



UL 1431

STANDARD FOR SAFETY

Personal Hygiene and Health Care Appliances

UL Standard for Safety for Personal Hygiene and Health Care Appliances, UL 1431

Third Edition, Dated March 23, 2011

Summary of Topics

This revision of UL 1431 dated May 14, 2024 includes the following changes in requirements:

- Update to Section [32A](#) to reflect changes to UL 4200A***
- Embedded Power Units; [3.19.3](#), Sections [87](#) – [103](#)***

Text that has been changed in any manner or impacted by ULSE's electronic publishing system is marked with a vertical line in the margin.

The revised requirements are substantially in accordance with Proposal(s) on this subject dated March 15, 2024.

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1

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Comments or proposals for revisions on any part of the Standard may be submitted to ULSE at any time. Proposals should be submitted via a Proposal Request in ULSE's Collaborative Standards Development System (CSDS) at <https://csds.ul.com>.

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CONTENTS

INTRODUCTION

1	Scope	9
2	Glossary	9
3	Components	11
3.1	General	11
3.2	Attachment Plugs, Receptacles, Connectors, and Terminals	13
3.3	Batteries and Battery Chargers	13
3.4	Boxes and Raceways	14
3.5	Capacitors and Filters	14
3.6	Controls	14
3.7	Cords, Cables, and Internal Wiring	17
3.8	Cord Reels	17
3.9	Film-Coated Wire (Magnet Wire)	18
3.10	Gaskets and Seals	18
3.11	Ground-Fault, Arc-Fault, and Leakage Current Detectors / Interrupters	18
3.12	Heaters, Heating Elements and Pads	18
3.13	Insulation Systems	19
3.14	Light Sources and Associated Components	19
3.15	Marking and Labeling Systems	19
3.16	Motors and Motor Overload Protection	19
3.17	Overcurrent Protection	22
3.18	Polymeric Materials and Enclosures	22
3.19	Power Supplies	22
3.20	Printed Wiring Boards	23
3.21	Semiconductors and Small Electronic Components	23
3.22	Supplemental Insulation, Insulating Bushings, and Assembly Aids	24
3.23	Switches	24
3.24	Transformers	25
3.25	Valves (Electrically Operated) and Solenoids	25
3.26	Video and Audio Components	25
3.27	Induction Power Transmitters and Receivers for Use with Low Energy Products	26
4	Units of Measurement	26
5	References	26
6	General	26

CONSTRUCTION

7	General	26
8	Frame and Enclosure	26
9	Mechanical Assembly	34
10	Protection Against Corrosion	34
11	Supply Connections	35
11.1	Permanently connected products	35
11.2	Cord- and plug-connected products	37
12	Live Parts	42
13	Reservoir	42
14	Dispensers	42
15	Internal Wiring	42
16	Separation of Circuits	44
17	Printed Wiring	44
18	Heating Element	44
19	Electrical Insulation	44



20	Thermal Insulation.....	45
21	Overload Protection.....	45
22	Overtemperature Protection	45
23	Arc-Fault, and Leakage Current Detectors / Interrupters	45
24	Receptacles.....	46
25	Switches and Controls	46
26	Controls – End Product Test Parameters.....	46
	26.1 General.....	46
	26.2 Auxiliary Controls.....	46
	26.3 Operating Controls (regulating controls)	46
	26.4 Protective Controls (limiting controls)	48
	26.5 Controls using a Temperature Sensing Device	49
27	Transformers	49
28	Motors	51
	28.1 Construction	51
	28.2 Overload Protection	52
	28.3 Insulation Systems.....	52
29	Spacings	53
	29.1 Field-wiring terminals	53
	29.2 Primary circuits.....	53
	29.3 Secondary circuits	54
	29.4 Spacings on printed wiring boards	54
30	Grounding	55
31	Brushes and Brush Holders.....	55
32	Double Insulation	56
32A	Button Batteries or Coin Cell Batteries of Lithium Technologies.....	56

PROTECTION AGAINST INJURY TO PERSONS

33	General	56
34	Sharp Edges.....	56
35	Enclosures and Guards	57
36	Materials.....	57
37	Surface Temperatures	58
38	Stability	58
39	Strength of Handles.....	59
40	Rotating or Moving Members.....	59
41	Parts Subject to Pressure.....	59
42	Pressure-Relief Devices	60
43	Switches, Controls, and Interlocks	61

PERFORMANCE

44	General	62
45	Operational Test.....	62
46	Leakage Current Test	62
47	Leakage Current Following Humidity Conditioning Test	65
48	Starting Current Test.....	65
49	Input Test.....	66
50	Temperature Test	66
	50.1 General.....	66
	50.2 Maximum normal load.....	70
51	Dielectric Voltage-Withstand Test	71
	51.1 General.....	71
	51.2 Primary circuits.....	72

51.3	Secondary circuits	72
51.4	Maximum voltage	73
51.5	Induced potential	73
52	Immersion Test.....	73
53	Grounding Impedance Test	74
54	Abnormal Operation Tests.....	74
54.1	General.....	74
54.2	Output loading test.....	75
54.3	Switch position test	76
54.4	Component breakdown test.....	76
55	Connector Cycling Test	76
56	Reservoir Overflow Test.....	76
57	Dispenser Leakage Test	77
58	Cleaning Test.....	77
59	Thermostats Test.....	77
59.1	General.....	77
59.2	Overload	77
59.3	Endurance	78
60	Printed Wiring Assemblies Test	79
60.1	Dielectric voltage-withstand test.....	79
60.2	Limited power test.....	79
60.3	Abnormal operation test	81
60.4	Dielectric voltage-withstand or arcing test	81
61	Strain Relief Test	82
61.1	Supply cord test.....	82
61.2	Output or interconnecting cable strain relief test	82
62	Solenoids	82
63	General Purpose Transformers	83
63.1	General.....	83
63.2	Voltage Measurement Test	83
63.3	Overload Test.....	83
63.4	Repeated Dielectric Voltage-Withstand Test.....	84
64	Thermoplastic motor insulation systems.....	84
64.1	General.....	84
64.2	Abnormal conditioning.....	84
64.3	Overload-burnout conditioning.....	85
64.4	Thermal aging	85

MANUFACTURING AND PRODUCTION TESTS

65	Dielectric Voltage-Withstand Test	87
66	Grounding Continuity Test.....	89

RATINGS

67	Details.....	89
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MARKINGS

68	Details.....	89
68.1	General.....	89
68.2	Permanently-connected products.....	90
69	Servicing	91
70	Fuse Replacement	91
71	Oxygen.....	91



USE AND CARE INSTRUCTIONS

72	General	91
73	Warning Instructions	92
74	User Instructions	94
75	Grounding Instructions	94
76	Two-Wire Polarized Attachment Plug Instructions	96

HYDROMASSAGE UNITS

77	General	96
78	Construction	96
	78.1 General	96
	78.2 Cord-Connected Hydromassage Unit Immersion Protection	97
	78.3 Immersion-Detection Circuit Interrupters (IDCIs)	98
79	Performance	98
	79.1 Stability test – all types	98
	79.2 Siphoning and back flow test – air blower type	99
	79.3 Exposure to water test	99
	79.4 Immersion-Detection Circuit-Interrupter (IDCI) Trip Time Measurement Test	100
	79.5 Dew Point Humidity Test	101
	79.6 Conductive Coating Test	101
80	Marking and Instructions	102

APPLIANCES GENERATING ULTRAVIOLET (UV) RADIATION

81	General	103
82	Construction	103
83	Protection against injury to persons	103
	83.1 Protection from overexposure to ultraviolet radiation	103
	83.2 Protection from ozone emissions	104
	83.3 Glass covers and guards	105
84	Performance	105
	84.1 Ultraviolet irradiance test	105
	84.2 Ozone emissions	105
	84.3 Glass impact	107
85	Markings	107
86	Instructions	108

EMBEDDED POWER UNITS

87	General	109
88	Glossary	110
89	Protective Devices	110
90	Components	111
91	Coil Insulation	111
	91.1 General	111
	91.2 Insulation for transformers	111
92	Output Connections	114
93	Battery Charger Backfeed Protection	114

PERFORMANCE

94	General	114
95	Maximum Output Voltage Test	114



96	Output Current and Power Test and 15 W determination	115
96.1	General.....	115
96.2	Inherently limited	116
96.3	Not inherently limited	117
96.4	15 W determination at output	117
97	Calibration of Overcurrent Protection Devices Test.....	117
98	Temperature	118
99	Dielectric Voltage Withstand Test.....	118
100	Induced Potential.....	118
101	Endurance Test on Overcurrent- and Overtemperature-Protective Devices Contained in the Embedded Power Unit	118
102	Abnormal Tests	119
102.1	General.....	119
102.2	Output loading	120
102.3	Output loading – alternate method.....	121
102.4	Transformer burnout	121
102.5	Component breakdown	122
102.6	Backfeed protection	122
102.7	Blocked fan test	123
103	Tests on Insulating Materials	123

No Text on This Page

INTRODUCTION

1 Scope

1.1 These requirements cover household electric products having personal hygienics or health care applications, such as hydromassage units, contact lens disinfectors and cleaners, and toothbrushes, rated at 250 V or less, for use on premises wiring systems in accordance with the National Electrical Code.

