant daytime and evening hot-water needs.

- **Thermosyphon systems**

Water flows through the system when warm water rises as cooler water sinks. The collector must be installed below the storage tank so that warm water will rise into the tank. These systems are reliable, but contractors must pay careful attention to the roof design because of the heavy storage tank. They are usually more expensive than integral collector-storage passive systems.



Solar water heating systems almost always require a backup system for cloudy days and times of increased demand. Conventional storage water heaters usually provide backup and may already be part of the solar system package. A backup system may also be part of the solar collector, such as rooftop tanks with thermosyphon systems. Since an integral-collector storage system already stores hot water in addition to collecting solar heat, it may be packaged with a demand (tankless or instantaneous) water heater for backup.

## Heat Exchangers for Solar Water Heating Systems

Solar water heating systems use heat exchangers to transfer solar energy absorbed in solar collectors to the liquid or air used to heat water or a space.

Heat exchangers can be made of steel, copper, bronze, stainless steel, aluminum, or cast iron. Solar heating systems usually use copper, because it is a good thermal conductor and has greater resistance to corrosion.

## Types of Heat Exchangers

Solar water heating systems use two types of heat exchangers:

- **Liquid-to-liquid**

This heat exchanger uses a heat-transfer fluid that circulates through the solar collector, absorbs heat, and then flows through a heat exchanger to transfer its heat to water in a storage tank. Heat-transfer fluids, such as antifreeze, protect the solar collector from freezing in cold weather. Liquid-to-liquid heat exchangers have either one or two barriers (single wall or double wall) between the heat-transfer fluid and the domestic water supply.

A single-wall heat exchanger is a pipe or tube surrounded by a fluid. Either the fluid passing through the tubing or the fluid surrounding the tubing can be the heat-transfer fluid, while the other fluid is the potable water. Double-wall heat exchangers have two walls between the two fluids. Two walls are often used when the heat-transfer fluid is toxic, such as ethylene glycol (antifreeze). Double walls are often required as a safety measure in case of leaks, helping ensure that the antifreeze does not mix with the potable water supply. An example of a double-wall, liquid-to-liquid heat exchanger is the "wrap-around heat exchanger," in which a tube is wrapped around and bonded to the outside of a hot water tank. The tube must be adequately insulated to reduce heat losses.

While double-wall heat exchangers increase safety, they are less efficient because heat must transfer through two surfaces rather than one. To transfer the same amount of heat, a double-wall heat exchanger must be larger than a single-wall exchanger.

- **Air-to-liquid**

Solar heating systems with air heater collectors usually do not need a heat exchanger between the solar collector and the air distribution system. Those systems with air heater collectors that heat water use air-to-liquid heat exchangers, which are similar to liquid-to-air heat exchangers.

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**EXAM QUESTIONS:**

- 11.) **Passive solar water heating systems have circulating pumps and controls.**
  - a. True
  - b. False
  
- 12.) **Which type of solar collector is typically used for solar pool heating?**
  - a. Unglazed flat-plate collectors
  - b. ICS systems
  - c. Evacuated tube solar collectors
  - d. None of the above
  
- 13.) **This type of solar collector is more frequently used for commercial applications.**
  - a. Unglazed flat-plate collectors
  - b. ICS systems
  - c. Evacuated tube solar collectors
  - d. None of the above

- 14.) **This type of solar collector should be installed only in mild-freeze climates because the outdoor pipes could freeze in severe, cold weather.**
- Unglazed flat-plate collectors
  - ICS systems
  - Evacuated tube solar collectors
  - None of the above
- 15.) **Indirect circulation systems are popular in climates prone to freezing temperatures.**
- True
  - False
- 16.) **Passive solar water heating systems are typically more expensive than active systems.**
- True
  - False
- 17.) **Which of the following is a passive solar water heating system?**
- Direct circulation system
  - Indirect circulation system
  - Thermosyphon system
  - All of the above
- 18.) **Solar water heating systems almost always require a backup system for cloudy days and times of increased demand.**
- True
  - False
- 19.) **This heat exchanger uses a heat-transfer fluid that circulates through the solar collector, absorbs heat, and then flows through a heat exchanger to transfer its heat to water in a storage tank.**
- Liquid-to-liquid
  - Air-to-liquid
  - Coil-in tank
  - All of the above

---

## Heat Exchanger Designs

There are many heat exchanger designs. Here are some common ones:

- **Coil-in-tank**

The heat exchanger is a coil of tubing in the storage tank. It can be a single tube (single-wall heat exchanger) or the thickness of two tubes (double-wall heat exchanger). A less efficient alternative is to place the coil on the outside of the collector tank with a cover of insulation.

