UL 561

STANDARD FOR SAFETY

Floor-Finishing Machines

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UL Standard for Safety for Floor-Finishing Machines, UL 561

Seventh Edition, Dated October 31, 2011

SUMMARY OF TOPICS

This revision of ANSI/UL 561 dated June 29, 2021 includes the following changes in requirements:

– Replacing the References to the Standard For Power Conversion Equipment, UL 508C, With Reference to the Standard For Adjustable Speed Electrical Power Drive Systems – Part 5-1: Safety Requirements – Electrical, Thermal and Energy, UL 61800-5-1; 4.5.4.1 and 4.14.4.4

– Type SJ Power Supply Cords for Commercial Spray Extraction Machines; 10.8

– Addition of UL 969A into UL 561; 46.1

Text that has been changed in any manner or impacted by UL'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 January 15, 2021 and April 16, 2021.

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The Department of Defense (DoD) has adopted UL 561 on March 11, 1991. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

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

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Full document details: UL 561 2021

CONTENTS

INTRODUCTION

1 Scope 7
2 General 7
2.1 Terminology 7
2.2 Units of measurement 7
2.3 Undated references 7
3 Glossary 7
4 Components 9
4.1 General 9
4.2 Attachment Plugs, receptacles, connectors, and terminals 10
4.3 Boxes, conduits, and raceways 11
4.4 Capacitors and filters 11
4.5 Controls 11
4.6 Cords, cables, and internal wiring 14
4.7 Film-coated wire (magnet wire) 15
4.8 Gaskets and seals 15
4.9 Ground-fault, arc-fault, and leakage current detectors/interrupters 15
4.10 Heating elements and heaters 15
4.11 Insulation systems 15
4.12 Light sources and associated components 16
4.13 Marking and labeling systems 16
4.14 Motors and motor overload protection 16
4.15 Overcurrent protection 19
4.16 Polymeric materials and enclosures 19
4.17 Power supplies 19
4.18 Printed wiring boards 19
4.19 Pumps 20
4.20 Semiconductors and small electronic components 20
4.21 Supplemental insulation, insulating bushings, and assembly aids 21
4.22 Switches 21
4.23 Transformers 22
4.24 Valves (electrically operated) and solenoids 22

ALL APPLIANCES

CONSTRUCTION

5 Frame and Enclosure 22
6 Accessibility of Uninsulated Live Parts, Film-Coated Wire, and Moving Parts 23
7 Mechanical Assembly 28
8 Enclosure 29
8.1 General 29
9 Resistance to Corrosion 29
10 Supply Connections 29
11 Strain Relief 31
12 Bushings 31
13 Live Parts 32
14 Internal Wiring 33
15 Tabs Used in Electrical Quick-Connect Terminals 34
15.1 General 34
15.2 Material requirements 34
15.3 Dimensional requirements 34

AVA Documents
Document Sharing Hub
Full document details: UL 561 2021

16 Insulating Material 39
17 Motors and Motor Protection 39
18 Insulation Systems 40
19 Motor Circuit Overload Protection 40
20 Arc-Fault and Leakage Current Detectors/Interrupters 40
21 Switches and Controls 40
22 Controls – End Product Test Parameters 41
22.1 General 41
22.2 Auxiliary controls 41
22.3 Operating controls (regulating controls) 41
22.4 Protective controls (limiting controls) 42
22.5 Controls using a temperature sensing device 44
23 Capacitors 44
24 Lampholders 45
25 Receptacles 45
26 Spacings 45
27 Grounding 47
28 Reduction of Risk of Injury to Persons 48

PERFORMANCE

29 Leakage Current Test 48
30 Leakage Current Test After Humidity Conditioning 51
31 Starting Current Test 51
32 Input Test 51
33 Temperature Test 51
33.1 General 51
33.2 Maximum intended load 54
34 Dielectric Voltage-Withstand Test 55
35 Strain Relief Test 56
36 Push-Back Relief Test 56
37 Flooding Test 56
37.1 General 56
37.2 Component malfunction or breakdown 57
37.3 Wet pick-up 57
37.4 Wet scrubbing 57
37.5 Overflow 57
37.6 Polymeric water-handling components 57
37.7 Impact test for polymeric reservoirs 57
37.8 Temperature stability test for polymeric reservoirs 58
38 Cord Reel Flexing Test 58
39 Abnormal Operation Test 58
39.1 General 58
39.2 Locked rotor 59
39.3 Overcurrent 59
40 Abnormal Operation Test – Electronic Components Test 59
40.1 General 59
40.2 Electronic components 60
41 Overload Test 60
42 Permanence of Marking Test 61
42.1 General 61
42.2 Oven-aging test 61
42.3 Standard-atmosphere test 61

