UL 2999

STANDARD FOR SAFETY

Individual Commercial Office Furnishings

UL Standard for Safety for Individual Commercial Office Furnishings, UL 2999

First Edition, Dated May 22, 2020

Summary of Topics

This is the First Edition of ANSI/UL 2999, Standard for Individual Commercial Office Furnishings and is an ANSI affirmed American National Standard.

The new requirements are substantially in accordance with Proposal(s) on this subject dated July 5, 2019 and February 7, 2020.

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Standard for Individual Commercial Office Furnishings

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This ANSI/UL Standard for Safety consists of the First Edition.

The most recent designation of ANSI/UL 2999 as an American National Standard (ANSI) occurred on May 22, 2020. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

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

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INTRODUCTION

1 Scope

1.1 These requirements cover individual commercial office furnishings. The products are used in accordance with the National Electrical Code, ANSI/NFPA 70. They are intended for dry locations only. These furnishings include both electrified and non-electrified and may include, but not limited to:

a) Motor-operated tables and desks;

b) Tables and desks (non-motor-operated);

c) Storage Cabinets;

d) Seating;

e) Bench Systems; and

f) Motorized adjustable carts and stands for audio/video equipment.

1.2 These requirements cover products rated 600 V ac or less.

1.3 Furnishings intended for the small office or homes shall be evaluated to the Standard for Household and Commercial Furnishing, UL 962.

1.4 Office furnishing panel systems are covered by the Standard for Office Furnishings, UL 1286.

1.5 A non-motorized furnishing only intended to support audio/video equipment shall be evaluated in accordance with one of the following:

a) If the audio/video support system is an entertainment center, cart, or a stand and it is intended for support or attachment of audio/video equipment, the Standard for Household, Commercial, and Institutional-Use Carts, Stands and Entertainment Centers for Use with Audio and/or Video Equipment, UL 1678;

b) If the audio/video support system is intended to be mounted to walls or ceilings as the primary support means and not supported by the floor, the Standard for Wall- and Ceiling-Mounts and Accessories, UL 2442;

c) If a cart, stand or support surface is supplied with the audio or video equipment by the manufacturer of the audio or video equipment, the requirements contained in the Standard for Audio, Video, and Similar Electronic Apparatus – Safety Requirements, UL 60065, 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; applies as applicable to the product;

d) Information Technology and Communications Equipment Cabinets, Enclosure and Rack Systems are investigated to 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.

1.6 Prefabricated rooms, booths, and pods shall be evaluated to the Standard for Household and Commercial Furnishing, UL 962.

2 Glossary

2.1 For the purpose of this standard the following definitions apply.

2.2 ACCESSIBLE PART – A part located so that it is able to be contacted by a person, either directly or by means of the probe illustrated in Figure 13.1.

2.3 ACCESSORY – An optional part that electrically and/or mechanically interfaces with the basic furnishing and is intended to be attached to the furnishing by the user or installer. Subassemblies field assembled to form the basic furnishing are not accessories.

2.4 APPLIANCE CONNECTOR – The mating part of the appliance coupler integral with, or intended to be attached to, the power supply cord.

2.5 APPLIANCE COUPLER – A means of enabling the connection and disconnection at will, of a cord to an appliance or other equipment. It consists of two parts: an appliance connector and an appliance inlet.

2.6 APPLIANCE INLET – The mating part of the appliance coupler integrated or incorporated in the appliance or equipment or intended to be fixed to it.

2.7 APPURTENANCE – Accessory objects on a furnishing such as a door, drawer, or a sliding work surface.

2.8 ATTENDED – When an individual is physically present where the furnishing is, is able to see the complete furnishing, and the area around the furnishing.

2.9 BATTERY – General term for:

a) Any single cell; or

b) A group of cells connected together either in a series and/or parallel configuration.

May be ready for use or may be an installed component. The term "battery(ies)" shall refer to single or multi-cell batteries.

2.10 BATTERY PACK – A battery which is ready for use, contained in a supplemental rigid enclosure, with or without protective devices.

2.11 BATTERY, PRIMARY – A battery that can only be discharged once. It is not designed to be electrically recharged and must be protected from a charging current.

2.12 BATTERY, SECONDARY – A battery that is intended to be discharged and recharged many times.

2.13 BATTERY, TECHNICIAN-REPLACEABLE – A battery intended for use in a product in which service and replacement of the battery will be done only by a person who has been trained to service and repair the product.

2.14 BATTERY, VENTED – A lead acid storage battery the electrodes of which are made of lead and the electrolyte consists of a solution of sulfuric acid in which the products of electrolysis and evaporation are allowed to escape freely to the atmosphere. These batteries have commonly been referred to as flooded or wet.

2.15 BELLOWS – A telescoping guard that hinders someone from contacting a hazardous part.

2.16 BENCHING SYSTEM – A series of primary surfaces interconnected longitudinally to a length greater than 72 inches by an integrated/shared support structure to extend the span of the overall surface.

2.17 BONDED (BONDING) – The permanent joining of metallic parts to form an electrically conductive path that provides electrical continuity and the capacity to conduct any current likely to be imposed without a risk of electric shock, fire, or injury to persons.

2.18 BRANCH CIRCUIT – The circuit conductors between the final over current device protecting the circuit and the outlet(s).

2.19 BRANCH CIRCUIT, MULTIWIRE – A branch circuit that consists of two or more ungrounded conductors that have a voltage between them, and a grounded conductor that has equal voltage between it and each ungrounded conductor of the circuit and that is connected to the neutral or grounded conductor of the system.