- **Shell-and-tube**

The heat exchanger is separate from (external to) the storage tank. It has two separate fluid loops inside a case or shell. The fluids flow in opposite directions to each other through the heat exchanger, maximizing heat transfer. In one loop, the fluid to be heated (such as potable water) circulates through the inner tubes. In the second loop, the heat-transfer fluid flows between the shell and the tubes of water. The tubes and shell should be made of the same material. When the collector or heat-transfer fluid is toxic, double-wall tubes are used, and a non-toxic intermediary transfer fluid is placed between the outer and inner walls of the tubes.

- **Tube-in-tube**

In this very efficient design, the tubes of water and the heat-transfer fluid are in direct thermal contact with each other. The water and the heat-transfer fluid flow in opposite directions to each other. This type of heat exchanger has two loops similar to those described in the shell-and-tube heat exchanger.

## Sizing

A heat exchanger must be sized correctly to be effective. There are many factors to consider for proper sizing, including the following:

- Type of heat exchanger
- Characteristics of the heat-transfer fluid (specific heat, viscosity, and density)
- Flow rate
- Inlet and outlet temperatures for each fluid.

Usually, manufacturers will supply heat transfer ratings for their heat exchangers (in Btu/hour) for various fluid temperatures and flow rates. Also, the size of a heat exchanger's surface area affects its speed and efficiency: a large surface area transfers heat faster and more efficiently.

## Installation

For the best performance, always follow the manufacturer's installation recommendations for the heat exchanger. Be sure to choose a heat-transfer fluid that is compatible with the type of heat exchanger you will be using. If you want to build your own heat exchanger, be aware that using different metals in heat exchanger construction may cause corrosion. Also, because dissimilar metals have different thermal expansion and contraction characteristics, leaks or cracks may develop. Either of these conditions may reduce the life span of the heat exchanger.

## Heat-Transfer Fluids for Solar Water Heating Systems

Heat-transfer fluids carry heat through solar collectors and a heat exchanger to the heat storage tanks in solar water heating systems. When selecting a heat-transfer fluid, you should consider the following criteria:

- Coefficient of expansion – the fractional change in length (or sometimes in volume, when specified) of a material for a unit change in temperature
- Viscosity – resistance of a liquid to sheer forces (and hence to flow)
- Thermal capacity – the ability of matter to store heat
- Freezing point – the temperature below which a liquid turns into a solid
- Boiling point – the temperature at which a liquid boils

- Flash point – the lowest temperature at which the vapor above a liquid can be ignited in air.

For example, in a cold climate, solar water heating systems require fluids with low freezing points. Fluids exposed to high temperatures, as in a desert climate, should have a high boiling point. Viscosity and thermal capacity determine the amount of pumping energy required. A fluid with low viscosity and high specific heat is easier to pump, because it is less resistant to flow and transfers more heat. Other properties that help determine the effectiveness of a fluid is its corrosiveness and stability.

## Types of Heat-Transfer Fluids

The following are some of the most commonly used heat-transfer fluids and their properties. Consult the local authority having jurisdiction to determine the requirements for heat transfer fluid in solar water heating systems in your area.

- **Air**

Air will not freeze or boil, and is non-corrosive. However, it has a very low heat capacity, and tends to leak out of collectors, ducts, and dampers.

- **Water**

Water is nontoxic and inexpensive. With a high specific heat, and a very low viscosity, it's easy to pump. Unfortunately, water has a relatively low boiling point and a high freezing point. It can also be corrosive if the pH (acidity/alkalinity level) is not maintained at a neutral level. Water with a high mineral content (i.e., "hard" water) can cause mineral deposits to form in collector tubing and system plumbing.

- **Glycol/water mixtures**

Glycol/water mixtures have a 50/50 or 60/40 glycol-to-water ratio. Ethylene and propylene glycol are "antifreezes."

- **Hydrocarbon oils**

Hydrocarbon oils have a higher viscosity and lower specific heat than water. They require more energy to pump. These oils are relatively inexpensive and have a low freezing point. The basic categories of hydrocarbon oils are synthetic hydrocarbons, paraffin hydrocarbons, and aromatic refined mineral oils. Synthetic hydrocarbons are relatively nontoxic and require little maintenance. Paraffin hydrocarbons have a wider temperature range between freezing and boiling points than water, but they are toxic and require a double-walled, closed-loop heat exchanger. Aromatic oils are the least viscous of the hydrocarbon oils.