MANUFACTURING AND PRODUCTION TESTS

Documents
Document Sharing Hub
Full document details: UL 561 2021

43 Production-Line Dielectric Voltage-Withstand Test 61
44 Production-Line Grounding Continuity Test 63

MARKINGS

45 General 63
46 Cord Tags 65

PACKING AND SHIPMENT

47 Safety Instructions 66

DOUBLE-INSULATED PRODUCTS

GENERAL

48 Scope 68
49 Glossary 68

CONSTRUCTION

50 Insulation 69
51 Enclosure 70
51.1 General 70
51.2 Accessibility of live parts 70
52 Supply Connections 70
53 Grounding 71
54 Internal Wiring 71
55 Capacitors 72
56 Brush Caps 72
57 Commutators and Armature End Turns 72
58 Switches 73
59 Brush Holders 73
60 Spacings 73

PERFORMANCE

61 Leakage Current Test 74
62 Insulation Resistance Test 74
63 Dielectric Voltage-Withstand Test 75
64 Resistance to Impact Test 76
65 Resistance to Heat Test 77
66 Overload Test 78
67 Armature Test 79

MANUFACTURING AND PRODUCTION TEST

68 Production-Line Dielectric Voltage-Withstand Test 79

MARKINGS

69 General 79

Documents
Document Sharing Hub
Full document details: UL 561 2021

No Text on This Page

Documents
Document Sharing Hub

Full document details: UL 561 2021

INTRODUCTION

1 Scope

1.1 These requirements cover electrically powered floor-finishing machines to be used in accordance with the National Electrical Code, NFPA 70. This product category includes the following: a floor polisher, floor scrubber, floor sander, floor scraper, tile remover, rug shampooer, rug and floor washer, and a similar machine for commercial use. A machine such as a sander and wet scrubber with vacuum attachments is also covered.

1.2 These requirements do not cover vacuum cleaning machines, permanently connected machines, or cord-connected machines that are intended to be fastened in place or located in a dedicated space. These requirements do not cover machines rated more than 600 volts, nor do they cover machines involving universal motors rated more than 250 volts. These requirements do not cover floor finishing machines for household use, which are covered in the Standard for Vacuum Cleaners, Blower Cleaners, and Household Floor Finishing Machines, UL 1017/CSA-C22.2 No. 243.

1.3 A machine that uses some other source of energy (such as gas or steam) in addition to electrical energy will be investigated under these requirements and under such additional requirements as applicable to the machine under consideration.

2 General

2.1 Terminology

2.1.1 In the following text, a requirement that applies to one type of equipment (polisher, scrubber, or the like) is identified by a specific reference in that requirement to the type of equipment involved. In the absence of such specific reference, or if the term product or machine is used, it is understood that the requirement applies to all types of equipment covered by the standard.

2.2 Units of measurement

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

2.2.2 Unless indicated otherwise, all voltage and current values mentioned in this standard are root mean square (rms).

2.3 Undated references

2.3.1 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.

3 Glossary

3.1 For the purpose of this standard, the following definitions apply.

3.2 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).

3.3 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.

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Full document details: UL 561 2021

3.4 COMMERCIAL USE PRODUCT – A product not intended for use only in the home.

3.5 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.

3.6 CONTROL, AUTOMATIC ACTION – A control in which at least one aspect is non-manual.

3.7 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.

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

3.9 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 reduce the risk of electric shock, fire, or injury to persons, is considered an operating control.

3.10 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.

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

3.11 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.

3.12 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.

3.13 HAND-GUIDED PRODUCT – A portable product which during intended use is contacted by the hand of the user for purposes of electrical or physical control, but not for complete support.

3.14 HAND-SUPPORTED PRODUCT – A portable product that is completely supported by the user during the performance of its intended function. The hand of the user may also be used to exercise electrical or physical control of the operation of the product.

3.15 LINE-VOLTAGE CIRCUIT – A circuit involving a potential of not more than 600 volts and having circuit characteristics in excess of those of a low-voltage circuit.

