



Test Report issued under the responsibility of:

TEST REPORT	
UL 1310	
Test report for Class 2 Power Units	
Report reference No.....	SJS2202010WY-UL-R1
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Approved by(+signature).....	Manager Victory Song
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Standard.....	UL 1310:2019
Test procedure.....	UL
Non-standard test method.....	N/A
Test Report Form No.....	UL 1310
Test Report Form(s) Originator.....	UL(US)
Master TRF.....	2019-03
Test item	
Description	Pulse Repair Battery Charger
Trade Mark.....	FOXSUR
Model/Type reference.....	FBC1205D
Model differences.....	N/A
Ratings	Input: 100-240V~, 50/60Hz, MAX.75W Output: 13.8-15.5Vdc , Max.5A,Class II





POSSIBLE TEST CASE VERDICTS:	Pulse Repair Battery Charger
- test case does not apply to the test object.....:	N/A
- test object does meet the requirement.....:	P (Pass)
- test object does not meet the requirement.....:	F (Fail)
Date of order..... :	2022-02-07
Date of receipt of test item.....:	2022-02-07
Date(s) of performance of test..... :	From 2022-02-07 to 2022-02-15
Test item particulars: N/A	
General remarks: "(see remark #)" refers to a remark appended to the report. "(see appended table)" refers to a table appended to the report. Throughout this report a comma is used as the decimal separator. The test results presented in this report relate only to the object tested. This report shall not be reproduced except in full without the written approval of the testing laboratory.	
Summary of testing: UL 1310:2019 List of Attachments (including a total number of pages in each attachment): Attachment 1: 6 pages of photo document.	

Copy of marking plate:

Note:

- 1.... The word "CAUTION" or "ATTENTION" in letters shall not be less than 1/8 inch (3.2 mm) high.
- 2.... The letters of "Do not remove this tag" in output cord shall no be less than 3/32 inch (2.4mm) high.
- 3.... The letters of caution content shall not be less than 1/16 inch (1.6 mm) high.





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Clause	Requirement – Test	Measuring result – Remark	Verdict
Introduction			P
1	Scope		P
2	Components		P
2.1	Except as indicated in 2.2, a component of a product 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.		P
2.2	A component is not required to comply with a specific requirement that:		P
	a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard, or		P
	b) Is superseded by a requirement in this standard.		P
2.3	A component shall be used in accordance with its rating established for the intended conditions of use.		P
2.4	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.		P
3	Units of Measurement		P
4	Undated References		P
5	Glossary		P
6	Terminology		P
CONSTRUCTION			P
7	Mechanical Assembly		P
7.1	A unit shall be formed and assembled so that it has the strength and rigidity necessary to resist the abuses to which it is likely to be subjected, without producing or increasing a risk of fire, electric shock, or injury to persons due to total or partial collapse with resulting reduction of spacings, loosening or displacement of parts, or other serious defects. See also 46.1.1.		P
7.2	A unit shall have all parts reliably secured in place.		P
7.3	An enclosure, an opening, a frame, a guard, a knob, a handle, or the like shall not be sufficiently sharp to cause a risk of injury in normal maintenance or use.		P
7.4	A unit shall be constructed so that it is not necessary to open or remove the enclosure	The enclosure fixed well by 4 screws.	P



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	when the unit is used as intended.		
7.5	Each lampholder, switch, and similar component shall be mounted securely and shall be prevented from turning by more than friction between surfaces. For example, the use of a lock washer is acceptable to prevent the turning of a device having a single hole mounting means.		N/A
	Exception No. 1: A lampholder of a type in which the lamp cannot be replaced (such as a neon pilot or indicator light in which the lamp is sealed in by a nonremovable jewel) need not be prevented from turning if rotation cannot reduce spacings below the minimum acceptable values or produce stress on an electrical connection.		N/A
	Exception No. 2: A switch or other similar component need not comply with this requirement if the turning of such a component and servicing of the part introduces no additional risk of fire or electric shock, such as reduced spacings below minimum acceptable values or stress on an electrical connection.		N/A
7.6	A replaceable lamp in a unit shall be wired in the secondary circuit, and shall be replaceable without opening the enclosure. There shall be no primary live part accessible to contact during lamp replacement.		N/A
7.7	A nonreplaceable pilot lamp, such as an indicating-type overload- or short-circuit protector, a neon light, or an indicator light, is one in which the lamp is sealed-in, such as by a nonremovable jewel.		N/A
7.8	A switch in the primary circuit or an overcurrent-protective device shall be located within the unit enclosure in such a manner as not to be accessible or exposed to tampering nor subject to damage during normal use. This requirement does not apply to the actuating means of a switch, except as noted in 7.10.		N/A
7.9	If the exterior part of the switch or control forms part of a unit enclosure, the part shall be subjected to the Abuse Tests, Section 46.		N/A
7.10	The requirements in 7.8 also apply to the actuating means – toggle, handle, or the like – if the dislodging of such part exposes live parts or film-coated magnet wire that can be contacted as specified in Accessibility of Live Parts, Section 16.		N/A
7.11	The maximum acceptable moment, center of gravity, dimensions, and weight of a direct plug-in unit shall comply with the following requirements (See 7.12):		P
	a) The quotient of WY/Z shall not exceed 48		P



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	ounces (1361 g);		
	b) The quotient of WY/S shall not exceed 48 ounces (1361 g);		P
	c) The product of WX shall not exceed 80 ounce-inches (0.56 N·m) for a unit not intended for use by travelers, and 36 ounce-inches (0.25 N·m) for a unit intended for use by travelers (see 14.1.4); and		P
	d) The weight of a unit shall not exceed 28 ounces (794 g).		P
7.12	The moment and weight specified in 7.11 are to be determined as follows:		P
	a) For units with an output cord, the cord is to be cut off at the enclosure, or at the strain-relief means if the strain-relief means is outside the enclosure.		P
	b) For units with directly mounted accessories, the values are to be measured with the accessories in place.		P
	c) An integral tab is not to be included in measurements of the linear dimensions for the purpose of determining moments unless:		P
	1) The tab and enclosure withstand the impact described in 46.2.1 with one impact on the tab itself, without deformation; and		P
	2) For a polymeric enclosed unit having an integral tab, the tab and enclosure do not distort at temperatures to which the material may be subjected under conditions of normal and abnormal use as determined by the mold stress relief distortion test in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.		N/A
7.13	When inserted in a duplex receptacle, no part of a direct plug-in unit, including an integral tab or output wiring, shall interfere with full insertion of an attachment plug into the adjacent receptacle. See Figure 7.2 and Figure 7.3.		P
	Exception: This requirement does not apply to a unit that renders the adjacent receptacle completely unusable in any one mounting position.		N/A
7.14	A portable cord-connected unit intended for wall mounting shall employ key hole slots or the equivalent as a mounting means.		N/A
7.15	A mounting tab shall not be provided with a direct plug-in unit unless all of the following conditions are met:		N/A
	a) The unit is intended for use on a 15-ampere, 125- or 250-volt receptacle;		N/A



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	b) A screw is provided and constructed to secure the mounting tab of the unit to a duplex receptacle that has a center screw (see Figure 7.2);		N/A
	c) For a unit without a grounding pin, the mounting tab is constructed so that the unit may be mounted to both grounding and nongrounding receptacles; and		N/A
	d) The unit is marked as specified in 52.4.		N/A
7.16	The enclosure of a unit shall be capable of being gripped for removal from the receptacle to which it is connected, and the perimeter of the face section from which the blades project shall not be less than 0.20 inch (5.1 mm) from any point on either blade. In order to determine compliance with this requirement for units with rounded edges, the perimeter of the face section is considered to be the point at which the articulate probe is able to access as shown in Figure 7.5.		P
	Exception: For products that are intended for use with children's toys, this distance shall be increased to 7.9 mm, as required in the Standard for Toy Transformers, UL 697. These products shall be marked "intended for use with children's toys," or an equivalent marking.		N/A
7.17	With reference to 7.16, for an extension from the face for mechanical support of the blades provided as shown in Figure 7.4, the point of measurement shall be determined by application of the articulate probe, Figure 16.2, as shown in Figure 7.5.		P
7.18	With reference to 7.16, for a direct plug-in unit employing removable blades for the input connectors, the measurement shall also be determined on the plug module while removed from the direct plug-in unit.		P
8	Enclosure		P
8.1	A unit shall be provided with an enclosure that shall house all current-carrying parts that pose a risk of electric shock. The enclosure shall have the strength and properties necessary to reduce the risk of mechanical damage to the various parts.		P
8.2	A unit shall have no openings larger than those complying with 16.2.1.	No openings	P
8.3	If an acceptable grade of vulcanized fiber is used as part of the enclosure for the support of secondary parts (terminals and the like) that do not present a risk of fire or electric shock, the amount of fiber shall not be more than is necessary to support the secondary parts in question. The fiber shall not be less than 1/32 inch (0.8 mm) thick and shall not introduce a risk		N/A



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	of fire, electric shock, or injury to persons as a result of abuse. See 46.1.1.		
8.4	An enclosure constructed of sheet metal shall be formed from stock having a thickness not less than that specified in Table 8.1. The thickness of enclosure sheet metal other than steel or aluminum shall not be less than that specified in Table 8.1 for uncoated steel and shall have the necessary strength and rigidity.		N/A
	Exception: For transformers with end bells forming part of the enclosure, sheet steel having a thickness of not less than 0.020 inch (0.51 mm) if uncoated, or 0.023 inch (0.58 mm) if zinc coated, may be used if the drawn end bells have maximum dimensions of 2-1/4 inches (57.2 mm) on the flat portion and 1-1/2 inches (38.1 mm) at the base of the drawn portion.		N/A
8.5	In addition to the performance tests specified in this Standard, the factors to be considered when evaluating a polymeric enclosure are:	UL approved enclosure material	P
	a) Material Flammability properties;		P
	b) Resistance to arcing properties; and		P
	c) Moisture absorptive properties.		P
	These properties shall comply with the requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. For the purpose of this requirement, a semipermanent mounted unit is to be considered a portable unit.		P
8.6	A conductive coating applied to a nonmetallic surface such as the inside surface of a cover, enclosure, and the like shall comply with the appropriate requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, unless it can be determined that flaking or peeling of the coating does not result in a reduction of spacings or the bridging of live parts that may result in a risk of fire, electric shock, or injury to persons.		N/A
8.7	An adhesive used in the assembly of the enclosure shall be investigated as specified in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.		N/A
	Exception: A method utilizing fusion techniques, such as solvent cementing, ultrasonic welding, electromagnetic induction, and thermal welding need not be investigated.		N/A
9	Protection Against Corrosion		N/A
9.1	Except as noted in 9.2, iron and steel parts shall be protected against corrosion by galvanizing, plating, enameling, or other equivalent means if the corrosion of such unprotected parts results in		N/A



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	a risk of fire, electric shock, or injury to persons.		
	Exception: This requirement does not apply to a part made of stainless steel.		N/A
9.2	The requirement in 9.1 applies to all enclosing cases or to other parts upon which intended mechanical operation may depend. It does not apply to laminations and small minor parts of iron or steel, such as washers, screws, and bolts, that are not current carrying, if the corrosion of such unprotected parts would not result in a risk of fire, electric shock, or injury to persons, or result in the device not operating as intended.		N/A
10	Switches		N/A
10.1	The requirements in this Section apply to switches not in a Class 2 circuit, and to switches in a Class 2 circuit the breakdown of which electrically or mechanically is likely to introduce a risk of fire or electric shock.	No switch used	N/A
10.2	A switch subjected to a temperature higher than 50°C (122°F) shall be evaluated with respect to the temperature limits of the materials used.		N/A
10.3	A switch shall be located and positioned so that it is not subject to mechanical damage during normal use or as a result of abuse. See 46.1.1.		N/A
10.4	Other than as indicated in 10.7 and 10.8, a switch or other control device shall be acceptable for the application and shall have current and voltage ratings not less than those of the load that it controls.		N/A
10.5	A primary circuit switch shall be connected to an ungrounded circuit conductor.		N/A
10.6	A primary circuit switch shall have a current rating not less than twice the normal current draw under normal load conditions, or the switch shall be investigated for the application in accordance with the Overload and Endurance Tests on Switches and Controls, Section 36.		N/A
10.7	A switch or other control device connected in the output circuit may be used if the device complies with the Normal Temperature Test and the Overload Test on Secondary Switches. See 33.1 and 37.1.		N/A
10.8	A switch or other controller not having an acceptable rating and located on a direct plug-in unit where it cannot be operated unless the unit is withdrawn from a receptacle may be used if it complies with the Operation Test, Section 38.		N/A
11	Protective Devices		P
11.1	A protective device built into a unit shall comply with the requirements for that component.	UL approved fuse.	P



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11.2	The protective device may be located in either the primary or secondary circuit.	Fuse F1 located in primary circuit	P
11.3	Crossed or nicked (reduced) cross-section conductors shall not be employed as a protective device.		P
11.4	Protective devices mentioned in 11.1 include, but are not limited to, eutectic material, fuses, overtemperature and overcurrent protectors, thermal protectors, and similar devices intended to interrupt or limit the flow of current as a result of overload.		P
11.5	A thermostat, thermal cutoff, Positive Temperature Coefficient (PTC) resistor, or Negative Temperature Coefficient (NTC) resistor incorporated in a unit shall not cause a risk of fire or electric shock due to improper application.		P
11.6	A manually reset thermostat shall be constructed so that automatic tripping of the thermostat is not prevented by any setting or position of the reset mechanism.		N/A
11.7	An automatically or manually reset protective device or a replaceable overcurrent-protective device shall not open when the unit is delivering its rated output. See the Normal Temperature Test, Section 33.		N/A
11.8	A primary circuit overcurrent protective device of the single-pole type, other than an automatic control without a marked "off" position, shall be connected to an ungrounded circuit conductor. See Exception No. 5 to 14.2.1.		N/A
11.9	When a single fuse is located in the primary circuit, it shall be connected to an ungrounded circuit conductor.		N/A
	Exception: This requirement does not apply to a unit not intended to be serviced.		P
11.10	When both circuit conductors of a product intended for connection to a nominal 120 volt branch circuit are fused, the fuse in the grounded circuit conductor shall be rated not less than the fuse in the ungrounded circuit conductor. See 52.8.		N/A
	Exception: This requirement does not apply to a unit not intended to be serviced.		N/A
11.11	A unit investigated for compliance with the energy limitations of 30.3.1 shall be provided with protection, such as a fuse or PTC, complying with the Calibration of Overcurrent Protection Devices Test, Section 31.		N/A
11.12	A protective device that is provided to comply with 11.11 shall not be of the automatic reclosing		N/A



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	type, and shall not have automatic tripping prevented by any setting or position of the reset mechanism. When an accessible control of a manual reset protective device is held in the on or reset position, and the protective device is automatically tripped, the contact shall not automatically return to the closed position.		
11.13	An overcurrent protective device shall be located inside the unit enclosure. The device shall be inaccessible to tampering.		P
	Exception: A unit may be provided with an externally replaceable overcurrent protective device. If the device is relied upon for acceptable performance, the device shall not be interchangeable with a device having a higher current rating.		N/A
11.14	A fuse provided in the secondary circuit of a not inherently limiting Class 2 power unit shall be rated in accordance with Table 30.2.		N/A
12	Components		P
12.1	A component – a fixed resistor, Positive Temperature Coefficient (PTC) or Negative Temperature Coefficient (NTC) resistor, diode, or the like – employed to limit (see 5.8) the output of a unit to within the required current or power levels, or otherwise used to obtain acceptable performance, shall have permanence and stability which does not decrease its limiting capacities. Among the factors considered when evaluating a limiting component are:		P
	a) Effect of operating temperature;		P
	b) Electrical stress level;		P
	c) Effect of transient surges; and		P
	d) Resistance to moisture.		P
12.2	There shall be no components connected between primary and output circuits which result in a conductive connection (see 5.4). If capacitive coupling is provided between primary and output circuits, it shall consist of either:		P
	a) A capacitor complying with the antenna coupling requirements specified in 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; or	C1	P
	b) Two capacitors connected in series, each capacitor complying with the requirements in 34.1.3.		N/A
12.2 revised May 30, 2014			



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13	Coil Insulation		P
13.1	General		P
13.1.1	A coil shall be provided with insulation between the coil and any dead metal part, and between each adjacent pair of windings.		P
	Exception No. 1: Two or more secondary windings may be considered as a single winding and interposing insulation is not required, if, when interconnected, the windings comply with the performance requirements for a single winding.		P
	Exception No. 2: Insulation is not required if the spacings required by 24.1 are provided.		N/A
13.1.2	Coil insulation, unless inherently moisture resistant, shall be treated to render it moisture resistant.		N/A
13.1.3	Film-coated magnet wire is considered to be moisture resistant.		P
13.2	Insulation for transformers		P
13.2.1	The insulation between uninsulated, primary wires of opposite polarity shall be one of the following:		P
	a) Electrical grade paper, waxed or otherwise treated to resist the absorption of moisture, having a total thickness of not less than 0.012 inch (0.305 mm); or		N/A
	b) Other insulating material having a dielectric breakdown strength of not less than 2500 volts in the thickness used as determined by the Tests on Insulating Materials, Section 40.		P
13.2.2	Insulation between the primary and secondary windings shall be one of the following (for additional requirements, see 13.2.3 and 13.2.4):		P
	a) Electrical grade paper, waxed or otherwise treated to resist the absorption of moisture, having a total minimum thickness of 0.012 inch (0.305 mm).		N/A
	b) A molded polymeric material such as a coil form or bobbin having a minimum thickness of 0.025 inch (0.64 mm).		P
	c) Insulation – other than of a molded polymeric material – as specified in 13.2.1(b).		P
13.2.3	Tape used as insulation in lieu of spacings for a flanged bobbin wound transformer shall provide a continuous 1/32 inch (0.8 mm) minimum wide bent up edge against the bobbin flanges.		P
13.2.4	A flanged, bobbin-wound transformer shall be subjected to the output loading test described in 39.2. The test shall be continued for 15 days if		P