- **Refrigerants/phase change fluids**

These are commonly used as the heat transfer fluid in refrigerators, air conditioners, and heat pumps. They generally have a low boiling point and a high heat capacity. This enables a small amount of the refrigerant to transfer a large amount of heat very efficiently. Refrigerants respond quickly to solar heat, making them more effective on cloudy days than other transfer fluids. Heat absorption occurs when the refrigerant boils (changes phase from liquid to gas) in the solar collector. Release of the collected heat takes place when the now-gaseous refrigerant condenses to a liquid again in a heat exchanger or condenser.

For years chlorofluorocarbon (CFC) refrigerants, such as Freon, were the primary fluids used by refrigerator, air-conditioner, and heat pump manufacturers because they are nonflammable, low in toxicity, stable, noncorrosive, and do not freeze. However, due the negative effect that CFCs have on the earth's ozone layer, CFC production is being phased out, as is the production of hydro chlorofluorocarbons (HCFC). The few companies that produced refrigerant-charged solar systems have either stopped manufacturing the systems entirely, or are currently seeking alternative refrigerants. Some companies have investigated methyl alcohol as a replacement for refrigerants.

Since July 1, 1992, intentional venting of CFCs and HCFCs during service and maintenance or disposal of the equipment containing these compounds is illegal and punishable by stiff fines. Although production of CFCs ceased in the U.S. in 1996, a licensed refrigeration technician can still service your system. You may wish to contact your service professional to discuss the possible replacement of the CFC refrigerant with methyl alcohol or some other heat transfer fluid.

Ammonia can also be used as a refrigerant. It's commonly used in industrial applications. Due to safety considerations it's not used in residential systems. The refrigerants can be aqueous ammonia or a calcium chloride ammonia mixture.

- **Silicones**

Silicones have a very low freezing point, and a very high boiling point. They are noncorrosive and long-lasting. Because silicones have a high viscosity and low heat capacities, they require more energy to pump. Silicones also leak easily, even through microscopic holes in a solar loop.

## **Solar Water Heating System Freeze Protection**

Solar water heating systems, which use liquids as heat-transfer fluids, need protection from freezing in climates where temperatures fall below 42°F (6°C).

Don't rely on a collector's and the piping's (collector loop's) insulation to keep them from freezing. The main purpose of the insulation is to reduce heat loss and increase performance. For protecting the collector and piping from damage due to freezing temperatures, you basically have two options:

- Use an antifreeze solution as the heat-transfer fluid.
- Drain the collector(s) and piping (collector loop), either manually or automatically, when there's a chance the temperature might drop below the liquid's freezing point.

### **Using an Antifreeze Solution**

Solar water heating systems that use an antifreeze solution (propylene glycol or ethylene glycol) as a heat-transfer fluid have effective freeze protection as long as the proper antifreeze concentration is maintained. Antifreeze fluids degrade over time and normally should be changed every 3–5 years. Since these systems are pressurized, it is not practical for the average homeowner to check the condition of the antifreeze solution.

### **Draining the Collector and Piping**

Solar water heating systems that use only water as a heat-transfer fluid are the most vulnerable to freeze damage. "Draindown" or "drainback" systems typically use a controller to drain the collector loop automatically. Sensors on the collector and storage tank tell the controller when to shut off the circulation pump, to drain the collector loop, and when to start the pump again.

Improper placement or the use of low-quality sensors can lead to their failure to detect freezing conditions. The controller may not drain the system, and expensive freeze damage may occur. Make sure that the sensor(s) have been installed according to the manufacturer's recommendations, and check the controller at least once a year to be sure that it is operating correctly.

To ensure that the collector loop drains completely, there should also be a means to prevent a vacuum from forming inside the collector loop as the liquid drains out. Usually an air vent is installed at the highest point in the collector loop. It is a good practice to insulate air vents so that they do not freeze. Also make sure that nothing blocks the airflow into the system when the drain cycle is active.

Collectors and piping must slope properly to allow the water to drain completely. All collectors and piping should have a minimum slope of 0.25 inches per foot (2.1 centimeters per meter).

In integral collector storage or "batch" systems, the collector is also the storage tank. Placing large amounts of insulation around the unglazed parts of the collector and covering the glazing at night or on cloudy days will help to protect the collector from cold temperatures. However, water in the collector can freeze over extended periods of very cold weather. The collector supply and return pipes are also susceptible to freezing, especially if they run through an unheated space or outside. This can happen even when the pipes are well insulated. It is best to drain the entire system before freezing temperatures occur to avoid any possible freeze damage.