2.20 CARTON – A carton is a box or envelope of cardboard, pasteboard, shrink film, or similar material (but not newspaper, wrapping paper, tissue paper, or similar paper products) in which a product or parts of a product are packaged for shipment.

2.21 CELL, COMPONENT – The basic functional electrochemical unit containing an assembly of electrodes, electrolyte, container, terminals, and usually separators, that is a source of electrical energy by direct conversion of chemical energy. May be ready for use or may be provided as component of battery pack.

2.22 CHANNEL – A passage intended for the routing and holding of communication wiring, low-voltage wiring, and wiring having functional insulation plus a layer of supplementary insulation. A channel is not required to provide mechanical protection and is not evaluated as an enclosure.

2.23 CLASS 2 CIRCUIT – A circuit having power and voltage limitations as defined in the Article 725 of National Electrical Code, ANSI/NFPA 70 Such a circuit shall comply with:

a) The Standard for Low Voltage Transformers – Part 3: Class 2 and 3 Transformers, UL 5085-3; or

b) The Standard for Class 2 Power Units, UL 1310.

2.24 COMMERCIAL – A place in which business is transacted, such as an office building, factory, warehouse, retailer, or similar location, and which is not a residence. It also includes institutions.

2.25 CONNECTOR, UNIT-TO-UNIT MECHANICAL – An assembly that is used to connect two or more adjacent units for the purpose of providing mechanical support between the units.

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

2.27 2.27 CONTROL, AUXILIARY – A device or assembly of devices that provides a functional utility, is not relied upon as an operational or protective control, and therefore is not relied upon for safety. For example, an efficiency control not relied upon to reduce the risk of electric shock, fire, or injury to persons during normal or abnormal operation of the end product is considered an auxiliary control.

2.28 CONTROL CIRCUIT – A system of components that may include programmable logic devices other than a thermal protector or a motor current protector that has the ability to detect the condition of a furnishing's operation or that controls a furniture function.

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

2.30 CONTROL, OPERATING – A device or assembly of devices, the operation of which starts or regulates the end product during normal operation. For example, a thermostat, a thermal cutout/limiter or another layer of protection, the failure of which would reduce the risk of electric shock, fire, or injury to persons, is considered an operating control.

2.31 CONTROL, PROTECTIVE (limiting) – A device or assembly of devices, the operation of which is intended to reduce the risk of electric shock, fire or injury to persons during normal and reasonably anticipated abnormal operation of the appliance. For example, a thermal cutout/limiter, or any other control/circuit relied upon for normal and abnormal conditions, is considered a protective control.

2.32 CONTROL, TYPE 1 ACTION – The actuation of an automatic control for which the manufacturing deviation and the drift (tolerance before and after certain conditions) of its operating value, operating time, or operating sequence has not been declared and tested in accordance with the Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1.

2.33 CONTROL, TYPE 2 ACTION – The actuation of an automatic control for which the manufacturing deviation and the drift (tolerance before and after certain conditions) of its operating value, operating time, or operating sequence have been declared and tested in accordance with the Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1.

2.34 CORD CONNECTOR (convenience outlet) – A female contact device that is wired or molded on flexible cord and intended to be installed as part of an office furnishing wiring system to supply current to utilization equipment.

2.35 CRITICAL COMPONENTS – Any component that if changed may have an effect on the performance of the furnishing or that is restricted by the construction requirements

2.36 DAISY CHAIN – A series of cord connected products with receptacles that are plugged into another product with receptacles, which is then plugged into a building outlet. One example would be a Furniture Power Distribution Unit (FPDU) plugged into another FPDU.

2.37 DEAD METAL PART – Any metal part that is not intended to carry current.

2.38 DECORATIVE PART – A part that does not serve any function, such as mechanical support or for electrical protection. It is just there for aesthetics.

2.39 DIRECT AND INDIRECT CONTACT OF LIVE PARTS – A non-metallic part is considered in direct contact of a live part when it is touching the live part or within 1/32 inch (0.8 mm) of the live part. Indirect contact is when a non-metallic part is supporting another non-metallic material that is in direct contact with a live part.

2.40 ELECTRICAL CONNECTING ASSEMBLY TYPES – Electrical systems intended for office furnishing systems. Specific types include:

a) BASE FEED – An electrical assembly that contains supply conductors used to provide electrical power from a branch-circuit electrical supply located in the floor, column or wall of the building structure to the base of the office furnishing starter unit.

b PASS-THROUGH UNIT – An electrical assembly without any means for connection of utilization equipment and used to pass electrical power through a unit.

c) TOP FEED – An electrical assembly that contains the electrical supply conductors used to provide electrical power from a branch-circuit electrical supply located in the ceiling or wall of the building structure to the office furnishing starter unit.

d) UNIT-TO-UNIT – An electrical assembly that is used to electrically interconnect two adjacent mechanically connected units.

e) SYSTEMS JUMPER – An electrical connection assembly that is used for the interconnection of office furnishing electrical systems and manufactured wiring systems.

f) SYSTEM-TO-SYSTEM ADAPTER – An electrical connection assembly that is used for the interconnection of one type or configuration of office furnishing electrical system to a different type or configuration of office furnishing electrical system.

2.41 ENCLOSURE – A container that holds the electrical components and serves as an electrical and mechanical enclosure.

2.42 ENCLOSURE, ELECTRICAL – That part of the product that:

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

b) Retards propagation of flame initiated by electrical disturbances occurring within.

2.43 ENCLOSURE, MECHANICAL – A part of the equipment intended to reduce the risk of injury due to mechanical and other physical hazards.