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	the transformer has:		
	a) The primary winding wound over the secondary winding or the secondary winding wound over the primary winding; and		P
	b) The primary winding insulated from the secondary winding by a layer of insulating material other than that specified in 13.2.2(b).		N/A
	Exception: The test is not required to be applied for 15 days if the following requirements are met:		P
	a) Multiple layered winding wire is used, which has been evaluated to the requirements for miscellaneous insulating devices and materials of the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A, the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B, and the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C;		P
	b) The spacing requirements of Table 24.1 and Table 24.2 are met;		P
	c) The requirements in the Standard for Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment, UL 840, are met, along with the use of additional securement of the winding, and a Comparative Tracking Index (CTI) rating of 100 for all insulating material is determined; or		P
	d) Insulated wiring is used which has been evaluated to the Standard for Single- and Multi-Layer Insulated Winding Wire, UL 2353.		P
13.2.5	Insulation between the primary winding and the core shall be one of the following:	Core was considered as primary parts	N/A
	a) Electrical grade paper, waxed or otherwise treated to resist moisture, having a minimum total thickness of 0.012 inch (0.305 mm).		N/A
	b) A molded polymeric material such as a coil form or bobbin having a minimum thickness of 0.025 inch (0.64 mm).		N/A
	c) Insulation – other than of a molded polymeric material – as specified in 13.2.1(b).		N/A
	Exception: Insulation may be reduced or waived between the primary and core when all of the following conditions are met:		P
	a) The core is of a low electrical conductance material, for example ferrite used in switch-mode product;		P
	b) The core is treated as a live and electrically conductive part when judging insulation and spacings between the core and:		P
	i) Accessible metal parts;		P



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	ii) The secondary windings; and		P
	iii) Any other output circuitry.		P
	c) In applying (b), the core shall be considered to be at the maximum potential of the primary winding; and		P
	d) Insulation between secondary windings and core are in accordance with 13.2.5.		P
13.2.6	Insulation between the primary winding lead connections and a metallic enclosure shall be one of the following:		N/A
	a) Electrical grade paper, waxed or otherwise treated to resist the absorption of moisture, not less than 0.012 inch (0.305 mm) thick if used in conjunction with an air spacing of one-half that specified in 24.1.		N/A
	b) Electrical grade paper, waxed or otherwise treated to resist the absorption of moisture having a total thickness of not less than 0.028 inch (0.71 mm) when the insulation is in contact with the enclosure.		N/A
	c) Insulation having a dielectric breakdown strength of not less than 2500 volts in the thickness used for (a) and 5000 volts in the thickness used for (b) as determined by Tests on Insulating Materials, Section 40.		N/A
13.2.7	Insulation in accordance with 13.2.8 shall be provided between a crossover lead and:	Insulation tape provided	P
	a) The turns of the winding to which it is connected;		P
	b) The adjacent winding;		P
	c) The metallic enclosure; and		N/A
	d) The core.		P
13.2.8	To comply with 13.2.7, insulation shall be one of the following:		P
	a) Electrical grade paper, waxed or otherwise treated to resist the absorption of moisture, having a total thickness of not less than 0.012 inch (0.305 mm); or		N/A
	b) Insulation as specified in 13.2.1(b).		P
	Exception No. 1: Any type or thickness of insulation, or a through air spacing less than specified in 24.1, between a crossover lead and the winding to which it is connected may be used if either:		P
	a) The coil withstands the dielectric voltage withstand test described in 34.1.1 and 34.1.2 with the potential applied between the coil leads and with the coil lead cut at the point where it		P



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	enters the inner layer; or		
	b) The coil withstands the induced potential test described in 34.2.1 – 34.2.3. See 13.2.9.		N/A
	Exception No. 2: This requirement does not apply to insulation between a Class 2 secondary crossover lead and:		P
	a) The secondary winding to which the crossover lead is connected;		P
	b) The metallic enclosure; and		N/A
	c) The core.		N/A
13.2.9	With reference to Exception No. 1 to 13.2.8, the magnet coil of a molded bobbin transformer having a slot for the crossover or start lead – unspliced at the windings – is acceptable as crossover lead insulation if:		P
	a) The slots provide a graduated through air spacing to the winding, increasing to the end turns; and		P
	b) The magnet-coil winding withstands the induced potential test described in 34.2.1 – 34.2.3 or the dielectric voltage withstand test described in 34.1.1 and 34.1.2.		P
13.2.10	Insulation between the primary-lead connections and the adjacent winding, and between secondary-lead connections and the primary winding shall be one of the following:		P
	a) Electrical grade paper, waxed or otherwise treated to resist the absorption of moisture, having a total thickness of not less than 0.028 inch (0.71 mm); or		P
	b) Other insulating material having a dielectric breakdown strength of not less than 5000 volts in the thickness used as determined by Tests on Insulating Materials, Section 40.		P
14	Input Connections		P
14.1	Direct plug-in units		P
14.1.1	The integral blade assembly of direct plug-in units shall comply with the construction requirements in the Standard for Attachment Plugs and Receptacles, UL 498, and Wiring Devices – Dimensional Specifications, ANSI/NEMA WD6. See 7.16 and 7.17.		P
14.1.2	If a direct plug-in unit employs a manually operated line connected single-pole switch or a fuse with an accessible contact, it shall employ a polarized- or grounding-type blade assembly.		N/A
14.1.3	If a direct plug-in unit employs removable, folding or retractable blades for the input connectors, it shall comply with the requirements specified in Section 44, Direct Plug-in Security of Input		N/A



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	Contacts Test.		
14.1.4	A power unit intended for use by travelers shall comply with (a) – (e):		N/A
	a) The blade assembly shall be a 125 volt, 15 amp configuration;		N/A
	b) The power unit shall employ a user adjustable voltage selector and comply with 39.6.1, or be capable of operating at different voltages without user adjustment;		N/A
	c) The input voltage rating shall include nominal 120 volt;		N/A
	d) The power unit shall be marked as specified in 51.8; and		N/A
	e) The power unit shall be provided with instructions as specified in 54.4.		N/A
14.2	Cord-connected units		N/A
14.2.1	A portable or stationary unit shall be provided with a flexible cord in accordance with Table 14.1 and an attachment plug for connection to the branch circuit. The blade assembly for connection to the branch circuit shall be of the polarized- or grounding-type. The length of cord external to the unit and including the attachment plug shall not be less than 6 feet (1.8 m) as measured from the face of the attachment plug to the point of attachment or entry.		N/A
	Exception No. 1: A unit weighing 1 pound (454 g) or less is acceptable if the total length of the input and output cords is 6 feet or more, and the length of the input cord is at least 3 feet (0.91 m).		N/A
	Exception No. 2: A stationary power unit intended to be fastened in place may require a form of supply connection that facilitates the interchange of equipment to maintain continuous service or otherwise meet special conditions of use. For such service, a Type S, SE, or equivalent flexible cord may be employed and may be of a length appropriate for the purpose, but no longer than 10 feet (3 m). Normally, a 2 foot (610 mm) length of cord will be sufficient for the plug and the receptacle connection.		N/A
	Exception No. 3: A power unit marked in accordance with 51.7 and provided with instructions in accordance with 54.3 is not required to be provided with the detachable power supply cord.		N/A
	Exception No. 4: If a power unit is intended for use in a country other than the U.S.A, the detachable power supply cord shall comply with the requirements of the country of destination.		N/A
	Exception No. 5: For products that do not require		N/A



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Clause	Requirement – Test	Measuring result – Remark	Verdict						
	a discharge path, a cord connected unit is not required to be supplied with a polarized plug when it does not include any single pole switches or fuseholders with accessible contacts.								
Table 14.1 Acceptable flexible cords for cord connected power units									
<table><tr><th>Flexible cord type</th><th>Maximum length, feet (m)</th></tr><tr><td>At least as serviceable as SP-2, SPE-2, SPT-2, SV, SVE, SVT</td><td>10 (3)</td></tr><tr><td>At least as serviceable as S, SE, SO, SP-3, SPT-3, ST, STO, SJ, SJE, SJO, SJT, SJTO</td><td>Not specified</td></tr></table>				Flexible cord type	Maximum length, feet (m)	At least as serviceable as SP-2, SPE-2, SPT-2, SV, SVE, SVT	10 (3)	At least as serviceable as S, SE, SO, SP-3, SPT-3, ST, STO, SJ, SJE, SJO, SJT, SJTO	Not specified
Flexible cord type	Maximum length, feet (m)								
At least as serviceable as SP-2, SPE-2, SPT-2, SV, SVE, SVT	10 (3)								
At least as serviceable as S, SE, SO, SP-3, SPT-3, ST, STO, SJ, SJE, SJO, SJT, SJTO	Not specified								
14.2.2	If a unit with a permanently attached power supply cord can be adapted for use on two or more different voltages by field alteration of internal connections, the attachment plug provided with the unit shall be of a type required for the voltage and current for which the unit is connected when shipped from the factory.		N/A						
14.2.3	If a multiple voltage rated power unit is intended for use with a detachable power supply cord, the cord shall be provided with the unit if either of the following apply:		N/A						
	a) The power unit is provided with an operator adjustable voltage selector and complies with 39.6.1; or		N/A						
	b) The power unit is capable of operating at different voltages without user adjustment.		N/A						
	The power unit shall be provided with instructions in accordance with 54.1 and 54.2.		N/A						
	Exception: A power unit marked in accordance with 51.7 and provided with instructions in accordance with 54.3 is not required to be provided with the detachable power supply cord.		N/A						
14.2.4	A power unit intended for use by travelers shall comply with (a) – (e):		N/A						
	a) The power supply cord shall terminate in a 125 volt, 15 amp plug configuration;		N/A						
	b) The power unit shall employ a user adjustable voltage selector and comply with 39.6.1, or be capable of operating at different voltages without user adjustment;		N/A						
	c) The input voltage rating shall include nominal 120 volt;		N/A						
	d) The power unit shall be marked as indicated in 51.8; and		N/A						
	e) The power unit shall be provided with instructions per 54.4.		N/A						
14.3	DC input units		N/A						



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Clause	Requirement – Test	Measuring result – Remark	Verdict
14.3.1	Units with a dc input shall be provided with a vehicle battery adapter in compliance with the Standard for Vehicle Battery Adapters, UL 2089, or with a cable as specified in 76.1.	AC input unit	N/A
	Exception: A vehicle battery adapter is not required to be provided with the unit, when the unit is marked for use with a required vehicle battery adapter complying with the Standard for Vehicle Battery Adapters, UL 2089.		N/A
14.3.2	A fuse provided with a dc input jack shall not be relied upon to provide the overcurrent protection specified in the Output Current and Power Test, Section 30.		N/A
14.3.3	A unit employing an integral cigarette lighter connector assembly shall also comply with the Standard for Vehicle Battery Adapters, UL 2089. In addition, the overall mass of the unit shall not exceed 250 g (8.8 oz). The product of the total mass, and the distance between the center of gravity and the input contact positioned to simulate full insertion into a vehicle power outlet, shall not exceed 13500 g-mm (18.7 oz-in). For a unit with an attached cord, the determination shall be made with the cord severed at the enclosure, or at the strain-relief means if the strain-relief means is outside the enclosure. For a unit with a detachable cord, the determination shall be made with the cord severed from the mating connector connected to the cigarette lighter connector.		N/A
15	Output Connections		P
15.1	General		P
15.1.1	A unit shall be provided with an output cord, terminals, insulated leads, or output connectors. A battery charger with backfeed protection shall be provided with an output cord terminating in a connector, or a connector attached to or integral with the enclosure. See 15.4.3.	Output cord	P
15.2	Output wiring		P
15.2.1	The output wiring shall be stranded conductors having insulation not less than 0.013 inch (0.33 mm) thick, and permanently attached to the output circuit. The wiring shall extend at least 6 feet (1.8 m) outside the unit, and shall comply with the requirements in 18.1 and 18.2.		P
	Exception No. 1: Wiring less than 6 feet long may be used if longer wiring introduces a risk of fire, electric shock, or injury to persons.		N/A
	Exception No. 2: A product covered by Exception No. 1 to 14.2.1 need not extend the output wiring 6 feet (1.8 m) outside the unit.		N/A



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Clause	Requirement – Test	Measuring result – Remark	Verdict
15.2.2	For a cord-connected power unit with a minimum 6-foot (1.8-m) power-supply cord, the output flexible cord required by 15.1.1, whether permanently attached to the power unit or provided in the form of a separate cord set, shall be of any desirable length. The maximum combined length of the input and output cords shall not exceed 20 feet (6.1 m).		N/A
15.2.3	With respect to 15.2.1, for units with jacketed multiconductor output wiring, the individual conductor insulation may be less than 0.013 inch (0.33 mm) provided that the following conditions are met:		N/A
	a) The thickness of the individual conductor insulation plus the thickness of the jacket is not less than 0.013 inch; and		N/A
	b) The unit complies with the requirements in 28.1 and 30.2.1 with any combination of output conductors interconnected.		N/A
15.2.4	A fitting having female contacts shall be constructed so that it does not receive the blades of a standard attachment plug. A fitting having male contacts shall be constructed so that the contacts do not touch a live part of a standard attachment-plug receptacle.		P
15.3	Output terminals		N/A
15.3.1	A terminal plate tapped for a wire-binding screw or stud shall be of brass or other nonferrous metal, or plated steel, not less than 0.030 inch (0.76 mm) thick, and shall provide not less than two full threads in the metal for the binding screw.		N/A
	Exception No. 1: Two full threads are not required if a lesser number of threads results in a secure connection in which the threads do not strip when subjected to the test specified in 45.1.		N/A
	Exception No. 2: A plate may be less than 0.030 inch thick if the tapped threads have acceptable mechanical strength. See 45.1.		N/A
	Exception No. 3: This requirement does not apply to a terminal plate that complies with the Exception to 45.1.		N/A
15.3.2	A wire-binding screw or terminal stud shall not be smaller than No. 6 (3.5 mm diameter) and shall not have more than 32 threads per inch (25.4 mm). The screw or stud shall be of brass or other nonferrous metal, or plated iron or steel.		N/A
15.3.3	Terminal studs shall be prevented from turning by means other than friction between mounting surfaces. The acceptability of a lock washer or similar means to prevent turning shall be		N/A



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Clause	Requirement – Test	Measuring result – Remark	Verdict
	determined by the test described in 45.1 and 45.2.		
15.3.4	A multi-output unit employing output terminals the output of which exceeds the current limit specified in 30.2 with outputs interconnected shall be marked in accordance with 52.12.		N/A
15.4	Output connectors		N/A
15.4.1	A unit with multiple outputs where interconnection exceeds Class 2 levels as defined in this standard shall be provided with a polarized connector.		N/A
15.4.2	Output connectors mounted on the enclosure and intended for direct connection of accessories, such as separable battery holders and the like, shall provide a secure connection between mating parts. The connections shall be polarized if the output is direct-current or if multiple outputs are provided.		N/A
15.4.3	A battery charger shall be provided with a means to inhibit backfeed of current during a fault in the output circuit, including faults in the output wiring, which results in a risk of fire or electric shock. The means of prevention shall protect each output and shall consist of any of the following:		N/A
	a) A fuse, calibrated in accordance with the Standard for Low-Voltage Fuses – Part 1: General Requirements, UL 248-1, and the Standard for Low-Voltage Fuses – Part 14: Supplemental Fuses, UL 248-14, located in the output connector and rated to correspond with the maximum overcurrent protection rating in Table 30.2 for the open circuit voltage involved;		N/A
	b) A diode or fixed impedance located in the output connector where it will limit backfeed current in accordance with the test specified in 39.9.1 and 39.9.2;		N/A
	c) An overcurrent protector equivalent to (a) located in the output connector; or		N/A
	d) An output cord equivalent to that specified in Table 14.1 with respect to insulating material and thickness; and the battery charger complies with the test specified in 39.9.3 and 39.9.4.		N/A
	Exception No. 1: A means of protection is not required when a specific battery or battery pack, to be used with the charger, does not exceed Class 2 parameters at any level of charge condition. See 52.9. If the specific battery or battery pack employs limiting circuitry, it shall either:		N/A
	a) Comply with Class 2 parameters with all circuitry defeated; or		N/A
	b) Comply with the Standard for Household and		N/A



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Clause	Requirement – Test	Measuring result – Remark	Verdict
	Commercial Batteries, UL 2054.		
	Exception No. 2: A battery charger employing integral batteries is not required to comply with 15.4.3. 15.4.3 revised October 11, 2013		N/A
15.4.4	Connectors normally used with coaxial cable shall not be used for output connections.		N/A
15.5	Bushings		P
15.5.1	At a point where a flexible cord passes or is intended to pass through an opening in a metal wall, barrier, or enclosing case, there shall be a bushing or the equivalent that shall:		P
	a) Be substantial;		P
	b) Be secured in place; and		P
	c) Have a smooth, rounded surface against which the cord may bear.		P
15.5.2	If the cord hole is in a nonconducting material, a smooth, rounded surface is considered to be the equivalent of a bushing.		P
16	Accessibility of Live Parts		P
16.1	General		P
16.1.1	A live part that poses a risk of electric shock shall be located or enclosed so that the risk of contact is reduced.		P
16.1.2	The input impedance of the voltmeter used to measure voltage in accordance with the requirements of 16.2.1 and 16.3.1 is to be a minimum of one megohm. The input impedance of a meter with more than one megohm input impedance can be lowered by using shunt impedance.		P
16.1.3	A guard, baffle, or cover that can be removed without using a tool is to be removed when determining if a live part is accessible to the user. A live part that can be contacted by the test pin, articulate probe, or accessibility probe illustrated in Figure 16.1, Figure 16.2, or Figure 16.4 is considered to be accessible.		P
	Exception: For direct plug-in units provided with removable blades for the input connectors, accessibility of live parts shall also be determined on the plug module while removed from the direct plug-in unit, even if tools are required for removal.		N/A
16.2	Live parts other than exposed wiring terminals		P
16.2.1	The test pin and articulate probe illustrated in Figures 16.1 and 16.2, respectively, when applied as indicated in 16.2.2, shall not contact:		P



