UL 970

STANDARD FOR SAFETY

Retail Fixtures and Merchandise Displays

UL Standard for Safety for Retail Fixtures and Merchandise Displays, UL 970

First Edition, Dated February 20, 2020

Summary of Topics

This revision of ANSI/UL 970 dated January 12, 2024 includes the following changes in requirements:

– Addition of a New Annex to Specify Requirements Specific to UV Radiation Disinfecting Equipment; Annex B

– Addition of a New Annex to Specify Requirements Specific to Chemical Disinfecting Equipment; Annex C

– Revision to UL 4200A Reference in 3.2.1.1

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

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated November 24, 2023.

No Text on This Page

FEBRUARY 20, 2020
(Title Page Reprinted: January 12, 2024)

ANSI/UL 970-2024

UL 970

Standard for Retail Fixtures and Merchandise Displays

First Edition

February 20, 2020

This ANSI/UL Standard for Safety consists of the First Edition including revisions through January 12, 2024.

The most recent designation of ANSI/UL 970 as an American National Standard (ANSI) occurred on January 12, 2024. 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 ULSE at any time. Proposals should be submitted via a Proposal Request in the Collaborative Standards Development System (CSDS) at https://csds.ul.com.

No Text on This Page

CONTENTS

PART 1 – ALL DISPLAYS

INTRODUCTION

CONSTRUCTION

PERFORMANCE

MECHANICAL TESTS

ELECTRICAL TESTS

MANUFACTURING AND PRODUCTION TESTS

MARKINGS

INSTRUCTIONS

PART 2 – SHOWCASES NOT REQUIRING PERFORMANCE TESTING

INTRODUCTION

CONSTRUCTION

MARKING AND INSTRUCTIONS

PART 3 – TEMPORARY DISPLAYS

INTRODUCTION

CONSTRUCTION

PERFORMANCE TESTS

ANNEX A (informative) – STANDARDS FOR COMPONENTS

ANNEX B (normative) – DISINFECTING EQUIPMENT THAT GENERATES UV RADIATION

ANNEX C (normative) – DISINFECTING EQUIPMENT THAT USES CHEMICAL DISINFECTANTS

PART 1 – ALL DISPLAYS

INTRODUCTION

1 Scope

1.1 These requirements cover non-refrigerated or non-heated commercial displays and other case goods used in retail establishment, including bakeries and restaurants. The term display(s) will be used to refer to all of the types of products covered by this standard. The products are used in accordance with the National Electrical Code, ANSI/NFPA 70. They are intended for dry, damp, or wet locations. These displays include both electrified and non-electrified products and may include, but are not limited to:

a) Displays

1) Shelving units (Gondolas);

2) Merchandise kiosks (such as the mini-stores in the middle of a mall);

3) Point of Sale (POS);

4) Motorized displays;

5) Hanging displays;

6) Wall systems;

7) Showcases;

8) Display Cases;

9) Product platforms;

10) Temporary Displays

b) Cash stations

1) Cash Wraps;

2) check-out stands (motorized and non-motorized); and

c) Other types of retail fixtures or case good

1) Retail use disinfecting equipment;

1.2 These requirements cover products rated 600 V ac or less, including those powered by primary or secondary batteries.

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 14.1.

2.3 ACCESSORY – An optional part that electrically and/or mechanically interfaces with the basic displays and is intended to be attached to the displays by the user or installer. Subassemblies field assembled to form the basic displays 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 displays such as a door, drawer, or a sliding work surface.

2.8 BATTERY – General term for:

a) Any single energy cell; or

b) A group of energy 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.

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

2.10 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.

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

2.12 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.

2.13 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.

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

2.15 BRANCH CIRCUIT – The circuit conductors between the final overcurrent device protecting the circuit and the outlet(s).

2.16 *Deleted*

2.17 CASH WRAP (POINT-OF-PURCHASE or CHECKOUT STAND) – Location where the customer pays for the product being purchased.

2.18 *Deleted*

2.19 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.

2.20 CHECKOUT STAND – See the definition of Cash Wrap in 2.17.

2.21 CLASS 2 CIRCUIT – A circuit having power and voltage limitations as defined in Article 725 of the 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.

2.22 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.

2.23 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.

2.24 *Deleted*

2.25 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 fire, electric shock, or injury to persons during normal or abnormal operation of the end product is considered an auxiliary control.

2.26 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 display's operation or that controls a display function.

2.27 *Deleted*

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

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

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

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

2.32 CORD CONNECTOR (outlet) – A female contact device that is wired or molded on flexible cord and intended to be installed as part of a display's wiring system to supply current to utilization equipment.

2.33 CRITICAL COMPONENTS – Any component that if changed may have an effect on the safety or performance of the displays or that is restricted by the construction requirements.

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

2.35 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.

2.36 DISPLAY – A product that is intended to dispense, display or store merchandise and may include customer interaction. For this standard it may include any of the items listed in 1.1.

