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FOREWORD

A. This Outline of Investigation contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Outline of Investigation. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of these requirements by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Outline of Investigation will not necessarily be judged to comply with the Outline of Investigation if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product employing materials or having forms of construction differing from those detailed in the requirements of this Outline of Investigation may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be judged to comply with the Outline of Investigation.

E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Outline of Investigation is processed. UL shall not be responsible to anyone for the use of or reliance upon this Outline of Investigation by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of or reliance upon this Outline of Investigation.

F. Many tests required by the Outline of Investigations of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

December 26, 1989

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SUBJECT 979

OUTLINE OF INVESTIGATION

FOR

**WATER SOFTENERS AND
DEMINERALIZERS**

Issue Number: 1

June, 1982

The following tentative requirements will be employed by Underwriters Laboratories Inc. as a guide in the investigation of a product of this type. However, it should be understood that these requirements are not to be considered complete or final in the determination of either UL's judgement or the manufacturer's development of this product. Additional tests or requirements may be necessary if features of construction or use are present which have not been anticipated by this Outline of Investigation. Certain tests included in these requirements may be omitted on the basis of previous recognition for particular materials and components.

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GENERAL

1. Scope

1.1 These requirements cover electrically operated water softener units, water softener control units, demineralizers, and filters. These appliances are intended for use on circuits of 300 volts or less in accordance with the National Electrical Code.

1.2 These requirements cover household equipment intended for cord connection to the power supply.

1.3 Industrial units are covered by UL 508, the Standard for Industrial Control Equipment (except for the pressure system).

2. Units of Measurement

2.1 If a measurement is accompanied by a value in other units, the second value may be approximate; the first stated value is the requirement.

3. Components

3.1 A component of an appliance shall comply with the requirements for that component; but those requirements may be modified if appropriate for the particular application.

CONSTRUCTION

4. General

4.1 An appliance shall be made and finished with the degree of uniformity and grade of workmanship practicable in a well-equipped factory.

5. Frame and Enclosure

General

5.1 An appliance shall be so formed and assembled that it will have the strength and rigidity necessary to resist the abuses to which it is likely to be subjected without increasing the risk of fire, electric shock, or injury to persons due to total or partial collapse with resulting reduction of spacings, loosening or displacement of parts, or other serious defects.

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5.1A An edge, projection, or corner of an enclosure, opening, frame, guard, knob, handle, or the like, of an appliance shall be smooth and rounded and not sufficiently sharp to cause a cut type injury when contacted during normal use or user maintenance.

5.2 An electrical part of an appliance shall be located or enclosed so that persons will not unintentionally contact a live part, unless the voltage on the part is 30 volts or less or the available current measured through a 1500-ohm, noninductive resistor is 5 milliamperes or less.

5.3 A device, such as a lampholder, fuseholder, circuit breaker, of the replaceable type, shall be designed and installed so that persons servicing the lamps, fuses, circuit breakers, or other devices will not unintentionally contact any uninsulated live part other than a screw shell or the clips of a fuseholder.

5.4 The enclosure of an appliance shall be complete. No dependence shall be placed on adjacent walls or equipment to complete an enclosure.

5.5 The enclosure of an appliance shall be provided with means for support. Mounting holes shall be located or guarded so that nails or similar hangers will not come in contact with any bare, covered, or uninsulated live part.

5.6 For unreinforced, flat surfaces in general, cast metal shall be not less than 1/8 inch (3.2 mm) thick.

Exception No. 1: Malleable iron may be not less than 3/32 inch (2.4 mm) thick, and die-cast metal may be not less than 5/64 inch (2.0 mm) thick.

Exception No. 2: For a curved, ribbed, or otherwise reinforced surface, or if the shape and/or size of the surface is such that equivalent mechanical strength is provided, cast metal in general may not be less than 3/32 inch, malleable iron may not be less than 1/16 inch (1.6 mm), and die-cast metal may not be less than 3/64 inch (1.2 mm) thick.