2.44 ENTRAPMENT ENVIRONMENTS:

a) USAGE AREA I – An area where children or people with cognitive disabilities are anticipated to be present and likely not constantly supervised. Examples include residences, hotel rooms, retail stores, theaters, restaurants, and classrooms.

b) USAGE AREA II – An area where children or people with cognitive disabilities are anticipated to be present, but the furnishings are locked out and only operated by a trained person. Examples include medical exam rooms, customer service areas, and retail sales areas, such as carpet dispensers.

c) USAGE AREA III – An area where it is anticipated adults with normal cognitive abilities are present, trained to use the furnishings present, and children or people with cognitive disabilities are rarely present or if present are closely supervised, such as in a commercial office.

2.45 FIELD-WIRING TERMINAL – A terminal to which a conductor is intended to be connected in the field.

2.46 FUNCTIONAL LOAD – A level of loading intended to be typical of hard use.

2.47 FURNISHING SUPPORT SYSTEM – A system of components intended to secure a furnishing to the building or other structure.

2.48 FURNISHING TYPES:

a) FIXED FURNISHING – Intended to be permanently connected electrically to a source of supply and the building.

b) PORTABLE FURNISHING – A small furnishing that meets all of the following:

1) Not secured to the building structure unless provided with a securement means that allows the furnishing to be removed without the use of tools;

2) Connected electrically to an electrical source of supply with a power supply cord and plug; and

3) Likely to be frequently relocated, without the use of tools or equipment, due to its small size and weight. A product with a mass exceeding 40 lbs (18 kg) is not generally considered to be portable.

c) STATIONARY FURNISHING –

1) Connected electrically to an electrical source of supply with a power supply cord and plug; and

2) Unlikely to be frequently relocated due to size, weight or configuration or intended to be fastened in place requiring tools for removal.

2.49 FURNITURE POWER DISTRIBUTION UNIT – An outlet assembly that complies with the Standard for Furniture Power Distribution Units, UL 962A.

2.50 GROUND – A conducting connection, whether intentional or accidental, between an electrical circuit or equipment and the earth or to some conducting body that serves in place of the earth.

2.51 GROUNDED – Connected to earth or to some conductive body that serves in place of earth.

2.52 GROUNDED CONDUCTOR – A system or circuit conductor that is intentionally grounded.

2.53 GROUNDING CONDUCTOR EQUIPMENT – The conductive path(s) that provides a ground-fault current path and connects normally non-current-carrying metal parts of equipment together and to the system grounded conductor or to the grounding electrode conductor, or both.

2.54 INDIVIDUAL OFFICE FURNISHING – A furnishing used for conducting business in an office that is intended to stand alone or be mechanically and electrically connected to another individual office furnishing.

2.55 INSULATION, BASIC – Insulation applied to live parts to provide basic protection against electric shock.

2.56 INSULATION, SUPPLEMENTARY – A separate layer of insulation that is provided in addition to the basic insulation to reduce the risk of electric shock in the event of breakdown of the basic insulation.

2.57 ISOLATED SECONDARY CIRCUIT – A circuit derived from an isolated secondary winding of a transformer and that has no direct connection back to the line-connected circuit (other than through grounding means). A secondary circuit that has a direct connection back to the line-connected circuit is determined to be part of the line-connected circuit.

2.58 LED – Light Emitting Diode

2.59 LEAKAGE CURRENT – All currents, including capacitively coupled currents, that flow through a person upon contact between accessible conductive surfaces of a product and ground or other accessible surfaces of the product.

2.60 LIMITED POWER SOURCE (LPS) – A limited power source is as defined in the Standard for Information Technology Equipment – Safety – Part 1: General Requirements, UL 60950-1, and shall comply with the requirements of UL 60950-1.

2.61 LINE OF SIGHT – The ability to see the furnishing so that the user can observe the furnishing is moving to make sure that it will not harm anyone in the area.

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

2.63 LIVE PART – Any part where current is flowing.

2.64 LOADING:

a) FULLY LOADED – Where the furnishing has the complete test load on the product.

b) PARTIALLY LOADED – The furnishing is partially loaded. It may have a load anywhere greater than zero (unloaded) or less than the complete test load (Fully Loaded).

c) UNLOADED – Where the furnishing has no load being held by the product.

2.65 LOCATION, DRY – A location not normally subject to dampness, but may include a location subject to temporary dampness, as in the case of a building under construction, provided ventilation is adequate to prevent an accumulation of moisture.

2.66 LOCKED-ROTOR – The armature or rotor is prevented from rotating.

2.67 LOW-VOLTAGE CIRCUIT – A circuit involving a potential of not more than 30 volts alternating current (42.4 peak) open circuit supplied by a primary battery, by a Class 2 transformer, or by a combination of a transformer and a fixed impedance that as a unit, complies with all performance requirements for a Class 2 transformer. A circuit derived from a line-voltage circuit by connecting a resistance in series with the supply circuit as a means of limiting the voltage and current, is not considered to be a low voltage circuit.

2.68 MATTRESS – A pad used for sleeping.

2.69 MIU – Measurement Indication Unit. In the past, leakage current values have been given in milliamperes (mA), however the term Measurement Indication Unit (MIU) is being adopted in conformance with the latest edition of the American National Standard for Leakage Current for Appliances, ANSI C101-1992. The term MIU refers to the numerical indication of a defined measurement instrument. The MIU unit is related to the level of physiological effect produced by body current, independent of frequency. The MIU coincides numerically with milliamperes only at low frequencies. At high frequencies, the milliamperes flowing through the instrument can significantly deviate. Therefore, the term MIU has been selected instead of milliamperes for measurement of leakage current.

2.70 MODULAR WIRING SYSTEMS FOR OFFICE FURNITURE – See Electrical Connecting Assemblies, 2.34.

2.71 NORMAL USE – The intended function applied by the user or operator utilizing the installation and operation instructions for the furnishing.

