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Voluntary Industry Standards

S-100-85

FOR HOUSEHOLD COMMERCIAL AND PORTABLE EXCHANGE WATER SOFTENERS

WATER QUALITY ASSOCIATION

A not-for-profit international trade association representing firms and individuals engaged in the design, manufacture, production, distribution and sale of equipment, products, supplies and services for providing quality water for specific uses in residential, commercial, industrial and institutional establishments. Membership is voluntary.

One of the basic purposes of WQA is to promote the acceptance and use of industry equipment, products, and services. Activities, programs and services are designed to enable the industry to perform with the greatest economy and efficiency and to provide the greatest service to the public. The benefits of this shared experience accrue to all, and might otherwise be unobtainable.

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S-100
VOLUNTARY INDUSTRY STANDARD FOR HOUSEHOLD, COMMERCIAL AND PORTABLE EXCHANGE WATER SOFTENERS

OBJECTIVE: The objective of this standard is to provide a standard of hardness removal, capacity, performance, construction, sanitation and service for installed new Household, Commercial and Portable exchange water softeners.

I. CLASSIFICATION AND DEFINITIONS

A. CLASSIFICATIONS

1. **Household Water Softeners.** Household water softeners are connected to the water system with conventional plumbing fittings, are designed for intermittent household use at service flow rates of at least 4 but less than 16 U.S. gallons per minute, and are regenerated in place.
   a. **Manual**—All regeneration operations are performed manually. Direct salting regeneration—Dry salt is added directly into the ion exchanger tank after sufficient water is removed to make room for the salt. Termination of the rinsing process may be automatic, but return to service, and bypass of hard water, where desired, are controlled manually.
   b. **Semi-Automatic**—Direct salting regeneration. All operations are performed manually, including bypass of hard water where desired, except termination of rinse and return to service, which are performed automatically.
   c. **Automatic**—All operations, including bypass of hard water and return to service, are performed automatically after manual initiation. Dry salt or brine may be used for regeneration.
   d. **Fully Automatic**—All operations, including bypass (of hard or soft water depending upon design) and return to service are initiated and performed automatically. Salt storage is sufficient for multiple regenerations.
   e. **Demand Initiated Regeneration (DIR)**—All operations, including bypass (of hard or soft water depending on design) and return to service are initiated and performed automatically in response to the demand for treated water. Salt storage shall be sufficient for multiple regenerations.
2. **Commercial Water Softeners.** Commercial water softeners are connected to the water system with conventional plumbing fittings, are designed for commercial or light industrial use at service flow rates up to 250 U.S. gallons per minute, and are regenerated in place.
   a. **Manual**—All regeneration operations are performed manually.
   b. **Semi-Automatic**—All regeneration operations are performed manually except termination of rinse and return to service which are performed automatically.
   c. **Automatic**—All regeneration operations are initiated and performed automatically, including return to service.
   d. **Demand Initiated Regeneration (DIR)**—All operations, including bypass (of hard or soft water depending on design) and return to service are initiated and performed automatically in response to the demand for treated water. Salt storage shall be sufficient for multiple regenerations.

3. **Portable Exchange Water Softeners.** Portable exchange water softeners are connected to the water system with special fittings designed for easy connection and disconnection. These softeners do not include the valving or controls required for regeneration, and are disconnected and transported to a central station or plant for regeneration. Portable exchange water softeners are designed for service flow rates of at least 4.0 U.S. gallons per minute.

B. DEFINITIONS

1. **Brine**—A solution of sodium chloride (salt) used for regenerating water softeners.
2. **Bypass**—A connection or a valve system that allows hard water to flow to the water system while the water softener is being regenerated or serviced in any manner.
3. **Calcium**—One of the principal elements making up the earth's crust, the compounds of which when dissolved in water make the water hard. The presence of calcium in water is a factor contributing to the formation of scale and insoluble soap curds which are means of clearly identifying hard water.
4. **Calcium carbonate**—A common basis for expressing the concentration of hardness and other salts in chemically equivalent terms.
5. **Cation exchange**—In water softening is principally the exchange of calcium and magnesium ions in water for sodium ions on an insoluble ion exchange material. Ferrous iron and other metals such as manganese and aluminum are sometimes present in small quantities. These metals are also exchanged, but they may precipitate and foul the exchanger bed.
6. **Collectors**—A term used to identify a system designed to collect backwash water from the surface of ion exchange beds.
7. **Color throw**—The imparting of color by any part of a water softener to the effluent during any stage of the operating cycle.
8. **Corrosion**—The destructive disintegration of metals by electro-chemical means.
9. **Cubic feet**—The volumetric unit used for measuring ion exchange materials. Volume is measured on an in-place, backwashed, drained and settled condition.
10. **Distributors**—Devices located at the top or bottom of a water softener to distribute or collect the water and to retain the cation exchange material in the unit.
11. **Downflow**—A term applied to designate the direction (down) in which water flows through the ion exchanger during any phase of the operating cycle of a water softener.
12. **Drain**—A line used to carry backwash water, spent regenerant and rinse water to the waste system.
13. **Effluent**—The water of solution which emerges from a water softener during any phase of the operating cycle.
14. **Filter**—A device installed in a water system through which water flows for the removal of turbidity, taste, color or odor.
15. **Flow rate**—The quantity of water and/or brine flowing measured in gallons per minute (gpm).
16. **Grains per gallon (gpg)**—A common basis of reporting water analysis in the United States and Canada. One grain per U.S. gallon equals 17.1 milligrams per liter or 17.1 parts per million (ppm). One grain per Imperial gallon equals 14.3 milligrams per liter or 14.3 parts per million (ppm). One grain is 1/7000 pounds or .0647 grams.

30 grains = 513 mg/l hardness

17. **Hardness**—Dissolved calcium and magnesium salts in water. Compounds of these two elements are responsible for most scaling in pipes and water heaters, and cause numerous problems in laundry, kitchen and bath. Hardness is usually expressed in grains per gallon or parts per million as calcium carbonate equivalent.
18. **Hardness leakage**—Calcium and magnesium present in water after passing through a water softener.
19. **Hard water**—Water containing calcium and magnesium salts in concentration of 1 grain per gallon or more (as calcium carbonate equivalent).
20. **Installation**—The piping or valving by which water softeners are connected into the water supply system, including a drain pipe.
21. **Ion exchange**—A process whereby an exchange material contains labile ions that will exchange with other ions in a surrounding solution.
22. **Ion exchanger**—An insoluble material containing labile ions that will exchange reversibly with other ions in a surrounding solution.
23. **Iron**—Iron is an element often present in the ground waters in a soluble form (such as ferrous bicarbonate) in quantities usually ranging from 0 to 10 parts per million. Iron in water is objectionable because of severe staining.
24. **Magnesium**—One of the elements making up the earth's crust, the compounds of which when dissolved in water make the water hard. The presence of magnesium in water is a factor contributing to the formation of scale, and insoluble soap curds which are means of clearly identifying hard water.
25. **Parts per million (ppm)**—A common basis of reporting water analysis in the United States and Canada. One part per million (ppm) equals 1 pound per million pounds of water, 17.1 ppm equals one grain per U.S. gallon, 14.3 ppm equals one grain per Imperial gallon.
26. **pH value**—A number denoting alkalinity or acidity. Numbers below 7.0 indicate acidity, which increases as the number becomes smaller. Numbers above 7.0 indicate alkalinity, which increases as the number becomes larger. The pH scale runs from 0 to 14, 7.0 being the neutral point.
27. **Pressure drop**—A decrease of water pressure measured in pounds per square inch (psi).
28. **Rated service flow**—The manufacturer's specified maximum flow at which the softener will deliver soft water.
29. **Rated softening capacity**—Softener capacity rating shall be based on grains of hardness removed (as calcium carbonate) while producing soft water between successive regenerations and must be related to pounds of salt required for each regeneration.
30. **Regeneration**—In general includes the backwash, brine and fresh water rinse steps, necessary to prepare the exchanger bed for service after exhaustion. Specifically, the term may be applied to the "brine" step in which a sodium chloride solution is passed thru the exchanger bed. The sodium ions displace the hardness ions from the exchanger to permit the hardness to be rinsed to drain.
31. **Resin**—The term used to designate a synthetic organic ion exchange material such as high capacity cation exchange resin widely used in water softeners.
32. **Rinse**—That part of the regenerating cycle of a water softener where fresh water is introduced to remove spent regenerant and excess salt prior to placing the softener into service.
33. **Salt**—High purity sodium chloride of a granular, rock or briquetted type used for generating a water softener.
34. **Service run**—That part of the operating cycle of a water softener in which the hard water supply is passed through a regenerated and rinsed bed of ion exchange material, thereby producing soft water.

35. **Shielded (insulated)**—The separation of metallic parts by a non-conductor.
36. **Siliceous gel**—A manufactured granular hydrated sodium alumino silicate often called synthetic gel zeolite, used in water softeners.
37. **Soft water**—Water containing less than 1 grain per gallon dissolved calcium and magnesium salts (as calcium carbonate equivalent).
38. **Trigger Point**—A step in a demand initiated water softener control cycle when regeneration is initiated.
39. **Turbidity**—The term used to define any undissolved materials in water such as finely divided particles of sand, clay, etc.
40. **Upflow**—A term applied to designate the direction (up) in which water flows through the ion exchange bed during any phase of the operating cycle.
41. **Validation**—Determination by WQA that a prototype of the model validated has met the minimum performance requirements of this Standard, the manufacturer's performance ratings, and the requirements of non-toxicity of this Standard. All tests of performance standards and manufacturer's performance ratings shall be made pursuant to Section VI of this Standard. Certification by the National Sanitation Foundation that materials in contact with water meet NSF Standard 43 and 44 shall be sufficient evidence of compliance with the non-toxicity requirements of this Standard.

II. PERFORMANCE STANDARDS

A. QUALITY OF SOFT WATER. When operated in accordance with the manufacturer's instructions, a water softener shall deliver water at its specified service flow rate(s) having less than 1.0 grain hardness (as calcium carbonate) per U.S. gallon when influent water contains not more than 20 grains per gallon of hardness (as calcium carbonate) and not more than 5.0 gpg of sodium salts (as calcium carbonate).

B. CAPACITY RATINGS. Each softener capacity rating shall be based on the grains of hardness (as calcium carbonate) removed while producing soft water between successive regenerations of a single ion exchanger tank. Capacity ratings for multiple tank systems shall be based on a single tank, but the total capacity of the system increased in proportion to the number of ion exchanger tanks in the system.

1. Capacity ratings for household and commercial softeners shall be related to the pounds of salt required for regeneration.
2. Manufacturer's capacity ratings for portable exchange softeners, where established, shall be based upon the standard regeneration procedures and salt dosages specified by the manufacturer.
3. Brine measuring systems used with brine tank softeners shall deliver the amount of salt specified by the manufacturer for the maximum validated capacity rating, ±10%.

C. SOFTENER FLOW RATINGS. All softener flow ratings shall be based on a single ion exchanger tank. In a multiple tank system, the total flow available from the system may or may not be increased in proportion to the number of tanks, depending upon the application and mode of regeneration or exchange.

1. **Household Water Softeners.** A household water softener shall have a Service Flow Rating of not less than 4.0 U.S. gpm, and shall deliver soft water at its Service Flow Rating for a period of not less than 10 minutes. A household water softener shall deliver soft water and its full capacity rating at a continuous flow of one-half its Service Flow Rating.
2. **Commercial Water Softeners.** A commercial water softener shall deliver soft water at its Peak Service Flow Rating for a period of not less than 10

minutes, and soft water and its full capacity rating with continuous flow at its continuous Operating Flow Rating.

3. **Portable Exchange Water Softeners.** A portable exchange water softener shall have a Service Flow Rating of not less than 4.0 U.S. gpm, and shall deliver soft water at its Service Flow Rating for a period of not less than 10 minutes. A portable exchange water softener shall deliver soft water and full capacity rating with continuous flow at one-half its Service Flow Rating.

D. **PRESSURE DROP.** Softener pressure drop is defined as the pressure drop from inlet to outlet of the softener including valving and ion exchanger.

1. **Household Water Softeners.** The pressure drop of a household water softener shall not exceed 15.0 psi at the Service Flow Rating on water at 60° F.
2. **Commercial Water Softeners.** The pressure drop of a commercial water softener on 60° F. water shall be given for the Continuous Operating Flow Rating and the Peak Service Flow Rating.
3. **Portable Exchange Water Softeners.** The pressure drop of a portable exchange water softener shall not exceed 15.0 psi at the Service Flow Rating on water at 60° F.

III. MATERIALS AND CONSTRUCTION STANDARDS

A. GENERAL MATERIAL REQUIREMENTS

1. Materials shall be selected for their strength and resistance to corrosion by water and brine; shall be free of objectionable color throw, taste and odor; shall not impart toxic substances to the water.
2. Water softeners shall be designed and constructed so that when installed in accordance with the manufacturer's instructions they will meet established public health and safety requirements. Certification by a qualified testing laboratory that a water softener meets the requirements of NSF Standard 44 or equal shall be sufficient evidence of compliance with this sub-section. Brine tanks, brine tank components, and connecting tubing are specifically exempted from the requirements of NSF Standard 44.
3. All non-metallic interior coatings or linings shall meet the requirements for plastic materials in NSF Standard 44. All non-metallic components shall be constructed for a working temperature of at least 100° F. Unless exposed non-metallic components are capable of resisting, or are formulated to resist, deterioration due to sunlight, the manufacturer shall warn the installer and user against exposed installations with a label or tag attached to the unit.

B. TANKS

1. Tanks may be constructed of mild steels when the interior is protected by a lining or coating such as hot dip galvanizing, ceramic or rubber lining. Unprotected mild steels may be used for the larger commercial softeners where interior protection may not be practical. Minimum wall thickness will be determined to meet the performance specifications of Section III.D. of this Standard.
2. Galvanized tanks shall contain not less than 1.5 ounces of zinc per square foot. If the internal coating or protective mechanism is not suitable for protecting the exterior of the tank, a suitable external protective means such as hot dip galvanizing, porcelain enamel, or organic finish shall be used.

