

PLUMBING CODE REQUIREMENTS
AND SIZING GUIDE FOR
RESIDENTIAL WATER SOFTENERS

Second Edition

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BACKGROUND

Plumbing codes list minimum performance requirements for potable water supply and distribution systems. Since water softening devices are an integral part of many residential water supply systems, it is imperative for water softeners to be constructed, sized, and installed in accordance with the provisions of nationally recognized performance standards and the model plumbing codes.

MODEL PLUMBING CODES IN THE UNITED STATES

There are five model plumbing code organizations in the United States.

- *Uniform Plumbing Code* (UPC) (adopted mainly in the western U.S.)
- *Standard Plumbing Code* (SPC) (adopted mainly in the southern U.S.)
- *BOCA Plumbing Code* (BOCA) (adopted mainly in the eastern U.S.)
- *International Plumbing Code* (IPC)
- *CABO Plumbing Code* (CABO) (written exclusively for residential construction)

The International Plumbing Code (IPC) is a new code and a joint effort between the three major model code groups (UPC, SPC, and BOCA). This code was first published in 1995 with the intention of eventually replacing the UPC, SPC, and BOCA codes with one unified code. The CABO plumbing code is derived from the three major model codes and is designed specifically for plumbing of one and two family (residential) dwellings.

A local municipality can choose to adopt one of the model codes as published, or can add amendments to deal with factors that are unique to the area. The provisions of the model plumbing codes are generally consistent, but contain somewhat different requirements to address factors that are unique to the area of the country for which each is written. For example, the UPC contains explicit requirements for strapping water heaters due to the risk of earthquakes in the western U.S.

PLUMBING CODE REQUIREMENTS FOR WATER SOFTENERS

- A. The following information shall be incorporated in Manufacturer's design and installation instructions. Design, installation and maintenance instructions shall be in compliance with model plumbing codes.
1. All of the model plumbing codes require water supply systems to be designed to deliver a specified flow rate (gallons of water per minute). Each code lists procedures for calculating design flow rates, which are directly related to the number of plumbing fixtures in the building.¹ Consequently, a water softener must have a listed flow rate that meets or exceeds the design water flow rate of all portions of the plumbing system served by the water softener.
 2. The minimum static water pressure at the building entrance must be at least 40 psi.²
 3. The performance of water softeners shall comply with the provisions of WQA S-100³ (Water Quality Association S-100-95: *Household, Commercial, and Portable Exchange Water Softeners; An Equipment Validation Standard*).
 4. The nominal diameter of water supply piping to the softener must be at least ¾-inch.⁴
 5. The inlet and outlet diameter of the water softener must match the diameter of the water supply piping at the location where the softener will be installed.⁵
 6. Plumbing fixtures must have a minimum available flow pressure of 8 psi.⁶
 7. Sizing provisions contained in Manufacturer's documentation are intended to help designers and installers provide homes with water softeners that are capable of supplying water at pressures and flow rates required by the model plumbing codes. Sizing provisions for all model plumbing codes shall be provided.
 8. The following table illustrates the design flow rates required by the model plumbing codes. This example is for a house with two baths, with required design flow rates calculated in accordance with CABO, UPC, SBCCI and IPC code requirements. NOTE: Hosebibs should be connected to the water supply upstream of the water softener, or a manual bypass valve should be provided to isolate the water softener during hosebib usage.
 9. Residential fire (sprinkler) suppression systems shall be addressed in Manufacturer's design and sizing criteria.