1.2 These requirements do not cover professional medical and dental equipment, electrically heated pads, facial saunas, sun and heat lamps, permanently-installed whirlpool baths, spas and hot tubs, shavers, hair dryers, steam and dry heat cabinets or other equipment or products that are covered by separate, individual requirements separate from this Standard.

1.3 The requirements of this Standard do not consider the complete spectrum of physiological or therapeutic effects, beneficial or otherwise, except where generally recognized limits for conditions where a potential risk of injury to persons are defined.

2 Glossary

2.1 For the purpose of this Standard, the following definitions apply.

2.2 **ACCESSIBLE PART** – A part located so that it can be contacted by a person, either directly or by means of a probe or tool during user servicing, or that is not recessed the required distance behind an opening.

2.3 **APPLIANCE COUPLER** – A single-outlet, female contact device for attachment to a flexible cord as part of a detachable power-supply cord to be connected to an appliance inlet (motor attachment plug).

2.4 **APPLIANCE INLET (Motor Attachment Plug)** – A male contact device mounted on an end product appliance to provide an integral blade configuration for the connection of an appliance coupler or cord connector.

2.5 **APPLIANCE (FLATIRON) PLUG** – An appliance coupler type of device having a cord guard and a slot configuration specified for use with heating or cooking appliances.

2.6 **BASIC INSULATION** – The insulation applied to live parts to provide basic protection against electric shock. Basic insulation does not necessarily include insulation used exclusively for functional purposes.

2.7 **COMPONENT** – A device or fabricated part of the appliance covered by the scope of a safety standard dedicated to the purpose. When incorporated in an appliance, equipment otherwise typically field installed (e.g. luminaire) is considered to be a component. Unless otherwise specified, materials that compose a device or fabricated part, such as thermoplastic or copper, are not considered components.

2.8 **CORD CONNECTOR** – A female contact device wired on flexible cord for use as an extension from an outlet to make a detachable electrical connection to an attachment plug or, as an appliance coupler, to an equipment inlet.

2.9 **CONTROL, AUTOMATIC ACTION** – An appliance coupler type of device having a cord guard and a slot configuration specified for use with heating or cooking appliances.

2.10 **CONTROL, AUXILIARY** – A device or assembly of devices that provides a functional utility, is not relied upon as an operational or protective control, and therefore is not relied upon for safety. For example,

an efficiency control not relied upon to reduce the risk of electric shock, fire, or injury to persons during normal or abnormal operation of the end product is considered an auxiliary control.

2.11 CONTROL, MANUAL – A device that requires direct human interaction to activate or rest the control.

2.12 CONTROL, OPERATING – A device or assembly of devices, the operation of which starts or regulates the end product during normal operation. For example, a thermostat, the failure of which a thermal cutout/limiter or another layer of protection would mitigate the potential hazard, is considered an operating control. Operating controls are also referred to as “regulating controls”.

2.13 CONTROL, PROTECTIVE – A device or assembly of devices, the operation of which is intended to reduce the risk of electric shock, fire or injury to persons during normal and reasonably anticipated abnormal operation of the appliance. For example, a thermal cutout/limiter, or any other control/circuit relied upon for normal and abnormal conditions, is considered a protective control. Protective controls are also referred to as “limiting controls” and “safety controls”.

Note – During the evaluation of the protective control / circuit, the protective functions are verified under normal and single-fault conditions of the control.

2.14 CONTROL, TYPE 1 ACTION – The actuation of an automatic control for which the manufacturing deviation and the drift (tolerance before and after certain conditions) of its operating value, operating time, or operating sequence has not been declared and tested under this standard.

2.15 CONTROL, TYPE 2 ACTION – The actuation of an automatic control for which the manufacturing deviation and the drift (tolerance before and after certain conditions) of its operating value, operating time, or operating sequence have been declared and tested under this standard.

2.16 DOUBLE INSULATION – An insulation system comprised of basic insulation and supplementary insulation, with the two insulations physically separated and so arranged that they are not simultaneously subjected to the same deteriorating influences (temperature, contaminants, and the like) to the same degree. See [2.6](#), [2.25](#), and [2.28](#).

2.17 ENCLOSURE – An external portion of a product that serves to house or support component parts or both.

2.18 ENERGIZED (LIVE) PART – A part energized with respect to some other part or with respect to earth.

2.19 FIELD-WIRING TERMINAL – Any terminal to which a supply or other wire is to be connected by an installer is a field-wiring terminal. If the wire, to be connected to the terminal, is provided as part of the unit and a pressure terminal, connector, soldering lug, soldered loop, crimped eyelet, or other means for making the connection is factory-assembled to the wire, it is not a field wiring terminal.

2.20 INTERLOCK – A device used to de-energize electrical components or stop moving parts that become exposed when an enclosure is opened or when a cover is removed.

2.21 ISOLATING TRANSFORMER – A transformer of which one or more output windings is electrically separated from the input winding and all other output windings.

2.22 LIMITED ENERGY PRIMARY CIRCUIT – A line voltage circuit that incorporates a limiting impedance in series with the supply circuit so that:

a) The circuit potential on the load side of the limiting impedance does not exceed 42.4 V peak (the peak voltage of a 30-V sine wave), under normal conditions, and

b) The maximum energy available at the load side of the limiting impedance circuit is 15 VA under any condition, including abnormal operation.

2.23 LOW VOLTAGE CIRCUIT – A circuit involving an open circuit potential of not more than 42.4 V peak (the peak voltage of a 30-V sine wave) supplied by a primary battery, by a standard Class 2 transformer, or by a combination of a transformer and fixed impedance that, as a unit, complies with all performance requirements for Class 2 transformers.

2.24 OPERATOR (USER) SERVICING – Any form of servicing that might be performed by personnel other than qualified service personnel. Some examples are:

a) The attachment of accessories by means of attachment plugs and receptacles or by means of other separable connectors not involving disassembly or use of tools.

b) Resetting of circuit breakers or replacement of fuses, and lamps that are accessible without the use of tools.

c) Routine operating adjustments necessary to adapt the product for its different intended functions.

d) Routine cleaning and changing of filters.

2.25 REINFORCED INSULATION – Improved basic insulation with such mechanical and electrical qualities that it, in itself, provides the same degree of protection against electric shock as double insulation.

2.26 SAFETY CIRCUIT – Any circuit, either in the primary or secondary, that is relied upon to reduce the risk of fire, electric shock, or unintentional contact with moving parts, for example, an interlock circuit is considered to be a safety circuit.

2.27 SECONDARY CIRCUITS – Secondary circuits are those circuits supplied from transformer output windings that are electrically separated from the input windings.

2.28 SUPPLEMENTARY (PROTECTING) INSULATION – An independent insulation provided in addition to the basic insulation to protect against electrical shock in case of mechanical rupture or electrical breakdown of the basic insulation.

2.29 HYDROMASSAGE UNITS – For the purpose of this Standard, hydromassage units are considered to be two types:

Water Pump Type – A unit that agitates the bath water by having its moving parts in direct contact with the water, is considered to be of the water pump type.

Air Blower Type – A unit that agitates the bath water by means of air that is generated by the unit, and whose moving parts do not come in contact with the water, is considered to be of the air blower type.

3 Components

3.1 General

3.1.1 A component of a product covered by this standard shall:

- a) Comply with the requirements for that component as indicated in [3.2](#) – [3.26](#);
- b) Be used in accordance with its rating(s) established for the intended conditions of use;
- c) Be used within its established use limitations or conditions of acceptability;
- d) Additionally comply with the applicable requirements of this end product standard; and
- e) Not contain mercury, with the exception of fluorescent lamps.

Exception: As specified in [3.1.2](#) and [3.1.3](#).

Note – Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

3.1.2 A component of a product covered by this standard is not required to comply with a specific component requirement that:

- a) Involves a feature or characteristic not required in the application of the component in the product,
- b) Is superseded by a requirement in this standard, or
- c) Is separately investigated when forming part of another component, provided the component is used within its established ratings and limitations.

3.1.3 A component complying with a UL component standard other than those cited in [3.2](#) – [3.26](#) is acceptable if:

- a) The component also complies with the applicable component standard of [3.2](#) – [3.26](#); or
- b) The component standard:

3.1.4 A component that is also intended to perform other functions, such as over current protection, ground-fault circuit-interruption, surge suppression, any other similar functions, or any combination thereof, shall comply additionally with the requirements of the applicable UL standard(s) that cover devices that provide those functions.

Exception: Where these other functions are not required for the application and not identified as part of markings, instructions, or packaging for the appliance, the additional component standard(s) need not be applied.

3.1.5 A component not anticipated by the requirements of this standard, not specifically covered by the component standards of [3.2](#) – [3.26](#), and that involves a potential risk of electric shock, fire, or personal injury, shall be additionally investigated in accordance with the applicable UL standard, and shall comply with [3.1.1](#) b) – d).