3. Tanks, other than mild steel, shall be suitably corrosion resistant as to types of material and/or protective mechanism. Suitable types of materials include corrosion resistant, or non-corrosive materials such as high nickel alloys, stainless steel, and plastic.
4. Brine or other accessory tanks shall be of durable construction and shall be provided with adequate covers. Covers shall be capable of gripping in place to provide protection against outside contaminants.

C. VALVES, PIPING, SCREENS & ELECTRICAL COMPONENTS

1. Valves, piping, distributors and collectors shall be constructed of suitable corrosion-resistant materials, and dissimilar metals shall be insulated or shielded in accordance with good engineering practice.
2. Electrical and/or hydraulic operating controls shall be of sturdy construction with durable valves and timing mechanisms. They shall be designed to prevent admittance of salt water into the water system when the manufacturer's instructions are followed.
   a. All electrical components shall be "approved" as defined in the 1968 National Electrical Code (published by the National Fire Protection Association).
   b. Electrical control devices which use Class I Systems, as defined in the National Electrical Code, shall be capable of withstanding the standard dielectric strength test of 1,000 volts plus twice the maximum rated voltage for a period of one minute.
   c. Flexible cords used to supply electrical power to Class I clocks and/or control valves shall be of adequate size for the load but in no case smaller than AWG size 18 wire, shall incorporate a conductor for grounding purposes, and shall use an acceptable strain relief fitting at the case to prevent pull or strain on terminals or joints. The strain relief shall meet a test pull of 20 pounds.

D. WORKING PRESSURES AND HYDROSTATIC TESTS

1. **Household and Portable Exchange Water Softeners.** All components subject to line pressure shall be constructed for a working pressure of at least 125 psig and the following hydrostatic requirements when tested in accordance with Section VI:
   a. Complete softener assemblies shall be watertight throughout a hydrostatic test pressure of 2.4 times the working pressure (300 psi minimum) for a period of 15 minutes.
   b. Metallic pressure tanks shall be watertight throughout a hydrostatic test pressure of 2.4 times the working pressure (300 psi minimum) for a period of 15 minutes without excessive permanent distortion, defined as an increase in tank circumference more than 0.2 percent of the original circumference, or top or bottom head deflection more than 0.5 percent of the tank diameter.
   c. Non-metallic pressure tanks shall have a burst pressure of at least 4 times the working pressure (500 psi minimum), and shall be watertight at 150 psi after a minimum of 100,000 pressure cycles of 0 to 150 psi.

      Approval of a non-metallic tank under this or an equal specification by a recognized testing agency shall be considered to be acceptable evidence of compliance with this section. Such approval shall be by a recognized approval seal or by letter of certification from a recognized testing agency.
   d. Valves, both control and brine valves subject to line pressure, shall be watertight at 150 psi after a minimum of 100,000 pressure cycles of 0 to 150 psi.

2. **Commercial Water Softeners.** All components subject to line pressure shall be constructed for a working pressure of at least 100 psig and the following hydrostatic requirements when tested in accordance with Section VI:
   a. Complete softener assemblies shall be watertight throughout a hydrostatic test pressure of 1.5 times the working pressure (150 psi minimum) for a period of 15 minutes.
   b. Metallic pressure tanks shall be watertight throughout a hydrostatic test pressure of 1.5 times the working pressure (150 psi minimum) for a period of 15 minutes without excessive permanent distortion, defined as an increase in tank circumference more than 0.2 percent of the original circumference, or top or bottom head deflection more than 0.5 percent of the tank diameter.
   c. Non-metallic pressure tanks shall have a burst pressure of at least 4 times the working pressure (400 psi minimum).

E. **ION EXCHANGERS**
1. Ion exchanger materials shall be free from objectionable color throw, taste, odor, and shall not impart toxic substances to the water.
2. Ion exchange resins shall meet the requirements contained in the Food Additives Amendment to the Food, Drug, and Cosmetic Act, Subpart D, Section 121.1148 as amended February, 1968 (33 F.R.2845).

IV. INSTRUCTION AND INFORMATION REQUIREMENTS

A. INSTALLATION INSTRUCTIONS. The equipment manufacturer shall provide adequate installation instructions, including arrangement of plumbing connections, electrical wiring where applicable, disinfection procedures and other requirements of this Standard, with details relating to the specific softener model.

B. OPERATING PRESSURE. The manufacturer may specify the maximum pressure at which a permanently installed softener may be operated. He may also require the use of a pressure reducing valve ahead of the softener to prevent operation at pressure in excess of his recommendations, but shall warn installers of the flow reducing effects of such pressure reducing valves.

C. INFORMATION AND LABELING REQUIREMENTS
1. The manufacturer of household and commercial water softeners shall furnish the following data with the softener for the user:
   a. Softening capacity rating(s). At least one rating shall be stated for a softener with a fixed salt level, and three ratings or a capacity vs. salt curve for a softener with adjustable salt level.
   b. The type, grade and amount of salt in pounds required to obtain the softening capacity rating(s) with each regeneration. At least one alternate type and/or grade of salt, described in generic terms, shall be given.
   c. Service flow rating(s) in gpm.
   d. Pressure drop in psi at service flow rating(s).*

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*Pressure drop data as required in this section may be expressed in the following manner: "The pressure drop does not exceed 15.0 psi at the service flow rate of _____ U.S. gpm."

e. Maximum flow rate to drain during regeneration cycle. (For drain line sizing.)
f. Detailed operation, regeneration and maintenance instructions.
g. Type of conditioning material used, and quantity in cubic feet.
h. Maximum working and/or operating pressure, in psig.
i. Maximum operating temperature in degrees Fahrenheit (F°).

2. Each household or commercial water softener shall bear a permanent label or labels showing the manufacturer's name and address, the model number, serial number if assigned, the service flow rating(s), the pressure drop in psi at the service flow rating(s),* the recommended type and/or grade of salt, and the name or mark of the approved validating agency.

3. The manufacturer of portable exchange water softeners shall furnish the following data with the softener for the user:
   a. Service flow rating in gpm.
   b. Pressure drop in psi at service flow rating.*
   c. Maximum working and/or operating pressure in psig.
   d. Maximum operating temperature in degrees Fahrenheit (F°).
   e. The name or mark of the approved validating agency.

D. INFORMATION AND LABELING REQUIREMENTS FOR DEMAND INITIATED REGENERATION (D.I.R.) WATER SOFTENERS

The manufacturer of household D.I.R. water softeners shall affix a permanent label to each validated unit specifying the following:

1. Manufacturer's name and address.
2. Model number.
3. Serial number.
4. Salt efficiency reported in grains exchange per pound of salt at a specified salt setting when influent test water has 15 grains per gallon (as $CaCO_3$) hardness.
5. Service flow rate, gpm.
6. Pressure drop in psi at service flow rate.

V. MANUFACTURER'S SALES LITERATURE AND SPECIFICATIONS

1. Published capacity ratings.
   a. Sales literature and specifications shall show only validated capacity ratings, as defined in this Standard.
   b. All published capacity ratings shall be related to the validated pounds of salt required for each regeneration.
2. Published service flow rates and pressure drops.
   a. Sales literature and specifications shall show only validated service flow ratings, as defined in this Standard.
   b. All published service flow ratings shall be related to the validated pressure drops at those flow ratings.

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*Pressure drop data as required in this section may be expressed in the following manner: "The pressure drop does not exceed 15.0 psi at the service flow rate of _____ U.S. gpm."

VI. VALIDATION OF PERFORMANCE RATINGS

A. HOUSEHOLD WATER SOFTENERS

1. Validation by Test; Standard Minimum Series. The following measurements and performance ratings shall be verified by actual tests by the Water Quality Association or other approved testing agency on at least one size of each model:
   a. Rated capacity at three approximately equally spaced salt levels. The results of these tests shall be graphed to establish ratings at intermediate levels, but the curves shall not be extrapolated beyond the test limits.
   b. Salt delivered by the brine system, at one of the salt levels as specified by the manufacturer.
   c. Peak Service Flow.
   d. Pressure Drop Curves.
   e. Hydrostatic Test.
   f. Thickness of galvanizing or other coating, where applicable.
   g. Dielectric strength, where applicable.
   h. Ion exchanger, where applicable.
   i. 0 to 150 psig cycle tests, where applicable.
2. Validation by Calculation may be used to extend test results to other sizes of the same model. Any unit submitted for Validation by Calculation must have a resin volume of 0.5 cubic feet or more. Water softeners may be considered the same model when they are identical in valving, internal design and construction, types of ion exchanger, and operation, and vary only in amount of ion exchanger and tank size, provided:
   a. The same type of salt is used.
   b. The softener tank cross section area is not more than 200% or less than 50% of the tested softener tank.
   c. The ion exchanger bed depth is not less than 75% of the bed depth of the tested softener.
   d. The Service Flow Rate in gpm per square foot of bed cross section area is not more than 120% of the Service Flow Rate of the tested softener.
   e. The backwash flow rate in gpm per square foot of bed cross section area is not less than 80% of the flow rate of the tested softener.
   f. The rinse flow in gpm per square foot of bed cross section area is not more than 120% of the tested softener.
   g. The capacity per cubic foot of ion exchanger at the same salt level per cubic foot is not increased.
   h. The salt level in pounds of salt per Kilograin of capacity is not decreased.
   i. Allowable capacity variation is not more than $\pm$12% when compared to actual laboratory test data.
3. Validation by Calculation procedures: The specifications of the softener to be Validated by Calculation shall be checked for conformance with the tolerances of Section 2, above, and capacity and pressure drop ratings determined.
   a. Calculate the three capacity ratings at the same salt levels per cubic foot of ion exchanger used for the tested softener by applying the following equation at each salt level:

$$\frac{Vc}{Vb} \quad X \quad Cb = Cc \qquad \text{in which}$$

Vc is the volume of ion exchanger in the calculated softener, Vb is the volume of ion exchanger in the tested softener, Cb is the capacity of the tested softener at the same salt level, Cc is the capacity of the calculated softener. The results of these calculations shall be graphed to established ratings at intermediate levels, but the curve shall not be extrapolated.

b. Determine the pressure drop of the calculated softener by first plotting the corrected ion exchanger pressure drops of the tested softener against flow rates in gpm per square foot on log-log graph paper. Express the increments of flow rate of the calculated softener in gpm per square foot and read the corresponding pressure drops from the graph. Correct these pressure drop values for variation in bed depth by applying the following equation:

$$Pe = Pg \times \frac{Bc}{Bb} \quad \text{in which}$$

Pe is the pressure drop through the ion exchanger of the calculated softener,
Pg is the pressure drop from the graph,
Bc is the bed depth of the calculated softener, and
Bb is the bed depth of the basic tested softener.

Then $Pe + Pt = Pc$ in which

Pt is the pressure drop of the empty tested softener, and Pc is the pressure drop of the filled calculated softener. Plot the calculated pressure drop values against each increment of flow rate in gpm on log-log graph paper, and determine the pressure drop at the Service Flow Rate.

c. Hydrostatic and cycling tests may be required at the discretion of the Water Quality Association.

B. COMMERCIAL WATER SOFTENERS

1. Validation by Test; Standard Minimum Series. It is considered impractical to ship complete commercial water softeners to a central laboratory for verification of performance ratings by complete tests. Therefore the following inspections may be made, and performance ratings verified by tests witnessed by the Water Quality Association, or other approved testing agency, on at least one size of each model at the plant of the equipment manufacturer:

- **a.** Pressure drop curve on empty softener.
- **b.** Regeneration flow rates.
- **c.** Hydrostatic test.
- **d.** Thickness of galvanizing or other coating, where applicable.
- **e.** Dielectric strength, where applicable.
- **f.** Ion exchangers, where applicable.
- **g.** 0 to 150 psig cycle tests, where applicable.
- **h.** Calculation of capacity, pressure drop and service flow ratings, based on reliable data from the supplier of the ion exchanger or other source acceptable to the Water Quality Association.

2. Validation by Calculation may be used to extend test results and calculated ratings from Section B.1 above to other sizes of the same model, using the applicable restrictions and procedures of Sections A.2 and A.3 above.

C. PORTABLE EXCHANGE WATER SOFTENERS

1. Validation by Test; Standard Minimum Series. The following performance ratings shall be verified by actual tests by the Water Quality Association or other approved testing agency on at least one size of each model, using new or conditioned softeners as indicated:
   a. Pressure drop curves. One on empty new tank, three on filled conditioned softeners.
   b. Hydrostatic test on one new empty tank. This may be the same tank used for the empty pressure drop curve.
   c. Thickness of galvanizing or other coating, where applicable. This may be the same tank used for the empty pressure drop curve.
   d. Ion exchanger tests, where applicable.
   e. 0 to 150 psi cycle tests, where applicable, on a new empty tank. This should not be the same tank used for the hydrostatic test.
2. Validation by Calculation may be used to extend test results to other sizes of the same model. Portable exchange water softeners may be considered the same model when they are identical in connectors, internal design and construction, and type of ion exchanger, and vary only in amount of ion exchanger and tank size, provided:
   a. The softener cross section area is not more than 200% or less than 50% of the tested softener tank.
   b. The ion exchanger bed depth is not less than 75% of the bed depth of the tested softener.
   c. The peak service flow rate in gpm per square foot of bed cross section area is not more than 120% of the peak service flow rate of the tested softener.
   d. The capacity per cubic foot of ion exchanger is not increased.
3. Validation by Calculation may be used to extend test results to other sizes of the same model, using the applicable restrictions and procedures of Section A above.