¹1995 CABO Sect. 3409, 1997 UPC Appendix A, 1997 SPC Appendix F, 1995 IPC Appendix E

²1997 CABO Sect. 3403.2

³1997 UPC: Appendix C

⁴1997 UPC Sect. 610.8, 1995 IPC Sect. 604.1, 1995 CABO Sect. 3403.4, 1997 SPC Sect. 608.2

⁵1997 UPC Sect. 610.2

⁶1997 SPC Sect. 607.4, 1995 CABO Sect. 3403.2.1, 1995 IPC Sect. 605.3

PLANNING THE INSTALLATION

The following information is required to properly size water softeners:

- Water pressure at the service entrance to the house (can be obtained from local water service provider or by measuring the static pressure at the service entrance).
- The number of the following plumbing fixtures:
 - Bathroom sinks and utility sinks (lavatories)
 - Bathtubs (with/without overhead shower head)
 - Showers Stalls
 - Water Closets
 - Kitchen Sinks
 - Dishwashers
 - Clothes Washers
 - Hose Bibbs (outdoor faucets)
- Determine the location where the water softener will be installed in the water supply piping. This location should be located near the service entrance but *downstream* from the main water supply shutoff valve⁷. Furthermore, the softener should be located *upstream* from water fixtures and appliances with the following exceptions:
 - **Fire Sprinklers:** If the house is equipped with a fire sprinkler system that draws water from a single connection point near the service entrance, the required water softener size can be reduced by installing the softener *downstream* from the branch supplying the sprinkler system. If the sprinkler system draws water from individual branches of the water supply system, this reduction is not possible and the sprinklers must be included in the water softener sizing calculations.
 - **Outdoor Hose Bibbs:** Since water hardness is typically irrelevant for outdoor uses, it may be possible isolate outdoor hose bibbs from the water softener. If the outdoor hose bibbs connect to the water supply piping near the service entrance, the required water softener size can be reduced by installing the softener downstream from the branch supplying the hose bibbs.
- Determine the local plumbing code adopted by the town where the water softener will be installed (UPC, SPC, BOCA, IPC, or CABO). Note that some localities use their own plumbing code, and the model codes may not apply.

⁷1997 SPC 610.1, 1997 UPC 605.5

SIZING PROCEDURES

Model plumbing codes have similar requirements for sizing water supply piping. These requirements are designed to ensure that water fixtures will have an adequate supply of water under normal household use.

1. Begin by making a list of the type and number of water fixtures that will be installed downstream from the water softener. Determine whether fire sprinklers and outdoor hose bibbs will be supplied by the water softener. *The required flowrate of the water softener can be significantly reduced if fire sprinklers and hose bibbs can be isolated from the water softener (not connected to the water softener outlet).*
2. Refer to the sizing tables in this document. Each page has two tables that contain sizing requirements for a particular model plumbing code. Choose the page that corresponds to the model plumbing code that will be used to size the water softener.
3. Plumbing codes account for water demand by assigning *water supply fixture units* (wsfu) to each water appliance. Using the first table on the page, find the wsfu rating for each water fixture in the house (to be located downstream from the water softener). Add these individual wsfu ratings to obtain a total wsfu rating for the entire house.
4. Use the total wsfu rating to find the required minimum flowrate (gallons per minute) from the second table on the page (interpolate the flowrate if necessary).
5. If the home is equipped with fire sprinklers that **cannot** be isolated from the water softener (ie: water softener cannot be installed downstream from the take-off for the fire sprinklers), the minimum required flowrate of the water softener is 26 gallons per minute.⁸
6. Refer to the flowrates calculated in steps 4 and 5 above. **The higher value is the minimum required flowrate for the water softener** (gallons per minute of water). For homes without fire sprinkler systems, the minimum required flowrate is the value calculated in step 4.
7. The example on the following page demonstrates the proper procedure for sizing a water softener for a particular house.

⁸NFPA 13D-1994 Sect. 4-1 (two sprinklers rated at 13 gallons per minute).

