

## STANDARD INFORMATION

**This SUN establishes the Continuing Certification approach for Electrostatic Air Cleaners**

**Standard Number:** UL 867

**Standard Name:** Electrostatic Air Cleaners

**Standard Edition and Issue Date:** 5<sup>th</sup> Edition Dated August 4, 2011

**Date of Revision:** August 7, 2018

**Date of Previous Revision of Standard:** September 16, 2016

## EFFECTIVE DATE OF NEW/REVISED REQUIREMENTS

**Effective Date:** **No action is required for currently certified products to maintain certification.**

**This SUN is being presented to assist users of the standard to appreciate the significance of the changes made to the standard that will apply should the product described be modified after August 7, 2020**

## IMPACT, OVERVIEW, AND ACTION REQUIRED

**Impact Statement:** Effective immediately, this revised standard will be exclusively used for evaluation of new products unless the Applicant requests in writing that current requirements be used along with their understanding that their listings will be withdrawn on Effective Date noted above, unless the product is found to comply with new/revised requirements.

### Overview of Changes:

- Addition of Requirements for Remotely Operated Electrostatic Air Cleaners
- Update of Motor-Protection Requirements
- Nonmetallic Parts Requirements
- Alternate Power Supplies
- Transformers and Insulating Materials
- Addition of many tests
- Cord-Connected Conversion to Permanently-Connected Products
- Protection Against Injury to Persons
- Requirements Specifying Minimum Circuit Ampacity and Maximum Overcurrent Protective Device Size

Specific details of new/revised requirements are found in table below.

***Current Listings Not Active? – Please immediately identify any current Listing Reports or products that are no longer active and should be removed from our records. We will do this at no charge as long as Intertek is notified in writing prior to the review of your reports.***



## STANDARD INFORMATION

CLAUSE	VERDICT	COMMENT
<p style="text-align: center;"><i>Additions to existing requirements are <u>underlined</u> and deletions are shown <del>lined out</del> below.</i></p>		
4A	Info	<b>Components</b>
4A.9	Info	<b>Power supplies</b>
A4.9.1		<p>A <del>Class 2</del> power supply <u>other than a high-voltage power supply</u> shall comply with one of the following:</p> <p>a) <u>For a power supply providing a low-voltage circuit output:</u></p> <ul style="list-style-type: none"> <li>1) Standard for Class 2 Power Units, UL 1310; or</li> <li>2) Standard for Information Technology Equipment – Safety – Part 1: General Requirements, UL 60950-1, with an output marked “Class 2”, or that complies with the limited power source (LPS) requirements and is marked “LPS”.</li> </ul> <p>b) <u>For a power supply providing a line-voltage circuit output:</u></p> <ul style="list-style-type: none"> <li>1) <u>Standard for Power Units Other Than Class 2, UL 1012; or</u></li> <li>2) <u>Standard for Information Technology Equipment – Safety – Part 1: General Requirements, UL 60950-1.</u></li> </ul> <p>c) <u>For a switch mode power supply unit not complying with (a) or (b), the relevant requirements in this Standard, including the Switch Mode Power Supply Units – Overload Test, Section 49D, shall be applied.</u></p>
4A.11	Info	<b>Transformers</b>
		<p><b><i>New clause added;</i></b></p> <p>If a general purpose transformer has a Class 105 (A) insulation system, the transformer shall comply with:</p> <p>a) The spacings requirements in Table 23.1; or</p> <p>b) Except as specified in 4A.11.4, be provided with an insulation system consisting of a combination of magnet wire and be one or more of the following major component insulation materials:</p> <ul style="list-style-type: none"> <li>1) Thermoset materials;</li> <li>2) Those specified in Table 4A.1 at the specified minimum thickness;</li> <li>3) Materials or a combination of materials, whether polymeric or not polymeric (treated cloth, for example), that are thinner or other than those specified in Table 4A.1, and used to isolate the windings from dead metal parts and:               <ul style="list-style-type: none"> <li>i) Have a relative or generic thermal index for electrical properties of at least 221°F (105°C); and</li> <li>ii) Be unfilled glass-reinforced nylon, polycarbonate, polybutylene terephthalate, polyethylene terephthalate, phenolic or acetal.</li> </ul> </li> <li>4) Other polymeric materials complying with the Thermal Aging Test, Section 46B.</li> </ul>
4A.11.3		<p>(This clause is covered by the detailed text in the previous row under 4A.11)</p>



CLAUSE	VERDICT	COMMENT
		<b><i>New clause added;</i></b>
4A.11.4		<p>Insulating materials not complying with 4A.11.3(b) shall comply with 4A.11.5 and be used between a crossover lead and the:</p> <ul style="list-style-type: none"> <li>a) Turns of the transformer winding to which the lead is connected;</li> <li>b) Adjacent winding;</li> <li>c) Metallic enclosure; or</li> <li>d) Transformer core.</li> </ul>
		<b><i>New clause added;</i></b>
4A.11.5		<p>The insulating materials referenced in 4A.11.4 shall:</p> <ul style="list-style-type: none"> <li>a) Be electrical grade paper, waxed or otherwise treated to resist the absorption of moisture, having a total thickness not less than 0.013 inch (0.33 mm); or</li> <li>b) Be mechanically and thermally equivalent insulating material(s) to (a) and: <ul style="list-style-type: none"> <li>1) Have a dielectric breakdown strength of 2500 volts or more in the thickness used; or</li> <li>2) Withstand the dielectric voltage-withstand test potential in 46.1.1(a) with the potential applied between the coil leads and with the coil lead cut at the point where it enters the inner layer; or</li> <li>3) Withstand the induced-potential test in 46.3.</li> </ul> </li> </ul>
		<b><i>New clause added;</i></b>
4A.11.6		<p>Leads provided as part of a Class 105 (A) insulation system on a general purpose transformer shall be rated 194°F (90°C) minimum.</p>
		<b><i>New clause added;</i></b>
4A.11.7		<p>The following shall comply with the Standard for Systems of Insulating Materials – General, UL 1446:</p> <ul style="list-style-type: none"> <li>a) Materials used in an insulation system operating above Class 105 (A) temperatures; or</li> <li>b) Insulation systems employing integral ground insulation.</li> </ul>
4A.13	Info	<b>Information technology equipment</b>
		<b><i>New clause added;</i></b>
4A.13.1		<p>Information technology equipment such as a printer, visual display unit, router, communication connectors/data ports or computer shall comply with the Standard for Information Technology Equipment – Safety – Part 1: General Requirements, UL 60950-1.</p>
		<b><i>New section added;</i></b>
4A.14		<b>Optical isolators and semiconductor devices</b>