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Clause	Requirement – Test	Measuring result – Remark	Verdict
	a) A primary circuit; or		P
	b) Any live part with a voltage greater than that specified in 16.2.2 with respect to ground or any other live part simultaneously accessible to the test pin or articulate probe.		P
16.2.2	The maximum voltages which may be accessible in accordance with 16.2.1(a) are:		P
	a) 42.4 V peak for sinusoidal or nonsinusoidal AC;		P
	b) 60 V for continuous DC, or 60 V peak for interrupted DC outside the range of 10 – 200 Hz;		P
	c) 24.8 V peak for DC interrupted at a rate of 10 – 200 Hz; and		N/A
	d) As indicated in Figure 16.3 for combinations of AC and DC.		N/A
	For the purpose of this requirement, initial transients lasting less than 200 milliseconds may be ignored. Since short term peak voltage is of interest during tests involving a fault, voltages are to be monitored by using a storage oscilloscope for the first two seconds after any fault is introduced.		P
	Exception: The voltage may be exceeded if the current between the parts does not exceed 0.5 mA when measured in accordance with Leakage Current Test, Section 26. 16.2.2 revised October 11, 2013		P
16.2.3	The test pin and articulate probe referenced in 16.2.1 are to be applied with a force not exceeding 1 pound (4.4 N) to determine whether the live parts are accessible. The test pin shall not be applied to fuseholders and the like.		P
16.3	Exposed wiring terminals		P
16.3.1	The accessibility probe illustrated in Figure 16.4, when applied as indicated in 16.3.3, shall not contact an exposed wiring terminal with a voltage greater than that specified in 16.3.2 with respect to ground or to any other terminal simultaneously accessible to the probe.		P
16.3.2	The maximum voltages which may be accessible in accordance with 16.3.1 are:		P
	a) 42.4 V peak for sinusoidal or nonsinusoidal AC;		N/A
	b) 42.4 V for continuous DC, or 42.4 V peak for interrupted DC outside the range of 10 – 200 Hz;		P
	c) 24.8 V peak for DC interrupted at a rate of 10 – 200 Hz; and		N/A
	d) 42.4 V peak for combinations of AC and DC. 16.3.2 revised October 11, 2013		N/A



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Clause	Requirement – Test	Measuring result – Remark	Verdict
16.3.3	The accessibility probe referenced in 16.3.1 is to be applied with a force not exceeding 5.62 pounds (25 N) to determine whether the exposed wiring terminals are accessible. Prior to applying the probe, wire binding screws are to secure the largest wire in accordance with Table 45.1.		P
17	Live Parts		P
17.1	A current-carrying part shall be silver, copper, a copper alloy, plated iron or steel, stainless steel, or other corrosion-resistant alloys acceptable for the application.		P
17.2	An uninsulated live part shall be secured to the base or mounting surface so that it does not turn or shift in position if such motion results in a reduction of spacings below the minimum acceptable values.		P
17.3	Friction between surfaces is not acceptable as a means to prevent shifting or turning of a live part but a lock washer is acceptable.		N/A
18	Strain Relief		P
18.1	Strain relief shall be provided for the supply cord and output wiring, and shall be tested in accordance with the Strain Relief Test, Section 41.		P
18.2	Means shall be provided to prevent the cord or wiring from being pushed into the enclosure through the cord-entry hole when such displacement results in:		P
	a) Subjecting the supply cord or lead to mechanical damage;		P
	b) Exposing the supply cord or lead to a temperature higher than that for which it is rated;		P
	c) Reducing spacings (such as to a metal strain-relief clamp) below the minimum required values; or		P
	d) Damaging internal connections or components.		P
	To determine compliance, the supply cord or lead shall be tested in accordance with Section 42, Push-Back Relief Test.		P
19	Internal Wiring		P
19.1	The internal wiring of a unit shall consist of insulated conductors having mechanical strength, dielectric properties, and ampacity for the application. See 19.6.		P
19.2	Each splice and connection shall be mechanically secure, shall provide reliable electrical contact, and shall be provided with insulation at least equivalent to that of the wire involved unless acceptable permanent spacing		P



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	between the splice and all other metal parts will be maintained. When determining the required minimum thickness of splice insulation, the circuit voltage and interaction with other circuits shall be taken into consideration.		
19.3	A wire connector for making a splice in a unit shall be a type that is applied by a tool in which the application force of the tool making the splice is independent of the force applied by the operator of the tool.		P
19.4	The connection between a lead, including a flexible cord, and the transformer winding or other part of the unit shall be soldered, welded, or otherwise securely connected within the enclosure. A soldered joint shall be mechanically secure before soldering.		P
19.5	If a lead is rigidly held in place without the use of solder, or if it is retained in place so as not to be subjected to any motion, no additional mechanical security is required. Mechanical securement of a lead is not required if separation of the connection does not result in a risk of fire or electric shock.		P
19.6	Unless it is to be evaluated as an uninsulated live part, insulated internal wiring – including an equipment-grounding conductor – shall consist of wire of a type or types acceptable for the application, when considered with respect to:		P
	a) The temperature and voltage to which the wiring is likely to be subjected;		P
	b) Exposure to oil, grease, cleaning fluid, or other substances likely to have a deleterious effect on the insulation; and		N/A
	c) Other conditions of service to which it is likely to be subjected.		P
19.7	An insulated conductor shall be located or protected to reduce the risk of contact with any sharp edge, burr, fin, moving part, or the like, that can damage the conductor insulation.		P
20	Separation of Circuits		P
20.1	Unless provided with insulation rated for the highest voltage involved, insulated conductors of different circuits – internal wiring – shall be separated by barriers or shall be segregated and shall, in any case, be separated or segregated from uninsulated live parts connected to different circuits.		P
20.2	Segregation of insulated conductors may be accomplished by clamping, routing, or equivalent means that provides permanent separation from an insulated or uninsulated live part of a different circuit.		P



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20.3	A barrier used to separate or segregate internal wiring shall have mechanical strength and be held in place to provide permanent separation, and it shall be acceptable for the temperatures involved.		P
20.4	A barrier intended to separate or segregate low-voltage field wiring from line-voltage parts shall be of material of sufficient thickness to serve its intended purpose. It shall be supported so that its deformation cannot be readily accomplished to defeat its purpose.		P
21	Insulating Materials		P
21.1	Integral parts such as insulating washers and bushings, and bases or supports for mounting of live parts, shall be of moisture-resistant materials that are not damaged by the temperatures and stresses to which they are subjected under conditions of actual use.		P
21.2	An insulating material is to be evaluated for the application in accordance with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. Consideration is to be given to such factors as its mechanical strength, resistance to ignition sources, dielectric strength, insulation resistance, and heat-resistant properties in both the aged and unaged conditions, the degree to which it is enclosed, and any other features affecting the risk of fire and electric shock.		P
	Exception: Materials, such as mica, ceramic, or some molded compounds are usually acceptable for use as the sole support of live parts.		P
22	Printed-Wiring Boards		P
22.1	A printed-wiring board in a unit shall comply with the Standard for Printed-Wiring Boards, UL 796, and shall be classed V-1 or less flammable, in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.		P
	Exception No. 1: This requirement does not apply to a printed-wiring board that contains only Class 2 circuits where deterioration or breakage of the bond between the conductor and the base material does not result in a risk of fire or electric shock.		N/A
	Exception No. 2: For a direct plug-in unit, a V-2 material may be used if the enclosure has no openings.		N/A
	Exception No. 3: For a cord-connected unit, a V-2 material may be used if the unit is closed beneath the material or has an equivalent barrier.		N/A
22.2	A resistor, capacitor, inductor, or other part that		P



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	is mounted on a printed circuit board to form a printed circuit assembly shall be secured so that it cannot be displaced to cause a risk of fire or electric shock by a force likely to be exerted on it during assembly or normal operation as determined during the Abuse Tests, Section 46.		
22.3	A printed-wiring board as indicated in Exception No. 1 to 24.1 shall also:		P
	a) Comply with the Standard for Printed-Wiring Boards, UL 796; and		P
	b) Have a minimum flammability classification of V-0 in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.		P
23	Grounding		N/A
23.1	General		N/A
23.1.1	Provision shall be made for grounding of all dead metal parts that are exposed or that are likely to be touched by a person during intended operation or adjustment of the unit, and that are likely to become energized through electric fault.	No grounding provided	N/A
	Exception: A metal part, such as an adhesive-attached metal foil marking, a screw, or a rivet separated from wiring and spaced from uninsulated live parts as if it were a grounded part need not be connected to the grounding member.		N/A
23.1.2	For a direct plug-in unit intended for semipermanent installation, a metal mounting tab may serve as the grounding member.		N/A
23.1.3	A metallic ground pin, if employed, shall be conductively connected to accessible metal parts. For units not having accessible dead metal parts, the grounding means shall be connected to:		N/A
	a) The core of the transformer or other internal dead metal part;		N/A
	b) The transformer secondary output; or		N/A
	c) A grounding wire in the output cord which terminates at the output connector.		N/A
	For a direct plug-in unit provided with a non-metallic ground pin, see 23.1.7. 23.1.3 revised October 30, 2013		N/A
23.1.4	With reference to 23.1.3(c), for units having the grounding means connected to a bonding wire in the output cord, the bonding wire shall comply with 23.2.6.		N/A
23.1.5	To determine whether a part is likely to become energized, such factors as construction, the proximity of wiring, a dielectric voltage withstand		N/A



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	test after the overload and endurance tests, a burnout test, and similar considerations are to be evaluated.		
23.1.6	Bonding shall comply with 23.2 whether the grounding connection is required or not. A soldering lug, a screwless (push-in) connector, a quick-connect, or other friction-fit connector shall not be used. A sheet metal screw shall not be used to connect a grounding conductor or connection device to an enclosure.		N/A
	Exception: A quick-connect terminal may be used in conjunction with solder for securing the grounding conductor.		N/A
23.1.7	A direct plug-in unit provided with a non-metallic ground pin for increased stability (dummy ground pin) shall comply with 23.1.8 and, if applicable, 23.1.9. 23.1.7 added October 30, 2013		N/A
23.1.8	The orientation of the non-metallic ground pin with respect to the supply blades shall be in accordance with Figure 7.2 or 7.3. 23.1.8 added October 30, 2013		N/A
23.1.9	A direct plug-in unit intended for use with a duplex receptacle where a non-metallic ground pin is oriented for insertion in the grounding contact of the receptacle adjacent to that used for the supply blades shall:		N/A
	a) Render the supply contacts of the receptacle adjacent to that associated with the direct plug-in supply blades completely unusable; and		N/A
	b) Be provided with the following marking or instruction:		N/A
	1) "For use only with a duplex receptacle" or equivalent; or		N/A
	2) A pictorial illustrating proper orientation in a duplex receptacle. 23.1.9 added October 30, 2013		N/A
23.2	Bonding conductor		N/A
23.2.1	Bonding shall be accomplished by a metal-to-metal contact of parts or by a separate bonding conductor as specified in 23.2.6.		N/A
23.2.2	A bonding conductor shall be copper, copper alloy, or another acceptable material.		N/A
23.2.3	Ferrous metal in the grounding path shall be protected against corrosion by enameling, galvanizing, plating, or other equivalent means.		N/A
	Exception: Corrosion protection is not required to be provided at electrical connections.		N/A
23.2.4	A separate bonding conductor:		N/A



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	a) Shall be protected from mechanical damage or located within the outer enclosure; and		N/A
	b) Shall not be secured by a removable fastener used for a purpose in addition to bonding, unless the bonding conductor is not likely to be omitted if the fastener is removed and replaced as intended.		N/A
	A bonding conductor shall be in metal-to-metal contact with the parts to be bonded.		N/A
23.2.5	A splice shall not be employed in a bonding conductor.		N/A
23.2.6	A separate component-bonding conductor relied upon as the primary ground path shall:		N/A
	a) Not be smaller than any internal conductor supplying the part to be bonded; or		N/A
	b) Comply with the Bonding Conductor Test, Section 47.		N/A
24	Spacings		P
24.1	Spacings between live parts of opposite polarity, between live and dead metal parts, and between live parts and a metal enclosure, shall be as specified in Table 24.1 or Table 24.2, as appropriate. If a live part is not rigidly secured in position by a means other than friction between surfaces, or if a movable dead metal part is in proximity to an uninsulated live part, the construction shall be such that at least the minimum spacings will be maintained.		P
	Exception No. 1: Spacings between traces on a printed-wiring board need not comply with Tables 24.1 and 24.2 if the printed-wiring board complies with the abnormal operation test in 39.8. See also 22.3. The requirements specified in 22.3 and 39.8 do not substitute for the minimum required spacings between the printed-wiring board foils and dead metal parts or the spacings between the primary and secondary foils of the printed-wiring board as specified in Table 24.1 or 24.2.		P
	Exception No. 2: This requirement does not apply to a unit complying with the requirements in 24.5 – 24.9.		P
24.2	For the purpose of determining working voltage in units employing nonlinear circuitry:		P
	a) When the dc value is used, the peak value of any superimposed ripple shall be included;		P
	b) Non-repetitive transients (due, for example, to atmospheric disturbances) shall be disregarded;		P
	c) The voltage of a Class 2 circuit is regarded as zero for determination of through air spacings.		P



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	However, the voltage of a Class 2 circuit shall be taken into account for determination of over surface spacings;		
	d) Ungrounded accessible conductive parts shall be assumed to be grounded;		P
	e) Where a transformer winding or other part is floating (not connected to a circuit which establishes its potential relative to earth), it shall be assumed to be grounded at the point by which the highest working voltage is obtained;		P
	f) For insulation between two transformer windings, the highest voltage between any two points in the two windings shall be used, taking into account external voltages to which the windings are able to be connected;		P
	g) For insulation between a transformer winding and another part, the highest voltage between any point on the winding and the other part shall be used; and		P
	h) Nominal values of mains supply voltage shall be used.		P
24.3	All uninsulated live parts connected to different circuits, including all secondary circuits, shall be spaced from one another as though they were parts of opposite polarity and shall be evaluated on the basis of the highest voltage involved.		P
24.4	At other than field-wiring terminals, spacings in a Class 2 secondary circuit from the transformer secondary winding on or beyond the energy-limiting component, as may be appropriate, are not specified between live parts of opposite polarity and between a live part and a dead metal part.		P
24.5	As an alternative to the spacing requirements of Table 24.1 or Table 24.2, as appropriate, the spacing requirements in the Standard for Insulation Coordination Including Clearances and Creepage Distances For Electrical Equipment, UL 840, may be used. The spacing requirements of UL 840 shall not be used for output wiring terminals and spacings to a dead metal enclosure.	UL840 considered	P
24.6	It is anticipated that the level of pollution expected will be pollution degree 2. Hermetically sealed or encapsulated enclosures, or coated printed wiring boards in compliance with the Printed-Wiring Board Coating Performance Test specified in the Standard for Insulation Coordination Including Clearances and Creepage Distances For Electrical Equipment, UL 840, are considered pollution degree 1.		P
24.7	It is anticipated the equipment will be rated overvoltage category II and overvoltage category		P



UL 1310			
Clause	Requirement – Test	Measuring result – Remark	Verdict
	I as defined in the Standard for Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment, UL 840.		
24.8	In order to apply Clearance B (controlled overvoltage) clearances, control of overvoltage shall be achieved by providing an overvoltage device or system as an integral part of the product.		P
24.9	All printed-wiring boards are considered to have a minimum comparative tracking index (CTI) of 100 without further investigation.		P
24.10	An insulating barrier or liner used to provide spacings shall be of material acceptable for the application and shall not be less than 0.028 inch (0.71 mm) thick.		N/A
	Exception No. 1: A barrier or liner used in conjunction with not less than half the required spacing through air may be less than 0.028 inch (0.71 mm) thick, but not less than 0.012 inch (0.305 mm) thick if the barrier or liner is of acceptable insulating material that is:		N/A
	a) Resistant to moisture;		N/A
	b) Of acceptable mechanical strength if exposed or otherwise likely to be subjected to mechanical damage;		N/A
	c) Reliably held in place; and		N/A
	d) Located so that it is not adversely affected by operation of the device – particularly arcing.		N/A
	Exception No. 2: A barrier or liner may be less than 0.028 inch thick but not less than 0.010 inch (0.25 mm) thick in the secondary circuit where the potential is not more than 50 volts if it is:		N/A
	a) Resistant to moisture;		N/A
	b) Of acceptable mechanical strength if exposed or otherwise likely to be subjected to mechanical damage; and		N/A
	c) Reliably held in place.		N/A
24.11	Insulating material having a thickness less than that specified in 24.10 may be used if, upon investigation, it is found to be acceptable for the application, and has a dielectric breakdown strength of not less than 5000 volts in the thickness used for 24.10, or 2500 volts in the thickness used for Exception No. 1 to 24.10, as determined by the Tests on Insulating Materials, Section 40.		P
24.12	Units, which are marked "Double Insulated" or marked with the symbol for double insulation, shall be investigated to the Standard for Double Insulation Systems for Use in Electronic		N/A



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Clause	Requirement – Test	Measuring result – Remark	Verdict
	Equipment, UL 2097.		
PERFORMANCE			P
25	General		P
26	Leakage Current Test		P
26.1	The leakage current of a unit, tested in accordance with 26.3 – 26.7, shall not be more than:		P
	a) 0.5 milliamperere for a portable unit; or		P
	b) 0.75 milliamperere for a stationary unit.		N/A
26.9	A sample is to be subjected to the complete leakage current test program as covered by 26.7 without interruption for other tests. The unit shall then comply with the Dielectric Voltage Withstand Test, Section 34.		P
27	Leakage Current Test and Dielectric Voltage Withstand Test After Humidity Exposure		P
27.1	A unit shall comply with the Leakage Current Test, Section 26, and Dielectric Voltage Withstand Test, Section 34, following exposure for 48 hours to air having a relative humidity of 88 ± 2 percent at a temperature of $32 \pm 2^{\circ}\text{C}$ ($89.6 \pm 3.6^{\circ}\text{F}$).		P
28	Maximum Output Voltage Test		P
28.1	The maximum output voltage under any load condition (including no load) between any two output terminations of a unit shall not be more than the peak voltages specified in 16.2.2 when the primary is connected to the supply circuit. The Exception to 16.2.2 does not apply to this requirement. See 28.3.		P
28.2	If a unit has more then one pair of output terminations, the output voltage mentioned in 28.1 is to be measured with any combination of interconnections of the output terminations.		P
28.3	The maximum voltage between output terminations of a multiple output unit may exceed the values specified in 28.1 when the output terminations are interconnected, if the following conditions are met:		N/A
	a) The maximum output voltage between any two terminations is not more than the values indicated in 28.1 when no connections are made between the output terminations; and		N/A
	b) The unit is marked in accordance with 52.10.		N/A
29	Maximum Input Test		P
29.1	The primary input of a direct plug-in or cord-connected unit shall not be more than 660 watts when the unit is connected to the supply circuit with any condition of secondary load,		P



