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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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: [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.	

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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.

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.

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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.

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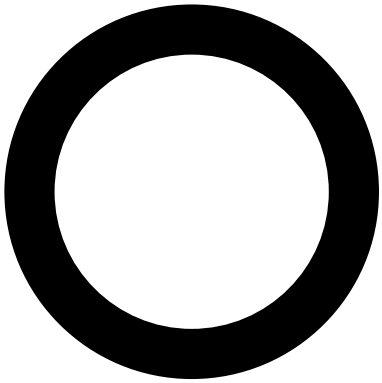
b) The symbol shown in Figure 6.2, when the OFF position of the switch is marked with the symbol shown in Figure 6.1. See also 74.6.

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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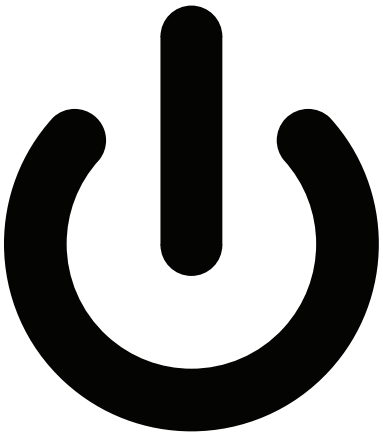
Figure 6.3

Symbol for Standby Condition



su2581

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:

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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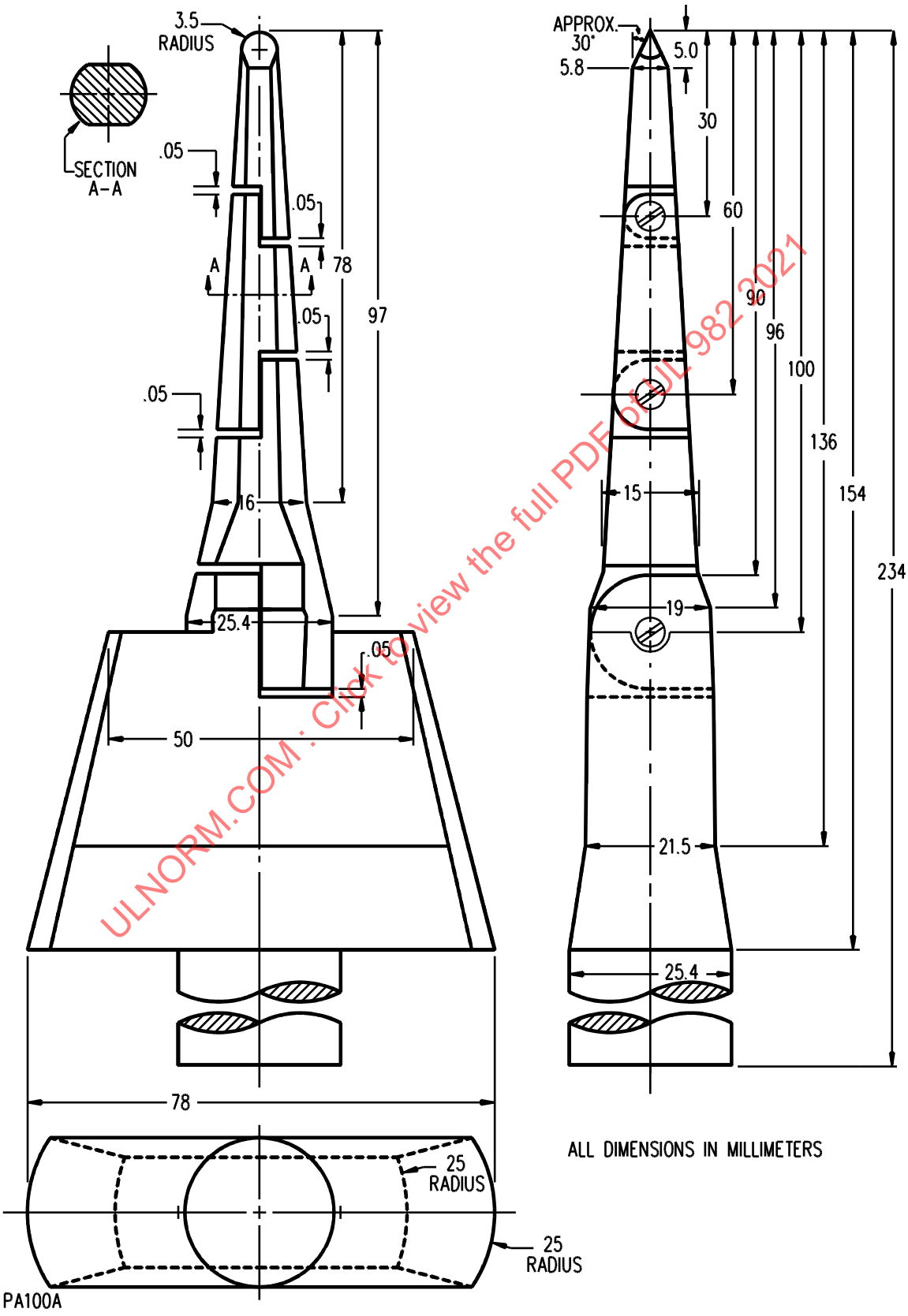
Figure 7.1

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:

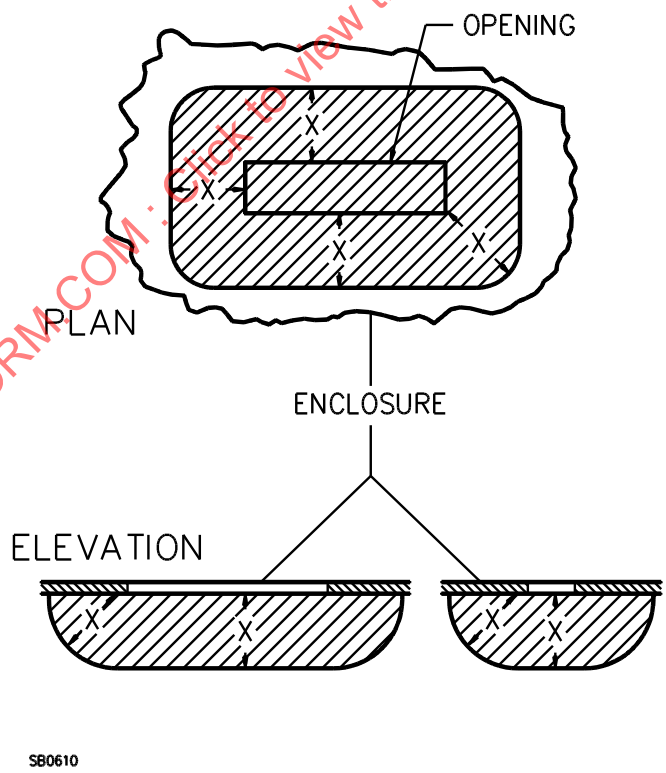
a) Less than X distance from the perimeter of the opening; as well as

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



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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:

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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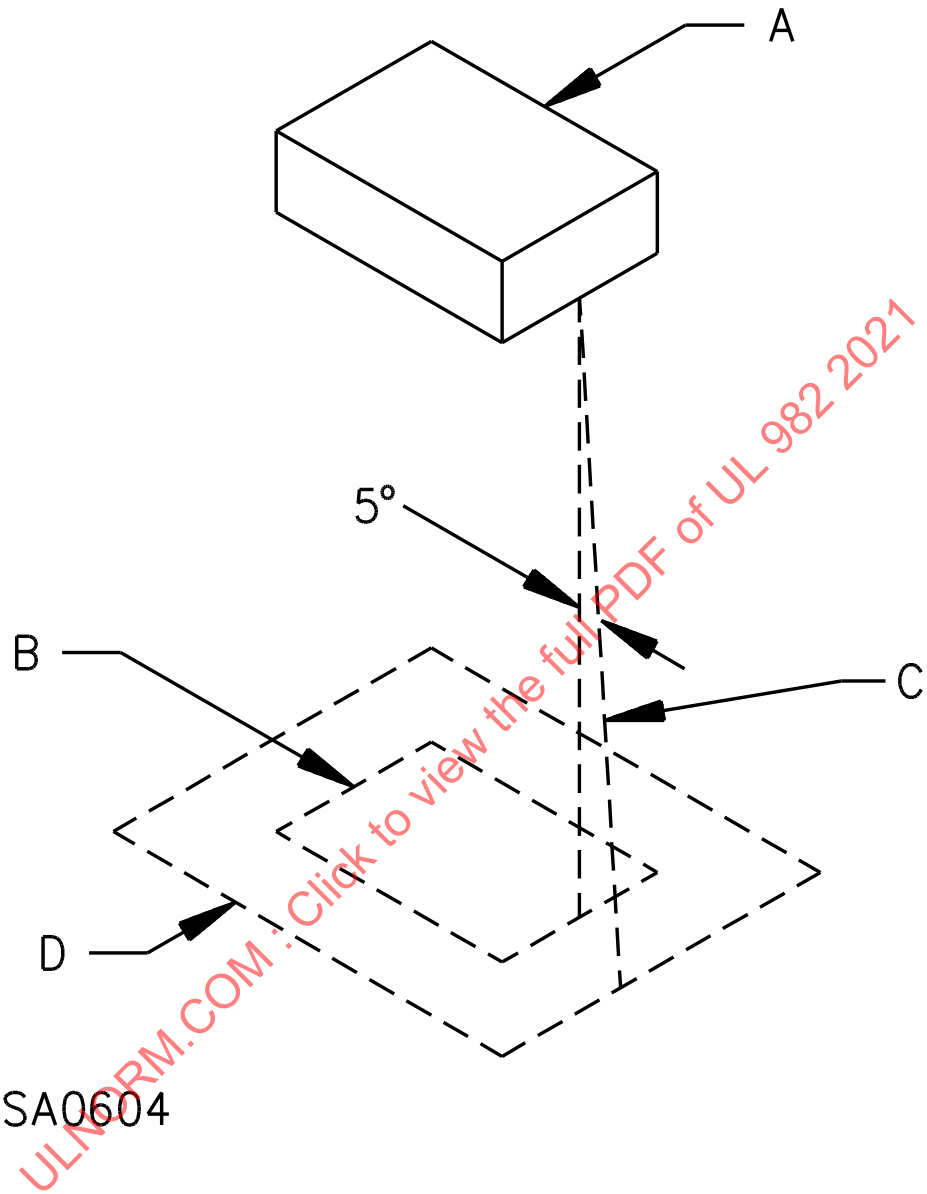
Figure 7.3

Location and Extent of Barrier



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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.

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.

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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.

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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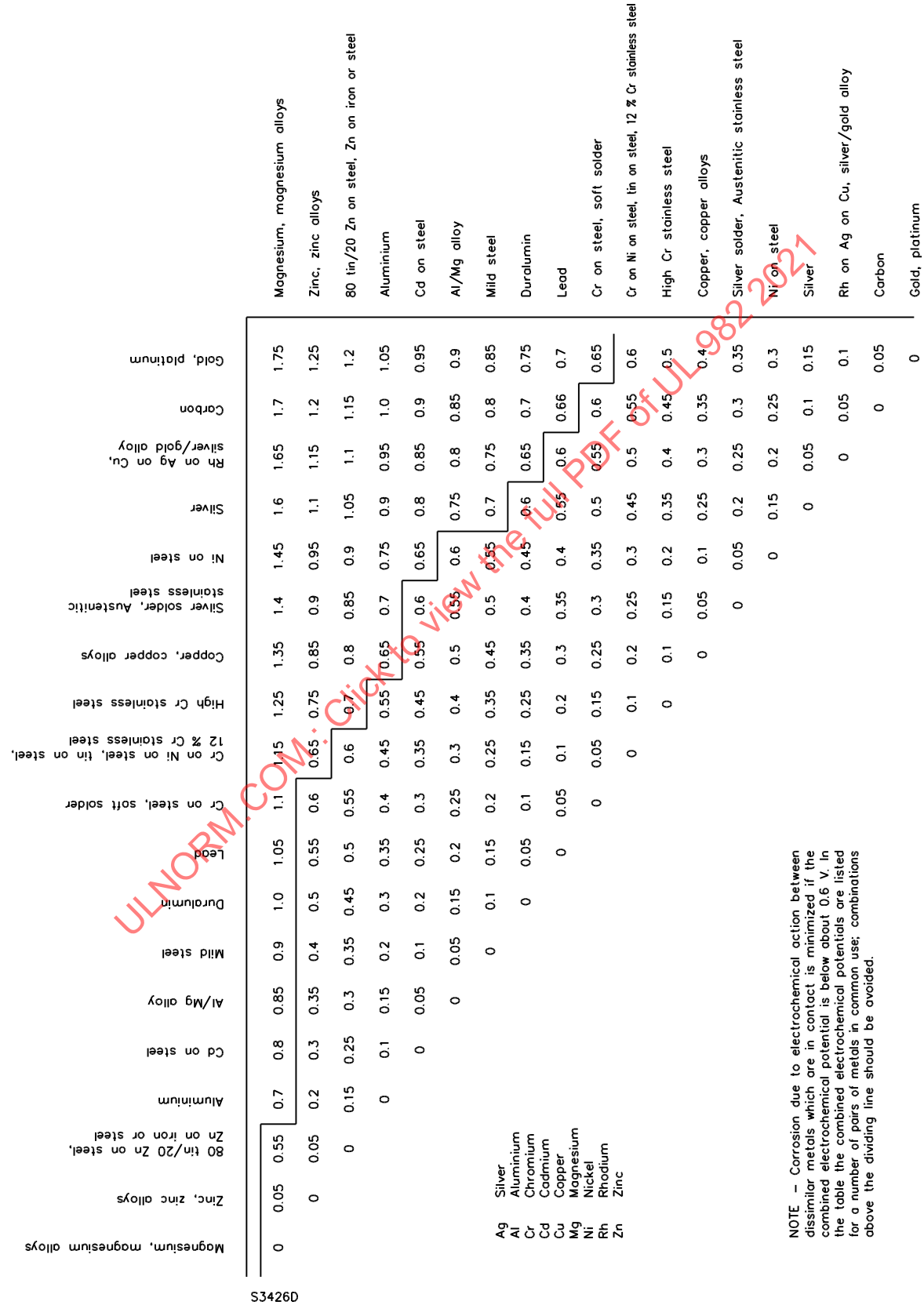
Figure 9.1

Table of Electrochemical Potentials



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.

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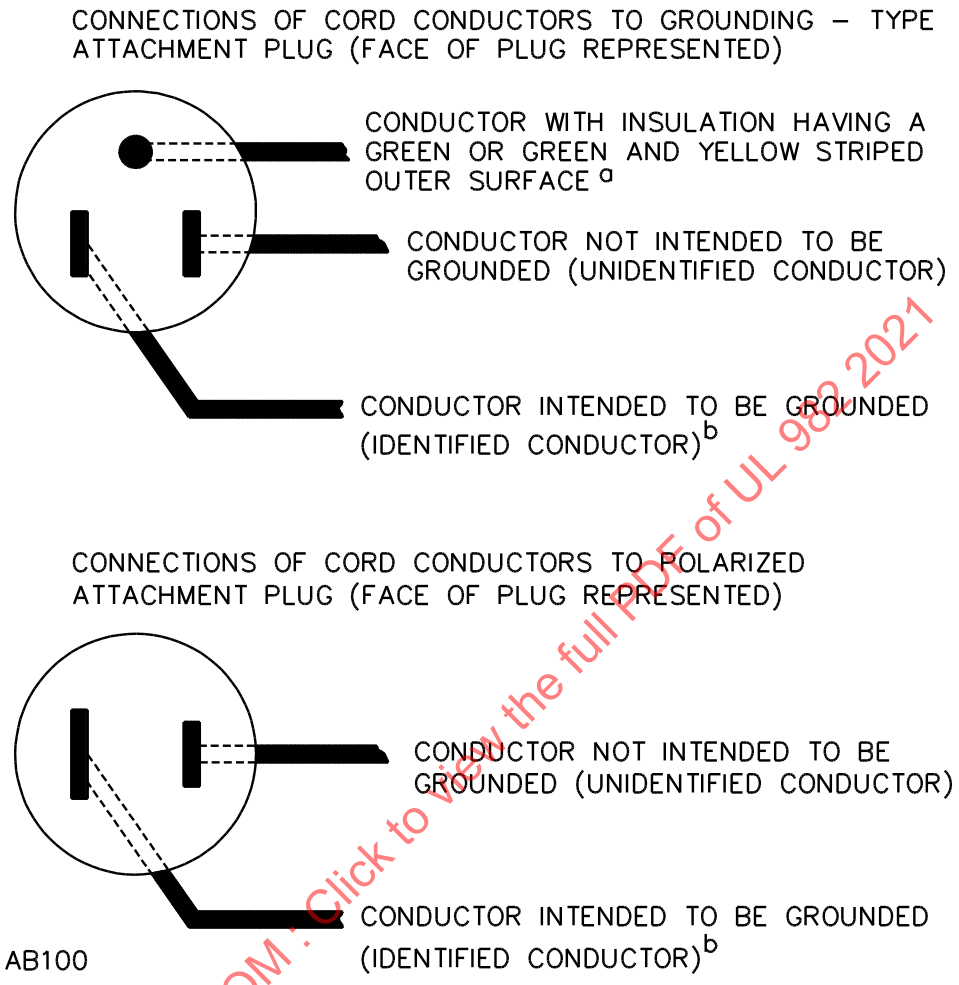
10.1.9 The attachment plug shall be of a type with a current rating not less than the rated current of the appliance and the voltage rating equal to the rated voltage of the appliance. When an appliance is able to be adapted for use on two or more different values of voltage by field alteration of internal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

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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switches or overcurrent protective devices of the single-pole type other than automatic controls without a marked OFF position are connected.

11.3.2 A terminal intended for the connection of a grounded supply conductor shall be of or plated with metal that is substantially white in color and shall be readily distinguishable from the other terminals, or proper identification of that terminal shall be clearly shown in some other manner, such as on an attached wiring diagram. A lead intended for the connection of a grounded power-supply conductor shall be finished white or gray color and shall be readily distinguishable from the other leads.

11.3.3 The surface of an insulated lead intended solely for the connection of an equipment-grounding conductor shall be green with or without one or more yellow stripes, and no other lead shall be so identified.

11.3.4 A terminal solely for connection of an equipment-grounding conductor shall be capable of securing a conductor of the size intended for the particular application, in accordance with the National Electrical Code, ANSI/NFPA 70.

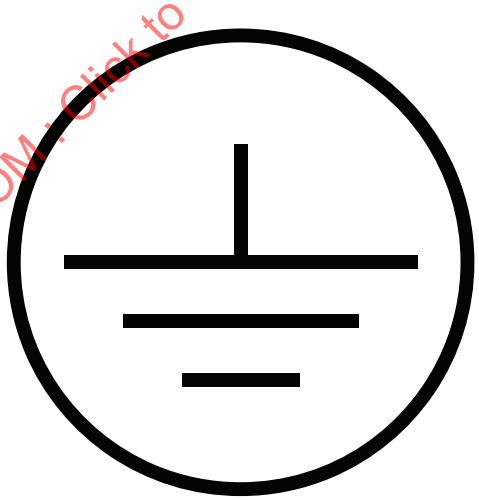
11.3.5 A wire-binding screw intended for the connection of an equipment grounding conductor shall be identified by:

a) Use of a green-colored head that is slotted or hexagonal, or both; or

b) The grounding symbol illustrated in Figure 11.1 on or adjacent to the terminal or on a wiring diagram provided on the product.

Figure 11.1

Grounding Symbol



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11.3.6 A pressure wire connector intended for the connection of such a conductor shall be identified by:

a) Being marked "G," "GR," "GND," "Ground," "Grounding," or the like; or

b) A marking on a wiring diagram provided on the appliance; or

c) The grounding symbol illustrated in Figure 11.1 on or adjacent to the terminal or on a wiring diagram provided on the product.

11.3.7 The wire binding screw or pressure wire connector shall be located that it is unlikely to be removed during servicing of the appliance.

12 Direct Plug-In Rechargeable Appliances

12.1 With respect to 6.3.6, a direct plug-in rechargeable appliance shall comply with the Weights and Moments Test of 52.1, Blade Security Pull Test of 52.2 and Blade Security Push Test of 52.3.

12.2 The integral blade assembly of a direct plug-in rechargeable appliance shall comply with the Blade Security Pull Test of 52.2 and the Blade Security Push Test of 52.3.

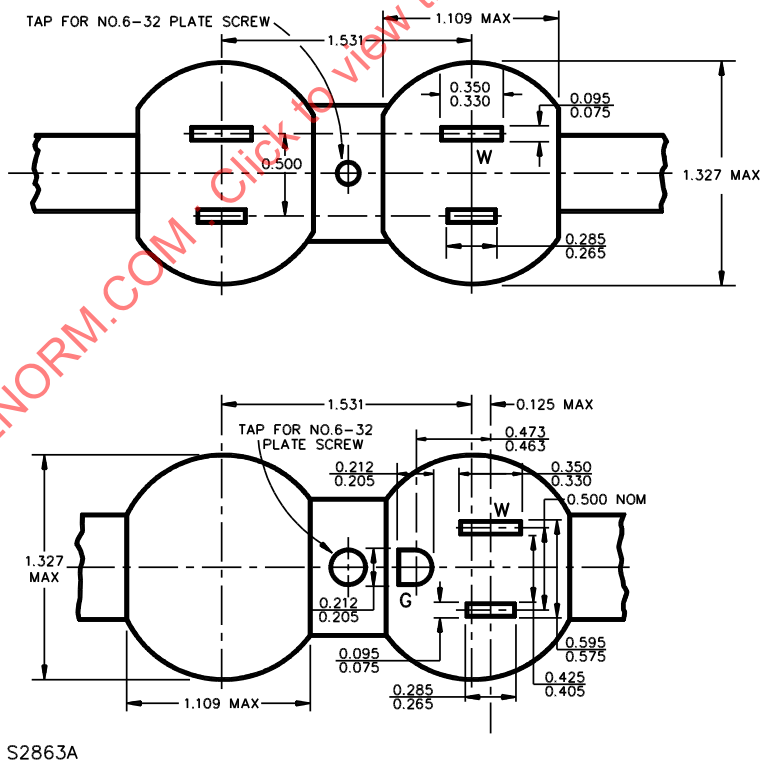
12.3 A direct plug-in rechargeable appliance employing folding or retractable blades shall comply with the Blade Flexing Test of 52.4.

12.4 When inserted in a duplex receptacle, no part of a direct plug-in rechargeable appliance, including output wiring, shall interfere with full insertion of an attachment plug into the adjacent receptacle. See Figure 12.1.

Exception: This requirement does not apply to a direct plug-in rechargeable appliance that renders the adjacent receptacle completely unusable in any one mounting position.

Figure 12.1

125V, 15A Duplex Receptacle



12.5 A mounting tab shall not be provided with a direct plug-in rechargeable appliance.

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12.6 The enclosure of a direct plug-in rechargeable appliance shall be capable of being gripped for removal from the receptacle to which it is connected, and the perimeter of the face section from which the blades project shall not be less than 0.20 inch (5.1 mm) from any point on either blade. In order to determine compliance with this requirement for direct plug-in rechargeable appliances with rounded edges, the perimeter of the face section is considered to be the point at which the articulate probe is able to access as shown in Figure 12.2.

12.7 With reference to 12.6, for an extension from the face for mechanical support of the blades provided as shown in Figure 12.2, the point of measurement shall be determined by application of the articulate probe, Figure 7.1, as shown in Figure 12.3.

Figure 12.2

Extension for Mechanical Support of Blades

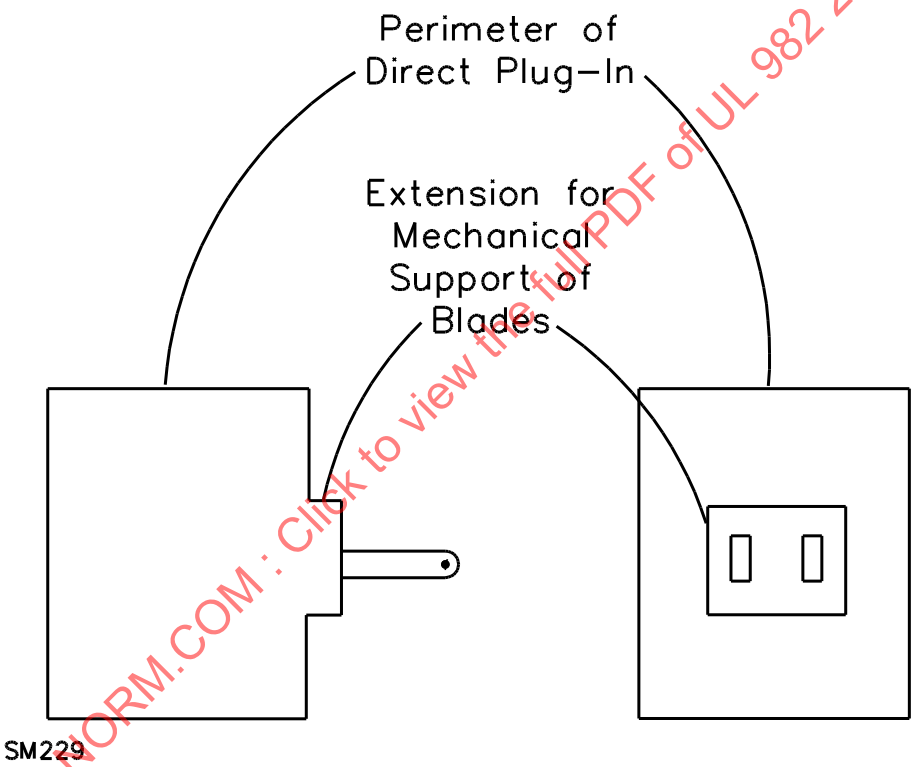

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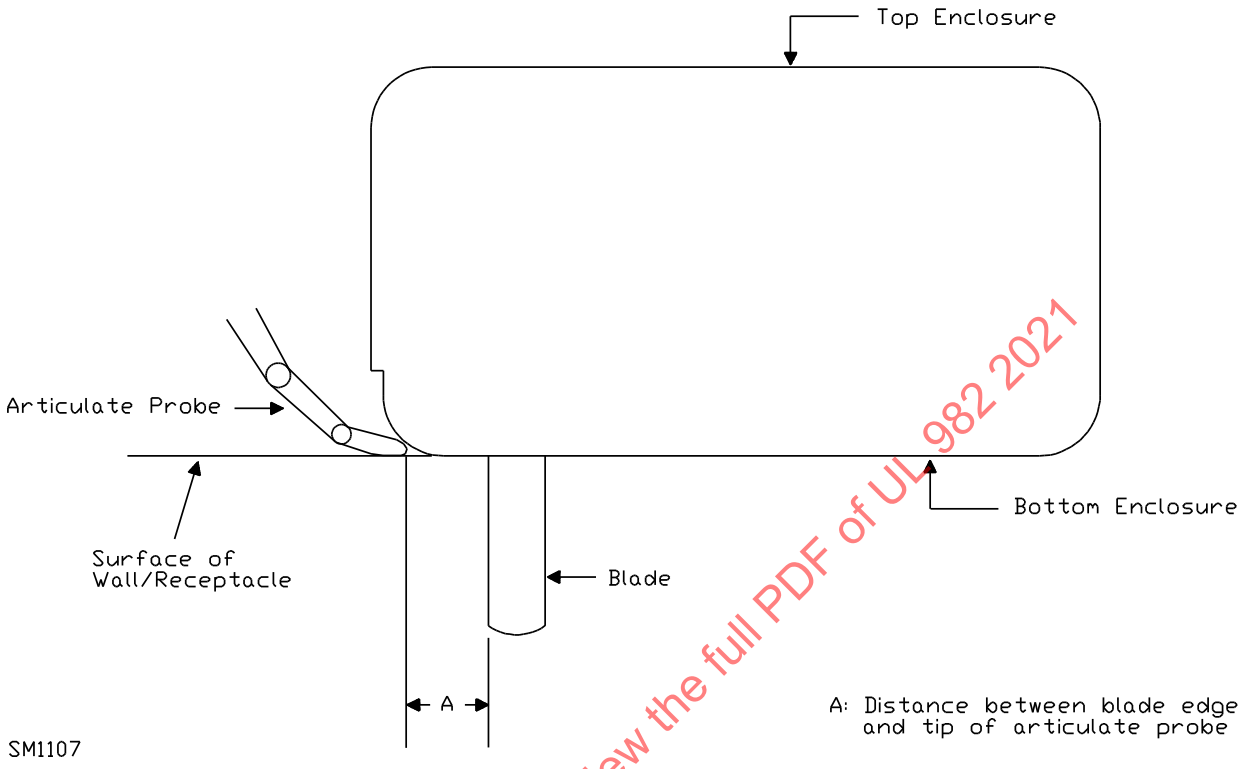
Figure 12.3

Determination of Perimeter of Direct Plug-In Rechargeable Appliances with Rounded Edges



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12.8 The integral blade assembly of a direct plug-in rechargeable appliance shall comply with the construction requirements in the Standard for Attachment Plugs and Receptacles, UL 498, and Wiring Devices – Dimensional Specifications, ANSI/NEMA WD6. See 12.6 and 12.7.

12.9 If a direct plug-in rechargeable appliance employs a manually operated line connected single-pole switch or a fuse with an accessible contact, it shall employ a polarized- or grounding-type blade assembly.

13 Internal Wiring

13.1 The internal wiring and connections between parts of an appliance shall be enclosed or guarded, except that a length of flexible cord may be employed for external connections if flexibility is essential.

13.2 For the purpose of these requirements the internal wiring of an appliance is considered to be all the interconnecting wiring from the point where the power-supply cord of a cord-connected appliance enters the enclosure, or from the wiring terminals or leads for power-supply connections of a fixed appliance, even though some of this may be in the form of flexible cord.

13.3 The protection of insulated wiring and of wire providing grounding continuity, as required by 13.1, is considered to exist if, when judged as though it were magnet wire, the wiring is acceptable according to 7.9. Internal wiring not so protected may be accepted if it is so secured within the enclosure that it is unlikely to be subjected to stress or physical abuse.

13.4 Unless it is to be judged as an uninsulated live part, insulated internal wiring of an appliance (including a grounding conductor) shall consist of wire that is appropriate for the particular application, when considered with respect to:

a) The temperature and voltage to which the wiring is likely to be subjected;

b) Exposure to oil, grease, or other substances likely to have a deleterious effect on the insulation;

c) Exposure to moisture; and

d) Other conditions of service to which it is likely to be subjected.

13.5 Wiring shall be protected from sharp edges (including male screw threads), burrs, fins, moving parts, and other agents that might abrade the insulation of conductors.

13.6 A hole by which insulated wires pass through a sheet metal wall within the overall enclosure shall be provided with a smoothly rounded bushing or shall have smooth surfaces, free of burrs, fins, sharp edges, and the like, upon which the wires may bear, to prevent abrasion of the insulation.

13.7 Insulated wires may be bunched and passed through a single opening in a metal wall within the enclosure of the appliance.

13.8 All splices and connections shall be mechanically secure and shall provide an effective electrical contact.

13.9 A soldered connection shall be such that mechanical security will be provided. If the nature or location of a soldered connection is such that loosening of the solder is likely to occur, and if such loosening of the solder will result in any grounding or short-circuiting of live parts or other adverse condition, the connection shall be made mechanically secure before being soldered.

13.10 A wire-binding screw or nut shall be provided with means to prevent it from being loosened due to vibration if such loosening might result in a risk of fire, electric shock or injury to persons.

13.11 A risk of fire, electric shock or injury to persons is not considered to result if a spade lug with upturned ends or a closed-loop lug is used.

13.12 Unless spacings cannot be reduced so as to create a risk of fire, electric shock or injury to persons, a splice shall be provided with insulation equivalent to that of the wires involved.

13.13 In a determination of whether or not splice insulation consisting of coated-fabric, thermoplastic, or other material is acceptable, consideration is to be given to such factors as its dielectric properties, heat-resistance and moisture-resistance characteristics, and the like. Thermoplastic insulating tape wrapped over a sharp edge is not acceptable. An insulated splicing device is acceptable within the limits of its voltage and temperature ratings.

13.14 Stranded internal wiring shall be so connected to a wire-binding screw that loose strands of wire will be prevented from contacting other live parts not always of the same polarity as the wire and from contacting dead metal parts. This may be accomplished by use of pressure thermal connectors, soldering lugs, crimped eyelets, soldering all strands of the wire together, or other equivalent means.

13.15 An internal wiring bushing of neoprene or polyvinyl chloride may be used anywhere inside an appliance if the edges of the hole in which the bushing is mounted are smooth and free from burrs, fins and the like.

13.16 Where the normal operation of an appliance causes movement of the internal wiring, the appliance shall comply with the Wiring Flexing Test, Section 61, unless the wiring is located in a low-voltage circuit the functioning of which is not relied upon for compliance with this standard.

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14 Live Parts

14.1 A current-carrying part shall be of silver, copper, a copper alloy or other material equivalent for the purpose.

14.2 Plated iron or steel may be used for a current-carrying part:

a) Whose temperature during normal operation is more than 100°C (212°F);

b) Within a motor or associated governor; or

c) If acceptable in accordance with 6.1.1.

