# UL 982

## STANDARD FOR SAFETY

Motor-Operated Household Food Preparing Machines

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UL Standard for Safety for Motor-Operated Household Food Preparing Machines, UL 982

Eighth Edition, Dated September 27, 2019

***Summary of Topics***

***This revision of ANSI/UL 982 dated April 5, 2021 is to editorially correct paragraph 72.3.3.***

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# UL 982

## Standard for Motor-Operated Household Food Preparing Machines

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## INTRODUCTION

### 1 Scope

1.1 These requirements cover household motor-operated food preparing machines and kitchen accessories such as knife sharpeners and can openers, that are intended to be operated for short-periods of time resulting in cumulative use-time per year of less than 100 hours and that are for use in accordance with the National Electrical Code, ANSI/NFPA 70.

1.2 In the following text, a requirement that applies to one type of equipment coming within its scope, such as a blender, or mixer will be so 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 appliance is employed, it is to be understood that the requirement applies to all of the types of equipment covered by the standard.

1.3 These requirements cover cord-connected and permanently wired motor-operated appliances rated at a nominal 120 V including appliances supplied by low-voltage power supplies, and battery-operated appliances provided with battery chargers.

1.4 These requirements cover appliances for household use. The requirements in the Standard for Motor-Operated Commercial Food Preparing Machines, UL 763 are employed for the evaluation of appliances also intended for commercial application.

1.5 This standard does not cover sanitation, contamination, or noise aspects of these products. Reference to these items can be found in the Standard for Food, Drug and Beverage Equipment, ANSI/ASME F2.1.

1.6 An appliance employing a heating element is judged on the basis of its compliance with the requirements of this Standard, insofar as they apply and further appropriate requirements applicable to household cooking appliances.

### 2 Units of Measurement

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

### 3 Undated References

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.

### 4 Glossary

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

4.2 ACCESSIBLE PART OR SURFACE – A part or surface subject to contact by persons under any condition of normal operation or user function. See 7.9, 7.11, 7.12, 26.5, 37.4 and 49.1.5 for details.

4.3 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).

4.4 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.

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4.5 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.

4.6 ATTENDED APPLIANCE – An appliance intended for use where operator presence is required for the equipment to function but is not necessarily required for the equipment to operate. Operator absence is effectively limited to short durations due to one or more characteristics of the equipment such as production of excessive noise or vibration. Examples include food processors, can openers, blenders, and food mixers.

4.7 ATTENDED PORTABLE INTERMITTENT-DUTY APPLIANCE – A portable attended appliance intended for infrequent and short-time use. Food mixers and can openers are examples of this type of equipment.

4.8 *Deleted*

4.9 AUTOMATICALLY CONTROLLED APPLIANCE – An appliance is considered to be automatically controlled under any one or more of the following conditions:

a) If the repeated starting of the appliance, 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 one or more times.

c) If, upon energizing the appliance, the initial starting of the motor may be intentionally delayed beyond normal, conventional starting.

d) If, during any single predetermined cycle of operation, automatic changing of the mechanical load may reduce the motor speed to the point of reestablishing the starting-winding connections to the supply circuit.

4.10 BABY FOOD CHOPPER – A food chopper intended to chop cooked meat or vegetables in small quantities for immediate consumption as indicated in the operating instructions. A chopper also intended for processing other food loads, such as cheese, nuts or raw meat or vegetables, is considered a food chopper.

4.11 BABY FOOD GRINDER - A meat grinder intended to grind cooked meat or vegetables in small quantities for immediate consumption as indicated in the operating instructions. A grinder also intended for processing raw meat is considered a meat grinder.

4.12 BLENDER TAMPER – A food pusher provided with a blender to be applied through the cover opening to facilitate blending of some food loads.

4.13 BLENDER WITH A HEATING FUNCTION – A blender with instructions or control settings for heating the contents of the container either by friction during blending or by a heating element. A heating function may also be called a soup making function.

4.14 BLENDING MIXER – An appliance intended to pulverize solids, such as ice, vegetables or fruit, and to combine them into a blend, or to merge liquids and solids into a blend. A blending mixer may also be referred to as a blender.

4.15 CART – A stand – see 4.51 – provided with casters, wheels, rollers, or the like to make it mobile.

4.16 CASTER – A roller or swiveled wheel attached to a cart or stand that makes the cart or stand mobile.

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4.17 CENTRIFUGAL JUICER – An appliance intended to juice various fruits and vegetables by use of a grating disc mounted within a straining basket that spins at high speed so that the juice is filtered through the strainer and the pulp is discharged via a discharge opening at the top of the straining basket.

4.18 CLOSED-TOP BLENDER CONTAINER – Food blending container with one opening that is used for securing the blade assembly.

4.19 COFFEE, SPICE, OR GRAIN GRINDER – A motor operated appliance that crushes coffee beans, spices, or grain into a powder by passing them through a system of closely fitting wheels or cones having serrated surfaces. This appliance will have an intake hopper and a discharge container.

4.20 COFFEE, SPICE OR GRAIN MILL – A motor operated appliance that chops coffee beans, spices, or grain into a powder by means of a system of blades rotating at high speed.

4.21 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.

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

4.23 CONTROL, OPERATING – A device or assembly of devices, the operation of which starts or regulates the end product during normal operation to comply with this end-product Standard. Operating controls are also referred to as “regulating controls”.

4.24 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. Protective controls are also referred to as “limiting controls” and “safety controls”.

4.25 CORD/CORDLESS APPLIANCE – An appliance that can be operated while cord connected or via the battery (cordless).

4.26 COUNTER-SUPPORTED APPLIANCE – An appliance that is physically supported by a counter, table or bench during the performance of its intended electrically-operated functions, such as for a blender – blending, is to be considered a counter supported appliance. Reference is to be made to the specific product's Use and Care Literature in establishing the intended electrically-operated functions of the appliance.

4.27 DAMP LOCATION – Partially protected place or area where the appliance is either used or stored under canopies, marquees, roofed open porches, and like locations, and interior locations subject to moderate degrees of moisture, such as some basements, barns, and cold-storage warehouses.

4.28 DRY LOCATION – A place or area where the appliance is either used or stored not normally subject to dampness or wetness. A location temporarily subject to dampness or wetness, as in the case of a building under construction, is included in this category.

4.29 ENCLOSURE – That part of the appliance that:

a) Renders inaccessible all or any parts of the equipment that may otherwise present a risk of electric shock; or

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b) Reduces the likelihood of propagation of flame initiated by electrical disturbances occurring within.

4.30 FIXED APPLIANCE – An appliance that is fastened or otherwise secured at a specific location.

4.31 FOOD CHOPPER – A food processor without a slicing or shredding blade and without feed or discharge openings.

4.32 FOOD MIXER – An appliance intended for mixing food ingredients in a bowl with beater(s), dough hook(s), or a whisk. It may be hand-held or stand supported.

4.33 FOOD PROCESSOR – An appliance provided with various chopping, mixing, slicing and shredding blades that processes food by means of rotating blades within a container. A food processor may have additional blades intended for mixing dough. A food processor has a feed chute and may have a discharge opening.

4.34 HAND-SUPPORTED APPLIANCE – An appliance that is physically supported by any part of the body of the user during the performance of its intended electrically-operated functions, such as for an electric knife – carving meat, is to be considered a hand-supported appliance. Reference is to be made to the specific product's Use and Care Literature in establishing the intended electrically-operated functions of the appliance.

4.35 INDIVIDUAL SERVING SIZE OPEN-TOP BLENDER CONTAINER– Blender container, with a maximum capacity not exceeding 20 oz., where the blender blades are attached to the bottom of the container and the drinking lid is attached to the top of the container during blending. The drinking lid is provided with an integral cover which seals the drink opening during blending. When blending is completed, the container is inverted, so that the blender blades may be removed and the container bottom secured. The product is then consumed directly from the container via the sealable drink opening in the lid.

4.36 INTERLOCK – A device or arrangement by means of which the functioning of one part is controlled by the functioning of another, for safety purposes.

4.37 LINE-VOLTAGE CIRCUIT– A circuit classified as line voltage for the purpose of this Standard is one involving a maximum potential of not more than 125 V and having circuit characteristics in excess of those of a low-voltage circuit.

4.38 LIQUID MIXER – An appliance with an exposed rotating shaft intended to mix liquid ingredients within a provided cup. This is also known as a drink mixer or spindle type mixer.

4.39 LOW-VOLTAGE CIRCUIT – A circuit classified as low voltage is one involving a peak open-circuit potential of not more than 42.4 V supplied by a primary battery, by a standard Class 2 transformer, or by a combination of a transformer and a fixed impedance which, as a unit, complies with all performance requirements for Class 2 transformers.

4.40 MASTICATING JUICER – An appliance intended to juice various fruits and vegetables by use of an auger to crush the food load and a strainer to separate the juice from the pulp. A masticating juicer may also be referred to as an auger juicer or a slow juicer.

4.41 MAXIMUM CAPACITY – The maximum capacity of a container when completely filled regardless of any marked capacity or fill lines. When so indicated, the maximum capacity is determined while the unit is operating.

4.42 MEAT GRINDER – An appliance consisting of an auger and a feed tube intended for grinding pieces of raw meat into ground meat.

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4.43 OPEN-TOP BLENDER CONTAINER – Food blending container with opening on the top provided with a separable cover.

4.44 PORTABLE APPLIANCE – An appliance that is actually moved or can easily be moved from one place to another in normal use. Some portable appliances, however, are not likely to be moved from one place to another in normal use.

4.45 RATED CAPACITY – The capacity of a container when filled to the maximum marked capacity or maximum fill line, whichever is greater.

4.46 REAMER JUICER – An appliance intended to juice citrus fruits by pushing the fruit halves against a rotating reamer cone.

4.47 REMOTELY CONTROLLED APPLIANCE – Control of an appliance by a command that can be initiated out of sight of the appliance using means such as telecommunications, sound controls or bus systems

4.48 SELF-HOLDING PROTECTOR – A device that is calibrated to open the motor circuit upon reaching a certain temperature but requires both cool down below the calibration point and removal of power for resetting of the protector. This is considered a manual reset device.

4.49 SLICER – An appliance with an exposed rotating slicing blade and a food carriage intended for slicing meats and cheeses.

4.50 SOUP MAKING BLENDER – A blender with instructions or control settings for heating the contents of the container either by friction during blending or by a heating element.

4.51 STAND – A structure intended to support an appliance.

4.52 STAND-BY MODE – When movable parts are not in motion, but the appliance control is energized. A separate means to de-energize the appliance, other than unplugging the appliance, is provided.

4.53 STATIONARY APPLIANCE – An appliance that is not easily moved from one place to another in normal use.

4.54 SUPPLEMENTARY OVERCURRENT PROTECTOR – A device designed to open the circuit automatically on a predetermined value of time versus current or voltage within the appliance. It is intended for use as overcurrent, or over- or under-voltage protection within the appliance where branch-circuit overcurrent protection is already provided.

4.55 UNATTENDED APPLIANCE – An appliance that is not an attended appliance. Examples include ice cream freezers and butter churns.

4.56 VACUUM BLENDER – A blender that incorporates, or is provided with, a pump to create a vacuum in the blender container during blending.