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Clause	Requirement – Test	Measuring result – Remark	Verdict
	including the short-circuiting of any combination of outputs.		
30	Output Current and Power Test		P
30.1	General		P
30.1.1	The maximum output current and output volt-amperes specified in 30.2 and 30.3 are to be determined using a current meter and a watt meter. A resistive load is to be adjusted to result in maximum reading of the meters. With no further adjustment of the load, the sample is to be de-energized and cooled to room temperature. The sample is then to be energized and maximum current and wattage measurements are to be taken at the time specified in 30.2.		P
	Exception: An inherently limited or a not inherently limited Class 2 transformer that complies with the requirements in the Standard for Low Voltage Transformers – Part 1: General Requirements, UL 5085-1, and the Standard for Low Voltage Transformers – Part 3: Class 2 and Class 3 Transformers, UL 5085-3, is not required to be tested in accordance with 30.2 or 30.3.		P
30.2	Inherently limited		P
30.2.1	Under any condition of resistive loading – including short-circuit and interconnection of outputs when not prohibited by marking – the maximum output current shall not exceed the value specified in Table 30.1 and the maximum output volt-amperes shall not be more than 100 volt-amperes, except as indicated in 30.2.3 and 30.3.1, for the following conditions, as applicable:		P
	a) For a unit which employs a transformer with no form of protection, the measurement is to be made 60 seconds after the unit is connected to the source of supply.		N/A
	b) For a unit which employs a transformer and an energy limiting impedance or energy limiting circuit (a resistor, a PTC device, or similar circuitry) required for the purpose (See 5.8), the measurement is to be made five seconds after the unit is connected to the source of supply.		P
	c) For a unit which employs a transformer and either a thermal cutoff, a fuse, or both, all protection is to be defeated during the test and the measurement made 60 seconds after the unit is connected to the source of supply.		N/A
	d) For a unit that employs a transformer and a combination of a limiting impedance or circuit required for the purpose, and a protective device (such as a thermal cutoff, a fuse, or both), all protective devices are to be defeated and the measurement is to be made five seconds after		N/A



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Clause	Requirement – Test	Measuring result – Remark	Verdict																		
	the unit is connected to the source of supply.																				
	e) For a unit that employs a dc input, in accordance with 1.1, and a combination of a limiting impedance or circuit required for the purpose, and a protective device (i.e. thermal cutoff, fuse, or both), the protective device is to be defeated and the measurement is to be made five seconds after the unit is connected to the source of supply.		N/A																		
Table 30.1 Maximum output current for inherently limited units <table border="1"> <thead> <tr> <th rowspan="2">Circuit voltage (V_{max})^{a,b} ac or dc Volts</th><th colspan="2">Maximum nameplate ratings</th><th rowspan="2">Maximum output current (I_{max})^c, Amperes</th></tr> <tr> <th>Volt-Amperes</th><th>Amperes</th></tr> </thead> <tbody> <tr> <td>0 – 20</td><td>$5.0 \times V_{max}$</td><td>5.0</td><td>8.0</td></tr> <tr> <td>Over 20 to 30</td><td>100</td><td>$100/V_{max}$</td><td>8.0</td></tr> <tr> <td>Over 30 to 60, dc only</td><td>100</td><td>$100/V_{max}$</td><td>$150/V_{max}$</td></tr> </tbody> </table> ^a V_{max} : Maximum output voltage regardless of load with rated input voltage applied. ^b Voltage ranges shown are for sinusoidal alternating current and continuous direct current. For nonsinusoidal alternating current, maximum voltage shall not be greater than 42.4 volts peak. For direct current interrupted at a rate of 10 – 200 hertz, maximum voltage shall not be greater than 24.8 volts. ^c I_{max} is maximum output current regardless of load.				Circuit voltage (V_{max}) ^{a,b} ac or dc Volts	Maximum nameplate ratings		Maximum output current (I_{max}) ^c , Amperes	Volt-Amperes	Amperes	0 – 20	$5.0 \times V_{max}$	5.0	8.0	Over 20 to 30	100	$100/V_{max}$	8.0	Over 30 to 60, dc only	100	$100/V_{max}$	$150/V_{max}$
Circuit voltage (V_{max}) ^{a,b} ac or dc Volts	Maximum nameplate ratings		Maximum output current (I_{max}) ^c , Amperes																		
	Volt-Amperes	Amperes																			
0 – 20	$5.0 \times V_{max}$	5.0	8.0																		
Over 20 to 30	100	$100/V_{max}$	8.0																		
Over 30 to 60, dc only	100	$100/V_{max}$	$150/V_{max}$																		
30.2.2	If the value of current and power cannot be obtained due to operation of a protective device, damage to the transformer, or the like:		N/A																		
	a) The values are to be extrapolated, if feasible, from the values measured earlier in the time period; or		N/A																		
	b) A protective device may be shunted to obtain the required data.		N/A																		
30.2.3	The current between output terminations of a multi-output unit is not required to comply with 30.2.1 when output terminations are interconnected if the following conditions are met:		N/A																		
	a) The output current between any two terminations is not more than the limit specified in 30.2.1 when no connections are made between output terminations of separate outputs;		N/A																		
	b) The unit is marked in accordance with 52.10; and		N/A																		
	c) There is no emission of flame or molten metal from the unit enclosure and no other evidence of a risk of fire or electric shock.		N/A																		
30.3	Not inherently limited		N/A																		
30.3.1	When the unit includes means to automatically de-energize the output circuit (see 11.11), the values of the output current and volt-amperes specified in 30.2.1 shall not exceed those specified in Table 30.2.		N/A																		



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Clause	Requirement – Test	Measuring result – Remark			Verdict	
30.3.2	To determine if a unit complies with the requirement in 30.3.1, the unit is to be allowed to deliver the test current to a resistance load, with the primary connected to a source of supply. The unit is to be draped with a double layer of cheesecloth conforming to the device outline. Charring, glowing, or flaming of the cheesecloth is unacceptable.				N/A	
Table 30.2 Maximum output current and volt-amperes for not inherently limited units						
Circuit voltage (V _{max}) ^{a,b} ac or dc, volts		Maximum nameplate ratings		Maximum output (I _{max}) ^c , amperes	Maximum output volt-amperes, (VA _{max}) ^d	Maximum overcurrent protection rating, amperes
		Volt-amperes	Amperes			
0 – 20		5.0 X V _{max}	5.0	1000/V _{max}	250 ^e	5.0
Over 20 to 30		100	100/V _{max}	1000/V _{max}	250	100/V _{max}
Over 30 to 60, dc only		100	100/V _{max}	1000/V _{max}	250	100/V _{max}
^a V_{max} is the maximum output voltage regardless of load with rated input voltage applied. ^b Voltage ranges shown are for sinusoidal alternating current and continuous direct current. For nonsinusoidal alternating current, maximum voltage shall not be greater than 42.4 volts peak. For direct current interrupted at a rate of 10 – 200 hertz, maximum voltage shall not be greater than 24.8 volts. ^c I_{max} is maximum ampere output regardless of load after operation as specified in 30.2.1. ^d VA_{max} is maximum volt-ampere output regardless of load after operation as specified in 30.2.1. ^e Maximum volt-amperes is 350 if maximum circuit voltage is 15 or less.						
31	Calibration of Overcurrent Protection Devices Test					N/A
31.1	A protective device provided as a part of a not inherently limited unit shall operate in not more than the time indicated in Table 31.1 when the unit is delivering the specified secondary current. There shall be no emission of flame or molten metal from the enclosure, and no evidence of a risk of fire or electric shock as described in 39.1.2. The unit shall withstand the dielectric voltage withstand test as specified in 34.1.1(a), applied between the primary winding and secondary windings, and between the primary and exposed dead metal parts.				N/A	
	Exception: This test need not be conducted if a suitably rated (see Table 30.2) and calibrated fuse is provided in the output circuit.				N/A	
31.2	During the test, the grounding means is to be connected to ground through a 3-ampere nontime-delay fuse and the unit is to be draped with a double layer of cheesecloth conforming to the outline of the unit.				N/A	
32	Full-Load Output Current Test					P
32.1	A unit shall deliver its rated full-load secondary current continuously.				P	
	Exception: The test of 32.2 is not required for a battery charger that is marked for a specific battery load per the Exception to 50.1 and is not				N/A	



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Clause	Requirement – Test	Measuring result – Remark	Verdict
	marked with the output ratings.		
33	Normal Temperature Test		P
33.1	The temperature rises on various materials and parts shall not exceed the limits specified in Table 33.1 when the unit is operated as specified in 33.2 – 33.5. Upon completion of this test, the unit shall comply with the Dielectric Voltage Withstand Test, Section 34.		P
34	Dielectric Voltage Withstand Test		P
34.1	General		P
34.1.1	One minute after the applicable test, the unit shall withstand for 1 minute without breakdown the application of a potential. The test potential shall be:		P
	a) One thousand volts ac plus twice the maximum rated voltage between:		P
	1) The primary circuit and accessible dead metal parts; and		P
	2) The primary and secondary circuit or circuits.		P
	b) One thousand volts ac plus two times the sum of secondary voltages between secondary windings for units described in 28.3 or 30.2.3.		N/A
	c) Five hundred volts ac between a secondary circuit and dead metal parts.		N/A
	d) A dc potential of 1.414 times (2 V + 1000), where V is the rms supply voltage, between the terminals of a capacitor used for radio-interference elimination or arc suppression.		P
	Exception: If an ac potential results in excessive leakage through capacitors during the test specified in (a), (b), and (c), the capacitors are to be removed from the circuit for the ac potential. With the capacitors connected in the circuit, the unit shall withstand a dc potential of 1.414 times the ac rms potential between the points specified.		P
34.2	Induced potential		N/A
34.2.1	One sample of a transformer as described in Exception No. 1 to 13.2.8 and 13.2.9 is to be subjected to this test. While in a heated condition from operation as described in Normal Temperature, Section 33, the primary winding shall withstand without breakdown an alternating potential of twice the rated voltage of the winding. The potential is to be:		N/A
	a) Applied for 7200 cycles if the frequency is 120 hertz or more; or		N/A
	b) 60 seconds if the frequency is less than 120 hertz.		N/A



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Clause	Requirement – Test	Measuring result – Remark	Verdict
	b) 60 seconds if the frequency is less than 120 hertz.		N/A
35	Endurance Test on Overcurrent- and Overtemperature-Protective Devices		N/A
35.1	One sample of a unit employing a manually reset overcurrent- or overtemperature-protective device shall be operated under the condition of maximum obtainable output current, including short circuit, and the protector shall be cycled for 50 operations as quickly as the protector can be reset. During this test the grounding means, if provided, is to be connected to ground through a 3-ampere nontime delay fuse. A risk of fire or electric shock as described in 39.1.2 shall not result and the temperature rise at any point on the enclosure shall not exceed 65°C (117°F). The protector device shall be operational upon completion of the test.		N/A
35.2	One sample of a unit employing an automatically reset protective device or a protector that stays open as long as the overload is connected is to be connected and operated under the conditions described in 35.1 for 15 days but not less than 2000 cycles. A risk of fire or electric shock – see 39.1.2 – shall not result and the temperature rise at any point on the enclosure shall not exceed 65°C (117°F). Temperatures are to be measured at the end of the test. The protective device shall be operational upon completion of the test.		N/A
35.4	Following the endurance test, the unit is to be subjected to a repeat dielectric voltage withstand test as described in Section 34.		N/A
36	Overload and Endurance Tests on Switches and Controls		N/A
36.1	A switch or other control that has not been shown to be acceptable for the purpose in accordance with 10.6 shall perform acceptably when subjected to an overload test consisting of 50 cycles of operation making and breaking the applicable load, and to an endurance test consisting of 6000 cycles of operation at rated load. There shall be no electrical or mechanical breakdown of the device, undue burning or pitting of the contacts as a result of the overload or endurance test, or opening of the fuse in the grounding connection.		N/A
37	Overload Test on Secondary Switches		N/A
37.1	If tests are required in accordance with 10.7, a switch or other control device shall be tested as described in 37.2. The performance is unacceptable if:		N/A
	a) The fuse in the grounding connection opens during the test;		N/A



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	b) There is welding of contacts or mechanism breakdown; or		N/A
	c) The device is otherwise incapable of completing the tests.		N/A
38	Operation Test		N/A
38.1	A switch or other controller required to be tested in accordance with 10.8 is to be subjected to 1000 operations through all positions. The operations are to be with no electrical load. There shall be no mechanical breakdown of the switching mechanism or loosening of parts.		N/A
38.2	After the 1000 operations, the switch shall be capable of making and breaking the circuit for 50 cycles of operation as indicated in the Overload and Endurance Tests on Switches and Controls, Section 36. For a voltage selector switch, the test voltage is to be based on the highest rated voltage.		N/A
39	Abnormal Tests		P
39.1	General		P
39.1.1	A unit shall not emit flame or molten metal or become a risk of fire or electric shock when subjected to the following tests: output loading, reverse polarity, switch position, component breakdown, and when required, the printed wiring board abnormal operation test. Each abnormal test shall be followed by a dielectric voltage withstand test as required by 34.1.1(a).		P
39.1.2	A risk of fire or electric shock is considered to exist if any of the following occur:		P
	a) Opening of the grounding fuse;	No	P
	b) Charring of cheesecloth;	No	P
	c) Emission of flame or molten material from the unit enclosure and output cord, if provided;	No	P
	d) Any condition that exposes live parts which pose a risk of electric shock as specified in Accessibility of Live Parts, Section 16;	No	P
	e) Indication of dielectric breakdown;	No	P
	f) For a direct plug-in unit, loss of structural integrity to a degree where the unit cannot be removed from a receptacle immediately after the test without deformation or a risk of electric shock; or		N/A
	g) Opening of the branch-circuit overcurrent protective device.	No	P
39.2	Output loading		P
39.2.1	During the tests of 39.2.2 and 39.2.3, a fuse or circuit breaker provided as part of the unit is to		P



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Clause	Requirement – Test	Measuring result – Remark	Verdict
	remain in the circuit, and a user replaceable fuse is to be replaced by the largest fuse the fuseholder will accept. A manually reset protector is to be operated for 10 cycles and the protector contacts shall be operative upon completion of the test. If an automatic reset protector is provided, or the input current is a value other than zero, the test is to be continued for:		
	a) 7 hours; or		N/A
	b) 15 days in accordance with 13.2.4.		P
	For units with more than one output, the remaining outputs are to be open circuited or loaded to rated conditions in accordance with Table 25.2, whichever results in a more severe operating condition.		N/A
39.3	Output loading – alternate method		N/A
39.3.1	With reference to the Exception to 39.2.3, if the output short circuit test of 39.2.2 results in opening of a thermal link or fuse, the alternate method of 39.3.2 or 39.3.3 may be performed in lieu of 39.2.3.		N/A
39.4	Transformer burnout		P
39.4.1	A unit having components in the output circuit shall not emit flame or molten metal or result in a risk of fire or electric shock as described in 39.1.2 while first operating as described in the temperature test, followed by operation under the loading conditions described in 39.4.3 for linear designs, 39.4.4 for switch mode designs. Each test is to be followed by a dielectric voltage withstand test described in 34.1.1(a) with the potential applied between primary and secondary windings. During this test the grounding means, if provided, is to be connected directly to ground. The unit is to be operated continuously:		P
	a) Until ultimate conditions are observed, including opening of a thermal cutoff or a similar device;		N/A
	b) For 7 hours if temperatures stabilize or cycling of an automatically reset protector occurs; or		P
	c) For 50 cycles of resetting a manually reset protector.		N/A
39.5	Reverse polarity		P
39.5.1	For a device intended for charging batteries and provided with nonpolarized output connections, the external output leads are to be connected in reverse polarity to a fully charged battery intended for the application. The unit is then to be connected to its maximum test voltage, and operated until the ultimate condition is observed,		N/A



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Clause	Requirement – Test	Measuring result – Remark	Verdict
	or 4 hours if cycling of an automatically reset protector occurs.		
39.6	Switch position		N/A
39.6.1	In accordance with 14.1.4, 14.2.3, and 14.2.4, a unit employing a primary-voltage selector switch shall be connected to the maximum test voltage and to its rated normal load. The switch is then to be adjusted to the lowest voltage position. Operation of the unit is to continue:		N/A
	a) Until ultimate conditions are observed;		N/A
	b) For 7 hours, if cycling of an automatically reset protector occurs; or		N/A
	c) For 10 cycles of resetting a manually reset protector.		N/A
39.7	Component breakdown		P
39.7.1	When tested in accordance with 39.7.2, a unit having components – such as diodes, resistors, transistors, capacitors, and the like – with a single component fault of short or open, shall not result in:		P
	a) The output capacity exceeding Class 2 characteristics; and		P
	b) Any condition as specified in 39.1.2.		P
	Exception No. 1: This test need not be conducted for component breakdowns that result in open or short circuiting of the output, in short circuiting of the transformer, or for a component in a Class 2 circuit. See the transformer burnout test specified in 39.4.		P
	Exception No. 2: This test need not be conducted if the components have been investigated and found to have permanence and stability so as to not decrease their limiting capabilities. See 12.1. For the purpose of this test, capacitors connected across the output are not considered likely to open.		P
39.8	Printed-wiring board abnormal operation test		N/A
39.8.1	To comply with Exception No. 1 to 24.1, a printed-wiring board is to be tested as described in 39.8.2 – 39.8.5.		N/A
39.9	Backfeed protection		N/A
39.9.1	The output connector of a battery charger provided with backfeed protection in accordance with 15.4.3 (b) or (c) shall be subjected to the test described in 39.9.2. As a result of the test, the backfeed current shall not exceed 8.0 amperes at five seconds, and there shall be no emission of flame or molten material from the enclosure or output cord.		N/A