2.72 OFFICE FURNISHING PANEL SYSTEM – Consists of panels, study carrels, work stations and pedestal-style systems that are mechanically interconnected to form an office furnishing system to be installed in accordance with Article 605 of the National Electrical Code, ANSI/NFPA 70. They may be provided with an electrical distribution system, including switches and receptacles. They may contain channels for routing communication cable within the system components separate from power-circuit raceways. The systems may include filing cabinets, desks, work surfaces, shelves, storage units, etc., that

have a particular electrical or mechanical function unique to an office furnishing system. These types of furnishing systems are covered by the Standard for Office Furnishings, UL 1286.

2.73 PANEL – A flat or curved surface that controls and/or defines space; provides privacy and a means for hanging components.

2.74 PORTABLE LUMINAIRE – A portable luminaire is a cord and plug connected luminaire that provides illumination for a room or specific area and is able to be moved to a new location with or without the use of readily available tools.

2.75 PROOF LOAD – A level of loading or force in excess of hard use.

2.76 PUBLIC OCCUPANCIES – Include but are not limited to health care facilities, old age convalescent and care homes, college dormitories, residence halls, jails, prisons, nursing care homes, public auditoriums, hotels and motels.

2.77 RACEWAY – An enclosure (See 2.35) that is intended specifically for mechanical, fire, and electrical protection for the internal system wiring.

2.78 RECEPTACLE, CONVENIENCE (convenience outlet) – A female contact device intended to be installed as part of an office furnishing to supply current to utilization equipment, which is used to plug in electrical products that are not provided with the furnishing, but connected by users in the field, and unused when the furnishing is shipped and generally easily accessible to the user for this purpose.

2.79 RELOCATABLE POWER TAP (RPT) – An outlet assembly that complies with the Standard for Relocatable Power Taps, UL 1363 and is considered for temporary use.

2.80 REMOTELY CONTROLLED – The ability to control a furnishing that is out of sight of the operator.

2.81 RFID – Radio-frequency identification.

2.82 RISK OF ELECTRIC SHOCK – A risk of shock is considered to exist at parts accessible to the user or operator in a normally dry location during the intended use or servicing if the voltage exceeds 42.4 Vac peak (the peak voltage of a 30-Vac sine wave), 60 Vdc and in a normally wet location if the voltage exceeds 21.2 Vac peak (the peak voltage of a 15-Vac sine wave), 30 Vdc and the available current exceeds the leakage current levels specified in Leakage Current Test, Section 61.

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

2.84 SAFETY CIRCUIT – A control circuit designed to guard against or mitigate risk of fire, shock or personal injury.

2.85 SAFETY EXTRA LOW VOLTAGE (SELV) CIRCUIT – An isolated secondary circuit that under normal operating conditions and single fault conditions provides a voltage that is 30 V rms (42.4 V peak) or 60 V DC or less. The current may exceed Class 2 limitations. These circuits are derived from a source evaluated to the SELV requirements in the Standard for Information Technology Equipment – Safety – Part 1: General Requirements, UL 60950-1 for the application of these requirements.

2.86 SCREEN – Non-load-carrying space divider that is less than ceiling height and does not carry power.

2.87 SECURITY LOCKOUT DEVICE – A device that prevents unauthorized users from operating the equipment, such as a lock and key, or a keypad with a code.

2.88 SMART DEVICE – A device that has the ability to run software such as a smart phone.

2.89 STARTER UNIT – The piece of furnishings that is connected to the external supply source and that potentially has provision for electrical connection of additional portions of a furnishing system. The starter unit is located as the first unit in the system.

2.90 SUB-ASSEMBLY – An individual component or a group of components that when all of the sub-assemblies are combined form the completed furnishing. Sub-Assemblies are normally used when the sub-assemblies are shipped from different manufacturing locations and are assembled in the field by the user or installer.

2.91 SUSPENDED FURNISHING – A furnishing that is suspended from a ceiling or wall and is not supported by the floor.

2.92 TABLE/DESK ELECTRICAL SYSTEM – A cord and plug electrical system with receptacles that is provided with overcurrent protection and designed to limit the total number of receptacles that can be daisy chained.

2.93 TIP OVER – The condition where the unrestricted unit will not return to its normal upright position.

2.94 UPHOLSTERED FURNISHING OR FURNITURE – Furnishings / Furniture that is provided with coverings, padding, webbing and/or springs, to be used as a seat or other supporting means for a person.

2.95 VENTING – A condition that occurs when the battery or cell releases excessive internal pressure in a manner intended by design to preclude rupture, explosion or self-ignition.

2.96 VIDEO MOUNTING SYSTEM TYPES:

a) ADJUSTABLE MOUNT – A mounting system designed with components that may be adjusted once, infrequently or requires a tool be used for adjustment and is intended to support the video display in a fixed position after assembly and installation.

b) ARTICULATING MOUNT – A mounting system intended to allow active movement, adjustment, and repositioning, after installation.

c) MONITOR ARM – A device identified to support a computer video display that is in turn supported by or secured to a desk or table.

d) WORK SURFACE – A horizontal surface used to perform tasks and/or for storage space.

2.97 WORKING PRESSURE – The maximum system pressure measured during normal operating conditions. When more than one pressurized system is provided the furnishing is capable of having multiple working pressures.

3 Components

3.1 General

3.1.1 Except as indicated in 3.1.2, a component of products covered by this standard shall comply with the requirements for that component. See Annex A for a list of standards covering components used in the products covered by this standard, but it is not all inclusive.

3.1.2 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; or

b) Is superseded by a requirement in this standard.