4.57 VEGETABLE SHREDDER/SLICER – An appliance with various slicing and shredding attachments in the form of discs or cones intended for slicing and shredding vegetables and cheeses. A cheese grating attachment may also be provided. A vegetable shedder/slicer has a feed chute and may have a discharge opening.

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4.58 WAND-TYPE MIXER – A hand-held appliance with a momentary contact switch and a guarded rotating cutting blade on the bottom. This is also known as a wand mixer, hand blender, or immersion blender.

4.59 WET LOCATION – A place or area where the appliance is either used or stored exposed to weather and unprotected.

## CONSTRUCTION

### 5 General

5.1 An appliance shall employ materials that are intended for the particular use and shall be made and finished with the degree of uniformity and grade of workmanship practicable in a well-equipped factory.

5.2 A blender with a heating function shall be evaluated as a blender in accordance with this standard, including the blender with a heating function requirements in Sections 10, 28, 30.4.7, 36.3, 64.1, 72.3 and 76.2, and also to the applicable requirements for a soup warmer in accordance with the following Sections of the Standard for Household Electric Coffee Markers and Brewing Type Appliances, UL 1082:

a) Handles;

b) Protection Against Injury to Persons;

c) Normal Temperature Test, with respect to operation in a test corner and the handle temperatures except as specified in 28.2;

d) Dynamic Stability Test;

e) Overfill; and

f) Gaskets and Seals, except gaskets and seals that are removable for cleaning shall comply with Section 41.

5.3 In addition to the requirements specified in 5.2, a blender with a heating function in which liquid is heated to greater than 115°F (46°C) shall also be evaluated to the following Sections of UL 1082:

a) Handle Securement Tests;

b) Stability Test; and

c) Tip Over Test.

5.4 In addition to the requirements specified in 5.2 and 5.3, a blender with a heating function provided with a heating element shall also be evaluated to the Standard for Household Electric Skillets and Frying-Type Appliances, UL 1083, if it is intended to cook with oil to a depth greater than 0.5 in. (13 mm) during normal operation, and the following Sections of the Standard for Household Electric Coffee Markers and Brewing Type Appliances, UL 1082:

a) Heating Elements,

b) Thermal Cutoffs,

c) Controls and Control Circuits,

d) Overheating Protection,

e) Power Input,

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f) Normal Temperature Test,

g) Broken Element Test,

h) Thermal Degradation,

i) Dry Operation,

j) Boil Dry Operation,

k) Fusible Devices Test,

l) Automatic Controls Test, and

m) For appliances likely to be immersed in water for cleaning: Leakage Current as a Result of Moisture Tests.

5.5 An appliance intended to be supplied by a Universal Serial Bus (USB) power source, whether the USB power supply is provided with the appliance or not, shall be considered as powered by a Class 2 power supply and shall be:

a) Provided with cable assemblies or wiring external to the unit, coiled or uncoiled, rated:

1) VW-1 or FT 1 or better in accordance with the Standard for Appliance Wire Material, UL 758, if not exceeding 3.05 m (10 ft) in length; or

2) CL2 or better in accordance with the Standard for Power-Limited Circuit Cables, UL 13, if longer than 3.05 m (10 ft) in length;

b) Incapable of being supplied by other sources when powered from the USB source;

c) Tested in accordance with 31.6 and 49.3;

d) Rated and marked in accordance with 71.12 – 71.14; and

e) Provided with user instructions in accordance with 76.33.

5.6 Appliances intended to be powered by an automotive adapter shall be:

a) Provided with a plug and cord complying with the Standard for Vehicle Battery Adapters, UL 2089;

b) Incapable of being supplied by other sources when powered from the automotive adapter; and

c) Tested in accordance with 31.7.

## 6 Components

### 6.1 General

6.1.1 Except as indicated in 6.1.2, a component of a product covered by this standard shall comply with the requirements for that component, as indicated in 6.2 – 6.20 and the additional component requirements of this standard.

6.1.2 A component is not required to comply with a specific requirement that:

a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard,

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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.

6.1.3 A component shall be used in accordance with its rating established for the intended conditions of use.

6.1.4 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.

6.1.5 A component not anticipated by the requirements of this standard, not specifically covered by the component standards specified in this standard and that involves a potential risk of electric shock, fire, or personal injury, shall be additionally investigated.

6.1.6 With respect to 6.1.5, 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 motor-operated household food preparing machines.

6.1.7 Unless otherwise specified, components that do not present a risk of electric shock, fire of injury to persons, such as connectors in a low voltage circuit, are not required to meet the specified component standards.

### 6.2 Attachment plugs, receptacles, connectors, and terminals

6.2.1 Attachment plugs, appliance couplers, and appliance inlets (motor attachment plugs) shall comply with the Standard for Attachment Plugs and Receptacles, UL 498 or the Standard for Appliance Couplers for Household and Similar General Purposes – Part 1: General Requirements, UL 60320-1.

*Exception No. 1: Attachment plugs and appliance couplers integral to power supply cords are covered under the requirements in the Standard for Cord Sets and Power-Supply Cords, UL 817, and need not comply with UL 498 or UL 60320-1.*

*Exception No. 2: A pin terminal assembly need not comply with UL 498 or UL 60320-1 if it complies with the following construction requirements and all applicable performance requirements as outlined in this standard:*

*a) Mechanical Assembly, Section 8;*

*b) Power Supply Connections – Permanently-Connected Appliances, Section 11;*

*c) Live Parts, Section 14;*

*d) Electrical Insulation Section 15; and*

*e) Spacings, Section 17.*

6.2.2 Female devices (such as 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.

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6.2.3 Quick-connect terminals, both connectors and tabs, shall comply with the Standard for Electrical Quick-Connect Terminals, UL 310, and shall be suitable for the wire size, type (solid or stranded), conductor material (copper or aluminum) and the number of conductors terminated. If insulated, the rated voltage and temperature shall be suitable for the intended use. Quick-connect terminals shall be applied per the installation instructions of the quick-connect terminal manufacturer.

6.2.4 Single and multipole connectors for use in data, signal, control and power applications within the appliance 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 Use in Data, Signal, Control and Power Applications, UL 1977.

6.2.5 Wire connectors shall comply with the Standard for Wiring Connectors, UL 486A-486B, the Standard for Splicing Wire Connectors, UL 486C, or the Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors, UL 486E, and shall be suitable for the wire size, type (solid or stranded), conductor material (copper or aluminum) and the number of conductors terminated. If insulated, the rated voltage and temperature shall be suitable for the intended use. Wire connectors shall be applied per the installation instructions of the wire connector manufacturer.

6.2.6 Terminal blocks shall comply with the Standard for Terminal Blocks, UL 1059, and, if applicable, be suitably rated for field wiring. A terminal block shall be suitable for the number of conductors per termination, wire size, type (solid or stranded), conductor material (copper or aluminum), voltage and current of the intended use.

### 6.3 Batteries and battery chargers

6.3.1 Lithium ion (Li-Ion) single cell batteries shall comply with the requirements for secondary lithium cells outlined in the Standard for Lithium Batteries, UL 1642. Lithium ion multiple cell batteries or lithium ion battery packs shall comply with the Standard for Household and Commercial Batteries, UL 2054.

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

6.3.3 Rechargeable nickel metal-hydride (Ni-MH) battery cells and packs shall comply with the applicable 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.

6.3.4 Primary batteries (non-rechargeable) that comply with the relevant UL standard, as applicable, and 6.1 are considered to fulfill the requirements of this standard.

6.3.5 Class 2 battery charger shall comply with the Standard for Class 2 Power Units, UL 1310. Limited Power Source (LPS) battery chargers shall comply with the Standard for Information Technology Equipment – Safety – Part 1: General Requirements, UL 60950-1 or the Standard for Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements, UL 62368-1.

6.3.6 A battery charger integral to the appliance or an induction charger shall comply with the applicable construction and performance requirements of this end-product standard. See also Section 12 for direct plug-in rechargeable appliances.

### 6.4 Capacitors and filters

6.4.1 Capacitors that are connected between the ungrounded and grounded conductors (across the line) or from one of these conductors to accessible dead metal of the appliance shall comply with:

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a) The Standard for Electromagnetic Interference Filters, UL 1283; or

b) The Standard for Safety Requirements for Fixed Capacitors for Use in Electronic Equipment – Part 14: Sectional Specification: Fixed Capacitors for Electromagnetic Interference Suppression and Connection to the Supply Mains, UL 60384-14

6.4.2 A capacitor of a capacitor motor and a capacitor connected across the line (such as a capacitor for radio-interference elimination) shall be housed within an enclosure or container that protects the plates against physical damage and prevents the emission of flame or molten material resulting from failure of the capacitor. Except as noted in 6.4.3 and 6.4.5 the container shall be sheet steel having an average thickness of 0.020 inch (0.51 mm) or shall be so constructed as to afford equivalent protection.

*Exception: A capacitor complying with the Standard for Capacitors, UL 810, or an electromagnetic interference filter with an integral enclosure complying with the Standard for Electromagnetic Interference Filters, UL 1283, is considered to be adequately protected.*

6.4.3 The container of a capacitor may be of sheet metal less in thickness than that mentioned in 6.4.2 or of other appropriate material if the capacitor is mounted in an enclosure that houses other parts of the appliance that is acceptable for the enclosure of live parts.

6.4.4 Under both normal and abnormal conditions of use, a capacitor employing a dielectric medium more combustible than askarel shall not cause or increase a risk of electric shock or fire and shall be protected against expulsion of the dielectric medium.

*Exception: A protected capacitor complying with the Standard for Capacitors, UL 810, or an electromagnetic interference filter complying with the Standard for Electromagnetic Interference Filters, UL 1283, is considered to have adequate protection against expulsion of the dielectric medium.*

6.4.5 The individual enclosure of an electrolytic capacitor with means for venting is required to be such as to provide protection against physical injury only and the requirement for minimum enclosure thickness does not apply. The individual enclosure of an electrolytic capacitor not provided with means for venting and with an opening more than 1/16 inch (1.6 mm) wide between the capacitor enclosure and the motor need not comply with the requirement for enclosure thickness given in 6.4.2, if the capacitor does not present a risk of fire when subjected to the Capacitor Failure Test, Section 50.

*Exception: An electrolytic capacitor complying with the Standard for Capacitors, UL 810 is considered to have adequate ventilation.*

6.4.6 The voltage rating of a capacitor, other than a motor capacitor, shall be no less than the maximum steady-state potential to which the capacitor is subjected during operation of the appliance.

## 6.5 Controls

### 6.5.1 General

6.5.1.1 Components, wiring, printed wiring assemblies, insulation materials, and the like, and associated circuitry employed in controls shall be investigated and found acceptable for the application in accordance with the specific control standards with respect to the risk of electric shock, fire and injury to persons.

6.5.1.2 Auxiliary controls shall be evaluated in accordance with the applicable construction and performance requirements of this end-product standard. Auxiliary controls evaluated to the requirements specified for operating controls in 6.5.2 are considered to comply with this end-product standard.

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6.5.1.3 A control regulating the motor speed and any other control not relied upon for compliance with this standard shall be evaluated as an auxiliary control.

### 6.5.2 Operating controls

6.5.2.1 Operating controls shall comply with:

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

b) The Standard for Temperature-Indicating and -Regulating Devices, UL 873; or

c) The Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1, and, where applicable, the relevant Part 2 standard from the UL 60730 series.

