

Subject 970

February 12, 2018

SUMMARY OF TOPICS

The following is being proposed for preliminary review and comment only:

1. For Preliminary Review Only: Proposed First Edition of the Standard for Retail Fixtures and Merchandise Displays, UL 970

COMMENTS DUE: March 14, 2018

This proposal is for review and comment only (no ballot at this time). Please note that comments on a preliminary review document will not receive a response from the proposal author through CSDS. Instead, the proposal author will be asked to review the comments and adjust the proposals and/or supporting rationale as the author determines to be appropriate. The preliminary review process is an informal mechanism that provides authors with the opportunity to refine their proposals before they advance to the next stage in UL's standards development process.

In some cases, the author of the proposals may choose to discontinue them. In this case, the author need not do anything after preliminary review has ended. Normally, the next step in the process is the more formal STP ballot and stakeholder review process. Only comments posted during the STP ballot and stakeholder review process will be provided with a response in CSDS.

1. For Preliminary Review Only: Proposed First Edition of the Standard for Retail Fixtures and Merchandise Displays, UL 970

RATIONALE

Proposal submitted by: Bruce Bohren, UL LLC

Currently the requirements for commercial displays are covered in UL 962, the Standard for Household and Commercial Furnishings. The requirements for showcases are covered by UL 65, the Standard for Wired Cabinets. This standard would bring these products together under one standard. In addition, the requirements will be updated to present technology and written specifically towards these types of products.

If this proposed standard passes consensus and is published then the retail fixtures and merchandise display requirements will be removed from UL 962 and UL 65.



CONTENTS

PART 1 – ALL COMMERCIAL DISPLAYS

INTRODUCTION

1	Scope	9
2	Glossary	9
3	Components	17
3.1	General	17
3.2	Batteries	18
3.2.1	General	18
3.2.2	Battery chargers and circuits	19
3.2.3	Non-replaceable batteries	19
3.2.4	Technician-replaceable batteries	19
3.2.5	Battery compartments	19
3.2.6	Battery circuits	21
3.2.7	Battery charging	21
3.3	Capacitors	21
3.4	Connectors	22
3.5	Controls	22
3.5.1	General	22
3.5.2	Auxiliary controls	23
3.5.3	Operating controls	23
3.5.4	Protective controls	25
3.5.5	Electromechanical and electronic controls	27
3.5.6	Motor controls	27
3.5.7	Pressure controls	28
3.5.8	Remote controls	28
3.5.9	Temperature controls	28
3.5.10	Timer controls	29
3.6	Furniture power distribution unit (FPDU) and Relocatable power taps (RPT)	29
3.7	Gaskets and Bushings	29
3.8	Motors – Construction and overload protection	30
3.9	Printed-wiring boards	31
3.10	Receptacles (Outlets)	32
3.11	Receptacles, wet locations	36
3.12	Switching devices	37
3.12.1	General	37
3.12.2	Switch electrical ratings	38
3.12.3	Specific applications	39
4	Units of Measurement	39
5	Undated References	39
6	Environmental Considerations	39
6.1	General	39
6.2	Potting compound	40
6.3	Conformal coating	40
7	Assembly	40
8	Accessories	42
9	Retrofit Kits	43

UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL



Documents

Document Sharing Hub

CONSTRUCTION

10	General	43
11	Power-Supply Connections	44
11.1	Permanently connected commercial display	44
11.2	Cord-connected commercial display	46
11.3	Multiple power supply cords	50
11.4	Detachable power supply cords	52
11.5	Secondary connections	52
11.6	Strain relief	53
11.7	Protection of cord and wiring	54
12	Enclosures and Guards	55
12.1	General	55
12.2	Personal injury, entrapment, pinch points, and shear considerations	55
12.3	Mechanical enclosures and guards – Mechanical considerations	56
12.4	Mechanical connectors	58
12.5	Electrical enclosures – General	59
12.6	Wet location enclosures	59
12.7	Metallic electrical enclosures	60
12.8	Knockouts	60
12.9	Electrical enclosures of polymeric material	62
12.10	Barriers	62
12.11	Openings	65
12.11.1	General	65
12.11.2	Openings, wet locations	65
12.12	Doors or covers	66
12.13	Mounting means	66
12.14	Polymeric supporting devices	67
12.15	Glass components	67
12.16	Joints	67
13	Protection Against Corrosion	68
13.1	Dry locations	68
13.2	Damp and wet locations	69
14	Accessibility of Uninsulated Live Parts and Film-Coated Wire	70
15	Grounding and Bonding	74
15.1	General	74
15.2	Grounding	74
15.3	Grounding identification	76
15.4	Bonding	76
16	Polarity and Identification	76
17	Separation of Circuits	77
18	Internal Wiring	77
18.1	Conductors	77
18.2	Splices	79
18.3	Cord used for internal wiring	79
18.4	Conductors subject to flexing	79
19	Spacings	79
20	Materials in Direct and Indirect Contact of Live Parts	81
21	Commercial displays with Extendable Elements	83
22	Operator Attended Products	83
23	Parts Subject to Pressure	84
23.1	Factory sealed systems	84
23.2	Open systems and systems with pumps	85

UL COPYRIGHTED MATERIAL –
 NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
 DISTRIBUTION WITHOUT PERMISSION FROM UL



Documents
 Document Sharing Hub

24	Abnormal Conditions – General	85
25	Safety Circuits	85
26	Flammability	86
26.1	Upholstered seating	86
26.2	Other commercial display types	87
27	Water Shields	87
28	Reserved for Future Use	88

PERFORMANCE

MECHANICAL TESTS

29	General Conditions	88
29.1	General	88
29.2	Trial installation	88
30	Conditioning of Products	88
30.1	Conditioning of polymeric components	88
30.2	Conditioning of components secured by adhesives	89
31	Adhesive Securement Test	89
32	Structural Test Requirements for Commercial Displays (Loading)	89
32.1	General	89
32.2	Rated load	90
32.3	Abnormal load	90
32.4	Appurtenance strength test	90
33	Stability	91
33.1	General test criteria	91
33.2	Stability configuration test requirements	91
33.3	Stability test for portable commercial displays	92
33.4	Stability tests for other stationary and fixed commercial displays	93
33.5	Stability test for commercial displays having a support surface or mounting surface for a television (TV) or monitor	93
33.6	Stability test for commercial displays provided with a step	94
33.7	Stability test for commercial displays provided with a foot or leg rest	94
33.8	Appurtenance stability test	94
33.9	Force stability test	98
33.10	Impact stability test	100
34	Structure Mounted or Secured Commercial Display Tests	102
34.1	General	102
34.2	Suspended commercial display, securement test	102
34.3	Vertically secured – Base supported, securement test	102
34.4	Base secured – Base supported, securement test	103
35	Tests on Glass Sheets	103
35.1	Impact test	103
35.2	Retention test	104
36	Wheel, Roller, or Caster Securement Test	104
37	Common North American Structures	105
37.1	General	105
37.2	Insert type masonry anchors	105
37.3	Power driven masonry anchors/fasteners	105
37.4	Welding studs	106
37.5	Wood studs	106
37.6	Steel studs	106
38	Cycle Test for Commercial Displays with Articulating Components	106

UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM



Documents

Document Sharing Hub

39	Hydrostatic Pressure Test	107
40	Entrapment Force Measurement and Operator Attended Tests	107
41	Operator Attended Tests	112
42	Snap-Fit Cover Pull-Out Test	112
43	Tightening Torque Test	112
44	Portable Commercial Display with Liquid Drop Test	113
45	Tests on Mechanical Connectors	113
45.1	Mechanical connector test	113
45.2	Flexing	113
46	Reserved for Future Use	115
47	Reserved for Future Use	115
48	Reserved for Future Use	115
49	Reserved for Future Use	115
50	Reserved for Future Use	115
51	Reserved for Future Use	115
52	Reserved for Future Use	115
53	Reserved for Future Use	115
54	Reserved for Future Use	115
55	Reserved for Future Use	115
56	Reserved for Future Use	115
57	Reserved for Future Use	115
58	Reserved for Future Use	115

ELECTRICAL TESTS

59	General	115
60	Leakage Current Test	115
61	Starting Current Test	119
62	Input Test	120
63	Temperature Test	120
63.1	General	120
63.2	Motor-operated commercial display	123
64	Battery Operated Commercial Displays	124
64.1	General	124
64.2	Method I	124
64.3	Method II	124
64.4	Discharge test	125
64.5	Battery installation test	125
65	Strain Relief Test	125
65.1	Cords	125
65.2	Strain relief for internal conductors and connectors test	126
66	Conductor Cycling Endurance Test	126
67	Grounding-Impedance Test	126
68	Dielectric Voltage-Withstand Test	127
69	Printed-Wiring Board Tests	128
69.1	Printed-Wiring Board (PWB) ground path test	128
69.2	Printed Circuit Board (PWB) Conductor Overcurrent Test	129
70	Motors Testing	130
70.1	General	130
70.2	Running overload motor test	130
70.3	Locked rotor test	131
71	Abnormal – Tests	131
71.1	General	131

UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM



Documents

Document Sharing Hub

71.2	Continuous operation	133
71.3	Output or commercial display interconnection field-wiring	133
71.4	Electronic components	133
71.5	Cooling fans and blowers	134
72	Lamp Drape Test	134
73	Spill Test	135
73.1	Procedure	135
73.2	Spill test dielectric voltage-withstand test	137
74	Flooding Test	137
75	Upholstered Commercial displays with Heating Pads	138
75.1	Resistance to moisture test	138
75.2	Thermostat test	139
75.2.1	General	139
75.2.2	Original calibration	139
75.2.3	Overload	139
75.2.4	Endurance	139
75.2.5	Recalibration	140
75.3	Flexing and twisting test	140
75.3.1	Flexing	140
75.3.2	Twisting	141
76	Magnetic Field Test	142
77	Circuit Power / Voltage Limit Measurement Tests	143
77.1	15 W power limit test	143
77.2	Determination of low-voltage, limited-energy circuit status	144
78	Environmental Conditioning	145
78.1	Humidity exposure	145
78.2	Water shield impact conditioning	145
78.3	Impact test	146
79	General – Test Conditions	146
80	General – Test Results	147
81	Sprinkler Test	147
82	Rain Test	150
83	Thermal Conditioning	152
84	Gasket Adhesion Test	152

MANUFACTURING AND PRODUCTION TESTS

85	Grounding-Continuity Test	153
86	Polarity	153
87	Dielectric voltage-withstand test	153
88	Electrical Ratings	154

MARKINGS

89	General	155
90	Battery-Operated Commercial Display	159
91	Motor-Operated Commercial Displays	160
92	Permanently Electrically-Connected Commercial Displays	160
93	Accessory Markings	161
94	Reserved for Future Use	162
95	Markings for Sub-Assemblies	162
96	Retrofit Kits	162
97	Wet Location	164

UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM  **Documents**
Document Sharing Hub

INSTRUCTIONS

98 General	165
99 Accessory Instructions	167
100 Assembly Instructions	167
101 Battery Operated Commercial Displays	167
102 Operator Attended Products Instructions	168
103 Retro-Fit Kits	168
104 Sub-Assemblies	169
105 Wet Locations	170
106 Instructions Pertaining to a Risk of Fire, Electric Shock, or Injury to Persons	170
107 Operating Instructions	173
108 User-Maintenance Instructions	173
109 Grounding and Double Insulation Instructions	173
110 Reserved for Future Use	175
111 Reserved for Future Use	175
112 Reserved for Future Use	175

PART 2 – SHOWCASES NOT REQUIRING PERFORMANCE TESTING

INTRODUCTION

113 General	175
-------------------	-----

CONSTRUCTION

114 Ballast	176
115 Direct Plug-In Power	177
116 Cord-Connected Showcases	177
117 Electric-Discharge Lamps	177
118 Power Supplies	178
119 Receptacles	178
120 Showcases – Sections	179

MARKING AND INSTRUCTIONS

121 Markings for Showcases Shipped in Sections	180
122 Instructions for Showcases Shipped in Sections	180
123 Production Line Tests	181
123.1 General	181
123.2 Insulation Resistance	181

PART 3 – TEMPORARY COMMERCIAL DISPLAYS

INTRODUCTION

124 Introduction and Scope	181
124.1 General	181
124.2 Scope	182
125 Definitions	182

**UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL**

Documents
Document Sharing Hub

CONSTRUCTION

126 Protection Against Corrosion	182
127 Flammability	182

PERFORMANCE TESTS

128 Testing	182
-------------------	-----

Appendix A

Standards for Components	A184
--------------------------------	------

PROPOSAL

PART 1 – ALL COMMERCIAL DISPLAYS

INTRODUCTION

1 Scope

1.1 These requirements cover commercial displays and other case goods used in retail establishment, including bakeries and restaurants. The term commercial displays 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 commercial displays include both electrified and non-electrified products and may include, but not limited to:

- a) Shelving units (Gondolas);
- b) Merchandise kiosks (such as the mini-stores in the middle of a mall);
- c) Point of Sale (POS);
- d) Motorized carpet displays;
- e) Hanging displays;
- f) Wall systems;
- g) Showcases;
- h) Display Cases;
- i) Cash Wraps;
- j) Temporary Displays; and
- k) Product platforms.

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

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 commercial displays and is intended to be attached to the commercial displays by the user or installer. Subassemblies field assembled to form the basic commercial 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 commercial 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 BRANCH CIRCUIT – The circuit conductors between the final overcurrent device protecting the circuit and the outlet(s).

2.15 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.

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

2.17 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.

2.18 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.

2.19 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.

2.20 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.

2.21 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.

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

2.23 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.

2.24 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 commercial displays' operation or that controls a furniture function.

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

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

2.27 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.)

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

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

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

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

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

2.33 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 a material that is in direct contact.

2.34 ENCLOSURE – An enclosure that serves as an electrical and mechanical enclosure.

2.35 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.

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

2.37 ENTRAPMENT – An area on the commercial 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 commercial displays are locked out and only operated by a trained person.

2.38 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 commercial 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 commercial display.

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

2.40 LOADS:

- a) ABNORMAL – A foreseeable misuse of loading that is beyond the rated load.
- b) RATED – The loading or force intended for normal use.