3.16 LOW-VOLTAGE CIRCUIT – A circuit involving a peak open-circuit potential of not more than 42.4 volts supplied by a primary battery, by a Class 2 transformer, or by a combination of a transformer and a fixed impedance that, as a unit, complies with all performance requirements for a Class 2 transformer. A circuit derived from a line-voltage circuit by connecting a resistance in series with the supply circuit as a means of limiting the voltage and current is not considered to be a low-voltage circuit.

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Full document details: UL 561 2021

3.17 MEASUREMENT INDICATION UNIT (MIU) – The output voltage across the meter, in millivolts RMS, read from the measurement instrument in Figure 29.1, divided by 500 ohms. (The instrument indication is equal to the RMS value in milliamperes when the frequency is 60 Hz – sinusoidal current. The reading may not be a direct indication of the RMS or other common amplitude quantifier of leakage current when the leakage current is of a complex waveform or frequency other than 50 or 60 Hz).

4 Components

4.1 General

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

a) Comply with the requirements for that component as indicated in 4.2 – 4.24;

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.

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.

Exception No. 1: 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, or

b) Is superseded by a requirement in this end product standard,

c) Is separately investigated when forming part of another component, provided the component is used within its established ratings and limitations.

Exception No. 2: A component that complies with a UL component standard other than those specified in 4.2 – 4.24 is acceptable if:

a) The component also complies with the applicable component standard of 4.2 – 4.24; or

b) The component standard:

1) Is compatible with the ampacity and overcurrent protection requirements of the National Electrical Code, ANSI/NFPA 70, where applicable;

2) Considers long-term thermal properties of polymeric insulating materials in accordance with the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B, and

3) Any use limitations of the other component standard are identified and appropriately accommodated in the end use application. For example, a component used in a household application, but intended for industrial use and that complies with the relevant component standard may assume user expertise not common in household applications.

4.1.2 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

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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.

4.1.3 A component not anticipated by the requirements of this end product standard, not specifically covered by the component standards in 4.2 – 4.24, and that involves a risk of electric shock, fire, or personal injury, shall be additionally investigated in accordance with the applicable UL standard, and shall comply with 4.1.1(b) – (e).

4.1.3.1 With regard to 4.1.3, reference to construction and performance requirements in another UL end product standard is applicable where that standard anticipates normal and abnormal use conditions consistent with the application of UL 561.

4.2 Attachment Plugs, receptacles, connectors, and terminals

4.2.1 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 4.2.9.

Exception No. 1: Attachment plugs and appliance couplers integral to cord sets or power supply cords are investigated in accordance with the requirements in the Standard for Cord Sets and Power-Supply Cords, UL 817 and need not comply with UL 498.

Exception No. 2: A fabricated pin terminal assembly(ies) need not comply with UL 498 if it complies with Accessibility of Uninsulated Live Parts, Film-Coated Wire, and Moving Parts, Section 6, Live Parts, Section 13, Insulating Material, Section 16, and Spacings, Section 26 of this end product standard, as well as the applicable performance requirements when tested in the end-product.

4.2.2 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 No. 1: 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.

Exception No. 2: A connector that complies with UL 310 may be used with an appropriately sized tab that complies with Tabs Used in Electrical Quick-Connect Terminals, Section 15. The connector is the part of a quick-connect terminal that is pushed onto the male tab, and the tab is the part that receives the female connector.

4.2.3 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 4.2.9.

4.2.4 Wire connectors shall comply with the Standard for Wiring Connectors, UL 486A-UL486B.

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

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4.2.6 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 4.2.9.

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

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

Exception: A fabricated part performing the function of a terminal block need not comply with UL 1059 if the part complies with the requirements of Live Parts, Section 13, Internal Wiring, Section 14, Insulating Material, Section 16, and Spacings, Section 26 of this end product standard, as well as the applicable performance requirements when tested in the end-product. This exception does not apply to protective conductor terminal blocks.

4.2.9 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.

4.3 Boxes, conduits, and raceways

4.3.1 Electrical boxes and the associated bushings, conduits, fittings, and raceways of the types specified in the National Electrical Code, ANSI/ NFPA 70, and that comply with the relevant UL standard (such as Flexible Metal Conduit, UL 1, Metallic Outlet Boxes, UL 514A, Conduit, Tubing, and Cable Fittings, UL 514B, Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers, UL 514C, Cover Plates for Flush-Mounted Wiring Devices, UL 514D), and Components, General, 4.1 are considered to comply with the requirements of this end product standard.