*Exception: Except as specified in Exception No. 2 of 6.5.2.2, an electronic operating control may alternatively be evaluated as an auxiliary control in accordance with 6.5.1.2.*

6.5.2.2 A control limiting the operating time during normal operation, starting or stopping the motor, and any control required for compliance with this standard during normal operation of the appliance shall be evaluated as an operating control.

*Exception No. 1: An electronic control acting as an interlock required for compliance with this standard, shall be evaluated as a protective control.*

*Exception No. 2: An electronic control starting or stopping the motor shall be evaluated as an auxiliary control if:*

*a) The appliance has no accessible moving parts during normal operation likely to cause injury;*

*b) The electronic control is placing the appliance in stand-by mode, where a single malfunction of a component can cause unexpected operation, in accordance with the Exception to 27.14; or*

*c) During the Electronic Control Circuits Test of Section 53, malfunction or breakdown of a component does not result in loss of OFF control or unexpected operation of the motor.*

6.5.2.3 A capacitive touch screen control on a blender with a two-step ON function as specified in 30.4.6.3 shall additionally be subjected to the following without loss of the two-step ON function:

a) Electronic Control Circuits Test of Section 53,

b) Electrostatic Discharge of in accordance with Electromagnetic compatibility (EMC) – Part 4-2: Testing and Measurement Techniques – Electrostatic Discharge Immunity Test, IEC 61000-4-2, test level 4 being applicable. Ten discharges having a positive polarity and ten discharges having a negative polarity are applied at each preselected point, and

c) Radiated Fields in accordance with Electromagnetic compatibility (EMC) – Part 4-3: Testing and Measurement Techniques – Radiated, Radio-Frequency, Electromagnetic Field Immunity Test, IEC 61000-4-3, test level 3 being applicable.

6.5.2.4 When evaluating an operating control to the UL 60730 series, the minimum test parameters specified in Table 6.1 shall be applied.

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**Table 6.1**
**Operating Control Parameters**

| Operating control parameter | Minimum specification |
|---|---|
| FMEA | Conduct a failure-mode and effect analysis (FMEA) to identify component failures which may result in a risk of electric shock or fire. |
| Operating Ambient | Determined via the Normal Temperature Test on the appliance (Section 36) |
| Endurance Testing | 6000 cycles of operation required for controls starting or stopping the motor |
| Overvoltage Category | Overvoltage Category II |
| Pollution Degree | Pollution Degree 2 |
| Enclosure Flammability | As specified in Section 64 for portable appliances or Section 65 for other appliances |

### 6.5.3 Protective controls

6.5.3.1 Protective controls shall comply with:

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

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

c) The Standard for Thermal-Links – Requirements and Application Guide, UL 60691; or

d) The Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1, and, where applicable, the relevant Part 2 standard from the UL 60730 series.

6.5.3.2 In addition to the standards referenced in 6.5.3.1, electronic protective controls shall also be evaluated for reliability in accordance with:

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

b) The Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1, except Clause H 11.12 (Controls using software).

6.5.3.3 In addition to the standards referenced in 6.5.3.1 and 6.5.3.2, electronic protective controls relying upon software as a protective component shall also comply with:

a) The Standard for Software in Programmable Components, UL 1998; or

b) The Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1.

6.5.3.4 A control serving as motor overload protection required in accordance with 6.10, limiting the operating time under abnormal operating conditions or acting as an interlock required for compliance with this standard, and any other control relied upon for compliance with this standard shall be evaluated as a protective control.

*Exception: If the appliance complies with this standard with the control defeated, the control shall be evaluated as an auxiliary control.*

6.5.3.5 When evaluating a protective control to the UL 60730 series, the minimum test parameters specified in Table 6.2 shall be applied.

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**Table 6.2**
**Protective Control Parameters**

| Protective control parameter | Minimum specification |
|---|---|
| FMEA | Conduct a failure-mode and effect analysis (FMEA) to identify component failures which may result in a risk of electric shock, fire or injury and confirming protective function continues to operate as intended.[1] |
| Operating Ambient | Determined via the Normal Temperature Test on the appliance (Section 36) |
| Endurance Testing | Except for interlocks, as indicated in 6.19.3.2, 6000 cycles of operation required for controls starting or stopping the motor |
| Overvoltage Category | Overvoltage Category II |
| Pollution Degree | Pollution Degree 2 |
| Enclosure Flammability | As specified in Section 64 for portable appliances or Section 65 for other appliances |
| Conducted Disturbances | Test Level 3 |
| Radiated Electromagnetic Fields | Test Level 3 |
| Fast Transient Bursts | Test Level 3 applied for 2 minutes in each polarity |
| Surge Immunity | Installation Class 2 |
| Electrostatic Discharge | Test Level 3 |
| Thermal Cycling | Temperature range: 10.0 ±2°C to the Operating Ambient |
| Software Class | Software Class B (See 6.5.3.3) |
| Notes:<br>[1] For a magnetic interlock reed switch, the short-circuit failure mode of the contacts is excluded due to the Interlock System Endurance Test, Section 58.2. | |

## 6.6 Cords, cables, and internal wiring

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

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

6.6.3 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:*

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

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

*c) The Standard for Fixture Wire, UL 66.*

*Exception No. 2: Insulated conductors located in a low-voltage circuit not involving the risk of personal injury need not comply with UL 758.*

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## 6.7 Cord reels

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

## 6.8 Lampholders and indicating lamps

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

6.8.2 Light emitting diode (LED) light sources shall comply with the Standard for Light Emitting Diode (LED) Equipment For Use In Lighting Products, UL 8750, unless the LED light source forms a part of a luminaire complying with the appropriate UL Standards. Individual light emitting diodes connected to the printed wiring board of a control and intended for indicating or decorative accent purposes shall be evaluated with the control.

## 6.9 Motors

6.9.1 A motor shall be acceptable for the particular application, and shall be capable of handling the maximum normal load of the appliance as described in 36.1.12 – 36.26 without introducing a risk of fire, electric shock, or injury to persons.

6.9.2 A motor shall comply with:

a) The Standard for Rotating Electrical Machines – General Requirements, UL 1004-1, or

b) The construction and performance requirements of this standard, when tested in conjunction with the appliance.

*Exception No. 1: A motor located in a Low Voltage Circuit may be evaluated only for the Risk of Fire and Personal Injury in accordance with the applicable requirements of this standard.*

*Exception No. 2: An oil-filled motor shall be evaluated as an oil immersed machine in accordance with UL 1004-1.*

6.9.3 With respect to evaluation of a motor to the Standard for Rotating Electrical Machines – General Requirements, UL 1004-1 per 6.9.2(a), the following exceptions shall be applied:

a) Motor controls shall be evaluated in accordance with 6.5.

b) Parts of phenolic material in contact with live parts, other than magnet wire, such as brush holders or commutator insulation, shall be considered suitable without further evaluation of the material's electrical insulating properties if the material has:

1) A flammability rating of at least HB, and

2) A suitable relative thermal index (RTI) for the temperatures obtained during the Normal Temperature Test.

*Exception: Phenolic material with an RTI of min 150°C (Electrical) is considered to meet this requirement for commutator insulation.*

c) Parts of other materials in contact with live parts, other than magnet wire, shall be evaluated in accordance with Spacings to enclosure, 64.10.

d) For motors used in attended, portable, intermittent-duty appliances utilizing alternative spacings specified in the Standard for Insulation Coordination Including Clearances and Creepage

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Distances for Electrical Equipment, UL 840, conditions and requirements for Pollution Degree 2 shall be applied

6.9.4 With respect to evaluation of a motor to this standard per 6.9.2 (b), the following additional requirements shall be applied:

a) A motor winding shall be resistant to the absorption of moisture and shall be formed and assembled in a uniform manner, such as free of loose turns, irregular crossovers, and poor ties. Magnet wire is not required to be additionally treated to resist absorption of moisture, but fiber slot liners, cloth coil wrap and similar moisture-absorptive materials should be provided with impregnation or otherwise treated to resist moisture absorption.

b) A brush holder assembly shall be constructed so that if a carbon brush becomes worn away to the maximum possible extent, the spring or other parts of the assembly shall not defeat the required spacings between live parts and dead metal parts, or result in a live part becoming accessible.

c) Motors that are provided with thermoplastic coil forms or thermoplastic insulating material shall comply with the requirements for Thermoplastic Coil Forms and Thermoplastic Insulating Material, Section 66.

d) Resilient elastomer (e.g. rubber), thermoplastic, or non-metallic mounting of a motor relied upon for bonding of the motor in an appliance provided with grounding shall comply with the respective requirements of Standard for Rotating Electrical Machines – General Requirements, UL 1004-1, if the dead metal parts of the motor are accessible during normal use or servicing of the appliance.

e) A starting or running capacitor of a motor in a permanently-connected appliance shall comply with UL 1004-1 with respect to the maximum available fault current.

f) A motor shall be marked with the motor manufacturer name or identification, catalog or model number, rated voltage and rated frequency.

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

h) A motor requiring a motor insulation system greater than Class 105 (A) due to motor winding temperatures obtained during appliance testing shall comply with UL 1446 for the Class insulation required.

i) All motor materials shall be evaluated with respect to corrosion protection and galvanic compatibility. (See 9.3.) Winding terminal materials shall be suitable for the connection of motor leads. Wire connectors used to join live parts of dissimilar materials shall comply with the Standard for Wire Connectors, UL 486A-486B.

### 6.10 Motor overload protection

6.10.1 An appliance shall incorporate thermal or overcurrent protection in accordance with 6.10.6 if the appliance is unattended or remotely or automatically controlled. See 4.9 and 4.47.

6.10.2 An automatically controlled blender is considered to comply with 6.10.1 if it is provided with locked-rotor protection in accordance with 6.10.6.

6.10.3 The motor of an ice cream freezer (bucket type), butter churn or pasta mixer-extruder shall comply with the locked rotor protection in 6.10.6.

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*Exception: An ice cream freezer, butter churn or pasta mixer-extruder motor is considered to comply with the requirement in 6.10.6, if when the ice cream freezer, butter churn or pasta mixer-extruder container and the driven member are frozen together, the motor is energized and the temperature limits specified in 6.10.6 are not exceeded.*

6.10.4 A motor intended to move air only by means of an air-moving fan that is integrally attached, keyed, or otherwise fixed to the motor shaft is not required to have running-overload protection.

6.10.5 A shaded-pole motor with a 2:1 or smaller ratio between locked-rotor and no-load currents and a 1 A or smaller difference between no-load and locked-rotor currents is considered to have acceptable overload protection if it is protected against locked-rotor conditions only.

6.10.6 Motor-overload protection required for an appliance shall consist of one of the following:

a) Thermal motor protection complying with the Standard for Thermally Protected Motors, UL 1004-3.

b) Impedance motor protection complying with (when the motor is tested as used in the appliance under locked-rotor conditions) the Standard for Impedance Protected Motors, UL 1004-2.

c) Electronic motor protection complying with the Standard for Electronically Protected Motors, UL 1004-7.

d) Other protection that is shown by test to be equivalent to the protection as specified in (a).