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Clause	Requirement – Test	Measuring result – Remark	Verdict
39.9.2	In accordance with 39.9.1, the output connector is to be connected to a source as specified in (a) or (b). A resistive load up to and including short circuit is to be connected as close as practicable across the output connector such that the maximum obtainable backfeed current is passed through the output connector. The current is to be measured at five seconds. The test is to be continued until ultimate results are obtained. The source shall be either: a) A fully charged battery of the size, type, and number specified by the manufacturer; or b) A dc source with a no load voltage rating equal to the output voltage rating of the battery charger and a nominal short-circuit capacity of 200 amperes.		N/A
39.9.3	A battery charger provided with backfeed protection in accordance with 15.4.3(d) shall be subjected to simulated component faults, one at a time, of open or short circuit which may result in backfeed of current into the secondary circuit (refer to 39.9.4). During the test the output connector shall be connected to a source as specified in 39.9.2 (a) or (b), and the test is to be continued until ultimate results are obtained. One minute after the test the unit shall be subjected to the dielectric voltage withstand test of 34.1.1 (a), (b) and (c). As a result of the test, there shall be no emission of flame or molten material from the enclosure or output cord, and no indication of dielectric breakdown.		N/A
39.9.4	In accordance with 39.9.3, faults shall be simulated for components such as diodes, transistors, capacitors, and the like unless the components have permanence and reliability (see 12.1). If an overcurrent protector, such as a fuse or PTC, operates to limit the backfeed current, the protector shall comply with requirements applicable to the component.		N/A
40	Tests on Insulating Materials		P
40.1	If required by 13.2.1(b), 13.2.2(c), 13.2.5(c), 13.2.6(c), 13.2.10(b), insulating material shall be subjected to the test described in 40.2.		P
	Exception: The insulating material need not be subjected to this test if it is generic material noted in 40.3 and Table 40.1.		P
41	Strain Relief Test		P
41.1	With internal connections disconnected, the strain relief means provided for a supply cord, or a multi-conductor output cord where the interconnection of outputs exceeds Class 2 shall withstand the force described in 41.3 applied to the cord for 1 minute without displacement or breakage of the cord or deformation of its		P



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Clause	Requirement – Test	Measuring result – Remark	Verdict
	anchoring surface.		
41.2	The output wiring of a unit other than one having a multi-conductor cord as specified in 41.1 shall withstand the force described in 41.4 applied for 1 minute. The results are considered acceptable if, with the output wiring connected internally, movement of the cord does not result in:		P
	a) A reduction of spacings to primary or dead metal parts;		P
	b) Damage to the transformer or enclosure; or		P
	c) Interruption of the output wiring.		P
42	Push-Back Relief Test		P
42.1	To determine compliance with 18.2, a product shall be tested in accordance with 42.2 without occurrence of any of the conditions specified in or 18.2 (a) – (d).		P
43	Direct Plug-In Blade Secureness Test		P
43.1	Each blade and the grounding pin, if provided, shall withstand a direct pull of 20 pounds-force (89 N) for 2 minutes without loosening. The two blades tested together shall also withstand a direct pull of 20 pounds for 2 minutes without loosening.		P
44	Direct Plug-In Security of Input Contacts Test		P
44.1	General		P
44.1.1	The plug-in blades and the grounding pin shall not loosen to a degree that introduces a risk of fire or electric shock as a result of the tests described in 44.1.2 and 44.1.3.		P
44.2	Removable, folding, and retractable blade units		N/A
44.2.1	In addition to the requirements of 44.1, units employing removable, folding, or retractable blades for the input contacts shall be subjected to the testing indicated in 44.2.2 – 44.2.5.		N/A
45	Security of Output Connectors Test		N/A
45.1	For a unit provided with wire-binding terminals as output connectors, a terminal or terminal stud shall not turn or cause stress on internal connections when subjected to the test of 45.2.		N/A
	Exception: This requirement does not apply to a terminal plate for a wire binding screw, a wire binding screw, or a stud where:		N/A
	a) Dislocation does not result in a reduction of spacings to parts which pose a risk of electric shock; and		N/A
	b) There is no likelihood of deformation to the extent that live parts which pose a risk of electric shock become accessible as determined by		N/A



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Clause	Requirement – Test	Measuring result – Remark		Verdict																								
	Accessibility of Live Parts, Section 16.																											
45.2	The appropriate torque specified in Table 45.1 is to be applied for 10 seconds to the terminals in a direction tending to tighten them. The terminals are then to be loosened fully.			N/A																								
Table 45.1 Tightening torque for wire-binding screws <table><tr><th rowspan="2">Size of terminal screw, number</th><th colspan="2">Wire sizes to be tested</th><th colspan="2">Tightening torque</th></tr><tr><th>AWG</th><th>(mm²)</th><th>pound-inches</th><th>(N·m)</th></tr><tr><td>6</td><td>16 – 22</td><td>(1.3 – 0.32)^a</td><td>12</td><td>(1.4)</td></tr><tr><td>8</td><td>14 and 16 – 22</td><td>(2.1)^b and (1.3 – 0.32)^a</td><td>16</td><td>(1.8)</td></tr><tr><td>10</td><td>10 – 14 or 16 – 22</td><td>(5.3 – 2.1)^b or (1.3 – 0.32)^a</td><td>20</td><td>(2.3)</td></tr></table> ^a Stranded wire. ^b Solid wire.					Size of terminal screw, number	Wire sizes to be tested		Tightening torque		AWG	(mm ²)	pound-inches	(N·m)	6	16 – 22	(1.3 – 0.32) ^a	12	(1.4)	8	14 and 16 – 22	(2.1) ^b and (1.3 – 0.32) ^a	16	(1.8)	10	10 – 14 or 16 – 22	(5.3 – 2.1) ^b or (1.3 – 0.32) ^a	20	(2.3)
Size of terminal screw, number	Wire sizes to be tested		Tightening torque																									
	AWG	(mm ²)	pound-inches	(N·m)																								
6	16 – 22	(1.3 – 0.32) ^a	12	(1.4)																								
8	14 and 16 – 22	(2.1) ^b and (1.3 – 0.32) ^a	16	(1.8)																								
10	10 – 14 or 16 – 22	(5.3 – 2.1) ^b or (1.3 – 0.32) ^a	20	(2.3)																								
45.3	Connection and disconnection of accessories shall not result in loosening of the connectors from a unit.			N/A																								
45.4	To determine compliance with 45.3, accessories are to be attached and detached from the unit 100 times and the connectors examined.			N/A																								
46	Abuse Tests			P																								
46.1	General			P																								
46.1.1	The enclosure of a unit shall withstand the applicable mechanical abuse tests described in 46.2 – 46.5 without:			P																								
	a) Making live parts which pose a risk of electric shock accessible to the probe illustrated in Figure 16.2; or			P																								
	b) Producing any other condition that results in a risk of electric shock.			P																								
46.1.2	The probe illustrated in Figure 16.2 applied as specified in 16.2.3 is to be used to determine whether a live part is accessible.			P																								
46.2	Impact on direct plug-in units			P																								
46.3	Impact on cord connected units			N/A																								
46.4	Rod pressure on direct plug-in units			N/A																								
46.5	Resistance to crushing on direct plug-in units			N/A																								
47	Bonding Conductor Test			N/A																								
47.1	With respect to 23.2.6, a bonding conductor that is smaller than any internal conductor supplying the part to be bonded is acceptable if, using a separate sample for each test, neither the bonding conductor nor the connection opens when:			N/A																								



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Clause	Requirement – Test	Measuring result – Remark	Verdict
	a) Carrying a current of 40 amperes for 2 minutes; and		N/A
	b) A sample is subjected to a limited-short-circuit test using a test current of 200 amperes while connected in series with a nonrenewable fuse rated 20 amperes.		N/A
MANUFACTURING AND PRODUCTION TESTS			P
48	Dielectric Voltage Withstand Test		P
49	Grounding Continuity Test		N/A
RATING			P
50	General		P
50.1	The electrical ratings of a unit shall include: primary or input voltage or input voltage range; primary or input frequency expressed in hertz, Hz, cycles-per-second, cps, cycles/second, or c/s; output in amperes, volt-amperes, or watts for each output; and output voltage for each output in alternating or direct current.	Refer to page 3 “Copy of markings plate”	P
	Exception: When a battery charger is configured for use as part of a specific system and the battery is evaluated as part of the system, or when the charger is marked for use with a specific battery pack, the output ratings are not required to be marked on the charger.		N/A
50.2	If a unit is marked with an input amperes, volt-amperes, or watts rating, the rating shall be at least 90 percent of the value which occurs under rated load conditions when temperatures stabilize.		P
50.3	The output rating of each output shall not exceed 30 volts rms or 60 volts dc.		P
50.4	The sum of the volt-ampere ratings of all outputs shall not be more than 100 volt-amperes.		P
	Exception: The sum of the volt-ampere ratings of all outputs may be more than 100 VA provided each output rating is not more than 100 VA and each output rating is individually marked.		N/A
50.5	If a volt-ampere or wattage rating is accompanied by an ampere rating, it shall be congruous with the other ratings.		N/A
MARKING			P
51	General		P
51.1	A unit shall be legibly and permanently marked, where readily visible, with:	Refer to page 3 “Copy of markings plate”	P
	a) The manufacturer’s name, trade name, or trademark;		P
	b) The date or other dating period of manufacture not exceeding any three		P



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Clause	Requirement – Test	Measuring result – Remark	Verdict
	consecutive months;		
	c) A distinctive catalog or model number, or the equivalent; and		P
	d) The electrical rating.		P
	Exception: The date of manufacture may be abbreviated, in an accepted conventional code, or in a code affirmed by the manufacturer.		P
51.2	If a manufacturer produces or assembles a unit at more than one factory, each unit shall have a distinctive marking to identify it as the product of a particular factory.		N/A
51.3	The repetition time cycle of a date code shall not be less than 20 years. The date code shall not require reference to the manufacturer's records to determine when the unit was manufactured.		P
51.4	A unit shall be marked with one of the following terms, as applicable:		P
	a) "Class 2 Battery Charger";		P
	b) "Class 2 Transformer";		N/A
	c) "Class 2 Power Supply"; or		N/A
	d) "Class 2 Power Unit."		N/A
	See 52.11. A power unit may additionally be marked for use with a specific end product or end product type if investigated for the intended application. See 1.4.		N/A
	Exception: Other designations conveying the intent of the terms specified may be used.		P
51.5	A unit shall not be marked "charger," or the equivalent, unless it employs a rectifying component.		P
51.6	The polarity of a direct-current output shall be plainly marked, unless the unit is provided with a polarized termination.	Provided with a polarized termination	P
51.7	A power unit not furnished with a detachable power supply cord as described in the Exceptions to 14.2.1 and 14.2.3 shall be marked adjacent to the appliance coupler to inform the user to see the instruction manual (see 54.3) for proper selection of the power supply cord.		N/A
	Exception: The marking may be in the form of a tag, nonpermanent label, or product insert that is provided on or packaged with the unit so that the marking is visible at the time of installation.		N/A
51.8	In accordance with 14.1.4 and 14.2.4, a power unit intended for use by travelers shall be marked with any of the following or equivalent:		P
	a) "See instruction manual for use in countries		P



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Clause	Requirement – Test	Measuring result – Remark	Verdict
	other than the U.S.A.”		
	b) “See instructions for input voltage conversion.” or		N/A
	c) “See instructions if the input plug does not fit the power outlet.”		N/A
51.9	A battery charger with backfeed protection in accordance with 15.4.3 shall be marked “Backfeed Protection” , “ BFP ” , or the equivalent.		N/A
52	Cautionary and Warning Markings		P
52.1	The marking shall be prefixed by the signal word “CAUTION” or “WARNING” in letters not less than 1/8 inch (3.2 mm) high. The remaining letters shall not be less than 1/16 inch (1.6 mm) high. 52.1 revised July 25, 2012		P
52.2	The marking shall be located on:		P
	a) A part that cannot be removed without impairing the operation of the unit; or		P
	b) A tag complying with the requirements in 52.3, 53.2, and 53.3. 52.2 revised July 25, 2012		N/A
52.3	The marking may be provided on a permanent tag that is secured to the input or output cord of a unit. The tag shall be attached in such a way that it cannot be easily removed. The tag shall also be marked “Do not remove this tag,” or the equivalent, in letters not less than 3/32 inch (2.4 mm) high. 52.3 revised July 25, 2012		N/A
52.4	A direct plug-in unit having a mounting tab for semipermanent mounting shall be marked – on the unit, a marking tag, or an instruction sheet packed with the unit – with the signal word of 52.1 and the following mounting instructions or the equivalent:		N/A
	a) “Risk of Electric Shock – Disconnect power to the receptacle before installing or removing the unit. When removing receptacle cover screw, cover may fall across plug pins or receptacle may become displaced”;		N/A
	b) “Use only with duplex receptacle having center screw”; and		N/A
	c) “Secure unit in place by receptacle cover screw.” 52.4 revised July 25, 2012		N/A
52.5	A direct plug-in unit intended to be semipermanently mounted that exceeds the surface temperature limits specified in Table 33.1 for either metallic or nonmetallic shall be legibly		N/A



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Clause	Requirement – Test	Measuring result – Remark	Verdict
	marked where readily visible after installation with the signal word of 52.1 and the following or the equivalent: "HOT SURFACES – Risk of Burns – Do not touch." 52.5 revised July 25, 2012		
52.6	A unit shall be marked with the signal word of 52.1 and "Risk of Electric Shock" and the following or the equivalent: "Dry location use only" or "Do not expose to liquid, vapor, or rain." 52.6 revised July 25, 2012		P
52.7	A direct plug-in unit that resembles an attachment plug of a power supply cord shall be plainly marked with the signal word of 52.1 and the following or the equivalent: "Risk of Fire or Electric Shock. Do not replace this plug assembly." 52.7 revised July 25, 2012		N/A
52.8	A unit which employs fusing in both supply conductors shall be marked, where readily visible during servicing, with the signal word of 52.1 and the following or equivalent: "Risk of Electric Shock. Both sides of line are fused. Test before touching."		N/A
	Exception: A unit not likely to be serviced need not employ this marking. 52.8 revised July 25, 2012		N/A
52.9	A unit intended to charge batteries shall be marked, where readily visible to the user, with the signal word of 52.1 followed by "Risk of Injury" or "Risk of Fire" and one of the following or equivalent:		P
	a) "Refer to the instruction manual for the size, type, and number of batteries to be charged."		P
	b) "Charge only [type] type rechargeable batteries."		N/A
	The [type] shall be filled in with an appropriate descriptor to instruct the user of the battery to be charged. (For example: 12 volt NiCd, AAA size NiCd, C size NiMH, [manufacturer name] Model [battery pack part number]) 52.9 revised July 25, 2012		N/A
52.10	With reference to 28.3 and 30.2.3, a multi-output unit shall be marked, where readily visible after installation, with the word "WARNING" and the following or equivalent: "Risk of Fire or Electric Shock. Do not interconnect output terminations." 52.10 revised July 25, 2012		N/A
52.11	A unit employing output field-wiring terminals shall be marked "CLASS 2 NOT WET, CLASS 3 WET" or the equivalent if the open circuit output voltage exceeds:		N/A
	a) 21.2 volts peak;		N/A



UL 1310			
Clause	Requirement – Test	Measuring result – Remark	Verdict
	b) 30 volts for continuous direct current; or		N/A
	c) 12.4 volts for DC interrupted at a rate of 10 to 200 Hz.		N/A
	Exception: If a unit having an output specified by (a) or (b) is marked with the maximum obtainable output peak voltage, it need not comply with the requirement.		N/A
52.12	A unit, as described in 15.3.4, shall be marked with the signal word of 52.1 and the following or the equivalent: "Risk of Fire. Use only Type SPT-2 or heavier cord, minimum ____ AWG copper." The minimum acceptable size is 18 AWG (0.82 mm ²). The marking is to be located adjacent to the terminals or connectors or on a tag attached to the unit. 52.12 revised July 25, 2012		N/A
53	Application of Labeling		P
53.1	Unless specifically excepted, markings required by this Standard shall be permanent. A permanent marking shall be molded, die-stamped, paint-stenciled; stamped or etched metal that is permanently secured; or indelibly stamped on a pressure-sensitive label secured by adhesive that complies with the Standard for Marking and Labeling Systems, UL 969. Ordinary usage, handling, storage, and the like of the unit are to be considered in determining whether a marking is permanent.		P
53.2	The tag mentioned in 52.3 shall be made of durable material that provides mechanical strength, such as cloth, plastic, or the equivalent, and shall be large enough to accommodate the required marking in a size that is legible – also see 53.3. The tag shall be either:		N/A
	a) A flat tag having a hole large enough to accommodate the cord, but neither so large nor so positioned that it can easily be torn from the cord. To prevent removal or tearing, the tag is not to have a slit from the cord hole; or		N/A
	b) A flag-type tag with an adhesive back wrapped tightly once around and adhering to the cord. The ends of the tag are to adhere to each other and are to project as a flag.		N/A
53.3	The markings on a tag shall be printed in contrasting colors on a background other than blue or yellow and shall be located on the projecting flag of a flag-type tag.		N/A
	INSTRUCTIONS		P
54	Instruction Manual		P
54.1	Multiple-voltage cord-connected equipment shall be provided with instructions to:		P