## **Selecting a Solar Water Heater**

Before you purchase and install a solar water heating system, you want to do the following:

- Consider the economics of a solar water heating system
- Evaluate your site's solar resource
- Determine the correct system size
- Determine the system's energy efficiency
- Estimate and compare system costs
- Investigate local codes, covenants, and regulations.

## **Installing and Maintaining the System**

The proper installation of solar water heaters depends on many factors. These factors include solar resource, climate, local building code requirements, and safety issues.

After installation, properly maintaining the system will keep it running smoothly. Passive systems don't require much maintenance. For active systems, discuss the maintenance requirements with the system provider, and consult the system's owner's manual. Plumbing and other conventional water heating components require the same maintenance as conventional systems. Glazing may need to be cleaned in dry climates where rainwater doesn't provide a natural rinse.

Regular maintenance on simple systems can be as infrequent as every 3–5 years. Systems with electrical components usually require a replacement part or two after 10 years.

## **Sizing a Solar Water Heating System**

Sizing your solar water heating system basically involves determining the total collector area and the storage volume you'll need to meet 90%–100% of your household's hot water needs during the summer.

## Collector Area

Contractors usually follow a guideline of around 20 square feet of collector area for each of the first two family members. For every additional person, add 8 square feet if you live in the U.S. Sun Belt area or 12–14 square feet if you live in the northern United States.

## Storage Volume

A small (50- to 60-gallon) storage tank is usually sufficient for one to two three people. A medium (80-gallon) storage tank works well for three to four people. A large tank is appropriate for four to six people.

For active systems, the size of the solar storage tank increases with the size of the collector—typically 1.5 gallons per square foot of collector. This helps prevent the system from overheating when the demand for hot water is low. In very warm, sunny climates, some experts suggest that the ratio should be increased to as much as 2 gallons of storage to 1 square foot of collector area.

## Other Calculations

Additional calculations involved in sizing your solar water heating system will include the following:

- Evaluation of your building site's solar resource
- Orientation and tilt of the solar collector.

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### **EXAM QUESTIONS:**

- 20.) **In this heat exchanger design, the tubes of water and the heat-transfer fluid are in direct thermal contact with each other?**
- a. Coil-in-tank
  - b. Shell-and-tube
  - c. Tube-in-tube
  - d. None of the above
- 21.) **This heat exchanger design is a coil of tubing in the storage tank.**
- a. Coil-in-tank
  - b. Shell-and-tube
  - c. Tube-in-tube
  - d. None of the above
- 22.) **Which of the following factors must be considered when sizing a heat exchanger?**
- a. Type
  - b. Flow rate
  - c. Inlet and outlet temperatures for each fluid
  - d. All of the above

- 23.) **The lowest temperature at which the vapor above a liquid can be ignited in air is called:**
- Freezing point
  - Flash point
  - Boiling point
  - Thermal capacity
- 24.) **Heat-transfer fluids for solar water heating systems exposed to high temperatures, as in a desert climate, should have a high boiling point.**
- True
  - False
- 25.) **Which of the following are types of heat-transfer fluids?**
- Air
  - Water
  - Silicones
  - All of the above
- 26.) **Solar water heating systems, which use liquids as heat-transfer fluids, need protection from freezing in climates where temperatures fall below \_\_\_\_ °F.**
- 22
  - 32
  - 42
  - 52
- 27.) **The main purpose of a collector's and the piping's (collector loop's) insulation is to keep them from freezing.**
- True
  - False
- 28.) **Solar water heating systems that use only \_\_\_\_\_ as a heat-transfer fluid are the most vulnerable to freeze damage.**
- Water
  - Air
  - Silicones
  - Oils
- 29.) **All collectors and piping for solar systems should have a minimum slope of \_\_\_\_ inches per foot.**
- 0.25
  - 0.50
  - 1.00
  - 1.25

- 30.) **How much collector area is needed for a solar system assuming you live in Wisconsin and there are 4 family members?**
- a. 20-20 square feet
  - b. 28-32 square feet
  - c. 48-52 square feet
  - d. 64-68 square feet