6.10.7 With respect to 6.10.6, for an appliance that includes a control that positively and reliably limits the length of the time the appliance can operate under normal operation, the duration of the temperature test and the endurance test, both under locked-rotor conditions, may be less than that specified but shall not be less than the time the appliance can operate. If an electronic control operates only under abnormal conditions to end the test or limit the motor temperatures, the control shall be evaluated as electronic motor protection per 6.10.6(c) or the test shall be repeated with the electronic control defeated.

6.10.8 With respect to 6.10.6 (a), a thermal link provided for motor overload protection need not be evaluated in accordance with the Standard for Thermally Protected Motors, UL 1004-3 if it complies with the Standard for Thermal Links – Requirements and Application Guide, UL 60691, and the appliance complies with this standard.

6.10.9 With respect to the evaluation of electronic motor protection in accordance with 6.10.6 (c), the control shall be evaluated in accordance with 6.5 as a protective control.

6.10.10 The functioning of a motor-protective device provided as part of an appliance (whether such device is required or not) shall not result in a risk of fire or injury to persons. Compliance shall be determined by the following as applicable:

a) For automatically-controlled appliances, compliance with 6.10.1;

b) For appliances actuated by a momentary contact switch, compliance with the Continuous Operation Test, Section 48;

c) For appliances with metal or partly-metallic enclosures, compliance with the Metal Enclosure Abnormal Locked Rotor Test, Section 49.1;

d) For appliances with polymeric enclosures, compliance with the Enclosures of Polymeric Material for Portable Appliances, Section 64.

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e) For appliances provided with an automatic reset overload-protective device, automatic restarting shall not result in injury to persons. See 27.2; and

f) For appliances provided with a self-holding protector, where automatic restarting would result in a risk of injury to persons, compliance with the Self-Holding Protector Abnormal Locked Rotor Test, Section 49.2.

### 6.11 Overcurrent protection

6.11.1 Fuses shall comply with the Standard for Low-Voltage Fuses – Part 1: General Requirements, UL 248-1; and the applicable Part of the UL 248 series for the specific fuse type.

6.11.2 Fuseholders shall comply with the Standard for Fuseholders – Part 1: General Requirements, UL 4248-1, and the applicable Part of the UL 4248 series for the specific fuseholder type.

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

6.11.4 A protective device shall be wholly inaccessible from outside the appliance except that the operating handle of a circuit breaker, the operating button of a manually operable motor protector, and similar parts may project outside the appliance enclosure.

6.11.5 If an appliance is provided with a single-pole overcurrent protective device and is required to employ a polarized plug, the overcurrent protective device shall be connected to the ungrounded conductor of the power-supply cord of an appliance. Table 10.3 specifies the polarity identification of the power-supply cord conductors.

*Exception: For portable, non-automatically starting appliances employing a motor rated 1-hp or less intended to be operated on a nominal 120 volts branch circuit and employing a plug rated at 15-amperes, an overcurrent protective device within the appliance is not prohibited from being located in either conductor of the power-supply cord, when the overcurrent protective device acts only as a supplementary overcurrent protector.*

### 6.12 Polymeric materials and enclosures

6.12.1 Polymeric materials shall have:

a) A suitable flammability rating in accordance with the Standard for Test for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, as specified in Section 64 for portable appliances or Section 65 for stationary and fixed appliances, and

b) A suitable Functional-Use Temperature Index, Generic Thermal Index, or Relative Thermal Index (RTI) in accordance with Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

See also Section 15 for polymeric electrical insulation, Section 64 for portable appliances, Section 65 for stationary or fixed appliances, and Section 66 for thermoplastic motor insulation.

*Exception: If the deterioration of a part formed of polymeric material does not result in noncompliance with this standard, the thermal index need not be determined.*

6.12.2 Metallized 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

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not applicable to metallized coating applied only to the exterior surfaces of the appliance such that flaking of the coating is not likely to enter the electrical enclosure of the appliance.

### 6.13 Power supplies

6.13.1 A Class 2 power supply shall comply with the Standard for Class 2 Power Units, UL 1310.

6.13.2 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 – Safety – Part 1: General Requirements, UL 60950-1.

6.13.3 Limited Power Source (LPS) power supplies shall comply with the Standard for Information Technology Equipment – Safety – Part 1: General Requirements, UL 60950-1 or the Standard for Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements, UL 62368-1.

### 6.14 Printed wiring boards

6.14.1 Printed wiring boards shall comply with the Standard for Printed Wiring Boards, UL 796.

6.14.2 Printed wiring boards shall have a flammability class of at least HB.

6.14.3 Printed wiring boards containing line voltage circuits shall be rated for direct support.

### 6.15 Pumps

6.15.1 A pump provided with a vacuum blender shall comply with the construction and performance requirements of this Standard, unless it complies with the Standard for Motor-Operated Air Compressors, Vacuum Pumps, and Painting Equipment, UL 1450.

### 6.16 Semiconductors, relays and small electrical and electronic components

6.16.1 A power switching semiconductor device that is relied upon to provide isolation to ground shall comply with the Standard for Electrically Isolated Semiconductor Devices, UL 1557. The dielectric voltage withstand tests required by UL 1557 shall be conducted applying the criteria of Section 37, Dielectric Voltage-Withstand Test, of this end product standard.

6.16.2 An optical isolator that is relied upon to provide isolation between primary and secondary circuits or between other circuits as required by this standard shall comply with the Standard for Optical Isolators, UL 1577. The dielectric voltage withstand tests required by UL 1577 shall be conducted applying the criteria of Section 37, Dielectric Voltage-Withstand Test, of this end product standard.

6.16.3 Except as otherwise specified in this standard, component requirements are not specified for small electrical parts on printed wiring boards, including diodes, transistors, resistors, inductors, integrated circuits, and capacitors not directly connected to the supply source.

6.16.4 Relays shall comply with the Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1, and, where applicable, the relevant Part 2 standard from the UL 60730 series; or the Standard for Industrial Control Equipment, UL 508.

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## 6.17 Solenoids and electrically operated valves

6.17.1 Solenoids shall comply with the Outline of Investigation for Solenoids, UL 906.

6.17.2 Electrically operated valves shall comply with:

a) The Standard for Electrically Operated Valves, UL 429; or

b) The Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1, and, where applicable, the relevant Part 2 standard from the UL 60730 series.

## 6.18 Supplemental insulation, insulating bushings and assembly aids

6.18.1 The requirements for supplemental insulation (e.g. tape, sleeving or tubing) are not specified unless the insulation or device is required for compliance with 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.

6.18.2 Wire positioning devices required for compliance with this standard shall comply with the Standard for Positioning Devices, UL 1565.

6.18.3 Insulating bushings required for compliance with this standard shall comply the Standard for Insulating Bushings, UL 635. 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.

## 6.19 Switches, timers and interlocks

### 6.19.1 Switches

6.19.1.1 Switches shall comply with:

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

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

c) The construction and performance requirements of this standard, when tested in conjunction with the appliance.

6.19.1.2 With respect to evaluation of a switch to this standard per 6.19.1.1(c), a switch shall comply with the Switch Overload Test of 56.1 and the Switch Endurance Test of 57.1.

6.19.1.3 A switch evaluated in accordance with 6.19.1.1 (a) or (b) shall be appropriate for the particular application, and shall have a current and voltage rating not less than that of the load which it controls when the appliance is operated normally.

6.19.1.4 In applying the requirement in 6.19.1.3 to a switch controlling a motor, the switch shall have a horsepower rating not less than that of the controlled motor.

*Exception No. 1: A switch with suitable general purpose voltage and current ratings, but without a suitable horsepower rating, may be used if it complies with the Switch Overload Test of 56.1 or if:*

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*a) The power factor in the locked rotor condition is at least 80 percent; and*

*b) The locked rotor current is not more than 150 percent of the switch rating, for switches rated 10 A or less; or*

*c) The locked rotor current is not more than 125 percent of the switch rating, for switches rated greater than 10 A.*

*Exception No. 2: A switch with a suitable voltage rating and a resistive current rating not less than twice the full-load current corresponding to the motor horsepower rating, per Article 430 of the National Electrical Code, ANSI/NFPA 70, may be used if it complies with the Switch Overload Test of 56.1. Where the horsepower rating of the motor is not specified, the resistive current rating shall not be less than twice the rating of the appliance.*

6.19.1.5 With reference to the requirement in 6.19.1.3, the resistive current rating of a switch that controls an inductive load other than a motor, such as a transformer or relay, shall not be less than twice the rated full-load current of the inductive load.

6.19.1.6 If, when energized, an appliance has moving parts that are likely to cause injury to persons, a motor control switch shall be provided on the appliance and shall have a plainly identified OFF position, or ON and OFF positions, in accordance with 6.19.1.7 and 6.19.1.8 as applicable. See also Exception No. 2 of 6.5.2.2 for electronic controls employed in place of a motor control OFF switch.

*Exception No. 1: If a momentary contact switch with no means for locking in the on condition is used as the motor control switch, the ON and OFF markings may be omitted.*

*Exception No. 2: The OFF marking specified in 6.19.1.7 may be omitted for a product with a reliable standby condition if the construction complies with all of the following:*

*a) The same push button switch actuator is used for placing the unit in the OFF, ON and Standby conditions,*

*b) The OFF and standby condition comply with the single fault reliability as specified in 27.14,*

*c) The switch is marked with the Standby symbol (IEC 60417-5009) shown in Figure 6.3, and*

*d) The function of the switch and meaning of the symbol is described in the instruction manual per 74.6.*

*Exception No. 3: The OFF and ON markings specified in 6.19.1.7 and 6.19.1.8 respectively may be replaced by the ON/OFF (push-push) symbol (IEC 60417-5010) shown in Figure 6.4 if a single switch push button actuator is used for ON and OFF with separate and stable ON and OFF positions.*

6.19.1.7 With reference to the requirement in 6.19.1.6, the OFF position of the switch shall be marked with either one or both of the following:

a) The word "OFF", or

b) The symbol shown in Figure 6.1. See also 74.6.

6.19.1.8 With reference to the requirement in 6.19.1.6, the ON position of the switch, when identified, shall be marked with one or both of the following, as determined by the marking of the OFF position of the switch:

a) The word "ON" when the OFF position of the switch is marked with the word "OFF", or

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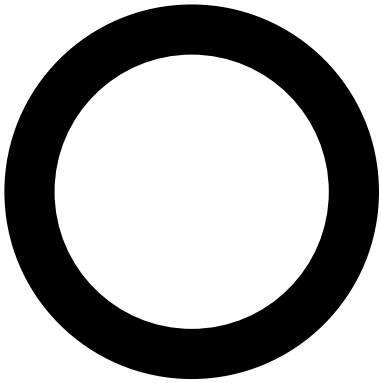
b) The symbol shown in Figure 6.2, when the OFF position of the switch is marked with the symbol shown in Figure 6.1. See also 74.6.