Plain (unplated) iron or steel is not acceptable. The foregoing restrictions do not apply to stainless steel and other corrosion-resistant alloys.

14.3 An uninsulated live part shall be so secured to the base or mounting surface that it will be prevented from turning or shifting in position if such motion may result in a reduction of spacings below the minimum acceptable values.

14.4 Friction between surfaces is not acceptable as the sole means to prevent the turning of a live part, but a lock washer properly applied is acceptable for this purpose.

15 Electrical Insulation

15.1 Insulating washers, bushings, and the like, and bases or supports for the mounting of live parts shall be of a moisture-resistant material that is acceptable for the particular application.

15.2 Insulating material employed in an appliance is judged with respect to its use in the particular application. Materials such as mica, some molding compounds, and certain refractory materials are capable of being used as the sole support of current-carrying parts; and some other materials that are not intended for general use, such as magnesium oxide, are capable of being used in conjunction with other insulating materials when so located and protected such that the risk of physical injury and the absorption of moisture are reduced. If a separate investigation is required to determine the fitness of a material as an insulator, the key factors to be examined are its physical strength, dielectric-properties, insulation-resistance, heat-resistant qualities, the degree to which it is enclosed or protected, and any other features pertinent to the risk of electric shock, fire and injury to persons involved, in conjunction with the conditions of actual service. All of the properties mentioned above are to be investigated with respect to the effects of thermal aging.

15.3 Screws or other fastenings used to mount or support small fragile, insulating parts are not to be so tight as to crack or break such parts with expansion and contraction.

15.4 Vulcanized fiber may be used for insulating bushings, washers, separators, and barriers, but not as the sole support for uninsulated live parts if shrinkage, moisture absorption, or warpage may introduce current leakage or other adverse conditions.

15.5 A small molded part, such as a terminal block, shall have such physical strength and rigidity that it will withstand the stresses of actual service.

15.6 Thermoplastic materials in direct contact or close proximity to live parts, other than magnet wire, shall have physical strength and rigidity, resistance to heat, resistance to flame propagation, dielectric strength, and other properties appropriate for the application. All of the properties mentioned above are to be considered with respect to the effects of thermal aging. See also 64.10.

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16 Thermal and Acoustic Insulation

16.1 Thermal and acoustic insulation, if employed, shall be of such a nature and so located and mounted or supported that it is not adversely affected by any normal operation of the appliance.

16.2 Combustible or electrically conductive thermal or acoustic insulation shall not make contact with uninsulated live parts of an appliance. Some types of mineral-wool thermal insulation contain conductive impurities in the form of slag, which make its use unacceptable if in contact with uninsulated live parts. See 38.1 and 64.10.6.

17 Spacings

17.1 A circuit derived from a source of supply classified in 4.37 as a line-voltage circuit by connecting a resistance in series with the supply circuit as a means for limiting the voltage and current, is not considered to be a low-voltage circuit as described in 4.39.

17.2 All uninsulated live parts connected to different (line-voltage, low-voltage) circuits shall be spaced from one another as though they were parts of opposite polarity, in accordance with the requirements in 17.4 and 17.5 and shall be judged on the basis of the highest voltage involved.

17.3 The spacing between uninsulated live parts of opposite polarity and between such parts and dead metal which may be grounded in service is not specified for parts of circuits that are classified as low-voltage in 4.39.

17.4 The spacing between wiring terminals (see 11.2.1) of opposite polarity, and the spacing between a wiring terminal and any other uninsulated metal part (dead or alive) not of the same polarity, shall not be less than 1/4 inch (6.4 mm) between terminals and other uninsulated metal parts not always of the same polarity (applies to the sum of the spacings involved where an isolated dead part is interposed).

17.5 Except as noted in 17.7 and 17.9, the spacing between uninsulated live parts of opposite polarity, uninsulated live parts and a dead metal part that is exposed to contact by persons or that may be grounded, and uninsulated live parts and uninsulated (or not acceptably insulated) parts in the secondary circuit, shall not be less than the value indicated in Table 17.1. If an uninsulated live part is not rigidly fixed in position (by means other than friction between surfaces), or if a movable dead metal part is in proximity to an uninsulated live part, the construction shall be such that the required minimum spacing will be maintained.

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Table 17.1
Minimum Spacings at Other than Supply Wiring Terminals

Potential involved, volts	Rating of motor employed [Motor diameter 7 inches (178 mm) or less[a]]	Minimum Spacings	
		Over surface inch (mm)	Through air, inch (mm)
0 – 130	1/3 horsepower (250 W output) or less	1/16 (1.6)	1/16 (1.6)
	More than 1/3 horsepower	3/32 (2.4)	3/32 (2.4)

NOTE – Film-coated wire is considered to be an uninsulated live part.

[a] This is the diameter, measured in the plane of laminations of the circle circumscribing the stator frame, excluding lugs, fins, boxes, and similar parts used solely for motor mounting, cooling, assembly, or connection.

17.6 In applying Table 17.1 to an appliance incorporating two or more motors of different sizes, the spacings inside each motor are judged on the basis of the size of that motor and the spacings elsewhere in the appliance are judged on the basis of the size of the largest motor in the appliance.

17.7 The spacing requirements given in 17.4 do not apply to the inherent spacings of a component of the appliance, such as a snap switch; such spacings are judged on the basis of the requirements for the component.

17.8 In the application of 6.10.1 and Table 17.1 to a motor not rated in horsepower, use is to be made of the appropriate table of the National Electrical Code, ANSI/NFPA 70 which gives the relationship between horsepower and full-load currents for motors. For a universal motor, the table applying to a single-phase, alternating current motor is to be used if the appliance is marked for use on alternating current only; otherwise, the table applying to direct-current motors is to be used.

17.9 If an isolated dead metal part is interposed between or is in close proximity to live parts of opposite polarity, to a live part and an accessible dead metal part, or to a live part and a dead metal part that may be grounded, the spacing may not be less than 3/64 inch (1.2 mm) between the isolated dead metal part and any one of the other parts previously mentioned, provided the total spacing between the isolated dead metal part and the two other parts is not less than the value indicated in Table 17.1.

17.10 Except as indicated in 17.11, an insulating lining or barrier of vulcanized fiber or similar materials employed where spacings would otherwise be unacceptable shall not be less than 1/32 inch (0.8 mm) thick and shall be so located or of such material that it will not be adversely affected by arcing; except that vulcanized fiber not less than 1/64 inch (0.4 mm) thick may be used in conjunction with an air spacing of not less than 50 percent of the spacing required for air alone.

17.11 Insulating material having a thickness less than that indicated in 17.10 may be used if, upon investigation, it is found to be appropriate for the particular application.

17.12 A printed wiring board with spacings between opposite polarity circuits (other than a low-voltage circuit, see 17.3) less than those required is acceptable provided that the spacings:

a) Are located on a portion of the printed wiring board provided with a conformal coating that complies with the requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, and the dielectric voltage-withstand test described in 37.9; or

b) Are located on the load side of a resistor such that a short circuit from the load side of the resistor to the other side of the line does not result in the resistor power dissipation exceeding the resistor wattage rating; or

c) Comply with the spacing requirements in the Standard for Solid-State Controls for Appliances, UL 244A. Compliance 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 fulfills these requirements; or

d) Comply with the applicable requirements in the Standard for Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment, UL 840 (See Section 18, Alternate Spacings – Clearances and Creepage Distances).

17.13 An expansion type protected capacitor shall have additional through-air expansion spacings in the axial direction to allow for movement of the terminals. The additional expansion spacing shall be at least 12.7 mm (1/2 inch) through air in addition to the applicable electrical spacings.

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18 Alternate Spacings – Clearances and Creepage Distances

18.1 As an alternative to the specified spacing requirements in Spacings, Section 17, the spacing requirements in the Standard for Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment, UL 840, may be used. The spacing requirements in UL 840 shall not be used for spacings between field wiring terminals or between uninsulated live parts and a metal enclosure. In determining the pollution degree and overvoltage category, the end-use application is to be considered and may modify those characteristics given in 18.2 – 18.5.

18.2 When applying specific requirements in the Standard for Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment, UL 840, it is anticipated that the degrees of pollution expected or controlled will be as indicated in Table 18.1. Household food preparing machines are generally considered Pollution Degree 2

Table 18.1
Degrees of Pollution

Equipment	Pollution degree
Hermetically sealed or encapsulated equipment or printed wiring boards with protective coating.[a]	1
Equipment for ordinary locations and indoor use, such as residential controls, commercial controls for use in a clean environment, nonsafety controls for installation on or in machines.	2
All safety or limit controls, equipment for outdoor use, and equipment influenced by surrounding environment, such as industrial controls, refrigeration controls, and water heater controls.	3
[a] Tested in accordance with the protective coating test in the Standard for Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment, UL 840.	

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18.3 When applying specific requirements in the Standard for Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment, UL 840, it is anticipated that the equipment will be identified by overvoltage categories as indicated in Table 18.2.

Table 18.2
Overvoltage Categories

Equipment	Overvoltage category
Intended for fixed wiring connection	III
Portable and stationary cord-connected	II
Power-limited and safety[a] low voltage	I
[a] Applicable to low-voltage circuits if a short circuit between the parts involved may result in operation of the controlled equipment that would increase the likelihood of a risk of fire, electric shock, or risk of personal injury.	

18.4 In order to evaluate clearances where the levels of overvoltage are controlled, control of overvoltage shall be achieved by providing an overvoltage device or system as an integral part of the product. The equipment shall be evaluated for the rated impulse withstand voltage specified in the Standard for Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment, UL 840.

18.5 Printed wiring boards constructed of Types XXXP, XXXPC, G-10, FR-2, FR-3, FR-4, FR-5, CEM-1, CEM-3, GPO-2, or GPO-3 industrial laminates in accordance with the Standard for Polymeric Material –

Industrial Laminates, Filament Wound Tubing, Vulcanized Fibre, and Materials Used in Printed Wiring Boards, UL 746E, are considered to have a minimum comparative tracking index of 100 without further investigation.

19 Grounding

19.1 Required grounding

19.1.1 The following types of appliances shall have provision for grounding:

a) An appliance for use in damp or wet locations (see 4.27, 4.28, and 4.59);

b) An appliance intended for outdoor use;

c) An appliance intended to be used on a circuit operating at more than 150 V to ground; and

d) An appliance intended for permanent connection to the supply source.

Exception: An appliance intended to operate at a nominal potential of 240 V and any other potential greater than 150 V is to be provided with means for grounding in accordance with 19.2.2, unless the marked rating on the appliance is 120/240 V and the appliance is wired for a nominal 120 V connection, or the appliance is otherwise marked to indicate that it is to be connected to a circuit operating at 150 V or less to ground.

19.2 Continuity

19.2.1 If a grounding means is provided on an appliance, whether required or not, all accessible dead metal parts and all dead metal parts within the enclosure which are exposed to contact during any servicing operation and which are likely to become energized shall be connected to the grounding means. Servicing here mentioned means user servicing, not repairs made by a qualified service man.

19.2.2 The following are considered to constitute means for grounding:

a) In an appliance intended to be permanently connected by a metal-enclosed wiring system – a knockout or equivalent opening in the metal enclosure of the appliance.

b) In an appliance intended to be permanently connected by a nonmetal-enclosed wiring system (for example, nonmetallic-sheathed cable) – an equipment-grounding terminal or lead.

c) In a cord-connected appliance – an equipment-grounding conductor in the cord.

19.2.3 An appliance marked as being provided with double insulation shall not be provided with a means for grounding.

19.3 Grounding identification

19.3.1 The grounding conductor of a flexible cord shall be green with or without one or more yellow stripes. The grounding conductor shall be secured to the frame or enclosure of the appliance by means of a screw that is not likely to be removed during any servicing operation not involving the power-supply cord, or by other equivalent means. Solder alone shall not be used for securing the grounding conductor. The grounding conductor shall be connected to the fixed member of a grounding-type attachment plug except that the grounding member of the plug on a portable hand-guided or hand-supported appliance may be of the movable, self-restoring type. Servicing as mentioned in this paragraph includes repair of the appliance by a qualified service person.

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19.3.2 If means for grounding is provided on the appliance even though not required, it shall comply with the pertinent requirements in this section of the Standard.

20 Flooding of Live Parts

20.1 An appliance shall preclude the following actions when such action would result in risk of fire or electric shock. Compliance shall be determined by the Flooding of Live Parts Tests, Section 40, the Test for Deterioration of Parts Subject to Flexing, Section 41, the Test for Reliability of Parts Not Subject to Flexing, Section 42, and the Insulation Resistance Test, Section 43:

a) Overflow of liquids into the electrical or motor enclosure of the appliance (40.1);

b) Drawing of liquids into the electrical or motor enclosure of the appliance (40.2); and

c) Malfunction of a timer switch or of a float- or pressure-operated switch, deterioration or damage of a boot or diaphragm, or the deterioration and reliability of seals and gaskets, resulting in the entrance of liquid into the electrical or motor enclosure of the appliance (Sections 41, 42, and 43).

20.2 If the failure of a liquid container provided as part of an appliance would result in a risk of fire or electric shock, the container shall be of a material which is compatible with the liquid intended to be used therein.

20.3 With respect to 20.1(b), a vacuum blender shall be provided with a means to prevent the vacuum pump from picking up liquid in the blender container if it increases the risk of electric shock or fire. The Ingress Test of 40.2.2 shall be conducted to determine if liquid ingress results in a risk of fire or electric shock. If the backflow prevention means is removable without the use of tools or the user is instructed to remove it for cleaning, the blender shall be subjected to the Ingress Test of 40.2.2 without the backflow prevention means in place.

PROTECTION AGAINST PERSONAL INJURY

21 General

21.1 If the operation and maintenance of an appliance by the user involves possible personal injury, protection shall be provided for the reduction of such a condition to an acceptable degree.

21.2 In applying the requirement of 21.1 consideration shall be given to reasonably foreseeable misuse of the appliance.

21.3 The acceptability of a guard, a safety release, an interlock, and the like and whether or not such a device is required, is to be determined from a study of the complete appliance, its operating characteristics, and the likelihood of an injury resulting from a cause other than gross negligence. The study is to include consideration of the results of a malfunction of any one component, but not more than one component at a time unless one malfunction contributes to another. If the study shows that a malfunction of a particular component can result in a risk of injury to persons, that component is to be investigated for reliability.

21.4 Specific tests, constructions, markings, guards, and the like are detailed for some appliances. Such detailed requirements apply to common constructions; specific features and appliances not covered herein are to be given separate consideration.

21.5 An enclosure, a frame, a guard, a handle, or the like shall not be sufficiently sharp to constitute a risk of injury to persons during normal maintenance and use.

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Exception No. 1: A part or portion of a part needed to perform a working function need not comply with this requirement.

Exception No. 2: A part or portion of a part inaccessible to the probe illustrated in Figure 7.1 need not comply with this requirement.

21.6 Compliance with the requirement of 21.5 is determined by applying the test procedures, equipment, and acceptance criteria described in the Standard for Tests for Sharpness of Edges on Equipment, UL 1439.

22 Attachments

22.1 Various functional attachments that are made available or recommended by the manufacturer for use with the basic appliance shall be included in the evaluation of the appliance. Unless recommended by the manufacturer, not more than one attachment shall be evaluated at a time with the appliance.

22.2 The literature accompanying a package containing a basic appliance and various attachments intended to be marketed as a complete unit shall indicate what attachments are intended for use with the basic appliance.

22.3 If an attachment is packaged and marketed separately from the basic appliance and recommended for use with it by the manufacturer of the basic appliance, it shall have an assigned catalog number (or equivalent). Also, information packaged with the basic appliance shall identify by catalog number, series number, or the like, the attachments which are intended for use with the basic appliance. Identification [catalog number (s), model number (s), series, and the like] of the basic appliance with which the attachment is intended to be used shall appear at the following locations:

a) On the package housing the attachment; and

b) On information material furnished with the attachment or on the attachment itself.

Exception: The package housing an attachment intended for use with all models of a specific type of basic appliance may be marked "For Use With (Company Name) (Type of Basic Appliance)."

22.4 The important safeguards, where applicable to the attachment, shall be packaged with the attachment.

23 Moving Members

23.1 A moving external member and its attachment to the appliance shall be constructed of such material, and in such manner, as to reduce the likelihood of its malfunction, its unintentional release, and its loosening of a part that can become a risk of injury to persons.

23.2 To determine if an appliance with a series motor complies with the requirement in 23.1, the appliance is to be operated at a voltage equal to 1.3 times the rated voltage for 1 minute with no externally added load. After the test, parts that can cause an injury shall not have worked loose.

23.3 An appliance employing a moving part which, if it becomes disengaged would create a risk of injury to persons, shall be provided with a means to retain the part in place under conditions of use.

23.4 To determine if a centrifugal juice extractor complies with the requirement in 23.1, the appliance shall be subjected to the Cut Strainer/Enclosure Stress Withstand Test and the Operational Test Following Environmental Conditioning Test, Sections 54 and 55 respectively, as applicable.

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23.5 To determine if a blender complies with the requirement in 23.1, the appliance shall be subjected to the Blender Blade Endurance Test, Section 46.

24 Stability

24.1 The stability of a counter-top appliance shall be such that it will not be overturned readily while in any position that might be encountered during normal use of the appliance, including positions that might be encountered prior to and after operation.

24.2 To determine if an appliance complies with the requirement in 24.1, the appliance is to be placed, with the motor switched off, in a position as described in 24.4 on a plane inclined at an angle of 10 degrees to the horizontal, the power-supply cord resting on the inclined plane in the most unfavorable position. If, however, the appliance is such that, were it to be tilted to an angle of 10 degrees when standing on a horizontal plane, a part of it not normally in contact with the supporting surface would touch the horizontal plane, the appliance is to be placed on a horizontal support and tilted in the most unfavorable direction through an angle of 10 degrees. The results are considered to be acceptable if the appliance does not overturn. Combination appliances shall be tested for the most unfavorable condition. One attachment will be used at a time.

24.3 An appliance intended to be filled with liquid by the user in normal use, is to be filled with water to its rated capacity, or if unmarked it is to be filled to the top. A can opener is to be tested without the can in place. A salad maker or food grinder is to be tested empty.

24.4 Tests are to be conducted under the most unfavorable conditions but with the appliance unenergized. The appliance is to be placed on an inclined plane with all doors, drawers, and other movable or adjustable parts in the position tending to decrease the stability. If tested on a horizontal plane the appliance is to be tipped in the direction of least stability. The appliance is to be tested in all possible positions that might typically be encountered while the appliance:

a) Is in a position of being assembled or prepared prior to operation – for example, positioning parts of the appliance prior to adding food or functional attachments;

b) Is in a position as if being used to perform one of its intended functions – for example, blending, or mixing; and

c) Is in a position of being disassembled or cleaned after operation – for example, with functional attachments removed.

24.5 An appliance that is adjustable in dimensions is to be adjusted to the position most likely to cause it to overturn.

24.6 An appliance provided with feet removable without the use of tools shall also be tested with the feet removed if this may increase the risk of overturning.

25 Stability – Floor Supported Carts and Stands

25.1 A floor-supported appliance cart or stand employing polymeric materials in its construction shall withstand the temperature-stability condition described in 25.2 without any shrinkage, warpage, or other distortion of the polymeric materials that results in an appliance cart or stand performing unacceptably when subjected to the requirements of 25.3 – 25.10.

Exception: A polymeric decorative part or a similar part shall comply with the requirement of 64.2.2.

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25.2 The complete assembly, appliance and cart or stand, shall be placed in an air-circulating oven for 7 hours. The oven is to be maintained at a temperature of 70°C (158°F). The appliance is not to be operating during the test.

25.3 During the temperature-stability test described in 25.2, an appliance intended for use with a companion cart or stand is to be positioned on the cart or stand in accordance with the recommended instructions.

25.4 A cart or stand with the intended appliance in place, that weighs 10 lb (4.5 kg) or more shall not tip over when it is placed at the center of an inclined plane that makes an angle of 10 degrees with the horizontal and turned to the position most likely to cause tip-over.

25.5 The test mentioned in 25.4 is to be separately conducted under conditions most likely to cause tip-over. If the appliance is positioned on the stand or cart, consideration shall be given to all accessories or options intended for use with the appliance. The cart or stand, with or without the appliance, shall be arranged in its intended position with all doors, drawers, casters, wheels, and other appurtenances in the position that results in the least stability. The assembly is to be tipped in the direction most likely to overturn the cart or stand, or the combination of an appliance with either the cart or stand. Legs and other means of support may be blocked to preclude the cart or stand from sliding.

25.6 A cart or stand intended to be floor supported shall be constructed so that permanent deformation or damage that results in a risk of injury to persons does not occur when it is subjected to the following:

a) A weight that exerts a force of three times its intended appliance load or 100 lbf (444.8 N) whichever is greater, and an evenly distributed load that exerts a 25 lbf (111.2 N) on each shelf or drawer. A drawer shall be in fully opened position.

b) A force of 50 lb (222.4 N) applied for 1 minute to any appurtenance accessible to a child.

25.7 To determine compliance with 25.6(a), the appliance is to be placed on the cart or stand and the additional weight added to the top of the appliance. Each shelf or drawer, if provided, is to be loaded with a uniform load that exerts a 25 lbf (111.2 N). If polymeric materials are employed in the construction of the cart or stand, the test is to be conducted before and after the temperature-stability test referred to in 25.1. The load is to be applied for 1 minute with the cart or stand at room temperature.

25.8 To determine compliance with 25.6(b), the force is to be applied through the end of a 2 inch (50.8 mm) diameter right circular cylinder. The force is to be applied to a shelf, drawer, dowel rung support, or equivalent part that is within 30 inches (762 mm) of the floor and is likely to support some or all of a child's weight. The force is to be applied for 1 minute with the cart or stand at room temperature.

25.9 A cart or stand shall withstand a single impact of 5 ft-lbf (6.8 N·m) without resulting in a risk of injury to persons or adversely affecting the stability. The force is to be applied to any part of the stand or cart in accordance with the test procedure outlined in 25.10.

25.10 The impact force is to be imparted by swinging a 2-inches (50.8-mm) diameter steel sphere weighing 1.18 lb (0.535 kg) from a height that will produce the impact specified in 25.9, 64.5.3.5, and Figure 64.4 illustrate the appropriate test apparatus.

25.11 An appliance cart or stand provided with wheels or casters, for mobility, shall employ a mechanical means other than friction, to secure the wheels or casters in place.

26 Enclosure and Guards

26.1 Except as indicated in 26.2, moving parts that may cause injury, shall be enclosed. See also 26.5.

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26.2 Moving parts that are necessarily exposed to perform the work function need not be enclosed but, when necessary, guarding is to be provided. The extent of guarding is to be based on the following factors:

a) The degree of exposure needed;

b) Sharpness of moving parts;

c) Likelihood of unintentional contact therewith;

d) Speed of the moving part; and

e) Likelihood that parts of the body or clothing would be endangered by the moving part.

These factors are to be considered with respect to both intended operation of the appliance and its reasonably foreseeable misuse.

26.3 Among the factors to be considered in judging the acceptability of a guard are:

a) Removability without the use of tools;

b) Removability for user servicing and the need for and ease of replacement;

c) Strength and rigidity;

d) Completeness;

e) Creation of additional risks of personal injury such as pinch points; and

f) The necessity for additional handling because of the increased need for user servicing (such as for cleaning and unjamming).

26.4 With respect to 26.3 (c), guards formed of nonmetallic materials, such as polymeric materials, ceramic and glass, shall be subjected to the Impact Test in accordance with 64.5.1.3.

Exception No. 1: Blender containers formed of nonmetallic materials shall be subjected to the blender container abuse tests as outlined in 30.4.4 instead of the Impact Test of 64.5.1.3.

Exception No. 2: Food mixer bowls of nonmetallic materials are not subjected to the Impact Test of 64.5.1.3.

26.5 A moving part is considered to be acceptably enclosed if it cannot be contacted with the probe illustrated in Figure 7.1 when food pushers and interlocked covers and guards are left in place.

26.6 If complete guarding of an obvious moving part that may cause injury to persons defeats the utility of the appliance, such as the cutting blades of a knife:

a) An appropriate control shall be provided; and

b) An appropriate caution marking shall be provided in the instruction booklet warning the user against the potential risk of injury.

26.7 A feeding mechanism, either manual or automatic, shall be so constructed or guarded to reduce to an acceptable degree, the likelihood or necessity of the operator's fingers being in an area that could afford injury.

26.8 A feed opening complying with one of the following is considered to comply with 26.7:

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a) Moving parts capable of causing injury are not accessible through the feed opening to the feed opening accessibility probe illustrated in Figure 26.1 without the food pusher or any removable guards in place,

b) Moving parts capable of causing injury are recessed not less than 4 inches (102 mm) below the plane of the opening, and the average inside dimension (one-half the sum of the maximum and minimum dimensions) of the feed opening is less than 2-1/2 inches (63.5 mm) with no dimension greater than 3 inches (76.2 mm),

c) Moving parts capable of causing injury are recessed not less than 3-1/2 inches (88.9 mm) below the plane of the opening, and the average inside dimension of the feed opening is less than 2 inches (50.8 mm) with no dimension greater than 3 inches (76.2 mm), or

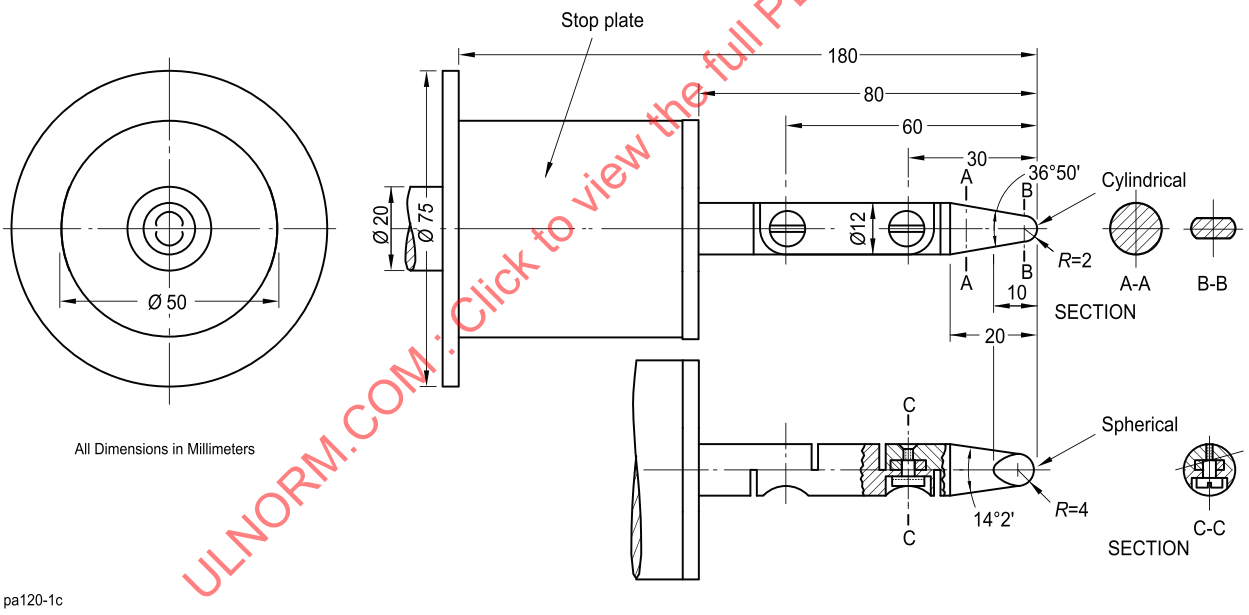
d) The food pusher is interlocked to prevent operation when it is not in place and when it is in place:

1) It completely fills the feed opening, or

2) Any remaining opening complies with 26.8 (a) – (c).

Figure 26.1

Feed Opening Accessibility Probe



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26.9 When determining compliance with 26.8 (b) or (c) for a feed opening with notches for alignment of the food pusher, the notches are not included in the maximum and average dimensions if there are no more than two notches provided and the maximum depth and width are less than 1/4 inch (6 mm) each.

26.10 When determining compliance with 26.8 (a) for a feed opening with projecting tabs, if the tabs are relied upon to reduce access to the moving parts, the tabs shall not have knife edges, shall withstand the

Stress Relief Distortion Test of 64.6 without deforming and the strength of the tabs shall be sufficient to withstand the forces encountered during normal operation as specified in 64.5.4.

26.11 When determining compliance with 26.8 (b) or (c) for a feed opening with projecting tabs, the tabs are disregarded when taking the measurements.

26.12 The dimensions at a narrowed section of the feed chute may be used for the average inside diameter if moving parts capable of causing injury are recessed below the narrowed section by not less than the distance specified in 26.8 (b) or (c), as applicable.

26.13 A pusher shall be provided when continuous manual feeding of an appliance is necessary.

26.14 An appliance provided with a discharge chute complying with the applicable feed-opening requirements or one of the following is considered to comply with 26.1:

a) The construction of the discharge opening is such that any moving part, accessible to the probe as specified in 26.8(a) through that opening, does not present a risk of injury to persons.

b) A guard is provided that automatically covers the discharge opening when the discharge container is removed.

c) The discharge opening is in the horizontal plane, its average inside dimension is less than 2-1/2 inches (63.5 mm) with no dimension greater than 3 inches (76.2 mm) and the distance from a moving part that can cause injury to persons to the nearest edge of the plane of the opening is not less than 2 inches (50.8 mm). A 3/8 inch (9.5 mm) diameter rod is not to contact a moving part that can cause injury to persons when it is inserted into the opening a distance of 3-1/2 inches (88.9 mm) or less.

27 Switches, Controls, and Interlocks

27.1 A device that automatically starts an appliance shall not be employed unless it can be demonstrated that automatic starting can not result in injury to persons.

27.2 The requirement in 27.1 necessitates the use of an interlock (see 4.36), if movable parts or the like might involve risk of injury upon the automatic starting or restarting of the motor.

27.3 The OFF position of a main ON/OFF switch other than a momentary-contact type shall be such that the operator can determine by visual inspection that the appliance is off.

Exception: Visual indication of whether the appliance is OFF prior to plugging in the appliance is not required if:

a) The main ON/OFF switching is achieved by an electronic control;

b) The electronic control is reset to the OFF condition by unplugging the appliance; and

c) The user must actuate the main ON/OFF switch after plugging in the appliance before the appliance will operate.

27.4 If an interlock is actuated by movement of a guard, the construction shall be such that the guard is in place when the switch permits operation of the parts being guarded. With the guard removed, the construction shall comply with 27.6.

27.5 For a multiple-purpose appliance, operation of a switch for one function shall not cause a risk of injury at another function.

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27.6 The actuator for an interlock shall be so located that unintentional operation is unlikely.

27.7 The actuator described in 27.6 may be guarded by recessing, ribs, barriers, or the like.

27.8 Operation in normal use shall not inconvenience the operator so as to encourage deliberate defeat of an interlock.

27.9 An interlock shall not be capable of being defeated by food materials that could accumulate with normal use of the appliance. For the purpose of this requirement, the interlock mechanisms shall not be located:

a) Within the food processing area;

b) On surfaces over which food materials may be poured when emptying food materials from the food processing area; or

c) On surfaces which are subjected to spillage or leakage of food materials during the Overflow Test of 40.1 or the Test of Deterioration of Parts Subject to Flexing of 41.1 that could accumulate to defeat the interlock.

27.10 An interlock shall not be capable of being defeated:

a) Without damaging the appliance;

b) Without making wiring connections or alterations; or

c) By the probe indicated in Figure 7.1.

27.11 *Deleted*

27.12 *Deleted*

Table 27.1
Typical Magnetic Flux Density
Table deleted

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27.13 An appliance employing a switch with an auto-pulse function (such as an ice pulse function on a blender) shall be constructed so that the blades do not fully stop rotating between pulses. The blades shall fully stop rotating only when the appliance switch is in the OFF position.

Exception No. 1: An appliance employing a switch with an auto-pulse function meets the intent of the requirement when the time between pulses is a maximum of one second.

Exception No. 2: An appliance employing a switch with an auto-pulse function meets the intent of the requirement if, when the auto-pulse function is activated, a visual indication is employed to notify the user, such as a light, or a depressed button that activates a mechanical switch.

27.14 A malfunction or breakdown of any single electronic component, located in any circuit of the product, shall not result in increased risk of injury to persons, such as a loss of OFF control or unexpected operation. See 6.5.

Exception: An appliance employing accessible moving parts and electronic controls placing the appliance in stand-by mode, where a single malfunction of a component can cause unexpected operation, shall be

provided with a motor control OFF switch in accordance with 6.19.1.6 and be constructed with a light which flashes only when the appliance is in the stand-by mode. See also Exception No. 2 of 6.5.2.2, 72.20 and 76.32.

28 Surface Temperatures

28.1 During the temperature test, a temperature on the surface of an appliance that may be contacted by the user shall be not more than the value indicated in Table 28.1.