3.1.3 A component shall be used in accordance with its rating established for the intended conditions of use. Intended use also includes how the component will be used. For instance, a portable power supply shall not be used on a stationary or fixed furnishing unless it can still be considered portable, which means that it can be easily disconnected from the power source and removed.

3.1.4 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.

3.1.5 Equipment in a Class 2 / LPS circuits shall comply with the safety requirements of a standard applicable to the equipment type. Examples of equipment and applicable Standards include:

a) Information, communication or audio/video product:

1) Standard for Audio, Video, and Similar Electronic Apparatus-Safety Requirements, UL 60065;

2) Standard for Information Technology Equipment – Safety – Part 1: General Requirements, UL 60950-1;

3) Standard for Safety for Audio/video, Information and Communication Technology Equipment – Part 1: Safety Requirements, UL 62368-1.

b) Wireless charging pad:

1) Standard for Induction Power Transmitters and Receivers for Use with Low Energy Products, UL 2738.

c) Luminaire:

1) Standard for Low Voltage Lighting Systems, UL 2108.

2) Standard for Portable Electric Luminaires, UL 153.

3.2 Batteries

3.2.1 General

3.2.1.1 Furnishings incorporating primary (non-rechargeable) batteries that are limited to a maximum of 15 watts total combined power under any condition of operation (Open Circuit, Loaded, and Short Circuit) and that meet the following requirements are not subjected to the performance tests:

a) AAAA, AAA, AA, C, D, or 9 V standardized single cell battery configurations; and

b) Are of a zinc-carbon, zinc-chloride, alkaline/manganese, or silver-oxide-type composition.

3.2.1.2 The process of installing or removing a battery from a furnishing or a remote control shall not cause the furnishing to operate in a manner that may cause personal injury.

3.2.1.3 Safe operation of the furnishing shall not be dependent upon the condition of the battery(ies) or stored power in the battery(ies) or battery circuit.

3.2.1.4 Batteries of a type other than specified in 3.2.1.2 shall comply with the requirements of the Standard for Household and Commercial Batteries, UL 2054, and if of the lead acid storage battery type, shall additionally comply with the Pressure Release Test, Flame Arrester and Vent Cap Tests in the Standard for Standby Batteries, UL 1989.

3.2.1.5 A battery shall be located and mounted so that the terminals of cells will be prevented from coming into contact with terminals of adjacent cells unless designed to do so or with metal parts of the battery compartment as the result of shifting of the battery. Cells constructed of conductive material shall be installed in trays of nonconductive material.

3.2.1.6 A battery shall be protected by an enclosure in accordance with 11.6 – 11.8.

3.2.2 Battery chargers and circuits

3.2.2.1 A battery charging circuit integral to the furnishing, a battery charger supplied with the furnishing, or available as an accessory to the furnishing operating at a Class 2 or LPS power output level shall comply with the applicable requirements. See 2.23 and 2.63, respectively.

3.2.2.2 A battery charging circuit integral to the furnishing, a battery charger supplied with the furnishing, or available as an accessory to the furnishing operating at above a Class 2 or LPS power output level shall comply with the requirements in the Standard for Power Units Other Than Class 2, UL 1012 or the Standard for Information Technology Equipment – Safety – Part 1: General Requirements, UL 60950-1, or the Standard for Audio/Visual, Information and Communication Technology Equipment – Part 1: Safety Requirements, UL 62368-1.

3.2.3 Non-replaceable batteries

3.2.3.1 A furnishing provided with a battery or batteries that are not intended to be replaced by the user shall be located within the furnishing enclosure such that it is inaccessible to the user.

3.2.4 Technician-replaceable batteries

3.2.4.1 A furnishing containing a battery or batteries that are only to be replaced by trained technicians shall be marked in accordance with 88.4 and shall include a statement in the instructions in accordance with 95.6.

3.2.5 Battery compartments

3.2.5.1 A battery compartment with replaceable batteries shall have no accessible contact with batteries, internal wiring or circuits in excess of Class 2 power and isolation. Accessibility is determined by the requirements in Section 13, Accessibility of Uninsulated Live Parts and Film-Coated Wire.

Exception: A battery compartment that allows access to batteries, internal wiring, circuits and components other than a Class 2 circuit shall:

a) If cord and plug connected – be provided with a caution marking (see 88.1), to disconnect all sources of power before opening the compartment. A circuit shall discharge any accessible electrical components in the battery compartment within 2 seconds; other than the battery; or

b) For a permanently connected furnishing – be provided with an interlock device that de-energizes and discharges any accessible electrical components within 2 seconds in the battery compartment; other than the battery; or

c) For a permanently connected furnishing – be provided with a disconnect switch that can be locked in the off position. When placed in the off position any accessible electrical components in the battery compartment shall be discharged within 2 seconds; other than the battery. Adjacent to the disconnect switch a caution marking (see 88.2) to disconnect all sources of power before opening the compartment.

3.2.5.2 A battery compartment provided with replaceable batteries shall comply with the requirements in 11.4, Mechanical Enclosure And Guards – Mechanical Considerations.

3.2.5.3 A furnishing that utilizes a battery that contains liquid or gel electrolyte shall be provided with a tray that is capable of retaining any liquid that could leak as a result of internal pressure build-up in the battery.