5.7 Reserved.

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5.8 An enclosure of sheet metal is to be judged with respect to its size, shape, thickness of metal, and its suitability for the particular application, considering the intended use of the complete appliance. The use of sheet steel having a thickness of less than 0.026 inch (0.66 mm) if uncoated or 0.029 inch (0.74 mm) if galvanized or of nonferrous sheet metal having an average thickness of less than 0.036 inch (0.91 mm) is not recommended.

Exception: Sheet metal thinner than that described may be used for relatively small areas or for surfaces that are curved or otherwise reinforced.

5.9 An overall polymeric enclosure shall comply with the requirements of UL 746C.

Doors and Covers

5.10 A door or cover that is accessible from outside the enclosure shall be hinged if it gives access to any kind of overload protective device that is required to be enclosed.

Exception: A cover, panel, door, or other part of the enclosure that, by its function, obviously must be in place if the appliance is to operate properly need not be permanently attached.

5.11 Means shall be provided for holding the door or cover over a fuseholder in a closed position. The door or cover shall be tight-fitting.

6. Protection Against Corrosion

6.1 An iron or steel part shall be suitably protected against corrosion by enameling, galvanizing plating, or other equivalent means, if the failure of such a part would be likely to result in a hazardous condition.

Exception: The requirement in this paragraph does not apply to bearings or laminations or to minor parts of iron or steel (such as washers, screws, and the like).

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6A. Exposure to Water

6A.1 The design of an appliance shall be such as to prevent water from coming into contact with insulated or uninsulated live parts. A water handling part shall be constructed of materials suitable for the application and shall have the strength to resist the uses and abuses to which it is liable to be subjected, see paragraphs 22A.1-22B.5.

6A.2 An appliance incorporating the brine tank and electrical controls in a common housing shall have a unvalved overflow drain in the housing.

7. Mechanical Assembly

7.1 An appliance shall be assembled so as not to be affected adversely by the vibration of normal operation.

7.2 A switch, fuseholder, lampholder, receptacle, plug connector, or other component that is handled by the user shall be mounted securely, and shall be prevented from turning.

Exception No. 1: The requirement that a switch be prevented from turning may be waived for a switch that normally is operated by mechanical means rather than by direct contact by persons if all three of the following conditions are met:

A. The switch is a plunger or other type that does not tend to rotate when operated. A toggle switch is considered subject to forces that tend to turn the switch during normal operation.

B. The means of mounting makes it unlikely that operation can loosen the switch.

C. The spacings cannot be reduced below the minimum acceptable values if the switch does rotate.

Exception No. 2: A lampholder of a type where the lamp cannot be replaced (such as a neon pilot or indicator light in which the lamp is sealed in by a nonremovable jewel) need not be prevented from turning if rotation cannot reduce spacings below the minimum acceptable values.

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7.3 The means for preventing the turning mentioned in paragraph 7.2 shall consist of more than friction between surfaces -- for example, a suitable lock washer, properly applied, is acceptable as a means to prevent turning of a small stem-mounted switch or other device having a single-hole mounting means.

8. Supply Connections -- Cord Connected Appliances

Cords and Plugs

8.1 A cord-connected appliance shall be provided with a length of flexible cord and an attachment-plug cap for connection to the branch-circuit supply.

8.2 Cord connected appliances shall be provided with a cord not less than 6 feet (1.8 m) in length and have a grounding conductor and grounding type attachment plug cap. The grounding conductor in a flexible cord shall be finished to show a green color with or without one or more yellow stripes.

8.3 If a polarized attachment-plug cap is used, the circuit conductors in the flexible cord shall be connected to the cap and to the wiring in the appliance so that the following devices used in the primary circuit are connected to the ungrounded side of the line:

- A. The center contact of an Edison-base lampholder,
- B. A fuseholder,
- C. Any other single-pole, overcurrent-protective device other than an automatic control without a marked off position,
- D. A single-pole switch.

8.4 The screw shell of a plug fuseholder and the accessible contact of an extractor fuseholder shall be connected toward the load.