UL 1310			
Clause	Requirement – Test	Measuring result – Remark	Verdict
	a) Indicate the type of detachable supply cord and attachment plug that is to be used for connection to the alternate voltage; and		P
	b) Inform the operator to set the voltage selector switch to the voltage to which the product will be connected. See 14.2.3.		N/A
54.2	Multiple voltage equipment intended for use with a detachable power supply cord shall be provided with instructions to indicate the type of detachable power supply cord that is to be used for connection to the alternate voltage in accordance with 14.2.3.		P
54.3	In accordance with the Exceptions to 14.2.1 and 14.2.3, the instructions for a power unit intended for use with a detachable power supply cord which is not provided with the unit shall contain complete details concerning proper selection of the power supply cord. The instructions shall specify selection of a cord complying with the requirements in 14.2.1.		N/A
	Exception: For a power unit intended for use in a foreign country, the instructions shall specify the appropriate cord to be used (see Exception No. 4 to 14.2.1).		N/A
54.4	With reference to 14.1.4 and 14.2.4, the instructions for a power unit intended for use by travelers shall include (a) – (c) or the equivalent, as appropriate. The items shall be preceded by "IMPORTANT SAFETY INSTRUCTIONS – SAVE THESE INSTRUCTIONS" and "DANGER – TO REDUCE THE RISK OF FIRE OR ELECTRIC SHOCK, CAREFULLY FOLLOW THESE INSTRUCTIONS" in letters of 1/8 inch (3.18 mm) high or in a readily visible contrasting text.		P
	a) "Be sure voltage selector is in correct voltage position before plugging in." The instructions shall also specify the procedures to follow for changing the voltage selector.		N/A
	b) "For use in the U.S.A., the voltage selector switch must be placed in the 120 volt position. For use in countries other than the U.S.A., the voltage selector may need to be placed in other than the 120 volt position. Confirm the voltage available at each country location before using the product."		N/A
	c) "For connection to a supply not in the U.S.A., use an attachment plug adapter of the proper configuration for the power outlet, if needed." Or, "If the shape of the plug does not fit the power outlet, use an attachment plug adaptor of the proper configuration for the power outlet."		P
54.5	The operating orientation of a direct plug-in		N/A



UL 1310			
Clause	Requirement – Test	Measuring result – Remark	Verdict
	power unit shall be indicated in the instructions as follows: "This power unit is intended to be correctly orientated in a vertical or floor mount position," or equivalent wording.		
	Exception: The instruction is not required for a direct plug-in power unit weighing 1 pound (454 g) or less.		N/A



UL 1310			
Clause	Requirement – Test	Measuring result – Remark	Verdict
OUTDOOR USE			N/A
55	General		N/A
56	Enclosures		N/A
56.1	A product intended for outdoor use shall comply with the Rain Test in 64.3.		N/A
	Exception: A type 3R, 3S, or 4X enclosure evaluated in accordance with the Standard for Enclosures for Electrical Equipment, Non-Environmental Considerations, UL 50, is not required to be subjected to the Rain Test.		N/A
56.2	A product that is for use in an outdoor location shall comply with 64.1 and 64.2, in addition to the Ultraviolet (UV) Light Test and Water Immersion Tests specified in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.		N/A
56.3	A power unit, or similar component, that is for use in an outdoor location and is to be mounted within 1 foot of the ground, whether as a separate product or provided as a part of a product, shall comply with the Standing Water Immersion Test in 64.4. A power unit installed at a height greater than 1 foot from the ground shall be marked in accordance with 65.6.		N/A
	Exception: This requirement does not apply to a direct plug-in product.		N/A
56.4	A gasket or similar sealing device used to comply with the Rain Test in 64.3 shall comply with Section 58, Gaskets.		N/A
56.5	A panel, or cover, in the outer enclosure of an appliance shall require the use of a tool for removal.		N/A
	Exception: This requirement does not apply when the removal or opening of the panel, or cover, does not result in a risk of electric shock when the appliance is subjected to the Rain Test described in 64.3.		N/A
56.6	An enclosure of a unit intended for outdoor use shall be constructed to reduce the risk of electric shock due to weather exposure and shall prevent live parts, electrical components, or wiring (not identified for use while in contact with water) from becoming wet. A part identified for use while in contact with water includes flexible cords (whose marking ends with a "W"), liquid tight flexible metal conduit, outlet boxes marked for use in wet locations, and rigid conduit.		N/A
56.7	To determine compliance with 56.6, a complete assembly shall be subjected to the Rain Test in 64.3.		N/A
56.8	The supporting surface of a power unit shall be		N/A



UL 1310			
Clause	Requirement – Test	Measuring result – Remark	Verdict
	supported by means other than ground level.		
	Exception: This requirement does not apply to a thermoplastic enclosed unit that complies with the Standing Water Immersion Test of 64.4.		N/A
56.9	A direct plug-in unit shall fully engage into a standard receptacle that is weatherproof only when the receptacle is covered (attachment plug cap not inserted and receptacle cover closed).		N/A
	Exception: This requirement does not apply to a direct plug-in unit marked in accordance with 65.4 and provided with instructions in accordance with 66.3.		N/A
57	Protection Against Corrosion		N/A
57.1	Metal shall be used in combinations that are galvanically compatible.		N/A
57.2	A hinge and other attachments shall be resistant to corrosion.		N/A
57.3	A decorative grille, or similar part, that is not required to form a part of the enclosure is not required to comply with 57.4 – 57.14.		N/A
57.4	A non-metallic enclosure shall be judged on the basis of the effect of exposure to ultraviolet light and water, in accordance with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.		N/A
57.5	A metallic enclosure shall be protected against corrosion as specified in 57.6 – 57.14. These requirements do not contemplate corrosion that is caused by exposure to earth or other corrosive agents.		N/A
57.6	Copper, bronze, and brass containing no less than 80 percent copper, or stainless steel may be used without additional protection against corrosion. Sheet, extruded, cast aluminum, die-cast zinc, and other metals shall be of a grade or alloy known to be resistant to atmospheric corrosion, shall be subjected to appropriate tests, or shall be protected against corrosion.		N/A
57.7	An enclosure of cast iron or malleable iron at least 3.2 mm (1/8 inch) thick shall be protected against corrosion by:		N/A
	a) A coating of zinc, cadmium, or the equivalent, which is 0.0038 mm (0.00015 inch) thick on the outside surface, and a visible coating of such metal on the inside surface; or		N/A
	b) One coat of an organic finish of the epoxy or alkyd-resin type, or other outdoor paint on each surface.		N/A
57.8	Corrosion tests are required unless suitability of a paint can be determined by consideration of its		N/A



UL 1310			
Clause	Requirement – Test	Measuring result – Remark	Verdict
	composition.		
57.9	An enclosure of sheet steel less than 3.20 mm (0.126 inch) thick if zinc-coated, or 3.12 mm (0.123 inch) thick if uncoated, shall be protected against corrosion by other metallic or non-metallic coatings that have been found to give equivalent protection as described in 57.12, or by one of the following means:		N/A
	a) Hot-dipped mill-galvanized sheet steel		N/A
	b) A zinc coating, other than that provided on hot-dipped mill-galvanized sheet steel		N/A
	c) A zinc coating		N/A
	d) A cadmium coating		N/A
	e) A cadmium coating		N/A
57.10	An enclosure of zinc-coated sheet steel 3.20 mm (0.126 inch) thick or thicker, or an enclosure of uncoated sheet steel 3.12 mm (0.123 inch) thick or thicker, shall be protected against corrosion by other metallic or non-metallic coatings that have been shown to give equivalent protection as described in 57.12 or by one of the following means:		N/A
	a) Hot-dipped mill-galvanized sheet steel		N/A
	b) A zinc coating		N/A
	c) Two coats of an organic finish of the epoxy or alkyd resin type or other outdoor paint on each surface. See 57.8; or		N/A
	d) Any one of the means specified in 57.9.		N/A
57.11	An enclosure of zinc-coated sheet steel 1.42 mm (0.056 inch) thick and an enclosure of uncoated sheet steel 1.35 mm (0.053 inch) thick intended to be mounted within and protected from direct exposure to weather by the enclosure of other equipment shall comply with 57.10. Such an enclosure shall not be marked rainproof or raintight.		N/A
57.12	A finish utilizing paint, metallic finish, or the combination of the two, may be used if comparative tests with galvanized sheet steel – without annealing, wiping, or other surface treatment – conforming with 57.9(a) or 57.10(a) indicate the finish provides equivalent protection, or when found to provide equivalent protection in accordance with the Standard for Organic Coatings for Steel Enclosures for Outdoor Use Electrical Equipment, UL 1332.		N/A
57.13	If tests are required, a test specimen of a finish as described in 57.7, 57.9(c), 57.10(c), and 57.12 shall be consistent with the finish that is used in production with respect to the base metal, cleaning or pretreatment method, application		N/A



UL 1310			
Clause	Requirement – Test	Measuring result – Remark	Verdict
	method, number of coats, curing method, and thickness.		
57.14	A hot-dipped mill-galvanized A60 (alloyed) coating or an annealed zinc coating that is bent, or similarly formed, after annealing and that is not otherwise required to be painted shall be painted in the bent or formed area if the bending, or forming process, has damaged the zinc coating. The zinc coating is considered to be damaged if flaking or cracking of the zinc coating at the outside of the bent or formed section is visible at 25 power magnification. Simple sheared, cut edges, and punched holes are not considered to be formed.		N/A
	Exception: An area on the inside surface of an enclosure that is not exposed to water during the water spray test is not required to be painted.		N/A
58	Gaskets		N/A
58.1	This section applies to gaskets that are required for an electrical enclosure to maintain a tight fit.		N/A
58.2	A gasket shall be secured with adhesive or by mechanical means, including force-fit or the combination of the gasket's shape and elastomeric properties. The gasket and its securing means shall not be damaged when the cover is opened.		N/A
58.3	The gasket material and adhesive combination, if applicable, shall comply with the Standard for Gaskets and Seals, UL 157. The Tensile Strength Test and Ultimate Elongation Test, when tested in accordance with the Standard for Gaskets and Seals, UL 157, shall have a tensile strength of no less than 60 percent and an elongation of no less than 75 percent of the values determined before conditioning.		N/A
59	Supply Connections		N/A
59.1	A conduit opening in the enclosure of a fixed power unit shall be evaluated in accordance with Sections 67 – 71.		N/A
59.2	The power supply cord provided with a power unit intended for use in an outdoor location shall be at least as serviceable as junior hard service cord type SJW, SJOW, SJTW, SJTOW, SW, SOW, STW, or STOW.		N/A
59.3	An outdoor power unit shall be provided with means for connection of the supply with one of the following:		N/A
	a) Terminals or leads for permanent connection to the supply for fixed equipment. A lead shall be no less than 152.4 mm (6 inches) in length and shall not exceed 609.6 mm (24 inches) in length. The requirements of Sections 67 – 71 shall also		N/A



UL 1310			
Clause	Requirement – Test	Measuring result – Remark	Verdict
	apply;		
	b) A non-detachable power supply cord for connection to the supply by means of a plug; or		N/A
	c) A direct plug-in unit.		N/A
59.4	A cord-connected power unit intended for use in an outdoor location shall employ a 3-conductor grounding type supply cord.		N/A
	Exception: A power unit that does not have parts required to be grounded is not required to employ a grounding type supply cord.		N/A
60	Output Connections and Wiring		N/A
60.1	Output wiring shall be suitable for outdoor use, "W" rated, and sunlight-resistant as applicable to outdoor cords.		N/A
60.2	An output connection shall be suitable for outdoor use, protected against corrosion, and sunlight-resistant as applicable to outdoor connections.		N/A
61	Spacings		N/A
61.1	A unit intended for outdoor use shall comply with Section 24, Spacings, except that 24.1 and 24.5 – 24.8 shall be replaced with 61.2.		N/A
61.2	The spacing between live parts of opposite polarity, live and dead metal parts, and live parts and a metal enclosure, shall be as specified in Table 24.1. This table applies to units with or without openings.		N/A
	Exception No. 1: A unit complying with the hose down test specified in the Standard for Enclosures for Electrical Equipment, Non-Environmental Considerations, UL 50, may be evaluated in accordance with Table 24.2.		N/A
	Exception No. 2: The spacing requirements within the Standard for Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment, UL 840, may be used as an alternative to the spacing requirements located in Table 24.1. If UL 840 is used, the following shall apply:		N/A
	a) The spacing requirement of UL 840 shall not be used for field wiring terminals or for spacings to a dead metal enclosure;		N/A
	b) The level of pollution for damp location and outdoor use equipment is pollution degree 3. A hermetically sealed or encapsulated enclosure, or a coated printed wiring board in compliance with the Printed Wiring Board Coating Performance Test of the Standard for Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment, UL		N/A



UL 1310			
Clause	Requirement – Test	Measuring result – Remark	Verdict
	840, is classified pollution degree 1;		
	c) The equipment is rated overvoltage category I and overvoltage category II as defined in the Standard for Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment, UL 840; and		N/A
	d) Control of overvoltage shall be achieved by providing an overvoltage device or system as an integral part of the product in order to apply Clearance B (controlled overvoltage) clearances. The device shall comply with the Standard for Surge Protective Devices, UL 1449.		N/A
62	Accessibility of Live Parts		N/A
62.1	A unit intended for outdoor use shall comply with Section 16, Accessibility of Live Parts, except that 16.2.2 and 16.3.2 shall be replaced with 62.2 and 62.3, respectively.		N/A
62.2	The maximum voltages which may be accessible in accordance with 16.2.1 are:		N/A
	a) 15 V for sinusoidal AC and 21.2 V peak for nonsinusoidal AC;		N/A
	b) 30 V for continuous DC, or 30 V peak for interrupted DC outside the range of 10 – 200 Hz; and		N/A
	c) 12.4 V peak for DC interrupted at a rate of 10 – 200 Hz.		N/A
	An initial transient lasting less than 200 milliseconds may be disregarded. Voltages are to be monitored using a storage oscilloscope for the first two seconds after any fault is introduced. 62.2 revised October 11, 2013		N/A
62.3	The maximum voltages which may be accessible in accordance with 16.3.1 are:		N/A
	a) 15 V for sinusoidal AC and 21.2 V peak for nonsinusoidal AC;		N/A
	b) 30 V for continuous DC, or 30 V peak for interrupted DC outside the range of 10 – 200 Hz; and		N/A
	c) 12.4 V peak for DC interrupted at a rate of 10 – 200 Hz. 62.3 revised October 11, 2013		N/A
63	Ground-Fault Circuit-Interrupters		N/A
63.1	Each power unit shall be protected by an integral ground-fault circuit-interrupter that complies with the requirements for a Class A ground-fault circuit-interrupter in the Standard for Ground-Fault Circuit-Interrupters, UL 943.		N/A
	Exception: An integral ground-fault circuit-interrupter is not required if the unit is marked in		N/A



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Clause	Requirement – Test	Measuring result – Remark	Verdict
	accordance with 65.2.		
63.2	If provided, a ground-fault circuit-interrupter (including any external open-neutral circuitry) shall be connected between the supply lead or terminal connections and all other electrical conductors and equipment. This determination is to be made with the unit connected in all intended voltage configurations.		N/A
63.3	In a power unit, the conductors on the load side of the ground-fault circuit-interrupter shall not occupy boxes or enclosures containing other conductors unless the additional conductors are also protected by a ground-fault circuit-interrupter.		N/A
	Exception: Conductors on the load side of a ground-fault circuit-interrupter may occupy the same boxes or enclosures as other conductors if the conductors are separated by a barrier or if the conductors are segregated, routed, or secured to provide permanent spacing from all other insulated or uninsulated live parts.		N/A
63.4	A ground-fault circuit-interrupter test button shall be accessible without the use of tools.		N/A
64	Performance		N/A
64.1	General		N/A
64.2	Abuse tests		N/A
64.2.1	A unit for use in an outdoor location shall comply with Section 46, Abuse Tests. In addition 46.2, 46.3, and 46.5 shall be repeated as specified in Section 46, except the drop test is to be applied on a concrete surface. Before the tests identified in 46.2, 46.3, and 46.5, the sample is to be cooled to a temperature of minus 35.0 ±2.0°C (minus 31.0 ±3.6°F) and maintained at this temperature for a minimum of 3 hours. Testing is to commence immediately upon removal from the cooling . One sample may be utilized for each test, however all samples shall comply with 64.2.2. 64.2.1 revised January 26, 2012		N/A
64.2.2	After completion of the tests specified in 64.2.1, each sample shall comply with 46.1.1 and 46.1.2, and shall be subjected to the Dielectric Voltage Withstand Test. An examination shall be conducted for evidence of the development of a risk of fire or electric shock. The Rain Test, 64.3, and the Standing Water Immersion Test, 64.4, shall be conducted if applicable.		N/A
64.3	Rain test		N/A
64.3.1	An enclosure designated rainproof or raintight shall be subjected to a water spray as described in 64.3.5. A rainproof enclosure shall have no		N/A



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Clause	Requirement – Test	Measuring result – Remark	Verdict
	wetting of a live part nor have entrance of water above the lowest live part. A raintight enclosure shall have no entrance of water into the enclosure.		
64.4	Standing water immersion test		N/A
64.4.1	The construction of a power unit designated for outdoor use, or any other outdoor-use product enclosure, mounted within 304.8 mm (1 foot) from the ground shall prevent the entrance of water into the interior space of the enclosure.		N/A
64.4.3	After being subjected to the standing water immersion test for the time specified, a power unit intended for outdoor use shall comply with the following:		N/A
	a) The requirements for the Leakage Current Test, Section 26, with the test being discontinued when the leakage current stabilizes; and		N/A
	b) The Dielectric Voltage Withstand Test, Section 34.		N/A
65	Markings		N/A
65.1	A required marking shall be capable of withstanding the stresses of ordinary usage, including exposure to weather and other ambient conditions, handling, storage, and similar conditions. An adhesive-backed label shall comply with the requirements in the Standard for Marking and Labeling Systems, UL 969, for the exposure conditions and surface temperatures of minimum range from 80°C (176°F) to minus 35°C (minus 31°F). If a tag is utilized, it shall be permanent and tear resistant.		N/A
65.2	An outdoor use power unit complying with the Exception to 63.1 shall be provided with a marking that consists of the following or equivalent wording:		N/A
	a) For a permanently connected power unit:		N/A
	"WARNING: Risk of Electric Shock. Install only on a circuit protected by a Class A GFCI."		N/A
	b) For a cord connected or direct plug-in power unit:		N/A
	"WARNING: Risk of Electric Shock. Install only to a covered Class A GFCI receptacle that has an enclosure that is weatherproof with the attachment plug cap inserted or removed."		N/A
65.3	An outdoor unit shall be marked "raintight" or "rainproof" in accordance with 64.3.1.		N/A
65.4	In accordance with 56.9, a direct plug-in power unit shall be marked "WARNING: Not for use with receptacles that are weatherproof only when the receptacle is covered (attachment plug cap		N/A