2.37 DISPLAY CASE – See the definition of Showcase in 2.76.

2.38 DISPLAY ELECTRICAL TYPES:

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

b) PORTABLE DISPLAYS – A small display that meets all of the following:

1) Not secured to the building structure unless provided with a securement means that allows the displays 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 due to its small size and weight (A product that allows an average person to pick it up without tools or equipment. A mass exceeding 40 lbs (18 kg) is not generally considered to be portable.)

c) STATIONARY DISPLAYS:

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.

2.39 DISPLAY SUPPORT SYSTEM – A system of components intended to secure a display to the building or other structure.

2.40 DISPLAY TYPES:

a) Permanent – Displays intended to be in use more than 90 days.

b) Temporary – Displays intended to be in use not more than 90 days.

2.41 ENCLOSURE – An enclosure that 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 – An area on the display that has the potential for causing personal injury to the user or anyone near the display. It is presumed that children or people with cognitive disabilities are anticipated to be present, but the displays are locked out and only operated by a trained person.

2.45 ENVIRONMENTAL LOCATIONS:

a) DAMP – An exterior or interior location that is normally or periodically subject to condensation of moisture in, on, or adjacent to, the display, and includes partially protected locations.

b) 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.

c) WET – A location in which water or other liquid can drip, splash, or flow on or against the display.

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

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

2.48 GLASS, SHEETS – A glass sheet, usually formed from sheet stock, the overall shape of which is essentially flat. The sheet can have a slight curvature or bend, and the surface may be smooth or textured.

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

2.50 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.

2.51 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.

2.52 KIOSK – A small open-fronted cubicle from which newspapers, refreshments, tickets, and other types of merchandise is sold.

2.53 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.

2.54 LIMITED POWER SOURCE (LPS) – An isolated 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.

2.55 LINE-OF-SIGHT – The ability to see the displays so that the user can observe the displays is moving to make sure that it will not harm anyone in the area and usually within 20 feet (6 m) of the unit.

2.56 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.

2.57 LIVE PART – Any part where current is flowing.

2.58 LOADING:

a) FULLY LOADED – Where the display has the normal test load on the product.

b) PARTIALLY LOADED – The display 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 display has no load being held by the product.

2.59 LOADS, MECHANICAL:

a) ABNORMAL – A foreseeable misuse of loading that is beyond the rated load.

b) RATED – The loading or force intended for normal use as defined by the manufacturer.

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

2.61 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.

2.62 LOW VOLTAGE LIMITED ENERGY (LVLE) – A circuit supplied by a source with no direct electrical connection between input and output, such as provided by a transformer or optical isolator, and with output parameters as follows: source with a maximum output voltage of 42.4 V peak ac (30 V rms) or 60 V dc; and a maximum output current limited to:

a) Maximum 8 amps for 0 – 42.4 V peak ac, or 0 – 30 V dc; or

b) 150/V amps, for a voltage between 30 – 60 V dc.

Measurements for determining LVLE circuit status shall be in accordance with the requirements in 63.2, Determination of Low-Voltage, Limited-Energy Circuit Status. LVLE includes:

c) Class 2 circuits; and

d) ES1 and PS1 or PS2 circuits, as specified in the Standard for Audio/video, Information and Communication Technology Equipment – Part 1: Safety Requirements, UL 62368-1.

2.63 OUTLET (RECEPTACLES):

a) CONVENIENCE – A female connector of one of the configurations covered in the Standard for Wiring Devices – Dimensional Requirements, ANSI/NEMA WD6 that is provided for the connection of an unknown small appliance, a work light, or similar product.

b) DEDICATED – A female connector of one of the configurations covered in the Standard for Wiring Devices – Dimensional Requirements, ANSI/NEMA WD6 that is provided for the connection of a known small appliance, a work light, or similar product that is normally provided with the product or in the field, such as a cash register.

2.64 POINT-OF-PURCHASE – See definition of Cash Wrap in 2.17.

2.65 POWER SUPPLY, REMOTE – A power supply that is not located near the display. It is usually in an equipment room away from the display.

2.66 PRESSURE-RELIEF DEVICES – A device used to control or limits the pressure in a system or vessel.

2.67 RACEWAY – An enclosure (See 2.41) that is intended specifically for the holding and routing of wiring either line voltage or communication and low-voltage with the proper separation between wiring of different voltages.

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

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

2.69A RETAIL FIXTURES – Are other types of case goods used in retail outlets that are not intended to display merchandise, such as cash wraps, check-out stands, and disinfecting products.

2.70 RETROFIT KIT – In the context of these requirements, is an accessory that includes all component parts needed, including instructions, for converting a light source from one type to another, changing graphics, or shelving.

2.71 RFID – Radio-frequency identification.

2.72 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-V ac sine wave), 60 V dc and in a normally wet location if the voltage exceeds 21.2 V ac peak (the peak voltage of a 15-V ac sine wave), 30 Vdc and the available current exceeds the leakage current levels specified in the Leakage Current Test, Section 46.

2.73 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.

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

2.75 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, or in the Standard for Audio/video, Information and Communication Technology Equipment – Part 1: Safety Requirements, UL 62368-1, for the application of these requirements.

2.76 SHOWCASE (DISPLAY CASE) – An enclosed cabinet like a jewelry or make-up counter intended to display merchandise.

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

2.78 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.