8.5 The flexible cord shall be a Type S, SO, ST, STO, SJ, SJO, SJT, SJTO, or shall be of a type at least as serviceable for the particular application. It shall be recognized for use at a voltage no lower than the rated voltage of the appliance and shall have an ampacity (current-carrying capacity expressed in amperes), as given for the type in the National Electrical Code, no lower than the current rating of the appliance.

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8.6 The attachment-plug cap for connection to the branch-circuit supply shall have an American National Standard configuration of pins and American National Standard ratings. It shall be of a type suitable for use (1) with a current no lower than the rated current of the appliance, and (2) at a voltage equal to the rated voltage of the appliance. If the appliance can be adapted for use on two or more different supply voltages by field alteration of internal connections, the attachment-plug cap provided with the appliance shall be suitable for the voltage for which the appliance is connected when it is shipped from the factory.

8.7 An appliance designed for connection to a remote-control or similar circuit instead of to a convenience power-supply outlet receptacle may employ a special plug that has been investigated to determine its suitability for the application.

8.8 Reserved.

8.9 If an appliance incorporates a removable cord set, the arrangement shall not expose any live part under any normal conditions.

Strain Relief

8.10 A power-supply cord shall be provided with means to prevent tension on the cord from being transmitted to terminals, splices, or wiring within the appliance.

8.11 A metal strain-relief clamp or band (without auxiliary protection) is acceptable.

8.12 Means shall be provided to prevent the flexible cord from being pushed into the appliance through the cord-entry hole if such displacement can result in damage to the cord or exposure of the cord to a temperature higher than that for which the cord is suitable, or can reduce spacings (such as to a metal strain-relief attachment) below the minimum acceptable values.

8.13 If a knot in a flexible cord serves as strain relief, the surfaces that the knot can touch shall be free of sharp edges, projections, or the like, that could damage the cord.

Bushings

8.14 At the point at which a supply cord passes through an opening in a wall, barrier, or the overall enclosure, there shall be a suitable bushing or the equivalent that shall be substantial, shall be reliably secured in place, and shall have a smooth, well-rounded surface against which the cord can bear.

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8.15 If the cord hole is in porcelain, phenolic composition or other suitable nonconducting material, a smooth, well-rounded surface is considered equivalent to a bushing.

8.16 Ceramic materials and some molded compositions, are acceptable generally for insulating bushings, but a bushing of wood or hot-molded shellac-and-tar composition is not acceptable.

8.17 Vulcanized fiber may be employed if the bushing is no less than 1/16 inch (1.6 mm) thick, with a minus tolerance of 1/64 inch (0.4 mm) to allow for manufacturing variations, and is formed and secured in place to avoid being affected adversely by conditions of ordinary moisture.

8.18 A separate soft-rubber, neoprene, or polyvinyl-chloride bushing of good quality may be employed on a supply cord at the point at which the cord enters the frame of a motor or the enclosure of a capacitor that is physically attached to a motor if:

A. The bushing is no less than 1/16 inch (1.6 mm) thick, with a minus tolerance of 1/64 inch (0.4 mm), and

B. The bushing is located where it cannot be exposed to oil, grease, oil vapor, or other substances that have a deleterious effect on the compound employed.

8.19 A bushing of any of the materials mentioned in paragraph 8.18 is acceptable on a supply cord anywhere in an appliance if it is used in conjunction with a type of cord for which an insulating bushing is not required. The edges of the hole in which such a bushing is so used shall be free from burrs, fins, and other conditions capable of damaging the bushing.

8.20 A bushing of the same material as and molded integrally with the supply cord is acceptable if the built-up section is no less than 1/16 inch (1.6 mm) thick at the point at which the cord passes through the enclosure.

8.21 An uninsulated metal grommet may be used in place of an insulating bushing if the insulating material is no thinner than 1/32 inch (0.8 mm), and completely fills the space between the grommet and the metal in which the grommet is mounted.