Table 28.1
Maximum Acceptable Surface Temperature[a]

Location	Composition of surface[b,c]	
	Metal	Non-metallic
Handles, levers, or knobs likely to be grasped for lifting, carrying or holding[d]	50°C (122°F)	60°C (140°F)
Handles or knobs which are contacted, but do not involve lifting, carrying, or holding and other surfaces subject to contact in operation and user maintenance	60°C (140°F)	85°C (185°F)
Surfaces other than a heating function surface and known to be hot due to proximity to the heating function surface	70°C (158°F)	95°C (203°F)

[a] All temperature limits are based on a 25°C (77°F) ambient temperature.

[b] If the temperature on a rivet or screw in a barrier or handle, which could be contacted, touched and the like in the normal lifting, carrying or holding action, exceeds the values given, it is to be recessed at least 1/2 the diameter of the hole and the hole shall be no larger than 3/8 inch (9.5 mm) in diameter.

[c] Coatings or special materials will be considered on an individual basis. A handle, knob, grip or the like that is made of nonmetallic material and is plated or clad with metal having a thickness of 0.005 inch (0.127 mm) or less is considered a nonmetallic part. This also applies to metal-foil pressure sensitive labels should they meet the above thickness requirement.

[d] See 28.2 for handle and surface temperatures for blenders with a heating function.

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28.2 For blenders with a heating function, the handle temperatures of points likely to be contacted by hand or fingers when lifting or tilting the appliance in the normal intended manner, including those points on the gripping surface of the handle and adjacent surfaces close enough to be touched while supporting the appliance by the handle shall comply with the temperature limits specified for “Points likely to be contacted by hand or fingers while supporting the appliance” for the Normal Temperature Test of UL 1082. See the Normal Temperature Test of UL 1082 for details on determining the points likely to be contacted by the hand or fingers, including rivet of screw heads in a barrier or handle. Other surface temperatures shall comply with temperature limits specified in Table 28.1, unless identified as a hot surface by marking in accordance with 72.3.9.

29 Button or Coin Cell Batteries of Lithium Technologies

29.1 To reduce the risk of injury due to battery ingestion, the battery compartment of an appliance or any accessory, such as a wireless control, incorporating one or more replaceable coin cell batteries of lithium technologies shall comply with the Standard for Products Incorporating Button or Coin Cell Batteries of Lithium Technologies, UL 4200A, if the appliance or any accessory is intended for use with one or more single cell batteries having a diameter of 1.25 inch (32 mm) or less with a diameter greater than its height.

30 Appliances

30.1 All knives

30.1.1 A knife shall be provided with a momentary contact switch that cannot be locked in the ON position.

30.1.2 A guard, recess, or a switch lockout as mentioned in 30.2 and 30.3 shall withstand the abuse to which a knife is likely to be subjected.

30.2 Cord-connected knives

30.2.1 The switch shall be positioned for positive (deliberate) control and shall be provided with guarding, recessing, spring force, or the like to reduce the likelihood of unintentionally energizing the knife by the operator when holding the knife or when the knife is placed against the edge of a 1 inch (25.4 mm) thick surface, simulating a cutting board.

a) Positioned for positive control means that the user can hold the knife in the normal operating position without actuating the switch, while being capable of deliberately actuating the switch with the same or other hand. The gripping area shall be constructed to minimize the likelihood of hand slippage which may result in a loss of positive control when handling the knife.

b) It shall not be possible to actuate the knife's switch using the edge of the cutting board with the knife in any orientation and the blades attached. The cutting board shall have perpendicular sides and shall be located away from the edges of the supporting surface and prevented from moving. If a switch lockout is provided, it shall be placed in the unlocked position unless it automatically returns to the locked position when released.

30.2.2 A switch is considered to comply with 30.2.1(a) if the appliance has a means, such as a blade guard or stop plate, to prevent the hand from contacting the blades in the event of hand slippage and:

a) The switch actuator requires two actions, such as a slide and press construction, to operate the appliance, where each action automatically returns to the off condition when released, or

b) The switch actuator is guarded or recessed such that applying a cylindrical rod with a 1.58 inch (40 mm) diameter and a hemispherical end to the switch actuator with a force not exceeding 1.1 lbf (5 N) does not result in operation of the appliance.

30.2.3 A permanent, legible, cautionary marking shall be provided on the external surface of the knife to indicate that the cord is to be disconnected when handling the blades; except that such marking may be omitted if a positive means is provided to prevent unintentional operation of the switch. Also see 72.4.

30.2.4 If a positive means is provided to prevent unintentional operation of the switch as indicated in 30.2.3, a marking such as: "Engage lockout before handling blades," or the equivalent, shall be provided on the external surface of the knife except that such marking may be omitted if the requirement in 30.2.3 is met.

30.3 Battery-operated knives

30.3.1 A battery-operated knife shall be provided with:

a) A positive means to prevent unintentional operation per 30.2.1; and

b) An electrical or mechanical lockout to prevent operation when handling the blades.

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30.3.2 A permanent, legible, cautionary marking shall be provided on the external surface of the knife that indicates that the switch is to be locked in the OFF position when handling the blades. The OFF position of a mechanism accomplishing this shall be plainly marked and visible to the operator. The marking OFF may be omitted if the OFF position is readily apparent. Also see 72.5.

30.4 Blenders

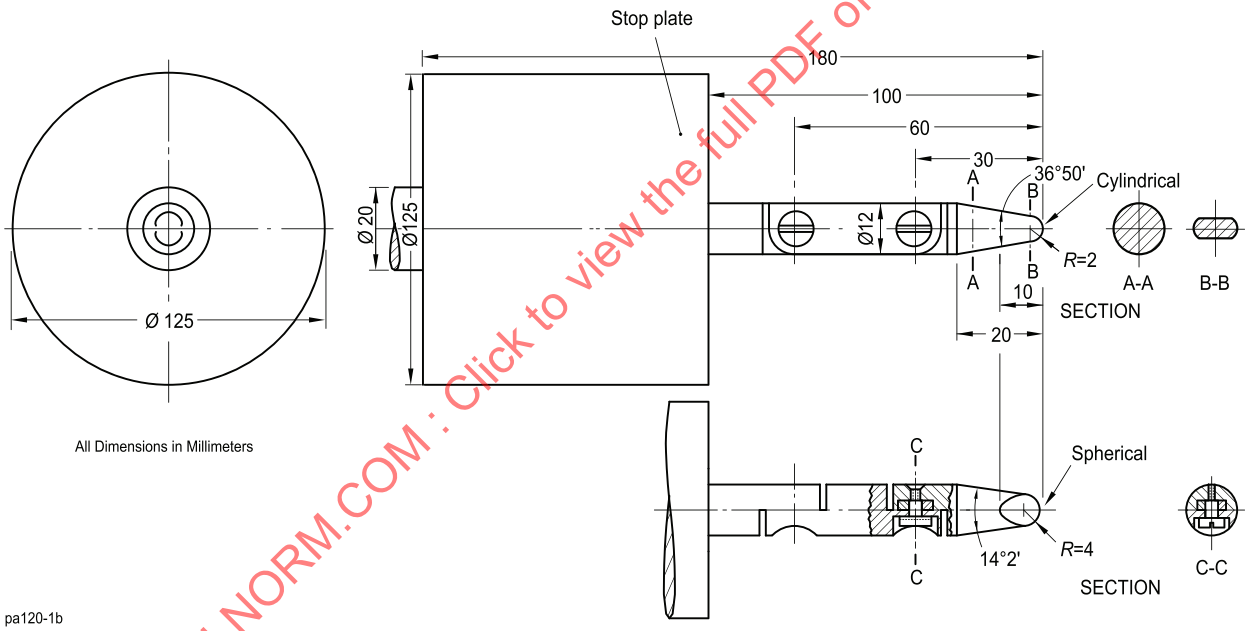
30.4.1 Blade accessibility

30.4.1.1 The blades of a blender with an open top container shall be recessed within the blender container to reduce the risk of injury due to unintentional contact with moving parts.

30.4.1.2 If the blades are not accessible to the probe illustrated in Figure 30.1 with the blender cover removed, the blender is consider to comply with 30.4.1.1.

Figure 30.1

Blender Accessibility Probe



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30.4.1.3 If the blender container is provided with a reliable, cover-actuated interlock and the blades are not accessible to the probe of Figure 7.1 with the blender cover in place through the cover opening, the blender is considered to comply with 30.4.1.1.

30.4.1.4 Unless the blender is marked in accordance with 72.3.3, unintentional operation of a blender with the blade assembly on the blender base without assembly to the container shall be prevented by a momentary contact position switch complying with 6.19.1 actuated by the container to allow the motor to start where the actuator is recessed or guarded to prevent actuation by applying the probe indicated in Figure 7.1 to the blade assembly or switch actuator. If more than one switch must be actuated for the

blades to operate, each actuator is evaluated individually unless a single application of the probe can activate both switches simultaneously. If the switch is a part of an electronic control:

a) The control shall be evaluated as an interlock and comply with Sections 6.5.3 and 27, or

b) Two momentary contact position switches shall be required to be actuated in order to operate the blender and the control shall comply with Sections 6.5.2 and 27.

30.4.1.5 For blenders where the blades are not removable from the blender base, unintentional operation of the blender without the container in place shall be prevented by an interlock switch complying with 6.19.3.

30.4.2 Blade securement

30.4.2.1 An appliance employing a moving part that, if it becomes disengaged, would create a risk of injury to persons shall be provided with a means to retain the part in place under conditions of use.

30.4.2.2 A positive means (not friction alone) shall be provided to prevent a blender cutting assembly from disengaging from the blender container during any normal operating position. For a blender container provided with a reliable, cover-actuated interlock where the cutting assembly is trapped between the cover and the drive coupler, the blade is considered to be secured by positive means.

30.4.2.3 To determine that a construction complies with 30.4.2.2, the container assembly is to be placed on the base in any position that permits normal operation.

30.4.3 Cover opening

30.4.3.1 An open-top container of a blender or a blender-type drink mixer shall be provided with a cover having one or more openings. Each cover opening shall not have a dimension larger than 2-5/8 inch (66.7 mm). At least one opening shall be provided with a minimum 1 inch (25.4 mm) dimension for adding ingredients while blending and to serve as a vent when blending hot liquids.

Exception No. 1: For an individual serving size open-top blender container:

a) The cover drink opening shall have a minimum dimension of less than 1 inch (25.4 mm), but no dimension less than 0.5 inch (12.7 mm),

b) The product shall be subjected to the Overflow Test of 40.1, but the Blender Cover Opening Splash Test is not applicable,

c) With the lid in place, the articulate probe of Figure 7.1, when applied through the drink opening, shall not be made to contact moveable parts capable of causing injury, and

d) The blender container shall be marked in accordance with 72.3.4.

Exception No. 2: If a cover-actuated interlock complying with Sections 6.19.3 and 27 prevents operation of the blender with the cover removed, the cover opening shall have a minimum dimension of at least 0.5 inch (12.7 mm) and a minimum area of at least 0.785 in^2 (506 mm^2).

Exception No. 3: A vacuum blender shall be provided with a cover for vacuum blending or a means to block the cover opening when blending with a vacuum in the container. A cover for vacuum blending shall have means to release the vacuum pressure in the blending container when vacuum blending is completed, but is not required to be provided with a cover opening if the cover is marked in accordance with 72.3.4 and:

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a) The blender is provided with a separate cover with a suitable cover opening(s),

b) The cover is interlocked to prevent operation without the cover in place, or

c) The top of the blender container is guarded by the vacuum pump assembly external to the blender container such that the maximum distance between the vacuum pump assembly and inside edge of the blender container, with the cover removed, is less than 1 inch (24.5 mm), so ingredients cannot readily be added during operation.

30.4.3.2 A blender provided with an opening in the cover located near the edge of the cover and intended for pouring, shall not present a risk of burn injury when blending hot liquids. Compliance is determined by conducting the Blender Cover Opening Splash Test, Section 44.

Exception No. 1: If the cover is provided with a second opening for ventilation, the Blender Cover Opening Splash Test is not conducted if:

a) The vent opening is located away from the edge of the cover,

b) The vent opening area is not less than 0.785 in^2 (506 mm^2),

c) The cover is marked in accordance with 72.3.5, and

d) Instructions are provided in accordance with 76.2.1(h).

Exception No. 2: The Blender Cover Opening Splash Test is not conducted if:

a) The cover is marked in accordance with 72.3.4, and

b) The instructions are provided in accordance with Exception No. 1 to 76.2.1.

30.4.3.3 If the blender cover is provided with a vented lid intended to remain in place over the cover opening when blending hot liquids, the blender shall be:

a) Provided with the marking of 72.3.6,

b) Provided with instructions per Exception No. 2 of 76.2.1,

c) Subjected to the Blender Vented Lid Test of Section 45 if the sum of the cross sectional areas of the vent is less than 0.785 in^2 (506 mm^2), and

d) Subjected to the Blender Cover Opening Splash Test of Section 44 as required by 30.4.3.2 with the vented lid in place.

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30.4.4 Blender container abuse

30.4.4.1 A blender container shall not break or crack during normal use.

30.4.4.2 A blender employing a thermoplastic container shall be subjected to the test outlined in 30.4.4.4 – 30.4.4.7.

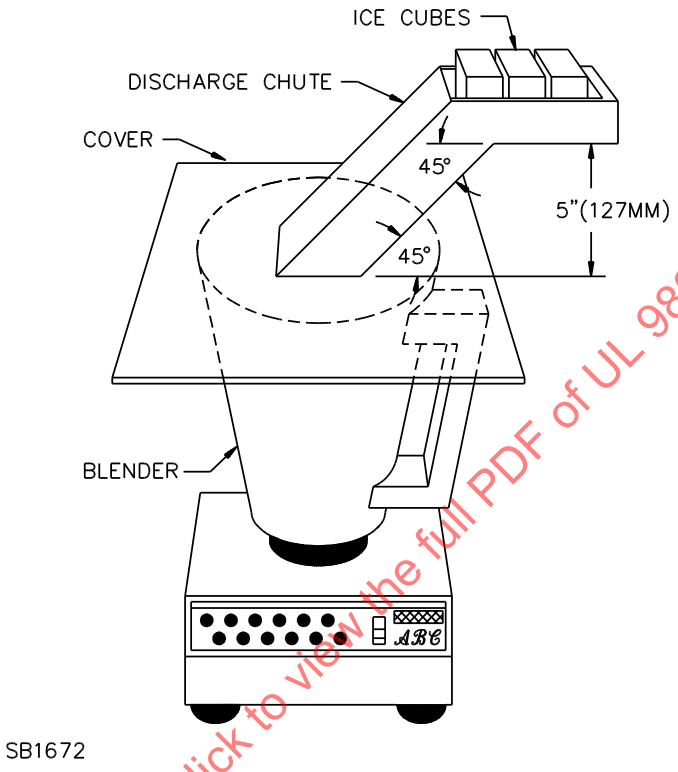
30.4.4.3 A blender employing a glass container shall be subjected to the conditioning and test outlined in 30.4.4.8.

30.4.4.4 To determine if an open top blender container complies with 30.4.4.1, the blender container is to be mounted in the test fixture as described in Figure 30.2. Each sample container, see 30.4.4.6, is then to be subjected to an impact of three ice cubes. While energized, the ice cubes are to be released one at a

time until one is consumed, then another ice cube released for a total of three. The container is to be initially dry at room temperature 77 ±3.6°F (25 ±2°C).

Figure 30.2

Open Top Blender Container Test



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30.4.4.5 The ice cubes shall be made in a tray containing 24 oz (700 cm^3) of distilled nonaerated water and providing 14 cubes. The ice cubes shall be maintained at a temperature of 32°F (0°C) or less prior to the test. The ice cubes when moved from storage are to be used within 5 minutes.

30.4.4.6 A total of three containers shall be tested as follows:

a) For a multiple speed blender, each container is to be tested at high, medium, and low speeds (one ice cube per speed).

b) For a two speed blender, two containers are to be used for the high speed and one container for the low speed.

c) For a single speed blender, three containers are to be used.

30.4.4.7 To determine if a closed top thermoplastic blender container or a vacuum blender container without an opening in the cover complies with 30.4.4.1, the blender is to be tested as mentioned in 30.4.4.4 – 30.4.4.6 except that the test fixture shown in Figure 30.2 is not to be used. Instead, the ice cubes are to be placed in the container prior to the blender being energized.

Exception: If the motor stalls, the blender is to be turned off and then back on to free the ice cubes. If stalling continues, 1 oz (30 ml) of water is to be added.

30.4.4.8 To determine if a glass blender container complies with 30.4.4.1, open top or closed top, three blender containers shall be conditioned and tested as follows:

a) Each of the glass containers under test shall be lightly abraded with 150 grit silicon carbide sandpaper. Both the internal and external surfaces shall be scuffed laterally and vertically.

b) After the container is abraded, the entire assembly (container, cutter assembly, jar nut, etc.) shall be assembled and heated until thermal saturation to 55°C (130°F) in either an air-circulating oven or in a hot water bath.

c) The container assembly shall be removed and immediately filled with a mixture of 2 cups ice cubes and 8 fl oz. alcohol (vodka). Ice cubes must be approximately the size to enclose a 1-inch (25-mm) cube. The ice cubes and alcohol shall be maintained, separately, at a temperature of -5°C (23°F) or less prior to the test. The ice cubes and alcohol, when moved from storage, are to be used within 5 minutes.

d) The mixture shall be pulsed five (5) times on highest speed. Each pulse shall consist of 3 seconds on followed by 3 seconds off.

30.4.5 Blender tamper

30.4.5.1 A blender provided with a tamper shall be constructed so that the tamper does not contact the blades when inserted through the cover opening with a force of 3.4 lbf (15 N).

30.4.6 Blender touch screen control

30.4.6.1 Unless provided with a reliable cover interlock or a closed-top blender container, a blender with a capacitive touch screen shall be constructed to reduce the risk of unintentional operation of the blender. The touch screen shall be:

a) Provided with a flashing light, warning marking of 72.20 and instructions as specified in 76.32 when a single touch is needed to initiate operation of the blender;

b) Recessed or guarded (See 30.4.6.2); or

c) Provided with a two-step operation as specified in 30.4.6.3.

30.4.6.2 The touch screen is considered to be recessed or guarded to reduce the risk of unintentional operation if a cylindrical rod, having a diameter of 1.58 inches (40 mm) and a hemispherical end, applied to the touch screen with the blender in any stand-by mode is unable to contact the touch screen in an area that would initiate operation of the blender.

30.4.6.3 A blender touch screen provided with a two-step operation to reduce the risk of accidental operation as specified in 30.4.6.1 shall require two separate actuations to start operation of the blender and be provided with:

a) A plainly identified one-step OFF or STOP function (See also 27.14 and Exception No. 2 of 6.5.2.2);

b) An indicator light or other visual indicator to indicate when the touch screen is in a condition where a single touch is needed to initiate operation of the blender (after Step 1);

c) A time-out function on the first step of no longer than 30 seconds; and

d) Instructions as specified in 76.2.2.

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30.4.6.4 With respect to 30.4.6.3, after the operation of the blender is manually stopped, or after automatically stopping at the completion of a programmed sequence, the blender shall return to a condition requiring a two-step function to initiate operation.

30.4.6.5 With respect to 30.4.6.4, for a blender with a momentary contact pulse operation, Step 1 may remain active as long as the duration between the Pulse operations is no more than 30 seconds.

30.4.7 Blenders with a heating function

30.4.7.1 A blender with a heating function shall have an open-top blender container. A closed-top blender container may be provided as an additional accessory, if it is marked in accordance with 72.3.8 and instructions are provided in accordance with 76.2.3 (b) or if the blender is interlocked to prevent operation in the heating mode when the closed-top container is placed on the blender base.

30.5 Food processors including food choppers

30.5.1 A food processor shall be provided with a cover actuated interlock to restrict access to moving parts involving risk of injury to persons. The interlock system shall comply with the Interlock System Testing of Section 58.

30.5.2 S-blade and slicing blade cutting assemblies provided with food processors, shall be provided with stems, finger holes, grips, handles or the like to minimize the risk of a cut-type injury during insertion and removal.

30.5.3 The maximum fill line or rated capacity shall be marked on the bowl of food processors with a feed opening where the processed food is collected in the bowl under the slicing or shredding blade. However, the marking is not necessary if the blades sit above the top edge of the bowl when fully assembled. See 76.19.1(f).

30.6 Coffee or grain grinders

30.6.1 When determining compliance of a feed or discharge opening on a coffee or grain grinder with 26.8(b), the minimum distance to the moving part shall not be less than 3-1/2 inches (88.9 mm).

30.6.2 A discharge opening on a coffee or grain grinder complying with 26.14, 30.6.1, or provided with a guard complying with the following is considered to comply with 26.1:

a) The maximum dimension of the opening is 3/8 inch (9.5 mm), and

b) The distance to the moving part capable of causing injury is at least 1/4 inch (6.4 mm) at the point where the opening dimension is limited to 3/8 inch (9.5 mm).

30.7 Vegetable shredders/slicers and centrifugal juicers

30.7.1 When determining compliance of a circular feed opening on a vegetable shredder/slicer or centrifugal juicer, in addition to a construction as specified in 26.8, a construction complying with all of the following is considered to comply with 26.7:

a) The inside diameter of the throat of a hopper feed opening for manual feeding, or any other opening, shall be a maximum of 3 inches (76.2 mm); and

b) Moving parts that may cause injury to persons shall be a minimum of 4 inches (101.6 mm) below the plane of the throat of the opening.

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30.7.2 In place of 26.8(c), if the average inside dimension of the throat of a hopper feed opening (one half the sum of the maximum and minimum dimensions) is reduced to 2 inches (50.8 mm), the distance to the moving parts may be a minimum of 3-1/2 inches (88.9 mm) below the plane of the throat of the opening.

30.7.3 For centrifugal juicers, in addition to a construction as specified in 26.8, 30.7.1 or 30.7.2, if moving parts capable of causing injury are recessed at least 8 inches (203.2 mm) below the plane of a circular feed opening and the inside diameter of the feed opening is at maximum of 3-1/2 inches (88.9 mm), the feed opening is considered to comply with 26.7.

30.7.4 A vegetable shredder or slicer that has feed openings with a minor dimension a maximum of 3 inches (76.2 mm) and a major dimension a maximum of 5 inches (127 mm) and provided with an integrally mounted food pusher is considered to comply with 26.7 if the pusher automatically returns to the closed position upon being released. (For example – gravity biased, spring loaded, and the like.)

30.7.5 A vegetable shredder/slicer shall be provided with a cover-actuated interlock to restrict access to moving parts involving a risk of injury to persons which complies with the Interlock System Testing of Section 58.

Exception: Cone-type shredders/slicers are not required to have an interlock.

30.7.6 A centrifugal juicer shall be provided with an interlock to restrict access to the juicing disk. The interlock system shall comply with the Interlock System Testing of Section 58, but the Interlock System Endurance Test of 58.2 shall be conducted for 6000 cycles. The Cutter Stopping Time Determination Test of 58.1 is not applicable.

30.8 Ice-cube crushers

30.8.1 When determining compliance of a feed or discharge opening on an ice-cube crusher with 26.8 (b), the minimum distance to the moving part shall not be less than 3-1/2 inches (88.9 mm).

30.8.2 A discharge opening on an ice crusher complying with 26.14, 30.8.1 or one of the following is considered to comply with 26.1:

a) With the discharge container removed, if one is provided, the probe illustrated in Figure 64.8 cannot be made to touch a moving part that can cause injury to persons.

b) A discharge container is provided as part of the appliance that significantly closes off the accessibility of the ice discharge opening when the appliance is operating, and

1) An "ice jam mechanism" (serving as a guard in the closed position) is provided, which substantially releases the normal stationary crushing parts when the mechanism is in the unlocked position; and

2) The appliance is marked adjacent to the jam release control knob, lever, or equivalent with the marking indicated in 72.13.1(c).

c) For a drum (cone) type ice crusher, the leading edge of a moving part that can cause injury to persons cannot be contacted by the user and the maximum speed of a moving part that can cause injury to persons is less than 1500 revolutions per minute.

d) For an ice cube crusher employing flail type hammers:

1) The tips of the flails are well rounded and smooth;

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2) The flails do not extend more than 0.025 inch (0.64 mm) beyond the plane of the opening; and

3) An ice catch container or the equivalent is provided.

30.9 Wand-type mixers

30.9.1 A hand-held wand-type mixer shall be provided with a momentary contact ON/OFF switch having the following features:

a) A distinct and separate motion, in addition to gripping the product, shall be required to energize the unit;

b) The motion shall not be easily defeatible;

c) A single motion shall be required to de-energize the unit; and

d) The switch shall not be capable of locking in the ON position.

30.9.2 A switch is considered to comply with 30.1.1(a) if applying a cylindrical rod with a 1.58 inch (40 mm) diameter and a hemispherical end to the switch actuator with a force not exceeding 1.1 lbf (5 N) does not result in operation of the appliance.

30.9.3 A wand-type mixer is considered to comply with 26.1 if it is provided with top and side blade guarding that affords the necessary protection for the blade against contact with sides/bottom of bowl surfaces, and the user against inadvertent blade contact. Any openings in the top and side blade guarding shall not permit the entrance of the flat end of a 3/8 inch (9.5 mm) diameter rod, when placed perpendicular to the guard. As an alternate means of evaluation, any openings in the guarding shall not permit contact of the flat end of a 5/16 inch (8 mm) diameter rod of unlimited length with the blades, when placed at an angle of 45 degrees to the drive shaft. The bottom circular opening shall not be guarded in a manner that would interfere with the intended operation of the appliance.

30.9.4 Slicing/cutting assemblies provided with wand-type mixers shall be provided with a means to minimize the risk of a cut-type injury (such as stems, finger holes, grips handles and the like) during insertion and removal.

30.10 Coffee or grain mills

30.10.1 A coffee or grain mill shall be provided with a cover actuated interlock to prevent access to moving parts involving a risk of injury to persons.

30.10.2 The interlock system mentioned in 30.10.1 shall comply with the Interlock System Testing of Section 58, but the Interlock System Endurance Test of 58.2 shall be conducted for 6000 cycles.

30.11 Pasta mixer-extruders

30.11.1 A pasta mixer-extruder shall be provided with a cover actuated interlock over the mixing chamber to protect against access to moving parts involving risk of injury to persons. The interlock system shall comply with the Interlock System Testing of Section 58, but the Interlock System Endurance Test of 58.2 shall be conducted for 6000 cycles.

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PERFORMANCE

31 General

31.1 Values of voltage and current are root-mean-square values, unless otherwise stated.

31.2 An appliance having both alternating-current and direct-current ratings is to be tested with the appliance connected to an alternating-current supply and again to a direct-current supply, unless it can be established that one test will result in the maximum operating conditions.

31.3 All operational tests shall be conducted with the appliance connected to a supply circuit of the maximum rated frequency and having the voltage specified in Table 31.1, unless otherwise noted in the standard. If the appliance has a rated voltage range including voltages outside of the range specified in Table 31.1, tests shall be repeated at the maximum and minimum rated voltages unless it is determined that the change in test voltage will not adversely affect the results.

Table 31.1
Test Voltages

Rated voltage (V)	Test voltage (V)
110 – 120	120

31.4 An appliance rated 50 – 60 Hz is to be tested both at 50 and 60 Hz, where performance is frequency dependent, unless it can be established that one test will result in the maximum operating conditions. Universal motors are generally considered not frequency dependent.

31.5 Wherever cloth is mentioned in the abnormal tests, the cloth is to be bleached cheesecloth, running 14 – 15 yd^2/lb (approximately 26 – 28 m^2/kg) and having what is known in the trade as a "count of 32 by 28," that is, for any square inch, 32 threads in one direction and 28 threads in the other direction (for any square centimeter, 13 threads in one direction and 11 in the other direction).

31.6 Unless otherwise specified, an appliance intended to be supplied by a Universal Serial Bus (USB) shall be tested with the appliance connected to a continuous independent DC source of supply with a voltage of 1.05 times the rated voltage and a current capacity of 8 A.

31.7 An appliance intended to be supplied by an automotive adapter shall be tested with the appliance connected to a continuous independent source of supply of 12 V dc.

32 Leakage Current Test

32.1 The leakage current of a cord-connected appliance rated for a nominal 120 V supply when tested in accordance with 32.3 – 32.7 shall not be more than:

a) 0.5 mA for an ungrounded (two-wire) portable, stationary, or fixed appliance;

b) 0.5 mA for a grounded (three-wire) portable appliance; and

c) 0.75 mA for a grounded (three-wire) 3-wire or 4-wire stationary or fixed appliance employing a standard attachment plug rated 20 A or less.

32.2 Leakage current refers to all currents, including capacitively coupled currents, which may be conveyed between accessible conductive surfaces of an appliance and ground or other accessible conductive surfaces of an appliance.

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32.3 All accessible conductive surfaces are to be tested for leakage currents. The leakage currents from these surfaces are to be measured to the grounded supply conductor individually as well as collectively where simultaneously accessible and from one surface to another where simultaneously accessible. Parts are considered to be accessible surfaces unless guarded by an enclosure considered to provide protection against the risk of electric shock as defined in 7.6 – 7.12. Surfaces are considered to be simultaneously accessible when they can be readily contacted by one or both hands of a person at the same time. These measurements do not apply to terminals operating at voltages which are not considered to involve the risk of electric shock.

32.4 If a conductive surface other than metal is used for the enclosure or part of the enclosure, the leakage current is to be measured using a metal foil with an area of 10 by 20 cm (3.9 by 7.9 inches) in contact with the surface. Where the surface is less than 10 by 20 cm, the metal foil is to be the same size as the surface. The metal foil is not to remain in place long enough to affect the temperature of the appliance.

32.5 The measurement circuit for leakage current is to be as shown in Figure 32.1. The ideal instrument is defined in (a) – (d). The meter which is actually used for a measurement need only indicate the same numerical value for a particular measurement as would the defined instrument. The meter used need not have all the attributes of the defined instrument.

a) The meter is to have an input impedance of 1500 ohms resistive shunted by a capacitance of 0.15 µf.

b) The meter is to indicate 1.11 times the average of the full-wave rectified composite waveform of voltage across the resistor or current through the resistor.

c) Over a frequency range of 0 – 100 khz, the measurement circuitry is to have a frequency response (ratio of indicated to actual value of current) equal to the ratio of the impedance of a 1500 ohm resistor shunted by a 0.15 µf capacitor to 1500 ohms. At an indication of 0.5 or 0.75 mA, the measurement is to have an error of not more than 5 percent at 60 Hz.

d) Unless the meter is being used to measure leakage from one part of an appliance to another, the meter is to be connected between the accessible parts and the grounded supply conductor.

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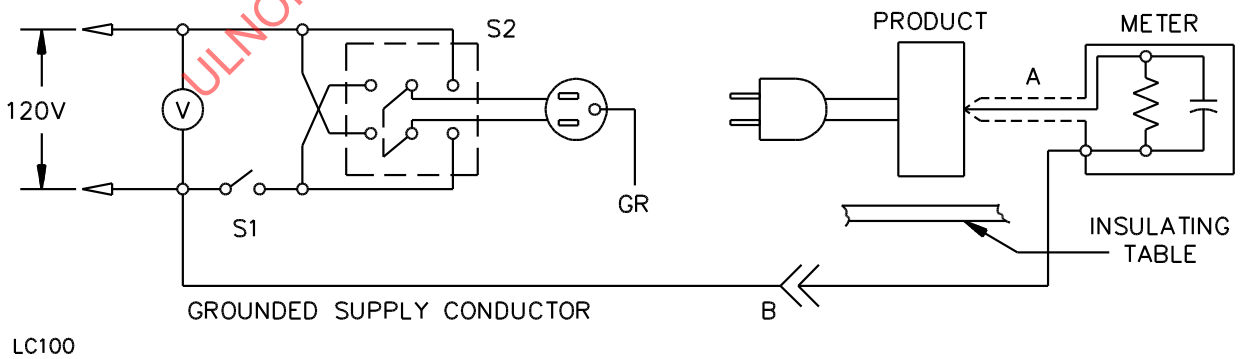
Figure 32.1

Leakage-Current Measurement Circuit



32.6 A representative appliance is to be tested for leakage current starting with the as-received condition but with its grounding conductor, if any, open at the attachment plug. The as-received condition is without prior energization except as occurring as part of the production-line testing. The supply voltage is to be adjusted to 120 V. The test sequence, with reference to the measuring circuit (Figure 32.1) is to be as follows:

a) With switch S1 open, the appliance is to be connected to the measuring circuit. Leakage current is to be measured using both positions of switch S2 and with the appliance switching devices in all their normal operating positions.

b) Switch S1 is then to be closed energizing the appliance, and within a period of 5 seconds, the leakage current is to be measured using both positions of switch S2, and with the appliance switching device in all their normal operating positions.

c) The leakage current is to be monitored until thermal stabilization. Both positions of switch S2 are to be used in determining this measurement. Thermal stabilization is to be obtained by operation as in the Normal Temperature Test, Section 36.

32.7 Normally a representative appliance will be carried through the complete leakage-current-test program as covered by 32.6, without interruption for other tests. With the concurrence of those concerned, it is possible to interrupt the leakage-current tests for the purpose of conducting other non-destructive tests.