EXAMPLE: Sizing Requirements for CABO Plumbing Code and UPC Plumbing Code

Compare the minimum required flowrate for a water softener sized in accordance with CABO requirements and UPC requirements for a house with the following water fixtures:

- 2-1/2 bathrooms (2 bath/showers, 3 lavatories, and 3 water closets)
- (1) Clothes washer
- (1) Kitchen sink
- (1) Dishwasher
- (2) Hose bibbs

Use the tables on the top of pages 6 and 7 to find the wsfu value for each individual water fixture. Page 6 lists the sizing criteria for CABO, and page 7 lists sizing criteria for UPC. Make certain to multiply the wsfu value by the number of fixtures to get the total wsfu's for each fixture type. Add the total wsfu's for each fixture type to get total wsfu's for the house. Use the total wsfu's for the house with the tables on the bottom of pages 6 and 7 to find the minimum required flowrate for the water softener. For the house in this example, we have:

Water Fixture Type	Number of Fixtures	CABO Sizing Reqs.		UPC Sizing Reqs.	
		wsfu's for each fixture	Total wsfu's	wsfu's for each fixture	Total wsfu's
2-1/2 Baths		5.6	5.6		
Bath/shwr.	2	-	(CABO	4.0	8.0
Lavatory	3	-	lists wsfu's	1.0	3.0
Water Closet	3	-	for	2.5	7.5
			bathrooms)		
Clothes Washer	1	1.4	1.4	4.0	4.0
Kitchen Sink	1	1.0	1.0	1.5	1.5
Dishwasher	1	1.4	1.4	1.5	1.5
Hose Bibbs	2	2.5	5.0	2.5 - 1 st bibb	3.5
				1.0 - 2 nd bibb	
Total wsfu's for House		-	14.4		29.0
Min. Required Flowrate (gpm)		10.6		19.5	

This example shows that water softener flowrate requirements vary between the plumbing codes. Consequently, it is very important to size the water softener in accordance with the model plumbing code recognized in the municipality where the softener is to be installed. **Make certain to use the proper table (that corresponds to the plumbing code in your area) when sizing the water softener.**

Sizing Water Softeners with the 1995 CABO Plumbing Code

- Determine the total number of water supply fixture units (wsfu rating) for all water fixtures to be supplied by the water softener from the following table:

Water Supply Fixture Unit Values for CABO Plumbing Code⁹

Type of Fixtures or Group of Fixtures	wsfu value (combined hot & cold)
Multiple Bath Groups	
1-1/2 baths	4.4
2 baths	5.2
2-1/2 baths	5.6
3 baths	6.3
3-1/2 baths	6.8
Additional 1-1/2 bath if part of group	0.8
Bathtub (with/without overhead shower)	1.4
Shower Stall	1.4
Lavatory	0.7
Water Closet (tank type)	2.2
Kitchen Sink	1.4
Dishwasher	1.4
Clothes Washer	1.4
Hose Bibb (outdoor faucet)	2.5

- After adding together the wsfu values of the individual water fixtures, use the table below to find the minimum required flowrate of the water softener.

Required Flowrate of Water Softener based on CABO wsfu Rating¹⁰

Total wsfu value of all water fixtures downstream from water softener	Required water softener flow rate (gallons per minute)
9	7.2
10	7.7
12	9.0
14	10.4
16	11.6
18	12.7
20	14.0
25	16.8
30	19.5

⁹1995 CABO Table 3409.2

¹⁰1995 CABO Table 3409.3

Sizing Water Softeners with the 1997 Uniform Plumbing Code

- Determine the total number of water supply fixture units (wsfu rating) for all water fixtures to be supplied by the water softener from the following table:

Water Supply Fixture Unit Values for Uniform Plumbing Code¹¹

Type of Fixtures or Group of Fixtures	wsfu value (combined hot & cold)
Bathtub (with/without shower)	4.0
Lavatory	1.0
Shower	2.0
Water Closet - 1.6 gallons/flush (tank type)	2.5
Water Closet - 3.5 gallons/flush (tank type)	3.0
Kitchen Sink	1.5
Dishwasher	1.5
Clothes Washer	4.0
Hose Bibb (outdoor faucet)	2.5
Hose Bibb - each additional	1.0

- After adding together the wsfu values of the individual water fixtures, use the table below to find the minimum required flowrate of the water softener.