2.79 SUB-ASSEMBLY – An individual component or a group of components that when all of the sub-assemblies are combined form the completed display. 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.

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

2.81 UPHOLSTERED DISPLAY – A display that is provided with coverings, padding, webbing and/or springs, which can be used as a support for the body of a human being, or his or her limbs and feet when sitting or resting in an upright or reclining position.

2.82 USE:

a) ABNORMAL USE – Foreseeable and likely misuse of a product when the instructions are not followed.

b) NORMAL USE – The intended function applied by the user or operator utilizing the installation and operation instructions for the display.

2.83 VENT or VENTED – 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.

2.84 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) *Deleted*

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

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

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 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 display 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 LVLE 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 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.

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

c) Luminaire:

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

2) Standard for Portable Electric Luminaires, UL 153.

Exception No. 1: LED Strips, LEDs on a printed wiring board or conductive strip, and dimmers used in LVLE circuits shall comply with the requirements in this Standard.

Exception No. 2: Electrical connectors and switches used in LVLE circuits shall comply with the requirements in this Standard.

Exception No. 3: Bluetooth controls shall comply the requirements in this Standard.

3.2 Batteries

3.2.1 General

3.2.1.1 The battery compartment of a display or any accessory, such as a wireless control, incorporating one or more replaceable coin cell batteries of lithium technology shall comply with the Standard for Products Incorporating Button Batteries or Coin Cell Batteries, UL 4200A.

3.2.1.2 Displays incorporating primary (non-rechargeable) batteries that are limited to a maximum of 15 watts total combined power under any condition of operation (see Section 63, Circuit Power / Voltage Limit Measurement Tests) 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.

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

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

3.2.1.5 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 Vent Cap Tests in the Standard for Valve Regulated or Vented Batteries with Aqueous Electrolytes, UL 1989.

3.2.1.6 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.

3.2.1.7 A battery shall be protected by an enclosure in accordance with 12.5 – 12.9.

3.2.2 Battery chargers and circuits

3.2.2.1 A battery charging circuit integral to the display, a battery charger supplied with the display, or available as an accessory to the display operating at a Class 2 or LVLE power output level shall comply with the appropriate requirements. See 2.21 and 2.62, respectively.

3.2.2.2 A battery charging circuit integral to the display, a battery charger supplied with the display, or available as an accessory to the display 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 and 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.

3.2.3 Non-replaceable batteries

3.2.3.1 A display provided with batteries that are not intended to be replaced by the user shall be located within the display enclosure and be non-accessible to the user.

3.2.4 Technician-replaceable batteries

3.2.4.1 Batteries that are only to be replaced by trained technicians shall be marked as indicated on or adjacent to the battery(ies) with a WARNING statement that service and replacement of the battery shall only be done by a person who has been trained to service and repair the product (see 76.4). The same WARNING statement shall be provided in the instruction manual (see 86.6).

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 14, 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 (76.2), 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 display – be provided with an interlock device that deenergizes and discharges any accessible electrical components within 2 seconds in the battery compartment; other than the battery; or

c) For a permanently connected display – 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 (76.2) 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 12.3, Mechanical Enclosure and Guards – Mechanical Considerations.

3.2.5.3 A display 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.

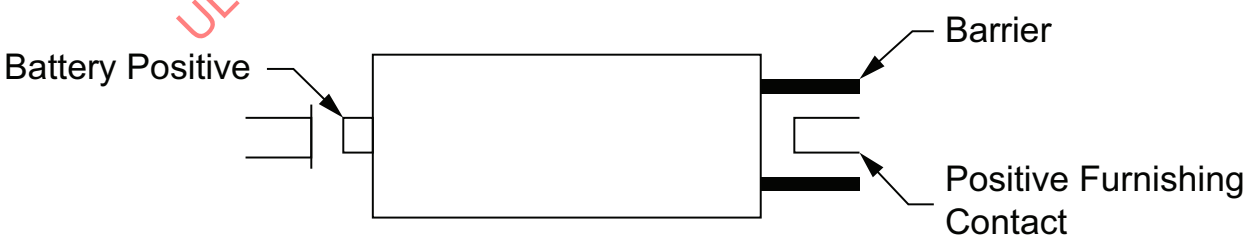
3.2.5.5 An enclosure or part of an enclosure that also serves as a compartment for a rechargeable vented battery shall be provided with ventilated openings to permit dispersion of gases from the battery.

3.2.5.6 Battery polarity installation shall be shown in diagrammatic form 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 and D cells and 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 display 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 57, Abnormal Tests..

3.2.7 Battery charging

3.2.7.1 A display 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 display.

3.2.7.2 The output characteristics of a battery charging circuit shall be compatible with its rechargeable battery. The display shall be provided with technical documentation on the compatibility of the rechargeable (secondary) battery with the battery charging circuit.

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 display. 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 display 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 display shall have a capacitance rating of not more than 0.10 microfarad.