33 Operational Tests

33.1 Operation of an appliance while simulating anticipated conditions of use shall not increase the risk of fire, electric shock, or injury to persons.

33.2 In conducting the test, the conditions mentioned in the manufacturer's instructions, including cleaning, maintenance, and the use of accessories may be included or omitted so as to simulate reasonably foreseeable actions of the user.

34 Starting Current Test

34.1 Protection by fuses

34.1.1 Except as noted in 34.1.2 and 34.2.1, an appliance shall be capable of starting and operating on a circuit protected by an intended (non-time-delay) fuse having a current rating corresponding to that of the branch circuit to which the appliance should be connected.

34.1.2 The requirement in 34.1.1 does not apply if:

a) The construction of the appliance or the nature of its usage is such that it is likely to be used continually on the same branch circuit after installation;

b) The appliance will start and operate normally on a circuit protected by a time-delay fuse; and

c) The appliance is marked in accordance with 71.9.

34.2 Other overcurrent protection

34.2.1 The requirement in 34.1.1 does not apply to a household appliance that would normally be used on a 15 or 20 A branch circuit, but the appliance shall start and operate on a circuit protected by a time-delay fuse having an ampere rating corresponding to that of the branch circuit on which the appliance would normally be used.

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34.2.2 In a test to determine whether or not an appliance complies with the requirement in 34.1.1, the appliance is to be started three times, with the appliance at room temperature at the beginning of the test. Each start of the motor is to be made under conditions representing the beginning of normal operation (the beginning of the normal operating cycle, in the case of an automatic appliance), and the motor is to be given time to come to rest between successive starts. The performance is unacceptable if the fuse opens. Tripping of an overload protector provided as part of the appliance is also considered to constitute unacceptable performance.

35 Input Test

35.1 The measured input in watts or amperes to an appliance shall not exceed the marked rating by an amount greater than the deviation shown in Table 35.1 when the appliance is operated under a condition of maximum normal load as described in 36.1.12 – 36.26. Unless otherwise indicated, the input is the maximum input while processing the load specified, but disregarding the initial starting current.

Table 35.1
Input Test Deviations

Rated input, watts	Deviation (+/-)	Rated input, amperes	Deviation (+/-)
Up to and including 33.3	10 W	Up to and including 0.29	0.09 A
Over 33.3 up to and including 150	30 percent	Over 0.29 up to and including 1.3	30 percent
Over 150 up to and including 300	45 W	Over 1.3 up to and including 2.6	0.4 A
Over 300	15 percent	Over 2.6	15 percent

35.2 If an appliance is provided with various functional attachments, or attachments are sold separately for use with the appliance, the marked electrical rating is determined per 35.1 when the appliance is operated with the attachment which results in the highest input..

35.3 The measured input in watts or amperes to an appliance may be less than the marked rating by an amount greater than the deviation shown in Table 35.1 if the temperature rises indicated in Table 36.1 are not exceeded when the appliance is subjected to an additional temperature test loaded to nameplate rating (amperage or wattage). The duty cycle is to be the same as that established for the normal temperature test (36.1.12 – 36.26). For multifunction appliances, the duty cycle is to be that which results in the highest temperatures during the normal temperature test, including the main function (s) of the appliance and any functional attachments:

a) Recommended for use at the highest speed, or

b) Resulting in higher inputs than functions operating at the highest speed.

Multispeed appliances are to be operated at the highest speed. During the conduct of this test, the appliance is to be connected to a 120 V, 60 Hz supply circuit. If it is not possible to artificially load the appliance to its marked rating (that is – due to motor stalling), the appliance is not considered to comply with the intent of the input test. If the load is to be increased by other than a food load, it is to be applied gradually (normally not over 5 seconds) before considering the on sequence of the duty cycle to have started.

35.4 For an appliance having a single voltage rating (such as 115 V) rather than being rated for a range of voltages (such as 110 – 120 V), maximum rated voltage is considered to be that single value of voltage. If the rating is given in terms of a range of voltages, maximum rated voltage is considered to be the highest value of the range.

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36 Normal Temperature Test

36.1 General

36.1.1 An appliance, when tested under the conditions of "Maximum Normal Load" as described in 36.1.12 – 36.26, shall not attain a temperature at any point high enough to constitute a risk of fire or to damage any materials employed in the appliance, nor shall the appliance show greater temperature rises at certain specified points than those indicated in Table 36.1 when operated at 120 V and in Table 36.2 when operated also at 127 V.

Table 36.1
Maximum Acceptable Temperature Rises at 120 V

	Materials and component parts	°C	(°F)
1.	Varnished-cloth insulation	60	(108)
2.	Fuses	65	(117)
3.	Fiber employed as electrical insulation	65	(117)
4.	Wood and other combustible material	65	(117)
5.	Class A insulation systems on coil windings of motors[a]:		
	Thermocouple method or Resistance method	85	(153)
6.	Transformers with Class 105 insulation systems:		
	Thermocouple method	65[a]	(117[a])
	Resistance method	75[a]	(135[a])
7.	Transformers with Class 130 insulation systems:		
	Thermocouple method	85[a]	(153[a])
	Resistance method	95[a]	(171[a])
8.	Class B insulation systems except as indicated in item 13:		
	Thermocouple method	85	(153)
9.	Phenolic composition employed as electrical insulation or as a part depended upon to reduce the risk of fire, electric shock, or injury to persons	125[b]	(225[b])
10.	Rubber- or thermoplastic-insulated wires and cords	35[b,c]	(63[b,c])
11.	Capacitors:		
	Electrolytic	40[d]	(72[d])
	Other types	65[e]	(117[e])
12.	Class 105 insulation systems on windings of relays, solenoids, and the like:		
	Thermocouple method	65	(117)
	Resistance method	85	(153)
13.	Class B insulation systems on coil windings of motors[a]:		
	Thermocouple method or resistance method	105	(189)
14.	a) Copper, tinned or bare strands:		
	1) less than 0.015 inch diameter	125	(225)
	2) 0.015 inch diameter and larger	175	(315)
	b) Nickel, gold, or silver platings or combinations of those platings, over copper conductors	225	(405)
15.	Class E insulation systems on coil windings of motors[a]:		
	Thermocouple method or Resistance method	95	(171)

Table 36.1 Continued on Next Page

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Table 36.1 Continued

Materials and component parts	°C	(°F)
16. Class F insulation systems on coil windings of motors[a]:		
Thermocouple method or Resistance method	130	(234)
17. Class H insulation systems on coil windings of motors[a]:		
Thermocouple method or Resistance method	155	(279)

[a] See 36.1.6 and 36.1.9.

[b] The limitations on phenolic composition and on rubber and thermoplastic insulation do not apply to compounds which have been investigated and found to have special heat-resistant properties.

[c] Rubber-insulated conductors within a Class-A-insulated motor, rubber-insulated motor leads, may be subjected to a temperature rise of more than 35°C (63°F), provided that a braid is employed on the conductor. However, this does not apply to thermoplastic-insulated wires.

[d] For an electrolytic capacitor which is physically integral with or attached to a motor, the temperature rise on insulating material integral with the capacitor enclosure may be more than 65°C (117°F).

[e] A capacitor which operates at a temperature rise of more than 65°C (117°F) may be investigated on the basis of the marked temperature limit.

Table 36.2
Maximum Acceptable Temperature Rises at 127 V

Materials and component parts	°C	(°F)
1. Class A insulation systems on coil windings of motors:		
Thermocouple or resistance method	100	(180)
2. Class B insulation systems on coil windings of motors:		
Thermocouple or resistance method	120	(216)
3. Class E insulation systems on coil windings of motors:		
Thermocouple or resistance method	110	(198)
4. Class F insulation systems on coil windings of motors:		
Thermocouple or resistance method	145	(261)
5. Class H insulation systems on coil windings of motors:		
Thermocouple or resistance method	170	(306)

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36.1.2 A thermal or overcurrent-protective device shall not open the circuit during the temperature test of the appliance mentioned in 36.1.1.

36.1.3 Temperatures are to be measured by thermocouples consisting of wires no larger than 24 AWG (0.21 mm^2) and no smaller than 30 AWG (0.05 mm^2), except that a coil temperature may be determined by the change-of-resistance method under the conditions indicated in 36.1.6.

36.1.4 The thermocouples and related instruments are to be accurate and calibrated in accordance with good laboratory practice. The thermocouple wire is to conform with the requirements specified in the Tolerances on Initial Values of EMF versus Temperature tables in the Standard Specification and Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples, ANSI/ASTM E230/E230M.

36.1.5 A thermocouple junction and adjacent thermocouple wires are to be securely held in good thermal contact with the surface of the material whose temperature is being measured.

36.1.6 The temperature of a coil or a winding is to be determined by either the thermocouple or change-of-resistance method. A thermocouple is able to be used for determining temperatures of a coil or winding if it can be mounted, without removal of encapsulating compound or similar material:

a) On the integrally applied insulation of a coil without a wrap; or

b) On the outer surface of a wrap that is not more than 1/32 inch (0.8 mm) thick and consists of cotton, paper, rayon, or similar insulating material, but not of thermal insulating material.

For a thermocouple measured temperature of an a-c motor coil, the thermocouple is to be mounted on the integrally applied insulation on the conductor.

36.1.7 All values for temperature rises in Table 36.1 and Table 36.2 are based on an assumed test area ambient temperature of 25°C (77°F); however, tests may be conducted at any ambient temperature within the range of 10 – 40°C (50 – 104°F).

36.1.8 The formulas for obtaining the temperature of copper and aluminum by the change-of-resistance method are as follows:

$$t_1 = \frac{R}{r}(234.5 + t_2) - 234.5 \text{ (copper)}$$

$$t_1 = \frac{R}{r}(225 + t_2) - 225.0 \text{ (aluminum)}$$

in which:

t_1 is the temperature in °C to be determined

t_2 is the known temperature in °C

R is the resistance in ohms at the temperature to be determined

r is the resistance in ohms at the known temperature

36.1.9 At a point on the surface of a winding of a relay, solenoid, and the like, for a Class 105 insulation system (item 12 of Table 36.1) where the temperature is affected by an external source of heat, the temperature rise measured by means of a thermocouple may be higher by 15°C (27°F) than the maximum indicated in Table 36.1 for 120 V. If the coil wrap is not caused to exceed its temperature limitation by radiation from an external source, the temperature of the coil may be measured by means of a thermocouple on the integral insulation of the coil conductors.

36.1.10 If an appliance incorporates a cord reel or storage compartment for the power-supply cord, one-third of the length of the cord is to be outside of the reel or storage compartment during the temperature test.

36.1.11 With reference to those tests that are to be continued until constant temperatures are attained, thermal equilibrium is considered to exist when three successive readings taken at intervals of 10 percent of the previously elapsed duration of the test, but not less than 5-minute intervals, indicate no change.

36.1.12 Maximum normal load is considered to be that load which approximates as closely as possible the most severe conditions of normal use. It is not a deliberate overload except as the conditions of actual use are likely to be somewhat more severe than the maximum load conditions that are recommended by the manufacturer of the appliance. Test loads that have been found to be close approximations of the most

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severe conditions of normal use are indicated in 36.2 – 36.26 for some common forms of appliances. However, appliances having features not contemplated in these test procedures may be tested as necessary to meet the intent of these requirements. See 36.1.17.

36.1.13 Combination type appliances such as can opener/knife sharpeners are to be tested individually for each function; the appliance is to be at room temperature at the beginning of each test unless it is intended that one type of function immediately be followed with another, such as to crush ice, then mix the crushed ice.

36.1.14 A multi-speed appliance intended for use with attachments shall be tested with the various attachments at the speed or speeds recommended for each attachment.

36.1.15 An appliance provided with feet removable without the use of tools shall also be tested with the feet removed if this may result in increased temperatures.

36.1.16 Where the operating time under maximum normal load, as defined in 36.2 – 36.26, is limited to a number of cycles or a period of time, the temperatures are to be monitored during the specified operating time only. Temperatures are to be monitored during the "off" time between cycles, but any temperature overshoot following the deenergizing of the appliance after the completion of the specified operating time or last cycle is to be ignored.

36.1.17 An appliance recommended to perform functions outside of the normal anticipated mode of operation for that appliance as defined by the manufacturer's instructions, such as a blender recommended for grinding coffee or grain, shall be subjected to additional normal load conditions to represent these functions as specified in 36.1 – 36.26.

36.1.18 For products with a food pusher, the pusher is to be applied with a force of 1.1 lbf (5 N). If additional force is required to process harder foods, the force is to be 2.2 lbf (10 N). If this force is not adequate to process the food, the force is increased to the minimum force needed to process the food load.

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36.2 Food mixers

36.2.1 The input to a food mixer is to be the average measured with the appliance loaded as indicated for the temperature test, while operating for time, T, as defined in 36.2.2 at the setting or combination of settings resulting in the maximum power consumption, including any momentary boost speed settings. The input is to be measured with the various mixing attachments, such as beaters and dough hooks, intended for use with the mixer.

36.2.2 For the temperature test, a food mixer is to be operated for a total of 15 minutes in the intended manner, involving all the different speeds provided by the appliance, excluding any momentary boost speed settings, and with a load as specified in 36.2.3. The mixing attachment resulting in the highest input is to be installed for the test. The appliance is to be operated through the entire sequence of speeds (increasing from the lowest speed to the highest speed and then decreasing back to the lowest speed) in accordance with the following:

$$T = \frac{15\ \text{min}}{2N - 1}$$

in which:

T is the time at each speed, and

N is the number of speed settings.

36.2.3 Dry 50 – 80 core sand is to be used as the load. The beater blades are to extend as nearly as possible to the bottom of the mixing bowl, and the depth of the level sand is to be such as to cover approximately 80 percent of the effective blade length when the blades are stationary. If this quantity of sand is enough to stall the blades of a multiple-speed machine on the low speed, just enough sand may be removed to permit motion of the blades for the low-speed operation only. If the appliance is provided with a whisk attachment, a water load is to be used instead of the sand load.

36.2.4 If a mixing bowl is not provided by the manufacturer, a bowl with an approximate height of 5-1/8 inches (13.0 cm) and an approximate inner diameter of 6-3/4 inches (17.2 cm) at the top tapering down to approximately 6.0 inches (15.2 cm) at the bottom is to be used. The inner surface of the bowl is to be smooth and the bottom is to blend smoothly.

36.3 Blending mixers

36.3.1 The input to a blending mixer is to be measured at 30 seconds of operation when loaded as specified in 36.3.5 and operated at the setting or combination of settings resulting in the maximum power consumption, including any momentary boost settings. If the appliance has a fluctuating load, the input is to be the average input from 25 to 35 seconds of operation.

36.3.2 For the temperature test, a blending mixer is to be tested as follows: The appliance is to be subjected to 10 cycles of operation, with each cycle consisting of 3 minutes of operation followed by a 1 minute off period. For each cycle, a single-speed mixer is to be loaded with a mixture of soaked diced carrots and water. The capacity of the mixer is to be determined in accordance with 36.3.5.

Exception No. 1: If the construction of the blender is such that it cannot be operated for 3 minutes without being restarted, each cycle is to be run at the maximum cycle time of the blender unless the cycle is less than 1 minute. If the cycle is less than 1 minute, the blender is to be recycled to obtain 1 minute cycles.

Exception No. 2: If the blender is only operable via a momentary contact switch with no means for locking it in the on position, each cycle is to consist of 1 minute of operation followed by a 1 minute off period.

36.3.3 If the appliance stalls at the beginning of any cycle, the obstruction is to be removed and the test continued. If it stalls while running, the obstruction is to be removed and the entire test restarted after the appliance has cooled to room temperature. If the appliance stalls more than twice while running, the results of the test are not acceptable.

36.3.4 A multispeed blending mixer is to be tested at its highest speed, excluding any momentary boost speed settings, and lowest speed, except that the load for the test at the lowest speed is to consist of water alone.

36.3.5 The blending mixer capacity is to be determined by loading the mixer with a mixture of soaked diced carrots and water in the ratio of 2 to 3 by weight, with approximately half of the weight of carrots consisting of pieces having a maximum dimension of less than 1/2 inch (12.7 mm) and approximately half consisting of pieces having a maximum dimension between 1/2 and 3/4 inch (12.7 and 19.1 mm). The carrot pieces are to be soaked in water for 24 hours and drained before being weighed and added to the mixture. The mixture is then to be placed in the blender mixer container to the rated capacity of the container or the maximum amount recommended in the instruction material packaged with the blender, whichever is greater. The blending mixer is to be operated at its highest speed, excluding any momentary boost settings, at the rated voltage until the mixture is well blended. If spill-over of the mixture occurs while the mixer is running at its highest speed, then the amount of mixture present in the container prior to spill-over is the amount to be used during the test. If the mixture level is below the lip of the mixer container while the mixer is running at its highest speed, additional mixture is to be added until the mixture level reaches the lip of the mixer container. The amount of mixture remaining in the mixer container, after

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replacement of the cover, is the amount to be used during the test. Any spill-over that occurs due to the replacement of the cover is to be ignored.

36.3.6 If a blender is provided with a tamper, the input and temperature test shall be conducted without the use of the tamper when processing the carrot/water load. If the blender is intended for processing dry loads, such as coffee of grains, and the use of the tamper is required to perform those functions, the tests shall also be conducted with that load as specified for the related appliance (coffee mill, grain mill, etc.) with a force of 1.1 lbf (5 N) applied to the tamper in continuous up and down strokes or circular motions as recommended by the instructions.

36.3.7 For the input test, a vacuum blender is also to be operated while blending with a vacuum in the blending container. If possible under normal use, the vacuum pump and blender are to be operated simultaneously. Otherwise, the vacuum pump input and blending input are to be measured separately with the blender operated as specified in 36.3.1 after 30 seconds of the blending function. The carrot/water specified in 36.3.5 is to be used, but the capacity shall not exceed the rated capacity for blending under a vacuum.

36.3.8 For the Normal Temperature Test, a vacuum blender is also to be operated as intended for vacuum and blending functions with a vacuum in the blender container as specified in 36.3.1 – 36.3.4 and 36.3.7. The vacuum pump is to be operated at the beginning of each cycle. The vacuum pump is to be operated for the maximum time allowed when the pump operation is terminated automatically after a set time or pressure is achieved. If the pump operation is not automatically terminated, the vacuum pump is to be operated for 30 seconds or the time specified in the manufacturer's instructions, whichever is greater.

36.3.9 The temperature test for a blender with a heating function is also to be tested as specified in 36.3.1 – 36.3.4 in the heating mode except as noted below:

a) For blenders with an automatic heating function or a timer, where the operating period is ended automatically after a set period of time or after reaching a set temperature, the operating time is to be the maximum time allowed by the timer or control. When the operating time is dependent upon the temperature of the blender container contents, the water used in the carrot/water load is not to be greater than 40°C and the temperature, if adjustable, is to be set to the maximum temperature. The blender is to be operated for 1 cycle or until the temperatures stabilize, whichever occurs first.

b) For blenders without an automatic heating function or timer and without a heating element, the operating time is to be the maximum time specified in the instructions for the heating function. The blender is to be operated for 1 cycle or until the temperatures stabilize, whichever occurs first.

c) For blenders without an automatic heating function or timer and with a heating element, operation is to be continued until temperatures have stabilized.

d) For blenders with a keep warm function, the blender operation is to be continued in the keep warm mode until temperatures have stabilized.

e) For blenders with a heating function intended for use with dry ingredients, the blender is also operated with no load for the maximum time allowed by the automatic heating function or timer or until temperatures have stabilized.

36.4 Liquid mixers

36.4.1 The input is to be measured at 30 seconds of operation when loaded with water to the capacity specified in 36.4.3. If the appliance has a fluctuating load, the input is to be the average input from 25 to 35 seconds of operation.

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36.4.2 For the temperature test, a liquid mixer is to be operated for 10 complete cycles, each cycle consisting of 3 minutes of operation with the maximum capacity water load, followed by a 1 minute idling period. During the idling period, the liquid container is completely removed from the driving mechanism. If adverse operation or abuse to the rotating drive coupling could occur during normal removal or replacement of the liquid container, the 1 minute period between water loads is to be with the drive coupling not rotating but with the motor running or the unit is to be deenergized if necessary to stop the rotation of the drive coupling. A liquid mixer so tested shall have operating instructions provided which describe this method of usage, that is, that the driver is to be stopped when removing or replacing the liquid container.

36.4.3 The liquid-mixer maximum capacity is to be the amount of water which completely fills the container with the unit operating at the highest speed setting if a multispeed motor is used. The container cover is to be removed when capacity is determined.

36.5 Reamer juicers

36.5.1 The input to a reamer juicer is to be the average measured extracting juice from one orange half. A force of 11.25 lbf (50 N) is to be applied to the orange half while juicing for 15 seconds.

36.5.2 For the temperature test a reamer juicer is to be operated for 24 complete cycles – each cycle consisting of extracting juice from one orange half for 15 seconds applying the force specified in 36.5.1 or loaded to represent the actual extraction operation, to be followed by a 15 seconds idling period with the motor on but without added load on the reamer.

36.5.3 For a reamer juicer provided with a momentary-contact switch, the motor is to be deenergized between extractions.

36.6 Centrifugal juicers and masticating juicers

36.6.1 The input to a centrifugal juicer or masticating juicer is to be the average measured extracting the juice from celery and spinach. The chute is to be loaded to full capacity for each input load. The juicer may be cleaned between juicing operations.

36.6.2 For the temperature test, a centrifugal juicer or masticating juicer is to be operated juicing two bunches of celery, (1-3/4 lb or 0.8 kg per bunch minimum) after which it is to be cleaned and then immediately followed with the juicing of 4 lb (1.8 kg) of spinach. If, during the operation of the unit, the juicer becomes so clogged that it begins to vibrate excessively, the appliance is to be turned off and cleaned as quickly as possible. Then it is to be turned on and the juicing operation is to be continued until the celery and spinach are consumed.

36.7 Meat grinders

36.7.1 The input to a meat grinder is to be the average measured while the appliance is processing small pieces of beef [approximately 2 inch (51 mm) cubes] of a variety such as boneless chuck and during the test, the meat is to be self-fed into the grinder without the application of external pressure to force it in.

36.7.2 For the temperature test, the appliance is to be operated without load, except that small pieces of meat are to be dropped in occasionally to lubricate the cutting piece, and the temperatures are to be measured when they have become constant.

36.8 Baby food grinders

36.8.1 The input to a baby food grinder is to be the average measured while the appliance is processing various cooked foods as specified in 36.8.2 while filled to the rated capacity or in the quantities specified in

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the instruction manual, whichever is less. The feed tube is to be filled with the cooked food load and with the food pusher, pressure is to be applied to maintain the food in contact with the cutter.

36.8.2 With respect to the food loads to be processed, various food loads recommended in the instruction manual are to be considered to determine the load resulting in the highest inputs. Food loads are to be prepared prior to processing as recommended in the instruction manual, such as cutting to a specified size. If no preparation instructions are provided, the foods are to be cut into 2 inch cubes. For a multispeed appliance, if the instructions recommend processing of certain food loads at other than the highest speed, they are to be processed at the recommended speed. Unless the instructions indicate that a particular food load is not recommended, the cooked food loads are to include beef, carrots, potatoes and apples in addition to any other recommended food loads that may result in a higher input.

36.8.3 For the temperature test, the appliance is to be operated grinding the food load resulting in the highest input during the input test. The food load is to be placed into the food tube. Pressure is to be maintained on the pusher to maintain the grinding action. When this quantity is ground, the food tube is to be refilled while the appliance is continuously operating until 8 oz (227 g) are processed.

36.9 Baby food choppers

36.9.1 The input to a baby food chopper is to be the average measured while the appliance is processing various cooked food loads as specified in 36.9.2 while filled to the rated capacity or in the quantities recommended in the instruction manual, whichever is less, for one cycle of operation as specified in 36.9.3.

36.9.2 With respect to the food loads to be processed, various food loads recommended in the instruction manual are to be considered to determine the load resulting in the highest inputs. Food loads are to be prepared prior to processing as recommended in the instruction manual, such as cutting to a specified size. If no preparation instructions are provided, the foods are to be cut into 2 inch cubes. For a multispeed appliance, if the instructions recommend processing of certain food loads at other than the highest speed, they are to be processed at the recommended speed. Unless the instructions indicate that a particular food load is not recommended, the cooked food loads are to include beef, carrots, potatoes and apples in addition to any other recommended food loads that may result in a higher input.

36.9.3 For the temperature test, the appliance is to be operated processing the food load resulting in the highest input during the input test in the quantity specified in the instruction manual. The appliance is to be operated under a duty cycle of 15 seconds chopping, or the time specified in the operating instructions, whichever is greater, followed by 1 minute OFF, during which time the processed food is to be emptied and the bowl is to be refilled until a total of 9 oz (255 g) has been processed.

36.10 Meat slicers

36.10.1 The input to a meat slicer is to be measured at 10 seconds of operation without load.

36.10.2 For the temperature test, the slicer is to be operated without load until temperatures have become constant.

36.11 Churns

36.11.1 The input to a butter churn is to be the average measured for 1 minute after evidence of butter formation when loaded as specified in 36.11.2.

36.11.2 For the temperature test, the churn is to be operated under the following conditions until butter is produced. The churn is to be loaded to the maximum capacity which it will accommodate without spillage while operating with a mixture consisting of eight parts of heavy cream to one part buttermilk – the mixture

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having been kept at a temperature of 18°C (64°F) for several hours prior to the test. Operation is to be discontinued within 3 minutes after the first evidence of butter formation.

36.12 Knife sharpeners

36.12.1 The input to a knife sharpener is to be measured after 10 seconds of operation without load.

36.12.2 For the temperature test, the appliance is to be operating continuously for 10 minutes under a no-load condition. The test is to be terminated immediately after the 10 minute period.

36.13 Can openers

36.13.1 The input to a can opener is to be measured while opening a No. 3 steel can [having a 4-1/4 inch (108 mm) cover diameter].

36.13.2 For the temperature test, the appliance is to be opening five No. 3 size steel cans in succession with an off time of 15 seconds between the opening of each can. During this interval, the opened can and cover are to be removed from the mechanism and an unopened can is to be inserted into the mechanism.

36.14 Ice crushers and ice shavers

36.14.1 The input on an ice crusher or shaver is to be the average measured while the appliance is crushing or shaving ice cubes for 10 seconds.

36.14.2 For the temperature test, the appliance is to be crushing or shaving 6 lb (2.7 kg) of ice cubes. The hopper is to be filled, emptied and refilled as many times as necessary to process 6 lb (2.7 kg) of ice cubes. A 1 minute OFF period is to be allowed while the hopper is refilled.

36.15 Vegetable shredder/slicers

36.15.1 The input to a vegetable shredder/slicer is to be the average measured using the various attachments provided while processing one feed chute filled to capacity, with the various foods as specified in 36.15.2.

36.15.2 With respect to the food loads to be processed, various food loads recommended in the instruction manual are to be considered to determine the load resulting in the highest inputs. Food loads are to be prepared prior to processing as recommended in the instruction manual, including cutting to a specified size, peeling, and chilling in the refrigerator or freezer. If no preparation instructions are provided, the foods are to be cut into pieces as needed to fit within the feed opening. For a multispeed appliance, if the instructions recommend processing of certain food loads at other than the highest speed, they are to be processed at the recommended speed. Unless the instructions indicate that a particular food load is not recommended, the following food loads are also to be included:

a) Slicing – carrots, potatoes and hard meats such as pepperoni; and

b) Shredding – mozzarella and cheddar cheese, cabbage, potatoes and carrots.

36.15.3 For the temperature test, the disc or cone to be tested is to be installed in the appliance as intended and the temperature test is to be performed in the following manner:

a) For an appliance without a discharge opening, the appliance is to be operated for 4 cycles of operation, slicing or shredding the food load resulting in the highest input during the input test. During each cycle of operation the bowl is to be filled to its maximum capacity or to a maximum-fill indicator with the food being processed, followed by a 1 minute OFF period.

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b) For an appliance with a discharge opening, the appliance is to be operated as follows:

1) The appliance is to be operated while slicing or shredding cabbage for 4 cycles, each cycle having a 3 minute shredding period followed by:

i) A 1 minute idling period with the motor on but without a load on the shredding mechanism. The cutting mechanism (cutter blade, cone, or similar devices) is not to be removed during the idling period; or

ii) A 1 minute OFF period for appliances with a momentary contact switch with no means for locking in the on position; and

2) The appliance is allowed to cool to room temperature and is then to be operated while slicing or shredding 5 lb (2.3 kg) of cheese or other food load resulting in the highest input during the input test, using the same cycling rate as specified for shredding cabbage. If another food load results in a longer operating time during the input test, the test shall be repeated with that food load.

36.16 Ice cream mixer freezers (bucket type)

36.16.1 The input to an ice cream mixer freezer is to be the average measured for 1 minute after evidence of formation of a sludge-type ice cream mixture (maximum of 40 minutes) when loaded as specified in 36.16.2.

36.16.2 For the temperature test, the appliance is to be loaded with an ice cream mix provided in the manufacturer's instructions. The ice cream container is to be filled to 2/3 of its maximum capacity unless the manufacturer's instructions indicate otherwise. The appliance is to be operated continuously (a minimum of 20 minutes) until a sludge-type ice cream mixture forms (maximum of 40 minutes).

36.16.3 An ice cream maker with an ice bucket is to be filled with a mixture of ice and rock salt according to the manufacturer's instructions.

36.16.4 For an ice cream maker intended for use with a freezer module in place of ice and rock salt, the freezer module is to be maintained at minus 10°C for the time recommended in the instruction manual or eight hours, whichever is longer, before being assembled to the appliance.

36.17 Mills and grinders, other than meat grinders

36.17.1 The input to a mill or grinder, other than a meat grinder, is to be measured while processing various food as specified in 36.17.2 in the intended manner for each type of grinding possible (fine, coarse, percolator, drip, and the like). For a mill, the input is to be the average measured while processing one batch as specified in 36.17.3. For a grinder, the input is to be measured at 15 seconds of operation.

36.17.2 With respect to the food loads to be processed, various food loads recommended in the instruction manual are to be considered to determine the load resulting in the highest inputs. Food loads are to be prepared prior to processing as recommended in the instruction manual, including cutting to a specified size, peeling, and chilling in the refrigerator or freezer. If no preparation instructions are provided, the foods are to be cut into pieces as needed to fit within the bowl or feed opening. For a multispeed appliance, if the instructions recommend processing of certain food loads at other than the highest speed, they are to be processed at the recommended speed. Unless the instructions indicate that a particular food load is not recommended, the following food loads are also to be included:

a) Coffee mill/grinder – Roasted coffee beans;

b) Grain mill/grinder – Hard wheat, white rice and corn;

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c) Spice mill/grinder – Cinnamon, cloves, allspice, turmeric and pepper.

36.17.3 For the temperature test, the appliance is to be loaded with coffee beans or the grain or spice load resulting in the highest input and operated at the grinding setting resulting in the highest input in the intended manner until a total of 1 lb (0.45 kg) has been processed or, for a spice mill or grinder, for 10 cycles, whichever comes first, as follows:

a) A grinder with a hopper rated capacity of 1 lb or more is to be operated continuously.

b) A grinder with a hopper rated capacity of less than 1 lb or with instructions recommending a maximum quantity of less than 1 lb for a specific food load is to be operated continuously grinding until the hopper is empty. A 1 minute OFF period is to be allowed while the hopper is refilled to the rated capacity or quantity recommended in the instruction manual.

c) A grinder which cannot be operated without a supplied ground catch container in place is to be operated until such a container is filled. A 1 minute OFF period is to be allowed while the container is emptied.

d) A mill is to be filled to the rated capacity or the quantity specified in the instructions for a specific food load, whichever is less, and operated continuously for 15s, or as specified in the instruction manual. A 1 minute OFF period is to be allowed while the processing chamber is emptied and refilled.

36.18 Knives

36.18.1 The input is to be measured while cutting approximately 3 inch (76 mm) diameter hard salami, approximately 3-1/2 inch (89 mm) square processed cheese, and approximately 5 inch (127 mm) diameter pumpernickel bread. Six different people are each to make three cuts on each food item. The readings recorded are to be the maximum current or wattage measured for any particular cut. The average input is to be calculated from all cuts made by all six people.

36.18.2 The average wattage obtained during the input test is to be used for the temperature test. The electric knife is to be operated under loaded conditions for 15 minutes, using a mechanical load placed on the blades to simulate cutting of food at the rate of 10 cuts per minute. Each simulated cut is to be made by gradually applying the mechanical load to the knife so that the input to the knife increases from the no-load value to the average value determined during the input measurement during the first second of the cut. This average value is to be maintained for 4 seconds, after which the load is to be withdrawn so that the input returns to the no-load value during the last second of the cut.