CLAUSE	VERDICT	COMMENT
6	Info	<b>Frame, Cabinet and Enclosure</b>
6.1	Info	<b>General</b>
		<b><i>New clause added;</i></b>
6.1.12		Each gasket required to seal an enclosure against the entrance of rain and condensate shall be held in place by mechanical fasteners or adhesives except as indicated in 6.1.13, and shall:  a) Be neoprene, rubber, thermoplastic, polyvinyl chloride or other materials with equivalent properties that comply with Section 49C; or b) Comply with the Standard for Gaskets and Seals, UL 157 if the gasket physical properties are equivalent to those specified in 49C.2 – 49C.10.
		<b><i>New clause added;</i></b>
6.1.13		In reference to 6.1.12, gaskets which are not held in place by mechanical fasteners or adhesives but are intended to be retained in the correct position by some other means shall be prevented from displacement either:  a) Due to their location within the equipment, or b) By the placement of other components in the enclosure so that if the equipment cover is removed, the gasket will be reengaged in the intended manner when the cover is replaced.
		<b><i>New clause added;</i></b>
6.1.14		Adhesives required to secure gaskets shall comply with 49C.11.
		<b><i>New clause added;</i></b>
6.1.15		Products intended for outdoor use shall comply with the Rain Test, Section 49B.
		<b><i>New clause added;</i></b>
6.1.16		For products intended for installation within a concealed space of a building structure, an opening complying with Section 7, Accessibility of Uninsulated Live Parts and Moving Parts, but located on a part of the product concealed by the building structure shall not have any dimension exceeding 17/64 in. (6.75 mm) or a cross-sectional area exceeding 0.055 in <sup>2</sup> (35.5 mm <sup>2</sup> ) and there shall be no more than:  a) Four openings in the rear of the enclosure; and b) Two openings in each of the other four sides of the enclosure.
6.3	Info	<b>Fixed products</b>
6.3.2.1		<del>Metallized or painted polymeric parts or enclosures shall comply with Section 6A, Nonmetallic Parts, the applicable requirements of the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. This requirement is not applicable to exterior surfaces of polymeric enclosure materials or parts provided that the metallized coating or paint does not offer a continuous path for an internal flame to propagate externally.</del>



CLAUSE	VERDICT	COMMENT
6A		<b><i>New section added;</i></b> <b>Nonmetallic Parts</b>
6B		<b><i>New section added;</i></b> <b>Nonmetallic Materials</b>
6C		<b><i>New section added;</i></b> <b>Nonmetallic Material Ignition Sources Separation</b>
8	Info	<b>Mechanical Assembly</b>
8.3	Info	<b>Mechanical barriers</b> A mechanical barrier shall be formed from one or more of the following:  a) Metal with at least the thickness specified in Tables 6.1 or 6.2 as provided under the columns titled “With supporting frame or equivalent reinforcing” for the dimensions of the mechanical barrier; b) A nonmetallic material of the necessary strength and rigidity and: 1) Rated 5VA; or 2) Evaluated to the 127 mm (5 inch) Flammability Test as described in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C; c) Any other material or construction determined to be equivalent to (a) – (b).
8.3.1		
11	Info	<b>Electrical Insulation</b>
11.3	Info	<b>Secondary circuits</b>
11.3.3		Insulating materials other than those specified in 11.3.1 and 11.3.2 may be used based on the results of shall comply with 11.4 or with the High-Voltage Insulating Material Arcing Test, Section 51.
11.4		<b><i>New section added;</i></b> <b>Insulating barriers</b> An insulating barrier shall:  a) Be constructed to withstand the most severe condition anticipated in service; b) Comply with requirements for mechanical barriers in 8.3 if exposed or otherwise subjected to mechanical damage; and c) Be reliably held in place.
11.4.1		
11.4.2		Materials used for an insulating barrier:  a) Shall be of the material(s) and minimum thickness as specified in Table 11.1 for high, line or low-voltage circuits.