3.1.6 With regard to a component being additionally investigated, reference to construction and performance requirements in another UL end product standard is appropriate where that standard anticipates normal and abnormal use conditions consistent with the application of UL 1431.

3.2 Attachment Plugs, Receptacles, Connectors, and Terminals

3.2.1 Attachment plugs, receptacles, appliance couplers, appliance inlets (motor attachment plugs), and appliance (flatiron) plugs, shall comply with the Standard for Attachment Plugs and Receptacles, UL 498. See [3.2.9](#).

Exception: Attachment plugs and appliance couplers integral to cord sets or power supply cords are covered under the requirements of UL 817 and need not comply with UL 498.

3.2.2 Quick-connect terminals, both connectors and tabs, for use with one or two 22 – 10 AWG copper conductors, having nominal widths of 2.8, 3.2, 4.8, 5.2, and 6.3 mm (0.110, 0.125, 0.187, 0.205, and 0.250 in), intended for internal wiring connections in appliances, or for the field termination of conductors to the appliance, shall comply with the Standard for Electrical Quick-Connect Terminals, UL 310.

Exception: Other sizes of quick-connect terminals shall be investigated with respect to crimp pull out, insertion-withdrawal, temperature rise, and all tests shall be conducted in accordance with UL 310.

3.2.3 Single and multipole connectors for use in data, signal, control and power applications within and between electrical equipment, and that are intended for factory assembly to copper or copper alloy conductors, or for factory assembly to printed wiring boards, shall comply with the Standard for Component Connectors for Data, Signal, Control and Power Applications, UL 1977. See [3.2.9](#).

3.2.4 Wire connectors shall comply with the Standard for Wiring Connectors, UL 486A-UL 486B.

3.2.5 Splicing wire connectors shall comply with the Standard for Splicing Wire Connectors, UL 486C.

3.2.6 Multi-pole splicing wire connectors that are intended to facilitate the connection of hard-wired utilization equipment to the branch-circuit conductors of buildings shall comply with the Standard for Multi-Pole Splicing Wire Connectors, UL 2459. See [3.2.9](#).

3.2.7 Equipment wiring terminals for use with all alloys of copper, aluminum, or copper-clad aluminum conductors, shall comply with Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors, UL 486E.

3.2.8 Terminal blocks shall comply with the Standard for Terminal Blocks, UL 1059, and, if applicable, be suitably rated for field wiring.

3.2.9 Female devices (such as receptacles, appliance couplers, and connectors) that are intended, or that may be used, to interrupt current in the end product, shall be suitably rated for current interruption of the specific type of load, when evaluated with its mating plug or connector. For example, an appliance coupler that can be used to interrupt the current of a motor load shall have a suitable horsepower rating when tested with its mating plug.

3.3 Batteries and Battery Chargers

3.3.1 A lithium ion (Li-On) single cell battery shall comply with the requirements for secondary lithium cells in the Standard for Lithium Batteries, UL 1642. A lithium ion multiple cell battery, and a lithium ion battery pack, shall comply with the applicable requirements for secondary lithium cells or battery packs in the Standard for Household and Commercial Batteries, UL 2054.

3.3.2 Rechargeable nickel cadmium (Ni-Cad) cells and battery packs shall comply with the applicable construction and performance requirements of this end product standard.

3.3.3 Rechargeable nickel metal-hydride (Ni-MH) battery cells and packs shall comply with construction and performance requirements of this end product standard, or the applicable requirements for secondary cells or battery packs in the Standard for Household and Commercial Batteries, UL 2054.

3.3.4 Primary batteries (non-rechargeable) that comply with the relevant UL standard and [3.1](#) are considered to fulfill the requirements of this Standard.

3.3.5 A Class 2 battery charger shall comply with one of the following:

- a) Standard for Class 2 Power Units, UL 1310; or
- b) Standard for Information Technology Equipment – Safety – Part 1: General Requirements, UL 60950-1, with an output marked "Class 2", or that complies with the limited power source (LPS) requirements and is marked "LPS"; or
- c) Standard for Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements, UL 62368-1 with an output marked "Class 2", or that complies with the limited power source (LPS) requirements and is marked "LPS".

3.3.6 A non-Class 2 battery charger shall comply with one of the following:

- a) Standard for Power Units Other Than Class 2, UL 1012; or
- b) Standard for Information Technology Equipment – Safety – Part 1: General Requirements, UL 60950-1; or
- c) Standard for Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements, UL 62368-1.

3.4 Boxes and Raceways

3.4.1 Electrical boxes and the associated bushings and fittings, and raceways, of the types specified in Chapter 3 of NFPA 70 and that comply with the relevant UL standard (such as UL 514A, UL 514C, UL 514D) and [3.1](#), General, are considered to fulfill the requirements of this standard.

3.5 Capacitors and Filters

3.5.1 The component requirements for a capacitor are not specified. A capacitor complying with the Standard for Capacitors, UL 810.

3.5.2 Electromagnetic interference filters with integral enclosures that comply with the Standard for Electromagnetic Interference Filters, UL 1283.

3.6 Controls

3.6.1 General

3.6.1.1 Auxiliary controls shall be evaluated using the applicable requirements of this end product standard and the parameters in Section [26](#).

3.6.1.2 Operating (regulating) controls shall be evaluated using the applicable component standard requirements specified in [3.6.2](#) – [3.6.7](#), and if applicable, the parameters in Section [26](#), unless otherwise specified in this end product standard.

3.6.1.3 Operating controls that rely upon software for the normal operation of the end product where deviation or drift of the control may result in a hazard, such as a speed control unexpectedly changing its output, shall comply with the:

- a) Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991; and Standard for Software in Programmable Components, UL 1998; or
- b) Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1.

3.6.1.4 Protective (limiting) controls shall be evaluated using the applicable component standard requirements specified in [3.6.2](#) – [3.6.7](#), and if applicable, the parameters in Section [26](#), unless otherwise specified in this end product standard.

3.6.1.5 Solid-state protective controls that do not rely upon software as a protective component shall comply with the:

- a) Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991; or
- b) Standard for Automatic Electrical Controls for Household and Similar Use, UL 60730-1, except Clause H 11.12 (Controls using software).

3.6.1.6 Protective controls that rely upon software as a protective component shall comply with the:

- a) Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991; and Standard for Software in Programmable Components, UL 1998; or
- b) Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1.

3.6.1.7 An electronic, non-protective control that is simple in design need only be subjected to the applicable requirements of this end-product standard. A control that does not include an integrated circuit or microprocessor, but does consist of a discrete switching device, capacitors, transistors, and resistors, is considered simple in design. See Section [54](#).

3.6.2 Electromechanical and Electronic Controls

3.6.2.1 A control, other than as specified in [3.6.3](#) – [3.6.7](#), shall comply with the:

- a) Standard for Solid-State Controls for Appliances, UL 244A;
- b) Standard for Temperature-Indicating and -Regulating Equipment, UL 873; or
- c) Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1.

3.6.3 Liquid Level Controls

3.6.3.1 A liquid level control shall comply with the:

- a) Standard for Solid-State Controls for Appliances, UL 244A;
- b) Standard for Temperature-Indicating and -Regulating Equipment, UL 873;
- c) Standard for Industrial Control Equipment, UL 508; or

d) Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1; and the

1) Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Automatic Electrical Water Level Controls of the Float Type for Household and Similar Applications, UL 60730-2-16A; or

2) Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Automatic Electrical Water and Air Flow Sensing Controls, Including Mechanical Requirements, UL 60730-2-18.

3.6.4 Motor and Speed Controls

3.6.4.1 A control used to start, stop, regulate or control the speed of a motor shall comply with the:

a) Standard for Solid-State Controls for Appliances, UL 244A;

b) Standard for Temperature-Indicating and -Regulating Equipment, UL 873;

c) Standard for Industrial Control Equipment, UL 508;

d) Standard for Adjustable Speed Electrical Power Drive Systems – Part 5-1: Safety Requirements – Electrical, Thermal and Energy, UL 61800-5-1; or

e) Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1.

3.6.5 Pressure Controls

3.6.5.1 A pressure control shall comply with one of the following:

a) Standard for Temperature-Indicating and -Regulating Equipment, UL 873;

b) Standard for Industrial Control Equipment, UL 508;

c) Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1; and the Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Automatic Electrical Pressure Sensing Controls Including Mechanical Requirements, UL 60730-2-6, or

d) Standard for Limit Controls, UL 353.

3.6.6 Temperature Controls

3.6.6.1 A temperature control shall comply with the:

a) Standard for Solid-State Controls for Appliances, UL 244A;

b) Standard for Temperature-Indicating and -Regulating Equipment, UL 873;

c) Standard for Industrial Control Equipment, UL 508; or

d) Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1; and the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Temperature Sensing Controls, UL 60730-2-9.

Exception: A thermostat used in a heating pad assembly that complies with Section 59 of this end product standard is considered to meet the intent of this requirement.

3.6.6.2 A temperature sensing positive temperature coefficient (PTC) or negative temperature coefficient (NTC) thermistor, that performs the same function as an operating or protective control shall comply with the Standard for Thermistor-Type Devices, UL 1434.