**Figure 6.1**

**Symbol for OFF Position**



IEC 60417 Symbol 5008

**Figure 6.2**

**Symbol for ON Position**

IEC 60417 Symbol 5007

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**Figure 6.3**

**Symbol for Standby Condition**

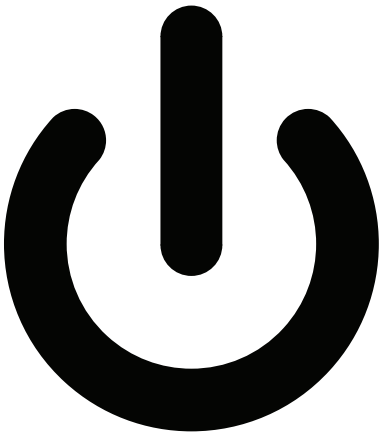

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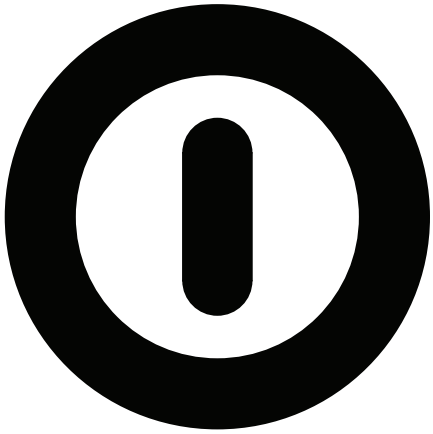
**Figure 6.4**

**Symbol for ON/OFF Position**



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6.19.1.9 If a portable appliance employs a motor rated at more than 1/3 horsepower, a motor-control switch for the motor shall be provided in the appliance. See 17.8.

6.19.1.10 An appliance shall not employ a through-cord switch.

6.19.1.11 A manually operated, line-connected, single pole switch, a triac controlling a motor, or other control device, intended for appliance ON-OFF operation shall be connected to the ungrounded conductor of the power-supply cord. Table 10.3 specifies the polarity identification of the power-supply cord conductors.

### 6.19.2 Timing switches and controls

6.19.2.1 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 electro-mechanical arrangements shall comply with:

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

b) Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1, and, where applicable, the relevant Part 2 standard from the UL 60730 series.

6.19.2.2 A timer or time switch, incorporating electronic timing circuits or switching circuits, with or without separable contacts, shall be evaluated in accordance with 6.5.

### 6.19.3 Interlock systems

6.19.3.1 An interlock system required for compliance with this standard shall be capable of completing the Interlock Endurance Test of 58.2 without malfunction.

6.19.3.2 With respect to 6.19.3.1, except as indicated for centrifugal juicers per 30.7.6, coffee mills per 30.10.2 and pasta mixer-extruders per 30.11.1, the Interlock Endurance Test shall consist of 10,000 cycles of operation in the intended manner.

6.19.3.3 An interlock system required for compliance with this standard shall be such that both of the following conditions are met:

a) When the cover or guard is removed, the moving parts shall stop within 4 seconds when subjected to the Cutter Stopping Time Determination Test of 58.1.

*Exception: A centrifugal juicer shall not be subjected to the Cutter Stopping Time Determination Test.*

b) If the cover or guard can be assembled for use to actuate the interlock switch without being properly locked in place, any access opening to moving parts that can be created by the misalignment shall have a maximum vertical dimension of not more than 1 inch (25.4 mm) between the bowl and cover when subjected to the Cover/Guard Misalignment Test of 58.3.

## 6.20 Transformers

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

6.20.2 Class 2 and Class 3 transformers shall comply with the Standard for Low Voltage Transformers – Part 3: Class 2 and Class 3 Transformers, UL 5085-3.

# 7 Frame and Enclosure

7.1 The frame and enclosure of an appliance shall be strong and rigid enough to resist the abuses likely to be encountered during normal service. The construction of the appliance shall preclude total or partial collapse with the attendant reduction of required minimum acceptable spacings, loosening or displacement of parts, and other serious defects which alone or in combination constitute an increase in the risk of fire, electric shock, or injury to persons.

7.2 An appliance shall be provided with enclosures of material acceptable for the particular application that shall house all electrical parts that may present a risk of fire or injury to persons under normal use and under reasonably foreseeable misuse.

7.3 Among the factors taken into consideration when an enclosure is being judged for acceptability are its:

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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 during conditions of normal or abnormal use.

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

7.4 If a blender has an exterior surface of glass or comparably brittle material, such as a capacitive touch screen, which is part of the enclosure of live parts, the material shall be capable of withstanding the stresses likely to be encountered in actual service. Such parts shall be subjected to the Impact Test in accordance with 64.5.1.4.

7.5 The appliance enclosure shall house all moving parts except for those which need be exposed to perform their intended function, such as the beater blades to a mixer. See PROTECTION AGAINST PERSONAL INJURY.

7.6 Electrical parts of an appliance shall be so located or enclosed that protection against unintentional contact with uninsulated live parts will be provided.

7.7 The construction of an enclosure of a knife-sharpener (or a combination appliance having a knife-sharpening function, including an appliance provided with a mechanical sharpening block that is open to the motor or electrical compartment) shall preclude the drawing-in of filings developed during the sharpening function if such an event introduces a risk of fire or electric shock. See 39.3 – 39.5.

7.8 The construction of an appliance intended for outdoor use shall be such as to prevent water from coming into contact with uninsulated live parts when the appliance is subjected to a test to simulate conditions that might occur during actual use. See Resistance to Moisture Test, Section 47.

*Exception: This requirement is not applicable if the appliance is marked in accordance with 72.15 for outdoor use type.*

7.9 An opening smaller than 1 inch (25.4 mm) in an enclosure is acceptable if a probe, as illustrated in Figure 7.1 when inserted point first into an opening, cannot be made to touch any uninsulated live part or film-coated wire. The probe shall be applied in all possible articulated positions.

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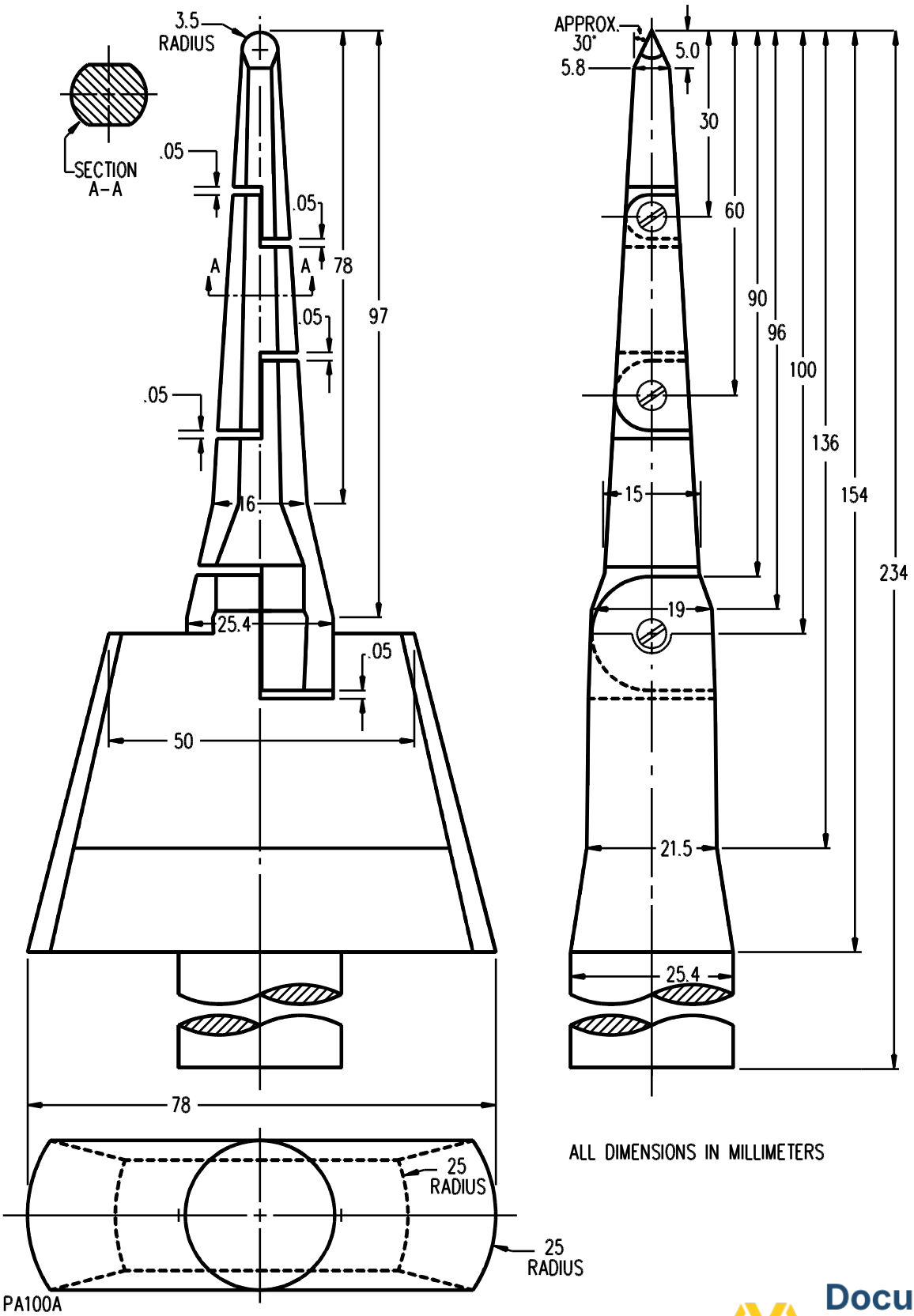
**Figure 7.1**

**Probe**

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7.10 An opening provided for hanging or mounting an appliance shall be so located or guarded that a nail, hook, or the like does not displace a part that creates a risk of fire or electric shock and does not contact one of the following:

a) An uninsulated live metal part;

b) Magnet wire;

c) Internal wiring;

d) Moving parts; or

e) Any other part likely to create a risk of fire or electrical shock.

7.11 An opening 1 inch (25.4 mm) or larger in an enclosure as illustrated in Figure 7.2 is acceptable if, within the enclosure, there is no uninsulated live part or magnet wire:

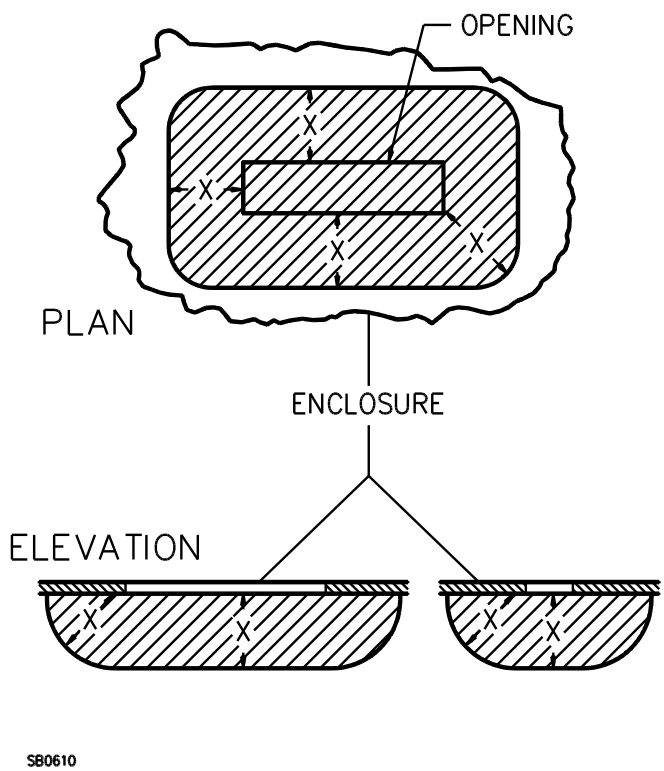
a) Less than X distance from the perimeter of the opening; as well as

b) Within the volume generated by projecting the perimeter X distance normal to its plane.