D. ORDER OF TESTS

1. Where all tests are to be run on one softener, the order of tests shall be as follows:
   a. Pressure drop curve of softener without ion exchanger, but with supporting bed, where used.
   b. Ion exchanger tests, where applicable.
   c. Capacity tests.
   d. Service flow rating(s).
   e. Pressure drop curve of softener with ion exchanger.
   f. Hydrostatic test.
   g. Brine system tests.
   h. Measurement of thickness of galvanizing or coatings, where applicable.
   i. Dielectric strength test, where applicable.
   j. 0 to 150 psig cycle tests, where applicable.
2. Where total elapsed time or other factors must be considered, duplicate components or assemblies may be used to permit concurrent tests, as follows:
   a. Extra ion exchanger may be tested concurrently with any of the above tests.
   b. An extra brine valve, where the float type is provided, may be used to test brine measurement concurrently with any of the above tests.
   c. An extra softener, complete except for ion exchanger, or individual plastic components as required, may be used for concurrent 0 to 150 psig cycle tests.

d. Thickness of galvanizing or coatings and the dielectric strength test may be concurrent with any of the above tests, provided the necessary components or assemblies are made available.

E. PRESSURE DROP

1. Apparatus.

a. Manometer. Mercury Manometer, Merriam Model 20AA25WM, or equal. A 70" manometer will permit the measurement of up to approximately 30 psi differential pressure. Permanently mount the manometer in a plumb position.

Traps should be installed in the pressure lines to the manometer, to prevent water from reaching the mercury columns, and to catch the mercury if it is inadvertently blown from the manometer. The traps may be conveniently constructed from 2" pipe, approximately 24" long. Holes may be drilled and tapped in the caps and side walls for the drain and shutoff cocks and pressure lines to the mercury columns. Refer to schematic Figure A.

Connecting tubing may be 1/4" O.D. copper tubing, or of plastic tubing, with appropriate fittings.

Redistilled mercury, suitable for instrument use, must be used.

b. Pressure tap assemblies. Pressure taps shall be installed in pipe nipples of the proper diameter to be directly connected to the inlet and outlet ports of the unit under test, without the use of reducers or bushings. Couplings are permitted in the case of male inlet or outlet threads.

The outlet nipple shall be of sufficient length to permit installation in the test unit without interference with the inlet nipple, when inlet and outlet ports are on minimum centers.

The pressure taps shall be located not less than three times the nominal inside diameter (3 X D) of the pipe nipple from either end of the nipple. See schematic Figure C.

The pressure taps shall be by use of fittings or adaptors fastened to the pipe in such a way that the fittings does not extend beyond the inner wall of pipe. See schematic Figure B.

The size of the pressure tap hole through the pipe wall shall not exceed the dimensions given below:

Nominal Inside Pipe Diameter d"	Maximum Pressure Hole Diameter d"
less than 1-1/2"	1/8"
1-1/2" or more	1/4"

The length of the pressure hole measured from the inner surface of the pipe shall be not less than three times the diameter of the pressure hole (3 X d). See schematic Figure B.

There shall be no burrs, wire edges, or other irregularities on the inside of the pipe at the pressure connections or along the edge of the hole through the pipe wall.

c. Flow meter. Shall be a direct reading flow meter of the type manufactured by Fischer & Porter and Brooks Rotameter Company,

with an accuracy of plus or minus 2% of full flow, or equal. An orifice plate flow meter of equal accuracy may be used if desired. A range of 2 to 20 gpm will cover tests for household and portable exchange softeners, but tests on commercial softeners will require higher capacities.

Install the flow meter in a permanent plumb position in accordance with the instructions of the manufacturer. Avoid the excessive use of reducers and bushings.

d. Pressure gauge. Install a pressure gauge in the outlet of the flow meter. The pressure of the test water line must be at least 30 psi at full test flow.

e. Thermometer. A Fahrenheit thermometer suitable for installation in the water line is recommended. Alternately, a glass portable thermometer may be used to check the temperature of the test water. Graduations shall not be more than 2° F. apart.

f. Connecting hoses. Connecting hoses may be used for the water supply to the test unit, and for the outlet line to the drain. The hose should have an I.D. of at least 1", and in no case should be smaller than the softener inlet and outlet.

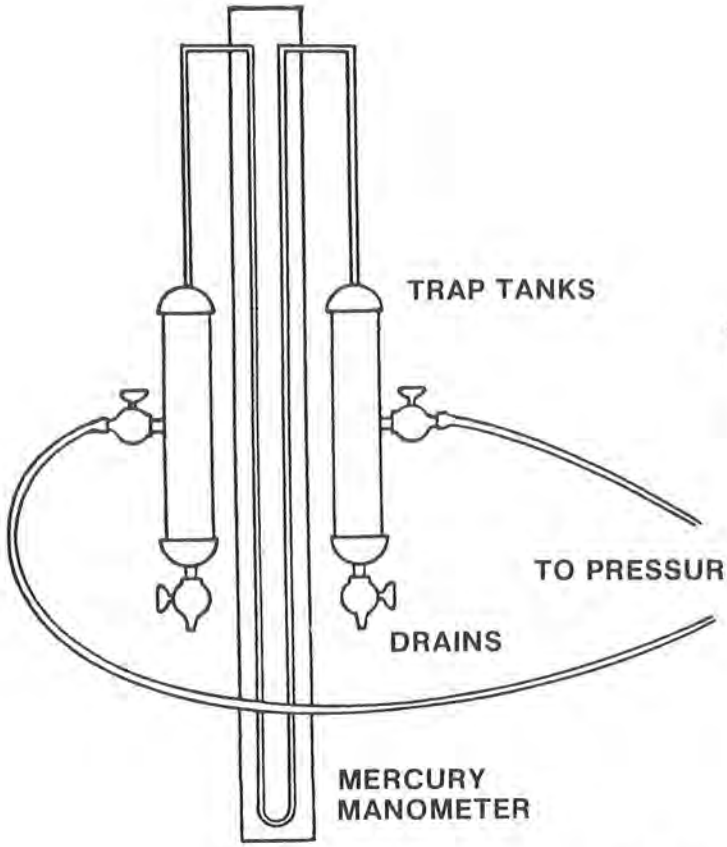


Fig. A

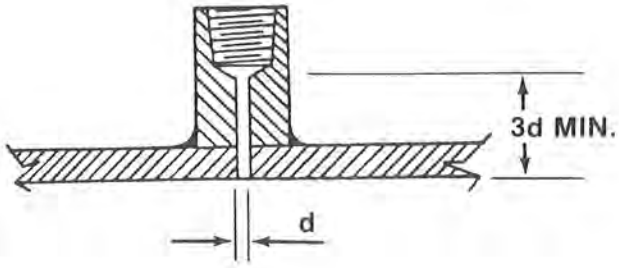


Fig. B

NOTE: EDGE OF HOLE MUST BE CLEAN AND SHARP OR SLIGHTLY ROUNDED. FREE FROM BURPS, WIRE EDGES OR OTHER IRREGULARITIES.

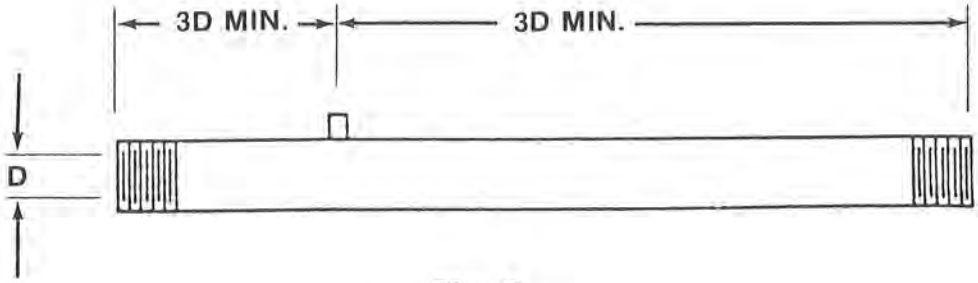


Fig. C

g. General assembly of apparatus. The specific components listed above plus necessary incidental fittings shall be assembled in the following sequence:

Inlet water line	Inlet pressure tap assembly
Inlet valve	Unit under test
Thermometer	Outlet pressure tap assembly
Flow meter	Throttling valve
Pressure gauge	Hose to drain
Connecting hose	

Install the connecting tubing between the manometer traps and the pressure taps.

(**NOTE:** At no time shall brass or copper be used where it may be in contact with the mercury, as amalgamation may result.)

2. Test procedure.
   a. With the test unit installed as in 1.g., close the manometer drain and shutoff cocks. Open the throttling valve and slowly open the inlet valve to fill the test unit with water. Flush the system thoroughly to eliminate air pockets. Close the outlet valve.
   b. If the test unit is a water softener containing ion exchange material, regenerate the unit in place. Avoid jarring or other disturbance. Then place the softener valving in the service position.
   c. Open the manometer shutoff cocks simultaneously to apply pressure to both legs of the manometer. Allow the two manometer mercury columns to reach equilibrium.
   d. Adjust the position of the manometer scale to bring both the mercury columns to the zero position, if possible. If not possible, record the initial column readings at zero flow.
   e. With the throttling valve, adjust the flow through the test unit in increments of approximately 2 gpm for household softener tests. Other increments may be used if desirable for special investigations or other types of units. A minimum of four readings is necessary, and five or more is recommended. Record the mercury levels of both columns to the closest 0.1 inch, at each increment of flow.
   f. Readings shall be continued until the rated service flow is exceeded by at least 2 gpm. Readings may be further continued until the maximum of the flow meter has been reached, or the mercury in the manometer has reached an unsafe level.
   g. At the conclusion of the test, slowly close the inlet valve. When the pressure in the system has dropped to zero, open the manometer trap drain cocks and disconnect the test unit.
3. Calculation of results.
   a. Add the mercury level readings of the left and right columns to determine the total mercury differential at each flow rate. Subtract the sum of the initial mercury readings at zero flow from each total.
   b. Multiply each total mercury differential by 0.489 to convert from inches of mercury to pounds per square inch.
   c. As the viscosity of water affects the pressure drop through a bed of ion exchanger, and the viscosity changes with water temperature, it is necessary to make a correction of the observed pressure drop of a softener containing the ion exchanger.

To express the pressure drop at the standard temperature of 60° F., apply the following equation to the observed differential in psi at each increment of flow:

$$Pb = Pt + F\ (Pf - Pt)$$ in which

Pb is the pressure drop of the tested softener, corrected to 60° F.,
Pt is the pressure drop of the empty softener at the same flow rate,
Pf is the observed pressure drop at the softener containing the ion exchanger at the same flow rate, and
F is the correction factor from the following table.

Test Water Temperature F°	Correction Factor	Test Water Temperature F°	Correction Factor
46	0.81	66	1.09
47	0.82	67	1.10
48	0.83	68	1.12
49	0.85	69	1.13
50	0.86	70	1.15
51	0.87	71	1.16
52	0.89	72	1.18
53	0.90	73	1.19
54	0.91	74	1.21
55	0.93	75	1.22
56	0.94	76	1.24
57	0.96	77	1.26
58	0.97	78	1.27
59	0.99	79	1.29
60	1.00	80	1.31
61	1.01	81	1.32
62	1.03	82	1.34
63	1.04	83	1.35
64	1.06	84	1.37
65	1.07	85	1.38

F. ION EXCHANGE RESIN TESTS

Where required, these tests shall be conducted on unused resin in accordance with the procedures given in the current Food Additives Amendment to the Food, Drug and Cosmetic Act, Subpart D, Section 121.1148. A copy of this Section, current at the time of printing, is given in Appendix III.

G. RATED CAPACITY TEST METHOD

1. Test apparatus and arrangement. See Figure D.
   - **a.** Softener shall be connected to the water supply in accordance with manufacturer's standard installation instructions.
   - **b.** A water flow meter shall be placed in the inlet line to the softener to measure flow rate in gallons per minute.
   - **c.** A totalizing type water meter shall be placed in the outlet line from the water softener to measure volume of water softened.

d. A pressure regulator and a suitable pressure gauge shall be placed in the inlet line to the water softener for controlling water pressure.

e. A sampling cock or equivalent device shall be provided in the inlet line for sampling the hard water.

f. A valve shall be provided in the outlet line for controlling the service flow rate.