2.41 COMMERCIAL DISPLAYS SUPPORT SYSTEM – A system of components intended to secure a commercial display to the building or other structure.

2.42 COMMERCIAL DISPLAYS TYPES:

- a) FIXED COMMERCIAL DISPLAYS – Intended to be permanently connected electrically to a source of supply.
- b) PORTABLE COMMERCIAL DISPLAYS – A small commercial displays that meets all of the following:
 - 1) Not secured to the building structure unless provided with a securement means that allows the commercial 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 up without tools or equipment.)
- c) STATIONARY COMMERCIAL 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.

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

2.44 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.

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

2.46 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.

2.47 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.

2.48 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.

2.49 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.

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

2.51 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.

2.52 LIVE PART – Any part where current is flowing.

2.53 LOADING:

- a) FULLY LOADED – Where the commercial displays has the normal test load on the product.
- b) PARTIALLY LOADED – The commercial displays 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 commercial displays has no load being held by the product.

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

2.55 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 per the requirements in Determination of Low-Voltage, Limited-Energy Circuit Status of 77.2. LVLE includes Class 2 and LPS circuits.

2.56 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.

2.57 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.

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

2.59 RACEWAY – An enclosure (See 2.35) that is intended specifically for the holding and routing of wiring.

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

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

2.62 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.

2.63 RFID – Radio-frequency identification.

2.64 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 60.

2.65 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.

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

2.67 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.

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

2.69 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.

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

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

2.72 UPHOLSTERED COMMERCIAL DISPLAY OR FURNITURE – Commercial displays / Furniture 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.

2.73 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 commercial display.

2.74 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.

2.75 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.

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

2.77 WORKING PRESSURE – The maximum system pressure measured during normal operating conditions. When more than one pressurized system is provided the commercial display 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 Appendix 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 commercial 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 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.

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 commercial 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 or Coin Cell Batteries of Lithium Technologies, UL 4200A, if the batteries have dimension of:

- a) Diameter of 1.25 inch (32 mm) or less; and
- b) Height that is less than its diameter.

3.2.1.2 Commercial displays 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.

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

3.2.1.4 Safe operation of the commercial 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 and Vent Cap Tests in the Standard for Standby Batteries, 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 commercial display, a battery charger supplied with the commercial display, or available as an accessory to the commercial display operating at a Class 2 or LPS power output level shall comply with the appropriate requirements. See 2.18 and 2.49, respectively.

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

3.2.3 Non-replaceable batteries

3.2.3.1 A commercial display provided with batteries that are not intended to be replaced by the user shall be located within the commercial 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 (Refer to 90.4). The same WARNING statement shall be provided in the instruction manual (Refer to 101.6).

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 Accessibility of Uninsulated Live Parts and Film-Coated Wire, Section 14.

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 (refer to 90.2), 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 commercial display – 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 commercial 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 (Refer to 90.2, 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 Mechanical enclosure and guards – Mechanical considerations, 12.3.

3.2.5.3 A commercial 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.

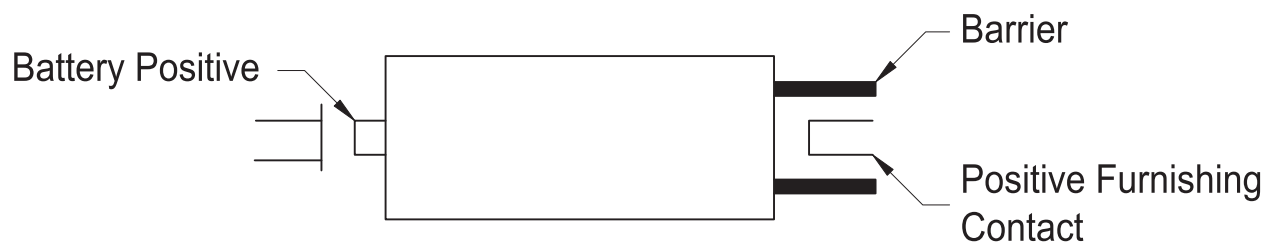
3.2.5.4 The battery tray capacity shall be at least equal to the volume of electrolyte of all the cells of the battery.

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 commercial display battery compartment. For example, a non-conductive barrier. Refer to Figure 3.1.

Figure 3.1
Battery shown – Installed reverse polarity
Battery Shown - Installed Reverse Polarity



su0431

UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL



Documents
Document Sharing Hub

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 Abnormal – Tests, Section 71.

3.2.7 Battery charging

3.2.7.1 A commercial 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 commercial display.

3.2.7.2 The output characteristics of a battery charging circuit shall be compatible with its rechargeable battery. The commercial 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 commercial 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 commercial 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 commercial display shall have a capacitance rating of not more than 0.10 microfarad.

3.3.4 A commercial 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),
- d) A connector located in a SELV circuit that during the Temperature Test, Section 63 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 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 commercial 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 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; or
- b) The Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1.

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 per 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

Commercial 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
$400 \leq \text{CTI} < 600$ (PLC = 1)	II
$175 \leq \text{CTI} < 400$ (PLC = 2 or 3)	IIIa
$100 \leq \text{CTI} < 175$ (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

Commercial 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

3.5.3.4 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.

UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL



Documents
Document Sharing Hub

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

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 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:

- 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 63;
- 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;

UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL



Documents
Document Sharing Hub

g) Thermal Cycling Test shall be conducted at ambient temperatures of $10.0 \pm 2^{\circ}\text{C}$ ($50.0 \pm 3^{\circ}\text{F}$) and the maximum ambient temperature determined by conducting the Temperature Test, Section 63. 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 63; 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 3.5.4.4 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) 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 70°C (158°F);

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) The Computational Investigation is not applicable to appliances covered by this end product standard;

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 1 is to be used;

j) Conduct a failure-mode and effect analysis (FMEA).

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 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 commercial 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 commercial 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 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 commercial 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 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; or
- d) 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.

**UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL**



Documents
Document Sharing Hub

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:

- a) The Standard for Solid-State Controls for Appliances, UL 244A; or
- b) 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 commercial display.

3.6.2 RPTs and FPDUs shall not be daisy-chained where one unit is plugged into another unit.

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 Sections 83 and 84.

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 84. Other means of securement shall be investigated to determine compliance.

3.8 Motors – Construction and overload protection

3.8.1 A motor 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, 70.2, and Locked rotor test, 70.3.

3.8.2 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.

3.8.3 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 commercial display is marked for use on alternating current only; otherwise the table applying to direct-current motors is to be used.

3.8.4 The functioning of a motor-protective device provided as part of a commercial 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.

3.8.5 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.

3.8.6 With reference to 3.8.1, 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
Motor 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

3.8.7 Motor-overload protection in which contacts control a relay coil in a motor starter shall comply with the requirements in 3.8.1.

3.9 Printed-wiring boards

3.9.1 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.

3.9.2 A commercial 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, Section 69.1 and the Printed Circuit Board (PWB) Conductor Overcurrent Test, Section 69.2.

3.9.3 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, 69.2.