X equals 5 times the diameter of the largest diameter rod which can be inserted through the opening.

**Figure 7.2**

**Opening in Enclosure**




7.12 During the examination of an appliance in connection with the requirements in 7.2 – 7.6 any part of the enclosure is to be disregarded – that is, it will not be assumed that the part in question affords protection against electric shock or injury to persons – if it either:

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a) Must be opened or removed, with or without the use of tools, to perform manufacturer's recommended user servicing, maintenance, operating adjustments, attachment of accessories, or other instructions; or

b) Can be opened or removed without the use of tools.

*Exception: A part that requires a tool for opening or removal to perform manufacturer's recommended user servicing, maintenance, operating adjustments, attachment of accessories, or other instructions is to remain in place if the appliance is marked in accordance with 71.8.*

7.13 If a part of an enclosure that relies for mechanical securement on non-metallic parts, such as plastic tabs or snap-action inserts and post, complies with the requirements for Non-Metallic Enclosure Fasteners Test of 64.15 the part is considered to require a tool for removal.

7.14 The enclosure of a remotely or automatically controlled appliance or a blender with a heating function provided with a heating element shall prevent molten metal, burning insulation, flaming particles, or the like from falling on combustible materials, including the surface upon which the appliance is supported. See 4.9 and 4.46.

7.15 The requirement in 7.14 will necessitate the use of a barrier material that resists ignition:

a) Under a motor unless:

1) The structural parts of the motor or of the appliance 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 appliance when the motor is energized under each of the following fault conditions:

i) Open main winding;

ii) Open starting winding;

iii) Starting switch short-circuited; and

iv) For a permanent-split-capacitor motor the capacitor is short circuited. The short circuit is to be applied before the motor is energized and the rotor is to be blocked; or

3) The motor is provided with a thermal motor protector (a protective device that is sensitive to temperature and current) that will prevent 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; and

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, except for terminals, unless it can be shown that malfunction of the component would not result in a possible fire or there are no openings in the bottom of the appliance enclosure.

7.16 The barrier mentioned in 7.15 shall be horizontal, shall be located as indicated in Figure 7.3, and shall not be an area less than that described in that illustration. Openings for drainage, ventilation, and the like may be employed in the barrier, provided that such openings would not permit molten metal, burning insulation or the like to fall on combustible material.

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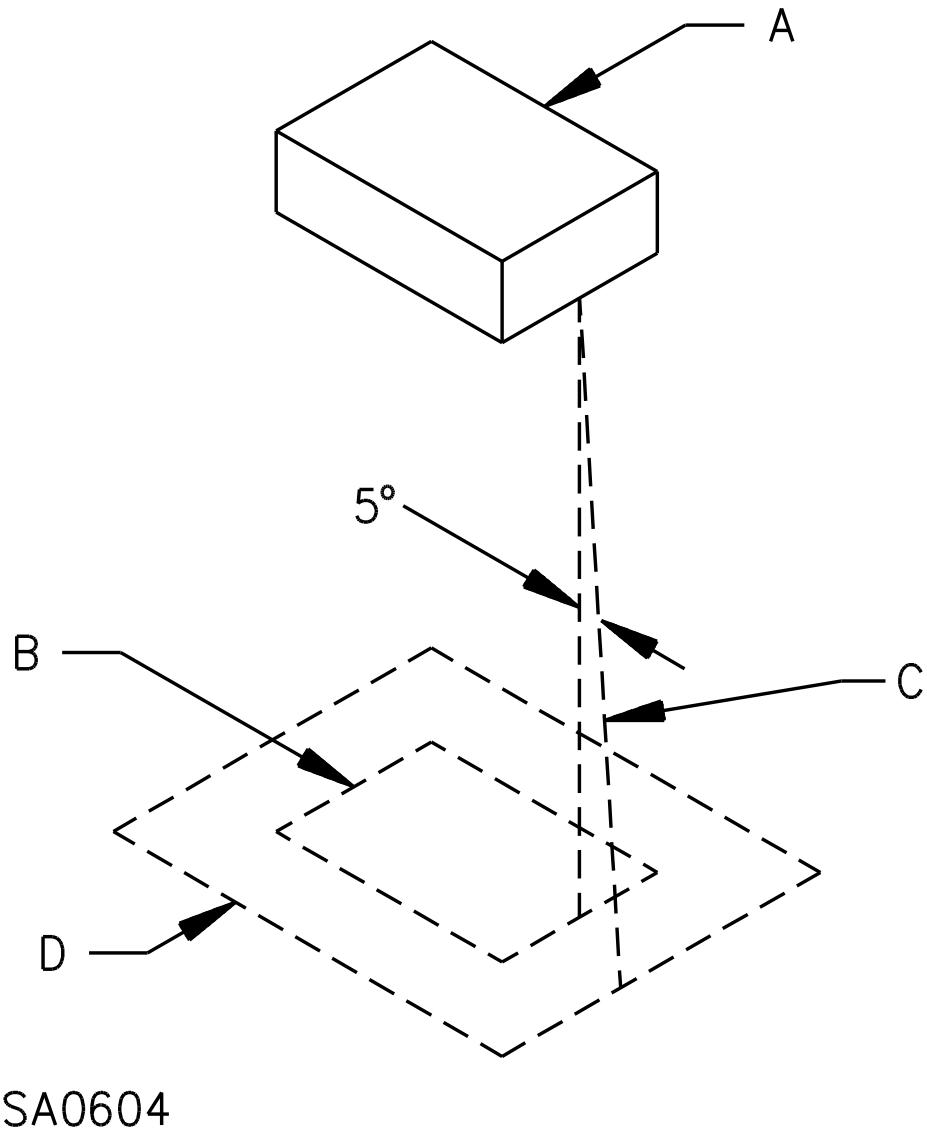
**Figure 7.3**

**Location and Extent of Barrier**




Notes:

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.When moving, the line is always:

a) Tangent to the component;

b) 5 degrees from the vertical; and

c) So oriented 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.

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7.17 The arrangement and guarding of parts of an appliance shall permit easy and proper installation and removal of strainers, baskets, and the like that must be removed, cleaned, and refilled by the user. The removal and replacement of these vessels and their ingredients shall not result in damage to or contamination of wiring, electrical components, or other parts.

7.18 The assembly described in 7.17 shall be such as to minimize the likelihood of spillage on live parts, including magnet wire.

7.19 Cast- and sheet-metal portions of the enclosure shall not be thinner than indicated in Table 7.1 unless the enclosure is found to be acceptable when judged under considerations such as those mentioned in 7.3 and 7.20.

**Table 7.1**
**Minimum Acceptable Thicknesses of Enclosure Metal**

| Enclosure metal | At small, flat, unreinforced surfaces and at surfaces that are reinforced by curving, ribbing, and the like (or are otherwise of a shape or size) to provide adequate physical strength | | At surfaces to which a wiring system is to be connected in the field | | At relatively large unreinforced flat surfaces | |
|---|---|---|---|---|---|---|
| | inches | (mm) | inches | (mm) | inches | (mm) |
| Die-cast metal | 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) |
| 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 judged under considerations such as those mentioned in 7.3 and 7.20.

7.20 In addition to being considered with reference to the factors mentioned in 7.3 an enclosure of sheet metal is to be judged with respect to its size, shape, and the thickness of metal considering the intended use of the appliance.

7.21 A cord-connected appliance that is provided with keyhole slots, notches, hanger holes, and the like for hanging on a wall shall be constructed in such a manner that the hanging means shall not be accessible without removing the appliance from the wall.

*Exception: A separate wall mounted battery charger for use with an appliance shall comply with the requirements in the Standard for Battery Chargers for Charging Engine-Starter Batteries, UL 1236.*

7.22 Cord connected wall-mounted appliances employing a permanently fastened mounting bracket shall be removable from the bracket without the use of a tool.

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## 8 Mechanical Assembly

8.1 An appliance shall be so assembled that it will not be affected adversely by the vibration of normal operation. Brush caps shall be tightly threaded or otherwise designed to prevent loosening.

8.2 A switch, a lampholder, and attachment-plug receptacle, a motor-attachment plug, or similar components shall be mounted securely, and, except as noted in 8.3 and 8.4, shall be prevented from turning. See 8.5.

8.3 The requirement that a switch be prevented from turning may be waived if all four of the following conditions are met:

a) The switch is to be of a 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 normal operation of the switch);

b) The means for mounting the switch makes it unlikely that operation of the switch will loosen it;

c) The spacings are not to be reduced below the minimum required if the switch rotates; and

d) The normal operation of the switch is to be by mechanical means rather than by direct contact by persons.

8.4 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 a nonremovable jewel) need not be prevented from turning if rotation cannot reduce spacings below the minimum required values.

8.5 The means for preventing the turning mentioned in 8.2 is to consist of more than friction between surfaces – for example, a lock washer, properly applied, is acceptable as the means for preventing a small stem-mounted switch or other device having a single-hole mounting means from turning.

8.6 Small molded parts such as brush caps, shall be constructed to have the mechanical strength and rigidity to withstand the stresses of actual service. Brush caps shall be secured or located to be protected from mechanical damage which might result during normal use.

8.7 Receptacles mounted to and supported by a cover shall be secured by more than one screw or shall be a device assembly or box cover intended for securing by a single screw.

## 9 Protection Against Corrosion

9.1 Except as noted in 9.2, iron and steel parts shall be protected against corrosion by enameling, galvanizing, plating, or other equivalent means, if the failure of such unprotected parts would be likely to result in a condition that can cause risk of fire, electric shock or injury to persons.

9.2 In certain instances where 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 and the inside surface of sheet steel enclosures may not be required to be protected against corrosion. The requirement in 9.1 does not apply to bearings, cast-iron parts, laminations, and shafts or to minor parts of iron or steel as washers, screws, and the like.

9.3 Metal shall be used in combinations that are galvanically compatible and shall not be subject to significant corrosion due to electrochemical action within the appliance. Compliance is checked by inspection and by reference to Figure 9.1. Combinations above the line in the table shown in Figure 9.1 shall be avoided. Corrosion resistance may be achieved by a suitable plating or coating process.