3.3.4 A display 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 (Section 20, Materials in Direct and Indirect Contact of Live Parts);

d) A connector located in a SELV circuit that during the Temperature Test, Section 49, does not exceed 50°C, shall be manufactured from a polymeric material with a minimum electrical RTI of 70°C, and complies with Section 19, Spacings, for materials in direct contact of live parts; or

e) Any connector may be used located in a LVLE circuit that during the Temperature Test does not exceed 50°C.

3.4.2 A display with multiple LVLE supply or load connections where interconnection could cumulatively exceed LVLE limits shall be provided with polarized connectors that prohibit such interconnection.

3.4.3 Coaxial cable connectors shall not be used for connections.

3.5 Controls

3.5.1 General

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

3.5.1.2 Where reference is made to declared deviation and drift, this indicates the manufacturer's declaration of the control's tolerance before and after certain conditioning tests.

3.5.1.3 A controller designed to manage power or signaling to single or multiple loads shall operate so that upon any single component failure the system does not result in a risk of fire, electric shock, or injury to persons.

3.5.1.4 An electronic auxiliary or operating control (e.g. a non-protective control), the failure of which would not increase the risk of fire, electric shock, or injury to persons, 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.

Exception: An auxiliary control that complies with a component standard(s) specified in 3.5, Controls, is considered to fulfill this requirement.

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, 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 fire, electric shock, 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 , except for (c), if using a standard other than the Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1 or the Standard for Safety of Household and Similar Electrical Appliances, Part 1: General Requirements, UL 60335-1, if motorized:

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

Display 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

Display control microenvironment	Pollution degree
No pollution or only dry, nonconductive pollution. The pollution has no influence. Typically a 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

3.5.4 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 if 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; or

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;

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.

3.5.4.4 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) A control used to sense abnormal temperatures of components within the appliance;

b) An interlock function to de-energize a motor;

c) Temperature protection of the motor due to locked rotor, running overload, loss of phase; or

d) Other function intended to reduce the risk of fire, electric shock, or injury to persons.

3.5.4.5 The following test parameters shall be among the items considered when determining the acceptability of an electronic protective control investigated using the Standard for Automatic Electrical

Controls – Part 1: General Requirements, UL 60730-1, and the Standard for Safety of Household and Similar Electrical Appliances, Part 1: General Requirements, UL 60335-1, if motorized:

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 49;

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 49. 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 49; 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 3.5.3.2(a) and 3.5.4.3(a) 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) With regard to electrical supervision of critical components, for attended appliances, a motor operated system becoming permanently inoperative with respect to movement of an exposed portion of the appliance meets the criteria for trouble indication. For unattended appliances, electrical supervision of critical components may not rely on trouble indication;

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

c) The Composite Operational and Cycling Test is to be conducted for 14 days at temperature extremes of 0°C (32°F) and 49°C (120°F) for outdoor displays;

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

Humidity Class	Intended Space
H1	Controls used in equipment intended for occupational spaces such as offices and residence.
H2	Controls used in equipment intended for laundry rooms, basements, etc.
H3	Controls intended for household heating appliances
H4	Controls intended for appliances used in bathrooms and areas exposed to high humidity.
H5	Controls intended for outdoor use.

e) A vibration level of 2 g is to be used for the Vibration Test;

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

g) For the Demonstrated Method Test, the multiplier for the test acceleration factor is to be 576.30 for intermittent use appliances, or 5,763.00 for continuous use appliances. The test acceleration factor equation is to be based on a 25°C (77°F) use ambient;

h) 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;

i) For the Electrical Fast Transient Burst Test, test level 3 is to be used;

j) Conduct a Failure-Mode and Effect Analysis (FMEA); and

k) If software 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 Temperature-Indicating and -Regulating Equipment, UL 873; or

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

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

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

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

e) 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 display 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 display portion singly or in combination whichever is determined to be worse 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 Industrial Control Equipment, UL 508, the Standard for Low-Voltage Switchgear and Controlgear – Part 4-1: Contactors and Motor-Starters – Electromechanical Contactors and Motor-Starters, UL 60947-4-1, the Standard for Low-voltage Switchgear and Controlgear – Part 5-2: Control Circuit Devices and Switching Elements – Proximity Switches, UL 60947-5-2, and the Standard for Programmable Controllers – Part 2: Equipment Requirements and Tests, UL 61131-2; or

b) 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 display whose operation could cause personal injury while in motion when using the remote or app unless they can only be used in line-of-sight.

3.5.8.2 Remote controls or applications on smart devices shall comply with the control requirements in this standard based on their application.

3.5.9 Temperature controls

3.5.9.1 A temperature control shall comply with:

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

b) The Standard for Industrial Control Equipment, UL 508, the Standard for Low-Voltage Switchgear and Controlgear – Part 4-1: Contactors and Motor-Starters – Electromechanical Contactors and Motor-Starters, UL 60947-4-1, the Standard for Low-voltage Switchgear and Controlgear – Part 5-2: Control Circuit Devices and Switching Elements – Proximity Switches, UL 60947-5-2, and the Standard for Programmable Controllers – Part 2: Equipment Requirements and Tests, UL 61131-2; or

c) The Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1 and the Standard for Automatic Electrical Controls – Part 2-9: Particular Requirements for Temperature Sensing Controls, UL 60730-2-9.