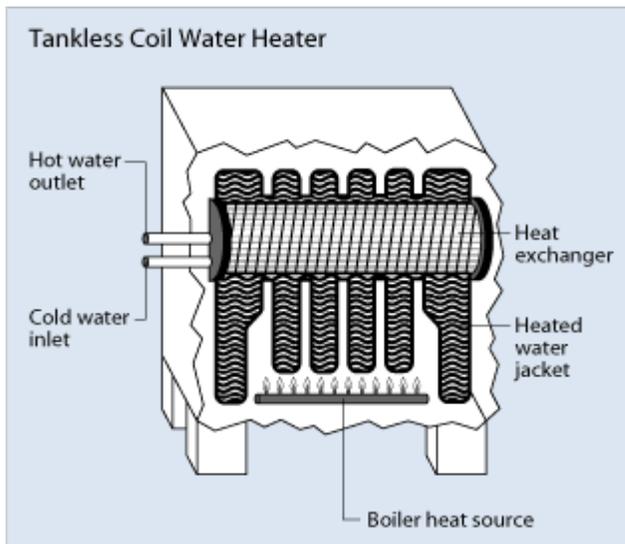
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## **Tankless Coil and Indirect Water Heaters**

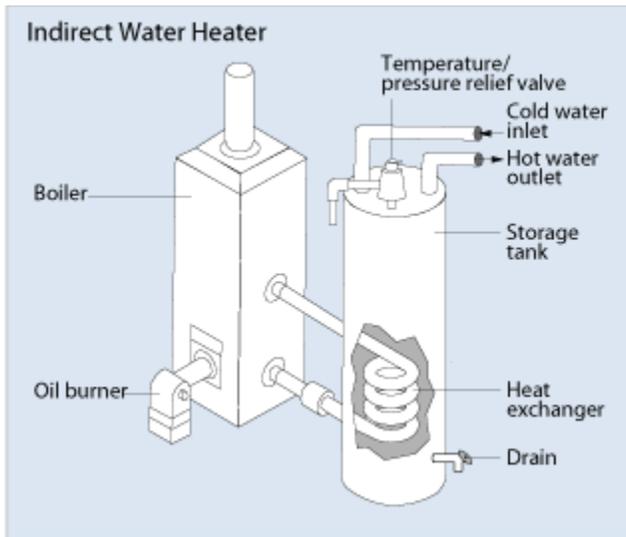
Tankless coil and indirect water heaters use a home's space heating system to heat water. They're part of what's called integrated or combination water and space heating systems.

### **How They Work**

A tankless coil water heater uses a heating coil or heat exchanger installed in a main furnace or boiler. Whenever a hot water faucet is turned on, the water flows through the heat exchanger. These water heaters provide hot water on demand without a tank, like a demand water heater, but because they rely on the furnace or boiler to heat the water directly, tankless coil water heaters work most efficiently during cold months when the heating system is used regularly. That's why they can be an inefficient choice for many homes, especially for those in warmer climates.



Indirect water heaters offer a more efficient choice for most homes, even though they require a storage tank. An indirect water heater uses the main furnace or boiler to heat a fluid that's circulated through a heat exchanger in the storage tank. The energy stored by the water tank allows the furnace to turn off and on less often, which saves energy. Therefore, an indirect water heater is used with a high-efficiency boiler and well-insulated tank can be the least expensive means of providing hot water.



Indirect systems can be fired by gas, oil, propane, electric, solar energy, or a combination of any of these. Tankless systems are typically electric or gas-fired. Also, these integrated or combination water heating systems not only can work with forced air systems but also with hydronic or radiant floor heating systems.

## Selecting a Combination Water and Space Heating System

Integrated or combination water and space heating systems usually cost more than a separate water heater and furnace or boiler, but installation and maintenance costs may be less. For example, you won't need multiple utility hook-ups since there's one source of heat. There also aren't as many moving parts to maintain or service. Some of these high efficiency systems may also provide you with lower utility costs.

Most combination water and space heating systems are usually designed for new construction. However, there are some retrofit units available that can work with an existing water heater.

When selecting a system, you need to consider its size. The sizing of a combination system involves some different calculations than those used for sizing a separate water heating or space heating system.

To determine the energy efficiency of a combination water and space heating system, use its combined appliance efficiency rating (CAE). The higher the number, the more energy efficient. Combination appliance efficiency ratings vary from 0.59 to 0.90.