36.19 Food processors including food choppers

36.19.1 The input under load to a food processor is to be the average measured in the following manner:

a) Cutting/chopping blade (S-blade) – The appliance is to be operated with the cutting/chopping blade installed as described in the manufacturer's instruction manual while processing various foods as specified in 36.19.2 and filled to rated capacity or in the quantities recommended in the instruction manual, whichever is less, for one cycle of operation as specified in 36.19.4(b).

b) Slicing discs, shredding discs, and any combination discs – The disc is to be installed in the food processor as intended. The food processor is to be operated as described in the instruction manual, slicing or shredding various foods as specified in 36.19.2. The food is to be placed in the feed chute and pressure is to be applied on the food pusher as specified in 36.1.18. If the appliance is provided with more than one construction, the construction with a discharge opening is to be used for the test.

c) Dough blade – The appliance is to be operated as specified in 36.19.3.

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36.19.2 With respect to the food loads to be processed, various food loads recommended in the instruction manual are to be considered to determine the load resulting in the highest inputs. Food loads are to be prepared prior to processing as recommended in the instruction manual, including cutting to a specified size, peeling, and chilling in the refrigerator or freezer. If no preparation instructions are provided, the foods are to be cut into pieces as needed to fit within the bowl or feed opening. For a multispeed appliance, if the instructions recommend processing of certain food loads at other than the highest speed, they are to be processed at the recommended speed. Unless the instructions indicate that a particular food load is not recommended, the following food loads are also to be included:

a) Cutting/chopping blade (S-blade) – raw meat, parmesan (hard) cheese, baking chocolate;

b) Slicing discs – carrots, potatoes and hard meats such as pepperoni; and

c) Shredding discs - mozzarella and cheddar cheese, cabbage, potatoes and carrots.

36.19.3 If the appliance is provided with a dough mixing attachment or instructions for mixing dough, it is also to be operated with the dough blade or the blade recommended for mixing dough while filled to rated capacity with dry 50 – 80 core. The input is to be measured at 30 seconds. If a basic dough recipe is provided in the instructions, the average input is also to be measured for 10 seconds after dough formation while mixing the basic dough recipe per the instructions while filled to the rated capacity or in the maximum quantity recommended in the instructions, whichever is less. For a multispeed appliance, if the instructions recommend mixing dough at other than the highest speed, the appliance is to be set at the recommended speed.

36.19.4 For the cutting/chopping blade (S-blade), the temperature test is to be conducted with the cutting/chopping blade installed in the appliance as intended and the appliance operating for 10 cycles. Each cycle of operation is to consist of an on time of 15 seconds or the time specified in the manufacturer's instructions, whichever is greater, followed by a 1 minute OFF period. The food processor is to be filled with the food load resulting in the highest input during the input test, in the quantities recommended in the instruction manual.

36.19.5 For a food processor intended for mixing dough, the temperature test is also to be conducted with the dough blade installed in the appliance as intended. The appliance is to be operated for 4 cycles of operation. Each cycle of operation is to consist of 3 minutes on followed by a 1 minute OFF period. The bowl is to be filled with the sand load or the dough load as specified in 36.19.3, whichever results in the highest input, and is to be changed between cycles.

Exception: If the food processor is only operable via a momentary contact switch with no means for locking it in the on position, each cycle is to consist of a period of operation as specified for mixing dough per the user instructions or 1 minute, whichever is greater, followed by a 1 minute off period.

36.19.6 For the slicing disc, shredding disc, and any combination disc, the disc to be tested is to be installed in the food processor bowl as intended and the temperature test is to be performed in the following manner:

a) For an appliance without a discharge opening, the appliance is to be operated for 4 cycles of operation, slicing or shredding the food resulting in the highest input during the input test. During each cycle of operation the bowl is to be filled to its rated capacity with the food being processed, followed by a 1 minute OFF period.

b) For an appliance with a discharge opening, the appliance is to be operated as follows:

1) The appliance is to be operated while slicing or shredding cabbage for 4 cycles, each cycle having a 3 minute shredding period followed by a 1 minute idling period with the motor on but without a load on the shredding mechanism. The cutting mechanism (cutter blade, cone, or similar devices) is not to be removed during the idling period; and

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2) The appliance is allowed to cool to room temperature and is then to be operated while slicing or shredding 5 lb (2.3 kg) of cheese or other food load resulting in the highest input during the input test or a longer total operating time, using the same cycling rate as specified for shredding cabbage.

36.20 Battery-operated appliances

36.20.1 The input to the charger of a battery-operated appliance is to be measured while charging a completely discharged battery pack after 5 minutes of operation. The battery pack is to be discharged by operating the appliance continuously until the motor stops. For a cord/cordless appliance, the input is also to be measured with the appliance connected to the charger and operating as specified in 36.1.12 – 36.26 for the particular appliance type.

36.20.2 The temperature test is to be conducted as follows:

a) The battery charger is to be operated while charging a battery pack discharged completely as indicated in 36.20.1 until constant temperatures are attained. Temperatures are to be monitored during the entire charging operation so that temperatures in excess of the requirements would be recorded, if any.

Exception No. 1: This test is not required to be conducted on a separate battery charger evaluated to the Standard for Class 2 Power Units, UL 1310, and suitable for charging the battery or battery pack provided.

Exception No. 2: This test is not required to be conducted on a separate power supply evaluated to the Standard for Class 2 Power Units, UL 1310, if the output ratings are not exceeded after 5 minutes of operation as indicated in 36.20.1.

b) All battery-operated appliances are to be operated with a fully charged battery per 36.1.12 – 36.26 to determine that surface temperatures do not exceed the limits of Table 28.1 and enclosure temperatures do not exceed the limits indicated in 64.13.1.

c) For a cord/cordless appliance, the appliance is also to be connected to the charger and operated as specified in 36.1.12 – 36.26 for the particular appliance type.

36.21 Under-cabinet or wall-mounted appliances

36.21.1 An under-cabinet or wall-mounted appliance is to be mounted on a cabinet bottom and rear wall of a test corner, respectively. The sample is to be placed as closely to the test surfaces specified as construction will permit, or as specified in the instruction manual (see 78.1). For products not provided with instructions for mounting in specific locations, the rear and one side of the sample is to contact the vertical walls of the test corner that meet at right angles. In addition, an under-cabinet appliance is to contact a cabinet bottom, and a wall-mounted appliance is to contact a cabinet bottom or a counter top, whichever produces the highest temperature. The test corner is to consist of dull black-painted fir plywood not less than 3/8 inch (9.5 mm) thick, having such a width and height that the vertical walls extend not less than 2 ft (600 mm) beyond the physical limits of the appliance. The cabinet bottom is to be 12 inches (300 mm) deep, located 16 inches (400 mm) above the counter-top. The surface beneath the unit is to be a softwood surface covered with a double layer of white tissue.

36.22 Wand-type mixers

36.22.1 The input to a wand-type mixer is to be measured at 30 seconds of operation when loaded as specified in 36.22.2. If the appliance has a fluctuating load, the input is to be the average input from 25 to 35 seconds of operation.

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36.22.2 For the temperature test, the carrot/water mixture described in 36.3.5 is to be added into a flat bottomed cylindrical bowl having a diameter of 4 inches (101.6 mm). The amount of the mixture placed in the bowl is to be 3/4 of the height of the shaft portion of the wand-type mixer or to the maximum immersion level marking on the shaft, if marked. The mixture is to be changed and replaced with a fresh mixture after each cycle. The appliance is to be operated for five cycles consisting of an ON period of one minute if no reference is made in the instruction manual for mixing heavy batters, such as pancake or waffle batter, or three minutes if reference is made in the instruction manual for recommending heavy batters; and an OFF period of one minute. During the ON period the wand-type mixer is to be turned on to its highest speed.

36.23 Wand-type mixers with a milk shake attachment

36.23.1 For a wand-type mixer with a milk shake attachment, the input is first to be measured at the highest speed setting, using the maximum quantity and ingredients recommended in the manufacturer's instructions. The input is to be measured at 30 seconds of operation. If the appliance has a fluctuating load, the input is to be the average input from 25 to 35 seconds of operation. The test is to be repeated with the maximum capacity of water. The maximum capacity is to be determined by filling the container to the point of no spillage during operation, either with the cover removed or to the maximum fill line with the cover on, whichever is greater.

36.23.2 The temperature test is to be conducted blending the recipe or water load, whichever results in the highest input, for five cycles of operation at the high speed. Each cycle is to consist of a one minute ON period followed by a one minute OFF period. The load is to be changed after each ON cycle.

36.24 Pasta mixer-extruders

36.24.1 The input to a pasta mixer-extruder appliance is to be measured with the appliance mixing and extruding pasta in the intended manner with the basic noodle recipe as specified in 36.24.2. The input is to be measured at the end of the mixing operation when the pasta dough is ready for extrusion. The input is also to be measured using each extrusion die provided with the appliance after extruding at least 3 inches (76.2 mm) of pasta. If after extruding at least 3 inches (76.2 mm) of pasta the appliance has a fluctuating load, the input is to be the average input for 10 seconds of operation after extruding 3 inches (76.2 mm) of pasta.

36.24.2 The temperature test is to be conducted preparing two batches of pasta. The extrusion die resulting in the highest input during the input test and the extrusion die resulting in the longest operating time, if different, is to be used for the extrusion process. A 1 minute OFF period is to be allowed between batches to clean the appliance. The mixing time and amount of ingredients are to be based on the manufacturer's instructions for preparation of a basic noodle recipe.

36.25 Pasta extruding attachments

36.25.1 The input to a pasta extruding attachment is to be measured with the appliance extruding pasta in the intended manner with the basic noodle recipe as specified in 36.25.2. The input is to be noted using each extrusion die provided with the appliance after extruding at least 1 inch (25.4 mm) of pasta. If the appliance has a fluctuating load, the input is to be the average input for 10 seconds of operation after extruding 1 inch (25.4 mm) of pasta.

36.25.2 The temperature test on a pasta extruding attachment is to be conducted after two batches of pasta dough (basic noodle recipe as recommended in the instruction provided with the appliance) have been prepared with the basic appliance or dough preparing attachment. The temperatures obtained during the preparation of the dough are not to be evaluated. A one minute OFF period is to be allowed to permit the assembly of the extruder attachment to the basic appliance as intended. The unit is then to be operated in its heated condition extruding pasta in the intended manner using the extrusion die resulting in the highest input during the input test and the extrusion die resulting in the longest operating time, if

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different. The test is to be conducted extruding the two batches of pasta dough without any OFF period during the extrusion process.

36.26 Handheld pizza cutters

36.26.1 The input to a pizza cutter is to be measured with the appliance cutting a minimum of three cooked pizzas. Six people are to be selected for the cutting operation. Each person is to make three cuts on each pizza and the maximum input measured for each cut. The average input is to be calculated from all cuts made by all six people. Various pizza types (i. e. crust and toppings) are to be considered to determine the worst case load for the input test.

36.26.2 For the temperature test, a mechanical load, based on the average value calculated from the input test, may be utilized and placed on the blade to simulate cutting pizza. Eight simulated cuts are to be conducted at a rate of four cuts per minute. Each cut is to be made so that the input to the pizza cutter is at the average wattage determined during the input test. This value is maintained for eleven seconds, after which the load is to be withdrawn so that the input returns to the no-load value for four seconds. A total of fifteen seconds completes the cutting cycle. The unit is to be turned off when the eight cuts are completed. The entire method above is then to be repeated twice with an eight second OFF period between the repetitions.

37 Dielectric Voltage-Withstand Test

37.1 An appliance shall be capable of withstanding for 1 minute without an indication of unacceptable performance the application of a potential applied between live parts and accessible metal parts and between any points of the primary and secondary circuits. The appliance is to be at the maximum operating temperature reached in normal use. Except as noted in 37.5, the test potential shall be as indicated in Table 37.1.

Table 37.1
Dielectric Voltage-Withstand Test Potential

Rating of motor employed by appliance, horsepower	Potential, volts AC	Potential, volts DC
a) Appliance employing a motor rated at 1/2 horsepower or less	1000	1400
b) Appliance employing a motor rated at more than 1/2 horsepower	1000 + 2V[a]	1400 + 2.8V[a]
c) Electric Knife	2500	3500

[a] Maximum rated voltage.

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37.2 An appliance shall be capable of withstanding for 1 minute without an indication of unacceptable performance the application of a potential applied between the terminals of a capacitor used for electromagnetic interference (EMI) reduction or arc suppression. The test potential shall be as indicated in Table 37.1 (a) or (b), as applicable.

37.3 With respect to 37.1, an appliance having an enclosure construction partially or totally of insulating material is to have accessible surfaces of the insulating material closely wrapped in metal foil. The test potential is to be applied between live parts and the foil.

37.4 With respect to 37.1 and 37.3, a part is considered to be accessible if it can be contacted by the probe illustrated in Figure 7.1 when applied in all possible articulated positions, with and without the parts referenced in 7.12 in place.

37.5 When the appliance involves an isolating transformer or an autotransformer, the test potential for the secondary circuit is to be:

a) 1000 V AC or 1400 V DC when the secondary operates at 51 – 125 V; or

b) 500 V AC or 700 V DC when the secondary operates at 50 V or less, except that this test does not apply when the secondary circuit is supplied from a Class 2 transformer.

37.6 To determine whether an appliance complies with the requirement in 37.1 and 37.5, the test potential is to be applied as described in 37.8 by means of test equipment having the characteristics outlined in 37.7.

37.7 The test equipment for conducting the dielectric voltage-withstand test is to have the following features and characteristics:

a) A means for indicating the test voltage that is being applied to the appliance under test. This may be accomplished by sensing the voltage at the test leads or by an equivalent means.

b) An output voltage that has:

1) A DC output or,

2) An AC output with:

i) A sinusoidal waveform;

ii) A frequency that is within the range of 40 – 70 Hz; and

iii) A peak value of the waveform that is not less than 1.3 and not more than 1.5 times the root-mean-square value.

c) A sensitivity of the test equipment that is such that when a resistor of 120,000 ohms is connected across the output, the test equipment does not indicate unacceptable performance for any output voltage less than the specified test voltage, and the test equipment does indicate unacceptable performance for any output voltage equal to or greater than the specified test value.The resistance of the calibrating resistor is to be adjusted as close to 120,000 as instrumentation accuracy can provide, but never more than 120,000 ohms.

Exception No. 1: The sensitivity of the test equipment may be reduced, a lower value of calibrating resistance may be used, when testing an appliance intended to be permanently wired or parts as mentioned in 37.2.

Exception No. 2: The sensitivity of the test equipment may be increased, a higher value of calibrating resistance may be used, if agreeable to those concerned.

37.8 The method of applying the test voltage to the appliance is to be such that there are not any transient voltages that result in the instantaneous voltage applied to the appliance exceeding 105 percent of the peak value of the specified test voltage. The applied potential is to be increased from zero at a substantially uniform rate so as to arrive at the specified test potential in approximately five seconds, and then, is to be maintained at the test potential for 1 minute. Manual control of the rate of rise may be used.

37.9 The printed foil pattern of a printed wiring board provided with a conformal coating as mentioned in 17.12 (a), shall withstand the potential specified in 37.1 (a) applied between printed wiring traces of opposite polarity for 1 minute without breakdown. Clean dry samples with the conformal coating are to be tested. The samples shall have been subjected to the production-soldering process. The components may be omitted for this test.

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38 Leakage Current Following Humidity Tests

38.1 A cord-connected appliance shall comply with the Leakage Current Test, Section 32, following exposure for 48 hours to a moist air having a relative humidity of 88 ±2 percent at a room temperature of 32.0 ±2.0°C (89.6 ±3.6°F).

a) The appliance is to be at a temperature just above the test chamber temperature when it is placed in a humidity room.

b) The appliance is to remain in the humidity chamber for 48 hours.

c) Following this exposure, while still in the test chamber, the sample is to be tested unenergized as indicated in 32.6(a).

d) The sample is then to be tested energized as indicated in 32.6 (b) and (c), except that the test may be discontinued when the leakage current has stabilized or decreased. This test may be made in the test chamber or immediately after the sample has been removed from the test chamber.

39 Leakage Current and Dielectric Voltage-Withstand Test (Repeated)

39.1 After exposure as described in 39.2, an electric knife or wand-type mixer shall comply with the requirement in 32.1 in a repeat leakage current test, except that the test shall be discontinued when the leakage current stabilizes.

39.2 An electric knife or wand-type mixer is to be connected to a supply circuit as described in 31.3 and the blades or shaft are to be immersed in a salt water solution (1/2 gram of sodium chloride per liter of distilled water) and then tilted upward appropriately 105 degrees to allow the water to run down the blades or shaft toward the enclosure. Twenty-five such operations are to be conducted at the rate of 10 operations per minute. This test is to be repeated on a second sample with the knife or wand-type mixer not operating.

39.3 A knife sharpener (or a combination appliance having a knife-sharpening function, including an appliance provided with a mechanical sharpening block):

a) Shall comply with the leakage current requirements as stated in 32.1 after being conditioned as described in 39.4 and 39.5; and

b) Shall comply with the dielectric voltage withstand requirements in 37.1 after being conditioned as described in 39.4 and 39.5.

39.4 The appliance is to be connected to a supply circuit as described in 31.3 and energized for 5 minutes. Five grams of 100 mesh electrolytic iron powder are to be dispersed onto the sharpener wheel in the area normally contacted by the knife. The filings are to be introduced onto the surface of the wheel by a 1/4 inch (6.4 mm) inside diameter tube.

39.5 After being energized for 5 minutes, the appliance is to be tilted to its balance point and then allowed to free fall to the supporting surface. After return to its normal at rest position, the free fall is to be repeated in three other directions, each displaced 90 degrees horizontally from the previous position.

40 Flooding of Live Parts Tests

40.1 Overflow test

40.1.1 To determine if an appliance that is provided with a container into which liquid is intended to be added by the user complies with 20.1(a) with respect to overflow, the appliance is to be positioned as

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intended for normal use, cover on but fill-hole or fill-holes open. The liquid container of the appliance is to be filled to the maximum capacity with a salt-water solution (1/2 gram of NaCl per liter of distilled water) and a further quantity equal to 15 percent of the maximum capacity of the container is poured in steadily over a period of 1 minute. When the appliance is so designed that a liquid container is situated over the motor, the spillage test is made with the appliance switched off or in operation, whichever imposes the more severe condition. When the liquid container is not situated over the motor, the appliance is operated three times in the following manner: The liquid container is filled to the maximum capacity with the test solution, and the appliance is then to be operated at the maximum speed setting until there is no more splashing. In between operations, the appliance is to be turned off and the liquid container re-filled with the test solution. During this conditioning, the appliance shall comply with the Leakage Current Test, Section 32. After this conditioning, the appliance shall comply with the Dielectric Voltage-Withstand Test, Section 37. See also 31.3.

40.2 Ingress test

40.2.1 To determine if a counter-top appliance complies with 20.1 (b) with respect to the drawing of liquids into the enclosure, the appliance is to be placed in a smooth bottomed shallow pan having at least twice the length and width of the bottom of the appliance being tested. Feet removable without use of tools shall be removed unless it is determined their removal will not affect the results. The pan is to be filled to a depth of 1/16 inch (1.6 mm) with a salt-water solution (1/2 gram of NaCl per liter of distilled water), and the appliance operated at maximum speed for 1 minute. During this conditioning, the appliance shall comply with the Leakage Current Test, Section 32. Following this conditioning, the appliance shall comply with the Dielectric Voltage-Withstand Test, Section 37.See also 31.3.

Exception: A counter-top machine employing bottom vents and legs which space the vents more than 2 inches (50.8 mm) above the counter top is not required to be tested.

40.2.2 To determine if a vacuum blender complies with 20.3, the blender container is to be filled to maximum capacity with the salt water solution of 40.2.1. The blender cover is to be secured in place, the blender connected to a supply circuit as specified in 31.3 and the vacuum pump operated for one cycle or until water is no longer picked up. If the vacuum pump can operate at the same time as the blender, the test is to be repeated with the blender and the pump operating simultaneously. During the test, the appliance shall comply with the Leakage Current Test, Section 32. Following the test, the appliance shall comply with the Dielectric Voltage-Withstand Test, Section 37.

41 Test for Deterioration of Parts Subject to Flexing

41.1 The deterioration of a part made of rubber, plastic, or a similar material, which is subject to flexing shall not result in a risk of electric shock when subjected to the test described in 41.2. A gasket, which is removable without the use of tools or is recommended to be removed for cleaning, is considered a part subject to flexing.

Exception: Infrequent motion of small amplitude, such as that encountered during normal operation of a diaphragm covering a pressure-operated switch, is not determined to constitute flexing as far as these requirements are concerned.

41.2 To determine whether an appliance complies with 41.1, the part subject to flexing is to be completely removed to simulate its deterioration. The appliance is to be subjected to the following tests as applicable to determine compliance with 41.1:

a) One complete cycle of operation;

b) Flooding Test described in 40.1 or 40.2;

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c) Leakage Current and Dielectric Withstand (Repeated) Test per 39.1 for an electric knife or wand-type mixer; and

d) Moisture Resistance Test described in 47.1 for an outdoor use appliance.

41.3 The appliance is to be tested after operation per 41.2(a) as follows:

a) A cord-connected appliance shall comply with the Leakage Current Test, Section 32, and the Dielectric Voltage-Withstand Test, Section 37.

b) A permanently-connected appliance shall comply with the Insulation Resistance Test, Section 43, and the Dielectric Voltage-Withstand Test, Section 37.

41.4 If during the Flooding Test of 40.1, the liquid container cannot be overfilled due to leakage when the gasket or seal is removed, the test is conducted by using 115 percent of the maximum capacity of the container. The test is discontinued when the liquid container has emptied or the leakage has stopped.

42 Test for Reliability of Parts Not Subject to Flexing

42.1 After the conditioning described in 42.2, a polymeric or elastomeric material used for a gasket, diaphragm, seal, or similar part, or a rubber part subject to hot soapy water during cleaning shall have a tensile strength of not less than 75 percent and elongation of not less than 60 percent of the values determined before conditioning. At the conclusion of the tests, there shall not be visible deterioration, deformation, melting, or cracking of the material and the material shall not harden as determined by normal hand flexing.

Exception No. 1: A material that has been investigated in accordance with 42.4 need not be subjected to the requirements in 42.1 – 42.3.

Exception No. 2: A noncomposite material that has been found to comply with the requirements in the Standard for Gaskets and Seals, UL 157, and that complies with the minimum intended elongation and tensile strength after aging, is determined to be in compliance with these requirements.

Exception No. 3: A material or construction that has been investigated in accordance with 41.1 need not be subjected to the requirements in 42.1 – 42.3.

42.2 A total of 20 pieces of each representative material is required for this test. Five pieces are to be tested for elongation in the as-received condition and 5 pieces are to be tested for tensile strength in the as-received condition. The 10 remaining pieces are to placed in a circulating-air oven at a temperature of 69 – 70°C (156 – 158°F) for 168 hours. Five of the conditioned pieces are to be tested for elongation and the other 5 pieces are to be tested for tensile strength. The test methods and apparatus are described in the Standard for Test Methods for Rubber Properties in Tension, ASTM D412.

42.3 A gasket of material other than mentioned in 42.1, such as bonded cork or impregnated fiber, that is not known to be reliable, shall be investigated for equivalent resistance to aging and temperature. Absorptive materials, such as cork or fiber shall not be used where they contact a live part.

42.4 To determine compliance with Exception No. 1 to 42.1, one sample of a gasket, a diaphragm, or a seal of an appliance is to be oven conditioned as specified in 42.2. After the oven conditioning, instead of the tensile and elongation testing, the gasket, diaphragm, or seal is then to be installed in the associated appliance and subjected to the following tests to determine the suitability of the gasket, diaphragm or seal. As an alternate test method, one entire representative appliance is to be subjected to the oven conditioning described in 42.2. When an entire appliance is subjected to the oven conditioning described in 42.2, the diaphragm or seal temperature shall be monitored and maintained at the oven temperature

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value indicated in 42.2. The entire appliance is then to be subjected to the following tests as applicable to determine the suitability of the gasket, diaphragm or seal:

a) One complete cycle of operation;

b) Flooding of Live Parts Tests described in 40.1 or 40.2;

c) Leakage Current and Dielectric Withstand (Repeated) Test per 39.1 for an electric knife or wand-type mixer; and

d) Moisture Resistance Test described in 47.1 for an outdoor use appliance.

42.5 The appliance is to be tested after operation per 42.4(a) as follows:

a) A cord-connected appliance shall comply with the Leakage Current Test, Section 32, and the Dielectric Voltage-Withstand Test, Section 37.

b) A permanently-connected appliance shall comply with the Insulation Resistance Test, Section 43, and the Dielectric Voltage-Withstand Test, Section 37.

43 Insulation Resistance Test

43.1 Following the Test for Deterioration of Parts Subject to Flexing, Section 41, a permanently-connected appliance shall have an insulation resistance of at least 50,000 ohms between current-carrying parts and noncurrent-carrying parts.

43.2 Insulation resistance is to be measured by applying a direct-current potential of 250 volts between live parts and the enclosure and other accessible dead metal parts, using two voltmeters – one voltmeter being connected across the supply line and the other connected in series with one of the leads to the appliance being tested. Designating the reading of the line voltage as V_1, the reading of the other voltmeter as V_2, and the resistance of V_2 as R, the insulation resistance is to be calculated by the formula:

$$\text{Insulation resistance} = \frac{(V_1 - V_2)R}{V_2}$$

44 Blender Cover Opening Splash Test

44.1 To determine compliance with 30.4.3.2 for a blender provided with an opening in the cover intended for pouring, the blender is to be tested in accordance with 44.2 and 44.3 in order to determine the ability of the blender cover to keep the contents of the blender container from splashing out.

44.2 The container of a representative blender is to be filled as indicated in 44.4 with water at a temperature of 93.3 ±5.5° C (200 ±10° F). The exterior of the blender is to be wiped dry. The blender container is to be mounted on the blender and the blender is to be placed on a horizontal work surface that is dry. The cover opening intended for pouring is then to be opened and the blender operated for 3 cycles of operation consisting of 15 seconds at the highest speed setting available.

Exception: If the cover opening is provided with a vented lid as specified in 30.4.3.3, the lid shall remain in place during the test.

44.3 No water shall be observed splashing out of the cover opening. The work surface and blender exterior shall remain dry.

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44.4 The blender container shall be filled to the maximum fill line. If the blender container is not provided with a maximum fill line, the container shall be filled to the maximum level recommended in the instructions. If a separate fill line is clearly marked on the blender container for the blending of hot liquids, the container shall be filled to this level or the maximum recommended level for blending hot liquids in the instructions, whichever is greater.

45 Blender Vented Lid Test

45.1 With respect to 30.4.3.3, the blender container shall remain intact and the cover and vented lid shall remain in place when operated as described in 45.2.

45.2 The container of a representative blender shall be filled to the maximum fill line or maximum recommended level with hot water at a temperature of 93.3 ±5.5°C (200 ±10°F). The blender container shall be mounted on the blender and the blender cover and the vented cap or lid shall be positioned in place as intended for normal operation. The blender shall be operated for 3 minutes at the highest speed setting available.

46 Blender Blade Endurance Test

46.1 *Deleted*

46.2 *Deleted*

46.3 *Deleted*

46.4 *Deleted*

46.5 *Deleted*

46.6 General

46.6.1 Blender blades shall be subjected to the test of 46.7 or 46.8.

46.6.2 As a result of the testing, the blade assembly shall not break, separate into pieces, crack, become loose or show any signs of deterioration, as seen without magnification.

46.6.3 Where the blades are intended for use with multiple containers and blender motor bases, each unique blender blade and container construction combination shall be tested. Each combination shall be tested with the blender motor base that results in the highest measured input during the Input Test, Section 35.

46.7 500 Cycle endurance test

46.7.1 Three samples of each representative blender container and blade assembly shall be subjected to 500 cycles of ice crushing operation. Each cycle of ice crushing shall consist of 5 pulses of 0.4 ±0.1 seconds ON, at the highest speed setting, followed by 3 seconds OFF. For each cycle, the blender container shall be loaded with ice and tap water to the levels determined in 46.7.2. At the end of each cycle, the crushed ice and water mixture shall be emptied. If the blender has controls that gradually increase the speed to maximum power, the speed at maximum power, each pulse shall be ON for the time to reach maximum speed at maximum power, or 0.4 ±0.1 seconds, whichever is greater. If the manufacturer prefers, an electronic speed control may be bypassed to verify that the control is not relied upon to pass the test.

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46.7.2 To determine the volume of ice and water to be used, the container shall be loaded with a ratio of 2:1 by volume [e.g. 2 cups (473.2 ml) of ice and 1 cup (236.6 ml) of water]. A cup of ice (236.6 ml) by volume should weigh approximately 5.25 oz (150 g). The ice should fill the container to approximately 1/3 of its rated capacity. The ice may include both broken pieces and whole pieces, but must contain some pieces with the major dimension greater than or equal to 1 inch (25.4 mm) and a minor dimension greater than or equal to 0.5 inch (12 mm). The container assembly shall then be subjected to 1 cycle of 5 pulses. At the end of the cycle, the mixture must contain some pieces with the major dimension greater than 0.25 inch (6.3 mm). If the ice is not impacted for all 5 pulses, cavitation occurs, or the mixture does not contain pieces with a major dimension greater than 0.25 inch (6.3 mm) at the end of the cycle, then the size of the ice, volume of the ice, and/or volume of the water shall be adjusted until the resulting mixture is acceptable.

46.7.3 The container may be marked with the level of ice and water to be added based on the measured volume of ice and water determined in 46.7.2 to facilitate loading the container for each cycle. For the first 10 cycles of the test, and every 50 cycles of the test, the resulting ice crushed shall be checked to ensure that the mixture contains some pieces with the major dimension greater than 0.25 inch (6.3 mm). If at any point during the test the ice is not impacted for all 5 pulses, or if the brand of ice or method of making ice changes, the volume of ice and water shall be re-adjusted, and the resulting ice mixture checked for 10 cycles.

46.7.4 The ice shall be maintained at a temperature of -10°C (14°F) or less for at least 8 hours prior to the test. The ice, when moved from storage, shall be used within 5 minutes. The water should be initially 20°C ±10°C (68°F ±18°F).

46.8 Salt spray and 5 cycle endurance test

46.8.1 Three samples of the blade assembly shall be subjected to the salt spray conditioning in 46.8.2. Following the conditioning, the blade shall be assembled to the container and subjected to 5 operations with the blender container filled to 1/3 of its rated capacity with dried chickpeas. Each cycle consists of 30 seconds of operation and the container shall be emptied and refilled after each cycle.

46.8.2 Three samples of the blade assembly shall be subjected Salt Spray Resistance Testing as specified in the Standard Practice for Operating Salt Spray (Fog) Apparatus, ASTM B 117. The samples shall be exposed to the Salt Fog for 24 Hours. If the blade assembly cannot be removed from and reattached to the blender container without damaging the blades, the blade/container assembly may be subjected to the conditioning with the container positioned to prevent pooling of liquid in the container during conditioning.

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47 Resistance to Moisture Test

47.1 In a test to determine that an appliance intended for outdoor use complies with the requirement in 7.8, the appliance is to be subjected to a water spray test as described in 47.2. There shall be no obvious wetting of any electrical component, as evidenced by droplets of water on the component, and no water shall enter a compartment that houses field-installed wiring as a result of the water-spray test. After the test:

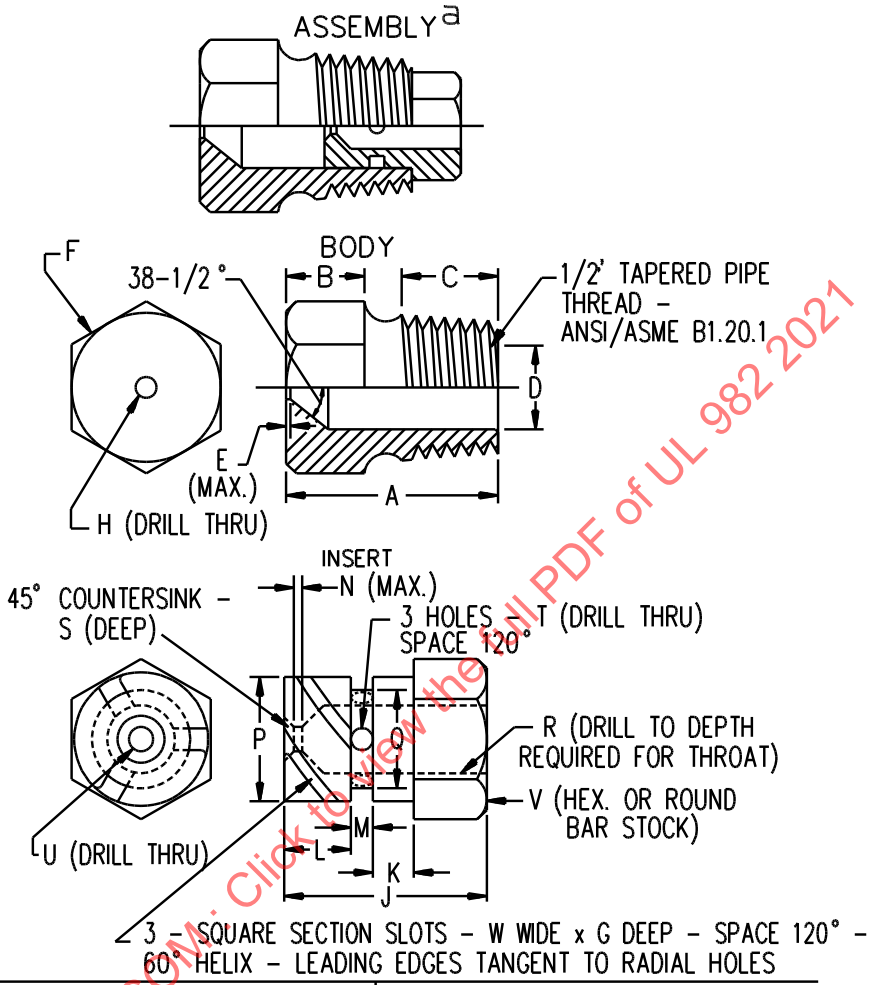
a) The appliance shall comply with the requirements in 32.1 in a repeated leakage-current test, except that the test shall be discontinued when the leakage current stabilizes; and

b) The appliance shall comply with the requirement in 37.1 in a repeated dielectric voltage-withstand test.