CLAUSE	VERDICT	COMMENT																								
		<p>b) Shall be vulcanized fiber or varnished cloth not less than 1/32 inch (0.8 mm) thick for line or low-voltage circuits.</p> <p>c) Shall be equivalent to those specified in (a) or (b) for each respective circuit.</p> <p>d) Are not specified for low-voltage circuits that do not contain a protective control.</p>																								
12	Info	<b>Supply Connections</b>																								
12.1	Info	<b>Permanently-connected products</b>																								
12.1.1	Info	<b>General</b>																								
		<i><b>New clause added;</b></i>																								
12.1.1.5		A product intended for duct- or plenum-mounting shall be permanently connected to the electrical supply source unless constructed as specified in 12.2.1.2.																								
12.1.2	Info	<b>Wiring compartment</b>																								
		<i><b>New clause added;</b></i>																								
12.1.2.3		Leads intended for connection to any external line-voltage circuit or to an external low-voltage circuit containing one or more protective controls shall be provided with strain relief if stress on the lead may be transmitted to terminals, splices, or internal wiring. Leads shall comply with 42.1 when subjected to a direct pull of 20 pounds-force (89 N).																								
12.1.3	Info	<b>Conduit connection means</b>																								
		<i><b>New clause added;</b></i>																								
12.1.3.6		The opening or knockout intended for the attachment of a permanent wiring system shall be based on the product minimum supply circuit ampacity (MCA) and the required field-supplied wire size in accordance with Table 12.2.																								
		<i><b>New table added;</b></i>																								
		<b>Field wiring knockout or opening dimension size<sup>a,b,d</sup></b>																								
		<table border="1"> <thead> <tr> <th>Product minimum supply circuit ampacity (MCA) determined in 57.8.1</th> <th>Required field-supplied wire size, AWG</th> <th>Trade size of conduit, inches</th> <th>Knockout or opening diameter size (range), in (mm)</th> </tr> </thead> <tbody> <tr> <td>Up to 15</td> <td>14</td> <td>1/2</td> <td>0.86 – 0.90 (21.8 – 23.0)</td> </tr> <tr> <td>15 - 20</td> <td>12</td> <td>1/2</td> <td>0.86 – 0.90 (21.8 – 23.0)</td> </tr> <tr> <td>20 - 30</td> <td>10</td> <td>1/2</td> <td>0.86 – 0.90 (21.8 – 23.0)</td> </tr> <tr> <td>30 - 40</td> <td>8</td> <td>1<sup>c</sup></td> <td>1.36 – 1.40 (34.5 – 35.7)<sup>c</sup></td> </tr> <tr> <td>40 - 55</td> <td>6</td> <td>1</td> <td>1.36 – 1.40 (34.5 – 35.7)</td> </tr> </tbody> </table>	Product minimum supply circuit ampacity (MCA) determined in 57.8.1	Required field-supplied wire size, AWG	Trade size of conduit, inches	Knockout or opening diameter size (range), in (mm)	Up to 15	14	1/2	0.86 – 0.90 (21.8 – 23.0)	15 - 20	12	1/2	0.86 – 0.90 (21.8 – 23.0)	20 - 30	10	1/2	0.86 – 0.90 (21.8 – 23.0)	30 - 40	8	1 <sup>c</sup>	1.36 – 1.40 (34.5 – 35.7) <sup>c</sup>	40 - 55	6	1	1.36 – 1.40 (34.5 – 35.7)
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40 - 55	6	1	1.36 – 1.40 (34.5 – 35.7)																							
Table 12.2		<p><sup>a</sup> Based on copper field wiring conductors having insulation that does not exceed 140°F (60°C) within the product during the Temperature Test, Section 45.</p> <p><sup>b</sup> Applies to either a 3 or 4 wire field wiring connection having 1 or 2 ungrounded wires, a grounded (neutral) wire and a grounding (earth) wire.</p> <p><sup>c</sup> If only a 3 wire connection is used with a product having a MCA of 30 – 40, the knockout or opening diameter can be decreased to 1.09 – 1.14 in (27.8 – 29.0 mm).</p> <p><sup>d</sup> These values were determined based on 310.15, "Ampacities for Conductors Rated 0 – 2000 Volts" in the National Electrical Code, NFPA 70; the trade size of conduit table in the Standard for Heating and Cooling Equipment, UL 1995; and Annex D, "Knockout Dimensions", in the Standard for Enclosures for Electrical Equipment, Non-Environmental Considerations, UL 50.</p>																								



CLAUSE	VERDICT	COMMENT
12.3		<b><i>New section added;</i></b> <b>Cord-connected conversion to permanently connected</b>
13A	Info	<b>Switches and Controllers</b>
13A.1		<u>Except as specified in 13A.6 or 13A.8, a switch or other control device shall be acceptable for the application have a rating not less than that of the load that it controls. Items to consider in determining the device rating could include the voltage, current, power factor, control device ambient temperature and other similar parameters. Power factor requirements for each specific load type are specified in 46C.5.:</u>
13A.2		<u>A switch or other control device, other than as specified in 13A.2.1 13A.4, shall be located within the confines of the frame, cabinet or enclosure of the product or be additionally protected so as to reduce the likelihood of contact by external objects. comply with the:</u> a) <del>Standard for Fan Speed Controls, UL 1917;</del> b) <del>Standard for Industrial Control Equipment, UL 508;</del> c) <del>Standard for Power Conversion Equipment, UL 508C; or</del> d) <del>Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1.</del>
13A.2.1		<b><i>New clause added;</i></b> In reference to 13A.2, if the actuating part of a switch or other control device is not located within the confines of the frame, cabinet or enclosure of the product: a) Unintentional operation of the switch or other control device shall not result in a risk of injury to persons; or b) The actuating part shall be guarded such as by recessing, ribs or barriers.
13A.2.2		<b><i>New clause added;</i></b> A protective control shall be an integral part of the product and control the load either, a) Directly; or b) Indirectly through a switching device which is an integral part of the product and that complies with the endurance test requirements for protective controls in 13A.3 or 13A.3.1.
13A.3		<b><i>New section added;</i></b> <b>Protective Controls</b>
13A.13		<b><i>New clause added;</i></b> An operating control not complying with 13A.3.9 shall:



CLAUSE	VERDICT	COMMENT
		<p>a) Comply with 13A.14(a), if the control is electronic; and b) Be powered entirely by no more than one low-voltage circuit; comply with the Limiting Impedance Test in UL 508; or comply with the low-power circuit requirement determined as specified in 19.11.1 of the Standard for Safety of Household and Similar Electrical Appliances, Part 1: General Requirements, UL 60335-1.</p>
		<p><b>New clause added;</b></p> <p>An operating control that complies with 13A.3.9 shall also comply with all the following:</p> <p>a) For electronic controls – Installation Class 2 for electromagnetic compatibility (EMC) shall be in accordance with the voltage surge testing in 49A.3.6 and comply with the results specified in 49A.3.2; b) Category II shall be the overvoltage category; c) Insulating materials shall have a minimum comparative tracking index (CTI) of 100 (Material Group III); d) The applicable pollution degree shall be as specified in 23.6.3 (a) – (e); and e) The operating control (limiter) endurance cycle requirements specified by either: 1) Table CC.2 of the Standard for Automatic Electrical Controls – Part 2-9: Particular Requirements for Temperature Sensing Controls, UL 60730-2-9, with the operating control (limiters) endurance cycle requirements being applied; or 2) Endurance Test – Switching Devices, Section 46C.</p>
13A.14		
		<p><b>New clause added;</b></p> <p>If an operating control complying with 13A.3.9 indirectly controls the load through a switching device, the endurance cycle requirements in 13A.14(e) shall be applied to the switching device.</p>
13A.15		
		<p><b>New clause added;</b></p> <p>Appendix B, Operating and Protective (“Safety Critical”) Control Functions, shall be referenced to determine whether a control function is considered to result in a risk of fire, electrical shock or injury to persons.</p>
13A.16		
		<p><b>New clause added;</b></p> <p>If a control can be used to reduce the risk of fire, electric shock or injury to persons under abnormal operating conditions of the product, but a redundant control (of similar or different design) operates to perform the identical function, the circuit shall be evaluated to determine which control will be relied upon as the protective control. The control determined to be the protective control shall comply with the protective control requirements in 13A.3. The control determined to be the operating control is not required to comply with the protective control requirements but shall comply with the operating control requirements in 13A.13 or with 13A.3.9 and 13A.14.</p>
13A.17		





CLAUSE	VERDICT	COMMENT
13A.18		<p><b><i>New clause added;</i></b></p> <p>A thermistor shall comply with Annex J of the Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1 or the Standard for Thermistor-Type Devices, UL 1434. The calibration shall be as specified in 13A.3.6. If a thermistor is used:</p> <ul style="list-style-type: none"><li>a) To reduce the risk of fire, electric shock or injury to persons under abnormal operating conditions of the product, the minimum number of endurance cycles shall be 100,000.</li><li>b) In other sensing applications of the product, the minimum number of endurance cycles shall be 6,000.</li></ul>
13A.19		<p><b><i>New clause added;</i></b></p> <p>A protective control as referenced in 13A.3(i) and having a protective electronic circuit:</p> <ul style="list-style-type: none"><li>a) In which electronic disconnection of the circuit could fail, shall have at least two components whose combined operation provides the load disconnection;</li><li>b) Shall prevent a risk of fire, electric shock or injury to persons under the relevant fault conditions specified in 49A.2;</li><li>c) In which an overcurrent protective device opens during application of any of the fault conditions specified in 49A.2, shall utilize an overcurrent protective device complying with the requirements applicable to that component. The fault condition causing the overcurrent protective device to open shall be repeated and the overcurrent protective device shall again open the protective electronic circuit. If the overcurrent protective device complies with the Standard for Miniature Fuses: Part 1, Definitions for Miniature Fuses and General Requirements for Miniature Fuse-Links, IEC 60127-1, as well as an applicable Part 2, then the protective device shall additionally comply with the Fuse-Link Test in 49A.5;</li><li>d) In which a conductor of the printed wiring board becomes open-circuited during the fault conditions test in 49A.2, then:<ul style="list-style-type: none"><li>1) The printed wiring board shall comply with the Needle-Flame Test in Annex E of Standard for Safety of Household and Similar Electrical Appliances, Part 1: General Requirements, UL 60335-1 or have a minimum flammability rating of V-0 when tested in accordance with the vertical flame test described in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94;</li><li>2) Any loosened conductor shall not reduce spacings below the values specified in relevant 23.1, 23.3, 23.6; and</li><li>3) The specific test in which the printed wiring became open-circuited shall be repeated a second time. There shall be no risk of fire, electric shock or injury to persons and spacings shall not be reduced below the values specified in relevant 23.1, 23.3, 23.6;</li></ul></li></ul>