3.6.6.3 A thermal cutoff shall comply with the Standard for Thermal-Links (Thermal Cutoffs) for Use in Electrical Appliances and Components, UL 60691.

3.6.7 Timer Controls

3.6.7.1 A timer control shall comply with the:

- a) Standard for Solid-State Controls for Appliances, UL 244A; or
- b) Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1; and the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Timers and Time Switches, UL 60730-2-7.

3.7 Cords, Cables, and Internal Wiring

3.7.1 A cord set or power supply cord shall comply with the Standard for Cord Sets and Power Supply Cords, UL 817.

3.7.2 Flexible cords and cables shall comply with the Standard for Flexible Cords and Cables, UL 62. Flexible cord and cables are considered to fulfill this requirement when pre-assembled in a cord set or power supply cord complying with the Standard for Cord Sets and Power Supply Cords, UL 817.

3.7.3 Internal wiring composed of insulated conductors shall comply with the Standard for Appliance Wiring Material, UL 758.

Exception No. 1: Insulated conductors need not comply with UL 758 if they comply with one of the following:

- a) *Standard for Thermoset-Insulated Wires and Cables, UL 44;*
- b) *Standard for Thermoplastic-Insulated Wires and Cables, UL 83;*
- c) *Standard for Fixture Wire, UL 66; or*
- d) *The appropriate UL standard(s) for other insulated conductor types specified in Chapter 3 (Wiring Methods and Materials) of NFPA 70.*

Exception No. 2: Insulated conductors for specialty applications (e.g. data processing or communications) and located in a low-voltage circuit not involving the risk of fire or personal injury need not comply with UL 758.

3.8 Cord Reels

3.8.1 A cord reel shall comply with the special-use cord reel requirements of the Standard for Cord Reels, UL 355.

3.9 Film-Coated Wire (Magnet Wire)

3.9.1 The component requirements for film coated wire and Class 105 (A) insulation systems are not specified.

3.9.2 Film coated wire in intimate combination with one or more insulators, and incorporated in an insulation system rated Class 120 (E) or higher, shall comply with the magnet wire requirements in the Standard for Systems of Insulating Materials – General, UL 1446.

3.10 Gaskets and Seals

3.10.1 Gaskets and seals shall comply with the Standard for Gaskets and Seals, UL 157 if they are used to prevent wetting of live parts as determined by the performance testing of this end product standard.

3.11 Ground-Fault, Arc-Fault, and Leakage Current Detectors / Interrupters

3.11.1 Ground-fault circuit-interrupters (GFCI) for protection against electrical shock shall comply with the Standard for Ground-Fault Circuit-Interrupters, UL 943. The following statement, or equivalent, shall be included as a marking near the GFCI, or as an instruction in the manual: “ Press the TEST button (then RESET button) every month to assure proper operation.”

3.11.2 Appliance-leakage-current interrupters (ALCI) for protection against electrical shock shall comply with Appliance-Leakage-Current Interrupters, UL 943B.

Note – An ALCI is not considered an acceptable substitute for a GFCI when NFPA 70 requires a GFCI.

3.11.3 Equipment ground-fault protective devices shall comply with the Standard for Ground-Fault Sensing and Relaying Equipment, UL 1053, and the applicable requirements of the Standard for Ground-Fault Circuit-Interrupters, UL 943.

3.11.4 Arc-fault circuit-interrupters (AFCI) shall comply with the Standard for Arc-Fault Circuit-Interrupters, UL 1699. See Section [23](#).

3.11.5 Leakage-current detector-interrupters (LCDI) and any shielded cord between the LCDI and appliance shall comply with the Standard for Arc-Fault Circuit-Interrupters, UL 1699. See Section [23](#).

3.12 Heaters, Heating Elements and Pads

3.12.1 Electric resistance heating elements shall comply with the construction requirements of the:

- a) Standard for Electric Heating Appliances, UL 499; or
- b) Standard for Sheathed Heating Elements, UL 1030.

Exception: Heating wire (e.g. rope heater) that complies with the Standard for Appliance Wiring Material, UL 758, and the requirements of this end product standard are considered to fulfill this requirement.

3.12.2 Thermistor-type heaters (e.g. PTC and NTC heaters) shall comply with the Standard for Thermistor-Type Devices, UL 1434.

3.12.3 A heating pad assembly shall comply with the applicable requirements in the Standard for Electric Heating Pads, UL 130.

3.13 Insulation Systems

3.13.1 Materials used in a Class 105 (A) insulation system shall comply with Section [28.3](#).

3.13.2 Materials used in an insulation system that operates above Class 105 (A) temperatures shall comply with the Standard for Systems of Insulating Materials - General, UL 1446.

3.13.3 All insulation systems employing integral ground insulation shall comply with the requirements specified in the Standard for Systems of Insulating Materials – General, UL 1446.

3.14 Light Sources and Associated Components

3.14.1 Lampholders and indicating lamps shall comply with the Standard for Lampholders, UL 496.

Exception: Lampholders forming part of a luminaire that complies with an applicable UL luminaire standard are considered to fulfill this requirement.

3.14.2 Lighting ballasts shall comply with the:

- a) Standard for Fluorescent-Lamp Ballasts, UL 935; or
- b) Standard for High-Intensity Discharge Lamp Ballasts, UL 1029.

Exception No. 1: Ballasts forming part of a luminaire that complies with an applicable UL luminaire standard are considered to fulfill this requirement.

Exception No. 2: Ballasts for other light sources shall comply with the applicable UL standard(s).

3.14.3 Light emitting diode (LED) light sources shall comply with the Standard for Light Emitting Diode (LED) Light Sources For Use In Lighting Products, UL 8750.

Exception No. 1: LED light sources forming part of a luminaire that complies with an applicable UL luminaire standard are considered to fulfill this requirement.

Exception No. 2: Individual LED light sources mounted on printed wiring boards and intended for indicating purposes need not comply with UL 8750, but shall comply with the applicable requirements of this end product standard.

3.15 Marking and Labeling Systems

3.15.1 A marking and labeling system shall comply with UL 969 (Marking and Labeling Systems) under the specified environmental conditions.

3.16 Motors and Motor Overload Protection

3.16.1 General

3.16.1.1 General-purpose type motors having a NEMA frame size shall comply with the requirements specified in [3.16.2](#). This includes fractional HP motors rated up to 1 HP (typically NEMA frame sizes 42, 48, or 56), and integral HP motors rated 1 HP and greater (typically NEMA frame sizes 140 – 449T).

3.16.1.2 Motors not enclosed, or partially enclosed, by the end product enclosure shall comply with the requirements specified in [3.16.2](#).

3.16.1.3 Component type motors completely enclosed within the end product enclosure shall comply with the requirements specified in [3.16.2](#) or [3.16.3](#).

3.16.1.4 Motors located in a low voltage circuit are evaluated for the risk of fire and personal injury in accordance with the applicable requirements of this end product standard.

3.16.1.5 Low voltage component fans that comply with the Standard for Electric Fans, UL 507 used for air handling only are considered to meet the requirements of this end product standard.

3.16.2 General-purpose type motors

3.16.2.1 A general-purpose type motor shall comply with the Standard for Rotating Electrical Machines – General Requirements, UL 1004-1.

3.16.3 Component type motors

3.16.3.1 Component type motors shall comply with either [3.16.3.2](#) or [3.16.3.3](#).

3.16.3.2 The motor shall comply with the Standard for Rotating Electrical Machines – General Requirements, UL 1004-1 except as noted in [Table 3.1](#).

Table 3.1
Superseded requirements

UL 1004-1 Exempted Requirement	Superseded by UL 1431 Requirements
Cord-Connected Motors, Section 15	11.2
Factory Wiring Terminals and Leads, Section 17	Section 15
Electrical Insulation, Section 22	Section 19
Non-Metallic Functional Parts, Section 28	Sections 8 , 19
Solid-State Controls, 7.2	3.6
Non-metallic enclosure thermal aging, 9.1.4	8.5
Motor enclosure, 9.2 – 9.4	Section 8
Grounding, Sections 10 and 11	Section 30
Ventilation Openings, Section 12: only applicable where the openings are on surfaces considered to be the appliance enclosure	8.5
Accessibility of Uninsulated Live Parts, Film-Coated Wire, and Moving Parts, Section 13	8.7- 8.19
Protection Against Corrosion, Section 14	Section 10
Switch, Section 27 is not applicable to centrifugal starting switches	Section 25
With the exception of Sections 35 and 40 (Resilient Elastomer Mounting and Electrolytic Capacitor Tests, respectively), the performance tests of UL 1004-1 are not applicable	All applicable performance tests.
Only the following marking requirements specified in 43.1 of UL 1004-1 are applicable: manufacturer's name or identification; rated voltage; rated frequency; number of phases if greater than 1; and multi-speed motors, other than a shaded-pole or a permanent-split-capacitor motor, shall be marked with the amperes and horsepower at each speed	68.1

3.16.3.3 The motor shall comply with the applicable component requirements in Section [3](#), the following construction requirements, and the applicable performance requirements (when tested in conjunction with the end product), of this end product standard:

- a) Protection against corrosion, Section [10](#).
- b) Terminal compartment, Section [11](#)
- c) Insulating Material, Section [19](#).
- d) Internal wiring, Section [15](#).
- e) Grounding, Section [30](#).
- f) Spacings, Section [29](#).