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### EXAM QUESTIONS:

- 31.) **Tankless coil water heaters work most efficiently during cold months when the heating system is used regularly.**
- True
  - False
- 32.) **Indirect water heaters do not require a storage tank.**
- True
  - False

33.) **Indirect systems can be fired by which of the following:**

- a. Oil
- b. Propane
- c. Electric or gas
- d. All of the above

34.) **Integrated or combination water and space heating systems usually cost more than a separate water heater and furnace or boiler.**

- a. True
- b. False

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## **Heat Pump Water Heaters**

Most homeowners who have heat pumps use them to heat and cool their homes. But a heat pump also can be used to heat water—either as stand-alone water heating system, or as combination water heating and space conditioning system.

### **How They Work**

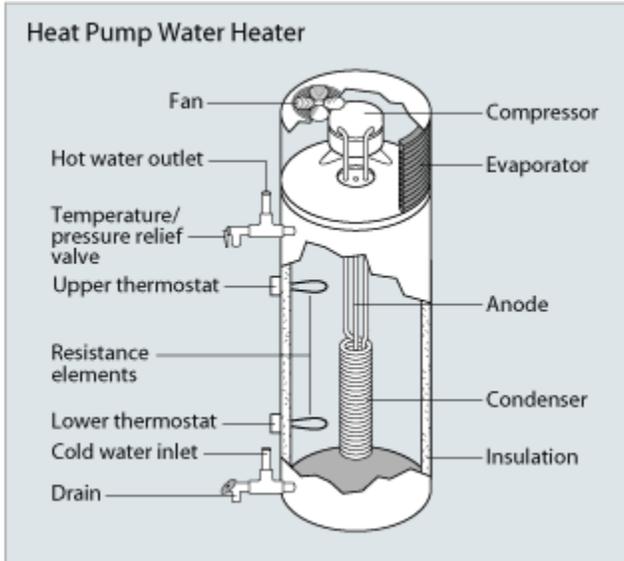
Heat pump water heaters use electricity to move heat from one place to another instead of generating heat directly. Therefore, they can be two to three times more energy efficient than conventional electric resistance water heaters. To move the heat, heat pumps work like a refrigerator in reverse.

While a refrigerator pulls heat from inside a box and dumps it into the surrounding room, a stand-alone *air-source heat pump* water heater pulls heat from the surrounding air and dumps it—at a higher temperature—into a tank to heat water. You can purchase a stand-alone heat pump water heating system as an integrated unit with a built-in water storage tank and back-up resistance heating elements. You can also retrofit a heat pump to work with an existing conventional storage water heater.

Heat pump water heaters require installation in locations that remain in the 40°–90°F (4.4°–32.2°C) range year-round and provide at least 1,000 cubic feet (28.3 cubic meters) of air space around the water heater. Cool exhaust air can be exhausted to the room or outdoors. Install them in a space with excess heat, such as a furnace room. Heat pump water heaters will not operate efficiently in a cold space. They tend to cool the spaces they are in. You can also install an air-source heat pump system that combines heating, cooling, and water heating. These combination systems pull their heat indoors from the outdoor air in the winter and from the indoor air in the summer. Because they remove heat from the air, any type of air-source heat pump system works more efficiently in a warm climate.

Homeowners primarily install geothermal heat pumps—which draw heat from the ground during the winter and from the indoor air during the summer—for heating and cooling their homes. For water heating, you can add a *desuperheater* to a geothermal heat pump system. A desuperheater is a small, auxiliary heat exchanger that uses superheated gases from the heat pump's compressor to heat water. This hot water then circulates through a pipe to the home's storage water heater tank.

Desuperheaters are also available for demand (tankless or instantaneous) water heaters. In the summer, the desuperheater uses the excess heat that would otherwise be expelled to the ground. Therefore, when the geothermal heat pump runs frequently during the summer, it can heat all of your water. During the fall, winter, and spring—when the desuperheater isn't producing as much excess heat—you'll need to rely more on your storage or demand water heater to heat the water. Some manufacturers also offer triple-function geothermal heat pump systems, which provide heating, cooling, and hot water. They use a separate heat exchanger to meet all of a household's hot water needs.



## Selecting a Heat Pump Water Heater

Heat pump water heater systems typically have higher initial costs than conventional storage water heaters. However, they have lower operating costs, which can offset their higher purchase and installation prices.

Before buying or installing a heat pump water heating system, you also need to consider the following:

- Size and first hour rating
- Fuel type and availability
- Energy efficiency (energy factor)
- Overall costs.