4.4 Capacitors and filters

4.4.1 The component requirements for capacitors are specified in Capacitors, Section 23.

4.4.2 Electromagnetic interference filters with integral enclosures that comply with one of the following standards are considered to comply with the requirements in 23.1.

a) The Standard for Electromagnetic Interference Filters, UL 1238; or

b) The Standard for Fixed Capacitors for Use in Electronic Equipment – Part 14, UL 60384-14.

4.5 Controls

4.5.1 General

4.5.1.1 Auxiliary controls shall be evaluated using the applicable requirements of this end product standard and the requirements in Auxiliary controls, 22.2, unless otherwise specified in this end product standard; see 4.5.1.4.

4.5.1.2 Operating (regulating) controls shall be evaluated using the applicable component standard requirements specified in 4.5.2 – 4.5.7, and if applicable, the parameters in Operating controls (regulating controls), 22.3, unless otherwise specified in this end product standard; see 4.5.1.4.

Documents
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4.5.1.2.1 Operating controls that rely upon software for the normal operation of the end product where deviation or drift of the operating parameters of the control may result in an increased risk of electric shock, fire, or injury to persons, shall comply with:

a) The Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991; and the Standard for Software in Programmable Components, UL 1998; or

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

4.5.1.3 Solid-state protective (limiting) controls shall be evaluated using the applicable component standard requirements specified in 4.5.2 – 4.5.7, and if applicable, the parameters in Protective controls (limiting controls), 22.4, unless otherwise specified in this end product standard.

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

a) The Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991; or

b) The Standard for Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements, UL 60730-1, except Controls Using Software.

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

a) The Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991; and the Standard for Software in Programmable Components, UL 1998; or

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

4.5.1.4 An electronic, auxiliary, or operating control (e.g. a non-protective control), the failure of which would not increase the risk of electric shock, fire, or personal injury, need only be subjected to the applicable requirements of this end product standard.

4.5.2 Electromechanical and electronic controls

4.5.2.1 A control, other than as specified in 4.5.3 – 4.5.7, shall comply with:

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

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

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

4.5.3 Liquid level controls

4.5.3.1 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

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Full document details: UL 561 2021

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;

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.

4.5.4 Motor and speed controls

4.5.4.1 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;

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

f) Standard for Switchgear and Controlgear, Low-Voltage – Part 1: General Rules, UL 60947-1, and the Standard for Switchgear and Controlgear, Low-Voltage – Part 4-1: Contactors and Motor-Starters – Electromechanical Contactors and Motor-Starters, UL 60947-4-1A.

4.5.5 Pressure controls

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

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

b) Standard for Industrial Control Equipment, UL 508; 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 Automatic Electrical Pressure Sensing Controls Including Mechanical Requirements, UL 60730-2-6.

4.5.6 Temperature controls

4.5.6.1 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.

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Full document details: UL 561 2021

4.5.6.2 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:

a) 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, with Annex J; or

b) Standard for Thermistor-Type Devices, UL 1434.

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

4.5.7 Timer controls

4.5.7.1 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.

4.6 Cords, cables, and internal wiring

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

4.6.2 Flexible cords and cables shall comply with the Standard for Flexible Cords and Cables, UL 62. Flexible cord and cables are considered to comply with this requirement when preassembled in a cord set or power supply cord that complies with the Standard for Cord Sets and Power Supply Cords, UL 817.

4.6.3 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) The Standard for Thermoset-Insulated Wires and Cables, UL 44;

b) The Standard for Thermoplastic-Insulated Wires and Cables, UL 83;

c) The Standard for Fixture Wire, UL 66; or

d) The applicable UL standard(s) for other insulated conductor types specified in Wiring Methods and Materials in the National Electrical Code, ANSI/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.

Documents
Document Sharing Hub
Full document details: UL 561 2021

4.7 Film-coated wire (magnet wire)

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

4.7.2 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.

4.8 Gaskets and seals

4.8.1 Gaskets and seals that are relied upon to prevent water entrance into electrical compartments and flooding of electrically live parts shall comply with the Flooding Test, Section 37.

4.9 Ground-fault, arc-fault, and leakage current detectors/interrupters

4.9.1 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."

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

Note – An ALCI is not considered an acceptable substitute for GFCI when the National Electrical Code, ANSI/NFPA 70, requires a GFCI.

4.9.3 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.

4.9.4 Arc-fault circuit-interrupters (AFCI) shall comply with the Standard for Arc-Fault Circuit-Interrupters, UL 1699. See Arc-Fault, and Leakage Current Detectors/Interrupters, Section 20.