3.10 Receptacles (Outlets)

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

3.10.2 A non-locking type 125-volt, 15 and 20 ampere receptacle (ANSI/NEMA 5-15R or 5-20R) used in commercial displays intended for use in business, corridors, waiting rooms and the like including non-patient care areas in clinics, medical and dental offices and outpatient facilities, shall be a Tamper-Resistant type and marked as shown in 89.18.

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.

3.10.3 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 89.17.

3.10.4 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.

3.10.5 Receptacles shall comply with the Spill Test, Section 73.

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.

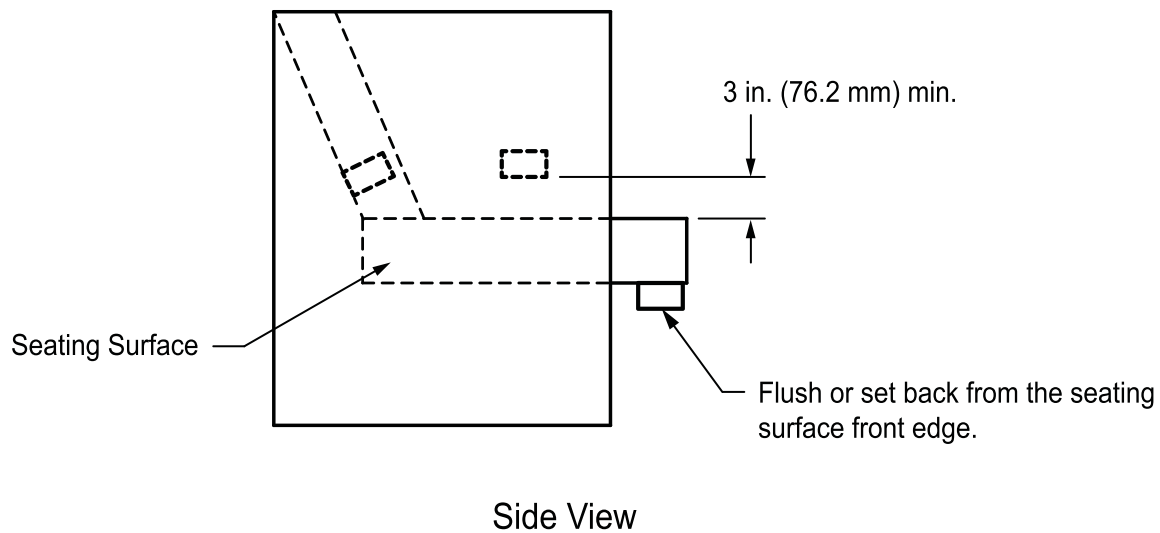
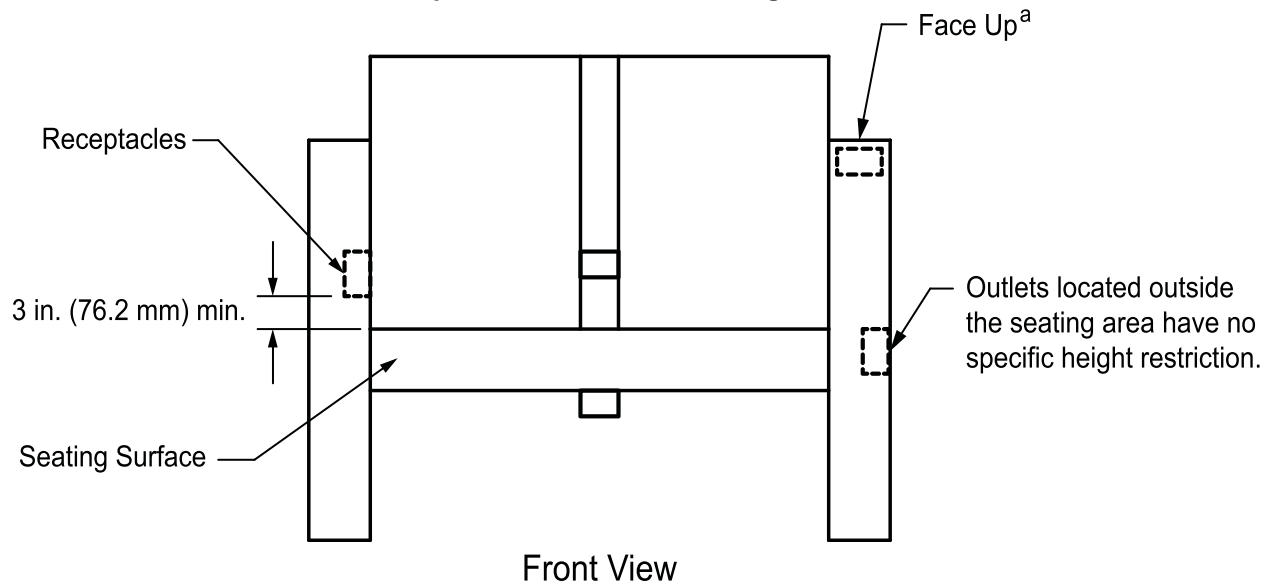
Exception No. 4: This requirement does not apply to a receptacle that is located adjacent to a seating surface and the receptacle is oriented in a position so its face is in a vertical plane ± 5 degrees and located at least 3 inches (76 mm) above the uncompressed seating surface.

3.10.6 A commercial 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 98.15.

3.10.7 A receptacle provided in a commercial 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 commercial display shall comply with 3.10.4.

Figure 3.2
Receptacle locations for seating surfaces



su1731a

^a See 3.10.4.

UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL



Documents

Document Sharing Hub

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

3.10.9 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 commercial display is able to retain the liquid the liquid would flood the receptacle.

3.10.10 For a cord and plug connected commercial display provided with one or more convenience receptacles overcurrent protection (OCP) shall be provided in accordance with Table 3.5. For a commercial 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 commercial displays

Furniture 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	NO	20 ^c	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 furniture is operated at the marked rated current.

^b When provided with an OCP.

^c An OCP is not required for a 12 Amp rated commercial display with four receptacles as long as:

- a) Internal wiring is 12 AWG;
- b) The power-supply cord is 12 AWG;
- c) All other components are evaluated for use at 20 A; and
- d) The Temperature Test, Section 63, load is 20 A.

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

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

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

3.10.14 A convenience receptacle shall be visible to the user.

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 commercial display will not be subject to abrasion because of the location of the receptacle.*

3.11 Receptacles, wet locations

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

3.11.2 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 per the Standard for Cover Plates for Flush-Mounted Wiring Devices, UL 514D.

3.11.3 Cord and plug connected commercial displays supplied with receptacles or connectors for the interconnection of commercial 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: Commercial displays that are powered from NEC Class 2 or LPS power sources operating at 15 volts AC or less or 21.2 Volts peak or less.

3.11.4 Wet location commercial 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: Commercial displays that are powered from NEC Class 2 or LPS power sources operating at 15 volts AC or less or 21.2 Volts peak or less.

3.11.5 Permanently connected commercial 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 commercial display to a class A GFCI circuit. See 105.2.,.

3.12 Switching devices

3.12.1 General

3.12.1.1 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.*

3.12.1.2 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.

3.12.1.3 With reference to 3.12.1.2 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 commercial display.

3.12.1.4 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.