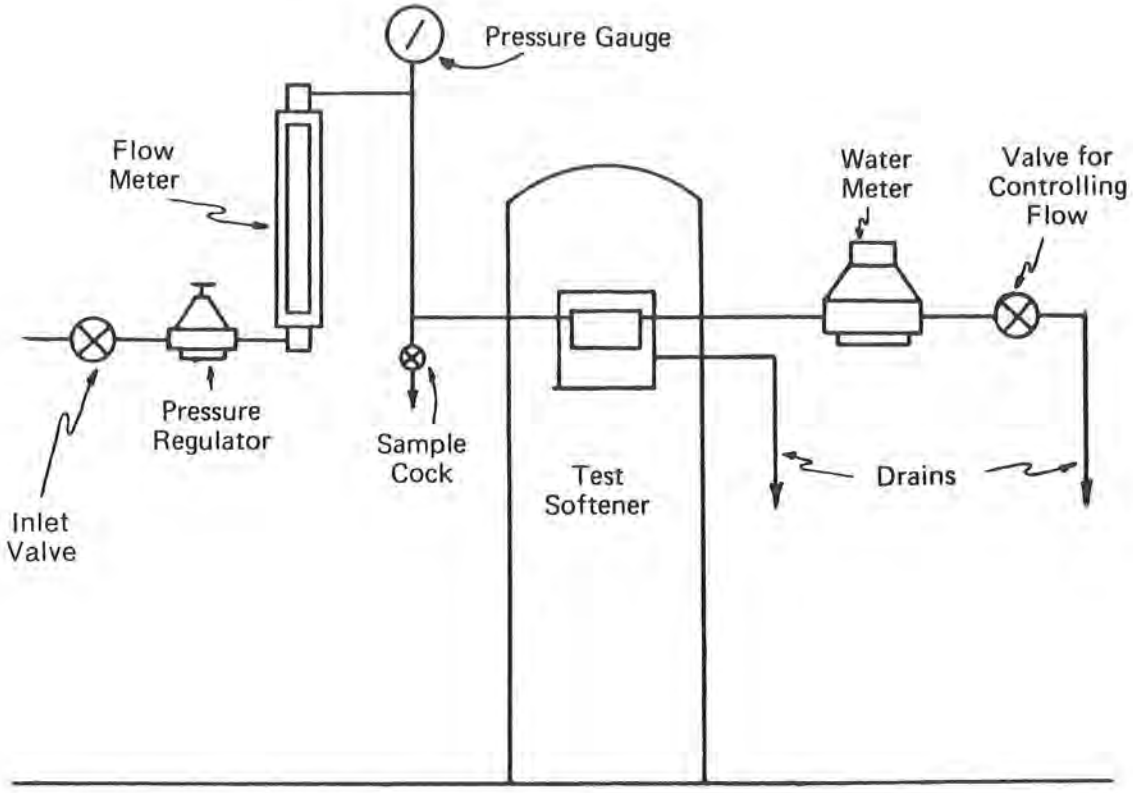


Fig. D

2. Test water. Water used for test runs shall have a hardness (as calcium carbonate) of between 15 and 20 gpg, not more than 5.0 gpg sodium salts (as calcium carbonate) not more than 0.1 mg/l total iron, pH in the rang of 6.9 to 9.5, water temperature shall be between 55° F. and 75° F., and water pressure shall be in the range of 30 to 40 psig.

(Softeners designated for operation in waters of lower hardness may be tested using such waters.)

If unavailable in natural form, it shall be prepared to this specification in the ratio 2/3 calcium and 1/3 magnesium. To increase the calcium hardness 2/3 grain per gallon, add 63.5 grams of $CaCl_2.2H_2O$ per 1000 gallons of

water. To increase the magnesium hardness by 1/3 grain per gallon, add 53.2 grams of $MgSO_4.7H_2O$ per 1000 gallons of water.

To determine the hardness of the influent water, a constant percentage of influent water shall be collected during the test run and the composite sample tested for hardness by accepted water hardness test methods. The procedure for hardness testing described in "Standard Methods for the Examination of Water and Wastewater" current edition, is recommended.

3. Test procedure.
   a. Set water pressure regulator to maintain a pressure at from 30 to 40 psi during the test.
   b. Establish the salt dosage and regenerate the softener in accordance with the manufacturer's instructions, with the exceptions noted in Section 4.
   c. Record initial water meter reading.
   d. Establish softener service flow rate at 50% of manufacturer's rated service flow.
   e. Softening capacity runs shall be at constant rate of flow.
   f. Determine completion of rinse by making an initial effluent soft water quality test to establish that water has less than 1 grain per gallon hardness (as calcium carbonate). This should be based on testing a sample of the fourth gallon of soft water produced for each cubic foot of ion exchange mineral in the water.
   g. Collect and test the hardness of the effluent from the softener at such intervals as required to accurately determine the capacity. With softener valves in softening position, water delivered at outlet shall be tested by accepted water hardness test methods with 1 grain per gallon hardness as the determining end point.
4. Brine systems for capacity tests.
   a. Salt in head softeners--Accurately weigh out the specified amount of the type of salt recommended by the manufacturer, and add to the softener according to the manufacturer's instructions.
   b. Open brine tank softeners--Install the brine valve supplied with the softener in a suitable open container. Connect the brine line to the softener as in a normal installation. Add saturated brine (prepared separately) to the open container until the point of minimum draw is reached. For each regeneration, measure the proper volume of saturated brine into the open container. (Note: 1 gallon of saturated brine contains 2.647 pounds of salt).

      During the regeneration, the saturated brine will be educted into the softener. If a float type brine valve is used, the float should be lifted manually when the education of brine is complete, to prevent the return of fresh water into the container. The valve may be conveniently held in its raised position by the use of an elastic band attached to the float rod. The band must be removed prior to the subsequent regeneration.

      If the softener uses a timed refill without a float, it is necessary to mark the position of the brine tube carefully, and to remove the assembly from the container to prevent the return of fresh water into the vessel. (Note: The volume of fresh water dispensed may be used to determine the accuracy of brine measurement. Refer to section on brine system tests.)
   c. Pressure brine tanks--In the place of the brine tank supplied with the softener, use the following apparatus, unless a positive determination of the salt level can be made:

Assemble a tank as shown in Figure E.

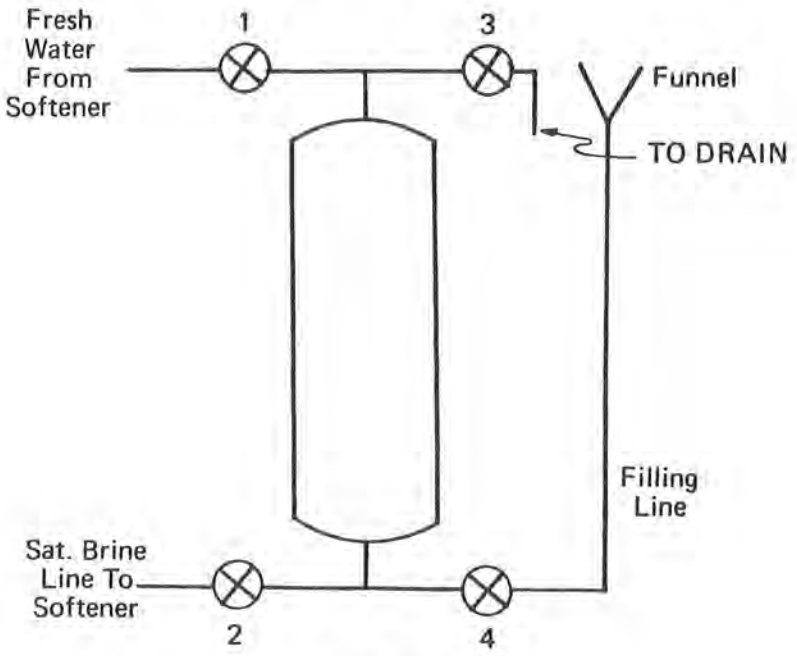


Fig. E

Connect the fresh water and brine lines to the softener under test as indicated. Fill the tank with water through the funnel and flush it thoroughly to remove air. With valves 1 and 2 closed and valves 3 and 4 open, carefully and slowly add the proper amount of saturated brine to the funnel. (Note: 1 gallon of saturated brine contains 2.647 pounds of salt.) When displacement of the fresh water has stopped, close valves 3 and 4 and open valves 1 and 2. Proceed with the regeneration.

Repeat the above procedure for each regeneration. (Note: The first cycle may produce less than the desired volume of brine.)

5. Test records and calculations.

- **a.** Record hardness of influent composite water sample.
- **b.** Record amount of salt in pounds for each regeneration.
- **c.** Record the initial hardness of effluent to determine completion of rinse.
- **d.** Record the hardness of the effluent at such intervals as required to accurately determine the breakthrough of hardness.
- **e.** Determine the end point of the softening run as described in the accepted water hardness test procedure at 1 grain per gallon of hardness in the effluent.
- **f.** Record total gallons of soft water produced.
- **g.** Softener capacity rating in grains of hardness removed shall be the gallons of acceptable soft water produced at rated flow, multiplied by the average hardness of the raw water as determined by a composite percentage sample required under Paragraph G.2., test water.
- **h.** At least five complete softening capacity runs shall be made on each model. Data for the first two runs shall be discarded. Rated capacity shall be based on the average of three successive runs which do not show a variation of 10% from the average.

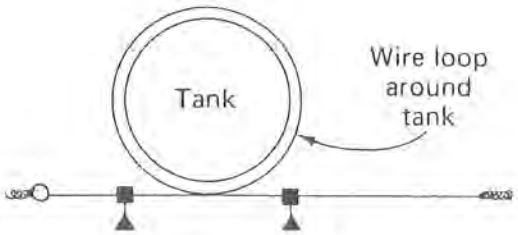
H. RATED SERVICE FLOW

1. Test apparatus and arrangement shall be the same as specified for capacity tests in Section VI.G.1.
2. The test water shall be the same as specified in Section VI.G.2., test procedure.
   a. Regenerate the softener according to the manufacturer's instructions.
   b. Establish the rated service flow through the softener.
   c. Collect a sample of the effluent each minute for a period of ten minutes.
   d. Determine and record the hardness of each sample.
   e. No sample shall have a total hardness greater than 1.0 gpg as $CaCO_3$.

I. HYDROSTATIC TESTS

1. Test apparatus and arrangement.
   a. Hand pump, complete with check valves, capable of producing 300 psig pressure.
   b. Bourdon tube pressure gauge, graduated in increments of not more than 5 psi, with ±2% accuracy.
   c. Micrometer caliper accurate to .001 inch; a range of 0 to 10 inches is recommended.
   d. Extensometers, accurate to .001 inch.
   e. Strong but flexible wire, such as stranded picture wire, with metal blocks which can be fixed in position on the wire. Round bar stock approximately 1 inch long, with a longitudinal hole for the wire, and a transverse threaded hole with a set screw, is suitable for this purpose. One length of wire with two blocks will be required for each foot or fraction of a foot of tank sidewall height.
   f. Shutoff valves and plugs.
   g. Connect the water supply to the inlet of the pump, and install the pressure gauge in the outlet of the pump.
2. Test procedure for non-metallic tank softeners.
   a. Close the outlet of the softener with a suitable valve, and connect the softener to the outlet of the pump.
   b. Fill the system and test unit with water in the temperature range of 55 to 75° F., and flush to avoid pockets of air.
   c. Close the outlet valve, and gradually raise the hydrostatic pressure until 300 psig, or the rated test pressure of the unit if higher than that value, is reached.
   d. Maintain the test pressure for 15 minutes, with periodic inspections of the softener for leaks. Any leakage of water from the softener constitutes a failure.
   e. Slowly open the outlet valve, with the water supply shut off, to bleed the pressure from the softener and system. Disconnect the softener.
3. Test procedure for metallic tank softeners.
   a. Install the test softener on the elevated rack or stand, and position the extensometers vertically against the tank bottom head, and the top of the softener tank, top-mounted valve, or other solidly mounted upper component.
   b. Slide two of the movable blocks onto a length of flexible wire, and fasten one end of the wire to a solid post adjacent to the softener approximately 6 inches above the base of the softener tank. Loop the wire around the softener and fasten the free end to a spring, or through a pulley to a suspended weight. Adjust the wire so that it makes the smallest possible loop around the tank and is in the same horizontal plane as the fastenings on both ends. Slide the movable blocks into

position adjacent to the softener and tighten the set screws. A 6" to 8" space between the blocks is suitable for most household softener tanks.



c. Repeat step b. with additional wires and blocks at not more than 12" intervals up the side sheet of the tank.
d. Proceed with steps 2.a. and 2.b. as with non-metallic tanks.
e. With no pressure on the softener, take initial readings from the extensometers, and measure the distances between the movable blocks on each wire, using the micrometer caliper.
f. Proceed with steps 2.c. and 2.d. as with non-metallic tanks.
g. Close the inlet valve and slowly open the outlet valve to bleed the pressure from the softener. Repeat the readings of the extensometers and the distances between the movable blocks on the wires. (Note: A decrease in the distance between blocks indicates an increase in tank circumference.)

J. SALT DELIVERED BY BRINE SYSTEM

1. Test apparatus.
   a. Salometer with concentration charts and temperature correction data.
   b. Thermometer, glass, calibrated in Fahrenheit degrees.
   c. Aspirator or educator connected to water line.
   d. Closed vessel to collect brine under vacuum. A 5 gallon glass bottle, or a non-metallic softener tank may be adapted for this purpose, for household softeners.
   e. Graduated cylinder, calibrated in .01 gallons, or in ml. A 4000 ml plastic graduated cylinder is convenient for this purpose. (3785 ml equal 1 gallon)
2. Test procedure for open brine tanks with float type valves.
   a. Install the brine valve in the brine tank according to the manufacturer's instructions, and fill the brine tank with the salt specified. Use adaptors as necessary to connect the brine line to a water line, and fill the tank until the float valve stops flow.
   b. After a minimum of 16 hours, disconnect the brine line from the water supply, and connect it to the intake of the brine collector. Apply a vacuum to the collector to draw the brine into the vessel. Continue the vacuum until the float valve stops further brine draw.
   c. Disconnect the vacuum line and drain the collector. Measure the volume of brine, its temperature and salometer reading. Make the necessary temperature corrections and calculate the pounds of salt dissolved and drawn from the brine tank in the cycle.
   d. Repeat the above cycle no more frequently than once per day. A minimum of five cycles is necessary, with an average of the last three used to calculate the rating. If any of the last three cycles vary more than 10% from the average, the cycles shall be continued until stability, or the lack of stability, is established.

3. Test procedure for open brine tanks with time-flow refills.
   a. The fresh water dispensed from the softener following the normal brine draw may be used to calculate the salt which would be dissolved. This fresh water may be collected and measured by removing the brine tube, from the vessel used for brine during the capacity tests, or as a separate test after the capacity tests have been completed.
   b. One gallon of fresh water will dissolve 2.9865 pounds of salt in the formation of saturated brine, and this factor shall be used to calculate the measuring accuracy of the system.
4. Test procedure for pressure brine tank systems.
   a. The technique used to check pressure brine tank systems will vary, depending upon the specific design. In any case, every effort must be made to determine the amount of salt brine produced for each regeneration cycle. The technique used must be specified in the report.

K. THICKNESS OF GALVANIZING OR COATINGS

1. A variety of instruments may be used for non-destructive tests to determine the thickness of galvanizing or other non-magnetic coating. The standardization and test procedures provided with each instrument shall be used for the tests.