3.16.4 Motor Overload Protection

3.16.4.1 Thermal protection devices integral with the motor shall comply with the:

- a) Standard for Overheating Protection for Motors, UL 2111;
- b) Standard for Thermally Protected Motors, UL 1004-3; or
- c) Standard for Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements, UL 60730-1; and the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2 Particular Requirements for Thermal Motor Protectors, UL 60730-2-2; in conjunction with the Standard for Thermally Protected Motors, UL 1004-3 (to evaluate the motor-protector combination).

3.16.4.2 Impedance protection shall comply with the:

- a) Standard for Overheating Protection for Motors, UL 2111; or
- b) Standard for Impedance Protected Motors, UL 1004-2.

3.16.4.3 Electronic protection integral to the motor shall comply with the Standard for Electronically Protected Motors, UL 1004-7.

3.16.4.4 Except as indicated in [3.16.4.3](#), electronically protected motor circuits shall comply with one of the following. See [3.6.4](#) for basic control requirements.

- a) Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991. When the protective electronic circuit is relying upon software as a protective component, it shall comply with the requirements in the standard for tests for Software in Programmable Components, UL 1998. If software is relied upon to perform a safety function, it shall be considered software Class 1;
- b) Standard for Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements, UL 60730-1. If software is relied upon to perform a safety function, it shall be considered software Class B; or
- c) Standard for Adjustable Speed Electrical Power Drive Systems – Part 5-1: Safety Requirements – Electrical, Thermal and Energy, UL 61800-5-1.

Exception: Compliance with the above standards is not required for an electronically protected motor circuit if there is no risk of fire, electric shock, or casualty hazard during abnormal testing with the motor electronic circuit rendered ineffective; compliance with the applicable requirements of this end product standard is then required.

3.17 Overcurrent Protection

3.17.1 Fuses shall comply with the Standard for Low-Voltage Fuses – Part 1: General Requirements, UL 248-1; and the applicable UL 248 Part 2 (e.g. UL 248-5). Defined use fuses that comply with UL 248-1 and another appropriate UL standard for the fuse are considered to fulfill this requirement.

3.17.2 Fuseholders shall comply with the:

- a) Standard for Fuseholders, UL 512; or
- b) Standard for Fuseholders – Part 1: General Requirements, UL 4248-1, and the applicable Part 2 (e.g. UL 4248-9).

3.17.3 Circuit breakers shall comply with the Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures, UL 489.

Exception: Circuit breakers used in telecommunications circuitry that comply with the Standard for Circuit Breakers For Use in Communications Equipment, UL 489A, need not comply with UL 489.

3.17.4 Circuit breakers having integral ground fault circuit interrupter capability for protection against electrical shock shall additionally comply with the Standard for Ground-Fault Circuit-Interrupters, UL 943.

3.17.5 Supplementary protectors shall comply with the Standard for Supplementary Protectors for Use in Electrical Equipment, UL 1077.

3.17.6 Fusing resistors shall comply with the Standard for Fusing Resistors and Temperature-Limited Resistors for Radio- and Television-Type Appliances, UL 1412.

3.18 Polymeric Materials and Enclosures

3.18.1 Unless otherwise specified in this end product standard, polymeric electrical insulating materials and enclosures shall comply with the applicable requirements of the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

3.18.2 Metallized or painted polymeric parts or enclosures shall comply with the applicable requirements of the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. This requirement is not applicable to exterior surfaces of polymeric enclosure materials or parts provided that the metallized coating or paint does not offer a continuous path for an internal flame to propagate externally.

3.19 Power Supplies

3.19.1 A Class 2 power supply shall comply with one of the following:

- a) Standard for Class 2 Power Units, UL 1310; or
- b) Standard for Information Technology Equipment Safety – Part 1: General Requirements, UL 60950-1, with an output marked "Class 2", or that complies with the limited power source (LPS) requirements and is marked "LPS"; or
- c) Standard for Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements, UL 62368-1 with an output marked "Class 2", or that complies with the limited power source (LPS) requirements and is marked "LPS".

3.19.2 A non-Class 2 power supply shall comply with one of the following:

- a) Standard for Power Units Other Than Class 2, UL 1012; or
- b) Standard for Information Technology Equipment, Part 1: General Requirements, UL 60950-1.

3.19.3 Embedded power units shall comply with the requirements of this Standard including those requirements found in Sections [87](#) – [103](#).

3.20 Printed Wiring Boards

3.20.1 Printed wiring boards, including the coatings, shall comply with the Standard for Printed Wiring Boards, UL 796.

Exception No. 1: A printed-wiring board in a Class 2 nonsafety circuit is not required to comply with the bonding requirements in UL 796 if the board is separated from parts of other circuits such that loosening of the bond between the foil conductor and the base material will not result in the foil conductors or components coming in contact with parts of other circuits of the control or of the end-use product.

Exception No. 2: Printed-wiring boards complying with Section [17](#) and the performance tests of Section [60](#) need not comply with UL 796.

3.21 Semiconductors and Small Electronic Components

3.21.1 A power switching semiconductor device that is relied upon to provide isolation to ground shall comply with the Standard of Safety for Electrically Isolated Semiconductor Devices, UL 1557. The dielectric voltage withstand tests required by UL 1557 shall be conducted applying the criteria of Section [51](#) of this end product standard.

3.21.2 An optical isolator that is relied upon to provide isolation between primary and secondary circuits or between other circuits as required by this end product standard shall comply with the Standard for Safety for Optical Isolators, UL 1577. The dielectric voltage withstand tests required by UL 1577 shall be conducted applying the criteria of Section [51](#) of this end product standard.

3.21.3 Except as specified in [3.21.4](#), component requirements are not specified for small electronic components on printed wiring boards, including diodes, transistors, resistors, inductors, integrated circuits, and capacitors not directly connected to the supply source.

3.21.4 Where an electronic component is determined to be a critical component during the testing of UL 1431, Section [54](#) (Abnormal Operation Test), one of the following standards shall be applied. See [26.4](#) of this end product standard for the test parameters to be used.

- a) Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991, including its Follow-Up Program; and as applicable, the Standard for Software in Programmable Components, UL 1998 for controls that rely upon software as a protective component; or
- b) Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1.

3.21.5 A critical component is a component that performs one or more safety-related functions whose failure results in a condition, such as the risk of fire, electric shock, or injury to persons, in the end product application.

3.21.6 A critical component may also be identified using a failure-mode and effect analysis (FMEA) in accordance with Failure-Mode and Effect Analysis (FMEA), Section 7 of UL 991.

3.21.7 Portions of a circuit comprised of a microcontroller or other programmable device that performs a back-up, limiting, or other safety function intended to reduce the risk of fire, electric shock, or injury to persons shall comply with the Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1, Annex H.

3.22 Supplemental Insulation, Insulating Bushings, and Assembly Aids

3.22.1 The requirements for supplemental insulation (e.g. tape, sleeving or tubing) are not specified unless the insulation or device is required to fulfill [32.1](#) or a performance requirement of this standard. In such cases:

- a) Insulating tape shall comply with the Standard for Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape, UL 510;
- b) Sleeving shall comply with the Standard for Coated Electrical Sleeving, UL 1441;
- c) Tubing shall comply with the Standard for Extruded Insulating Tubing, UL 224.

3.22.2 Wire positioning devices shall comply with Sections [16](#) and [19](#). A device that complies with the Standard for Positioning Devices, UL 1565, is considered to fulfill this requirement.

3.22.3 Insulating bushings that comply with Section [3.1](#) of this end product standard, and the Standard for Insulating Bushings, UL 635, are considered to fulfill the requirements of this Standard. Tests specified in this Standard (e.g. Strain Relief Test) may still need to be performed to confirm the combination of the insulating bushing and the supporting part are suitable.

3.23 Switches

3.23.1 Switches shall comply with one of the following, as applicable:

- a) Standard for Special-Use Switches, UL 1054;
- b) Standard for Switches for Appliances – Part 1: General Requirements, UL 61058-1;
- c) Standard for General-Use Snap Switches, UL 20; or
- d) Standard for Nonindustrial Photoelectric Switches for Lighting Control, UL 773A.

Exception: Switching devices that comply with the appropriate UL standard for specialty applications (e.g. transfer switch equipment), industrial use (e.g. contactors, relays, auxiliary devices), or are integral to another component (e.g. switched lampholder) need not comply.

3.23.2 A clock-operated switch, in which the switching contacts are actuated by a clock-work, by a gear-train, by electrically-wound spring motors, by electric clock-type motors, or by equivalent arrangements shall comply with one of the following:

- a) Standard for Clock-Operated Switches, UL 917; or
- b) Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1; and the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Timers and Time Switches, UL 60730-2-7.