4.9.5 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 Arc-Fault, and Leakage Current Detectors/Interrupters, Section 20.

4.10 Heating elements and heaters

4.10.1 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.

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

4.11 Insulation systems

4.11.1 Materials used in a Class 105 (A) insulation system shall comply with Insulation Systems, Section 18.

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4.11.2 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.

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

4.12 Light sources and associated components

4.12.1 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 comply with this requirement.

4.12.2 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 comply with this requirement.

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

4.12.3 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 comply with 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.

4.13 Marking and labeling systems

4.13.1 A marking and labeling system shall comply with the Permanence of Marking Test, Section 42.

Exception: A marking or labeling system that complies with the applicable requirements of the Standard for Marking and Labeling Systems, UL 969, is considered to comply with the requirement.

4.14 Motors and motor overload protection

4.14.1 General

4.14.1.1 General-purpose type motors having a NEMA frame size shall comply with the requirements specified in 4.14.2. 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).

4.14.1.2 Motors not enclosed, or partially enclosed, but the end product enclosure shall comply with the requirements specified in 4.14.2 or 4.14.3.2.

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Full document details: UL 561 2021

4.14.1.3 Component type motors completely enclosed within the end product enclosure shall comply with the requirements specified in 4.14.2 or 4.14.3.

4.14.2 General-purpose type motors

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

4.14.3 Component type motors

4.14.3.1 Component type motors shall comply with either 4.14.3.2 or 4.14.3.3.

4.14.3.2 The motor shall comply with the Standard for Rotating Electrical Machines - General Requirements, UL 1004-1 except as noted in Table 4.14.3.

Table 4.14.3
Superseded requirements

Rotating Electrical Machines - General Requirements, UL 1004-1 Exempted Requirements	Superseded by UL 561 Requirements
Cord-Connected Motors	Supply Connections, Section 10
Factory Wiring Terminals and Leads	Live Parts, Section 13
Electrical Insulation	Insulating Material, Section 16
Non-Metallic Functional Parts	Insulating Material, Section 16
Solid-State Controls, 7.2	Controls, 4.5
Non-metallic enclosure thermal aging, 9.1.4	Frame and Enclosure, Section 5
Motor enclosure, 9.2 - 9.4	Frame and Enclosure, Section 5
Grounding	Grounding, Section 27
Ventilation Openings, only applicable where the openings are on surfaces considered to be the appliance enclosure	Frame and Enclosure, Section 5 and Accessibility of Uninsulated Live Parts, Film-Coated Wire, and Moving Parts, Section 6
Accessibility of Uninsulated Live Parts, Film-Coated Wire, and Moving Parts	Accessibility of Uninsulated Live Parts, Film-Coated Wire, and Moving Parts, Section 6
Protection Against Corrosion	Resistance to Corrosion, Section 9
Available fault current ratings for motor start and running capacitors, 26.6: not applicable for cord and plug connected appliances	Capacitors, Section 23
Switch, is not applicable to centrifugal starting switches	Switches and Controls, Section 21
With the exception of the Resilient Elastomer Mounting and Electrolytic Capacitor Tests, the performance tests in the Standard for Rotating Electrical Machines - General Requirements, UL 1004-1 are not applicable	All applicable performance tests
Only marking requirements 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	45.1

4.14.3.3 The motor shall comply with the applicable component requirements in Components, Section 4, the following construction requirements, and the applicable performance requirements (when tested in conjunction with the end product), of this end product standard:

a) Resistance to Corrosion, Section 9.

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Full document details: UL 561 2021

b) Live Parts, Section 13.

c) Internal Wiring, Section 14.

d) Insulating Material, Section 16.

e) Motors and Motor Protection, Section 17 and Motor Circuit Overload Protection, Section 19.

f) Capacitors, Section 23.

g) Spacings, Section 26.

h) Grounding, Section 27.

4.14.4 Motor overload protection

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

a) Standard for Overheating Protection for Motors, UL 2111; or

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).

4.14.4.2 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.

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

4.14.4.4 Except as indicated in 4.14.4.3, electronically protected motor circuits shall comply with one of the following. See 4.5.4 for basic control requirements.

a) The 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 Software in Programmable Components, UL 1998. If software is relied upon to perform a safety function, it shall be considered software Class 1; or

b) The 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) The 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 personal injury during abnormal testing with the motor electronic circuit rendered ineffective; compliance with the applicable requirements of this end product standard is then required.

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4.15 Overcurrent protection

4.15.1 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 applicable UL standard for the fuse are considered to comply with this requirement.