L. DIELECTRIC STRENGTH TEST

1. Application. This test shall be applied to electrical control and operating devices, including but not limited to electrical timers, solenoid valves, motor driven valves, and associated wiring and connections, to check the safety of the assembled electrical system as used on the softener.
2. Apparatus.
   a. Hi-Pot tester, of the type available from Associated Research, Inc., and Ideal Industries, Inc.
   b. Insulating stand, platform or blocks of wood or other material which will completely insulate the softener from the ground.
3. Procedure.
   a. Place the complete softener on the stand, platform or blocks, so that it will be completely insulated from ground, including the floor and electrical or plumbing connections.
   b. Connect the leads of the tester to appropriate terminals or components as indicated below, turn on tester, increase the applied potential gradually from zero to the required test value of 1000 volts plus twice the maximum rated voltage of the equipment, and hold the voltage at that point for one minute. Any indication of leakage (of more than 0.5 milliampere), breakdown, arcing or corona, by the tester shall constitute a failure.
   c. A complete test shall include individual tests:
      c1. Between uninsulated live metal parts and the enclosure with the contacts open and closed.
      c2. Between uninsulated live metal parts of different circuits.
      c3. Between the live circuit and ground, and
      c4. Between terminals of opposite polarity with the contacts closed. For this last test, transformers, coils or similar devices normally connected between lines of opposite polarity are to be disconnected from one side of the line during the test.

M. 0 to 150 PSIG CYCLE TEST

1. Application. This test shall be applied to complete softener assemblies or to individual components as necessary to demonstrate compliance with the

cycle test requirements for non-metallic components subject to line pressure.

2. Apparatus. Assemble the following components as shown in Figures F and G.
   a. Open sump equipped with a low level alarm and switch to open the electrical circuit in the event of failure of the test unit.
   b. Positive displacement or centrifugal pump capable of maintaining 150 psig in pressure system during the test.
   c. Pressure relief valve for operation in 150 psig range.
   d. Solenoid valves for operation at 150 psig.
   e. Pressure gauges for operation at 150 psig, with ±2% accuracy.
   f. Air cushion tank or column.
   g. Electrical impulse counter with capacity of at least 100,000 cycles.
   h. Continuous cycling adjustable cam timer with 1 revolution every 5 seconds.
   i. Bleeder valves for adjustment of pressure increase rate.
3. Procedure.
   a. Fill the test unit with tap water at room temperature and connect to the test apparatus as shown in Figure G.
   b. Fill the sump with tap water at room temperature and operate the system at low pressure to bleed air from the test unit.
   c. Set the counter at zero, or record initial reading. Adjust the cam cycle timer, pressure relief valve and bleed valves to produce a pressure cycle from 0 to 150 psig in 1.5 seconds, maximum pressure for just an instant, and an immediate release of pressure. The pressure in the test unit shall return to zero psig before the initiation of another cycle.
   d. Continue the 0 to 150 psig cycling, with periodic inspections of the test unit and cycle, until 100,000 cycles have been completed. This will require approximately 139 hours or 5.8 days of continuous operation.
   e. Stop the cam cycle timer so that the 150 psig pressure is on the test unit and inspect the unit for leaks. Any evidence of leakage during the cycle tests or in the final inspection shall constitute a failure of the unit.

N. BURST TESTS FOR NON-METALLIC TANKS

1. The following test is normally conducted by the tank manufacturer, and conformance with the burst pressure requirements may be by certification by the tank manufacturer.
2. Test procedure.
   a. The tank to be tested shall be a complete unit, assembled if necessary to conform to its normal state of use.
   b. The tanks shall be connected to a water supply thru a pump system incorporating a Bourdon tube pressure gauge with a maximum reading hand or equal, a check valve, a shutoff valve and a drain valve. High strength fittings are to be used for the system subject to the high pressure.
   c. All remaining tank openings shall be closed by the use of high strength threaded fittings, where possible. Provision shall be made for flushing the tank to free it of air.
   d. A shield or enclosure shall be provided to protect the operator.
   e. The entire system shall be filled with water at room temperature, and flushed to avoid the pocketing of air.
   f. With all outlets closed, the hydrostatic pressure shall be raised at a rate of approximately 100 psi per second until the specified burst pressure is reached, or rupture or fracture of the tank occurs.

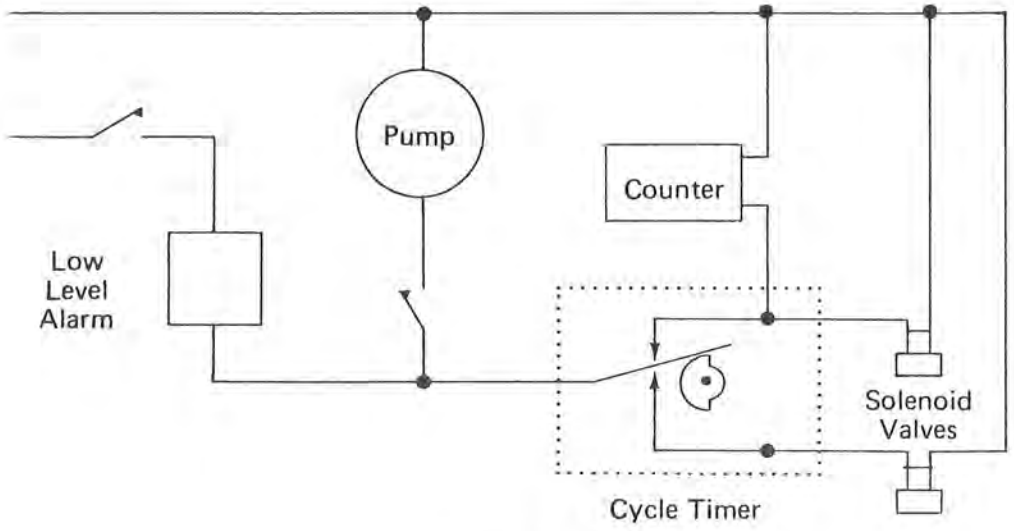

Pump
Counter
Low
Level
Alarm
Solenoid
Valves
Cycle Timer

Fig. F

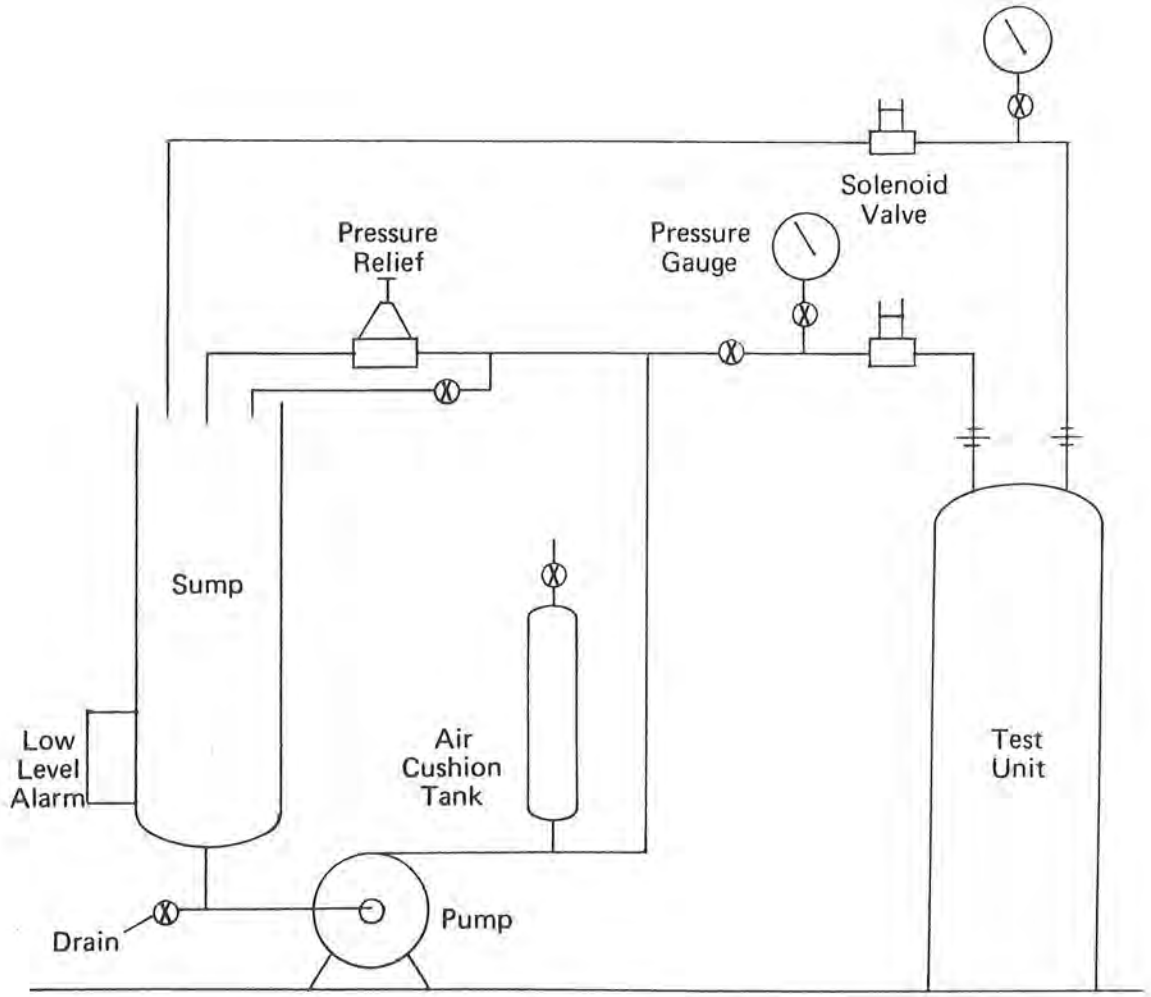

Solenoid
Valve
Pressure
Relief
Pressure
Gauge
Sump
Low
Level
Alarm
Air
Cushion
Tank
Test
Unit
Drain
Pump

Fig. G

O. DEMAND INITIATED REGENERATION (D.I.R.)

1. Validation by test. D.I.R. units (submitted for calculation to determine the salt efficiency of the system) must be tested in accordance with Voluntary Industry Standards S-100-81 with a minimum of two (2) exhaustion points being recorded. The first point is the trigger point at which a system requires regeneration, and the second point is when the one (1) grain hardness breakthrough is reached. Additional measurements and performance ratings shall be verified by actual tests as outlined under Section VI.A.1. of this Standard. Test water for these test runs shall have a hardness (as Calcium Carbonate) of 15 gpg ± 3 grains.
2. Calculation procedure for determining the salt efficiency of a system. Appendix IV indicates the yearly water usage of an average family of four (4). This water consumption information reduced to one half year (183 days) will be used to determine the following:
   - **a.** Total gallonage used in 183 days.
   - **b.** Total number of regenerations.
   - **c.** Total pounds of salt consumed, (S_t).
   - **d.** Total actual gallons of softened water (Vo_S) produced by a system determined by subtracting any hard water delivered during the service cycle including regeneration penalties from the total amount of softened water produced.
     - d1. There will be no regeneration penalty to a system that regenerates between the hours of 12 a.m. to 6 a.m.
     - d2. A regeneration water use penalty will be assessed on units that are capable of regenerating between the hours of 6 a.m. to 12 am. The regeneration penalty will be assessed at the rate of 0.25 gpm for the total regeneration time.
   - **e.** The salt efficiency of a system will be reported as grains of exchange per pound of salt and will be determined by the following equation.

$$\frac{(Vo_S)(15)}{S_t} = \text{grains/pound of salt}$$

   Vo_S is the total gallons of softened water produced as determined under 2.d.; S_t is the total pounds of salt consumed in 183 days.

   - **f.** The following information will be measured and recorded for each D.I.R. unit tested and will be reported to its submitter:
     - f1. Pounds of salt used per year.
     - f2. Gallons of water per regeneration.
     - f3. Capacity of system at various salt settings at trigger point.
     - f4. Total capacity of system at various salt settings when exhausting breakthrough is one (1) grain per gallon.
     - f5. Gallons of hard water bypassed during regeneration.
     - f6. Total gallons of hard water delivered per year (exhaustion water plus regeneration water).
     - f7. Total number of regenerations.
     - f8. Salt efficiency reported in grains exchange per pound of salt at a specific salt setting when influent water has a hardness of 15 grains per gallon (as $CaCO_3$).

The objective of this appendix is to provide a standard for installation, sanitation and service. These factors are beyond the direct control of the equipment manufacturer, are not subject to validation by inspection or tests of the softener, and thus are the prime responsibility of the dealer and/or installer.

APPENDIX I —

APPENDIX II —

APPENDIX III --

APPENDIX IV —

APPENDIX I

I. SELECTION OF EQUIPMENT

A. WATER ANALYSIS. A suitable chemical analysis of a private water supply shall be furnished with the recommendation for a permanently installed water softener and/or other water conditioning equipment.

B. SIZING OF WATER SOFTENERS.

1. Household manual and semi-automatic water softeners shall have sufficient rated softening capacity to deliver soft water at rated flow under normal demands for at least one week between successive regeneration. (See Figure 1.)
2. Household automatic water softeners with one exchanger tank shall have sufficient rated softening capacity to deliver soft water at rated flow under normal demands for at least three days between successive regenerations. (See Figure 2.)
3. Household fully automatic water softeners with one exchanger tank shall have sufficient rated softening capacity to deliver soft water at rated flow under normal demands for at least 24 hours between successive regenerations. (See Figure 3.)
4. Water softeners designed to provide for uninterrupted service shall be capable of delivering soft water under normal intermittent demands at rated flow at all times.
5. Where the flow rate requirements for a proposed installation are not known, and are impractical to determine by direct measurement, the procedure outlined in Table 1 and Figure 4 may be used.