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### **EXAM QUESTIONS:**

- 35.) Heat pump water heaters use \_\_\_\_\_ to move heat from one place to another instead of generating heat directly.
- a. Water
  - b. Heat
  - c. Electricity
  - d. Gas

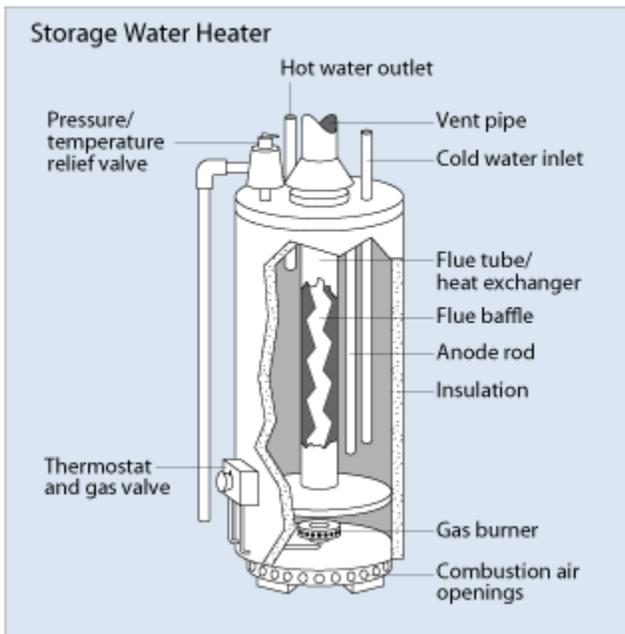
- 36.) **Wisconsin has an ideal climate to install a heat pump water heater.**
- a. True
  - b. False
- 37.) **Before installing a heat pump water system, you need to consider the following:**
- a. Size and first hour rating
  - b. Fuel type
  - c. Energy efficiency
  - d. All of the above
- 

## **Conventional Storage Water Heaters**

Conventional storage water heaters remain the most popular type of water heating system for the home. Here you'll find basic information about how storage water heaters work; what criteria to use when selecting the right model; and some installation, maintenance, and safety tips.

### **How They Work**

A single-family storage water heater offers a ready reservoir—from 20 to 80 gallons—of hot water. It operates by releasing hot water from the top of the tank when you turn on the hot water tap. To replace that hot water, cold water enters the bottom of the tank, ensuring that the tank is always full.



Conventional storage water heater fuel sources include natural gas, propane, fuel oil, and electricity. Natural gas and propane water heaters basically operate the same. A gas burner under the tank heats the water. A thermostat opens the gas valve as the water temperature falls. The valve closes when the temperature rises to the thermostat's setpoint. Oil-fired water heaters operate similarly, but they have power burners that mix oil and air

in a vaporizing mist, ignited by an electric spark. Electric water heaters have one or two electric elements, each with its own thermostat. With two electric elements, a standby element at the bottom of the tank maintains the minimum thermostat setting while the upper demand element provides hot water recovery when demand heightens.

Because water is constantly heated in the tank, energy can be wasted even when a hot water tap isn't running. This is called *standby heat loss*. Only tankless water heaters—such as demand water heaters and tankless coil water heaters—avoid standby heat losses. However, you can find some storage water heater models with heavily insulated tanks, which significantly reduce standby heat losses, lowering annual operating costs. Look for models with tanks that have a thermal resistance (R-Value) of R-12 to R-25.

Gas and oil water heaters also have venting-related energy losses. Two types of water heaters—a fan-assisted gas water heater and an atmospheric sealed-combustion water heater—reduce these losses. The fan-assisted gas water heater uses a draft-induced fan that regulates the air that passes through the burner, which minimizes the amount of excess air during combustion, increasing efficiency. The atmospheric sealed-combustion water heater uses a combustion and venting system that is totally sealed from the house.

You might also want to consider some less conventional storage water heaters—heat pump water heaters and solar water heaters. These water heaters are usually more expensive but they typically have lower annual operating costs.

## Selecting a Storage Water Heater

The lowest-priced storage water heater may be the most expensive to operate and maintain over its lifetime. While an oversized unit may be alluring, it carries a higher purchase price and increased energy costs due to higher standby energy losses.

## Installation and Maintenance

Proper installation and maintenance of your water heater can optimize its energy efficiency.

Proper installation depends on many factors. These factors include fuel type, climate, local building code requirements, and safety issues, especially concerning the combustion of gas- and oil-fired water heaters.

Periodic water heater maintenance can significantly extend your water heater's life and minimize loss of efficiency. Read your owner's manual for specific maintenance recommendations.