CLAUSE	VERDICT	COMMENT
		e) Shall maintain its required functions when subjected to the EMC related stresses specified in the Electromagnetic Compatibility (EMC) Tests, 49A.3; and f) That relies upon a programmable component for one or more of its safety functions shall be subjected to the Programmable Component Reduced Supply Voltage Test, Section 49A.4, unless restarting at any point in the operating cycle after interruption of operation due to a supply voltage dip will not result in a risk of fire, electric shock or injury to persons. The test shall be carried out after removal of all batteries and other components intended to maintain the programmable component supply voltage during supply source (mains) voltage dips, interruptions and variations.
13B		<b><i>New section added;</i></b>  <b>Remotely Operated Electrostatic Air Cleaners</b>
14	Info	<b>Grounding</b>
14.1	Info	<b>General</b>
14.1.2.1		<b><i>New clause added;</i></b>  An ungrounded high-voltage transformer core not complying with 14.1.2 shall comply with the dielectric voltage-withstand test specified in 46.2.1.
14.1.5		<b><i>New clause added;</i></b>  Functional grounding shall not be relied upon for equipment grounding or bonding.
15	Info	<b>Internal Wiring</b>
15.1	Info	<b>General</b>
15.1.1.1		<b><i>New clause added;</i></b>  To prevent particles from falling out of the product, open coil windings, internal wiring and wiring connections shall be:  a) Located in a compartment such as a cabinet or enclosure which is provided with a complete base pan; or b) Mounted or similarly positioned away from any openings in the bottom of the product.
15.1.9		<b><i>New clause added;</i></b>  Wiring routed to a hinged door, cover or other parts which may subject the wiring to movement shall comply with (a) – (g) if such movement is likely to cause a risk of fire, electric shock or injury to persons.  a) Stranded conductors shall be used; b) The arrangement shall prevent undue twisting or stressing of conductors as a result of the movement;



CLAUSE	VERDICT	COMMENT
		<p>c) The wiring shall be routed or protected to reduce the risk of damage of the insulation;</p> <p>d) Type S or SJ wiring shall be used if the wiring is exposed to a user or service person;</p> <p>e) Wires shall be tied together to form a bundle;</p> <p>f) Strain relief shall be provided so that stress will not be transmitted to terminals or splices. The Strain Relief Test in Section 42, using a force of 20 pounds (89 N), shall be conducted; and</p> <p>g) The wiring shall comply with the Wiring Endurance Test, Section 51C.</p>
16	Info	<p><b>Capacitors</b></p> <p><u>A capacitor other than a motor start or run capacitor that is connected across-the-line or line to ground in other than a secondary high-voltage circuit shall comply with one of the following: Section 42, Dielectric Voltage Withstand Test.</u></p> <p>a) <u>The Standard for Capacitors and Suppressors for Radio- and Television-Type Appliances, UL 1414 and with the Dielectric Voltage-Withstand Test in Section 46;</u></p> <p>b) <u>The Dielectric Voltage Withstand Test, Insulation Resistance Test, and Endurance Test in the Standard for Electromagnetic Interference Filters, UL 1283;</u></p> <p>c) <u>The Temperature Test, Table 45.1, (B)(1)(b) and either the Dielectric Voltage Withstand Test in Section 46 or in the Standard for Electromagnetic Interference Filters, UL 1283; or,</u></p> <p>d) <u>The Standard for Fixed Capacitors for Use in Electronic Equipment – Part 14: Sectional Specification: Fixed Capacitors for Electromagnetic Interference Suppression and Connection to the Supply Mains, UL 60384-14. Capacitor specifications shall be as follows:</u></p> <p>1) <u>Operating voltage – Not less than 110 percent of the product rated voltage.</u></p> <p>2) <u>For capacitors connected across the line (phase-to-phase) – Subclass X1 (<math>\leq 4.0</math> kV) or X2 (<math>\leq 2.5</math> kV) for impulse voltage (based on minimum Overvoltage Category of II).</u></p> <p>3) <u>For capacitors connected from line to ground – Subclass Y1 or Y2 for any product having a rated voltage not exceeding 500 volts; or as an alternate, subclass Y4 if a product has a rated voltage not exceeding 150 volts.</u></p> <p>4) <u>Upper category temperature – Based on the maximum capacitor surface temperature measured during the Temperature Test in Section 45, but not less than 185°F (85°C).</u></p> <p>5) <u>Lower category temperature – Based on the minimum surface temperature for which the capacitor has been designed to operate when installed within a product as intended, but not greater than 14°F (-10°C).</u></p> <p>6) <u>Duration of the damp-heat steady-state test – Not less than 21 days.</u></p> <p>7) <u>Passive flammability category B or C. As an alternate, a polymeric capacitor case shall have a V-0 flame rating as described in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.</u></p>



CLAUSE	VERDICT	COMMENT
		<b><i>New clause added;</i></b>
16.8		<p>In reference to 16.3, motor start or run capacitor that does not comply with UL 810 shall:</p> <ul style="list-style-type: none"> <li>a) Be housed within an enclosure or container that will reduce the risk of mechanical damage to the plates and the emission of flame or molten material resulting from breakdown of the capacitor;</li> <li>b) Be provided with a metal capacitor container providing the strength and protection not less than that of uncoated steel having a thickness of 0.020 inch (0.51 mm); and</li> <li>c) Be constructed to reduce the likelihood of expelling the dielectric medium under both normal and abnormal conditions of use.</li> </ul>
		<b><i>New clause added;</i></b>
16.9		<p>In reference to 16.6, a capacitor shall consist of a single Class Y1 capacitor or two Class Y2 capacitors connected in series if it is connected between:</p> <ul style="list-style-type: none"> <li>a) Two line conductors in a primary circuit;</li> <li>b) One line conductor and the neutral conductor;</li> <li>c) Primary and accessible secondary circuits; or</li> <li>d) The primary circuit and protective earth (equipment grounding conductor connection).</li> </ul>
20	Info	<b>Motors and Motor Overcurrent Protection</b>
		Each motor shall be provided with at least one of the following:
		<ul style="list-style-type: none"> <li>a) Thermal protection complying with the applicable requirements in the Standard for Thermally Protected Motors, UL 1004-3.</li> </ul> <p><del>Exception: A motor intended to move air only by means of an air moving fan that is integrally attached, keyed, or otherwise fixed to the motor shaft is not required to have running overload protection.</del></p>
20.3		<ul style="list-style-type: none"> <li>b) Impedance protection complying with the applicable requirements in the Standard for Motor- Operated Appliances, UL 73, when the motor is tested as used in the product under locked-rotor conditions.</li> <li>c) Impedance protection complying with the Standard for Impedance Protected Motors, UL 1004-2.</li> <li>d) Electronic protection complying with either the Standard for Electronically Protected Motors, UL 1004-7 or with the requirements in Section 13A, Switches and Controllers, applying to protective electronic circuits.</li> <li>e) Other protection that is shown by tests to be equivalent to the protection mentioned in (a) – (d).</li> </ul>