3.2.5.4 The battery tray capacity shall be at least equal to the volume of electrolyte of all the cells of the battery.

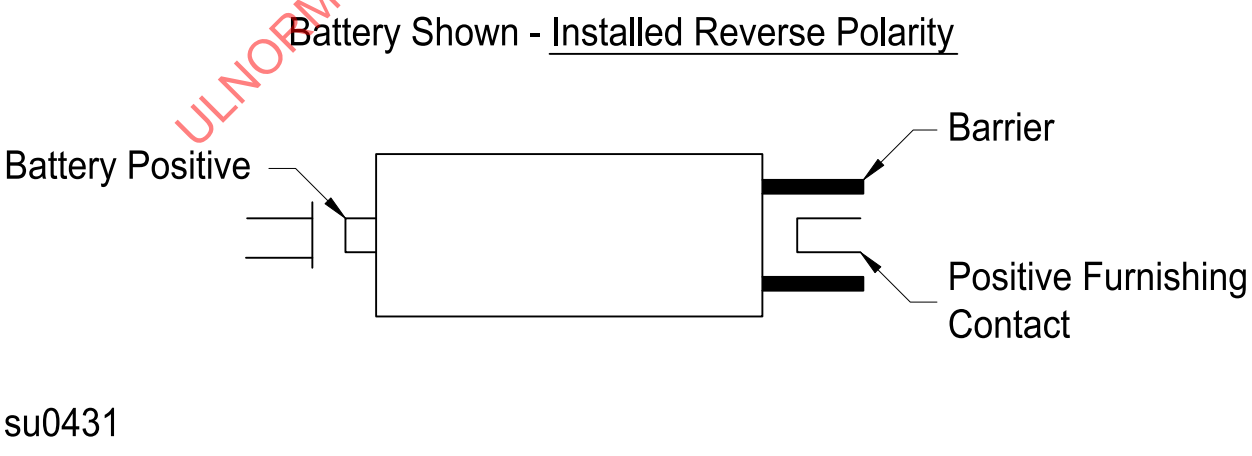
3.2.5.5 An enclosure or part of an enclosure that also serves as a compartment for a rechargeable vented battery shall be provided with ventilated openings to permit dispersion of gases from the battery.

3.2.5.6 A diagram indicating battery polarity installation shall be present in the battery compartment. Black conductor insulation shall be used for negative battery leads and red conductor insulation shall be used for positive battery leads if visible to the user or service person.

3.2.5.7 A battery holder or compartment where more than one AAAA, AAA, AA, C or D cells batteries or other battery configurations can be inadvertently installed in reverse polarity shall be provided with a means that prevents the negative battery terminal from making contact with the intended positive contact in the furnishing battery compartment. For example, a non-conductive barrier. See Figure 3.1.

Figure 3.1

Battery shown – Installed reverse polarity



3.2.6 Battery circuits

3.2.6.1 A current carrying conductor or component in the battery circuit shall be capable of carrying the full short circuit current of the battery without risk of fire or electric shock.

3.2.6.2 One of the following methods shall be used to determine compliance with 3.2.6.1:

a) Suitable overcurrent protective devices rated for the available current shall be installed in the circuit; or

b) Compliance with the requirements as outlined in Section 75, Abnormal – Tests.

3.2.7 Battery charging

3.2.7.1 A furnishing with replaceable (secondary) rechargeable batteries where it is possible to install the batteries in reverse polarity and when so doing completes the battery circuit shall be provided with back feed protection. The back feed protection may be either integral with the battery charger or the battery charging circuit within the furnishing.

3.2.7.2 The output characteristics of a battery charging circuit shall be compatible with its rechargeable battery. The instructions shall include reference to this as specified in 95.7.

3.3 Capacitors

3.3.1 A capacitor provided as a part of a capacitor motor and a capacitor connected across-the-line, such as a capacitor for radio-interference elimination or power-factor correction, shall be housed within an enclosure or container that protects the plates against mechanical damage and that reduces the risk of the emission of flame or molten material resulting from malfunction or breakdown of the capacitor. The container shall be of metal providing strength and protection not less than that of uncoated steel having a thickness of 0.020 inch (0.51 mm).

Exception: The individual container of a capacitor is able to be of sheet metal less than 0.020 inch (0.51 mm) thick or is able to be of material other than metal when the capacitor is mounted in an enclosure that houses other parts of the furnishing. The enclosure must be rated for use in enclosing live parts.

3.3.2 When the malfunction or breakdown of a capacitor results in a risk of fire, electric shock, or injury to persons, thermal or overcurrent protection shall be provided in the furnishing to reduce the risk of such a condition.

3.3.3 A capacitor connected from one side of the line to the frame or enclosure of a furnishing shall have a capacitance rating of not more than 0.10 microfarad.

3.3.4 A furnishing that is intended to be controlled by or operated in conjunction with a capacitor or a combination capacitor-and-transformer unit shall be supplied with such capacitor or unit.

3.3.5 Under both normal and abnormal conditions of use, a capacitor employing a dielectric medium more combustible than askarel shall not result in a risk of electric shock or fire and shall be protected against expulsion of the dielectric medium. A capacitor complying with the requirements for protected oil-filled capacitors in the Standard for Capacitors, UL 810, meets the intent of this requirement.

3.4 Connectors

3.4.1 A connector shall comply with one of the following:

a) The Standard for Attachment Plugs and Receptacles, UL 498;

b) The Standard for Insulated Multi-Pole Splicing Wire Connectors, UL 2459;

c) The Standard for Component Connectors for Use in Data, Signal, Control and Power Applications, UL 1977, provided the connector meets voltage and current requirements for the intended load and the material RTI is suitable for the maximum temperature on the connector developed in the Temperature Test. UL 1977 connectors shall meet minimum flammability class rating of HB, V-2, V-1,V-0, VTM-2, VTM-1, or VTM-0 and be suitable for direct contact of live parts (See Section 19, Materials in Direct and Indirect Contact of Live Parts);

d) A connector located in a SELV circuit that during the Section 64, Temperature Test does not exceed 50°C, shall be manufactured from a polymeric material with a minimum electrical RTI of 70°C, and complies with Materials in Direct and Indirect Contact of Live Parts, Section 19 for materials in direct contact of live parts; or

e) Any connector may be used located in a Class 2 or LPS circuit that during the Temperature Test, Section 64, does not exceed 50°C.