Routine maintenance for storage water heaters, depending on what type/model, may include:

- Flushing a quart of water from the storage tank every three months
- Checking the temperature and pressure valve every six months
- Inspecting the anode rod every three to four years.

## Sizing Storage and Heat Pump (with Tank) Water Heaters

To properly size a storage water heater for a home, use the water heater's first hour rating (FHR). The first hour rating is the amount of hot water in gallons the heater can supply per hour (starting with a tank full of hot water). It depends on the tank capacity, source of heat (burner or element), and the size of the burner or element.

The Energy Guide Label lists the first hour rating in the top left corner as "Capacity (first hour rating)." The Federal Trade Commission requires an Energy Guide Label on all new conventional storage water heaters but not on heat pump water heaters. Product literature from a manufacturer may also provide the first hour rating. Look for water heater models with a first hour rating that matches within 1 or 2 gallons of the peak hour demand—the daily peak 1-hour hot water demand for your home.

Do the following to estimate the peak hour demand:

- Determine what time of day (morning, noon, evening) the most hot water is used in the home. Keep in mind the number of people living in the home.
- Use the worksheet below to estimate your maximum usage of hot water during this one hour of the day—this is your peak hour demand. Note: the worksheet does not estimate total daily hot water usage.

The worksheet example shows a total peak hour demand of 46 gallons. Therefore, this household would need a water heater model with a first hour rating of 44 to 48 gallons.

Worksheet for Estimating Peak Hour Demand/First Hour Rating

Use	Average gallons of hot water per usage	Times used during 1 hour	Gallons used in 1 hour
Shower	12	×	=
Bath	9	×	=
Shaving	2	×	=
Hands & face washing	4	×	=
Hair shampoo	4	×	=
Hand dishwashing	4	×	=
Automatic dishwasher	14	×	=
Food preparation	5	×	=
Wringer clothes washer	26	×	=
Automatic clothes washer	32	×	=
Total Peak Hour Demand			=

**EXAMPLE**

3 showers  $12 \times 3 = 36$

1 shave  $2 \times 1 = 2$

1 shampoo  $4 \times 1 = 4$

1 hand dishwashing  $4 \times 1 = 4$

Peak Hour Demand = 46

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**EXAM QUESTIONS:**

**38.) The first hour rating is the amount of hot water in gallons the heater can supply per hour (starting with a tank full of hot water).**

- a. True
- b. False

**39.) What is the Peak Hour Demand for a household that takes 3 showers, 1 shave, 2 hands & face washing, and 1 food preparation during the daily peak 1-hour?**

- a. 47
- b. 51
- c. 54
- d. 58

**40.) What is the Peak Hour Demand for a household that takes 2 showers, 1 shave, 1 shampoo and 1 hand dishwashing during the daily peak 1-hour?**

- a. 34
- b. 40
- c. 46
- d. 54

WISCONSIN CONTRACTORS INSTITUTE – ANSWER SHEET

Water Heater Systems – 4 hours

First Name: \_\_\_\_\_ Last Name: \_\_\_\_\_ Date: \_\_\_\_\_

Address: \_\_\_\_\_ State: \_\_\_\_\_ ZIP: \_\_\_\_\_

WI Customer ID (license #): \_\_\_\_\_ (e.g. Master Plumber #)

Phone: \_\_\_\_\_ Email: \_\_\_\_\_

**Water Heaters**

1.     T F  
    a  b  c  d

2.      a  b  c  d

3.      a  b  c  d

4.      a  b  c  d

5.      a  b  c  d

6.      a  b  c  d

7.      a  b  c  d

8.      a  b  c  d

9.      a  b  c  d

10.     a  b  c  d

11.     a  b  c  d

12.     a  b  c  d

13.     a  b  c  d

14.     a  b  c  d

15.     a  b  c  d

16.     a  b  c  d

17.     a  b  c  d

18.     a  b  c  d

19.     a  b  c  d

20.     a  b  c  d

**Water Heaters**

21.    T F  
    a  b  c  d

22.     a  b  c  d

23.     a  b  c  d

24.     a  b  c  d

25.     a  b  c  d

26.     a  b  c  d

27.     a  b  c  d

28.     a  b  c  d

29.     a  b  c  d

30.     a  b  c  d

31.     a  b  c  d

32.     a  b  c  d

33.     a  b  c  d

34.     a  b  c  d

35.     a  b  c  d

36.     a  b  c  d

37.     a  b  c  d

38.     a  b  c  d

39.     a  b  c  d

40.     a  b  c  d