47.2 Compliance with the requirement in 47.1 is to be determined by mounting the appliance under the apparatus described in 47.3 and illustrated in Figure 47.1 and Figure 47.2.

Figure 47.1

Water-Spray-Test Spray Head



Item	inch	mm	Item	inch	mm
A	1-7/32	31.0	N	1/32	0.80
B	7/16	11.0	P	.575	14.61
C	9/16	14.0		.576	14.63
D	.578	14.68	Q	.453	11.51
	.580	14.73		.454	11.53
E	1/64	0.40	R	1/4	6.35
F	c	c	S	1/32	0.80
G	.06	1.52	T	(No. 35)[b]	2.80
H	(No.9)[b]	5.0	U	(No. 40)[b]	2.50
J	23/32	18.3	V	5/8	16.0
K	5/32	3.97	W	0.06	1.52
L	1/4	6.35			
M	3/32	2.38			

[a] Nylon Rain-Test Spray Heads are available from Underwriters Laboratories

[b] ANSI B94.11M Drill Size

[c] Optional - To serve as a wrench grip.

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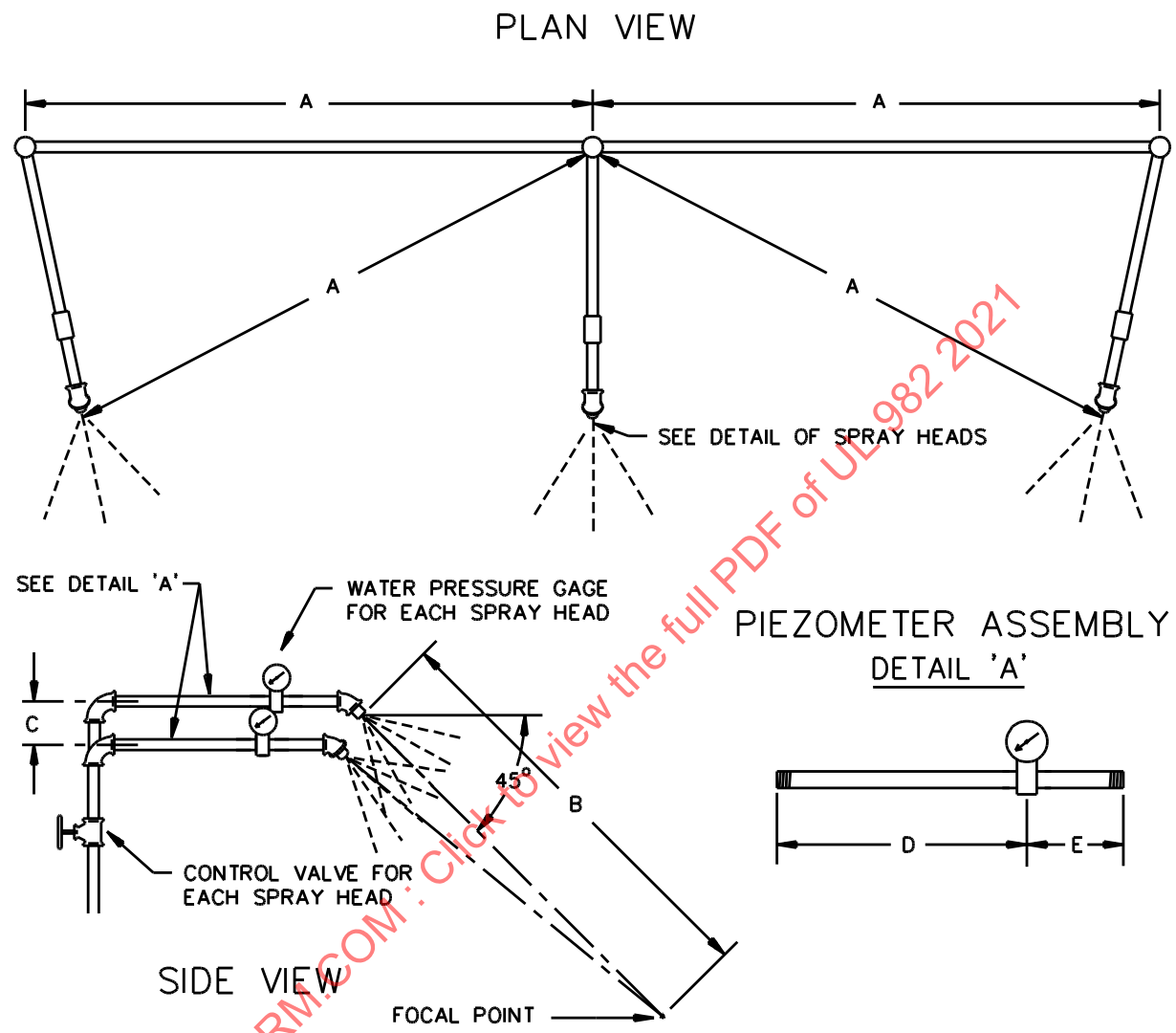
Figure 47.2

Water-Spray-Head Piping



Item	inch	mm
A	28	710
B	55	1400
C	2–1/4	55
D	9	230
E	3	75

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47.3 The water-spray test apparatus is to consist of three spray heads constructed in accordance with the details shown in Figure 47.1 and mounted in a water-supply pipe rack as shown in Figure 47.2. The water pressure is to be maintained at each spray head at approximately 5 lbf/in^2 (35 kN/m^2). The distance between the center nozzle and the appliance is to be brought into a focal area of the three spray heads in such a position and under such conditions that water is most likely to enter, except that consideration is to be given to the normal mounting position.

48 Continuous Operation Test

48.1 A product, that is only actuated by a momentary contact switch and employs a shaded-pole motor shall not produce a fire or electric shock when tested in accordance with 48.2. Included is any appliance that employs a momentary contact switch that initiates an automatic cycle or a momentary contact switch that can be locked in the ON position by a mechanical feature.

Exception No. 1: This requirement does not apply to a product that is hand supported.

Exception No. 2: This requirement does not apply to a product that employs a momentary contact switch that is not subject to a continual mechanical load when not in use.

48.2 The appliance is to be:

a) Connected to a supply circuit as described in 31.3 in series with a 20 A time-delay plug fuse;

b) Placed on a white tissue paper covered softwood surface;

c) Draped with a double layer of cheesecloth over the whole appliance with the cloth within 1/8 inch (3.2 mm) of the openings (if any) in the enclosure; and

d) Grounded by means of a 3 A non-time-delay plug fuse connected between exposed metal parts and earth ground.

The appliance is to be allowed to operate continuously at no load for 7 hours or until burnout occurs. For products employing an automatic reset motor protector in accordance with 6.10.10(b), operation shall be continued for 7 hours while the protector is allowed to cycle or until ultimate results have been determined. For a product employing a manually reset motor protector, the test shall be continued for four operations of the protective device (three resets, four trips). The results are considered to be acceptable if neither the cheesecloth nor the tissue paper is ignited, and if the 3 A grounding fuse is not open.

49 Abnormal Operation Test

49.1 Metal enclosure abnormal locked rotor test

49.1.1 For a portable appliance having a completely polymeric enclosure, the test of 49.1 is not applicable and the appliance is subjected to the requirements for Enclosures of Polymeric Material for Portable Appliances, Section 64.

49.1.2 An appliance having a polymeric enclosure that is part metallic (having some accessible dead metal) is to comply with:

a) Enclosures of Polymeric Material for Portable Appliances, Section 64, for the part of the enclosure that is polymeric; and

b) 49.1.3 for that part of the enclosure having accessible dead metal.

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49.1.3 An appliance having an enclosure that is of metal (accessible dead metal) after being tested in accordance with 49.1.4 shall:

a) Comply with the Dielectric Voltage-Withstand Test, Section 37, with the potential applied between live parts and accessible metal parts;

b) Not result in opening of the 3 A fuse;

c) Not result in access to live parts; and

d) Not result in ignition of the mounting surface or the cheesecloth as a result of emission of glowing or flaming materials.

49.1.4 The appliance is to be:

a) Connected to a supply circuit as described in 31.3 (in series with a 30 A time-delay plug fuse);

b) Placed on a white tissue paper covered soft wood surface;

c) Draped with a single layer of cheesecloth shaped so that it touches the surface completely around the appliance and draped loosely over the appliance; and

d) Grounded by means of a 3 A non-time-delay plug fuse connected between accessible metal parts and earth ground.

The appliance is to be operated continuously under a stalled condition (locked-rotor) as indicated in 49.1.6 and Table 49.1 for the specified time interval unless the appliance includes other controls (such as a timer) that will positively and reliably limit the duration of the operation to a shorter interval. For products employing an automatic reset motor protector in accordance with 6.10.10(c), operation shall be continued for the time specified while the protector is allowed to cycle or until ultimate results have been determined. For a product employing a manually reset motor protector, the test shall be continued for the time specified while resetting the protector as quickly as possible or four operations of the protective device (three resets, four trips), whichever occurs first. The locked rotor test is to be conducted at different speed settings if the appliance has a multiple speed setting. Opening of the 30 A fuse is not cause for unacceptable results.

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Table 49.1
Abnormal Operation Test Locked Rotor Operation

Examples of appliances	
30 second locked rotor test	**5 minute locked rotor test**
Coffee or Grain Mill	Coffee or Grain Grinder
Hand Mixer	Stand Mixer
Can Opener, Manual	Build-in Mixer
Centrifugal Juicer	Blenders
Knife	Can Opener (other than manual)
Reamer, Juicer	Drink Mixer
Meat Grinder	Food Processor
Slicer	
Knife Sharpener	
Vegetable Shredder/Slicer	
Ice Crusher	

49.1.5 With respect to 49.1.3 and 49.1.4, a metal part is considered to be accessible if it can be contacted by the probe illustrated in Figure 7.1 when applied in all possible articulated positions, with or without the parts referenced in 7.12 in place.

49.1.6 Appliances that are hand held or hand supported, those which have to be kept switched on by hand or those which are continuously loaded by hand shall be tested for 30 seconds locked rotor operation. Appliances that are intended to be used unattended and do not have motors intended to be remotely or automatically controlled shall be tested for 5 minutes locked rotor operation.

49.2 Self-holding protector abnormal locked rotor test

49.2.1 With regard to 6.10.10(f), each of three representative appliances shall be energized and have their rotors stalled until the overload-protective device opens. While still energized, the representative appliances shall then be allowed to cool down to room temperature. The representative appliance shall not automatically restart or have the possibility of accidentally being restarted. A distinct and deliberate motion shall be required to restart the representative appliance.

49.3 Overvoltage of appliances Intended to be supplied by Universal Serial Bus (USB)

49.3.1 Appliances intended to be supplied by a Universal Serial Bus (USB), shall be placed on a white tissue paper covered soft wood surface, draped loosely with a single layer of cheesecloth and subjected to the following conditions:

a) Apply sinusoidal input AC voltage to the USB connection from 5 – 30V in 5V increments starting at the rated voltage; and

b) Apply DC voltage with less than 10% ripple to the USB connection from 10 – 60V in 10V increments starting at the rated voltage.

49.3.2 For appliances operated via the USB connection, each increment shall be maintained for 5 minutes unless the appliance achieves ultimate results. For appliances charged via the USB connection, each increment shall be started with a fully discharged battery and shall be continued for 7 hours or until twice the normal charging period has elapsed, whichever is greater, unless the appliance achieves ultimate results or returns to room temperature.

49.3.3 The test shall not result in:

a) Exposure of moving parts capable of causing injury,

b) Explosion or ignition of the cells,

c) Ignition of the tissue paper, supporting surface, or cheesecloth, and

d) For USB charging of lithium ion cells, the upper limit charging voltage of each cell shall not be exceeded by more than 150 mV unless the cell is permanently prevented from being recharged.

50 Capacitor Failure Test

50.1 In accordance with 6.4.5, an electrolytic capacitor without venting means shall be subjected to the test of 50.2 without ignition of cotton placed around the capacitor enclosure.

50.2 Three samples of the capacitor shall be mounted in the orientation representing normal operation of the appliance and cotton shall be placed around the capacitor enclosure. The capacitor shall be initially supplied at normal operating voltage and this voltage shall be gradually increased to cause failure of the capacitor.

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51 Power Supplies and Battery Chargers Test

51.1 A power supply or battery-charging circuit for an appliance shall not produce a potential fire or electric shock condition should the battery or rectifier malfunction.

51.2 The appliance of 51.1 is to be tested on a 120 V, 60 Hz supply circuit in series with a 20 A, time-delay plug fuse. The appliance is to be placed on a white tissue paper covered softwood surface.

51.3 The appliance of 51.1 is to have its transformer secondary windings short-circuited. A 3 A non-time-delay plug fuse is to be connected between the dead metal of the transformer core and earth ground. Operation is to be continued until temperatures stabilize or burnout occurs. Results are considered to be acceptable if:

a) Grounding and line fuses are not opened;

b) The results of a repeated dielectric voltage-withstand test as described in 37.1 are acceptable; and

c) There is no ignition of the tissue paper.

The test is to be conducted three times using new components when necessary only if burnout occurs.

Exception: A separate battery charger or power unit complying with the Standard for Class 2 Power Units, UL 1310, is considered to comply with this requirement.

51.4 The appliance of 51.1 is to have its battery connections short-circuited at the battery. A 3 A non-time-delay fuse is to be connected between the dead metal of the transformer core and earth ground. Operation is to be continued until temperatures stabilize or burnout occurs. Results are considered to be acceptable if:

a) Either the grounding fuse/or line fuses are not opened;

b) The results of a repeated dielectric voltage-withstand test as described in 37.1 are acceptable; and

c) There is no ignition of the tissue paper.

The test is to be conducted three times using new components when necessary only if burnout occurs.

52 Direct Plug-In Appliance Testing

52.1 Weights and moments test

52.1.1 The maximum acceptable moment, center of gravity, dimensions, and weight of a direct plug-in rechargeable appliance shall comply with the following requirements when subjected to the Weights and Moments Test:

a) The quotient of WY/Z shall not exceed 48 ounces (1361 g);

b) The quotient of WY/S shall not exceed 48 ounces (1361 g);

c) The product of WX shall not exceed 80 ounce-inches (0.56 N·m); and

d) The weight of a direct plug-in rechargeable appliance shall not exceed 28 ounces (794 g).

Where the definitions for the symbols are as follows:

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W is the weight of the direct plug-in rechargeable appliance in ounces (g).

Y is the distance illustrated in Figure 52.1 in inches (mm).

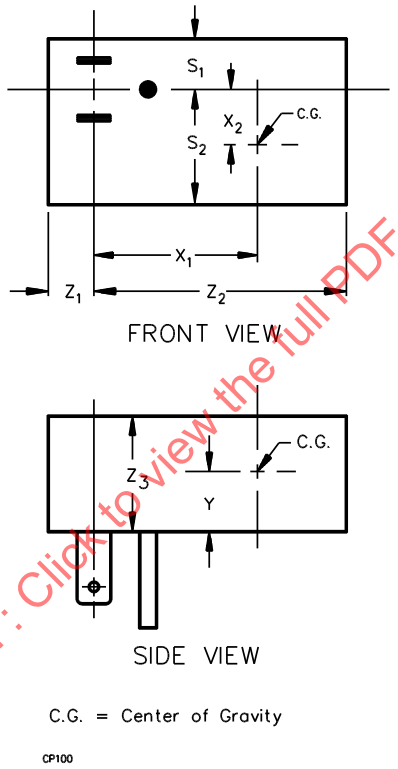
Z is the lesser of the two distances, Z_1 or Z_2, as illustrated in Figure 52.1 in inches (mm).

S is the lesser of the two distances, S_1 or S_2, as illustrated in Figure 52.1 in inches (mm).

X is the greater of the two distances, X_1 or X_2, as illustrated in Figure 52.1 in inches (mm).

Figure 52.1

Dimensions of a Direct Plug-In Rechargeable Appliance



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52.1.2 The moment and weight specified in 52.1.1 are to be determined as follows:

a) For direct plug-in rechargeable appliances with an output cord, the cord is to be cut off at the enclosure, or at the strain-relief means if the strain-relief means is outside the enclosure.

b) For direct plug-in rechargeable appliances with directly mounted accessories, the values are to be measured with the accessories in place.

c) An integral tab is not to be included in measurements of the linear dimensions for the purpose of determining moments.

52.2 Blade security pull test

52.2.1 Each blade and the grounding pin, if provided, shall withstand a direct pull of 20 pounds-force (89 N) for 2 minutes without loosening. The two blades tested together shall also withstand a direct pull of 20 pounds for 2 minutes without loosening.

52.2.2 To determine whether a direct plug-in rechargeable appliance complies with the requirement in 52.2.1, it shall be supported on a horizontal steel plate with the blades projecting downward through a hole having a diameter sufficient only to permit the blades to pass through it. A 20-pound (9.1-kg) weight shall be supported by each blade and the grounding pin, if provided, in succession and then by the two blades tested together. The displacement of either blade shall not exceed 3/32 inch (2.4 mm) measured 2 minutes after removal of the weight.

52.3 Blade security push test

52.3.1 The plug-in blades and the grounding pin shall not loosen to a degree that introduces a risk of fire or electric shock as a result of the tests described in 52.3.2 and 52.3.3.

52.3.2 A direct plug-in rechargeable appliance is to be rigidly supported in the blades-up position. Each blade, in turn, is to be individually subjected to a force of 30 pounds-force (133 N) applied gradually along the longitudinal axis of the blade in a direction towards the face of the direct plug-in rechargeable appliance. The 30 pounds-force is to be maintained for 1 minute.

52.3.3 The sample used in 52.3.2 is to be retested by being positioned as described in 52.3.2 and subjecting both blades and the grounding pin, if provided, in combination, to a single applied force of 40 pounds-force (178 N) for 1 minute.

52.4 Blade flexing test

52.4.1 In addition to the requirements of 52.2 and 52.3, direct plug-in rechargeable appliances employing folding or retractable blades for the input contacts shall be subjected to the testing indicated in 52.4.2 – 52.4.4.

52.4.2 The folding or retractable blades of the unit shall withstand 6000 cycles of rotating the blades from the plug-in position to the fully recessed position. For the purpose of this test, the blade is considered to be in the plug-in position when the actuator is extended, and the blades are in the "out" position and locked in place, as in normal use. The fully retracted position is considered to be when the actuator is retracted and the blades are returned to the "in" position.

52.4.3 At the conclusion of the cycling test of 52.4.2:

a) The direct plug-in rechargeable appliance shall be operational;

b) The direct plug-in rechargeable appliance shall not have any accessible live parts which pose a risk of electric shock, as specified in Section 7, Frame and Enclosure;

c) There shall not be a loss of structural integrity to a degree that the direct plug-in rechargeable appliance is able to be inserted only partially or the direct plug-in rechargeable appliance cannot be removed from a receptacle immediately after the test without deformation or risk of electric shock;

d) The direct plug-in rechargeable appliance is to comply with the Blade Security Pull Test of 52.2 and the Blade Security Push Test of 52.3; and

e) The blade connections internal to the direct plug-in rechargeable appliance shall not develop a high impedance, as determined by the test of 52.4.4.

52.4.4 In order to determine compliance with the requirement specified in 52.4.3(e), the direct plug-in rechargeable appliance is to be subjected to a temperature test in accordance with Section 36, Normal Temperature Test. The temperature test is to be performed both before and after the cycling described in 52.4.2. Particular attention is to be paid to the temperatures between the blades and the point of contact

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for the blades to determine if the electrical or mechanical integrity of the direct plug-in rechargeable appliance has been altered during the course of the cycling.

53 Electronic Control Circuits Test

53.1 A solid-state device (such as a rectifier or a transistor), a resistor, and a capacitor shall be subjected to the tests described in 53.2 – 53.4.

53.2 If an appliance employs one or more solid-state devices, a resistor or a similar component, no risk of fire, electric shock or risk of injury to persons shall develop when the circuit between any two terminals of any such component is opened or shorted; except that wire wound resistors are not to be shorted. If the appliance employs a capacitor in combination with one of the above-mentioned components, no risk of fire, electric shock or risk of injury to persons shall develop when the capacitor is short-circuited. Only one of the simulated fault conditions described above is to be imposed at one time. Accessible dead-metal parts of the appliance are to be connected through a 3 A fuse and the results are unacceptable if the fuse opens during the test. The test is to be conducted three times using new components when necessary only if burnout occurs.

53.3 Short-circuit tests for determining whether or not an appliance complies with the requirements in 53.2 are to take into account the normal usage of the appliance. For example, if the appliance is provided with a momentary-contact switch having no provision for being locked in the ON position, and if there is indication of malfunction (abnormal operation of the appliance, emission of smoke, failure of the appliance to operate in the normal manner, or other indication), the test is to be discontinued when the malfunction becomes evident. Otherwise the test is to be continued until ultimate results occur which usually requires 7 to 8 hours.

53.4 If an appliance is provided with means for controlling the speed, the test is to be conducted at both the maximum and minimum-speed settings of the control and can be conducted at interim speed settings.

54 Cut Strainer/Enclosure Stress Withstand Test

54.1 The following procedures are to be performed for a centrifugal juice extractor that uses a cutter strainer basket with a polymeric rim.

54.2 One group of three representative centrifugal juice extractor appliances is to be in as-received condition. Three equally spaced notches are to be cut into the plastic rim (or top ring) of the cutter strainer basket from each juice extractor to a depth not exceeding 0.12 inches (3.05 mm). The strainer basket is to be installed in the juice extractor as appropriate for normal operation. A juicer provided with a pulp discharge opening and a separate pulp container shall be operated with the pulp container in place. The appliance is then to be placed inside a protective enclosure, and is to be operated at its rated voltage for 30 seconds with the speed controls set at the highest speed.

54.3 If the strainer basket retains its structure after this operation, the depth of the notches is to be increased in 0.03 inch (0.76 mm) increments and operated in accordance with 54.2 until the strainer basket disintegrates. As required, the mesh is also to be deliberately damaged in order to induce the disintegration of the strainer basket.

54.4 Each of three additional representative strainer baskets and three juice extractor covers are to be immersed in a solution of Detergent Type B (as specified in IEC 60436), at a concentration of 3 grams/liter and a temperature of 65 ±1° C (140 ±1.8° F) for 48 hours; see 55.2 for composition of solution. The immersed strainer baskets and covers are then to be removed from the solution, rinsed with water, and stored at room temperature for 14 days.

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54.5 Each of the strainer baskets conditioned in 54.4 are to be subjected to the procedures described in 54.2 and 54.3. Each conditioned juice extractor cover is to be installed on a juice extractor appliance that is intended to operate with that cover.

54.6 No parts of the strainer basket or other components of the juice extractor shall be ejected from the appliance. The top cover of the juice extractor shall also remain intact.

Exception: Parts may be ejected through the pulp discharge opening if:

a) The pulp container is provided with the appliance; and

b) All ejected parts are confined within the pulp container.

55 Operational Test Following Environmental Conditionings

55.1 The following procedures are to be performed, in the order shown, for a centrifugal juice extractor that uses a cutter strainer basket with either a polymeric or metallic rim. Each of three representative strainer baskets is to be tested.

55.2 Chemical stress test: Each strainer basket is to be immersed in a detergent solution (corresponding to Detergent Type B) at a concentration of 3 grams/liter and a temperature of 65 ±1°C (140 ±1.8°F) for 48 hours, then removed from the solution, rinsed with water, and stored at room temperature for 14 days.

NOTE: A Detergent Type B solution, as specified in IEC 60436, contains the following component compounds:

30.0% of Trisodium citrate dihydrate

12.0% of Sokalan CP5 compound (50% active substance)

2.0% of Plurafac LF403

25.0% of Sodium disilicate

23.0% of Sodium carbonate

5.0% of Sodium perborate monohydrate

2.0% of TAED

0.5% of Amylase

0.5% of Protease

100.0%

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55.3 Thermal stress test: Each strainer basket is to be placed in a dry atmosphere at a temperature of 83 ±2°C (181.4 ±3.6°F) for one hour, then immersed in water at a temperature of 20 ±2°C (68 ±3.6°F). This procedure is to be performed a total of three times.

55.4 Impact test: Each strainer basket are dropped from a height of one meter onto a wooden floor in such a way that the axis of rotation is horizontal at the moment of impact. This procedure is to be performed a total of 12 times, with the strainer baskets being rotated by 30 degrees in each successive iteration to obtain 12 different points of impact.

55.5 Starting test: Each strainer basket is to be placed in a juice extractor appliance that is intended to operate with the strainer basket. The appliance is to be supplied with 1.06 times the rated voltage and then is to be operated for 15 seconds with the speed controls set at the highest speed, followed by a rest interval of 45 seconds. This procedure is to be performed a total of 25 times for each strainer basket.

55.6 A centrifugal juice extractor shall be capable of withstanding the stresses encountered during normal operation of the appliance. No parts of the strainer basket or other components of the juice extractor shall be ejected from the appliance. No cracks or other damage to any part of the assembled juice extractor shall be visible to the naked eye upon inspection.

56 Switch Overload Test

56.1 To determine compliance with 6.19.1.2 or Exception Nos. 1 and 2 of 6.19.1.4, a switch or other device without current and voltage ratings or that controls a motor and has not been shown to be investigated for that purpose shall perform acceptably when subjected to an overload test consisting of 50 cycles of operation, making and breaking the locked-rotor current of the motor. The power factor of the test load controlled by the switch shall be not more than the power factor under locked-rotor conditions of the appliance. There shall not be electrical or mechanical malfunction of the device or undue pitting or burning of the contacts as a result of the overload test.

56.2 In a test to determine if a switch or other control device is capable of performing acceptably in the overload test mentioned in 56.1, the appliance is to be connected to a grounded power-supply circuit of rated frequency and voltage, with the rotor of the motor locked in position. During the test, accessible dead metal parts of the device are to be connected to ground through a 3 A non-time-delay plug fuse and the connection is to be such that any single-pole current interrupting device is in an ungrounded conductor of the supply circuit. If the machine is intended for use on direct current, accessible dead metal parts of the machine are to be so connected as to be positive with respect to a single-pole, current interrupting device. The device is to be operated at the rate of no more than 10 cycles per minute, except that a faster rate of operation is to be employed if agreeable to all concerned. The performance is unacceptable if the fuse in the grounding connection is opened.

56.3 A switch or other device that controls a solenoid, relay coil, or the like and has not been shown to be investigated for that purpose shall perform acceptably when subjected to an overload test consisting of 50 cycles of operation as described in 56.4. There shall not be electrical or mechanical malfunction of the device, nor undue burning or pitting of the contacts as a result of the overload test.

56.4 In a test to determine if a switch or other control device complies with the requirements in 56.3, the appliance is to be connected to a supply circuit of rated frequency and 110 percent of maximum rated voltage. The load on the device under test is to be the same as that which is intended to control in normal service. During the test, accessible dead metal parts of the machine are to be connected to ground through a 3 A non-time-delay plug fuse, and the connection is to be such that any single-pole current interrupting device is in an ungrounded conductor of the supply circuit. The device is to be operated at a rate of not more than 10 cycles per minute except that a faster rate of operation is to be employed if agreeable to all concerned. The performance is unacceptable if the fuse in the grounding connection is opened during the test.

57 Switch Endurance Test

57.1 To determine compliance with 6.19.1.2, the switch shall be subjected to an endurance test consisting of 6000 cycles of operation, making and breaking the rated current of the appliance. If the appliance is not marked with a rated current, the test current shall be the input current measured under maximum normal load conditions as specified for the Input Test of Section 35, but not less than the measured input current with the unit loaded to its maximum marked wattage rating. As a result of the endurance test there shall not be any electrical or mechanical malfunction of the device or undue pitting or burning of the contacts; and the fuse in the grounding connection shall not open.

57.2 To determine if a switch complies with the endurance test mentioned in 57.1, the appliance is to be connected to a grounded power-supply circuit of rated frequency and voltage. The power factor of the test load controlled by the switch shall be not more than the power factor under normal load conditions of the

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appliance. During the test, accessible dead metal parts of the device are to be connected to ground through a 3 A non-time-delay plug fuse and the connection is to be such that any single-pole current interrupting device is in an ungrounded conductor of the supply circuit. If the machine is intended for use on direct current, accessible dead metal parts of the machine are to be so connected as to be positive with respect to a single-pole, current interrupting device. The device is to be operated at a rate of 6 – 10 cycles per minute, except that a faster rate of operation is to be employed if agreeable to all concerned.

58 Interlock System Testing

58.1 Cutter stopping time determination test

58.1.1 To determine compliance with 6.19.3.3(a), the time for the cutting blade of an appliance to stop shall not be more than 4 seconds when the appliance is subjected to the Cutter Stopping Time Determination Test.

58.1.2 The appliance is to be connected to a supply circuit as described in 31.3.

58.1.3 For appliances with multiple attachments, the test shall be conducted with each attachment installed as intended in the appliance.

58.1.4 The appliance controls shall be placed in the position resulting in the highest speed of operation.

58.1.5 The sample shall then be energized and allowed to obtain full speed. While operating, the cover or guard shall be removed or moved to expose the moving part and disengage the interlock mechanism. The amount of time necessary for the cutter to come to a complete stop after disengaging the interlock mechanism shall be measured.

Exception: If it is not possible to disengage the interlock mechanism while the appliance is energized, the appliance shall be de-energized, the cover or guard shall be immediately removed or moved and the cutter stopping time shall be measured.

58.2 Interlock system endurance test

58.2.1 In order to determine compliance with 6.19.3.1, the interlock system shall be capable of completing the Interlock System Endurance Test and remain electrically and mechanically functional.

58.2.2 The appliance shall be connected to a supply circuit as described in 31.3.

58.2.3 For appliances with multiple attachments, the attachment resulting in the longest stopping time during the Cutter Stopping Time Determination Test of 58.1 shall be installed in the appliance as intended.

58.2.4 The appliance controls shall be placed in the position resulting in the highest speed of operation and the interlock system, including any braking system, shall be operated for a total of 10,000 cycles of operation with each cycle consisting of the following steps:

a) The appliance shall be energized and allowed to reach its maximum speed.

b) The interlock mechanism shall be mechanically disengaged by removing or moving the cover or guard as applicable.

c) The cutter shall be allowed to come to a complete stop.

d) The interlock mechanism shall then be re-engaged allowing the sample to re-energize and operate.

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Exception No. 1: The interlock system of a centrifugal juicer, coffee mill, or pasta mixer-extruder shall be operated for 6,000 cycles of operation.

Exception No. 2: If it is not possible to actuate the interlock mechanism per (b) while the appliance is energized, the appliance shall be de-energized and the cover or guard shall be immediately removed or moved to disengage the interlock mechanism.

58.2.5 The rate of cycling shall be such that the motor temperature do not exceed the motor winding temperatures obtained during the Normal Temperature Test, Section 36.

58.2.6 After completion of the Interlock System Endurance Test, the Cutter Stopping Time Determination Test of 58.3 shall be repeated.

58.3 Cover/Guard misalignment test

58.3.1 To determine compliance with 6.19.3.3 (b), any opening created that would allow access to moving parts due to misalignment of the cover or guard shall not be more than 1 inch (24.4 mm) in the direction of the applied force, when the appliance is subjected to the Cover/Guard Misalignment Test.

58.3.2 The appliance shall be connected to a supply circuit as described in 31.3.

58.3.3 The cover or guard shall be installed in any way that allows for use of the appliance while actuating the interlock switch without fully engaging the bowl.

58.3.4 A 1 lbf shall be applied to the cover or guard, in any direction that will create an opening between the cover or guard and the bowl or chamber with the moving part. The maximum dimension of the opening or gap, along the axis of the applied force, shall be measured.

59 Strain Relief Test

59.1 The strain relief means provided on an attached flexible cord, when tested in accordance with 59.2, shall withstand for 1 minute without displacement a direct pull of 35 lbf (156 N) applied to the cord, with the connections within the appliance disconnected.

59.2 A 35 lb (15.9 kg) weight is to be suspended on the cord and so supported by the appliance that the strain-relief means will be stressed from any angle which the construction of the appliance permits. The strain relief is not acceptable if, at the point of disconnection of the conductors, there is such movement of the cord as to indicate that stress would have resulted on the connections.