3.23.3 A timer or time switch, incorporating electronic timing circuits or switching circuits, with or without separable contacts, shall comply with the requirements for an operating control with Type 1 action for 6000 cycles of operation, or as a manual control for 5000 cycles of operation, in accordance with the following:

- a) Standard for Solid-State Controls for Appliances, UL 244A; or
- b) Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1; and the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Timers and Time Switches, UL 60730-2-7.

3.23.4 A timer or time switch, incorporating electronic timing circuits or switching circuits, with or without separable contacts, that functions as a protective control, shall comply with the requirements for a protective control; see [3.6.1.3](#).

3.24 Transformers

3.24.1 General-purpose transformers shall comply with the Standard for Low Voltage Transformers: General Requirements, UL 5085-1; and the Standard for Low Voltage Transformers: General Purpose Transformers, UL 5085-2.

Exception No. 1: A transformer that is completely enclosed within the end product enclosure, and that meets the applicable construction and performance requirements of this end product standard when tested in conjunction with the end product, meets the intent of this requirement.

Exception No. 2: A transformer that complies with the Standard for Transformers and Motor Transformers for Use in Audio-, Radio-, and Television-Type Appliances, UL 1411, and that is used in a circuit involving an audio or video component, meets the intent of this requirement.

3.24.2 Class 2 and Class 3 transformers shall comply with the Standard for Low Voltage Transformers: General Requirements, UL 5085-1; and the Standard for Low Voltage Transformers: Class 2 and Class 3 Transformers, UL 5085-3.

Exception: Transformers located in a low voltage circuit, and that do not involve a risk of fire or personal injury, need not comply with this requirement.

3.25 Valves (Electrically Operated) and Solenoids

3.25.1 Electrically operated valves shall comply with the:

- a) Standard for Electrically Operated Valves, UL 429; or
- b) Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1; and the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Electrically Operated Water Valves, Including Mechanical Requirements, UL 60730-2-8.

3.25.2 Solenoids shall comply with the applicable construction and performance requirements of this end-product standard.

3.26 Video and Audio Components

3.26.1 A video component (e.g. a television or video) or an audio component (such as a CD player, radio, MP3 player, or audio sound system) provided shall comply with the following:

- a) The Standard for Audio, Video, and Similar Electronic Apparatus-Safety Requirements, UL 60065; or
- b) The Standard for Information Technology Equipment – Part 1: General Requirements, UL 60950-1; or
- c) Standard for Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements, UL 62368-1.

3.26.2 The location, orientation, and intended use of a video or audio component shall be evaluated with the massage or exercise machine to ensure that the component(s) does not increase the risk of shock, fire, or personal injury. Examples include, but are not limited to, the mechanical mounting of the component, and the effect of the audio and video component on the overall leakage current of the machine.

3.27 Induction Power Transmitters and Receivers for Use with Low Energy Products

3.27.1 Induction power transmitters and receivers typically used for charging batteries shall comply with the requirements of the Standard for Induction Power Transmitters and Receivers for use with Low Energy Products, UL 2738.

4 Units of Measurement

4.2 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

5 References

5.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

6 General

6.1 Requirements in this Standard apply generally to all personal hygiene and health care products and are supplemented by requirements for specific products. Throughout these requirements, the term "product" is used broadly to refer to any personal hygiene and health care product and its associated control assembly.

CONSTRUCTION

7 General

7.1 A container for liquid intended for use with the product, and supplied as part of the product, shall comply with applicable construction requirements.

8 Frame and Enclosure

8.1 The frame and enclosure of a product shall have the strength and rigidity necessary to resist the abuses likely to be encountered during intended service. The degree of resistance inherent in the product shall preclude total or partial collapse with the attendant reduction of spacings, loosening or displacement of parts, and other conditions which alone or in combination constitute an increase in the risk of fire, electric shock, or injury to persons.

8.2 A risk of fire is considered to exist at a component part or assembly if an investigation shows that the supply for such part or assembly is capable of delivering a power of more than 15 W into an external resistor connected between the point in question and any return to the power supply.

8.3 A risk of electric shock is considered to exist at parts accessible only to the user or operator during intended use or user servicing if the voltage exceeds 42.4 V peak (the peak voltage of a 30-V sine wave) and the available current exceeds the leakage current levels specified in Leakage Current Test, Section [46](#).

8.4 Among the factors taken into consideration in determining the acceptability of an enclosure are its:

- a) Physical strength,
- b) Resistance to impact,
- c) Moisture absorptive properties,
- d) Combustibility,
- e) Resistance to corrosion, and
- f) Resistance to distortion at temperatures to which the enclosure may be subjected under conditions of normal or abnormal use.

For a nonmetallic enclosure, all of these factors are considered with respect to thermal aging.

8.5 A polymeric enclosure shall comply with the applicable requirements in Section 4, Enclosures – General, in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. A polymeric enclosure used in the construction of cord connected equipment that is fixed or permanently installed to the building structure, such as plumbing, shall have a flammability rating of 5VA in accordance with UL 746C.

Exception: A portable unattended household appliance employing an HB enclosure may be considered acceptable if the appliance complies with Section 5, Portable Unattended Household Equipment – Alternate Path, in UL 746C.

8.6 The minimum thickness of a metal enclosure shall be as indicated in [Table 8.1](#).

Table 8.1
Minimum acceptable thicknesses of enclosure material

Metal	At small, flat, unreinforced surfaces and at surfaces that are reinforced by curving, ribbing and the like or are otherwise of a shape and/or size to provide physical strength		At surfaces to which a wiring system is to be connected in the field		At relatively large unreinforced flat surfaces	
	Inches	Millimeters	Inches	Millimeters	Inches	Millimeters
Die-cast	3/64	1.2	–	–	5/64	2.0
Cast malleable iron	1/16	1.6	–	–	3/32	2.4
Other cast metal	3/32	2.4	–	–	1/8	3.2
Uncoated sheet steel	0.026 ^a	0.66 ^a	0.032	0.81	0.026	0.66

Table 8.1 Continued on Next Page

Table 8.1 Continued

Metal	At small, flat, unreinforced surfaces and at surfaces that are reinforced by curving, ribbing and the like or are otherwise of a shape and/or size to provide physical strength		At surfaces to which a wiring system is to be connected in the field		At relatively large unreinforced flat surfaces	
	Inches	Millimeters	Inches	Millimeters	Inches	Millimeters
Galvanized sheet steel	0.029 ^a	0.74 ^a	0.034	0.86	0.029	0.74
Nonferrous sheet metal	0.036 ^a	0.91 ^a	0.045	1.14	0.036	0.91
^a Thinner sheet metal may be employed if found to be acceptable when the enclosure is evaluated under considerations such as those mentioned in 8.4 .						

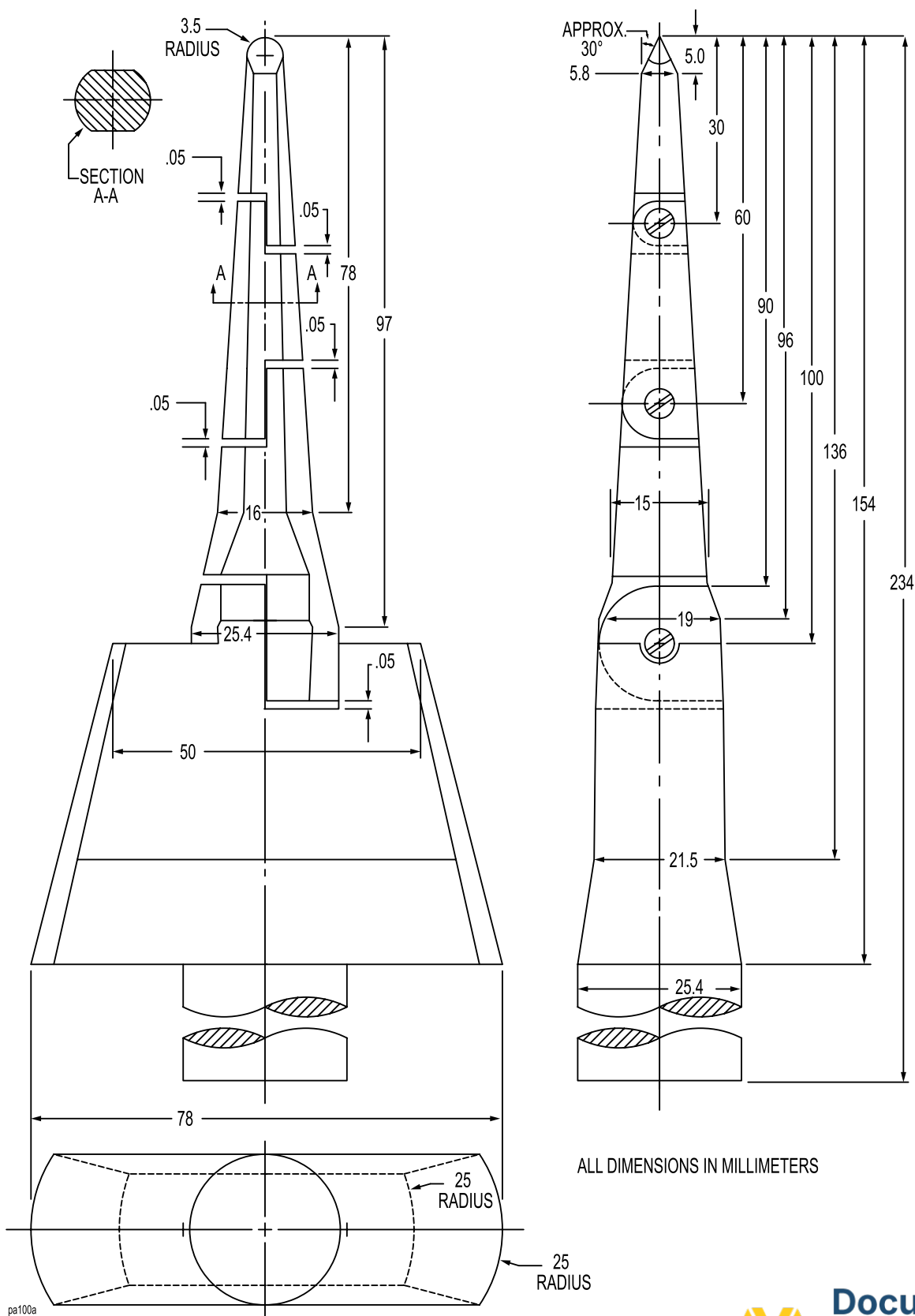
8.7 An electrical part of the product shall be so located or enclosed that protection against unintentional contact with any uninsulated live part and internal wiring will be provided.