CLAUSE	VERDICT	COMMENT
		<b><i>New clause added;</i></b>
20.3.1		In reference to 20.3 (a) and (d), a motor that moves air by means of a fan that is not integrally attached, keyed, or otherwise fixed to the motor shaft shall be evaluated for running heating protection.
		<b><i>New clause added;</i></b>
20.5		Openings in a motor shall be arranged to prevent particles from falling out of the motor onto flammable material within or under the product.
22	Info	<b>Filters</b>
		<del>A filter utilizing adhesive or other materials shall be equivalent to a Class 1 or Class 2 filter.</del>
22.2		<u>An air-cleaner filter intended for use in a fixed-type product shall comply with 22.1 or with:</u>  a) <u>The separation of ignition sources from nonmetallic materials requirements as shown in Figure 6C.1; or,</u> b) <u>Table 51A.1 applying the flammability requirements for functional parts, if the filter is within 2 in. (50.8 mm) of but not underneath an ignition source.</u>
		<b><i>New clause added;</i></b>
22.2.1		An air-cleaner filter intended for use in a portable product shall comply with 22.1 or 22.2 or be located more than 2 in. (50.8 mm) away from and not underneath any ignition source.
23	Info	<b>Spacings</b>
23.3	Info	<b>Line-voltage circuits</b>
		<b><i>New clause added;</i></b>
23.3.1.1		In reference to 23.3.1(c)(1) and 23.4.3(c), the conformal coating shall comply with the Conformal Coatings section in UL 746E, Polymeric Materials – Industrial Laminates, Filament Wound Tubing, Vulcanized Fibre, and Materials Used in Printed Wiring Boards.
24	Info	<b>Separation of Circuits</b>
24.3	Info	<b>Permanently-connected products</b>
		<b><i>New clause added;</i></b>
24.3.1.1		In reference to 24.3.1, if field-installed conductors contact low-voltage wiring terminals, any short-circuiting to such terminals that could occur shall not result in a risk of fire or electric shock.



CLAUSE	VERDICT	COMMENT
38	Info	<b>Input Test</b>
		<i><b>New clause added;</b></i>
38.3		A product intended for connection to a low-voltage supply source (such as by a USB type connector) shall be connected to a supply circuit using a test voltage that is 16.7 percent higher than the product rated voltage and capable of supplying a minimum 8 amperes at that test voltage. The product shall comply with 38.1.
40	Info	<b>Ozone Test</b>
40.1	Info	<b>General</b>
		<i><b>New clause added;</b></i>
40.1.3		<p>A product shall be tested in accordance with 40.2 – 40.4 under the most severe conditions for generating the maximum amount of ozone, taking into account all intended operating modes of the product. These conditions shall include the following:</p> <ul style="list-style-type: none"><li>a) High fan speed;</li><li>b) Low fan speed; and,</li><li>c) Any other operating conditions that could include but are not limited to: fan(s) inoperative, emitters(s)/ionizer(s) on, UV lamps on or other special features activated or inactivated.</li></ul>
		<i><b>New clause added;</b></i>
40.1.4		<p>In reference to 40.1.3, the testing in 40.2 – 40.4 shall include the product operating with:</p> <ul style="list-style-type: none"><li>a) Only one operating mode occurring at a time if the product is intended to operate in this manner; or</li><li>b) Multiple operating modes occurring simultaneously if simultaneous operation of the product in different modes is intended and testing the product in multiple operating modes represents the most severe condition(s) for maximizing ozone emission.</li><li>c) All air filter(s) removed unless an interlock switch causes ozone production to stop if the air filter(s) are removed, as specified in 40.1.5.</li></ul>
		<i><b>New clause added;</b></i>
40.1.5		<p>In reference to 40.1.4(c), for a product having an interlock switch causing ozone production to decrease or stop if an air filter is removed:</p> <ul style="list-style-type: none"><li>a) The testing in 40.2 – 40.4 shall be conducted with the interlock switch bypassed; or</li><li>b) The interlock switch shall comply with Section 29, Interlocks, and the operating instructions of the product shall specify the intended filter(s), including replacement filters, in accordance with 59.10.</li></ul>