4.15.2 Fuseholders shall comply with the Standard for Fuseholders - Part 1: General Requirements, UL 4248-1, and the applicable Part 2 (e.g. UL 4248-9).

4.15.3 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.

4.15.4 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.

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

4.16 Polymeric materials and enclosures

4.16.1 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.

4.16.2 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.

4.17 Power supplies

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

a) The Standard for Class 2 Power Units, UL 1310; or

b) The Standard for Information Technology Equipment, Part 1: General Requirements, UL 60950-11, with an output marked "Class 2", or that complies with the limited power source (LPS) requirements and is marked "LPS".

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

a) The Standard for Power Units Other Than Class 2, UL 1012; or

b) The Standard for Information Technology Equipment, Part 1: General Requirements, UL 60950-1.

4.18 Printed wiring boards

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

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Full document details: UL 561 2021

Exception: 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.

4.18.2 A printed-wiring board containing circuitry in a line-connected circuit or a safety circuit shall comply with the direct-support requirements for polymeric electrical insulating materials in Section 4.16 of this end product standard.

4.18.3 Unless otherwise specified, the flammability class and temperature rating shall be that specified in Polymeric materials and enclosures, 4.16 of this end product standard.

4.19 Pumps

4.19.1 Motor-operated water and liquid pumps shall comply with the applicable requirements of the Standard for Motor-Operated Water Pumps, UL 778.

Exception: A component type motor-operated pump that is completely enclosed within the end product enclosure that complies with the applicable requirements of this end-product standard, is considered to comply with 4.19.1.

4.20 Semiconductors and small electronic components

4.20.1 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 the Dielectric Voltage-Withstand Test, Section 34 of this end product standard.

4.20.2 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 the Dielectric Voltage-Withstand Test, Section 34 of this end product standard. The dielectric test voltage is to be applied between the input and the output terminals of the optical isolator.

4.20.3 Except as specified in 4.20.4, 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.

4.20.4 Where an electronic component is determined to be a critical component during the testing of UL 561, Abnormal Operation Test – Electronic Components Test, Section 40, one of the following standards shall be applied. See Protective controls (limiting controls), 22.4 of this end product standard for the test parameters to be used.

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

4.20.4.1 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.

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Full document details: UL 561 2021

4.20.4.2 A critical component may also be identified using a failure-mode and effect analysis (FMEA) in accordance with Failure-Mode and Effect Analysis (FMEA), in the Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991.

4.20.4.3 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.

4.21 Supplemental insulation, insulating bushings, and assembly aids

4.21.1 The requirements for supplemental insulation (e.g. tape, sleeving or tubing) are not specified unless the insulation or device is required to fulfill 14.9 and 14.10 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.

4.21.2 Wire positioning devices shall comply with 4.16.1. A device that complies with the Standard for Positioning Devices, UL 1565, is considered to comply with this requirement.

4.21.3 Insulating bushings that comply with Components, General, Section 4.1 of this end product standard, and the Standard for Insulating Bushings, UL 635, are considered to comply with 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.

4.22 Switches

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

a) The Standard for Special-Use Switches, UL 1054;

b) The Standard for Switches for Appliances – Part 1: General Requirements, UL 61058-1;

c) The Standard for General-Use Snap Switches, UL 20; or

d) The Standard for Nonindustrial Photoelectric Switches for Lighting Control, UL 773A.

Exception: Switching devices that comply with the applicable 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.

4.22.2 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) The Standard for Clock-Operated Switches, UL 917; or

b) The 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.

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Full document details: UL 561 2021

4.22.3 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) The Standard for Solid-State Controls for Appliances, UL 244A; or

b) The 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.

4.22.4 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 4.5.1.3.

4.23 Transformers

4.23.1 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.

4.23.2 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 Class 2 circuit, and that do not involve a risk of fire or personal injury, need not comply with this requirement.

4.24 Valves (electrically operated) and solenoids

4.24.1 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.

Exception: Automatic valves intended for use with natural gas, manufactured gas, LP-gas or LP-gas-air mixtures shall comply with ANSI Z21.21a/CSA 6.5a (Automatic Valves for Gas Appliances).

ALL APPLIANCES

CONSTRUCTION

5 Frame and Enclosure

5.1 A product shall be formed and assembled so that it will have the strength and rigidity needed 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.

5.2 A product shall be provided with an enclosure to house each part that may present a risk of fire, electric shock, or injury to persons under any condition of use.

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