8.8 A live part of a limited energy primary circuit is considered to require the same degree of protection against unintentional contact as is required of a live part of a line voltage circuit.

8.9 In connection with the requirements in [8.7](#), a part of the outer enclosure that may be removed without the use of a tool – to provide for the attachment of accessories, to allow access to means for making operating adjustment, or for another reason – is to be disregarded. It will not be assumed that the part in question affords protection against risk of electric shock.

8.10 In the enclosure of a product, an opening that a 1 inch (25.4 mm) diameter rod will not enter is acceptable if a probe as illustrated in [Figure 8.1](#) cannot be made to touch any part that involves a risk of electric shock to earth ground when inserted through the opening.

Figure 8.1
Accessibility probe



8.11 With respect to the application of the requirement of [8.10](#), the probe may be articulated into any configuration and may be rotated or angled to any position before, during, or after insertion into the opening, and the penetration may be to any depth allowed by the opening size, including minimal depth combined with maximal articulation.

8.12 An opening that has a minor dimension of 1 inch (25.4 mm) or more, in an enclosure, as illustrated in [Figure 8.2](#), is acceptable if, within the enclosure, there is no uninsulated live part or film-coated wire, that involves a risk of electric shock, less than, R distance from the inside edge of the perimeter of the opening and X distance from the plane of the opening. T equals the enclosure thickness, R equals X minus T, and X equals five times the diameter of the largest round rod that can be inserted through the opening but not less than 6-1/16 inches (154 mm). In evaluating an opening, any barrier located within the volume is to be ignored unless it intersects the boundaries of the volume in a continuous, closed line.

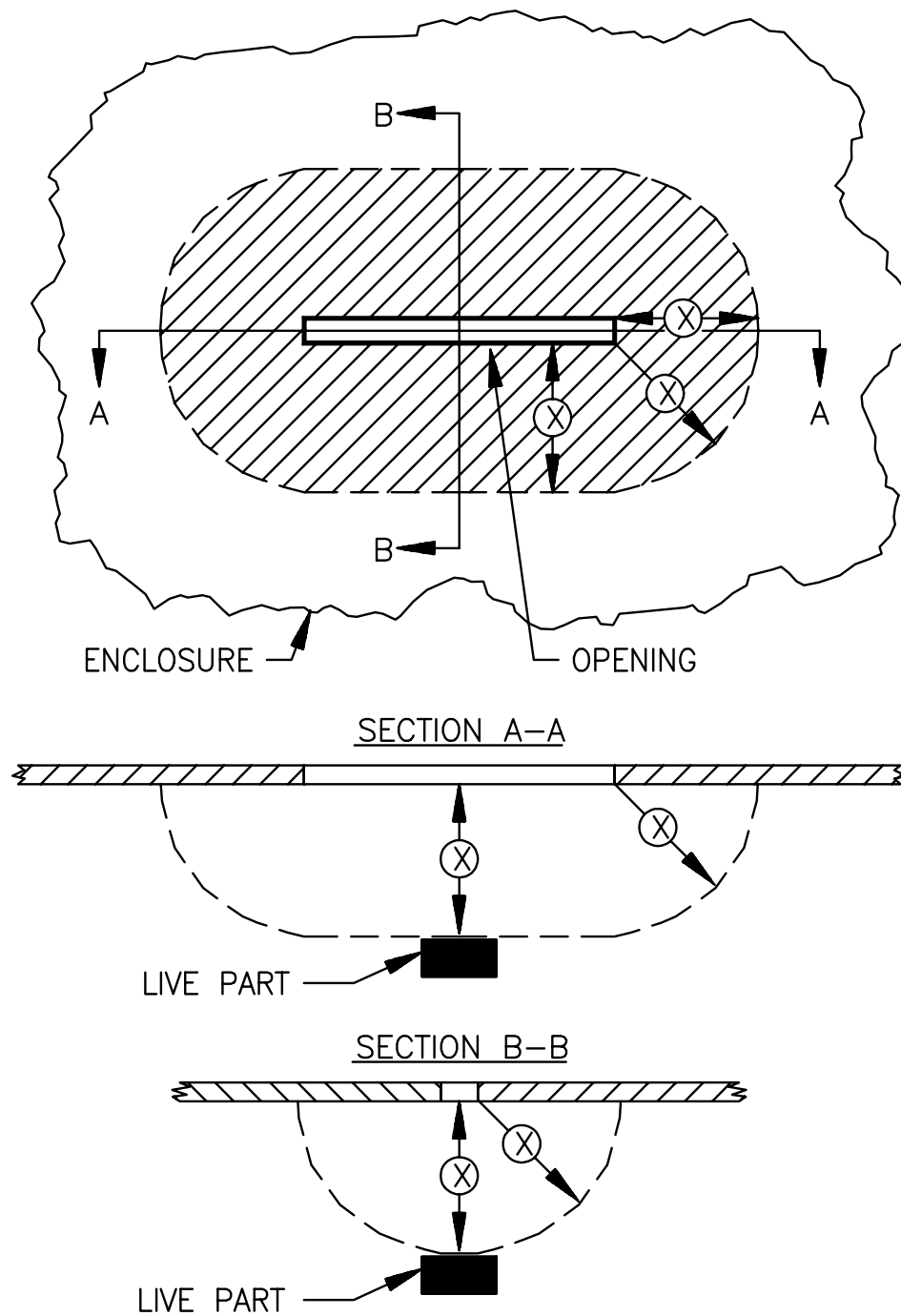
8.13 Insulated brush caps do not require additional enclosure.

8.14 The enclosure of a remotely or automatically controlled product shall not permit molten metal, burning insulation, flaming particles, or the like from falling on combustible materials, including the surface upon which the product is supported.

8.15 A product is automatically controlled under any one or more of the following conditions:

- a) If the repeated starting of the product, beyond one complete predetermined cycle of operation, to the point where some form of limit switch opens the circuit, is independent of any manual control.
- b) If, during any single predetermined cycle of operation, the motor is caused to stop and restart.
- c) If, upon energizing the product, the initial starting of the motor may be intentionally delayed beyond conventional starting.
- d) If, during any single predetermined cycle of operation, automatic changing of the mechanical load may reduce the motor speed sufficiently to reestablish starting-winding connections to the supply circuit.

Figure 8.2
Opening in enclosure



EC100A

Proportions exaggerated for clarity

8.16 The requirement in [8.14](#) will necessitate the use of a barrier of material that is resistant to combustion:

a) Under a motor unless:

- 1) The structural parts of the motor or of the product provide the equivalent of such a barrier;
- 2) The protection provided with the motor is such that no burning insulation or molten material falls to the surface that supports the product when the motor is energized under each of the following fault conditions:
 - i) Main winding opened,
 - ii) Starting winding opened,
 - iii) Starting switch short circuited, and
 - iv) For a permanent split capacitor motor, the capacitor short circuited (the short circuit is to be applied before the motor is energized, and the rotor is to be locked) or
- 3) The motor is provided with a thermal motor protector (a protective device that is sensitive to temperature and current) that will keep the temperature of the motor windings from becoming more than 125°C (257°F) under the maximum load under which the motor will run without causing the protector to cycle, and from becoming more than 150°C (302°F) with the rotor of the motor locked.