CLAUSE	VERDICT	COMMENT
		<b><i>New clause added;</i></b>
40.1.6		If ozone-monitoring circuitry is provided as part of the product, the test described in 40.2 – 40.4 shall be conducted with the circuitry bypassed unless the circuitry complies with the protective control requirements in Section 13A, Switches and Controllers.
40.4	Info	<b>Test method</b>
		<b><i>New section added;</i></b>
40.4.1		Prior to testing, the location of the peak ozone emission on a product shall be determined in accordance with 40.4.1.1 – 40.4.1.6.
42	Info	<b>Strain Relief Test</b>
		<b><i>New clause added;</i></b>
42.1.1		If a strain relief is connected to or integral with a nonmetallic part, one complete sample of the nonmetallic part is to be placed in a full draft circulating air oven maintained at least 18°F (10°C) higher than the maximum temperature of the nonmetallic part as measured during the Temperature Test, Section 45, but not less than 158°F (70°C). The nonmetallic part is to remain in the oven for 7 hours. After its careful removal from the oven and return to room temperature, the nonmetallic part is to be subjected to the test in 42.2 and comply with 42.1.
		<b><i>New clause added;</i></b>
42.3		A strain relief means for wiring leads intended for connection of field-installed supply conductors as specified in 12.1.2.3 or power supply conductors of an internally-mounted accessory as specified in 5.6 are to be subjected to a direct pull of 20 pounds-force (89 N). The force may be generated by suspending a 20 pound (9.1 kg) weight on the wiring leads.
		<b><i>New clause added;</i></b>
42.4		The force specified in 42.2 or 42.3 shall be applied so that the strain relief is stressed from any angle permitted by the construction of the product.
		<b><i>New clause added;</i></b>
42.5		The force shall be applied for not less than 1 minute.
45	Info	<b>Temperature Test</b>
		<b><i>New clause added;</i></b>
45.1.1		A product shall be operated under the most severe condition for generating the maximum temperatures, taking into account all intended operating modes of the product. Example operating modes include, but are not limited to: original and/or



CLAUSE	VERDICT	COMMENT
		any alternate air filter(s) in place, air filter removed, fans operating at different speeds (e.g., high, medium, low), fans inoperative, emitters/ionizers on or off, UV lamps on or off or other special feature activated or inactivated.
		<b><i>New clause added;</i></b>
45.1.2		For a product having an interlock switch to prevent operation if an air filter is removed:  a) The testing in 45.2 – 45.13 shall be conducted with the interlock switch bypassed; or, b) The interlock switch shall comply with Section 29, Interlocks, and the operating instructions of the product shall indicate the intended filter(s), including replacement filters, as specified in 59.10.
		<b><i>New clause added;</i></b>
45.5.1		A product powered entirely by a low-voltage supply source (such as by a USB type connector) shall be operated normally except with the air intake area restricted to any level between 0-50 percent of the overall air intake area so that the input current to the product is maximized.
46	Info	<b>Dielectric Voltage-Withstand Test</b>
46.1	Info	<b>General</b>
46.1.1		A product shall withstand without breakdown for 1 minute the application of <del>60-hertz sinusoidal</del> <u>a test potential at any frequency between 40 and 70 hertz for ac circuits or a test potential as specified in Table 53.1, Condition A for dc circuits,</u> as follows:  a) Twice the maximum <del>rated primary</del> <u>voltage rating of the line-voltage circuit plus 1000 volts applied between the line-voltage primary circuit and exposed or grounded dead metal.</u> b) 125 percent of the maximum measured or rated <del>secondary high-voltage circuit,</del> <u>whichever is higher, applied between: primary and secondary windings, and between secondary and resonating windings.</u> <u>1) High-voltage circuits and line-voltage circuits unless the product complies with 46.1.1.1; and,</u> <u>2) High-voltage circuit windings and resonating windings unless the product complies with 46.1.1.2.</u>  Exception: This test is to be omitted if any point of the secondary winding is grounded. If the resonating winding and the high-voltage windings are common, the test between the resonating winding and the secondary winding is to be omitted.






CLAUSE	VERDICT	COMMENT
		<p>c) 150 percent of the maximum <u>measured</u> or rated <del>primary</del> <u>high-voltage circuit</u> applied <u>between</u>: <del>to the ends of the primary winding with one end of the primary winding connected to the enclosure. See 46.1.2.</del></p> <p style="padding-left: 40px;">1) <u>High-voltage circuits and line-voltage circuits;</u> and, 2) <u>High-voltage circuits and dead metal parts.</u></p> <p>Exception: <del>A direct-current potential may be used for a direct-current circuit.</del></p>
		<b><i>New clause added;</i></b>
46.1.1.1		If the test specified in 46.1.1(b)(1) is not conducted, then any point of a high-voltage circuit winding shall be grounded.
		<b><i>New clause added;</i></b>
46.1.1.2		If the test specified in 46.1.1(b)(2) is not conducted, then the resonating winding and the high-voltage circuit windings shall be common.
		<b><i>New clause added;</i></b>
46.1.6.1		<p>A product employing a low-voltage circuit or entirely powered by a low-voltage circuit shall be capable of withstanding, for 1 minute, without breakdown, the following test potential applied between low-voltage live parts of opposite polarity and between low-voltage live parts and dead metal parts. The test potential shall be one of the following:</p> <p>a) An ac potential of 500 V at any frequency between 40 and 70 Hz; b) A dc potential of 700 V; or c) A dc potential of 500V if the product is intended to be connected only to a USB supply source.</p>
		<b><i>New clause added;</i></b>
46.1.6.2		With reference to 46.1.6.1, the test between low-voltage parts of opposite polarity shall be conducted on magnet coil windings of the transformer after breaking the inner coil lead where it enters the layer.
		<b><i>New section added;</i></b>
46C		<b>Endurance Test – Switching Devices</b>
49	Info	<b>Abnormal Operation Test</b>
49.6	Info	<b>Stalled rotor, restricted air inlet and blocked air outlet</b>
		<b><i>New clause added;</i></b>
49.6.1		These tests are applicable to a product if a risk of fire or electric shock is likely to occur due to shrinkage, warping or other deformation of any nonmetallic materials that may be heated under the conditions specified in (a) – (c). For each condition,