Required Flowrate of Water Softener based on UPC wsfu Rating¹²

Total wsfu value of all water fixtures downstream from water softener	Required water softener flow rate (gallons per minute)
7.5	6.0
10	8.0
15	11.5
20	15.0
25	17.5
30	20.0

¹¹1997 UPC Table 6-4: values based on individual dwelling

¹²Values determined from Chart A-3 in Appendix C of 1997 UPC per section A2.1

Sizing Water Softeners with the 1997 Standard Plumbing Code and 1995 International Plumbing Code

- Determine the total number of water supply fixture units (wsfu rating) for all water fixtures to be supplied by the water softener from the following table:

Water Supply Fixture Unit Values for Standard Plumbing Code and International Plumbing Code¹³

Type of Fixtures or Group of Fixtures	wsfu value (combined hot & cold)
Bathtub (with/without shower)	1.4
Lavatory	0.7
Shower	1.4
Water closet	2.2
Kitchen sink	1.4
Dishwasher	1.4
Clothes washer	1.4
Hose bibb	Designer's discretion*

*SPC and IPC states that load should be determined by comparing hose bibbs to fixtures using similar amounts of water at similar rates.

- After adding together the wsfu values of the individual water fixtures, use the table below to find the minimum required flowrate of the water softener.

Required Flowrate of Water Softener based on SPC and IPC wsfu Rating¹⁴

Total wsfu value of all water fixtures downstream from water softener	Required water softener flow rate (gallons per minute)
8	12.8
10	14.6
12	16.0
14	17.0
16	18.0
18	18.8
20	19.6
25	21.5
30	23.3

¹³1997 SPC Table F101B, 1995 IPC Table E101B (demand for fixtures in private buildings)

¹⁴1997 SPC Table F102, 1995 IPC Table E102 (demand for distribution systems with flush tanks)

REFERENCES

CABO One and Two Family Dwelling Code - 1995 Edition. Published by the Council of American Building Officials, 5203 Leesburg Pike, Falls Church, VA, 22041.

International Plumbing Code - 1995 Edition. Published by the International Code Council, Inc. Current Secretariat: Building Officials and Code Administrators International, Inc., 4051 West Flossmoor Road, Country Club Hills, IL, 60478-5795.

NFPA 13D: Standard for the Installation of Sprinkler Systems in One- and Two- Family Dwellings and Manufactured Homes - 1994 Edition. Published by the National Fire Protection Association, Inc.

Standard Plumbing Code - 1997 Edition. Published by the Southern Building Code Congress International, Inc., 900 Montclair Road, Birmingham, AL, 35213-1206.

Uniform Plumbing Code - 1997 Edition. Published by the International Association of Plumbing Officials, 20001 Walnut Drive South, Walnut, CA, 91789-2825.

Water Quality Association S-100-95: Household, Commercial, and Portable Exchange Water Softeners; An Equipment Validation Standard. Published by the Water Quality Association, 4151 Naperville Road, Lisle, IL, 60532.

SIZING FORM FOR WATER SOFTENERS

Step 1

List each type of water fixture (ie: bath/shower, lavatory, etc.) that will be connected to the outlet of the water softener in left column of the table below. In the next column to the right, list the total number of each type of water fixture that will be connected to the softener (i.e.: three lavatories). In the fourth column, list the wsfu unit for each type of water fixture from the appropriate model code (i.e.: 1.4 for a dishwasher using CABO sizing requirements). Multiply the values in columns 2 and 4 and write the result in the right-hand column of the table below. Repeat this process for each type of water fixture and add the values in the right-hand column to get the total wsfu's for the house.

Type of Water Fixture	# of fixtures to be connected to water softener	Multiply # of fixtures by..	wsfu value for fixture (from plumbing code)	Equals	Total wsfu's for each water fixture type
		x		=	
		x		=	
		x		=	
		x		=	
		x		=	
		x		=	
		x		=	
		x		=	
		x		=	
		x		=	
Total wsfu's for House (add total wsfu's for each fixture type)					

Step 2

With the total wsfu's for the house calculated in step 1, use the "required flowrate" table from the appropriate model plumbing code to find the minimum required flowrate of the water softener.