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

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

3.12.2 Switch electrical ratings

3.12.2.1 A switching device shall have a current and voltage rating not less than that of the load that it controls when the commercial display is operated as described in the normal Temperature Test, Section 63.

3.12.2.2 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.

3.12.2.3 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.

3.12.2.4 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; or
- 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.

3.12.2.5 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 3.12.2.1 – 3.12.2.4, as applicable, and the rated current of the resistive load.

3.12.2.6 A switching device provided as part of a commercial 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.

3.12.3 Specific applications

3.12.3.1 A switching device in a fixed or stationary commercial display that controls a heating element and has a marked "off" position shall open all ungrounded conductors of the heating-element circuit or cause the conductors to be opened.

3.12.3.2 An automatically reset protective device shall not be employed when automatic resetting results in injury to a person.

4 Units of Measurement

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

4.2 Values of voltage and current are rms values, unless otherwise stated.

5 Undated References

5.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

6 Environmental Considerations

6.1 General

6.1.1 A unit intended for dry locations only shall be so identified and shall not be provided with any information such as markings, instructions, or illustrations that implies or depicts damp or wet use.

6.1.2 A unit intended for damp locations shall be:

- a) Subjected to the Humidity Test of 78.1 unless all live parts and traces on the printed wiring board are potted (see 6.2) or conformal coated (see 6.3),
- b) If provided with a polymeric enclosure, comply with the Resistance to Impact test of the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, using a preconditioning temperature of $0 \pm 2.0^{\circ}\text{C}$ ($32 \pm 3.6^{\circ}\text{F}$), and
- c) Eligible to be marked as suitable for damp locations, and not be provided with any information such as markings, instructions, or illustrations that implies or depicts wet use.

Exception: A circuit operating at LVLE power levels in which voltage levels are below those that present a risk of electric shock per 2.64 is not required to be subjected to parts (a) and (b) above.

6.1.3 A unit intended for use in wet locations shall:

- a) Be subjected to the environmental tests of Sections 78 – 84 unless all live parts and traces on the printed wiring board are potted (see 6.2) or conformal coated (see 6.3),
- b) If provided with a polymeric enclosure, comply with the UV Light Exposure and Cold Impact Test of the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, using a preconditioning temperature of $\text{minus } 35.0 \pm 2.0^{\circ}\text{C}$ ($\text{minus } 31.0 \pm 3.6^{\circ}\text{F}$), and
- c) Be eligible to be marked as suitable for wet locations.

UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL



Documents
Document Sharing Hub

Exception: A circuit operating at LVLE power levels in which voltage levels are below those that present a risk of electric shock per 2.64 is not required to be subjected to parts (a) and (b) above.

6.2 Potting compound

6.2.1 Potting compound shall not leak, drip, or be released from a unit during any test conducted in accordance with this standard.

6.2.2 During the Temperature Test, Section 63, a potting compound shall comply with (a) or (b) as applicable:

a) Unless the material is thermosetting, a polymeric potting compound shall not exceed its Relative Thermal Index (RTI).

Exception No. 1: A thermoplastic polymeric potting compound may be used if the maximum potting compound temperature doesn't exceed 90°C (194°F) during the Temperature Test, Section 63.

Exception No. 2: A thermoplastic polymeric potting compound may be used if the maximum potting compound temperature is at least 15°C (27°F) less than the softening point of the compound as determined by the Standard Test Methods for Softening Point of Resins Derived from Pine Chemicals and Hydrocarbons, by Ring-and-Ball Apparatus, ASTM E28.

Exception No. 3: A thermoplastic polymeric potting compound may be used if the maximum potting compound temperature is at least 25°C (77°F) less than the softening point of the compound as determined by the Standard Test Methods for Vicat Softening Temperature of Plastics, ASTM D1525.

b) An asphalt potting compound shall remain at least 15°C (27°F) below its softening point as determined by the Standard Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus), ASTM D36/D36M.

6.3 Conformal coating

6.3.1 Where a conformal coating is used to meet the requirements of this standard, it shall comply with the requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, and be suitable for use in combination with the printed wiring board.

Exception: Conformal coatings applied to PWBs that contain only LVLE circuits need not comply.

7 Assembly

7.1 A commercial display shall be completely wired with all splices and electrical connections before the commercial display leaves the factory. The commercial display itself is not prohibited from being shipped unassembled.

Exception: Electrical connections made by connectors instead of splices are not required to be wired before the commercial display leaves the factory.

7.2 Commercial displays shipped unassembled where all individual pieces are shipped from the same manufacturing location shall be shipped from the factory in a carton or as an unpackaged complete assembly. Unassembled parts, when required elsewhere in the standard to accompany the commercial display, shall be included. Glassware is not required to be actually mounted in a frame or holder; it is able to be separately wrapped to protect it from breakage during shipment.

7.3 Commercial displays shipped unassembled where the individual pieces, (sub-assemblies) are shipped from more than one manufacturing location and shipped to the field for assembly shall be constructed so that each sub-assembly is capable of being incorporated into the final assembly without requiring alteration by the installer. Subassemblies that must bear a definite relationship to each other for the intended operation of the product shall be arranged and constructed to permit them to be incorporated into the complete assembly only in the correct relationship with each other, without requiring alteration or realignment. See Section 95, Markings for Sub-Assemblies, and Section 104, instructions for Sub-Assemblies.

7.4 When wires pass through a joint between sections of a commercial display that are separable for packing purposes, the joint shall be such that rotation of one section with respect to the other during the assembly of the sections is limited to not more than 360 degrees. Friction alone does not meet the intent of the requirement to prevent rotation.

Exception: When all of the following conditions exist, rotation between sections of a commercial display is not limited to 360 degrees:

- a) The internal diameter of the tubing through which the wires pass is 1/2 inch (12.7 mm) or more;*
- b) The rotation during assembly is limited to not more than one revolution for each 3 inches (76 mm) of unobstructed tubing length through which the wires pass, when such rotation does not place any stress on the conductors; and*
- c) The conductors do not involve splices unless the splices are:*
 - 1) Inaccessible during assembly in accordance with Figure 14.1, Articulate Probe; and*
 - 2) Secured and provided with strain relief that has been shown to be reliable and not easily defeated by the user.*

7.5 When a splice or an electrical connection is located in a section of a commercial display that is separable for packing purposes, as noted in 7.1, the unit shall be provided with strain relief to reduce the risk of stress being transmitted to the splice or electrical connection during unpackaging and assembly of the commercial display. The strain relief shall be reliable and not easily defeated by the user. See the Strain Relief for Internal Conductors and Connectors Test, 65.2.

7.6 When wires pass through a joint between sections of a commercial display that are separable for packing purposes the joint or section shall comply with 11.7, Protection of Cord and Wiring, while unassembled.

7.7 When in any position of adjustment, a spring-loaded or adjustable section of a commercial display shall not transmit stress to a splice or wiring within any section of the unit either during assembly or when completely assembled. For example, the stem of an adjustable height floor-commercial display unit shall raise and lower without binding or crimping the wiring of the unit.

7.8 As specified in 7.2, a carton is a box of cardboard, pasteboard, shrink film, or similar material (but not newspaper, wrapping paper, tissue paper, or similar paper products). It is not required to be rectangular in form, since the "pinch pack" of cardboard wrap with the ends pinched together and stapled is determined to be a carton.