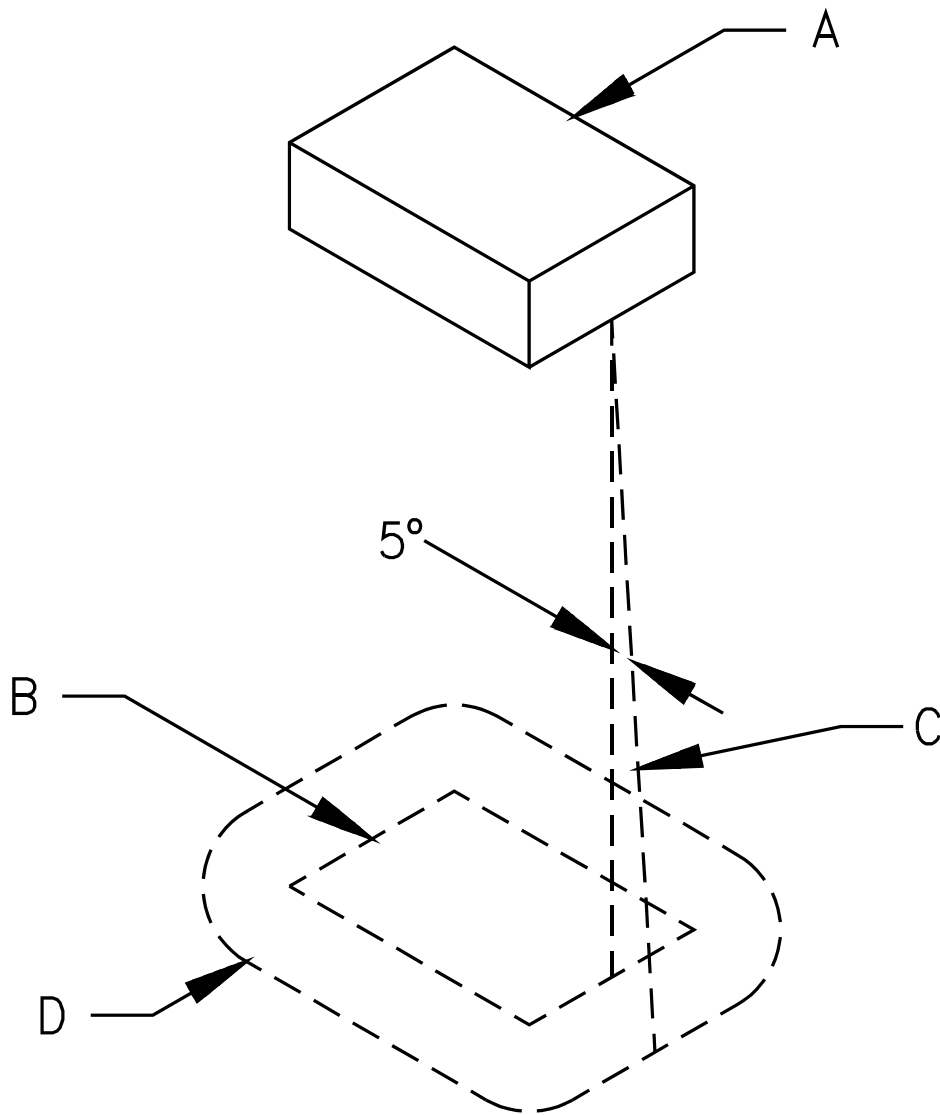
b) Under wiring, unless it is neoprene- or thermoplastic-insulated.

It will also necessitate that a switch, relay, solenoid, or the like be individually and completely enclosed unless there is no opening in the bottom of the product enclosure, or it can be shown that malfunction of the component would not result in a risk of fire.

Exception: Terminals of a switch, relay, solenoid or the like need not be individually and completely enclosed.

8.17 The barrier mentioned in [8.16](#) shall be horizontal, shall be located as indicated in [Figure 8.3](#), and shall not have an area less than that described in that illustration. An opening for drainage, ventilation, and the like may be employed in the barrier, provided that such an opening would not permit molten metal, burning insulation, or the like to fall on combustible material.

Figure 8.3
Location and extent of barrier



SA0604-1

A – Region to be shielded by barrier. This will consist of the entire component if it is not otherwise shielded and will consist of the unshielded portion of a component that is partially shielded by the component enclosure or equivalent.

B – Projection of outline of component on horizontal plane.

C – Inclined line that traces out minimum area of barrier. The line is always:

- 1) Tangent to the component,
- 2) 5 degrees from the vertical, and
- 3) Oriented so that the area traced out on a horizontal plane is maximum.

D – Location (horizontal) and minimum area for barrier. The area is that included inside the line of intersection traced out by the inclined line C and the horizontal plane of the barrier.

8.18 The door or cover of an enclosure shall be provided with means for holding it in place in the closed position.

8.19 The door or cover of an enclosure shall be hinged or attached in an equivalent manner if it gives access to any overload protective device, the functioning of which requires renewal, or if it is necessary to open the cover in connection with the intended operation of the protective device. Such a door or cover shall be provided with a latch or the equivalent, and shall be tight-fitting or shall overlap the surface of the enclosure around the opening.

9 Mechanical Assembly

9.1 The assembly of a product that involves a motor or other vibrating unit shall be such that the product will not be affected adversely by the vibration of intended operation. Brush caps shall be tightly threaded or otherwise so constructed as to keep them from loosening.

9.2 A switch, a lampholder, a receptacle, a motor-attachment plug, or similar component shall be mounted securely, and shall be kept from turning.

Exception No. 1: The requirement that a switch be kept from turning can be waived if all four of the following conditions are met:

- a) The switch is of the plunger or other type that does not tend to rotate when operated — a toggle switch is considered to be subject to forces that tend to turn the switch during intended operation of the switch.*
- b) The means of mounting the switch is such that the operation of the switch is unlikely to result in the switch becoming loosened.*
- c) The spacings are not reduced below the minimum acceptable values if the switch does rotate.*
- d) Intended operation of the switch is by mechanical means rather than by direct contact by persons.*

Exception No. 2: A lampholder of the type in which 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 kept from turning if the rotation cannot reduce spacings below the minimum acceptable values.

9.3 The means to keep a device from turning mentioned in [9.2](#) is to include more than friction between surfaces. For example, a lockwasher, properly applied, is acceptable as a means to prevent turning of a device having a single-hole mounting means.

9.4 Positive means shall be provided to keep parts of a product from turning with respect to each other if such turning would result in reduction of spacings, twisting of wires, and the like.

10 Protection Against Corrosion

10.1 Iron and steel parts shall be protected against corrosion by painting, galvanizing, plating, or other equivalent means if the degradation of such unprotected parts would be likely to result in a risk of fire, electric shock or injury to persons.

Exception No. 1: In certain instances in which the oxidation of iron or steel due to the exposure of the metal to air and moisture is not likely to be appreciable — thickness of metal and temperature also being factors — surfaces of sheet steel within an enclosure may not be required to be protected against corrosion. The requirement does not apply to bearings, laminations, or minor parts of iron or steel, such as washers, screws, and the like.

Exception No. 2: Cast-iron parts are not required to be protected against corrosion.

Exception No. 3: The sheath of a heating element operating in air and terminal parts attached directly to the heating element need not be protected against corrosion. The sheath of an immersion type heating element shall be of a metal resistant to corrosion resulting from the liquid in which the element is intended to be immersed.

10.2 A container for liquid shall be protected against the possible corrosive effect of the liquid intended to be used in the container.

11 Supply Connections

11.1 Permanently connected products

11.1.1 General

11.1.1.1 A permanently connected product – a product intended for permanent connection to the power supply – shall have provision for connection to the wiring systems that, in accordance with the National Electrical Code, ANSI/NFPA No. 70, would be acceptable for the product.

11.1.1.2 A product intended for permanent attachment to the building structure, water or steam supply, drains, and the like shall be provided with a means for permanent connection to the branch-circuit supply.

11.1.1.3 A product that is not actually moved or easily moved in intended use, but which is not obviously intended to be permanently connected, may be acceptable if provided with the shortest feasible length of Type SJE, SJT, SJO, or equivalent cord and an attachment plug for supply connection. The investigation of such feature will include consideration of the utility of the product and the necessity of having it readily detachable from its source of supply by means of the plug.

11.1.1.4 The location of a terminal or splice compartment in which power supply connections to a permanently connected product are to be made shall be such that these connections may be readily inspected after the product is installed as intended.

11.1.1.5 The compartment mentioned in [11.1.1.6](#) shall be so located that during conduit connections thereto, internal wiring and electrical components are not exposed to physical abuse or strain.

11.1.1.6 A terminal compartment intended for connection to a supply raceway shall be attached to the product so that it will not turn with respect thereto.

11.1.1.7 A compartment or part of an enclosure that contains field wiring splices other than low-voltage circuits (see [2.23](#)) shall not be provided with ventilating openings.

11.1.2 Wiring terminals

11.1.2.1 A product intended for permanent electrical connection to the power supply shall be provided with wiring terminals or leads for the connection of conductors having an ampacity not less than 125 percent of the current rating of the product when the load is continuous (3 hours or more) and not less than the current rating of the product when the load will be intermittent.

11.1.2.2 A wiring terminal shall be provided with a soldering lug or with a pressure wire connector securely fastened in place, for example, firmly bolted or held by a screw.