CLAUSE	VERDICT	COMMENT
		<p>the product is to be operated as specified in 49.1 and only one condition is to be applied at a time. At the conclusion of each condition, the product shall comply with 49.1.1.</p> <p>a) For products with a motor, the rotor of the motor is to be locked.</p> <p>b) Products having air inlet openings shall have the openings restricted by draping a single layer of cheesecloth over the product such that all air inlets are covered. The cheesecloth is to be the type as specified in 49.1.6.</p> <p>c) Products having air outlet openings shall have all air outlet openings blocked.</p>
49.7	Info	<p><b>Low-voltage powered product overvoltage test</b></p> <p><i>New clause added;</i></p>
49.7.1		<p>A product intended to be powered entirely by a low-voltage supply source (such as by a USB type connector) shall be connected to a supply circuit at an overvoltage condition using a test voltage that is 30 percent higher than the product rated voltage and capable of supplying a minimum 8 amperes at that test voltage. The product shall be operated as specified in 49.1. At the conclusion of the test, the product shall comply with 49.1.1.</p>
49A		<p><i>New section added;</i></p> <p><b>Protective Electronic Circuit Tests</b></p>
49B		<p><i>New section added;</i></p> <p><b>Rain Test</b></p>
49C		<p><i>New section added;</i></p> <p><b>Accelerated Aging Tests – Gaskets</b></p>
49D		<p><i>New section added;</i></p> <p><b>Switch Mode Power Supply Units – Overload Test</b></p>
51A		<p><i>New section added;</i></p> <p><b>Tests on Nonmetallic Materials</b></p>
51B		<p><i>New section added;</i></p> <p><b>Fastener Strength Test</b></p>
51C		<p><i>New section added;</i></p> <p><b>Wiring Endurance Test</b></p>
52	Info	<p><b>Permanence of Marking</b></p>



CLAUSE	VERDICT	COMMENT
		<b><i>New clause added;</i></b>
		In reference to 52.1, markings or labels complying with UL 969 shall also comply with one of the following:
52.2		a) Products intended for indoor use only – The indoor use, exposure to high humidity and occasional exposure to water at air ambient temperatures above 32°F (0°C), requirements shall be applied.
		b) Products intended for outdoor use – The indoor and outdoor use, where exposed to high humidity or occasionally to water, requirements shall be applied.
54A		<b><i>New section added;</i></b> <b>Protective Electronic Circuit Test</b>
	Info	<b>MARKINGS</b>
56	Info	<b>Visible During Installation and Inspection</b>
		<b><i>New clause added;</i></b>
56.9		A product intended to be powered by a Universal Serial Bus (USB) supply source shall be marked in proximity to the connection point with the abbreviation “USB” or with the USB symbol: 
57	Info	<b>Visible After Installation</b>
		<b><i>New clause added;</i></b>
		In reference to 57.2, the electrical rating for a product intended to be permanently-connected to the electrical supply source shall include the minimum supply circuit ampacity and the maximum overcurrent protective device size calculated as follows:
57.8.1		a) The minimum supply circuit conductor ampacity shall be the highest value calculated for each concurrent load condition and at least equal to: <ol style="list-style-type: none"> <li>1) 125 percent of the rated current of the largest motor, plus;</li> <li>2) The rated current of other motors and loads supplied.</li> </ol> b) The maximum ampere rating of a supply-circuit overcurrent-protective device shall not exceed 400 percent of the rated current of the largest motor plus an amount equal to the sum of any additional concurrent loads. If the value of this rating does not equal a standard overcurrent device size, then the value of this rating shall be the next lower standard overcurrent device size, but in no case shall the value of this rating be lower than the minimum supply circuit conductor ampacity as calculated in (a).
		<b><i>New clause added;</i></b>
57.8.2		In reference to 57.8.1, the largest motor shall be determined based on its rated current.



CLAUSE	VERDICT	COMMENT
59	Info	<b>Manufacturer's Literature</b> <i>New clause added;</i>
59.9		In reference to 13B.4, the instructions for a product intended to be remotely operated and in which the attachment plug of the product and receptacle serve as the manual means for disconnecting remote operation commands, external communication or data signals shall specify that unplugging the product disconnects the remote functions. <i>New clause added;</i>
59.10		If a product has an interlock switch that is required to comply with Section 29, Interlocks, in accordance with 40.1.5(b) or 45.1.2(b) to prevent operation if an air filter is removed, then the product operating instructions shall specify all intended filter(s), including replacement filters, needed for the intended operation of the product. <i>New clause added;</i>
59.11		If a product is intended to be connected to a Universal Serial Bus (USB) supply source, then the operating instructions shall specify the following or equivalent: a) That the product is not to be operated by any supply sources other than those specified in (b); and b) That the product is to be used only with the following products: 1) Information and Communication Technology Equipment; or 2) A Class 2 Power Unit. <i>New clause added;</i>
59.12		A product intended for installation within a concealed space of a building structure shall be provided with installation instructions that inform the installer: a) That permanent wiring is to be employed as required by local codes; b) Of specific directions for cutting the proper size hole in the building; and c) The correct method for mounting the product within the concealed space. <i>New clause added;</i>
59.13		A product intended to have the supply connection converted in accordance with 12.3 shall be provided with installation instructions that inform the installer how the supply connection is to be converted and that permanent wiring is to be employed as required by local codes. <i>New appendix added;</i>
Appendix B		<b>Operating and Protective ("Safety Critical") Control Functions</b>
CUSTOMERS PLEASE NOTE: This Table and column "Verdict" can be used in determining how your current or future production is or will be in compliance with new/revised requirements.		