7.9 A part that must be removed to assemble a commercial display in the intended manner to the supply circuit is not required to be fastened, but the construction shall be such, and the hardware shall be provided, to allow field assembly.

7.10 Any commercial display that is not completely assembled shall be provided with assembly instructions.

8 Accessories

8.1 A commercial display having provision for the use of an accessory shall be constructed so that the use of the accessory does not introduce a risk of fire, electric shock, or injury to persons.

8.2 A commercial display shall comply with the requirements in this Standard with or without the accessory installed.

8.3 Installation of an accessory by the user shall be restricted to an arrangement by which the electrical connections are accomplished by means of mating connectors, attachment plugs and receptacles, or attachment plugs and cord connectors that maintain correct polarity.

8.4 Installation of an accessory shall not require, splicing, cutting of wiring, or the soldering of connections by the installer.

Exception: Accessories, such as a power in-feed, that are intended to be connected and installed by a trained individual, such as an electrician, may be cut and spliced to connect to the building wiring system.

8.5 Strain-relief means shall be provided for the wiring of an accessory where stress may be transmitted to the connections during or after installation.

8.6 The mounting method and location of an accessory shall be specified in the installation instructions for the commercial display. See Accessory Instructions, Section 99.

8.7 Instructions shall be provided with the accessory covering the model number or series of commercial display the accessory is intended for use with. See Accessory Instructions, Section 99.

8.8 The instructions shall be sufficiently detailed and accurate so that installation is feasible, and that the furnishing complies with the requirements of this standard with the accessory installed. See Section 29.2 for Trial Installation.

8.9 An accessory may be shipped with or separately from the basic commercial display.

8.10 A part that is required for the commercial display to perform its basic function is not considered an accessory and shall be supplied with the basic commercial display.

9 Retrofit Kits

9.1 A retrofit kit will comply with all requirements in this standard and after installation of the retrofit kit, a commercial display shall comply with the requirements in this standard.

9.2 After installation of a retrofit kit, all components of the retrofit kit and all components of the luminaire that were affected by the installation of the retrofit kit shall be secured in place so that lamp replacement, inspection of splices to the branch-circuit supply wires, and routine maintenance will not loosen components or joints in the assembly.

9.3 Supplemental wiring including wires for interconnection of kit components and connectors required for installation of the retrofit kit shall be included in the kit.

9.4 Tubular LED lamps that are intended to replace fluorescent lamps and use existing lampholders only for mechanical support and are powered by separate supply connections shall comply with the requirements for tubular lamps in the Standard for Self-Ballasted Lamps and Lamp Adapters, UL 1993.

CONSTRUCTION

10 General

10.1 Each electrical device and insulated conductor shall have ratings (voltage, current, wattage, temperature, etc.) at least equal to the parameters that are applied to it during intended use.

10.2 Means shall be provided to reduce the risk of contact between the surface of a cabinet and a cabinet light other than at the intended mounting means so that the temperature of the mounting surface or the surface where the light falls does not exceed its temperature limit. The means provided shall have strength and rigidity to reduce the risk of distortion which facilitates installation in a manner other than intended.

10.3 When wires pass through a joint between sections of a commercial display the construction shall comply with the requirements in 7.4.

10.4 A commercial display shall be formed and assembled so that it has the strength, stability, and rigidity required to resist the abuses during normal use and maintenance to which it is subjected without increasing the risk of fire, electric shock, or injury to persons.

10.5 A commercial display shall be smooth and rounded and shall not be so sharp as to constitute a risk of injury to persons during intended use and maintenance of a product, when investigated in accordance with the Standard for Tests for Sharpness of Edges on Equipment, UL 1439.

10.6 A Commercial display or part of a commercial display is considered to be subjected to physical abuse if a 2-in (51-mm) diameter sphere is able to contact the part.

Exception: If the location of the part makes it unlikely that the part will be accidentally contacted it is not considered to be subjected to mechanical abuse such as directly underneath a fixed work surface.

10.7 When conductors are stranded, the connection means shall be such that loose strands are minimized.

10.8 All connections and splices shall be mechanically and electrically secure.

11 Power-Supply Connections

11.1 Permanently connected commercial display

11.1.1 A permanently connected commercial display shall be provided with field-wiring terminals or leads for the connection of conductors having an ampacity rated as intended for the commercial display, and in accordance with the National Electrical Code, ANSI/NFPA 70 and the Canadian Electrical Code, C22.1-15. A commercial display shall be provided with a splice compartment, junction box or length of raceway to make connections.

11.1.2 A lead that is intended to be connected in the field to a power-supply circuit conductor shall not be smaller than 18 AWG (0.82 mm²), and shall be sized based on the rated current of the commercial display.

11.1.3 A terminal or splice compartment shall be complete and shall enclose all field-wiring terminals and splices to be made in the field.

11.1.4 Each terminal or splice compartment in which power-supply connections are to be made in the field shall be located so that the connections are able to be readily accessible for inspection after installation of the commercial display.

11.1.5 The compartment specified in 11.1.4 shall be located so that, when making conduit connections, internal wiring and electrical components are not exposed to mechanical abuse or strain.

11.1.6 A terminal compartment intended for connection of a supply electrical enclosure shall be attached so as to be prevented from turning with respect to the supporting surface.

11.1.7 A wiring terminal shall be prevented from turning or shifting in position.

11.1.8 A wire-binding screw at a wiring terminal shall not be smaller than No. 10 (4.8 mm diameter). If a pre-tapped hole is not provided, a thread-forming screw shall be used.

Exception: A No. 8 (4.2 mm diameter) screw is able to be used at a terminal intended only for connection of a 14 AWG (2.1 mm²) or smaller conductor.

11.1.9 A terminal plate tapped for a wire-binding screw shall be of metal not less than 0.050 in (1.27 mm) thick.

Exception: A plate not less than 0.030 inch (0.76 mm) thick is able to be used when the tapped threads comply with Tightening Torque Test, Section 43.

11.1.10 A wire-binding screw shall be provided with an upturned lug, cupped washer, or equivalent means that retains a supply conductor of the size intended.

11.1.11 A terminal (for example, a plate and screw) intended for the connection of the grounded supply conductor shall be formed of or plated with metal that is substantially white in color and shall be readily distinguishable from other terminals or shall be clearly identified in some other manner, such as on an attached wiring diagram.

11.1.12 A lead intended for the connection of the grounded power-supply conductor shall be finished to show a white or gray color, and shall be readily distinguishable from other leads.

11.1.13 The free length of a lead located inside an outlet box or field-wiring compartment and intended for field connection to a branch circuit shall not be less than 6 in (152 mm).