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	not inserted and receptacle cover closed)."		
65.5	A permanently connected unit shall be marked in accordance with Section 70, Markings.		N/A
65.6	In accordance with 56.3, a unit intended to be mounted greater than 0.30 m (1 foot) from the ground surface shall be marked as follows: "WARNING: Risk of Electric Shock. Mount the unit at a height greater than 1 foot from the ground surface."		N/A
66	Instructions		N/A
66.1	The text of the safety instructions required by 66.3 shall be verbatim, or in equally definitive terminology, unless otherwise indicated.		N/A
	Exception: A variation from the specified wording may be used if a specific conflict of the application to a product exists.		N/A
66.2	The items in the list in 66.3 shall be numbered and may include additional important safety instructions deemed appropriate by the manufacturer.		N/A
66.3	The important safety instructions shall be provided with a power unit and include those items in the following list that are applicable. The statement "READ AND FOLLOW ALL SAFETY INSTRUCTIONS" shall be prominently displayed and precede the list, and the statement "SAVE THESE INSTRUCTIONS" shall be prominently displayed and follow the list. The word "WARNING" shall be entirely in upper case letters.		N/A
	IMPORTANT SAFETY INSTRUCTIONS		N/A
	When using electrical products, basic precautions should always be practiced including the following:		N/A
	1. READ AND FOLLOW ALL SAFETY INSTRUCTIONS.		N/A
	2. Read and follow all instructions that are on the product or provided with the product.		N/A
	3. For a cord-connected or direct plug-in power unit, do not use an extension cord.		N/A
	4. Reference the National Electrical Code, ANSI/NFPA 70, specifically for the installation of wiring and clearances from power and lighting conductors.		N/A
	5. Installation work and electrical wiring must be done by qualified person(s) in accordance with all applicable codes and standards, including fire-rated construction.		N/A
	6. For a cord-connected or direct plug-in power		N/A



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Clause	Requirement – Test	Measuring result – Remark	Verdict
	unit, do not install or use within 10 feet of a pool.		
	7. For a cord-connected or direct plug-in unit, do not use in a bathroom.		N/A
	8. For a direct plug-in or cord-connected power unit marked in accordance with 65.2:		N/A
	WARNING: Risk of Electric Shock. When used outdoors, install only to a covered Class A GFCI protected receptacle that is weatherproof with the power unit connected to the receptacle. If one is not provided, contact a qualified electrician for proper installation. Ensure that the power unit and cord do not interfere with completely closing the receptacle cover.		N/A
	9. For a permanently connected power unit marked in accordance with 65.2:		N/A
	WARNING: Risk of Electric Shock. When used outdoors, install only on a circuit protected by a Class A GFCI.		N/A
	10. WARNING: Risk of Fire. Installation involves special wiring methods to run wiring through a building structure. Consult a qualified electrician.		N/A
	11. For a unit intended to be mounted greater than 0.30 m (1 foot) from the ground surface:		N/A
	WARNING: Risk of Electric Shock. Mount the unit at a height greater than 1 foot from the ground surface.		N/A
	SAVE THESE INSTRUCTIONS – This manual contains important safety and operating instructions for power units.		N/A
66.4	A permanently connected unit shall be provided with instructions in accordance with Section 71, Installation Instructions.		N/A
66.5	For direct plug-in units, in accordance with 56.9, the installation instructions shall be provided with a warning to the user, using pictorials or equally effective means, not to use with receptacles that are weatherproof only when the receptacle is covered (attachment plug cap not inserted and receptacle cover closed).		N/A
66.6	With reference to instruction item 10 in 66.3, there shall be no literature, carton markings, or illustrations depicting or implying running wiring through a building structure.		N/A



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Clause	Requirement – Test	Measuring result – Remark	Verdict
PERMANENTLY-CONNECTED UNITS FOR CONNECTION TO A WIRING SYSTEM			N/A
67	General		N/A
68	Construction		N/A
68.1	A permanently-connected power unit shall have a provision for the connection of a wiring system in accordance with Sections 67 – 71.		N/A
68.2	A power unit supply conductor shall be sized in accordance with the National Electrical Code, ANSI/NFPA 70, as appropriate for the branch circuit specified.		N/A
68.3	A knockout in a sheet-metal enclosure shall be secured and removable without undue deformation of the enclosure.		N/A
68.4	A knockout shall be surrounded by a flat surface to accommodate for seating of a conduit bushing or locknut of the appropriate size.		N/A
68.5	There shall be three to five threads in the metal when threads for the connection of conduit are tapped all the way through a hole in an enclosure wall, or when an equivalent construction is employed. The construction of the device shall be such that a conduit bushing is able to be properly attached.		N/A
68.6	Threads for the connection of conduit that are not tapped all the way through a hole in an enclosure wall, conduit hub, or similar construction shall not be less than 3-1/2 threads in the metal. There shall be a smooth, rounded inlet hole for the conductors that shall provide protection to the conductors equivalent to that provided by a standard conduit bushing, and shall have an internal diameter similar to the corresponding trade size of a rigid conduit.		N/A
68.7	A field-wiring compartment in which power unit connections are to be made shall:		N/A
	a) Be located so that the connections may be readily inspected after the power unit is installed;		N/A
	b) Permit the connection to be introduced and connected easily; and		N/A
	c) Permit the connection of the supply wires after the power unit is fixed to its support.		N/A
	Exception: A power unit weighing five pounds or less is permitted for external mounting on an outlet box cover plate.		N/A
68.8	A field-wiring compartment intended for connection of a wiring system shall be attached to the power unit to prevent turning.		N/A
68.9	An outlet box, terminal box, wiring compartment, or similar component, in which connections to the power unit circuit are made in the field shall be		N/A



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Clause	Requirement – Test	Measuring result – Remark	Verdict
	free from any sharp edge including screw threads, a burr, a fin, a moving part, or similar component that may abrade the insulation on conductors, or otherwise damage the wiring.		
68.10	The outlet box, terminal box, wiring compartment, or similar component, in which connections to the power unit circuit are made in the field shall comply with the applicable requirements in the Standard for Metallic Outlet Boxes, UL 514A, the Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers, UL 514C, or the Standard for Enclosures for Electrical Equipment, Non-Environmental Considerations, UL 50.		N/A
68.11	A hole for the connection of conduit shall not be drilled and tapped in the field.		N/A
68.12	The equipment shall be provided with cable entries, conduit entries, knock-outs, or glands, that allow connection of the appropriate types of cables or conduits.		N/A
69	Wiring Terminals and Leads		N/A
69.1	The field-wiring terminals in 68.3 – 68.12 are terminals to which supply connections are made in the field when the power unit is installed.		N/A
69.2	A field-wiring terminal, or lead, shall be sized for the connection of conductors having an ampacity rated for the specified branch circuit overcurrent protection of the power unit.		N/A
69.2A	A field-wiring lead shall consist of general building wire rated minimum 600 V. It shall not be more than two standard wire sizes smaller than the copper conductor to which it will be connected and shall not be smaller than 18 AWG (0.82 mm ²). An 18 AWG field wiring lead shall not be longer than 12 inches (305 mm).		N/A
	Exception: An 18 AWG size field-wiring lead may be provided for connection to a No. 12 (3.3 mm ²) size branch circuit conductor. 69.2A added April 26, 2013		N/A
69.3	The grounding conductor shall:		N/A
	a) Not be smaller in size than the line and neutral conductors; and		N/A
	b) Not be identified for the connection of an aluminum conductor.		N/A
69.4	The power unit shall have all associated terminals located in proximity to each other and to the grounding terminal, if any.		N/A
69.5	The terminal block shall comply with the requirements for a terminal block suitable for field wiring using the applicable wire gauge in the Standard for Equipment Wiring Terminals for Use		N/A



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	with Aluminum and/or Copper Conductors, UL 486E.		
69.6	The connection of the grounding conductor shall be in accordance with the applicable requirements located in the Standard for Wire Connectors, UL 486A-486B, and shall be suitable for grounding and bonding equipment.		N/A
69.7	Metal employed for an equipment-grounding terminal shall be nonferrous, stainless steel, or of other metal that is inherently resistant to corrosion.		N/A
69.8	A wiring terminal shall be prevented from turning or shifting in position by a means other than friction between surfaces. This may be accomplished by two screws or rivets, square shoulders or mortises, a dowel pin, lug or offset, a connecting strap, a clip fitted into an adjacent part, or an equivalent method.		N/A
69.9	The free length of a lead inside an outlet box or wiring compartment shall be at least 152 mm (6.0 inches) and shall not exceed 609.6 mm (24.0 inches) in length if the lead is for field connection to an external circuit.		N/A
69.10	The wiring compartment for the supply connections shall not occupy the same space for any of the Class 2 wiring.		N/A
69A	Strain Relief Test		N/A
69A.1	A wiring lead intended for field-wiring connection shall withstand without damage or displacement, a direct pull of:		N/A
	a) 20 pounds (89 N) for 1 minute applied to a lead extending from the enclosure (such as through a knockout); and		N/A
	b) 10 pounds (44.5 N) for 1 minute applied to a lead within a wiring compartment. 69A.1 added April 26, 2013		N/A
70	Markings		N/A
70.1	In addition to the markings specified in this Standard, a permanently connected power unit shall be provided with the following markings:		N/A
	a) The type of conductors to be utilized, for example, "use copper conductors only";		N/A
	b) A terminal intended for connection of grounded power supply conductor shall be made of or plated with metal substantially white or gray in color and shall be readily distinguishable from other terminals;		N/A
	Exception: This requirement does not apply when proper identification of a terminal that is intended for connection of grounded power		N/A



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Clause	Requirement – Test	Measuring result – Remark	Verdict
	supply conductor is clearly shown in some other manner, such as on an attached wiring diagram or adjacent marking letter "N" or "Common".		
	c) The surface of a lead for the connection of a grounded power supply conductor shall be white or gray and shall be readily distinguishable from the other leads;		N/A
	d) The line conductor or the connection of the line conductor shall be easily distinguishable from the other connections, for example, adjacent marking letter "L";		N/A
	e) The terminal for the connection of the equipment grounding terminal, shall be identified by:		N/A
	1) A green colored terminal hexagonal screw, hexagonal nut, or a green colored pressure wire connector;		N/A
	2) The marking "G", "GND", or "GROUND" at or near the grounding terminal; or		N/A
	3) The grounding symbol illustrated in Figure 70.1, on or adjacent to the terminal.		N/A
	f) If the wiring compartment attains a temperature above 60°C (140°F) during normal operation, the unit shall be marked near the point at which the supply connections are made with the minimum temperature rating of the conductors that must be used; and		N/A
	g) The tightening torque, if applicable for wiring terminals.		N/A
70.2	A permanently connected unit that exceeds the surface temperature limits specified in Table 33.1 for either metallic or nonmetallic surfaces shall be legibly marked where readily visible after installation with the signal word of 52.1 and the following or the equivalent: "HOT SURFACES – Risk of Burns – Do not touch." 70.2 added May 30, 2014		N/A
71	Installation Instructions		N/A
71.1	In addition to the instructions specified in this Standard, a permanently connected power unit shall be provided with the instructions specified in this Section.		N/A
71.2	The instruction manual shall include the following:		N/A
	a) Information identifying the procedure for connection to the supply;		N/A
	b) Number of conductors;		N/A
	c) Branch circuit size;		N/A
	d) Tightening torque;		N/A



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Clause	Requirement – Test	Measuring result – Remark	Verdict
	e) Range of conductor sizes;		N/A
	f) Minimum temperature rating of the conductor; and		N/A
	g) The following or equivalent text: "A disconnect device shall be incorporated in the field wiring."		N/A
71.3	The installation instructions shall also make reference indicating installation work and electrical wiring of permanently-connected power units shall be performed only by qualified service personnel in accordance with all applicable codes and standards, including fire-rated construction.		N/A



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Clause	Requirement – Test	Measuring result – Remark	Verdict
PERMANENTLY-CONNECTED UNITS FOR INSTALLATION IN AN OUTLET BOX			N/A
71A	General		N/A
71B	Construction		N/A
71B.1	An outlet box power unit shall be provided with a suitable flush device cover plate or outlet box cover that complies with the applicable requirements of the Standard for Cover Plates for Flush-Mounted Wiring Devices, UL 514D.		N/A
	Exception: A unit need not be provided with a cover plate or box cover if all the following conditions are met:		N/A
	a) The unit is intended for use with a cover plate having dimensions that comply with the Standard for Wiring Devices - Dimensional Specifications, ANSI/NEMA WD6, for features intended to accommodate a flush-mounted wiring device of the dimensions specified in ANSI/ NEMA WD6;		N/A
	b) Markings specified in Section 71H, Markings, are visible after installation using a cover plate having dimensions specified in (a); and		N/A
	c) No cover plate modifications are needed in order to comply with this Standard. 71B.1 revised October 11, 2013		N/A
71B.2	The output connectors shall be insulated and extend beyond the plane of the power unit mounting yoke. 71B.2 added April 26, 2013		N/A
71C	Polymeric Enclosures		N/A
71C.1	A polymeric material used to enclose the power unit circuitry shall have a flame rating not less than 5V, in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, or comply with the 127 mm Flame Test specified in the Standard for Polymeric Material - Use in Electrical Equipment Evaluations, UL 746C. 71C.1 added April 26, 2013		N/A
71D	Spacings		N/A
71D.1	A power unit shall be constructed such that, after installation, a minimum of a 1/4 inch (6.35 mm) separation can be maintained between branch circuit wiring and circuitry associated with any Class 2 output. Compliance is checked by measurement and if necessary, by conducting the Assembly Test in 71E.2. 71D.1 added April 26, 2013		N/A
71D.2	A power unit shall provide clearance of 3/64 inch (1.2 mm) between each input terminal and the metal of a standard outlet box of the minimum size in which it is intended to be installed. Compliance is checked by conducting the		N/A



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	Assembly Test in 71E.2. 71D.2 added April 26, 2013		
71E	Performance		N/A
71E.1	General		N/A
71E.2	Assembly test		N/A
71E.2.1	A power unit shall:		N/A
	a) Maintain a minimum of a 1/4 inch (6.35 mm) separation of branch circuit wiring and circuitry associated with any Class 2 output;		N/A
	b) Maintain adequate clearance between each input terminal and the metal of a standard outlet box of the minimum size in which it is intended to be installed; and		N/A
	c) Not permit contact to be made between the probe shown in Figure 71E.1 and any live part through the output connectors or through any flush device cover plate or outlet box cover opening or joint surrounding the installed power unit. 71E.2.1 added April 26, 2013		N/A
71F	Installation Instructions		N/A
71F.1	A power unit shall be provided with installation instructions. These instructions shall be provided with each individual device and contain the following information:		N/A
	a) The dimensions of the intended outlet box necessary to mount and secure the power unit; and		N/A
	b) The largest branch circuit conductor size in AWG the device will accommodate. 71F.1 added April 26, 2013		N/A
71F.2	Instructions shall include information to alert the user that a single branch circuit shall supply the device. The instructions shall include a pictorial or photograph illustrating proper installation and wiring method of conductors. 71F.2 added April 26, 2013		N/A
71G	User Instructions		N/A
71G.1	Each smallest unit packaging shall include user instructions with information regarding:		N/A
	a) The use of appropriate Class 2 connectors with interconnecting cables; and		N/A
	b) That Class 2 output connections are not intended for supporting products or appliances. 71G.1 added April 26, 2013		N/A
71H	Markings		N/A
71H.1	The output connectors shall be identified as being Class 2 and marked with the output		N/A



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	electrical rating. The output electrical rating shall be permanently marked and visible after installation of the flush device cover plate or outlet box cover. 71H.1 added April 26, 2013		



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Clause	Requirement – Test	Measuring result – Remark	Verdict
POWER UNITS FOR INSTALLATION IN AIR-HANDLING SPACES			
72	General		N/A
72.1	The requirements in Sections 72 and 73 apply to a power unit intended for installation in air handling spaces, such as above suspended ceilings or below floors.		N/A
72.2	A power unit shall be a permanently connected type for input and output connections.		N/A
72.3	A power unit shall not employ an integral battery.		N/A
72.4	A power unit shall comply with the Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces, UL 2043. 72.4 revised October 11, 2013		N/A
73	Marking		N/A
73.1	A power unit may be marked as follows: "Suitable for use in other environmental air space in accordance with Section 300.22(C) of the National Electrical Code" or "Suitable for use in air-handling spaces."		N/A



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Clause	Requirement – Test	Measuring result – Remark	Verdict
POWER UNITS SUPPLIED FROM INFORMATION TECHNOLOGY EQUIPMENT DATA PORTS			N/A
74	General		N/A
74.1	These requirements apply to a power unit with a direct current input jack for being powered from a data port associated with information technology equipment. These requirements supplement and modify the requirements of Sections 3 – 54.		N/A
75	Glossary		N/A
76	Supply Connections		N/A
76.1	A unit shall be provided with a maximum 10 ft (3.05 m) length of cable for interconnection to the ITE. The cable shall be stranded conductors having insulation not less than 0.013 inch (0.33 mm) thick, and shall terminate in a data port connector.		N/A
76.2	With respect to 76.1, for units with jacketed multi-conductor cable for interconnection to the ITE, the individual conductor insulation may be less than 0.013 inch (0.33 mm) provided that the thickness of the individual conductor insulation plus the thickness of the jacket is not less than 0.013 inch (0.33 mm).		N/A
77	Enclosure		
77.1	When applying the requirements of Section 8, Enclosure, and the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, it shall be anticipated that the ITE supply source has a capacity of 8 amperes and 100 volt-amperes.		N/A
78	Performance		N/A
78.1	General		N/A
78.1.1	If a unit may be operated from more than one source of supply simultaneously, the unit shall comply with the following requirements when connected to the sources of supply individually and collectively:		N/A
	a) Section 28, Maximum Output Voltage Test;		N/A
	b) Section 30, Output Current and Power Test;		N/A
	c) Section 33, Normal Temperature Test;		N/A
	d) Section 39, Abnormal Tests;		N/A
	e) 39.2, Output Loading;		N/A
	f) 39.4, Transformer Burnout;		N/A
	g) 39.5, Reverse Polarity;		N/A
	h) 39.6, Switch Position;		N/A
	i) 39.7, Component Breakdown;		N/A