II. INSTALLATION

A. CODES. All installations shall be in compliance with applicable plumbing, electrical or qualified specialist codes, as well as the manufacturer's instructions and specifications, except where in conflict with such codes.

1. Regeneration wastes from permanently installed softeners shall be discharged to the building waste system, subject to the following precautions:
   a. The softener drain line shall not be connected directly to the waste system, but shall be emptied into a laundry tray, floor drain or properly trapped special outlet, preserving an air gap of at least 2 times the diameter of the drain line, but in no case less than 1-1/2 inches, above the top of the receptacle used.
   b. Installations requiring rinsing of brine through water supply lines shall not be acceptable.

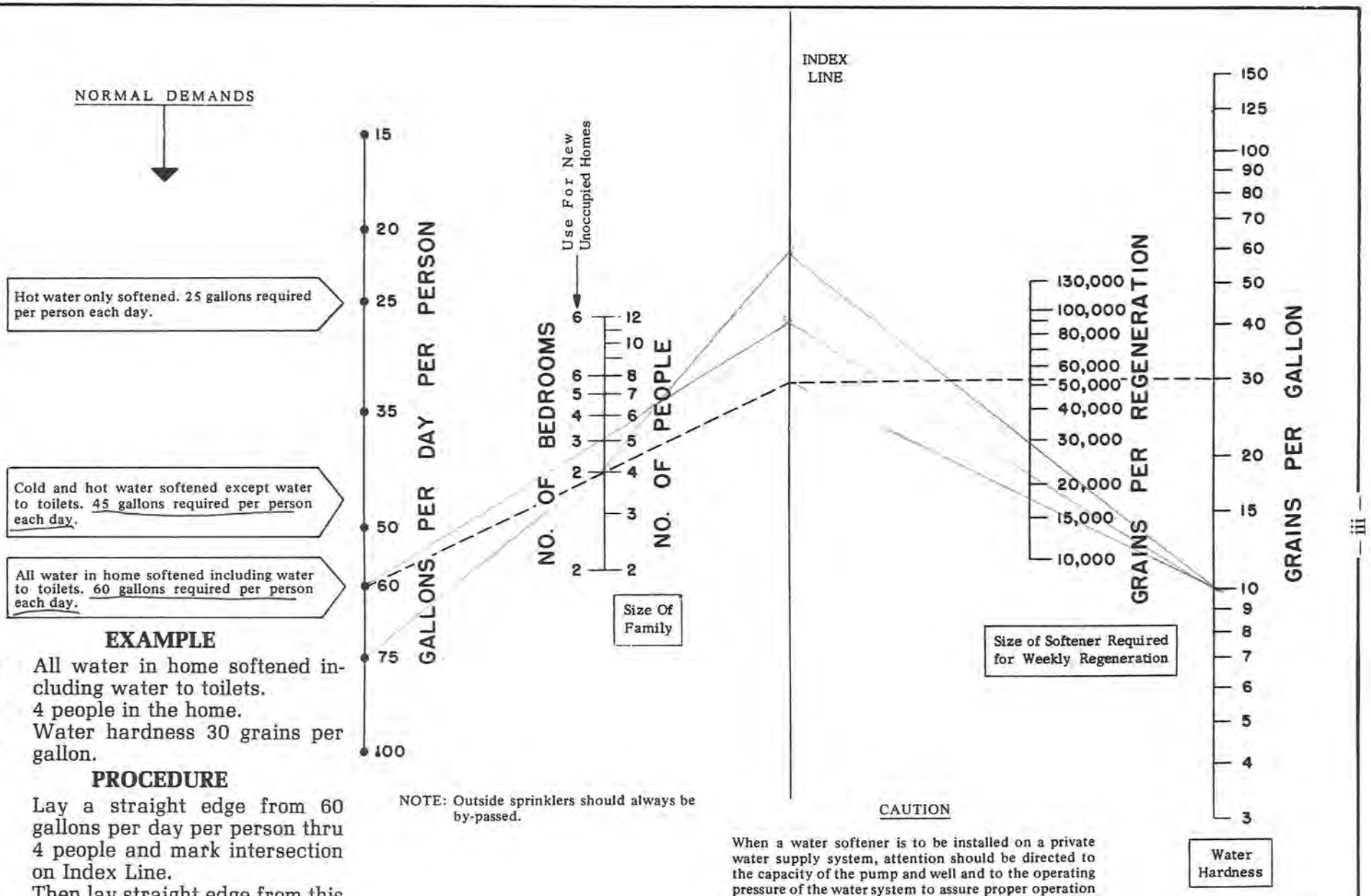
B. PIPING. A manual bypass for hard water shall be provided as part of the installation connections. Installations shall preserve the continuity of existing electrical grounding. Where a softener or pressure reducing valve acts as a check valve to prevent the reverse flow of water from a water heater, an acceptable relief valve shall be installed between the softener and the heater, or at the water heater.

C. **SANITATION.** Good sanitation practices shall be followed during the installation of water softeners. Permanently installed softeners shall be disinfected following installation in accordance with the procedures in Appendix III. Portable exchange softeners and regeneration plants shall meet the sanitation requirements given in Appendix IV.

D. **SERVICE.** A responsible servicing agency for permanently installed softeners should be permanently located and available within a reasonable distance of the installation.

E. **INFORMATION REQUIREMENTS.** The dealer and/or installer shall pass on to the user the information provided by the equipment manufacturer for this purpose, and shall also provide the user with the following information, preferably in the form of a permanent card or label mounted or fixed to or near the softener:

1. Bypass instructions.
2. The name, address and phone number of the responsible servicing agency.



EXAMPLE

a) All water in home softened including water to toilets.
b) 4 people in the home.
c) Water hardness 30 grains per gallon.

PROCEDURE

1. Lay a straight edge from 60 gallons per day per person thru 4 people and mark intersection on Index Line.
2. Then lay straight edge from this intersection to 30 grains hardness and note intersection on the Grains Per Regeneration line.

ANSWER

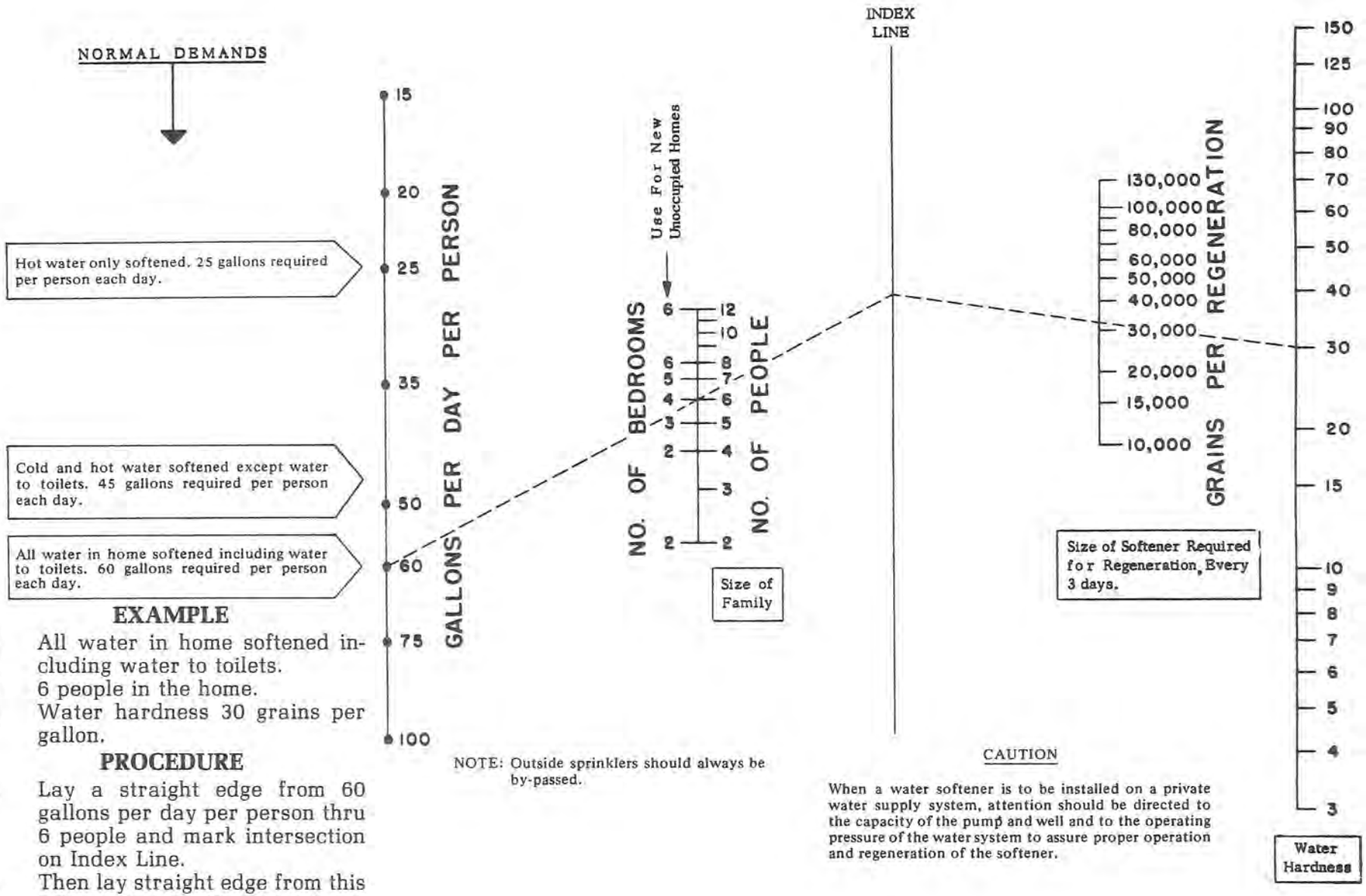
51,000 grains per week.

NOTE: Outside sprinklers should always be by-passed.

CAUTION

When a water softener is to be installed on a private water supply system, attention should be directed to the capacity of the pump and well and to the operating pressure of the water system to assure proper operation and regeneration of the softener.

FIG. 1—SELECTION GUIDE FOR MANUAL & SEMI-AUTOMATIC HOUSEHOLD WATER SOFTENERS



NOTE: Outside sprinklers should always be by-passed.

CAUTION

When a water softener is to be installed on a private water supply system, attention should be directed to the capacity of the pump and well and to the operating pressure of the water system to assure proper operation and regeneration of the softener.

EXAMPLE

a) All water in home softened including water to toilets.
b) 6 people in the home.
c) Water hardness 30 grains per gallon.

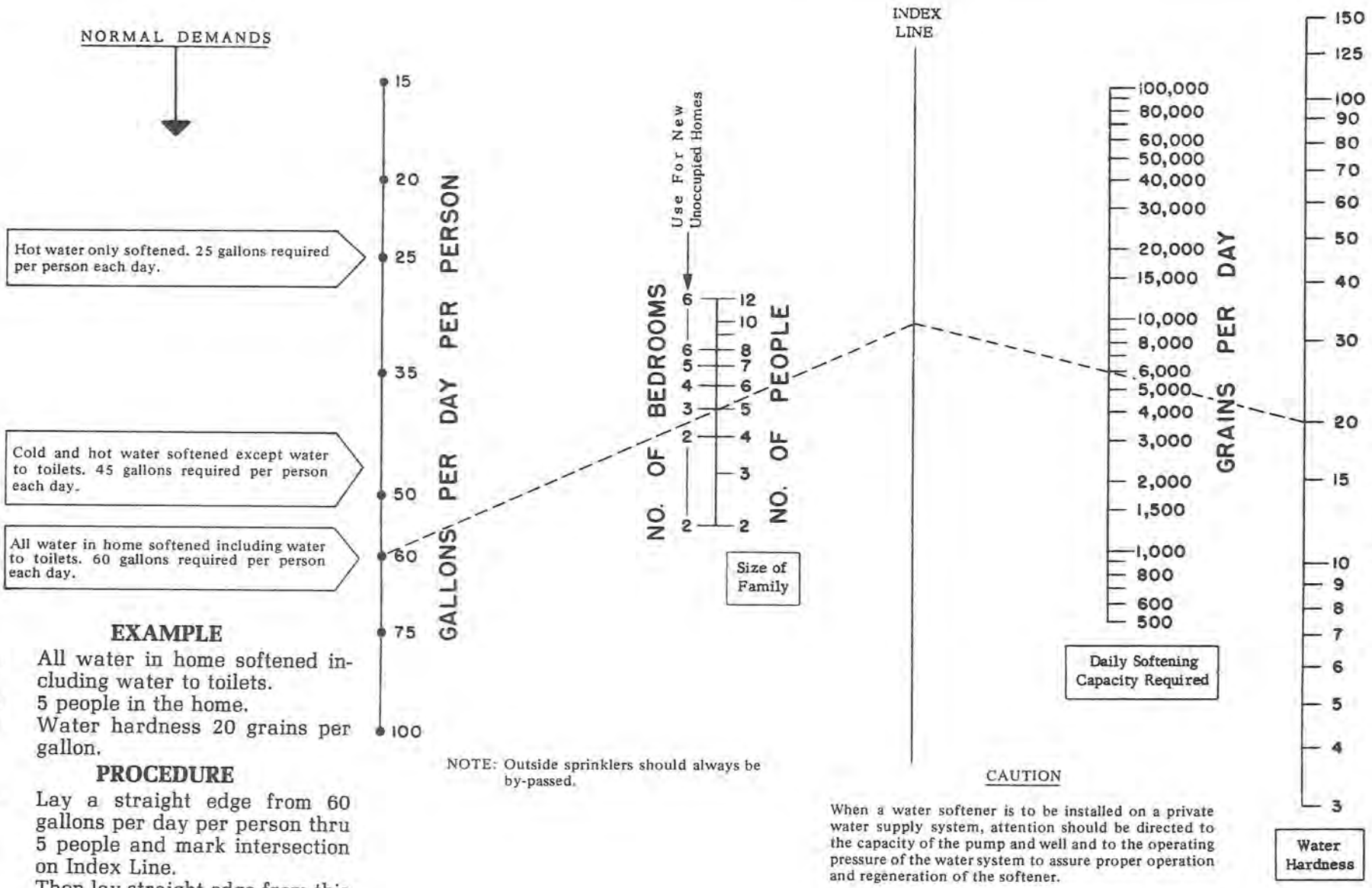
PROCEDURE

1. Lay a straight edge from 60 gallons per day per person thru 6 people and mark intersection on Index Line.
2. Then lay straight edge from this intersection to 30 grains hardness and note intersection on the Grains Per Regeneration line.