11.1.14 When a terminal block is provided, it shall be suitable for field wiring.

11.1.15 An opening for conduit shall have dimensions as indicated in Table 11.1.

Table 11.1
Dimensions associated with openings for conduit

Nominal trade size of conduit inches	Unthreaded opening diameter ^a		Throat minimum		Diameter maximum		Minimum diameter of flat surface	
	inch	(mm)	inch	(mm)	inch	(mm)	inch	(mm)
1/2	0.875	(22.2)	0.56	(14.2)	0.62	(15.7)	1.15	(29.2)
3/4	1.109	(28.2)	0.74	(18.8)	0.82	(20.8)	1.45	(36.8)
1	1.375	(34.9)	0.94	(23.9)	1.05	(26.7)	1.80	(45.7)
1-1/4	1.734	(44.0)	1.24	(31.5)	1.38	(35.1)	2.31	(58.7)

^a A plus tolerance of 0.031 inch (0.79 mm) and a minimum tolerance of 0.015 inch (0.38 mm) applies to the knockout diameter. Knockout diameters are measured other than at points where a tab remains after removal of knockout.

11.1.16 The minimum unobstructed diameter of the flat surface surrounding the back of an opening for unthreaded conduit shall be as indicated in Table 11.1.

11.1.17 When threads for the connection of threaded conduit are tapped all the way through a hole, there shall be no fewer than 3-1/2 or more than 5 threads. The construction of the hole shall be such that a conduit bushing is able to be properly attached and the minimum unobstructed diameter surrounding the back of the hole shall be as indicated in Table 11.1.

11.1.18 When threads for the connection of threaded conduit are not tapped all the way through a hole, there shall be no fewer than five full threads. The unthreaded parts of the hole and the back edge shall be smooth and well-rounded for protection of the conductors. The unthreaded throat diameter of the hole shall have an internal diameter as noted in Table 11.1.

11.1.19 The minimum usable volume of a field wiring compartment shall be as specified in Table 11.2.

Table 11.2
Minimum usable volume of terminal compartment

Size of conductors		Volume for each conductor that originates outside the compartment and terminates or is spliced within the compartment, and each conductor that passes through the compartment without splice or termination, including a grounding conductor	
AWG	(mm ²)	cm ³	(in ³)
18	(0.8)	24.6	(1.50)
16	(1.3)	28.7	(1.75)
14	(2.8)	32.77	(2.00)
12	(3.3)	36.87	(2.25)
10	(5.3)	40.97	(2.50)
8	(5.5)	49.2	(3.0)
6	(6.5)	81.9	(5.0)

11.1.20 Conduit shall only be used as permitted by the National Electrical Code, NFPA 70. For example, flexible metal conduit shall not be used where it is subject to physical abuse and flexed after installation.

11.2 Cord-connected commercial display

11.2.1 A commercial display intended to be connected to the power-supply source by means of a flexible cord and plug shall be provided with a flexible cord and an attachment plug for connection to the supply source. Commercial displays supplied with more than one power supply cord shall comply with 11.3, Multiple Power Supply Cords.

11.2.2 When a 3-wire grounding-type or a 2-wire polarized attachment plug is provided, the circuit conductors in the flexible cord shall be connected to the plug and to the wiring in the product so that any of the following devices used in the primary circuit shall be connected in an ungrounded current carrying conductor: the center contact of the Edison-Base lampholder, a single pole switch, an automatic control with a marked off position, a single fuseholder, and any other single-pole overcurrent protective device.

11.2.3 When a 3-wire grounding-type attachment plug or a 2-wire polarized attachment plug is provided, the attachment plug connection shall comply with Figure 11.1 and the polarity identification of the flexible cord shall comply with Table 11.3. See Operating Instructions, Section 107.

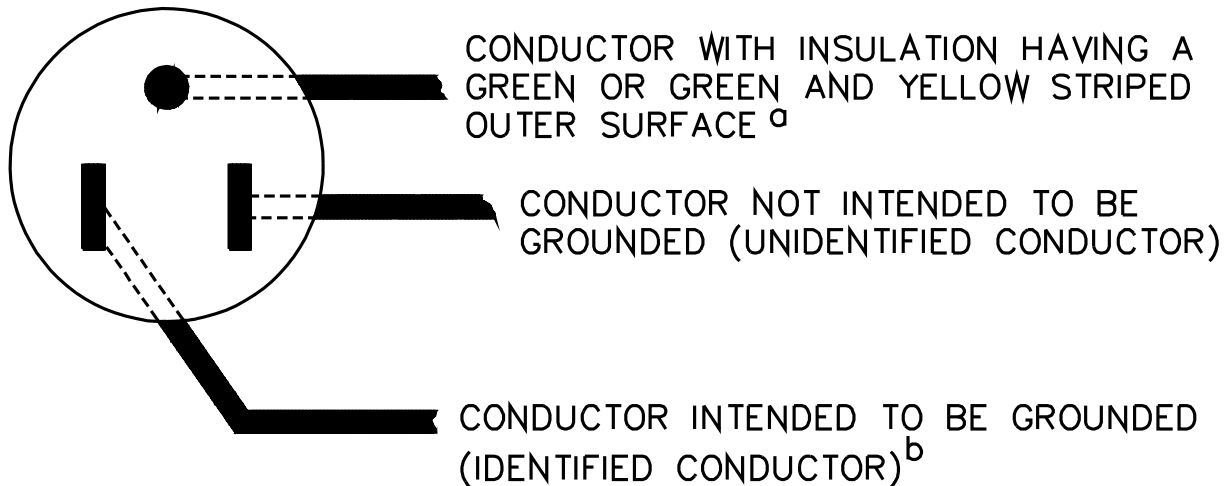
UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL



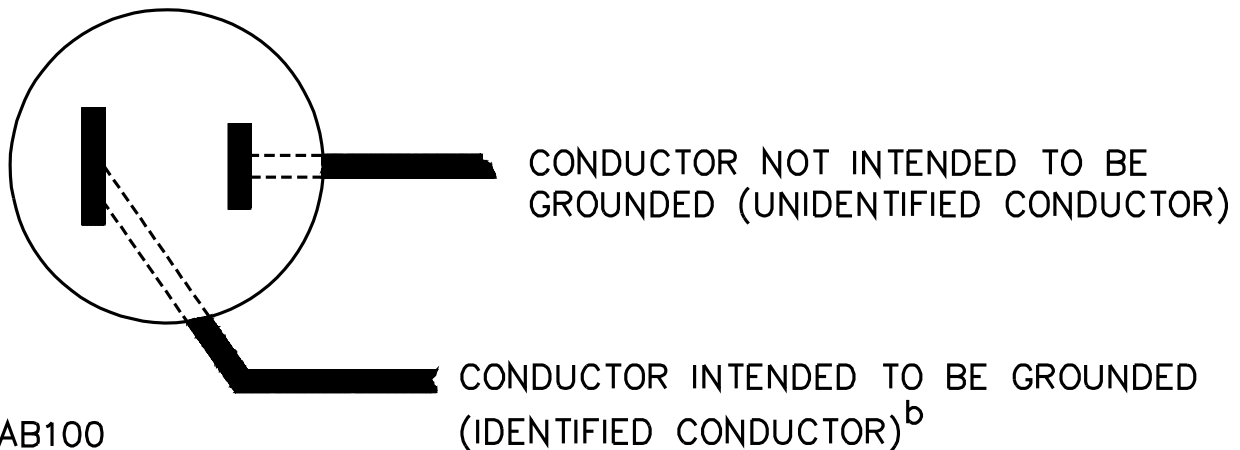
Documents
Document Sharing Hub

Figure 11.1
Connections to attachment plugs

CONNECTIONS OF CORD CONDUCTORS TO GROUNDING – TYPE ATTACHMENT PLUG (FACE OF PLUG REPRESENTED)



CONNECTIONS OF CORD CONDUCTORS TO POLARIZED ATTACHMENT PLUG (FACE OF PLUG REPRESENTED)



^a In the above illustration, the blade to which the green conductor is connected is able to have a U-shape instead of a circular cross section.