3.5.9.2 A temperature sensing positive temperature coefficient (PTC) or a negative temperature coefficient (NTC) thermistor that performs the same function as an operating or protective control shall comply with:

a) The Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1 and the Standard for Automatic Electrical Controls – Part 2-9: Particular Requirements for Temperature Sensing Controls, UL 60730-2-9; or

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

3.5.9.3 A thermal cutoff shall comply with the Standard for Thermal-Links – Requirements and Application Guide, UL 60691.

3.5.9.4 A temperature sensing positive temperature coefficient (PTC) or a negative temperature coefficient (NTC) thermistor, that performs the same function as an operating or protective control, shall be tested using the following number of cycles when testing a sensing device in accordance with the endurance test:

a) For a device employed as an operating device – 6,000 cycles;

b) For a device employed as a protective device – 100,000 cycles; and

c) For a device employed as a combination operating and protective device – 100,000 cycles.

3.5.10 Timer controls

3.5.10.1 A timer control shall comply with the Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1 and the Standard for Automatic Electrical Controls for Household and Similar Use, Part 2: Particular Requirements for Timers and Time Switches, UL 60730-2-7.

3.6 Furniture power distribution unit (FPDU) and relocatable power taps (RPT)

3.6.1 The cords of RPTs and FPDUs shall be counted as part of the number of cords provided on the display.

3.6.2 RPTs and FPDUs shall not be daisy-chained where one unit is plugged into another unit. Such devices are intended to be directly plugged into a building receptacle.

3.7 Gaskets and bushings

3.7.1 A gasket or bushing employed to comply with the requirements for wet locations shall comply with the requirements of the thermal conditioning test described in Section 69, Thermal Conditioning, and Section 70, Gasket Adhesion Test.

3.7.2 A gasket shall be secured so that normal use and maintenance will not cause the gasket to loosen. Clips or a clamping ring are examples of means of securement. When an adhesive is used to secure a gasket, the gasket assembly shall comply with the Gasket Adhesion Test, Section 70. Other means of securement shall be investigated to determine compliance.

3.8 Lasers

3.8.1 Lasers shall comply with the Code of Federal Regulations (CFR), Title 21, Part 1040.

3.8.2 With reference to 3.8.1, compliance of laser products with the 21 CFR Part 1040, shall be determined by:

a) Determining the Class of the laser product and the Class of the radiation emitted by the laser product (as defined in the CFR) from the manufacturer's Center for Devices and Radiological Health (CDRH) product report;

b) Verifying that the manufacturer's markings and labels having the information specified in the CFR are affixed on the laser product (as defined in the CFR);

c) Determining that the corresponding construction features, such as protective housing, interlocks, and similar features, are provided in accordance with the CFR;

d) Determining that the resulting construction complies with the construction requirements of this standard; and

e) Verifying that the manufacture's safety instructions required by the CFR are provided with the laser product (as defined in the CFR).

3.9 Motors – Construction and overload protection

3.9.1 A motor in a circuit greater than 15 watts under any loading condition shall comply with the Standard for Rotating Electrical Machines – General Requirements, UL 1004-1, and shall be provided with overload protection by one of the following methods:

a) The Standard for Impedance Protected Motors, UL 1004-2;

b) The Standard for Thermally Protected Motors, UL 1004-3;

c) The use of a fuse;

d) A protective control; or

e) The use of a circuit that disconnects power or reduces power from the motor in a sufficiently short time to prevent a fire hazard as determined by Controls, 3.5.

Methods (c), (d), and (e) shall comply with the Running Overload Motor Test, 56.2, and Locked Rotor Test, 56.3. All motor / controller combinations shall be evaluated together to determine the suitability of the motor with the controller.

3.9.2 The construction of LVLE and SELV motors do not need to comply with the Standard for Rotating Electrical Machines – General Requirements, UL 1004-1, provided they use a Class A Insulation System as defined in UL 1004-1 and comply with the requirements in this standard.

3.9.3 When a requirement in this standard refers to the horsepower rating of a motor and the motor is not rated in horsepower, use is to be made of the appropriate table of the National Electrical Code, ANSI/NFPA 70, which gives the relationships 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 when the display is marked for use on alternating current only; otherwise the table applying to direct-current motors is to be used.

3.9.4 The functioning of a motor-protective device provided as part of a display, whether such a device is required or not, shall not result in an increase in the risk of fire, electric shock, or injury to persons.

3.9.5 Overload devices, including types used for running overload protection, other than those that are inherent in a motor, shall be located in each ungrounded current carrying conductor of a single-phase supply system and in each current carrying ungrounded conductor of a 3-phase supply system.

3.9.6 With reference to 3.9.1, an overload-protective device conforming to the National Electrical Code, ANSI/NFPA 70, is identified as an overload device that is responsive to motor current and is rated or set as specified in column A of Table 3.4. When the rating of the motor-running overload protection determined to comply with the foregoing does not correspond to a standard size or rating of a fuse, nonadjustable circuit breaker, thermal cutout, thermal relay, or heating element of a thermal-trip motor switch, the next higher size, rating, or setting is able to be used, and is not able to be more than that specified in column B of Table 3.4. For a multispeed motor, each winding connection is to be evaluated separately.