59.3 For the investigation mentioned in 10.3.2, each of six samples of the clamp that have been applied to the cord in the intended manner are to be used. One group of three samples are to be subjected to the dielectric voltage-withstand and strain relief tests in the as-received condition. The other group of three samples are to be placed in an air oven for 168 hours. The oven temperature is to be 10°C (18°F) higher than the maximum temperature measured on the cord at the strain relief device under normal operating conditions, but not less than 70°C (158°F) in any case. The samples, after being conditioned in the oven, are to be subjected to the dielectric voltage-withstand and strain relief tests. The value of the applied potential is to be as indicated in 37.1. The potential is to be applied between the conductors and, if the clamp is metal, the potential is to be applied between the conductors and the clamp. After cooling to room temperature the conditioned samples are to comply with the strain relief test requirements in 59.1 and the dielectric voltage-withstand requirements in 37.1.

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60 Push Back Relief Test

60.1 To determine compliance with 10.3.3, a product shall be tested in accordance with 60.2 without occurrence of any of the conditions specified in 10.3.3 (a) – (d).

60.2 The supply cord is to be held up to 1 inch (25.4 mm) from the point where the cord emerges from the product and is then to be pushed back into the product. The cord is to be pushed back into the product in 1 inch (25.4 mm) increments until the cord buckles or the force to push the cord into the product exceed 6 lbf (26.7 N). The supply cord within the product is to be manipulated to determine compliance with 10.3.3.

61 Wiring Flexing Test

61.1 In accordance with 13.16, if the normal operation of an appliance causes movement of the internal wiring, the appliance shall be capable of operating for 6000 cycles in the intended manner while connected to a supply circuit of the voltage indicated in 31.3. There shall be no electrical or mechanical malfunction and, after the test, the appliance shall comply with the requirements for Dielectric Voltage-withstand Test, Section 37, with the wiring under test wrapped in metal foil and the movable member operating through the maximum limits of travel in both directions.

61.2 In a test to determine whether an appliance complies with the requirement in 61.1:

a) The electrical load applied to the internal wiring may be simulated to represent the voltage, current, and power factor of the load seen by the internal wiring under maximum normal operating conditions when subjected to flexing;

b) The cycling rate shall be:

1) Representative of the maximum speed of the movable member of the appliance during normal operation where the movable member is controlled by the motor, or

2) 12 cycles per minute where the movable member is operated manually; and

c) The movable member is to be so operated that it will reach the maximum limits of travel in both directions, each cycle.

61.3 When requested by the manufacturer, testing with an increased cycling rate is considered representative of the cycling rate specified in 61.2(b).

62 Appliance Coupler Retention

62.1 If a handheld appliance rated over 30 V (42 V peak) employs a detachable power-supply cord without a positive means of retention, the retention means shall comply with the endurance test specified in 62.2. At the end of this test the retention means shall withstand for 1 minute a 1 lb (4.4 N) withdrawal force axially applied to the cord, without the appliance coupler becoming disengaged from the retention system.

62.2 The retention means is to be subjected to 1000 cycles of appliance coupler insertion and removal, with each cycle consisting of an insertion into and removal from the appliance. The insertion and removal of the appliance coupler is to be done at a rate not exceeding ten cycles per minute unless the manufacturer agrees to a faster rate. The appliance is not to be energized during the test.

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63 Metal Enclosure Impact Tests

63.1 An appliance having an enclosure that is of metal shall comply with the tests outlined in 64.5.1.1 – 64.5.3.5, except that the ball impact value is to be 1.5 ft-lbf (2.03 J).

64 Enclosures of Polymeric Material for Portable Appliances

64.1 Scope

64.1.1 These requirements cover polymeric enclosures or parts of enclosures, of portable cord-connected food preparing appliances. For the purposes of the requirements in this section, an under-cabinet appliance is considered to be a portable appliance and blenders with a heating function are considered to be attended unless provided with a keep warm function or, for machines with heating elements, operable in the heating mode without blending.

64.1.2 These requirements also cover polymeric decorative and similar parts that do not serve as part of the enclosure for electrical parts or provide for protection against injury to persons.

64.2 General

64.2.1 A portable cord-connected food-preparing machine having an enclosure of polymeric material, shall comply with thermal-aging 64.13.1 and the applicable requirements from Figure 64.1. The following steps are to be followed in the use of Figure 64.1.

a) Select the appropriate path determined from the flow chart in Part 1 of Figure 64.1 that matches the conditions of use for the polymeric material under consideration.

b) Remaining within the confines of the Column I, II, or III determined in Part 1, proceed to Part 2 of Figure 64.1. Pick out the letter or letters (denoting a material's flammability class; refer to Figure 64.1 (legend) that are acceptable for the use application.

c) The applicable requirements can be found in Part 3 of Figure 64.1 and those determined consistent with the conditions of use and the material flammability class found in Parts 1 and 2.

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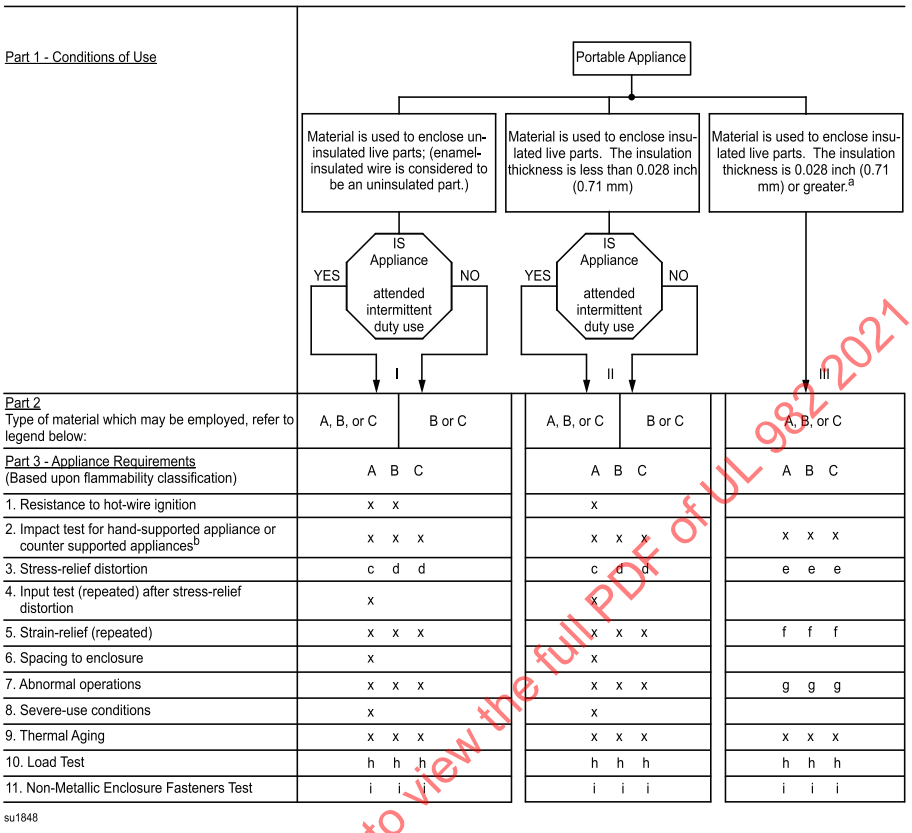
Figure 64.1

Test Related to Use of Polymeric Material for Enclosures of Portable Appliances



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Legend

A – A material classed as HB by means of the Horizontal Burning Test described in the requirements for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

B – A material classed as V-0, V-1, or V-2 as defined in the Vertical Burning Test described in the requirements for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

C – A material which when flame tested as used in the appliance, complies with the requirements of 64.3.1. The use of flame retardant coating applied to the inside of a polymeric enclosure when flame tested as used in the appliance is not intended unless the coating/material interface has been found to be usable by separate investigation.

Notes

X – Required Test

[a] The insulation thickness of the body material of component parts is considered equivalent to 0.028 inch (0.71 mm) insulation if the component has be judged on the basis of requirements covering the component in question.

[b] Impact tests shall also be conducted on guards for hazardous moving parts (see 64.5.1.3).

[c] See 64.6.2.

[d] See 64.6.3.

[e] Only required if failure of the material will cause a stress on the unction between a lead and terminal of a component. If the strain relief test if performed as intended for components with integral leads either as a separate test or as a part of the regular test procedure for the component, it shall be determined that failure of the material will not cause a stress on the junction between the lead and a terminal of the component.

[f] This test is required only if the strain-relief means are mounted on the polymeric enclosure.

[g] Only required if material is employed in the unattended mode.

[h] The Load Test is only applicable for wall or under-cabinet mounted appliances.

[i] The Non-Metallic Enclosure-Fasteners Test is only applicable where non-metallic fasteners are relied upon for securement on an enclosure part.

64.2.2 An external polymeric decorative part of the appliance, a polymeric part extending through the enclosure wall and considered likely to propagate flame, or a similar polymeric part not involved with protection against risk of fire, electric shock, or injury to persons shall be classified as HB, V-0, V-1, or V-2 as defined by the appropriate burning test in the Standard for Test for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, or the polymeric part as used in the appliance shall comply with the flame test of 64.3.1.

Exception No. 1: This requirement does not apply to small parts whose maximum volume does not exceed 2 cm^3 (0.12 in^3), or whose maximum dimension does not exceed 3 cm (1.2 inches), and whose location does not result in the propagation of flame from within the appliance to the outside surface.

Exception No. 2: This requirement does not apply to polymeric parts – such as feed tray assemblies, food pushers, stands, food containers and bowls, and container covers – that are detachable without the use of tools and whose location is not likely to result in the propagation of flame from within the appliance to the outside surface.

64.3 Flammability of enclosure

64.3.1 When tested in accordance with 64.3.2 – 64.3.5, the enclosure shall not support combustion for more than 1 minute after the second application of the test flame as stated in 64.3.4. The results are not acceptable if complete consumption of the sample occurs during the application of the flame or within 1 minute after the application of the flame.

64.3.2 Three samples of the appliance are to be placed in a circulating-air oven maintained at a uniform temperature not less than 10°C (18°F) higher than the maximum temperature of the material measured under normal operating conditions, but not less than 70°C (158°F) in any case. The samples are to remain in the oven for 168 hours. After being allowed to cool to room temperature, the samples are to be tested in accordance with 64.3.3 – 64.3.5.

Exception: The test described in 64.3.3 – 64.3.5 may be conducted on three unconditioned samples if:

a) It has been determined that the material used as the enclosure does not exhibit a reduction in its flame-resistant properties as a result of long-term thermal aging, and

b) The thermal-aging program used for such determination includes specimens having a thickness equal to or less than the wall of the polymeric enclosure.

64.3.3 Three sections of the enclosure of the appliance most likely to be ignited are to be subject to the flame test described in 64.3.4. A different sample of the appliance is to be used for each section tested. In the performance of the test, the appliance is to be supported in its normal operating position in a draft-free location, and nonpolymeric portions of the enclosure in contact with or fastened to the polymeric portions are not to be removed. Insofar as possible, the internal mechanism of the appliance is to be in place.

64.3.4 The flame of the Bunsen burner is to be adjusted to have a 3/4 inch (19 mm) high yellow flame with no blue cone. Two 30 second applications of the tip of the flame are to be made to each section of the enclosure selected as indicated in 64.3.3, with a 1 minute interval between the applications.

64.3.5 With reference to 64.3.3, the sections most likely to be ignited are considered as those adjacent to coil windings, splices, open-type switches, component terminals and other arcing or sparking parts.

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64.4 Resistance to hot-wire ignition

64.4.1 The polymeric material shall resist ignition for 7 seconds or longer when subjected to the hot wire ignition test described in the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A.

64.4.2 A polymeric material without an adequate hot wire ignition rating shall comply with one of the following as outlined in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C:

a) The Abnormal Overload Test;

b) The Glow-Wire End-Product Test; or

c) The Glow-Wire Ignitability Test.

64.5 Impact

64.5.1 General

64.5.1.1 Counter-supported sections of an appliance having more than one section shall comply with the requirements applied for a counter-supported appliance. Hand-supported sections of an appliance having more than one section shall comply with the requirements applied for a hand-supported appliance.

64.5.1.2 An appliance which has the ability to be used both as a counter-supported appliance as defined in 4.26 and as a hand-supported appliance as defined in 4.34 shall comply with the requirements for both.

64.5.1.3 The appropriate impact test in accordance with 64.5.1.1 and 64.5.1.2 shall also be conducted on nonmetallic guards of moving parts capable of causing injury, such as food processor bowls and covers.

64.5.1.4 The impact test in accordance with 64.5.3 shall also be conducted on breakable exterior surfaces as specified in 7.4. The blender shall then be subjected to the Overflow Test of 40.1 unless the blender is no longer functional or the surface withstands the impact test without cracking or breaking.

64.5.2 Hand-supported appliances

64.5.2.1 A hand-supported appliance shall withstand the drop impact described in 64.5.2.4 without occurrence of any one of the following conditions:

a) Making live parts accessible to contact (use accessibility probe for determination as indicated in 64.9.1);

b) Producing any other condition that would affect adversely the mechanical performance of the appliance; or

c) Producing any other condition that would increase the potential of electric shock of the appliance.

64.5.2.2 With reference to 64.5.2.1(b), cracking or denting of the enclosure is not to affect the function of any safety or constructional features such as thermostats, over-load-protective devices, or strain relief. Cracking or denting of the enclosure is not to result in exposure of moving parts capable of causing injury as determined in 64.9.1.

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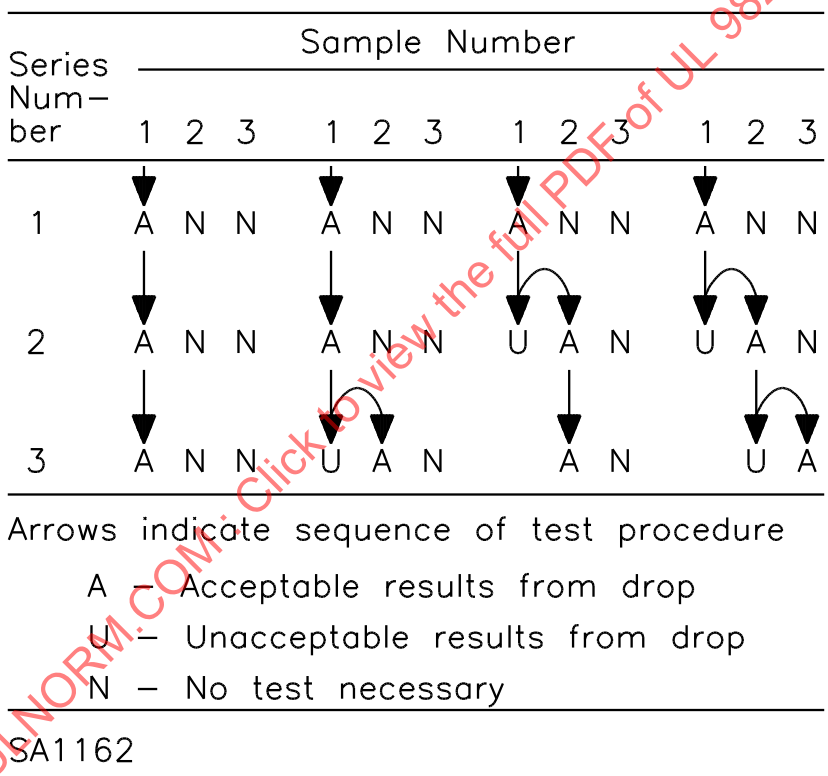
64.5.2.3 With reference to 64.5.2.1(c), the appliance is to comply with the Dielectric Voltage-Withstand Test, Section 37, after being subjected to the impact.

64.5.2.4 Each of three samples of the appliance, without attachments, is to be subjected to the impact that results from its being dropped three times (a series) through a distance of 3 ft (0.91 m) to strike a flat hardwood surface in the positions most likely to produce adverse results. In each drop, the sample is to strike a surface of the enclosure different from those of the other two drops in the series.

Exception: If the manufacturer so elects, fewer samples may be used in accordance with Figure 64.2 wherein each series consists of three drops of the sample. The overall performance is acceptable upon completion of any one of the procedures represented in the figure.

Figure 64.2

Procedure for Impact Test



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64.5.2.5 The hardwood surface mentioned in 64.5.2.4 is to consist of a layer of tongue-and-groove oak flooring mounted on two layers of 3/4 inch (19 mm) thick plywood. The oak flooring is to be nominally 3/4 inch by 2-1/4 inch (actual size 3/4 by 2-1/4 inch – 19 by 57 mm). The assembly is to rest on a concrete floor or an equivalent nonresilient surface.

64.5.3 Counter-supported appliances

64.5.3.1 A counter-supported appliance shall withstand the ball impact with the appliance restrained, as described in 64.5.3.4 without occurrence of any one of the following conditions:

a) Making live parts accessible to contact (use accessibility probe as indicated in 64.9.1 and 64.9.2 for determination);

b) Producing any other condition that affects adversely the mechanical performance of the appliance; or

c) Producing other conditions that increase the risk of electric shock.

64.5.3.2 With reference to 64.5.3.1(b), cracking or denting of the enclosure is not to affect the function of any safety or constructional features such as thermostats, overload-protective devices, or strain relief. Cracking or denting of the enclosure is not to result in exposure of moving parts capable of injury, as determined in 64.9.1 and 64.9.2.

64.5.3.3 With reference to 64.5.3.1(c), the appliance is to comply with the Dielectric Voltage-Withstand Test, Section 37, after being subjected to the impact.

64.5.3.4 Each of three samples of the appliance is to be subjected to one impact. This impact is to be imparted by dropping or swinging a 2 inches (50.8 mm) diameter steel sphere, weighing 1.18 lb (0.535 kg) from a height which will produce an impact of 0.75 ft-lbf (1.02 J). The sample is to be rigidly supported and the impact is to be made normal to the most vulnerable spots on the appliance enclosure that are exposed to a blow during normal use. A different spot on the enclosure is to be selected for each impact. Refer to Figure 64.3 with respect to the ball drop impact test and to Figure 64.4 for the ball pendulum impact test.

Exception: If the manufacturer elects, fewer than three samples may be used for the tests in accordance with Figure 64.2 wherein each series consists of one impact. The overall performance is acceptable upon completion of any one of the procedures represented in the figure.

64.5.3.5 With reference to Figure 64.3 and Figure 64.4, the "H" designation represents the vertical distance the sphere must travel to produce the desired impact. For the pendulum impact, the sphere is to contact the test sample when the string is in the vertical position. The supporting surface is to be as described in 64.5.2.5. The backing surface for the pendulum impact is to consist of 3/4 inch (19 mm) plywood over a rigid surface of concrete or an equivalent nonresilient backing surface may be used.

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Figure 64.3

Ball Drop Impact Test

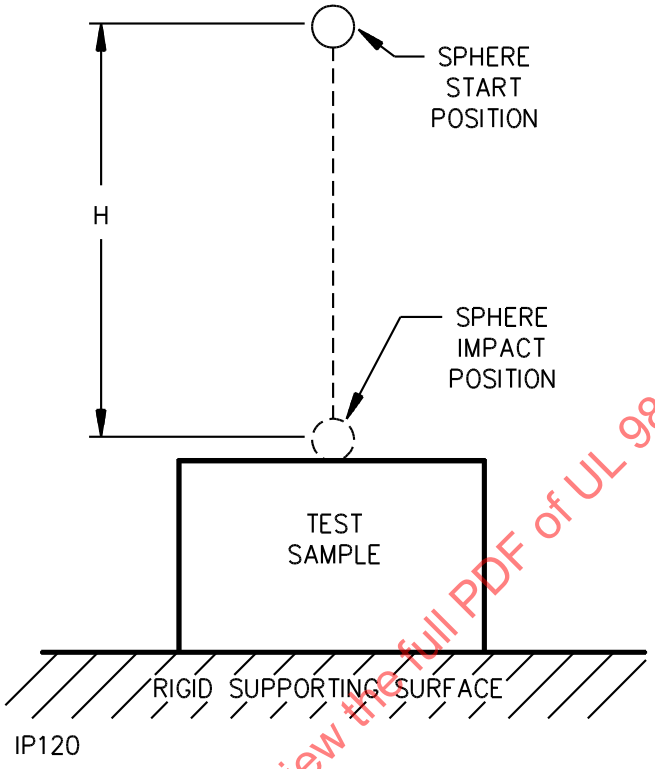

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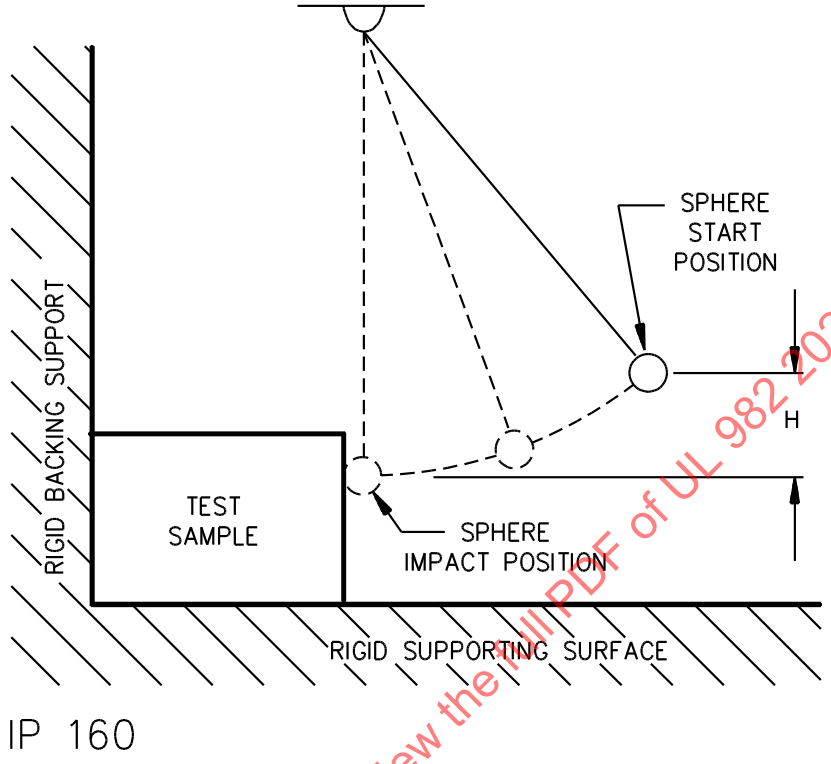
Figure 64.4

Ball Pendulum Impact Test



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64.5.4 Feed opening tab strength

64.5.4.1 General

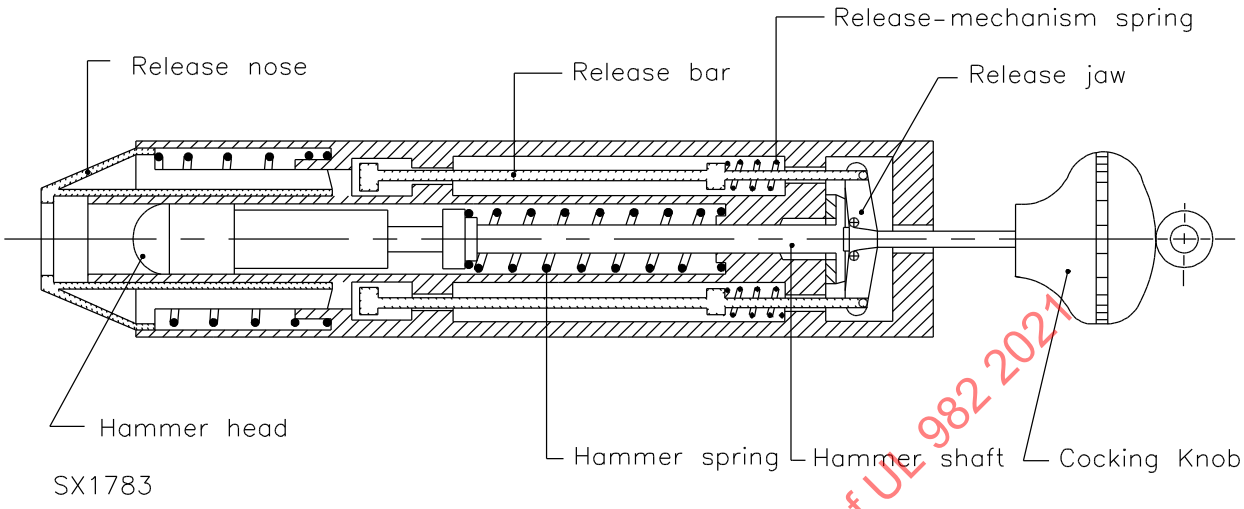
64.5.4.1.1 Projecting tabs within a feed opening shall be subjected to the Impact Hammer Test of 64.5.4.2 and the Applied Force Test or 64.5.4.3 if they are relied upon for compliance with 26.8(a). See 26.10.

64.5.4.2 Impact hammer test

64.5.4.2.1 A force of 0.375 ft-lb (0.5 J) shall be applied to the top and sides of projecting tabs using the IEC impact hammer of IEC 60068-2-75 as shown in Figure 64.5. It may be necessary to remove a portion of the feed opening in order to apply the impact hammer to the top and sides of the tabs. As a result of the impacts, the tabs shall not break.

Figure 64.5

IEC Impact Hammer



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64.5.4.3 Applied force test

64.5.4.3.1 A force of 11.25 lbf (50 N) shall be applied to the food pusher in the direction that food is normally fed for 1 minute with all notches intended to mate with projecting tabs blocked. As a result of the applied force, the tabs shall not break.

64.6 Stress-relief distortion

64.6.1 Conditioning of the appliance as described in 64.6.2 and 64.6.3 shall not cause distortion of the enclosure that results in any of the following:

a) Inability of the appliance to comply with the requirements for enclosure of live parts and integrity of the enclosure so affected that adequate mechanical protection is not afforded to internal component parts. (See 64.9.1 and 64.9.2); or

b) Inability of the appliance power-supply cord to comply with the strain-relief requirements. (See 64.8.1).

Exception: If the stress relief distortion test of 64.6.2 or 64.6.3 results in non-compliance with 64.6.1 due to distortion at a location that did not attain the maximum temperature during the Normal Temperature Test, Section 36, or severe-use conditioning temperature test, then the following shall apply:

a) The Normal Temperature Test, Section 36, or severe-use conditioning test, as applicable, shall be repeated to determine the maximum temperature of the area that exhibited distortion; and

b) Three additional samples of the entire appliance shall be subjected to the Stress-Relief Distortion Test of 64.6.2 or 64.6.3, as applicable, except that the oven temperature used for the

conditioning test shall be based on the local material temperature determined under (a) of this exception, rather than the maximum overall enclosure temperature, but not less than 70°C (158°F). The samples so conditioned shall comply with 64.6.1.

64.6.2 Based on Figure 64.1, three samples of the appliance employing a Type B or C material are to be placed in a circulating-air oven maintained at a uniform temperature at least 10°C (18°F) higher than the maximum temperature of the material measured under normal appliance-operating conditions, but not less than 70°C (158°F) in any case. The samples are to remain in the oven for 7 hours. After their careful removal from the oven and cooling to room temperature, they are to be investigated for compliance with 64.6.1.

64.6.3 Based on Figure 64.1, three samples of the appliance employing a Type A material are to be placed in a circulating-air oven maintained at a uniform temperature at least 10°C (18°F) higher than the maximum temperature of the material measured during the appliance conditioning described in 64.12.2 (b) and (c); but not less than 70°C (158°F) in any case. The samples are to remain in the oven for 7 hours. After their careful removal from the oven and cooling to room temperature, they are to be investigated for compliance with 64.6.1.

Exception: If burnout occurs during conditioning described in 64.12.2 (b) or (c) the maximum temperature measured on the sample that did not burn out is to be used. If burnout occurs during conditioning described in 64.12.2 (b) and (c), the maximum temperature measured under normal-operating conditions is to be used.

64.7 Input (repeated)

64.7.1 After being conditioned as described in 64.6.3, when operated at no load and rated voltage the appliance input current shall not be greater than 150 percent of the no-load current measured on an unconditioned sample as the result of any warping or other distortion of the enclosure.

64.8 Strain relief (repeated)

64.8.1 Following conditioning described in 64.6.2 and 64.6.3, after the samples have cooled to room temperature, they shall be subjected to the power supply-cord strain relief test described in 59.1.

64.9 Accessibility

64.9.1 An opening anywhere in the enclosure of a hand-supported appliance or in any portion of an appliance hand held in normal use is acceptable if a probe as illustrated in Figure 64.6, when inserted point first as far as possible into the opening;

a) Does not enter the opening for a distance of more than 1/8 inch (3.2 mm); and

b) Does not touch any uninsulated live part or magnet wire involving a risk of electric shock or moving part capable of causing injury.

Exception: If unacceptable results are obtained using the probe illustrated in Figure 64.6, the probe illustrated in Figure 7.1 may be used to determine that the part is not more accessible than with a sample prior to conditioning.

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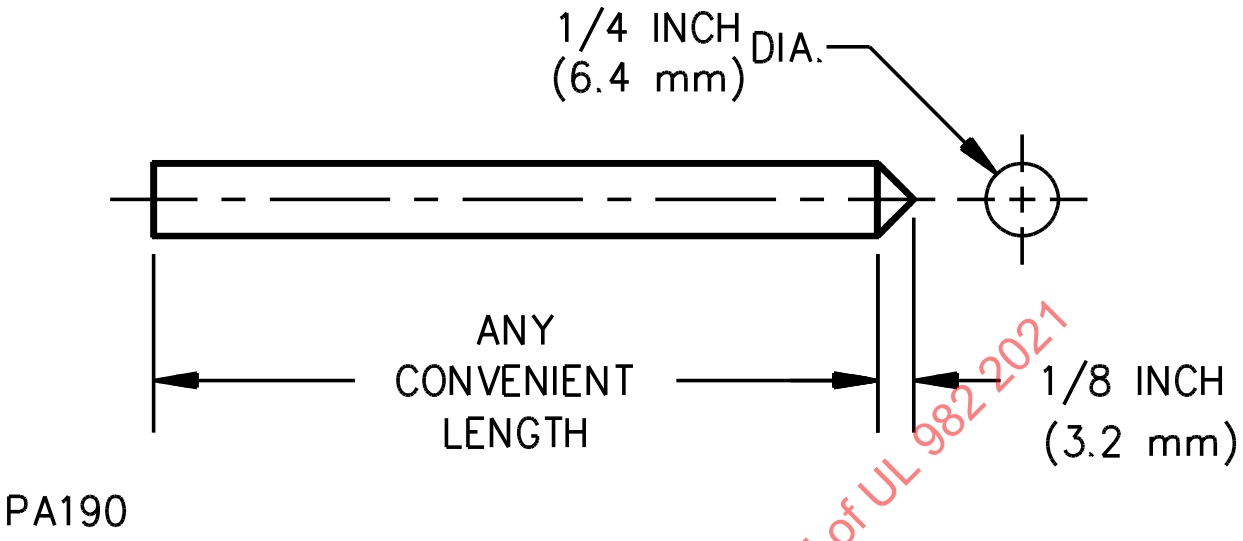
Figure 64.6

Probe



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64.9.2 In the enclosure of an appliance other than as described in 64.9.1, an opening which does not permit entrance of a 3/4 inch-diameter (19 mm) rod is acceptable if:

a) A probe as illustrated in Figure 64.7 cannot be made to touch any uninsulated live part or moving part capable of causing injury when inserted through the opening; and

b) A probe as illustrated in Figure 64.8 cannot be made to touch magnet wire when inserted through the opening.

Exception: If unacceptable results are obtained using the probe illustrated in Figure 64.7 and Figure 64.8, the probe illustrated in Figure 7.1 may be used to determine that the part is not more accessible than with a sample prior to conditioning.