^b Signifies a conductor identified in accordance with Table 11.3. The grounded (identified) conductor is the neutral supply conductor.

**UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL**



Documents
Document Sharing Hub

Table 11.3
Polarity identification of flexible cords

Method of identification	Usable combinations	
	Wire intended to be grounded ^{a,b}	All other wires ^a
Color of braid on individual conductors	Solid white or gray – without tracer	Solid color other than white or gray – without tracer
Color of insulation on individual conductors	Color other than white or gray, with tracer in braid	Solid color other than white or gray – without tracer
	–	Solid color other than white or gray
Other means	Light blue ^c	Solid color other than light blue, white, or gray
	–	No tin or other white metal on the strands of the conductor
^a A wire finished to show a green color with or without one or more yellow stripes or tracers is to be used only as an equipment-grounding conductor. See 15.3 and Figure 11.1. ^b The grounded conductor is the neutral supply conductor. ^c For jacketed cords.		

11.2.4 A commercial display required to be grounded shall be provided with a grounding-type attachment plug.

11.2.5 If the cord includes an equipment grounding conductor, the grounding conductor shall be connected to all exposed or accessible un-energized metal parts that may become energized of the commercial display by a mechanical means in accordance with Grounding and Bonding, Section 15, and to the grounding pin of a grounding attachment plug. See Figure 11.1.

11.2.6 The power-supply cord shall be rated for use at a voltage not less than the rated voltage of the product. The power-supply cord shall be sized in accordance with Table 11.4. A commercial display provided with a 20 Amp rated receptacle shall be provided with a minimum 12 AWG (3.3 mm²) conductor cord or when provided with a 15 Amp receptacle with a minimum 14 AWG (2.1 mm²) conductor cord.

Table 11.4
Power supply cord ampacity

Cord size AWG (mm ²)	Furniture maximum rating (Amperes) per cord	
	3 current-carrying conductors	2 current-carrying conductors
6 (13.3)	45	55
8 (8.4)	35	40
10 (5.3)	25	30
12 (3.3)	20	25
14 (2.1)	15	18
16 (1.3)	10	13
18 (0.82)	7	10

11.2.7 The flexible cord shall be of a type indicated in Table 11.5 or shall have properties such that it will be at least equally as serviceable for the particular application.

Table 11.5
Acceptable types of cord and applicable limitations on their use

Cords acceptable where temperatures of more than 121°C (250°F) are attained on any surface the cord can contact	Cords acceptable where 121°C (250°F) or lower temperatures are attained on any surface the cord can contact	Cords acceptable for wet locations
HSJ, HSJO, HSJOW	SJ, SJT, SJE, SJEO, S, SO, SOW, SOO, SOOW, STO, STOW, STOO, STOOOW, SEO or SEOW or equivalent	Type SJT suitable for outdoor wet locations use.

11.2.8 A power supply with a supply cord input shall comply with 11.2.6 and 11.2.7.

11.2.9 When a commercial display employs a power supply with a supply cord input and output conductors the combined length of the supply cord and the output conductors shall be in compliance with Table 11.6 requirements.

11.2.10 The length of a power supply cord shall be within the limits specified in Table 11.6.

Table 11.6
Length of power supply cord

Cord exit point (Based on the construction or the use instructions)	Minimum acceptable length		Maximum acceptable length	
	ft	(mm)	ft	(mm)
Commercial displays not intended to be along a wall	0.5	(152)	1.0	(305)
Cord exit point lower than 3 feet from the floor	5.0	(1524)	25	(7620)
Cord exit point greater than 3 feet from the floor	9.0	(2743)	25	(7620)

11.2.11 When the intended means of mounting or other features or constructions of a commercial display warrants other than the required length of power-supply cord, a shorter cord is able to be provided. Instructions shall be provided in accordance with 98.12.

11.2.12 The current rating of the attachment plug of a commercial display shall not be less than 125 percent of the maximum current input of the commercial display or the marked rating when no electrical load is provided as part of the commercial display.

11.2.13 Means shall be provided to support the cord to reduce risk of contact with a cabinet light at a location other than the cord exit.

Exception: If the temperature rating of the cord is equal to or above the maximum temperature measured during the Temperature Test, Section 63.

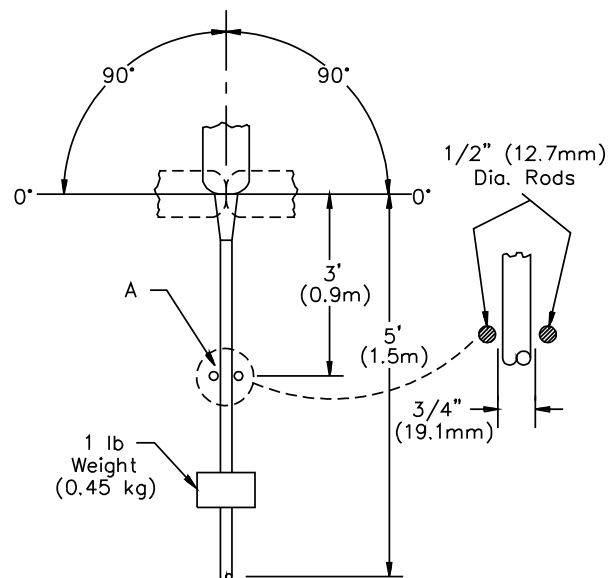
11.2.14 The commercial display shall be constructed so that neither the cord nor plug is damaged when the commercial display is placed against a wall. Examples of constructions include, but are not limited to wood blocks to hold the commercial display out from the wall and right angle (flat) cord/plugs.

11.2.15 Power supply cords and interconnecting cords that constitute a risk of injury, which includes shock and fire, from damage shall be protected from moving parts of a commercial display.

11.2.16 Cords subject to flexing shall be subjected to the Conductor Cycling Endurance Test, Section 66 unless:

- a) The cord is not flexed more than 90 degrees as shown in Figure 11.2;
- b) The cord is provided with a strain relief at each end of the cord where it enters an enclosure; and
- c) The cord is not subject to a twisting motion along its longitudinal axis.

**Figure 11.2
Cord flexing**



A – Portions of the cord damaged by contact with the guides or attachment of the weight may be removed prior to the electrical tests.

S2864

11.3 Multiple power supply cords

11.3.1 Cord connected commercial displays shall not be provided with more than one power supply cord unless all of the following conditions are met:

- a) Not more than two cords are provided;
- b) Each flexible cord is of the type, size, and rating required for the type of product and the load supplied;
- c) Each attachment plug cap's rating is:

**UL COPYRIGHTED MATERIAL –
NOT AUTHORIZED FOR FURTHER REPRODUCTION OR
DISTRIBUTION WITHOUT PERMISSION FROM UL**



Documents
Document Sharing Hub