Table 3.4
Maximum rating or setting of overload-protective device

Type of motor	Ampere rating of device as a percentage of motor full-load current rating	
	A	B
tor with marked service factor of 1.15 or more	125	140
Motor with marked temperature rise of 40°C (72°F) or less	125	140
Any other motor	115	130

3.9.7 Motor-overload protection in which contacts control a relay coil in a motor starter shall comply with the requirements in 3.9.1.

3.10 Printed-wiring boards

3.10.1 A printed-wiring board shall comply with the requirements in the Standard for Printed-Wiring Boards, UL 796, be suitable for direct contact, and shall be classed V-0, V-1, or V-2 in accordance with the requirements in the Standard for Test for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

Exception No. 1: A printed-wiring board containing only circuitry not exceeding Class 2 limits shall be rated minimum HB in accordance with the requirements in the Standard for Test for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

Exception No. 2: A printed-wiring board comprised of non-combustible materials is not required to comply with the Standard for Test for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

3.10.2 A display that has a receptacle grounding path through traces on a printed wiring board shall comply with the Printed-Wiring Board (PWB) Ground Path Test, 55.1 and the Printed Circuit Board (PWB) Conductor Overcurrent Test, 55.2.

3.10.3 A trace on a PWB providing a current path to an external load operating in excess of Class 2 power levels shall comply with the Printed Circuit Board (PWB) Conductor Overcurrent Test, 55.2.

3.11 Receptacles (Outlets)

3.11.1 A 15- or 20-ampere, nominal 120 volt receptacle in a display shall be of the grounding type. The grounding contact of the receptacle shall be bonded in accordance with 15.4, Bonding.

3.11.2 A non-locking type 125-volt, 15 and 20 ampere receptacle (ANSI/NEMA 5-15R or 5-20R) used in displays shall be a Tamper-Resistant type.

Exception No. 1: This requirement does not apply when receptacles are located more than 5-1/2 feet (1.7 m) above the floor.

Exception No. 2: This requirement does not apply when receptacles are part of a luminaire or appliance.

3.11.3 A non-locking type 125-volt, 15 and 20 ampere receptacle (ANSI/NEMA 5-15R or 5-20R) receptacles that are controlled by an automatic control device, or that incorporate control features that remove power from the receptacle for the purpose of energy management or building automation, shall be marked as shown in 75.17.

3.11.4 A receptacle shall:

a) Be flush with or project beyond a nonconductive surrounding surface; or

b) Project at least 0.015 inch (0.38 mm) beyond a conductive surrounding surface.

3.11.5 Receptacles shall comply with the Spill Test, Section 59.

Exception No. 1: This requirement does not apply to a receptacle that is oriented in a position so its face is in a vertical plane ±5 degrees.

Exception No. 2: This requirement does not apply to a receptacle that is covered or otherwise protected from spillage when not in use.

Exception No. 3: This requirement does not apply to a receptacle that is located at least 3 in (76 mm) above the work surface, measured from the lower edge of the receptacle, when the work surface is adjusted to its highest position.

Exception No. 4: This requirement does not apply to a receptacle that is located adjacent to a seating surface and the receptacle is oriented in a position so its face is in a vertical plane ±5 degrees and located at least 3 inches (76 mm) above the uncompressed seating surface.

3.11.6 A display intended to be permanently wired and provided with a receptacle installed within 6 ft (1.8 m) of a sink shall either be protected by an installed Class A type GFCI receptacle protecting all receptacles mounted within 6 ft (1.8 m) of the sink or shall specify in the installation instructions to connect the receptacle circuit to a branch circuit protected with a Class A GFCI device. See 83.15.

3.11.7 A receptacle provided in a display with a seating surface shall comply with one or more of the following. See Figure 3.2:

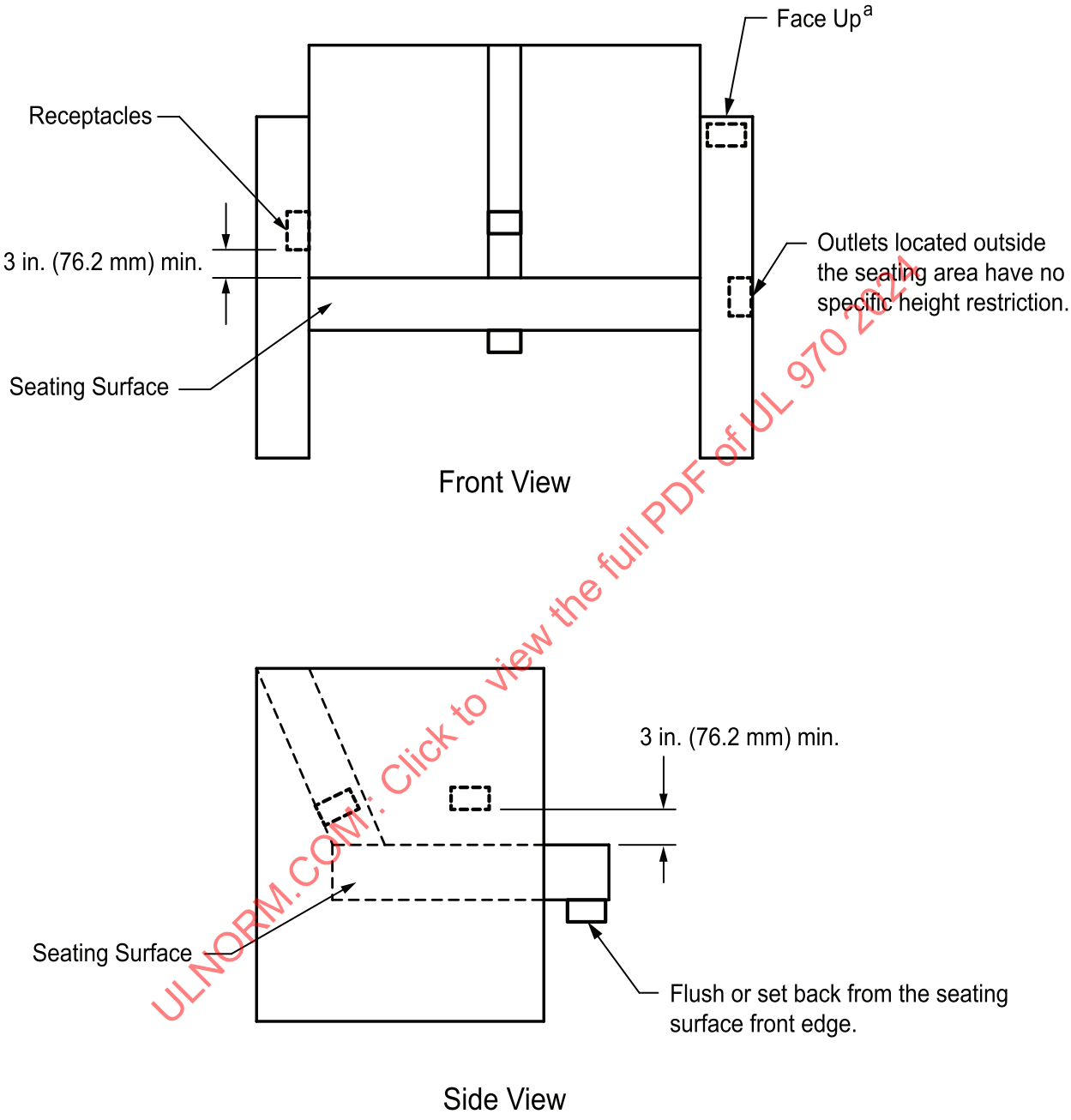
a) Be located at least 3 inches (76 mm) above the uncompressed seating surface.

b) The receptacle shall be located underneath the bottom edge of the seating surface flush with or recessed from the edge.

c) A receptacle mounted face up in an upholstered display shall comply with 3.11.4.

Figure 3.2

Receptacle locations for seating surfaces



su1731a

[a] See 3.11.4.

3.11.8 A receptacle shall not be provided in any storage area that is intended to store or hold liquids.

3.11.9 A receptacle shall not be mounted in an area that holds liquid containers that if the container breaks the liquid would directly enter a receptacle or if the display is able to retain the liquid the liquid would flood the receptacle.

3.11.10 For a cord and plug connected display provided with one or more convenience receptacles overcurrent protection (OCP) shall be provided in accordance with Table 3.5. For a display that has a convenience receptacle and additional loading such as lighting or a fan, OCP must be provided, such that the total rating of the product is not exceeded. For example, a product rated 12 amps and provided with a light that draws 2 amps, either the overall device shall be protected with a 12 amp OCP or the receptacle shall be provided with a 10 amp OCP.

Table 3.5
Guide to construction requirements for convenience receptacles in displays

Display rating (Amps)	Minimum power supply cord size (AWG)	Number of receptacles	Supplementary OCP required?	Supplementary OCP rating[a] (Amps)	Temperature test load (Amps)	Minimum internal wiring size (AWG)
13 – 16	12	<6		20	20	12
13 – 16	12	6	YES	20	20	12
12	14	<4	NO	15[c]	15	14
12	14	≥4	YES[c]	15	15	14
<12	14	<4	NO	15[b]	15	14
<12	14	≥4	YES	15	15	14

[a] OCP shall not trip when the display is operated at the marked rated current.

[b] When provided with an OCP.

[c] An OCP is not required for a 12 amp rated display with four receptacles as long as:
Internal wiring is 12 AWG;
The power-supply cord is 12 AWG;
All other components are evaluated for use at 20 A; and
The Temperature Test, Section 49, load is 20 A.

3.11.11 Required overcurrent protection shall either be a supplementary overcurrent protector or a replaceable fuse.

3.11.12 A user replaceable fuse shall not allow the user to contact an electrically energized part during the replacement of the fuse.

3.11.13 A fuseholder shall be of the lock out type and prevent insertion of a fuse larger than that specified.

3.11.14 A convenience receptacle shall be visible to the user.

FOR UL INTERNAL REFERENCE OR CSDS USE ONLY – NOT FOR OUTSIDE DISTRIBUTION
Exception: The receptacle may be hidden if:

a) It can be made visible by opening a hinged door or the like; and

b) The supply cord to a display will not be subject to abrasion because of the location of the receptacle.