Figure 64.7

Probe

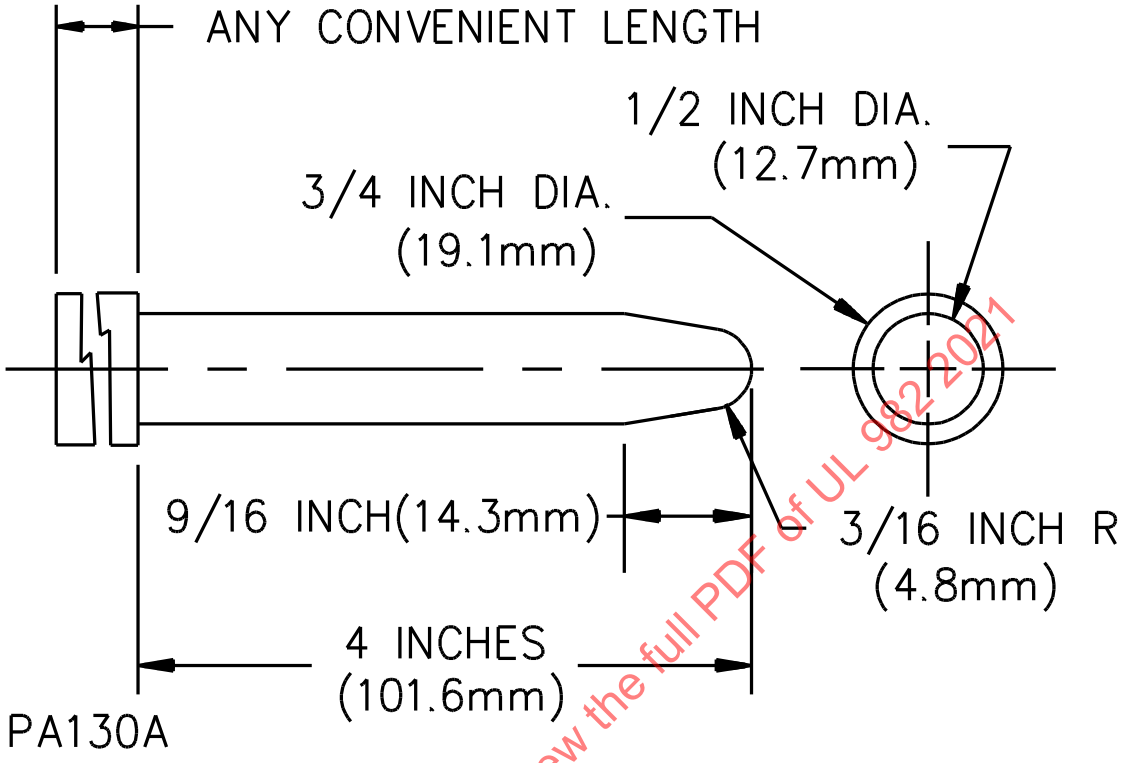

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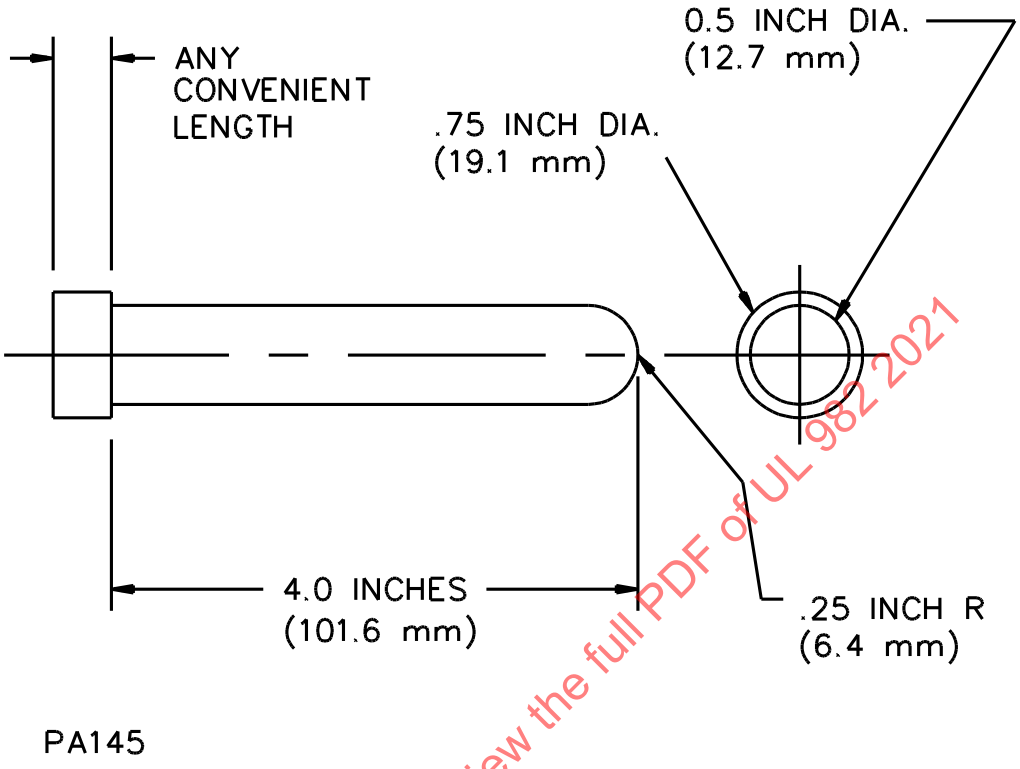
Figure 64.8

Probe



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64.10 Spacings to enclosure

64.10.1 The spacings between the polymeric enclosure and:

a) A nonarcing uninsulated live part (a bus bar, a connecting strap, a terminal, or the like) shall be not less than 1/32 inch (0.8 mm).

b) An arcing part (the commutator, unenclosed switch contacts, and the like) shall not be less than 1/2 inch (12.7 mm) except as indicated in 64.10.3.

64.10.2 The spacing mentioned in 64.10.1(b) is to be measured from the source of the arc. Examples of arcing parts are the interface of the brush and the commutator, and the interface of the switch contacts.

64.10.3 The spacing mentioned in 64.10.1(b) may be less than 1/2 inch (12.7 mm) but not less than 1/32 inch (0.8 mm) if the polymeric material resists ignition when subjected to the minimum number of arcs, as specified in Table 64.1, and tested in accordance with 64.10.4 and 64.10.5 or if the material complies with the End-Product Arc Resistance Test as specified in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

Table 64.1
High Current Arc Ignition Test – Number of Arcs

Material flame class	Number of arcs	PLC
HB	60	1
V-2	30	2
V-1	30	2
V-0	15	3
PLC = Performance Level Category		

64.10.4 Three specimens of the polymeric material, each 5 inches (127 mm) long, 1/2 inch (12.7 mm) wide, and having a thickness not more than the minimum enclosure thickness are to be tested.

64.10.5 The high current arc ignition test is to be performed as outlined in the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A.

64.10.6 The spacing mentioned in 64.10.1 (a) may be less than 1/32 inch (0.8 mm) if the polymeric material complies with the requirements for direct support of live parts in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, or an acceptable insulating barrier shall be provided.

64.10.7 With respect to 64.10.6, when determining the suitability of the Comparitive Tracking Index of the polymeric material, household food preparing machines intended for indoor use only are considered to be exposed to a relatively clean environment. Household food preparing machines intended for outdoor use are considered to be exposed to a moderate contaminate environment.

64.11 Abnormal operation

64.11.1 When tested in accordance with 64.11.2 there shall not be:

a) Ignition of the mounting surface or the cheesecloth as a result of emission of glowing or flaming materials;

b) Ignition of enclosure; or

c) Access to live parts.

In addition, the appliance shall comply with the Dielectric Voltage-Withstand Test, Section 37.

64.11.2 The appliance is to be operated under the various conditions of abnormal operation, such as stalled-rotor operation at different speed settings. During the test, the appliance is to be draped with one layer of cheesecloth while resting on white tissue paper on a soft wood surface and operated continuously until the ultimate results have been determined. In most cases, continuous operation for 7 hours will be necessary in order to make sure that the ultimate results have been determined. For products employing an automatic reset motor protector in accordance with 6.10.10(d), operation shall be continued for 7 hours while the protector is allowed to cycle or until ultimate results have been determined. For a product employing a manually reset motor protector, the test shall be continued for four operations of the protective device (three resets, four trips). Warping, breakage, expansion, or cracking of the enclosure material is acceptable if live parts are not exposed.

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64.12 Severe-use conditions

64.12.1 Except as indicated in 64.12.4, the no-load current input of an appliance that has completed the procedures described in 64.12.2 without burning out electrically shall not be greater than 150 percent of the no-load current measured on an unconditioned sample.

64.12.2 The sample of the appliance is to be operated in accordance with the conditions indicated below. The maximum temperature of the enclosure material during the conditioning described in (b) and (c) are to be recorded unless burnout occurs.

a) A sample of the appliance is to be operated with no load at the maximum rated voltage, but not less than 120 V for 7 hours. This conditioning is to be waived for an appliance provided with a momentary contact line switch (one which requires constant pressure to hold it in the ON position) having no means for locking the switch in the ON position.

b) A sample of the appliance is to be operated at 106 percent of maximum rated voltage under these same conditions of use as for the Normal Temperature Test, Section 36.

c) A sample of the appliance is to be operated at 94 percent of minimum rated voltage under the same conditions of use as for the Normal Temperature Test, Section 36.

Exception: A manufacturer may elect to use the same sample for each conditioning provided that acceptable results are obtained.

64.12.3 During the overload conditioning mentioned in 64.12.2, any automatic reset or user resettable overload-protective device provided with the appliance is to be short circuited.

Exception: Any automatic reset or user resettable over-current or over-temperature protector can be maintained in the circuit during the test provided that the device opens the circuit in accordance with the locked-rotor temperature and endurance test requirements as described in 6.10.6.

64.12.4 An appliance that does not burn out during the conditioning mentioned in 64.12.2 and has a no-load current input more than the value indicated in 64.12.1 is to be operated with no load at rated voltage until burnout occurs.

64.12.5 Burnout of the appliance during the conditioning described in 64.12.2 is not to result in emission of glowing or flaming materials or ignition of the enclosure and is to comply with the requirements of 64.6.1 (a) after cooling to room temperature. Three samples of the appliance shall be subjected to the specified conditioning to determine compliance.

64.13 Thermal aging

64.13.1 A material used for the enclosure of a portable cord-connected food-preparing appliance shall be resistant to thermal degradation at the maximum temperature to which it is exposed during normal use of the appliance. The thermal-aging characteristics of the material may be investigated by any one of the following procedures:

a) The material shall have a temperature index, based on historical data or a long-term thermal aging program, described in the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B, which indicates acceptability for use at the temperature involved; or

b) The polymeric material can be considered appropriate from a thermal-aging standpoint if the maximum temperature to which it is exposed during normal use of the appliance does not exceed 65°C (149°F) for any unattended portable appliance and 80°C (176°F) for any attended portable intermittent-duty appliance.

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64.14 Load test

64.14.1 A loading test is to be performed on an under-cabinet and wall-mounted appliance and an appliance provided with a hanging means (as described in 7.21). The test load is to consist of three times the combined weight of the appliance and the maximum normal load. A gradually increasing force is to be applied vertically through the center of gravity of the unit. The force is to be increased in a 5 to 10 second interval and then is to be maintained for 1 minute. For this test, the appliance should be mounted using the manufacturer's recommended surface/hardware combination that would result in a worst case application. The mounting means shall not break, loosen, or pull out of the wall or cabinet and the appliance shall not separate from the mounting means as a result of this test. There shall not be any damage to the appliance that would result in a risk of fire, electric shock or expose a moving part capable of causing injury. If the mounting assembly (mounting means or appliance retaining means) or enclosure or both is constructed of a thermoplastic material, the test shall be repeated on a sample subject to the stress-relief distortion test. (See 64.6.1 – 64.6.3). For products which are mounted for storage only, there is no added maximum normal load weight. For a blender the maximum normal load shall consist of the weight of the blender jar completely filled with the carrot-water mixture used in the Normal Temperature Test, Section 36.

Exception: The force applied to the mounting means of a wall mounted can opener shall be 25 lbf (111.4 N).

64.15 Non-metallic enclosure fasteners test

64.15.1 An enclosure or enclosure part secured by non-metallic fasteners shall not become detached and shall remain in the secured position when tested in accordance with this section. An enclosure or part that requires removal to perform manufacturer's recommended user servicing, maintenance, operating adjustments, attachment of accessories, and the like, is to be disassembled and assembled 10 times before the test is conducted. The tests are to be performed on a total of six samples; three samples as-received and three samples that have been conditioned to the temperatures obtained for the non-metallic enclosures under test in accordance with the Normal Temperature Test, Section 36. If the conditioning is done in oven, three samples of the appliance are to be placed in a circulating-air oven maintained at a uniform temperature of at least the maximum temperature of the material measured during the Normal Temperature Test and are to remain in the oven for 7 hours. The test is to be commenced within one minute after removal of the sample from the conditioning chamber or completion of the Normal Temperature Test.

Exception: For an enclosure not fabricated with thermoplastic materials, the testing after conditioning is not required.

64.15.2 Each sample is to be subjected to push and pull forces as specified in (a) and (b). The forces are to be applied in any direction likely to result in non-compliance. The force is to be applied gradually at a uniform rate until the specified value is obtained. The force is then to be maintained for 10 seconds. For each of the samples tested, the point of application and direction of the force is to be different.

a) A push force of 11.2 lbf (50 N); and

b) A pull force:

1) Of 11.2 lbf (50 N), if the shape of the part is such that the fingertips cannot easily slip off; or

2) Of 6.7 lbf (30 N), if the projection of the part which is gripped is less than 0.4 inch (10 mm) in the direction of removal.

64.15.3 The push force is to be applied by means of a rigid probe of the dimensions shown in Figure 64.1. The pull force is to be applied by an acceptable means such as a wire through an opening in the

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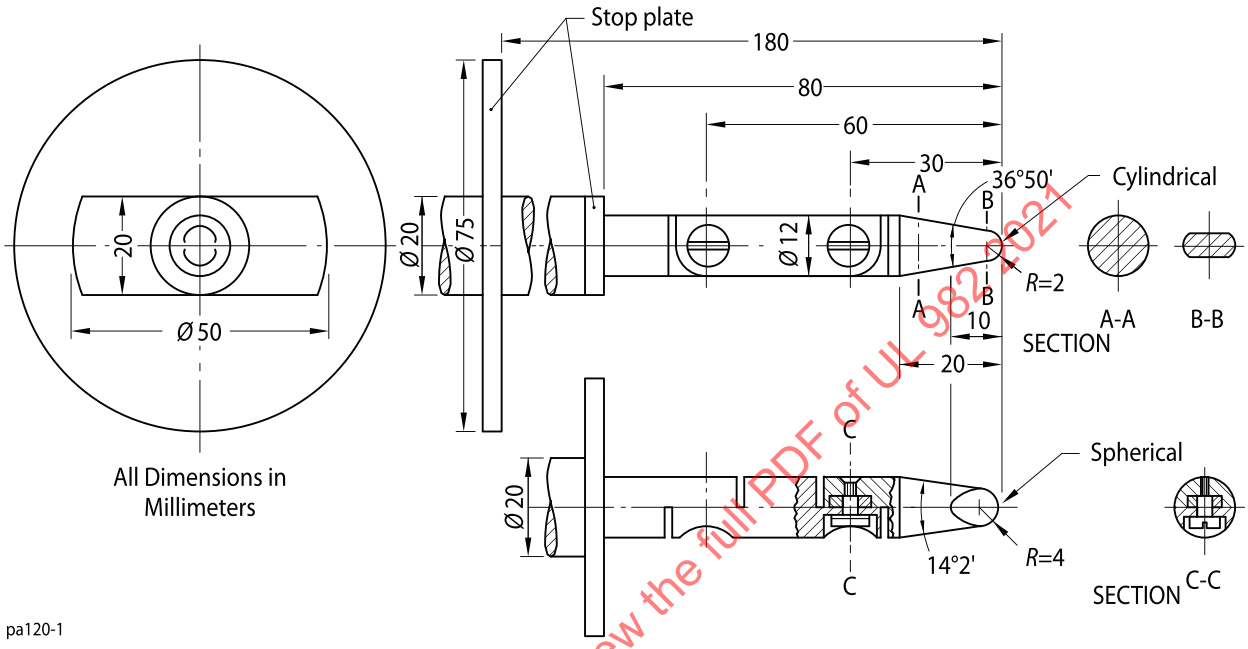
enclosure that does not affect the securement means of the enclosure or enclosure part being evaluated, so that the test results are not affected.

Figure 64.9

IEC Accessibility Probe with Stop Plate



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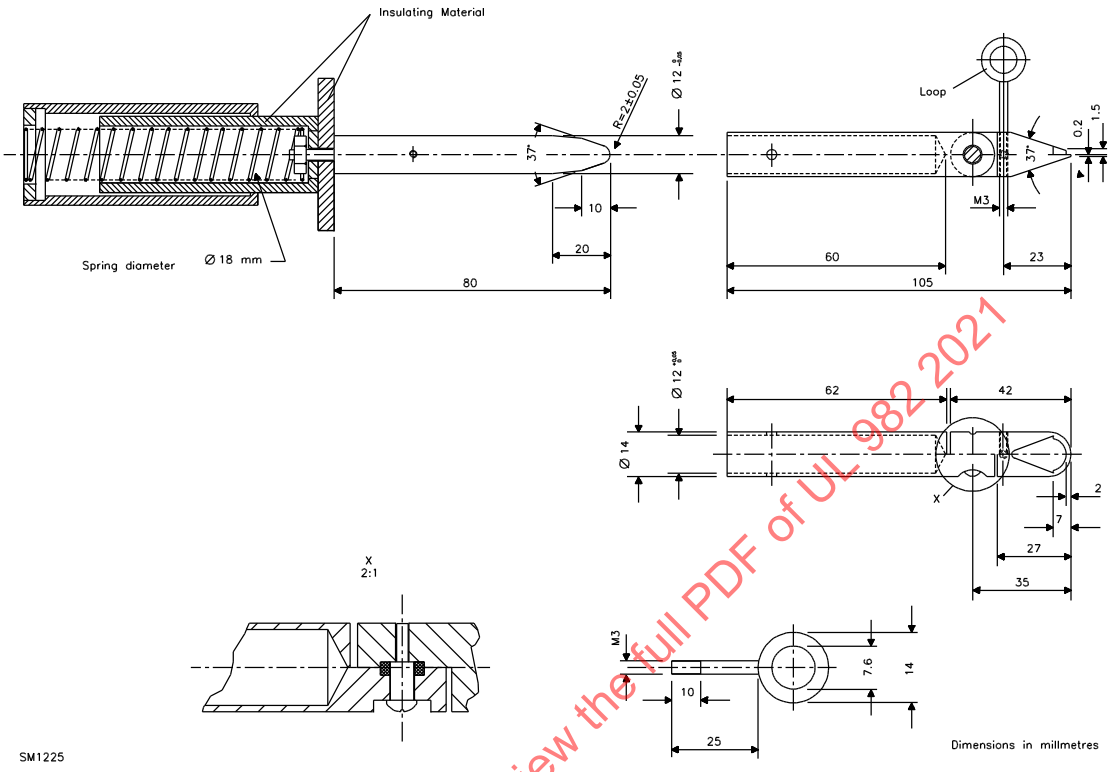
64.15.4 While the pull force specified in 64.15.2(b) is being applied, the test fingernail shown in Figure 64.10, is to be inserted in any aperture or joint with a force of 2.24 lbf (10 N). The fingernail is then to be slid sideways with a force of 2.24 lbf (10 N). The fingernail is not to be twisted or used as a lever.

Figure 64.10

Test Fingernail



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64.15.5 If the shape of the part is such that an axial pull is unlikely, no pull force is to be applied but the test fingernail shown in Figure 64.10 is to be inserted in any aperture or joint with a force of 2.24 lbf (10 N) and then is to be pulled for 10 seconds by means of the loop with a force of 6.7 lbf (30 N) in the direction of removal.

64.15.6 If the enclosure or enclosure part is likely to be subjected to a twisting force, a torque as specified in (a) or (b) is to be applied at the same time as the pull or push force. The torque is also to be applied when the test fingernail is pulled by means of the loop.

a) For major dimensions up to and including 2 inch (50.8 mm) – 17.7 in-lbf (2 N-m).

b) For major dimensions over 2 inch (50.8 mm) – 35.4 in-lbf (4 N-m).

64.15.7 If the projection of the enclosure or enclosure part that is gripped is less than the 0.4 inch (10 mm), the torque as specified in 64.15.6, is to be reduced to 50 percent of the value.

65 Enclosures of Polymeric Material for Stationary or Fixed Appliances

65.1 A stationary or fixed appliance that has an enclosure of polymeric material shall comply with the applicable requirements contained in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

Exception: An under-the-cabinet-appliance is to comply with the requirements for Enclosures of Polymeric Material for Portable Appliances, Section 64.

66 Thermoplastic Coil Forms and Thermoplastic Insulating Material

66.1 General

66.1.1 A thermoplastic material used as functional insulation in a motor insulation system shall electrically isolate the windings and other live parts of the system from other live parts of opposite polarity or dead metal parts.

66.1.2 A thermoplastic material used as functional insulation in a motor insulation system shall have short-term electrical, mechanical, and thermal properties such that the ability of the material to serve as electrical insulation and maintain physical spacing between the coil and dead metal parts of the system is not impaired as determined by the requirements contained in this section.

66.1.3 If a thermoplastic material used as functional insulation in a motor insulation system melts or distorts during normal use, abnormal-use or a combination of both conditions, such melting or distortion shall not result in a risk of electric shock or fire.

66.2 Normal conditioning

66.2.1 After being subjected to the conditioning described in 66.2.2, a thermoplastic coil form or thermoplastic insulating material employed in a motor shall not noticeably soften or distort.

Exception: Thermoplastic coil forms or thermoplastic insulating material having a 105°C (221°F) or greater electrical relative thermal index for the minimum thickness employed in the coil form or insulating part need not be subjected to this conditioning.

66.2.2 Three representative motors shall be subjected to this test. The motors are to be placed for a period of seven hours in an air circulating oven in which the temperature is maintained at 100°C (212°F).

66.2.3 Following the conditioning described in 66.2.2, each motor shall withstand without breakdown the application of the dielectric voltage withstand potential specified in the Dielectric Voltage-Withstand Test, Section 37, between coil windings and the metal laminations or other dead metal parts.

66.3 Abnormal conditioning

66.3.1 After being subjected to the abnormal conditioning described in 66.3.2, a thermoplastic coil form or thermoplastic insulating material used in motors shall comply with the following conditions:

a) The integrity of the material shall be such that the 3-ampere fuse specified in 66.3.2 remains intact during the test; and

b) Any molten metal or flaming shall be confined within the enclosure of the electrical equipment in which the electrical component is used.

66.3.2 One representative appliance is to be subjected to the following conditioning. After the rotor or armature of the motor has been restricted from moving, the windings are to be energized by applying the rated voltage. During the test, noncurrent-carrying metal parts of the motor that are insulated by the material under test are to be connected to ground through a 3-ampere, quick-acting fuse. The conditioning is to be continued for 7 hours or until:

a) Burnout of the motor occurs as a result of a winding opening, insulation melting, or the like;

b) A reliable, nonuser-serviceable, protective device, such as a fuse, functions; or

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c) The maximum-size branch-circuit protective device used to protect the circuit to which the equipment is likely to be connected, and which is not rated less than 20 amperes, functions.

66.3.3 While still in a well-heated state following the conditioning described in 66.3.2 the appliance shall withstand without breakdown the application of the dielectric voltage withstand potential specified in the Dielectric Voltage-Withstand Test, Section 37. The dielectric potential is to be applied between current-carrying parts and accessible dead-metal parts of the appliance. The 3-ampere fuse is to be removed from the circuit during the application of the test potential.

66.4 Running-burnout conditioning

66.4.1 A thermoplastic coil form or thermoplastic insulating material employed in a motor with a stalled-rotor current greater than twice the normal operating current shall comply with all of the following after the running-burnout conditioning described in 66.4.2:

a) The 3-ampere fuse described in 66.4.2 shall remain intact during the test.

b) The thermoplastic insulating material shall show no appreciable softening or melting to affect spacing.

c) Any molten metal or flaming shall be confined within the enclosure of electrical equipment within which the motor is used.

Exception: This test is not required to be conducted if the abnormal conditioning (stalled-rotor test) described in 66.3 continues for 7 hours without the occurrence of 66.3.2 (a), (b), or (c).

66.4.2 Three representative appliances are to be subjected to this test. Each appliance is to be run without a load for 1 hour, immediately followed by operation at normal load for 1 hour. Immediately following this, the load is to be increased in steps of 10 percent of the rated current for each of four successive 1-hour periods, followed by two 1/2-hour periods, followed by eight 1/4-hour periods, followed by such additional periods of 5 minutes until the motor burns out. During the test, noncurrent-carrying metal parts of the motor that are insulated by the material under test are to be connected to ground through a 3-ampere, quick-acting fuse.

Exception No. 1: A motor which burns out in less than 1 hour of a no-load condition meets the intent of the requirement.

Exception No. 2: The test is not prohibited from being conducted on the motor itself when the construction of the appliance is such that the appliance motor is unable to be loaded to achieve burnout.

66.4.3 While still in a well-heated state following the conditioning described in 66.4.2 the appliance shall withstand without breakdown the application of the dielectric voltage withstand potential specified in the Dielectric Voltage-Withstand Test, Section 37. The dielectric potential is to be applied between current-carrying parts and accessible dead-metal parts of the appliance. The 3-ampere fuse is to be removed from the circuit during the application of the test potential.

66.4.4 The functioning of an over-temperature or overcurrent protective device is considered to be acceptable provided the appliance still complies with the requirements in 66.4.1 and 66.4.3.

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MANUFACTURING AND PRODUCTION TESTS

67 Dielectric Voltage-Withstand Test

67.1 Each appliance shall withstand without breakdown as a routine production-line test, the application of an AC potential at a frequency within the range of 40 – 70 hertz or a DC potential between:

a) The primary wiring, including connected components, and accessible metal parts that are capable of becoming energized; and

b) Primary wiring and accessible low voltage (42.4 V peak or less) metal parts, including terminals.

67.2 The production-line test shall be conducted in accordance with either Condition A or Condition B of Table 67.1.

Table 67.1
Production-Line Test Conditions

Rating of motor employed by appliance, horsepower	Condition A			Condition B		
	Potential, volts AC	Potential, volts DC	Time, seconds	Potential, volts AC	Potential, volts DC	Time, seconds
1/2 horsepower or less	1000	1400	60	1200	1700	1
More than 1/2 horsepower	1000 + 2V[a]	1400 + 2.8V[a]	60	1200 + 2.4V[a]	1700 + 3.4V[a]	1

[a] Maximum rated voltage.

67.3 For an electric knife or wand-type mixer the test potential shall be:

a) 2500 V AC or 3500 V DC applied for one minute,

b) or 3000 V AC or 4200 V DC applied for one second.

67.4 The appliance may be in a heated or unheated condition for the test.

67.5 The test shall be conducted with the appliance complete – fully assembled. It is not intended that the appliance be unwired, modified, or disassembled for the test.

Exception No. 1: Parts such as snap covers or friction-fit knobs that would interfere with the performance of the test need not be in place.

Exception No. 2: The test may be performed before final assembly if such a test represents testing the complete appliance.

67.6 If the appliance employs a solid-state component that can be damaged by the test potential, the test on each appliance may be conducted before the component is electrically connected. In such a case, additional testing is to be made of a random sampling of each day's production with the circuitry rearranged to reduce the likelihood of damage to any solid-state component but retaining representative dielectric stress of the circuit.

67.7 The test equipment when adjusted for production-line testing, is to produce an output voltage that is not less than the factory test value specified, nor is the magnitude of the test voltage to be greater than 120 percent of the specified test potential when the tester is used in each of the following conditions:

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a) If the test duration is one second, the output voltage is to be maintained within the specified range:

1) When only a voltmeter having an input impedance of at least 2 megohms and a specimen of the product being tested are connected to the output terminals; and

2) When a relatively high resistance is connected in parallel with the voltmeter and the product being tested, and the value of the resistance is gradually reduced to the point where an indication of unacceptable performance just occurs.

b) If the test duration is one minute, the output voltage is to be maintained within the specified range, by manual or automatic means, throughout the one minute duration of the test or until there is an indication of unacceptable performance.

67.8 The specified control of the applied voltage, manual or automatic, shall be maintained under conditions of varying line voltage. Higher test potentials may be used if the higher dielectric stress is not likely to adversely affect the insulating systems of the product.

67.9 In addition to the characteristics indicated in 67.7, the test equipment is to have the following features and characteristics:

a) A means of indicating the test voltage that is being applied to the appliance under test. This may be accomplished by sensing the voltage at the test leads or by an equivalent means.

b) An output voltage that:

1) Has a sinusoidal waveform;

2) Has a frequency that is within the range of 40 – 70 Hz; and

3) Has a peak value of the waveform that is not to be less than 1.3 and not more than 1.5 times the root-mean-square value.

c) A means of effectively indicating unacceptable performance. The indication is to be:

1) Auditory if it can be readily heard above the background noise level;

2) Visual if it commands the attention of the operator; or

3) A device that automatically rejects an unacceptable product.

If the indication of unacceptable performance is auditory or visual, the indication is to remain active and conspicuous until the test equipment is reset manually.

d) When the test equipment is adjusted to produce the test voltage and a resistance of 120,000 ohms is connected across the output, the test equipment is to indicate an unacceptable performance within 0.5 second. A resistance of more than 120,000 ohms may be used to produce an indication of unacceptable performance, if the manufacturer elects to use a tester having higher sensitivity.

Exception: The sensitivity of the test equipment may be reduced, a lower value of resistance may be used, when testing an appliance intended to be permanently wired.

67.10 There is not to be any transient voltage applied to the appliance under test that results in the instantaneous voltage applied to the product exceeding 120 percent of the peak value of the test voltage that the manufacturer elects to use for this test. This requirement applies for the entire duration of the test,

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including the time that the voltage is first applied to the product and the time that the voltage is removed from this product.

67.11 During the test, enough of the primary switching components shall be in the ON position so that all primary circuitry will be stressed. Both sides of the primary circuit of the appliance are to be connected together to one terminal of the test equipment. The second equipment terminal is to be connected to accessible metal.

Exception: Appliances utilizing motors, relays, coils or transformers, having circuitry not subject to excessive secondary build-up in case of indication of unacceptable performance during the test, may be tested with only one side of the primary circuit connected to the dielectric test equipment.

68 Grounding Continuity Test

68.1 Each cord-connected appliance having provision for grounding shall be tested, as a routine production-line test, to determine grounding continuity between the grounding blade of the attachment plug and the accessible metal parts of the appliance that are likely to become energized.

68.2 Only a single test need be made if the accessible metal selected is conductively connected by design to all other accessible metal.

69 Polarization Test

69.1 As a routine production-line verification, each cord-connected appliance provided with a 2-wire polarized or 3-wire grounding attachment plug, shall be examined or tested for electrical continuity between the ungrounded circuit supply conductor of the attachment plug (see Figure 10.1 for attachment plug blade connections) and all components intended to be connected to the ungrounded conductor. If the continuity cannot be readily determined by visual inspection and component checking, an electrical continuity test is to be conducted.

70 Electrical Indicating Device

70.1 Any indicating device (an ohmmeter, a battery-and-buzzer combination, or the like) may be used to determine compliance with the continuity requirements in 68.1 and 69.1.

MARKINGS

71 General

71.1 An appliance shall be plainly marked where readily visible with:

a) The manufacturer's name, trade name, or trademark;

b) The date or other dating period of manufacture not exceeding any three consecutive months;

c) A distinctive catalog number or the equivalent; and

d) The electrical rating.

A date-code repetition time cycle shall not be less than 10 years.

Exception No. 1: The manufacturer's identification may be in a traceable code when the appliance is identified by the brand or trademark owned by a private labeler.

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Exception No. 2: The date of manufacture may be abbreviated or in an established accepted code, or a code affirmed by the manufacturer. The code shall not require reference to the manufacturer's records to determine when the appliance was produced.

71.2 With respect to 71.1, the date code marking may be die-stamp impressed, etched, or engraved on the power supply cord or attachment plug, provided that:

a) The appliance is not provided with a detachable power supply cord;

b) The recessed impression is no deeper than is needed for legibility;

c) The marking process does not emboss or raise the surface of the blade;

d) The specific dimensions of the blade, or configuration with respect to the plug face, are not altered during the marking process; and

e) The appliance shall not include instructions for removal, replacement or servicing of the supply cord or attachment plug, nor for conversion of the plug for different voltages (see 75.2 and 77.4).

71.3 An appliance shall be marked, where readily visible, to indicate that the appliance is intended for household type usage, such as, "Household Use Only", "Household Type", and the like. Lettering shall not be less than 3/32 inch (2.4 mm) high.

Exception: An appliance that has been evaluated for a household and commercial application may be marked "Household and Commercial Use", if such use is intended.

71.4 The electrical rating shall include the voltage, frequency, and input amperes or watts. An appliance, other than a battery-operated appliance, shall be provided with a rated voltage between 110 – 120 V, or shall be provided with a voltage range that includes 120 V. The ampere rating shall be included unless the full-load power factor is 80 percent or more or, for a cord-connected appliance, unless the rating is 50 W or less.

71.5 A required marking shall be permanent (see 72.1.5) and shall comply with the Standard for Marking and Labeling Systems, UL 969. The markings shall be located on a part that cannot be removed without impairing the operation of the appliance unless the requirement specifically indicates otherwise.

71.6 A motorized, hand-supported part of a battery-type appliance shall be marked with the name or other identification of the manufacturer, and with the catalog number or equivalent indication of the appliance with which it is intended to be used, unless the part is integral with or is permanently electrically connected to the appliance.

71.7 If a manufacturer produces or assembles appliances at more than one factory, each finished appliance shall have a distinctive marking – which may be in code – by means of which it may be identified as the product of a particular factory.

71.8 If the design of an appliance contemplates cleaning or servicing (such as the replacement of pilot lamps or fuses) by the user, and if such cleaning or servicing would involve the exposure of a normally enclosed or protected live part to unintentional contact, the appliance shall be plainly marked to indicate that such servicing or cleaning be done with the appliance disconnected from the supply circuit.

Exception: The marking for a lampholder may be placed inside the lamp compartment.

71.9 If an appliance will not start and attain normal running speed when connected to a circuit protected by an ordinary (not a time-delay) fuse as described in 34.1.1, the appliance shall be plainly marked with

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