3.4.2 A furnishing with multiple Class 2 / LPS supply or load connections where interconnection could cumulatively exceed Class 2 / LPS limits shall be provided with polarized connectors that prohibit such interconnection.

3.4.3 Coaxial cable connectors shall not be used for connections.

3.4.4 Connectors that are part of an Office Furnishing Electrical Connecting Assemblies shall comply with the Standard for Office Furnishings, UL 1286.

3.4.5 Connectors that are part of a Table/Desk Electrical System shall comply with the Standard for Household and Commercial Furnishings, UL 962, or the requirements in 3.4.6.

3.4.6 Electrical mating connectors shall:

a) Be reliably keyed by a physical, mechanical or electronic means to maintain correct polarity between power-feed and interconnected parts;

b) Be rated 15 amps minimum;

c) Comply with the requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. Connectors totally enclosed in a metal raceway shall be classed HB and connectors not so enclosed shall be classed V-2 or less flammable in accordance with the Standard for Test for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94;

d) Have the grounding-terminal conductors connect before or at the same time as mating supply conductors connect when two or more connectors are being mated as intended. During disconnection of mating connectors, the supply conductors shall disconnect before or at the same time the grounding conductor disconnects;

e) Not subject mating parts to tension during normal use of the product;

f) Be latched or otherwise secured together to provide electrical continuity between mating parts. Connectors that are not provided with a mechanical latch shall be subjected to the minimum separation force portion of the Mating Connector Tests, Section 69; and

g) Be subjected to Section 67, Electrical Distribution Systems;

h) Shall maintain polarity throughout the system.

j) Standard IEC or NEMA style attachment plugs (for example ANSI/NEMA 5-15 or IEC-C13) shall not be used.

k) Electronically keyed systems shall comply with 3.5, Controls.

3.5 Controls

3.5.1 General

3.5.1.1 Controls shall not introduce a risk of electric shock, fire, or personal injury.

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

3.5.2 Auxiliary controls

3.5.2.1 Auxiliary controls shall be evaluated using the applicable requirements of this end product standard unless otherwise specified in this end product standard.

3.5.3 Operating controls

3.5.3.1 Operating (regulating) controls shall be evaluated using the applicable component standard requirements specified in 3.5.5 – 3.5.10 and the parameters in 3.5.3.3 – 3.5.3.4, unless otherwise specified in this end product standard.

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

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

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

c) The Standard for Safety of Household and Similar Electrical Appliances, Part 1: General Requirements, UL 60335-1, if motorized.

3.5.3.3 The following test parameters shall be among the items considered when judging the acceptability of an operating control investigated using the Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1:

a) Control action Types 1 or 2;

b) Unless otherwise specified this standard, manual and automatic controls shall be tested for 6,000 cycles with under maximum normal load conditions, and 50 cycles under overload conditions;

c) Installation class 2 in accordance with the Standard For Electromagnetic Compatibility (EMC) – Part 4-5: Testing And Measurement Techniques – Surge Immunity Test, IEC 61000-4-5;

d) For the applicable Overvoltage Category, see Table 3.1;

e) For the applicable Material Group, see Table 3.2; and

f) For the applicable Pollution Degree, see Table 3.3.

Table 3.1
Overvoltage categories

Furnishing type	Overvoltage category
Intended for fixed wiring connection	III
Portable and stationary cord-connected	II
Control located in low-voltage circuit	I
NOTE – 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 risk of fire or electric shock.	

Table 3.2
Material group

CTI PLC value of insulating materials	Material group
CTI ≥ 600 (PLC = 0)	I
400 ≤ CTI < 600 (PLC = 1)	II
175 ≤ CTI < 400 (PLC = 2 or 3)	IIIa
100 ≤ CTI < 175 (PLC = 4)	IIIb
NOTE – PLC stands for Performance Level Category, and CTI stands for Comparative Tracking Index as specified in the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A.	

Table 3.3
Pollution degrees

Furnishing control microenvironment	Pollution degree
No pollution or only dry, nonconductive pollution. The pollution has no influence. Typically hermetically sealed or encapsulated control without contaminating influences, or printed wiring boards with a protective coating can achieve this degree.	1
Normally, only nonconductive pollution. However, a temporary conductivity caused by condensation may be expected. Typically indoor appliances for use in household or commercial clean environments achieve this degree.	2
Conductive pollution, or dry, nonconductive pollution that becomes conductive due to condensation that is expected. Typically controls located near and may be adversely affected by motors with graphite or graphite composite brushes, or outdoor use appliances achieve this degree.	3

3.5.3.4 The following test parameters shall be among the items considered when judging the acceptability of an operating control investigated using other than the Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1:

a) Control action Types 1 or 2;

b) Unless otherwise specified in this standard, manual and automatic controls shall be tested for 6,000 cycles with under maximum normal load conditions, and 50 cycles under overload conditions;

c) For the applicable Overvoltage Category, see Table 3.1;

d) For the applicable Material Group, see Table 3.2; and

e) For the applicable Pollution Degree, see Table 3.3.

3.5.4 Protective controls

3.5.4.1 Protective (limiting) controls shall be evaluated using the applicable component standard requirements specified in 3.5.5 – 3.5.10, and as applicable, the parameters in 3.5.4.5 – 3.5.4.7.