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## Figure 9.1

## Table of Electrochemical Potentials

| | Magnesium, magnesium alloys | Zinc, zinc alloys | 80 tin/20 Zn on steel, Zn on iron or steel | Aluminium | Cd on steel | Al/Mg alloy | Mild steel | Duralumin | Lead | Cr on steel, soft solder | Cr on Ni on steel, tin on steel, 12 % Cr stainless steel | High Cr stainless steel | Copper, copper alloys | Silver solder, Austenitic stainless steel | Ni on steel | Silver | Rh on Ag on Cu, silver/gold alloy | Carbon | Gold, platinum |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Magnesium, magnesium alloys | 0 | 0.05 | 0.55 | 0.7 | 0.8 | 0.85 | 0.9 | 1.0 | 1.05 | 1.1 | 1.15 | 1.25 | 1.35 | 1.4 | 1.45 | 1.6 | 1.65 | 1.7 | 1.75 |
| Zinc, zinc alloys | | 0 | 0.05 | 0.2 | 0.3 | 0.35 | 0.4 | 0.5 | 0.55 | 0.6 | 0.65 | 0.75 | 0.85 | 0.9 | 0.95 | 1.1 | 1.15 | 1.2 | 1.25 |
| 80 tin/20 Zn on steel, Zn on iron or steel | | | 0 | 0.15 | 0.25 | 0.3 | 0.35 | 0.45 | 0.5 | 0.55 | 0.6 | 0.7 | 0.8 | 0.85 | 0.9 | 1.05 | 1.1 | 1.15 | 1.2 |
| Aluminium | | | | 0 | 0.1 | 0.15 | 0.2 | 0.3 | 0.35 | 0.4 | 0.45 | 0.55 | 0.65 | 0.7 | 0.75 | 0.9 | 0.95 | 1.0 | 1.05 |
| Cd on steel | | | | | 0 | 0.05 | 0.1 | 0.2 | 0.25 | 0.3 | 0.35 | 0.45 | 0.55 | 0.6 | 0.65 | 0.8 | 0.85 | 0.9 | 0.95 |
| Al/Mg alloy | | | | | | 0 | 0.05 | 0.15 | 0.2 | 0.25 | 0.3 | 0.4 | 0.5 | 0.55 | 0.6 | 0.75 | 0.8 | 0.85 | 0.9 |
| Mild steel | | | | | | | 0 | 0.1 | 0.15 | 0.2 | 0.25 | 0.35 | 0.45 | 0.5 | 0.55 | 0.7 | 0.75 | 0.8 | 0.85 |
| Duralumin | | | | | | | | 0 | 0.05 | 0.1 | 0.15 | 0.25 | 0.35 | 0.4 | 0.45 | 0.6 | 0.65 | 0.7 | 0.75 |
| Lead | | | | | | | | | 0 | 0.05 | 0.1 | 0.2 | 0.3 | 0.35 | 0.4 | 0.55 | 0.6 | 0.66 | 0.7 |
| Cr on steel, soft solder | | | | | | | | | | 0 | 0.05 | 0.15 | 0.25 | 0.3 | 0.35 | 0.5 | 0.55 | 0.6 | 0.65 |
| Cr on Ni on steel, tin on steel, 12 % Cr stainless steel | | | | | | | | | | | 0 | 0.1 | 0.2 | 0.25 | 0.3 | 0.45 | 0.5 | 0.55 | 0.6 |
| High Cr stainless steel | | | | | | | | | | | | 0 | 0.1 | 0.15 | 0.2 | 0.35 | 0.4 | 0.45 | 0.5 |
| Copper, copper alloys | | | | | | | | | | | | | 0 | 0.05 | 0.1 | 0.25 | 0.3 | 0.35 | 0.4 |
| Silver solder, Austenitic stainless steel | | | | | | | | | | | | | | 0 | 0.05 | 0.2 | 0.25 | 0.3 | 0.35 |
| Ni on steel | | | | | | | | | | | | | | | 0 | 0.15 | 0.2 | 0.25 | 0.3 |
| Silver | | | | | | | | | | | | | | | | 0 | 0.05 | 0.1 | 0.15 |
| Rh on Ag on Cu, silver/gold alloy | | | | | | | | | | | | | | | | | 0 | 0.05 | 0.1 |
| Carbon | | | | | | | | | | | | | | | | | | 0 | 0.05 |
| Gold, platinum | | | | | | | | | | | | | | | | | | | 0 |

Ag Silver
Al Aluminium
Cr Chromium
Cd Cadmium
Cu Copper
Mg Magnesium
Ni Nickel
Rh Rhodium
Zn Zinc

NOTE – Corrosion due to electrochemical action between dissimilar metals which are in contact is minimized if the combined electrochemical potential is below about 0.6 V. In the table the combined electrochemical potentials are listed for a number of pairs of metals in common use; combinations above the dividing line should be avoided.

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## 10 Power Supply Connections – Cord-Connected Appliances

### 10.1 Cords and plugs

10.1.1 A cord-connected appliance (an appliance intended to be connected to the power-supply circuit by means of a flexible cord) shall be provided with an appropriate length of flexible cord and an attachment plug for connection to the supply circuit.

10.1.2 The flexible cord may be attached permanently to an appliance or may be in the form of a detachable power-supply cord with appropriate means for connection to the appliance. A hand-supported appliance employing a detachable power-supply cord shall include a positive means for retaining the appliance coupler body to the appliance during use. Typical retaining means may include a friction type fit coupled with a rib-type construction, snap-type fit or similar techniques. Friction type fit alone does not meet the intent of the requirement.

*Exception No. 1: A hand-held appliance is not required to employ a retaining means if the supply voltage is 30 V (42 V peak) or less.*

*Exception No. 2: A hand-held appliance rated over 30 V (42 V peak) is not required to employ a retaining means if it complies with the requirements for Appliance Coupler Retention, Section 62.*

10.1.3 Except as noted in 10.1.4, 10.1.5, 10.1.6 and 10.1.14, the flexible cord provided on a portable, under-cabinet or wall-mounted appliance shall be Type HPN, SPT-2, SVO, SVT, SVTO, or shall be of a type at least equally as serviceable for the particular application including its resistance to oil for the particular application. Rubber insulated cords shall be an oil resistant type. See 11.1.3 for cord types allowable for stationary appliances.

10.1.4 The flexible cord on a knife sharpener and on a battery-charger unit from which a battery-operated appliance is removed for use may be Type SPT-1.

10.1.5 A hand-supported product weighing 1.50 lb (0.68 kg) or less and having a power supply cord of the coiled type and a maximum extended length of 7.0 ft (2.1 m), may employ a Type SPT-1 cord, or shall be of a type at least equally as serviceable for the particular application including its resistance to oil.

10.1.6 A flexible cord on an appliance intended for outdoor use, shall be:

a) An outdoor use type (suffix W); and

b) At least a Type SJW or SJTW.

10.1.7 The flexible power-supply cord shall not be smaller than 18 AWG (0.82 $mm^2$), shall be rated for use at a voltage not less than the rated voltage of the appliance, and shall have an ampacity as given in Table 400-5 (A) of the National Electrical Code, ANSI/NFPA 70, not less than the current rating of the appliance. For reference purposes, an abbreviated table showing the ampacities for flexible cord with two current-carrying copper conductors is shown in Table 10.1.

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**Table 10.1**
**Ampacities for Flexible Cords**

| Conductor size | | Ampacity |
|---|---|---|
| AWG | ($mm^2$) | (Amperes) |
| 18 | (0.82) | 10 |
| 17 | (1.04) | 12 |
| 16 | (1.31) | 13 |
| 14 | (2.08) | 18 |
| 12 | (3.31) | 25 |

10.1.8 The power supply cord length shall be as outlined in Table 10.2. The power supply cord length of a blender with a heating function shall not be longer than 3.0 ft (0.9 m) if the appliance is lifted and tilted to dispense the liquid and 7.0 ft (2.1 m) if the appliance has a separable blender container or a spigot for dispensing the liquid.

**Table 10.2**
**Power Supply Cord Lengths**

| Type of appliance | Minimum acceptable length | | Maximum acceptable length | |
|---|---|---|---|---|
| | Feet | Meters | Feet | Meters |
| Intended for outdoor use | 6 | 1.82 | – | – |
| Hand-supported[1] | 5 | 1.52 | – | – |
| Counter-supported | 2 | 0.61 | – | – |
| Floor-supported cart or stand | 6 | 1.82 | – | – |
| Wall-mounted | 2 | 0.61 | 4.5[2] | 1.4[2] |

[1] See also 10.1.5.
[2] The cord may have a maximum length of 7 ft (2.1 m), if a means is provided for storing the excess length of cord.

10.1.9 The attachment plug shall be of a type with a current rating not less than the rated current of the appliance and the voltage rating equal to the rated voltage of the appliance. When an appliance is able to be adapted for use on two or more different values of voltage by field alteration of internal connections, the attachment plug provided with the appliance shall be rated for the voltage for which the appliance is connected when shipped from the factory.

10.1.10 The attachment plug of the power-supply cord of an appliance intended to be connected to a nominal 120 V circuit, and provided with a 15- or 20-ampere general-use receptacle shall be of the 3-wire grounding type. The attachment plug of the power-supply cord of an appliance provided with a manually operated, line-connected, single pole switch for appliance ON-OFF operation or an Edison-base lampholder shall be of the 2-wire polarized or 3-wire grounding type.

10.1.11 If a 3-wire grounding-type attachment plug or a 2-wire polarized attachment plug is provided on an appliance intended to be connected to a nominal 120 V circuit, the attachment plug connections shall comply with Figure 10.1 and the polarity identification of the flexible cord shall comply with Table 10.3.

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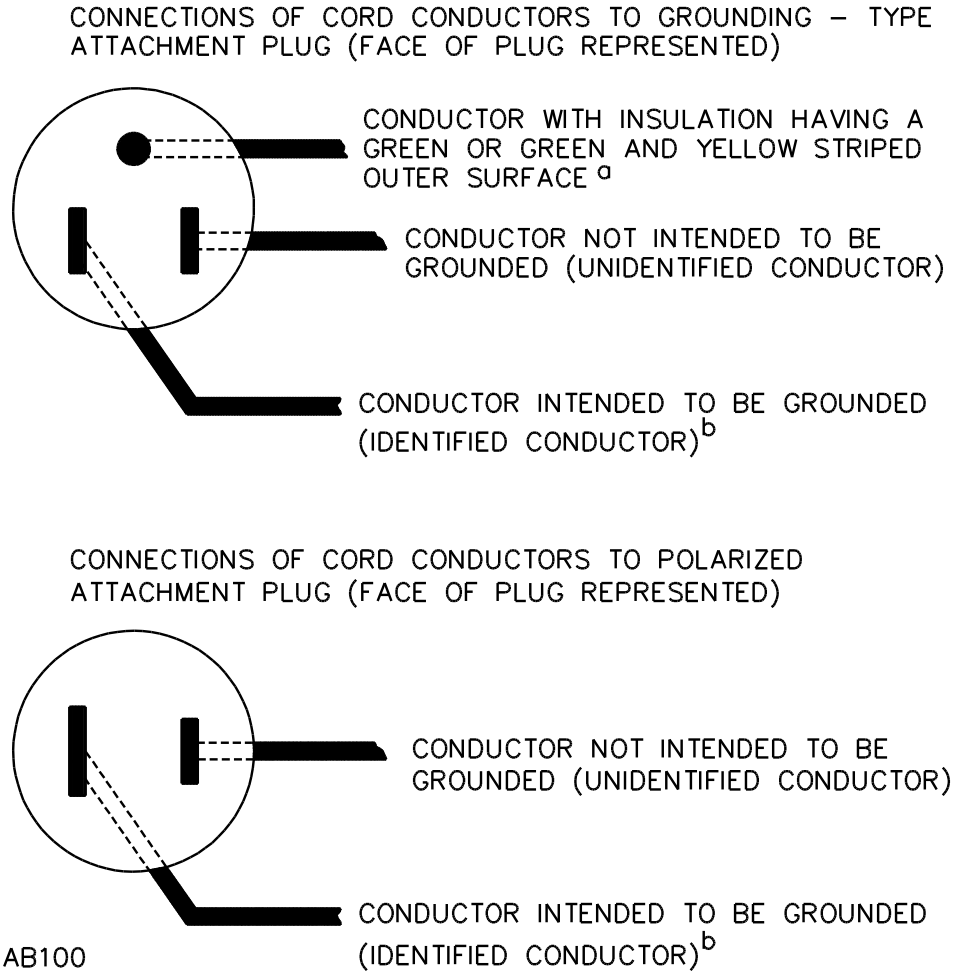
**Figure 10.1**

**Connection to Attachment Plugs**




[a] The blade to which the green conductor is connected may have a U-shaped or circular cross section.