ANSWER

33,000 grains per 3 days.

FIG. 2—SELECTION GUIDE FOR AUTOMATIC HOUSEHOLD WATER SOFTENERS



NOTE: Outside sprinklers should always be by-passed.

CAUTION

When a water softener is to be installed on a private water supply system, attention should be directed to the capacity of the pump and well and to the operating pressure of the water system to assure proper operation and regeneration of the softener.

EXAMPLE

a) All water in home softened including water to toilets.
b) 5 people in the home.
c) Water hardness 20 grains per gallon.

PROCEDURE

1. Lay a straight edge from 60 gallons per day per person thru 5 people and mark intersection on Index Line.
2. Then lay straight edge from this intersection to 20 grains hardness and note intersection on the Grains Per Regeneration line.

ANSWER

6,000 grains per day.

FIG. 3—SELECTION GUIDE FOR FULLY AUTOMATIC HOUSEHOLD WATER SOFTENERS

Guidelines for Estimating Flow Rate Requirements

Fixture or group	Occupancy	Type of supply control	Load in Fixture Units
Water Closet	Public	Flushometer	10
Water Closet	Public	Flush tank	5
Pedestal urinal	Public	Flushometer	10
Stall or wall urinal	Public	Flushometer	5
Stall or wall urinal	Public	Flush tank	3
Lavatory	Public	Faucet	2
Bathtub	Public	Faucet	4
Shower head	Public	Mixing valve	4
Service sink	Office, etc.	Faucet	3
Kitchen sink	Hotel or Restaurant	Faucet	4
Water Closet	Private	Flushometer	6
Water Closet	Private	Flush tank	3
Lavatory	Private	Faucet	1
Bathtub	Private	Faucet	2
Shower head	Private	Mixing valve	2
Bathroom group	Private	Flushometer for closet	8
Bathroom group	Private	Flush tank for closet	6
Separate shower	Private	Mixing valve	2
Kitchen sink	Private	Faucet	2
Laundry trays (1-3)	Private	Faucet	3
Combination fixture	Private	Faucet	3

The estimated flow rate requirements for plumbing fixtures used intermittently on a water supply line may be obtained by multiplying the number of each kind of fixture supplied through that supply line by its load from the above table, adding the products, and then referring to the appropriate curve with this sum.

In using this method, it should be noted that the flow rate required for fixtures or outlets which are likely to impose continuous demands during periods of heavy use of the listed fixtures, such as hose connections, air conditioning units, etc., should be estimated separately and added to the demand for fixtures used intermittently, in order to estimate total demand. Further, the curves in this section are not intended to estimate rare peak flow requirements, but to cover normal flow variations. However, occasional leakage of hardness into the treated water due to unusual high flow requirements will not present major difficulties in the normal installation.

Figure 4a

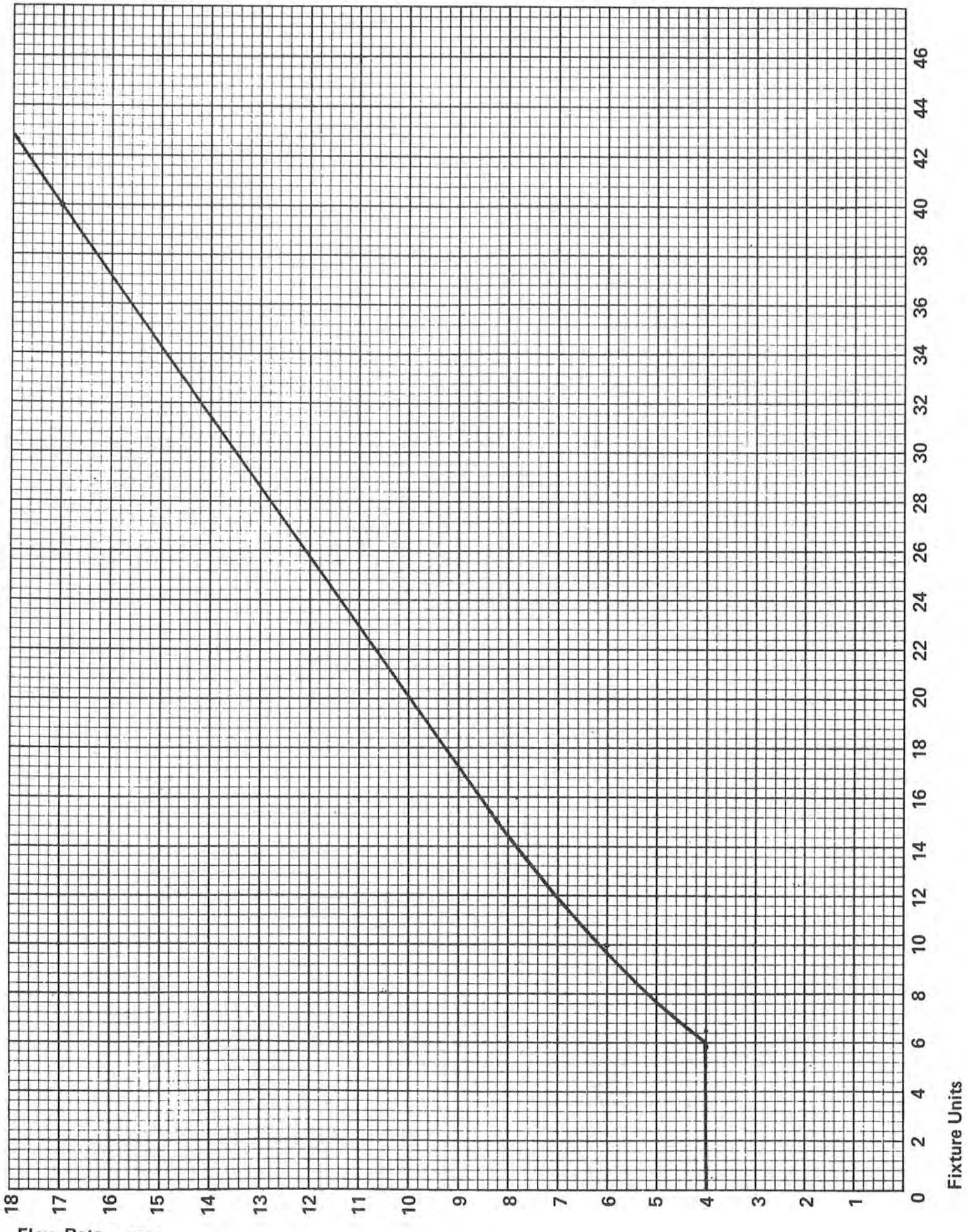
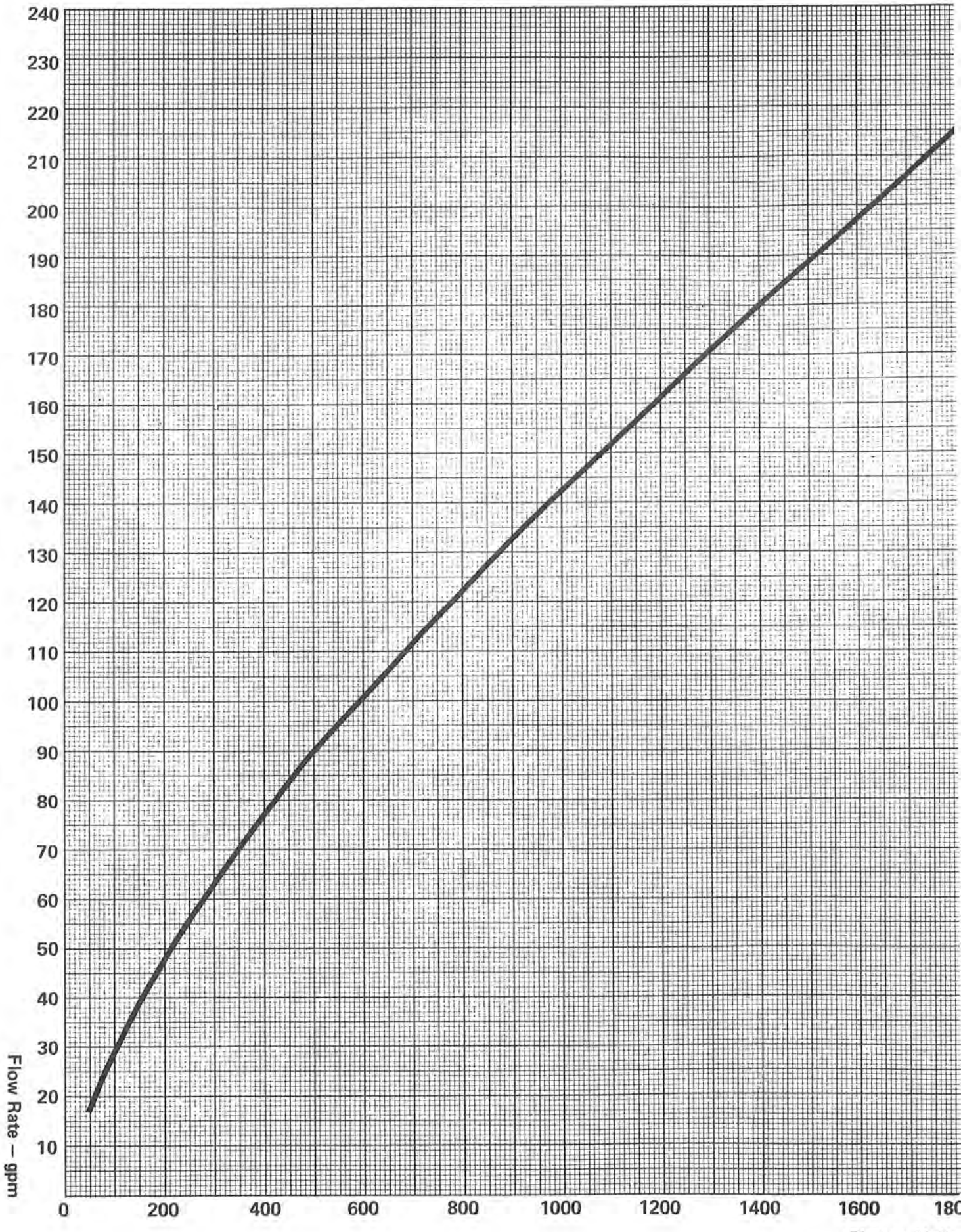

Flow Rate – gpm
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
Fixture Units

Figure 4b


240
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
Flow Rate — gpm
0
200
400
600
800
1000
1200
1400
1600
180
Fixture Units

APPENDIX II

METHODS FOR THE DISINFECTION OF WATER SOFTENERS

The materials of construction of the modern water softener will not support bacterial growth, nor will these materials contaminate a water supply. However, the normal conditions existing during shipping, storage and installation indicate the advisability of disinfecting a softener after installation, before the softener is used to treat potable water. In addition, during normal use, a softener may become fouled with organic matter, or in some cases, with bacteria from the water supply.

Thus, every softener should be disinfected after installation, some will require periodic disinfection during their normal life, and in a few cases disinfection with every regeneration would be recommended.

Depending upon the conditions of use, the style of softener, the type of ion exchanger, and the disinfectant available, a choice can be made among the following methods.

I. SODIUM OR CALCIUM HYPOCHLORITE

A. APPLICATION. These materials are satisfactory for use with polystyrene resins, synthetic gel zeolite, greens and bentonites. They are not recommended for use with phenolic resins or carbonaceous zeolites.

B. 5.25% SODIUM HYPOCHLORITE solutions are available under trade names such as Clorox, Linco, Bo Peep, White Sail and Eagle Brand Bleach. If stronger solutions are used, such as those sold for commercial laundries, adjust the dosage accordingly.

1. Dosage:
   - a. Polystyrene resin; 1.2 fluid ounce per cubic foot.
   - b. Non-resinous exchangers; 0.8 fluid ounce per cubic foot.
2. Salt-in-head softeners.
   - a. Backwash the softener, open the top, and drain down the freeboard water to about 1/2" above the exchanger.
   - b. Pour in the required amount of hypochlorite solution, and refill the softener upflow (backwash procedure).
   - c. Close the softener and proceed with the normal downflow regeneration procedure.
3. Brine tank softeners.
   - a. Backwash the softener, and add the required amount of hypochlorite solution to the brine well of the brine tank. (The brine tank should have water in it to permit the solution to be carried into the softener.)
   - b. Proceed with the normal regeneration.

C. CALCIUM HYPOCHLORITE, 70% available chlorine, is available in several forms, including tablets and granules, under trade names such as H.T.H., and Perchloron. These solid materials may be used directly, without dissolving before use.

1. Dosage: 2 grams (approximately 0.1 ounce) per cubic foot.
2. Salt-in-head softeners.
   - a. Backwash the softener and open the top.
   - b. Pour in the required amount of hypochlorite.
   - c. Close the softener and proceed with the normal downflow regeneration procedure.

3. Brine tank softeners.
   a. Backwash the softener, and add the required amount of hypochlorite to the brine well of the brine tank. (The brine tank should have water in it to permit the chlorine solution to be carried into the softener.)
   b. Proceed with the normal regeneration.