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

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

b) The Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1, except Controls Using Software;

c) The Standard for Safety of Household and Similar Electrical Appliances, Part 1: General Requirements, UL 60335-1, if motorized.

3.5.4.3 Solid-state protective controls that rely upon software as a protective component shall comply with:

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

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

3.5.4.4 An electronic control that performs a protective function shall comply with the applicable requirements in this Section (Controls) while tested using the parameters in 3.5.4.5 – 3.5.4.7. Examples of protective controls are: a control used to sense abnormal temperatures of components within the appliance; an interlock function to de-energize a motor; temperature protection of the motor due to locked rotor, running overload, loss of phase; or other function intended to reduce the risk of electric shock, fire, or injury to persons.

3.5.4.5 The following test parameters and conditions shall be as specified when determining the acceptability of an electronic protective control investigated using the Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1:

a) Failure-Mode and Effect Analysis (FMEA) or equivalent Risk Analysis method;

b) Power Supply Voltage Dips, Variation and Interruptions within a temperature range of 10° C (18° F) and the maximum ambient temperature determined by conducting the Temperature Test, Section 64;

c) Surge Immunity Test – installation class 3 shall be used;

d) Electrical Fast Transient/Burst Test, a test level 3 shall be used;

e) Electrostatic Discharge Test;

f) Radio-Frequency Electromagnetic Field Immunity:

1) Immunity to conducted disturbances – When applicable, test level 3 shall be used; and

2) Immunity to radiated electromagnetic fields; field strength of 3 V/m shall be used;

g) Thermal Cycling Test shall be conducted at ambient temperatures of 10.0 ±2°C (50.0 ±3°F) and the maximum ambient temperature determined by conducting the Temperature Test, Section 64. The test shall be conducted for 14 days;

h) Overload shall be conducted based on the maximum declared ambient temperature (T_{max}) or as determined by conducting the Temperature Test, Section 64; and

i) If software is relied upon as part of the protective electronic control, it shall be evaluated as software class B.

3.5.4.6 The test parameters and conditions used in the investigation of the circuit covered by 3.5.3.4 shall be as specified in the Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991, using the following test parameters:

a) Supervised safety circuits as defined by UL 991 may not rely on a trouble signal or indicator to prevent the risk of injury;

b) A field strength of 3 V/m is to be used for the Radiated EMI Test;

c) Composite Operational and Thermal Cycling Tests in accordance with UL 991 is not required on indoor furnishings;

d) The Humidity Class is to be based on the appliance's intended end use and is to be used for the Humidity Test;

e) A vibration level of 5 g is to be used for the Vibration Test;

f) When a computational investigation is conducted, lp shall not be greater than 6 failures/106 hours for the entire system. For external secondary entrapment protection devices that are sold separately, lp shall not be greater than 0 failures/106 hours. For internal secondary entrapment protection devices whether or not they are sold separately, lp shall not be greater than 0 failures/106 hours. The Operational Test is to be conducted for 16 days;

g) The Endurance Test is to be conducted concurrently with the Operational Test. The control shall perform its intended function while being conditioned for 14 days in an ambient air temperature of 60°C (140°F), or 10°C (18°F) greater than the operating temperature of the control, whichever is higher. During the test, the control is to be operated in a manner representing normal use;

h) For the Electrical Fast Transient Burst Test, test level 2 is to be used;

i) Conduct a failure-mode and effect analysis (FMEA);

j) If software or firmware is relied upon as part of the protective electronic control, it shall be evaluated as software class 1 in accordance with the Standard for Software in Programmable Components, UL 1998.

3.5.4.7 Unless otherwise specified in this standard, protective controls shall be evaluated for 100,000 cycles for Type 2 devices and 6,000 cycles for Type 1 devices with rated current.

3.5.5 Electromechanical and electronic controls

3.5.5.1 A control, other than as specified in 3.5.6 – 3.5.10, shall comply with:

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

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

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

3.5.6 Motor controls

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

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

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

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

d) The Standard for Power Conversion Equipment, UL 508C;

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

f) The Standard for Information Technology Equipment – Safety – Part 1: General Requirements, UL 60950-1; or

g) The Standard for Safety of Household and Similar Electrical Appliances, Part 1: General Requirements, UL 60335-1.

3.5.6.2 A component that only supplies power to a motor is not considered a controller, but a power supply.

3.5.6.3 The failure of a motor controller shall not introduce an electrical shock, fire or causality hazard as follows:

a) When a controller is designed to load switch (manage current to multiple loads) the reliability of the switching or load sharing shall be investigated so that under a fault condition an electrical shock, fire or causality hazard is not created.

b) When multiple motors apply a force to a portion of the furnishing the load on each motor shall be determined. Load management (switching) if provided by a controller shall be determined to be suitable for the loads or if it is determined the load management is not reliable then consideration shall be given to each motor applying its force to the furnishing portion singly or in combination whichever is determined to be worst case.

Exception: The above conditions do not apply where electronic drive circuits are determined to be reliable by single component faults as determined by evaluation with Controls, 3.5.

3.5.7 Pressure controls

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

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

b) The Standard for Industrial Control Equipment, UL 508; or

c) The Standard for Automatic Electrical Controls – Part: General Requirements, UL 60730-1; and the Standard for Automatic Electrical Controls – Part 2-6: Particular Requirements for Automatic Electrical Pressure Sensing Controls Including Mechanical Requirements, UL 60730-2-6.

3.5.8 Remote controls

3.5.8.1 Remote controls or applications on smart devices shall not be provided on any furnishing whose operation could cause personal injury (see 11.3, Personal Injury, Entrapment, Pinch Points, and Shear