[b] Signifies a conductor identified in accordance with Table 10.3.

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**Table 10.3**
**Polarity Identification of Flexible Cords**

| Method of identification | Acceptable combinations | | |
|---|---|---|---|
| | Conductor intended to be grounded[a,b] | | All other conductors[a] |
| Color of braids on individual conductors | A | Solid white or gray – without tracer | Solid color other than white or gray – without tracer |
| | B | Color other than white or gray, with tracer in braid | Solid color other than white or gray – without tracer |
| Color of insulation on individual conductors | C[c] | Solid white or gray | Solid color other than white or gray |
| | C1[d] | Solid light blue | Solid color other than light blue, white, or gray |
| Color of separators | D[d] | White or gray | Color other than white or gray |
| Other means | E[e] | Tin or other white metallic coating on all strands of the conductor | No tin or other white metallic coating on the strands of the conductor |
| | F[e] | A stripe, ridge, or groove on the exterior surface of the cord | |

[a] A conductor finished to show a green color with or without one or more yellow stripes or tracers is to be used only as an equipment grounding conductor.

[b] The grounded (identified) conductor is the neutral supply conductor.

[c] Only for cords – other than Types SP-1, SP-2, SPT-1, and SPT-2 – having no braid on any individual conductor.

[d] For jacketed cord.

[e] Only for Types SP-1, SP-2, SPT-1, and SPT-2 cords.

10.1.12 The conductor of the power-supply cord that is intended to be grounded shall have the following items connected to it:

a) The screw shell of an Edison-base lampholder; and

b) The terminal or lead of a receptacle intended to be grounded.

Table 10.3 identifies the supply cord conductor intended to be grounded.

10.1.13 An appliance employing a polarized detachable power-supply cord shall not accommodate a non-polarized cord.

10.1.14 For blenders with a heating function, where temperatures exceed 121°C (250°F) on any surface the power supply cord is likely to touch when the appliance is used as intended, the cord type shall be HPD, HPN, HSJ, HSJO or at least equally as serviceable.

## 10.2 Pin terminals

10.2.1 An appliance intended for use with a detachable power-supply cord shall not be provided with terminal pins that will accommodate a standard flatiron or appliance plug.

10.2.2 If an appliance is provided with pin terminals, the construction of the appliance shall be such that live parts will not be exposed to unintentional contact both during and after normal placement of the intended female fitting on the pins.

10.2.3 A pin guard is required, such that:

a) A straight edge nominally 1/16 inch (1.6 mm) thick placed in any position, across and in contact with edges of the pin terminal opening without the fitting cannot be made to contact any current-carrying pin; and

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b) With the fitting aligned with the pins and the face of the fitting in a plane located perpendicular to the end or ends of the farthest projecting current-carrying pins, the probe illustrated in Figure 7.1 shall not touch any current-carrying pin while the probe is inserted through any opening which is then present.

10.2.4 Pin terminals not provided as part of an appliance inlet complying with 6.2.1 shall also be subjected to the Blade Security Pull Test of 52.2 and the Blade Security Push Test of 52.3.

### 10.3 Strain relief

10.3.1 Strain relief shall be provided to prevent a mechanical stress on a flexible cord from being transmitted to terminals, splices, or interior wiring. See 59.1.

10.3.2 A clamp may be used on Types SPT-1, SPT-2, SVT and SVTO flexible cords protected by varnished-cloth tubing, phenolic, vulcanized fiber or the equivalent under the clamp, if the strain relief assembly complies with the requirements in 59.3. Thermoplastic tubing is not acceptable over thermoplastic cords.

*Exception: A non-metallic clamp may be used on Types SPT-1, SPT-2, SVT, and SVTO flexible cords without tubing, fiber or equivalent protection under the clamp if it complies with the requirements in 59.3.*

10.3.3 Means shall be provided to prevent the supply cord from being pushed into the enclosure of an appliance through the cord-entry hole when such displacement results in:

a) Subjecting the supply cord to mechanical damage;

b) Exposing the supply cord to a temperature higher than that for which it is rated;

c) Reducing spacings (such as to a metal strain-relief clamp) below the minimum required values; or

d) Damaging internal connections or components.

To determine compliance, the supply cord shall be tested in accordance with Section 60, Push Back Relief Test.

10.3.4 The flexible cord shall be restrained from any rotation that causes movement of internal wiring at splices and terminals.

10.3.5 If a knot in a flexible cord serves as strain relief, a surface with which the knot may come in contact shall be free from projections, sharp edges, burrs, fins, and the like, which may cause abrasion of the insulation of the conductors.

### 10.4 Cord bushings

10.4.1 At a point where a flexible cord or internal wiring passes through an opening in a wall, barrier, or enclosing case, and if subject to motion (flexing), there shall be an appropriate bushing or the equivalent which shall be substantial, reliably secured in place, and shall have a smooth, well-rounded surface against which the insulation may bear. If Type SPT-1 or SPT-2 is employed, if the wall or barrier is of metal, and if the construction is such that the cord may be subjected to strain or motion an insulating bushing shall be provided.

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

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10.4.3 Vulcanized fiber may be employed if the bushing is not less than 3/32 inch (2.4 mm) thick and is so formed and secured in place that it will not be affected adversely by moisture in normal use of the appliance.

10.4.4 At any point in an appliance, a bushing of the same material as, and molded integrally with the supply cord is acceptable on a Type SPT-1 or heavier cord if the built-up section is not less than 1/16 inch (1.6 mm) thick at the point where the cord passes through the enclosure.

10.4.5 An insulated metal grommet may be accepted instead of an insulating bushing, provided that the insulating material used is not less than 1/32 inch (0.8 mm) in thickness and fills completely the space between the grommet and the metal in which it is mounted.

### 10.5 Mechanical protection

10.5.1 The construction of an appliance shall be such that external surfaces of the enclosure that may be contacted by the power supply cord during normal use and storage shall be free of sharp edges or burrs that may abrade the insulation of the cord.

10.5.2 With respect to 10.5.1, if the appliance is provided with a cord storage area, it shall be free of sharp edges or burrs that might abrade the insulation of cord.

10.5.3 For an electric knife sharpener, the cord exit shall be located such that the cord will not be subjected to damage due to the movement of a knife through the knife sharpening slot during normal operation.

## 11 Power Supply Connections – Permanently-Connected Appliances

### 11.1 General

11.1.1 Except as noted in 11.1.3, a permanently connected appliance (an appliance intended for permanent connection to the power supply) shall have provision for connection of one of the wiring systems that, in accordance with the National Electrical Code, ANSI/NFPA 70, is appropriate for the appliance.

11.1.2 Sheet metal to which a wiring system is to be connected in the field shall have a minimum thickness of 0.032 inch (0.81 mm) if uncoated steel, a minimum thickness of 0.034 inch (0.86 mm) if galvanized steel, and a minimum thickness of 0.045 inch (1.14 mm) if nonferrous.

11.1.3 A stationary appliance may be acceptable if provided with a short length (a maximum of 8 ft or 2.44 m) of Type S, SO, ST, or STO cord and an attachment plug for supply connection. The investigation of such a feature will include consideration of the utility of the appliance and the necessity of having it readily detachable from its source of supply by means of the plug.

11.1.4 A terminal compartment or box in which connections to the power supply circuit will be made shall be located such that:

a) During the making of and inspection of electrical connections in the compartment, internal wiring and electrical components will not be exposed to mechanical abuse or stress; and

b) After the appliance has been installed as intended, such connections will be readily accessible for inspection.

11.1.5 A terminal compartment shall be so attached to the appliance as to be prevented from turning with respect to the wiring terminals.

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## 11.2 Wiring terminals

11.2.1 A wiring terminal is considered to be a terminal to which a wire may be connected in the field, unless the wire and a means of making the connection (a pressure terminal connector, soldering lug, soldered loop, crimped eyelet, and the like), factory-assembled to the wire, are provided as a part of the appliance.

11.2.2 A permanently connected appliance shall be provided with wiring terminals for the connection of the conductors having an ampacity in accordance with the National Electrical Code, ANSI/NFPA 70, or the appliance shall be provided with leads for such connection.

11.2.3 A wiring terminal shall be provided with a soldering lug or pressure terminal connector securely fastened in place (for example, firmly bolted or held by a screw), except that a wire-binding screw may be employed at a wiring terminal intended to accommodate a 10 AWG (5.3 $mm^2$) or smaller conductor if upturned lugs or the equivalent are provided to hold the wire in position.

11.2.4 A wiring terminal shall be prevented from turning.

11.2.5 Except as noted in 11.2.6, the free length of a lead inside an outlet box or wiring compartment shall be 6 inches (152 mm) or more if the lead is intended for field connection to an external circuit.

11.2.6 The lead may be less than 6 inches (152 mm) in length if it is evident that the use of a longer lead might result in an adverse condition.

11.2.7 A wire-binding screw at a wiring terminal shall not be smaller than No. 10, except that a No. 8 screw may be used at a terminal intended for the connection of a 14 AWG (2.1 $mm^2$) or smaller conductor, and a No. 6 screw may be used for the connection of a 16 or 18 AWG (1.3 or 0.82 $mm^2$) conductor. See 11.2.8.

11.2.8 It should be noted that, according to the National Electrical Code, ANSI/NFPA 70, 14 AWG (2.1 $mm^2$) is the smallest conductor that may be used for branch-circuit wiring, and thus is the smallest conductor that may be anticipated at a terminal for connection of a power-supply wire.

11.2.9 A terminal plate tapped for a wire-binding screw shall be of metal with a minimum thickness of 0.050 inch (1.27 mm) and shall not have less than two full threads in the metal, except that a special alloy plate a maximum of 0.050 inch (1.27 mm) thick and a minimum of 0.030 inch (0.76 mm) thick is acceptable if the tapped threads have appropriate mechanical strength.

11.2.10 A terminal plate formed from stock having the minimum required thickness, as given in 11.2.9, may have the metal extruded at the tapped hole to provide two full threads for the binding screw.

11.2.11 Upturned lugs or a cupped washer shall be capable of retaining a supply conductor of the size indicated in 11.2.2 under the head of the screw or washer.

11.2.12 A wire-binding screw shall thread into metal.

## 11.3 Grounded terminals and leads

11.3.1 A permanently connected appliance employing a lampholder of the Edison-screw-shell type, or a single-pole switch or overcurrent protective device other than an automatic control, shall have one terminal or lead identified for the connection of the grounded conductor of the supply circuit. The identified terminal or lead shall be the one that is electrically connected to screw shells of lampholders and to which no

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