NOTES

APPENDIX III

Sanitation Requirements for Portable Exchange Softeners and Regeneration Plants

I. Regeneration Plants

Regeneration plants shall be constructed and maintained in clean, orderly and sanitary condition. Plants shall be well lighted, properly drained, and have adequate washroom facilities. The water supply to the plant shall meet the bacteriological requirements of the U.S. EPA Drinking Water Standards.

II. Regeneration Equipment

Regeneration equipment shall be constructed and installed for ease in inspection, maintenance and cleaning, and shall be maintained in clean and sanitary condition. Supplies and incidental materials subject to contamination shall not be stored on the floor, but on platforms, shelves or racks provided for that purpose. Bulk storage facilities for salt or other chemicals shall be constructed to prevent the entrance of dirt, drainage or vermin. Low or below ground facilities shall be kept closed or covered as necessary for this purpose.

III. Personnel

All persons involved in the regeneration, exchange, installation, servicing, or any contact with the regeneration equipment or portable exchange units shall have at least annual health examinations, and have current health certificates. Such certificates may be in the form of cards carried by the personnel, or suitable certificates posted in the plant.

IV. Regeneration Sanitation Procedures

All portable exchange softeners shall be adequately disinfected during every regeneration, whether bulk or individual tank regeneration is practiced. This disinfection shall be achieved by the application of chlorine or a chlorine compound such as sodium hypochlorite or calcium hypochlorite during the fresh water rinse, to provide an effluent minimum chlorine residual and time combination as given in the following table:

Minimum Time Minutes	Minimum Chlorine Residual—ppm
4	20
5	15
10	7.5
15	5.0
20	4.0

Where bulk regeneration procedures are used, the exchange tanks shall be disinfected by the addition of 1 fluid ounce of 1% chlorine solution per cubic foot of tank volume before the return of the ion exchanger to the tank. One percent (1%) chlorine solution may be conveniently prepared by the appropriate dilution of 5, 10 or 15% sodium hypochlorite solutions.

Caps used to close tanks during delivery shall be submerged in 1% chlorine solution during the period of regeneration.

V. Bacteriological Tests

At least one set of water samples shall be tested each month for coliform organisms by a recognized laboratory for each 500 water softeners or fraction thereof regenerated per month, except that not more than two sets of sample per week shall be required. Each set of samples shall include one sample of the regeneration plant water supply, and one sample of the effluent from a regenerated water softener after approximately 10 gallons of fresh water have passed through the softener.

VI. Exchange Procedures

Handling and exchange procedures shall guard against accidental or incidental contamination of softeners. Regenerated softener fittings or connectors shall be protected by tight, secure and disinfected closures, which shall not be removed until necessary for installation. Exhausted softeners shall be protected by similar closures during transportation to the regeneration plant, but disinfection is not necessary.

APPENDIX IV

Yearly water usage data for use in determining salt efficiency of demand initiated regenerated water softeners

Month	Day	GPD	Month	Day	GPD	Month	Day	GPD
January	1	131	February	1	272	March	1	370
	2	293		2	441		2	140
	3	189		3	351		3	120
	4	216		4	108		4	240
	5	270		5	288		5	660
	6	54		6	90		6	130
	7	108		7	351		7	150
	8	0		8	531		8	410
	9	0		9	171		9	360
	10	0		10	90		10	220
	11	0		11	90		11	310
	12	0		12	405		12	80
	13	0		13	225		13	130
	14	0		14	99		14	360
	15	126		15	90		15	450
	16	99		16	99		16	370
	17	180		17	396		17	130
	18	243		18	504		18	130
	19	297		19	99		19	230
	20	297		20	126		20	100
	21	189		21	333		21	430
	22	207		22	270		22	320
	23	288		23	126		23	160
	24	81		24	279		24	370
	25	72		25	135		25	300
	26	450		26	270		26	600
	27	0		27	0		27	580
	28	0		28	0		28	150
	29	99					29	460
	30	99					30	280
	31	72					31	300

Month	Day	GPD	Month	Day	GPD	Month	Day	GPD
April	1	140	May	1	500	June	1	583
	2	430		2	240		2	242
	3	420		3	160		3	143
	4	240		4	380		4	220
	5	260		5	190		5	132
	6	120		6	120		6	330
	7	130		7	110		7	165
	8	0		8	160		8	275
	9	0		9	240		9	407
	10	150		10	410		10	242
	11	350		11	320		11	374
	12	200		12	170		12	143
	13	520		13	180		13	286
	14	290		14	110		14	671
	15	170		15	200		15	483
	16	390		16	350		16	176
	17	530		17	390		17	220
	18	360		18	400		18	209
	19	130		19	110		19	352
	20	370		20	120		20	440
	21	250		21	300		21	154
	22	120		22	110		22	160
	23	100		23	250		23	358
	24	290		24	370		24	231
	25	240		25	360		25	264
	26	260		26	100		26	330
	27	400		27	640		27	66
	28	330		28	220		28	132
	29	280		29	110		29	704
	30	310		30	90		30	0
				31	310			

Month	Day	GPD	Month	Day	GPD	Month	Day	GPD
July	1	0	August	1	110	September	1	130
	2	385		2	110		2	360
	3	308		3	495		3	450
	4	297		4	275		4	370
	5	440		5	121		5	130
	6	154		6	110		6	130
	7	121		7	121		7	230
	8	220		8	484		8	100
	9	297		9	616		9	430
	10	363		10	121		10	320
	11	363		11	154		11	160
	12	231		12	407		12	370
	13	253		13	0		13	300
	14	352		14	0		14	600
	15	99		15	0		15	580
	16	88		16	0		16	150
	17	550		17	0		17	460
	18	308		18	0		18	280
	19	99		19	0		19	300
	20	121		20	407		20	140
	21	121		21	154		21	430
	22	88		22	132		22	420
	23	341		23	264		23	240
	24	539		24	726		24	260
	25	429		25	143		25	120
	26	132		26	165		26	130
	27	352		27	451		27	380
	28	0		28	396		28	330
	29	0		29	242		29	150
	30	649		30	0		30	353
	31	209		31	0			

Month	Day	GPD	Month	Day	GPD	Month	Day	GPD
October	1	200	November	1	180	December	1	117
	2	520		2	110		2	235
	3	290		3	200		3	549
	4	170		4	350		4	396
	5	390		5	390		5	144
	6	530		6	400		6	180
	7	360		7	110		7	171
	8	130		8	120		8	288
	9	370		9	300		9	360
	10	250		10	110		10	126
	11	120		11	250		11	131
	12	100		12	370		12	293
	13	290		13	360		13	189
	14	240		14	100		14	216
	15	260		15	640		15	270
	16	400		16	220		16	54
	17	330		17	110		17	108
	18	280		18	90		18	576
	19	310		19	310		19	441
	20	500		20	530		20	189
	21	240		21	220		21	315
	22	160		22	130		22	252
	23	380		23	200		23	333
	24	190		24	120		24	360
	25	120		25	300		25	126
	26	110		26	150		26	99
	27	160		27	250		27	180
	28	240		28	370		28	243
	29	410		29	220		29	297
	30	320		30	340		30	297
	31	170					31	189

Amendment published in Federal Register:
* February 10, 1968; 33 F.R. 2845

§ 121.1148 Ion-exchange resins.

Ion-exchange resins may be safely used in the treatment of food under the following prescribed conditions:

(a) The ion-exchange resins are prepared in appropriate physical form, and consist of one or more of the following:

(1) Sulfonated copolymer of styrene and divinylbenzene.

(2) Sulfonated anthracite coal meeting the requirements of ASTM–D388–38, Class I, Group 2.

(3) Sulfite-modified cross-linked phenol-formaldehyde, with modification resulting in sulfonic acid groups on side chains.

(4) Methacrylic acid-divinylbenzene copolymer.

(5) Cross-linked polystyrene, first chloromethylated then aminated with trimethylamine, dimethylamine, diethylenetriamine, or dimethylethanolamine.

(6) Diethylenetriamine, triethylenetetramine, or tetraethylenepentamine cross-linked with epichlorohydrin.

(7) Cross-linked phenol-formaldehyde activated with one or both of the following: Triethylene tetramine and tetraethylenepentamine.

(8) Reaction resin of formaldehyde, acetone, and tetraethylenepentamine.

(9) Completely hydrolyzed copolymers of methyl acrylate and divinylbenzene.

(10) Completely hydrolyzed terpolymers of methyl acrylate, divinylbenzene, and acrylonitrile.

(11) Sulfonated terpolymers of styrene, divinylbenzene, and acrylonitrile or methyl acrylate.

(12) Methyl acrylate-divinylbenzene copolymer containing not less than 2 percent by weight of divinylbenzene, aminolyzed with dimethylaminopropylamine.

(13) Methyl acrylate-divinylbenzene copolymer containing not less than 3.5 percent by weight of divinylbenzene, aminolyzed with dimethylaminopropylamine.

(14) Epichlorohydrin cross-linked with ammonia.

*(15) Sulfonated tetrapolymer of styrene, divinylbenzene, acrylonitrile, and methyl acrylate derived from a mixture of monomers containing not more than a total of 2 percent by weight of acrylonitrile and methyl acrylate. *

(b) Ion-exchange resins are used in the purification of foods, including potable water, to remove undesirable ions or to replace less desirable ions with one or more of the following: Bicarbonate, calcium, carbonate, chloride, hydrogen, hydroxyl, magnesium, potassium, sodium, and sulfate except that the ion-exchange resins identified in paragraph (a) (12) and (13) of this section are used as follows:

(1) The ion-exchange resin identified in paragraph (a) (12) of this section is used only to treat water for use in the manufacture of distilled alcoholic beverages, subject to the following conditions:

(i) The water is subjected to treatment through a mixed bed consisting of the resin identified in paragraph (a) (12) of this section and one of the strongly acidic cation-exchange resins in the hydrogen form identified in paragraph (a) (1), (2), and (11) of this section; or

(ii) The water is first subjected to the resin identified in paragraph (a) (12) of this section and is subsequently subjected to treatment through a bed of activated carbon or one of the strongly acidic cation-exchange resins in the hydrogen form identified in paragraph (a) (1), (2), and (11) of this section.

(iii) The temperature of the water passing through the resin beds identified in subdivisions (i) and (ii) of this subparagraph is maintained at 30° C. or less, and the flow rate of the water passing through the beds is not less than 2 gallons per cubic foot per minute.

(iv) The ion-exchange resin identified in paragraph (a) (12) of this section is exempted from the requirements of paragraph (c) (4) of this section, but the strongly acidic cation-exchange resins referred to in subdivisions (i) and (ii) of this subparagraph used in the process meet the requirements of paragraph (c) (4) of this section, except for the exemption described in paragraph (d) of this section.

(2) The ion-exchange resin identified in paragraph (a) (13) of this section is used only to treat water having a pH of 5.0 or higher, subject to the following conditions:

(i) The water is first subjected to the resin identified in paragraph (a) (13) of this section in the bicarbonate form and is subsequently subjected to treatment through a bed of the cation-exchange resin in the hydrogen form identified in paragraph (a) (10) of this section, so that no more than 35 weight-percent of the bicarbonate ion entering this bed passes through the bed when the conditions of subdivision (ii) of this subparagraph are met.

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* February 10, 1968; 33 F.R. 2845

SUBPART D--FOOD ADDITIVES--Page 55.1
Remove old page 55.1 and insert this new page in your reprint.

(ii) The temperature of the water passing through the resin beds identified in paragraph (a) (10) and (13) of this section is maintained at 30° C. or less and the flow rate of the water passing through the bed is not less than 0.5 gallons per cubic foot per minute.

(c) To insure safe use of ion-exchange resins, each ion-exchange resin will be:

(1) Subjected to pre-use treatment by the manufacturer to guarantee a food-grade purity of ion-exchange resins, in accordance with good manufacturing practice.

(2) Accompanied by label or labeling to include directions for use consistent with the intended functional purpose of the resin.

(3) Used in compliance with the label or labeling required by subparagraph (2) of this paragraph.

(4) Found to result in no more than 1 part per million of organic extractives obtained with each of the named solvents, distilled water, 15 percent alcohol, and 5 percent acetic acid when, having been washed and otherwise treated in accordance with the manufacturer's directions for preparing them for use with food, the ion-exchange resin is subjected to the following test: Using a separate ion-exchange column for each solvent, prepare columns using 50 milliliters of the ready to use ion-exchange resin that is to be tested. While maintaining the highest temperature that will be encountered in use pass through these beds at the rate of 350–450 milliliters per hour the three test solvents distilled water, 15 percent (by volume) ethyl alcohol, and 5 percent (by weight) acetic acid. The first liter of effluent from each solvent is discarded, then the next 2 liters are used to determine organic extractives. The 2-liter sample is carefully evaporated to constant weight at 105° C.; this is total extractives. This residue is fired in a muffle furnace at 650° C. to constant weight; this is ash. Total extractives minus ash equals the organic extractives. If the organic extractives are greater than 1 part per million of the solvent used, a blank should be run on the solvent and a correction should be made by subtracting the total extractives obtained with the blank from the total extractives obtained in the resin test. The solvents used are to be made as follows:

Distilled water (de-ionized water is distilled).
15 percent ethyl alcohol made by mixing 15 volumes of absolute ethyl alcohol A.C.S. reagent grade, with 85 volumes of distilled de-ionized water.
5 percent acetic acid made by mixing 5 parts by weight of A.C.S. reagent grade glacial acetic acid with 95 parts by weight of distilled de-ionized water.

* (d) The ion-exchange resins identified in paragraph (a) (1), (2), (11), and (15) of this section are exempted from the acetic acid extraction requirement of paragraph (c)(4) of this section. *

The industry served by WQA and its members encompasses water quality improvement for homes, businesses, industry, and institutions in these broad areas:

- drinking water
- working water

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