3.11.15 *Deleted*

3.11.16 A dimmer shall not be used in a circuit that has receptacle(s) unless it is a dedicated receptacle and the product intended to be connected to that dedicated receptacle is intended to be dimmed.

3.11.17 Dedicated receptacles shall not be accessible or shall be marked in accordance with 75.36 to indicate the maximum allowed current.

3.12 Receptacles, wet locations

3.12.1 Receptacles shall be of the grounding type and weather resistant type.

3.12.2 Receptacles shall be supplied with a cover plate or hood intended to be used with a receptacle. Receptacle covers are relied upon to prevent the ingress of water and shall comply with the requirements for wet location type rain resistant or rain proof receptacle box covers in accordance with the Standard for Cover Plates for Flush-Mounted Wiring Devices, UL 514D.

3.12.3 Cord and plug connected displays supplied with receptacles or connectors for the interconnection of displays shall be supplied with a portable GFCI (cord GFCI) suitable for wet locations that complies with the requirements in the Standard for Ground-Fault Circuit-Interrupters, UL 943.

Exception: Displays that are powered from NEC Class 2 or LVLE power sources operating at 15 volts AC or less or 21.2 Volts peak or less.

3.12.4 Wet location displays provided with receptacle outlets and intended to be electrically interconnected shall utilize electrical connectors suitable for outdoor wet location use and shall be designed so that the electrical power must be supplied through the GFCI.

Exception: Displays that are powered from NEC Class 2 or LVLE power sources operating at 15 volts AC or less or 21.2 Volts peak or less.

3.12.5 Permanently connected displays provided with receptacles shall either incorporate a class A GFCI receptacle as the first in the series of outlets or shall specify in the installation instructions to connect the display to a class A GFCI circuit. See 90.2.

3.13 Switching devices

3.13.1 General

3.13.1.1 These requirements apply to controls that perform any electrical switching function, either automatically or manually controlled, such as switches, relays, contactors, thermostats, thermal cutoffs, and circuit breakers.

Exception: They do not apply to a switching device in secondary circuits when:

a) The circuit in which the switching device is located is not a safety circuit; or

b) The switching device does not have a marked "off" position and is not used as part of the circuit to disconnect power when a switch with a marked "off" position is turned to the "off" position.

3.13.1.2 All manually operated or adjustable switching devices shall be of the indicating type. The indicating means shall be incorporated on the device or knob, on an attached plate, or on the panel on which the device is mounted.

3.13.1.3 With reference to 3.13.1.2 a switching device that has only ″on″ and ″off″ positions is not prohibited from being provided with the international symbols ″I″ and ″O″ to signify ″on″ and ″off″ when the significance of these symbols is explained in the instructions packaged with the display.

3.13.1.4 When a switching device with a marked ″off″ position is mounted such that movement of the operating handle is vertical, the lower position shall be the ″off″ position.

Exception: This requirement does not apply to a switching device having two or more positions in addition to the "off" position, such as a double-throw switch.

3.13.1.5 A switching device shall be judged with respect to the temperature limitations of the materials employed.

3.13.1.6 A manually-operated motor-control switch shall be provided in a cord-connected motor-operated display that employs a motor rated more than 1/3 horsepower (250 W output).

3.13.2 Switch electrical ratings

3.13.2.1 switching device shall have a current and voltage rating not less than that of the load that it controls when the display is operated as described in the normal Temperature Test – General, 49.1.

3.13.2.2 The current rating of a switching device that controls a solenoid, a magnet, a transformer, an electric-discharge-lamp (such as fluorescent and HID) ballast, or any inductive load other than a motor shall be at least twice the rated full-load current of the component that it controls, unless the switch has been found acceptable for the control of an inductive load at least equal to the rated full-load current of the component.

3.13.2.3 A switching device that controls a motor load shall have a motor rating (full-load/locked rotor amps or horsepower) at least equivalent to the load.

3.13.2.4 A switching device that controls a screwshell-type lampholder or another tungsten-filament load shall:

a) Have a tungsten-filament lamp rating at least equivalent to the rating of the anticipated load, but not less than 25 W;

b) Have a current rating equivalent to at least six times the rating of the anticipated load, but not less than 150 W, for alternating-current circuits; or

c) Have a current rating equivalent to at least ten times the rating of the anticipated load, but not less than 250 W, for direct-current circuits.

Exception: This requirement does not apply to pilot or indicating lamps, or to lampholders for pilot or indicating lamps.

3.13.2.5 A switching device controlling any combination of a tungsten-filament load, a motor or other inductive load, and a resistive load, shall have a current rating at least equal to the sum of any ratings required by 3.13.2.1 – 3.13.2.4, as applicable, and the rated current of the resistive load.

3.13.2.6 A switching device provided as part of a display intended to be connected to a power-supply circuit involving a potential to ground of more than 150 volts shall be acceptable for the maximum potential to ground of the circuit.