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Clause	Requirement – Test	Measuring result – Remark	Verdict
	j) 39.9, Backfeed Protection; and		N/A
	k) 78.2, Abnormal Temperature Test.		N/A
78.2	Abnormal temperature test		N/A
78.2.1	A unit shall not emit flame or molten metal or become a risk of fire or electric shock (see 39.1.2) when subjected to the test in 78.2.2.		N/A
78.3	Strain relief test		N/A
78.3.1	An attached input cable for interconnection to the ITE is to withstand a 20 pounds-force (89 N) applied for 1 minute so that the strain relief means is stressed from the most severe angle that the construction permits. The results are acceptable if, with the input wiring connected internally, movement of the cable does not result in:		N/A
	a) A reduction of electrical spacings to primary and dead metal parts;		N/A
	b) Damage to the transformer or enclosure; or		N/A
	c) Interruption of the input wiring.		N/A
79	Markings		N/A
79.1	The input intended for connection to ITE shall be marked with its rated input voltage, “dc” and rated input current, wattage or volt-amperes.		N/A
79.2	The unit shall be marked “CAUTION – Risk of Injury and Fire” and one of the following or equivalent:		N/A
	a) “Connect only to equipment specified in the instructions” (see 80.1); or		N/A
	b) “Connect only to [type] certified to meet the Standard for Information Technology Equipment Safety – Part 1: General Requirements, UL 60950-1.”		N/A
	The [type] shall be filled in with the type of ITE to which it may be connected which complies with the Standard for Information Technology Equipment Safety – Part 1: General Requirements, UL 60950-1 (for example “a data port on equipment”).		N/A
80	Instructions		N/A
80.1	The instructions shall state “CAUTION – Risk of Injury and Fire.” The statement shall be followed by instructions specifying the type of ITE to which it may be connected which complies with the Standard for Information Technology Equipment Safety – Part 1: General Requirements, UL 60950-1. For example, the instruction may state “Connect only to a data port on equipment certified to meet the Standard for Information Technology Equipment Safety – Part 1: General		N/A



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Clause	Requirement – Test	Measuring result – Remark	Verdict
	Requirements, UL 60950-1.”		
	Exception: The instruction is not required for a unit marked in accordance with 79.2(b).		



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Clause	Requirement – Test	Measuring result – Remark	Verdict
FLUSH DEVICE COVER PLATES WITH INTEGRAL POWER SUPPLY			N/A
81	General		N/A
81.1	The requirements in Sections 81 – 89 apply to a flush device cover plate with integral power supply with Class 2 output connector(s) with or without a night light. These devices shall comply with the applicable requirements of this Standard except as modified by the requirements in Sections 81 – 89. 81.1 added December 12, 2014		N/A
81.2	These requirements are applicable to flush-type, parallel blade construction of the ANSI/NEMA 1-15R or 5-15R configurations only. These requirements do not cover products incorporating a flush device cover plate with connection means other than plug blades. 81.2 added December 12, 2014		N/A
81.3	These requirements are applicable only to non-metallic flush device cover plates that are intended for indoor use only. 81.3 added December 12, 2014		N/A
82	Construction		N/A
82.1	In addition to the construction, performance, and marking requirements contained in this Standard, a flush device cover plate with integral power supply with one or more Class 2 output low-voltage connectors with or without a night light shall comply with the applicable requirements of the Standard for Cover Plates for Flush-Mounted Wiring Devices, UL 514D. 82.1 added December 12, 2014		N/A
82.2	The flush device cover plate profile shall not hinder the complete seating of an attachment plug of the type intended for use with the receptacle. 82.2 added December 12, 2014		N/A
82.3	A flush device cover plate with integral power supply with one or more Class 2 output low-voltage connectors with a night light shall also comply with the applicable requirements of the Standard for Direct Plug-In Nightlights, UL 1786. 82.3 added December 12, 2014		N/A
82.4	The Class 2 low-voltage output connectors of a flush device cover plate with integral power supply with one or more Class 2 output low-voltage connectors with or without a night light shall be insulated and extend beyond the plane of the receptacle mounting yoke and be accessible when the cover plate is installed as intended. 82.4 added December 12, 2014		N/A
82.5	The Class 2 low-voltage power supply shall be configured for supply from a single branch circuit receptacle.		N/A



UL 1310			
Clause	Requirement – Test	Measuring result – Remark	Verdict
	82.5 added December 12, 2014		
82.6	A flush device cover plate with integral power supply with one or more Class 2 output low-voltage connectors with or without a night light intended for installation requiring the removal of a receptacle cover plate shall comply with the following:		N/A
	a) The device shall be able to be fully inserted in the outlets; and		N/A
	b) The device shall be able to be fully seated against the wall such that the outlet box opening in the wall is completely covered. 82.6 added December 12, 2014		N/A
83	Polymeric Enclosures		N/A
83.1	In addition to the insulating material requirements of the Standard for Cover Plates for Flush-Mounted Wiring Devices, UL 514D, a polymeric material used to enclose the power unit circuitry shall have a flame rating not less than 5V, in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, or comply with the 127 mm Flame Test specified in the Standard for Polymeric Material – Use in Electrical Equipment Evaluations, UL 746C. 83.1 added December 12, 2014		N/A
84	Spacings		N/A
84.1	A flush device cover plate with integral power supply with one or more Class 2 output low-voltage connectors shall maintain a minimum of a 1/4 inch (6.35 mm) separation of branch circuit wiring and Class 2 connections after installation. Compliance shall be determined by measurement and if required, the Assembly Test in Section 87. 84.1 added December 12, 2014		N/A
84.2	Class 2 output low-voltage connectors shall be located as to prevent a line blade of an attachment plug from being improperly inserted into the Class 2 output low-voltage connector (i.e. USB) slot and the line contacts of a receptacle. Compliance shall be determined by inspection and if required, the Assembly Test in Section 87. 84.2 added December 12, 2014		N/A
85	Configurations		N/A
85.1	The device shall comply with the cover plate dimensions as specified in Wiring Devices – Dimensional Specifications, NEMA WD 6, intended to accommodate the intended flush-mounted wiring device. 85.1 added December 12, 2014		N/A



UL 1310			
Clause	Requirement – Test	Measuring result – Remark	Verdict
85.2	The blade portion of the device shall comply with the NEMA 1-15P or 5-15P blade dimensions specified in Wiring Devices – Dimensional Specifications, NEMA WD 6. 85.2 added December 12, 2014		N/A
86	Class 2 Output Power Supply Testing		N/A
87	Assembly Test		N/A
87.1	A flush device cover plate with integral power supply with one or more Class 2 output low-voltage connectors with or without a night light shall comply with all of the following:		N/A
	a) Maintain a minimum of a 1/4 inch (6.35 mm) separation of branch circuit wiring and Class 2 connections;		N/A
	b) Not permit contact to be made between the probes shown in Figure 16.1, Figure 16.2, or Figure 16.4 and any live part through the Class 2 output connectors or through any opening or joint surrounding the installed device; and		N/A
	c) Not permit contact to be made between the Class 2 output connector and receptacle line contacts with a NEMA 1-15P attachment plug. 87.1 added December 12, 2014		N/A
88	Installation Instructions		N/A
88.1	Installation instructions shall appear on the device, on the smallest unit container, or on a separate instruction sheet provided with each device. If the installation instructions are provided on the smallest unit container or on a separate sheet, they shall be attached to the device in such a manner that they are unable to become detached during normal conditions of handling and storage prior to initial installation or usage. The use of an individual carton, blister pack, or equivalent securing of the device to the instructions, meets the intent of the requirement. However, friction attachment shall not be employed. 88.1 added December 12, 2014		N/A
88.2	A device intended for installation with receptacle cover plate or cover plate screw removed shall be provided with detailed installation instructions to enable proper installation of the device with the cover plate removed. The inclusion of a pictorial representation is optional. 88.2 added December 12, 2014		N/A
88.3	A device intended for installation over receptacle cover plates of specific dimensions shall be provided with installation instructions that describe the maximum overall dimensions of the receptacle cover plate with which the device is intended to be used.		N/A



UL 1310			
Clause	Requirement – Test	Measuring result – Remark	Verdict
	88.3 added December 12, 2014		
88.4	A device having blade spacing not in accordance with the Standard for Current Taps and Adapters, UL 498A, Figure 9.1 – Blade and Contact Spacing, shall be provided with installation instructions that specify, by catalog number or equivalent designation, the receptacles with which the device is to be used. 88.4 added December 12, 2014		N/A
88.5	Instructions shall include information to alert the user that a single branch circuit shall supply the device. The instructions shall include a pictorial or photograph illustrating proper installation. 88.5 added December 12, 2014		N/A
89	Markings		N/A
89.1	The output Class 2 connectors shall be marked as being “Class 2” and marked with the output electrical rating. These markings shall be permanently marked and visible after installation. 89.1 added December 12, 2014		N/A

APPENDIX A	N/A
Standards for Components	N/A



TABLE: list of critical components					P
object/part No.	manufacturer/ trademark	type/model	technical data	standard	mark(s) of conformit y
Power Plug	Various	Various	6A, 250VAC	UL	UL
Power cord	Various	Various	2 x 0.5mm ²	UL	UL
Plastic enclosure	Chi Mei Corporation Ltd	PA-765(+)	V-0, 125°C	UL 94	UL
PCB	Various	Various	Min 130°C, V-0	UL 94	UL
Primary lead wire	Shenzhen Eastwin Technology Co Ltd	1007	300V, 80°C, 24AWG	UL 758	UL
Fuse (F1)	Various	Various	250V/1A	UL 248-1	UL
Optocoupler (U4)	Everlight Electronics Co Ltd	EL817	DTi ≥ 0.4mm	UL 1577	UL
(Alt.)	Lite-on Technology Corporation	LTV-817	DTi ≥ 0.4mm	UL 1577	UL
Transformer (T1)	DongGuan FuKeSiDianZiSheBe i YouXianGongSi	JF09-6A	130°C, Class B	UL 1310	Test in appliance
-Bobbin	Sumitomo Bakelite Co.,Ltd	PM-9820	155°C	UL 94	UL
(Alt.)	Ei Dupont De Nemours&Co Inc UI	FR530	155°C	UL 94	UL
-Magnet wire	Pacific Electric Wire&Cable(Shenzh en) Co.,Ltd	MW75-C	130°C	UL 1446	UL
-Triple insulation wire	Furukawa Electric Co Ltd	TEX-E	130°C	UL 2353	UL
-Insulation tape	3m Company Electrical Markets Div	1350F-1(b)	130°C	UL 510	UL
-Teflon tube	Great Holding Industrial Co.,Ltd	TFS, TFT	125°C, min. 300V	UL 94	UL
-Varnish	Elantas Elec Trical Insulat10n Elanta Pdg Inc	468-2(x)	155°C	UL 1446	UL
Transformer (T1) (alternative)	DongGuan FuKeSiDianZiSheBe i YouXianGongSi	JF03-8A	130°C, Class B	UL 1310	UL
-Bobbin	Chang Chun	T373J	150°C	UL 94	UL
-Magnet wire	Bondtec Pacific	2UEW	130°C	UL 1446	UL
-Triple insulation wire	Furukawa Electric Co Ltd	TEX-E	130°C	UL 2353	UL
-Insulation tape	Jingjiang Yahua Pressure Sensitive Glue Co.,Ltd	CT-280B	130°C	UL 510	UL
-Teflon tube	Great Holding Industrial Co Ltd	TFS, TFT	125°C, min. 300V	UL 510	UL



-Varnish	Elantas	V1630FS	155°C	UL 1446	
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25.1	TABLE: Ball pressure test				P
Part	Test temperature (°C)		Impression diameter (mm)	Allowed impression diameter (mm)	
PCB	125		0.9	2.0	

26	TABLE: Leakage current test								P
		Measured Leakage Current, mA							
Condition	Switch S1	Switch 2 Position 1				Switch 2 Position 2			
		(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)
As Received	Open	0.01	0.21	0.01	-	0.01	0.21	0.01	-
	Closed								
	0-5 s	0.01	0.14	0.01	-	0.01	0.14	0.01	-
	5 s - 10 min	0.01	0.14	0.01	-	0.01	0.14	0.01	-
	10 min - thermal stability	0.01	0.14	0.01	-	0.01	0.14	0.01	-
	Limit	0.50	0.50	0.50	-	0.50	0.50	0.50	-
Humidity Conditioned (90% RH, 32°C, 48h)	Open	0.01	0.21	0.01	-	0.01	0.21	0.01	-
	Closed								
	0-5 s	0.01	0.14	0.01	-	0.01	0.14	0.01	-
	5 s - 10 min	0.01	0.14	0.01	-	0.01	0.14	0.01	-
	10 min - thermal stability	0.01	0.14	0.01	-	0.01	0.14	0.01	-
	Limit	0.50	0.50	0.50	-	0.50	0.50	0.50	-
Supplementary information:									
(a) Between exposed conductive surfaces and the grounded pole of the supply circuit.									
(b) Between output circuits and the grounded pole of the supply circuit.									
(c) Between output circuits and exposed conductive surfaces.									
(d) With output circuits conductively connected to exposed conductive surfaces, between output circuits/exposed conductive surfaces and the grounded pole of the supply circuit.									

33	TABLE: Normal Temperature Test				P
	Type reference..... :		See below		—
	Mounting position..... :		See below		—
	Test voltage..... :		100V or 240V		—
maximum temperature rise dT of part/at:		Measured temperature rise (K)			Limit (K)
Test condition		1	2	3	-
Power cord		8.7	7.6	6.5	40



PCB near U1	22.1	20.9	19.8	90			
E-cap(C1)	29.8	28.7	26.9	65			
PCB near Q3	32.6	35.7	31.2	90			
Transformer winding	51.2	50.2	42.5	65			
Transformer core	49.7	50.7	42.3	Ref.			
PCB near C5	26.1	26.0	24.2	65			
Output wire	13.3	14.1	20.2	40			
Enclosure inside above transformer	23.5	23.1	21.2	Ref.			
Enclosure inside under transformer	24.2	23.5	20.0	Ref.			
Enclosure outside above transformer	16.1	15.6	14.9	35			
Enclosure outside under transformer	13.2	12.1	11.7	35			
Ambient	40.0°C	40.0°C	40.0°C	-			
Supplementary information: Test condition: 1: 100V, horizontal position; 2: 100V, vertical position; 3: 240V, vertical position.							
Temperature T of winding:	t ₁ (°C)	R ₁ (Ω)	t ₂ (°C)	R ₂ (Ω)	dT (°C)	Allowed T _{max} (°C)	Insulation class
-	-	-	-	-	-	-	-
Supplementary information:							

34	TABLE: Dielectric Voltage Withstand Test		P
test voltage applied between parts:		Test voltage (V) a.c. / d.c. Duration: 1min.	breakdown Yes / No
Primary circuits and exposed conductive enclosure		1480 VAC	No
Primary circuits and secondary circuits		1480 VAC	No
Exposed conductive enclosure and output terminal (+)		500 VAC	No
Exposed conductive enclosure and output terminal (-)		500 VAC	No
Primary and secondary of transformer T1		1480 VAC	No
Supplementary information:			

39.6	TABLE: Component Breakdown Test	P
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Test component	Fault Condition	Observation	Maximum output		
			V	A	W
Output	OL	Max. output loading was 5.1A, when over 5.2A, unit shutdown, no damage, no hazards. Max. temperature rise at: transformer winding: 35.4K; Accessible enclosure: 19.5K; ambient:	15.5	5.1	79.05



		24.2°C.			
Output	SC	Unit shutdown and recoverable, no damage, no hazard.	0	0	0
*BD1 pin1-2	SC	F1 opened immediately, no hazard.	0	0	0
*C1	SC	F1 opened immediately, no hazard.	0	0	0
U1 PIN1-8	SC	Unit shutdown and recoverable, no hazard	0	0	0
U1 PIN2-8	SC	Unit shutdown and recoverable, no damage, no hazard.	0	0	0
*U1 PIN5-8	SC	F1 opened immediately, no hazard.	0	0	0
*U1 PIN3-5	SC	F1 opened immediately, no hazard.	0	0	0
U4 PIN1-2	SC	Unit shutdown and recoverable, no damage, no hazard.	0	0	0
T1 PIN1-3	SC	Unit shutdown and recoverable, no damage, no hazard.	0	0	0
T1 PIN4-5	SC	Unit shutdown and recoverable, no damage, no hazard.	0	0	0
T1 PIN6-7	SC	Unit shutdown and recoverable, no damage, no hazard.	0	0	0
D3	SC	Unit shutdown and recoverable, no damage, no hazard.	0	0	0
Supplementary information SC=Short circuit; OL=overload. *: denoted that each alternate source of current fuse was repeated totally 3 times and the same result were obtained.					

50.2	TABLE: Normal Input Test				P
Model	Measured Input			Marked Rated Input (A)	Input Current Deviation
	V	A	W		
FBC1205D	100V/50Hz	0.748	74.8	0.75	-0.27%
FBC1205D	100V/60Hz	0.748	74.8	0.75	-0.27%
FBC1205D	240V/50Hz	0.31	74.7	0.75	-0.40%
FBC1205D	240V/60Hz	0.311	74.7	0.75	-0.40%
Remark: The rated input current shall be at least 90% of the value which occurs under rated load conditions when temperatures stabilize.					

Attachment – Photo Documentation

Fig.1



Fig.2



Fig.3



Fig.4



Fig.5

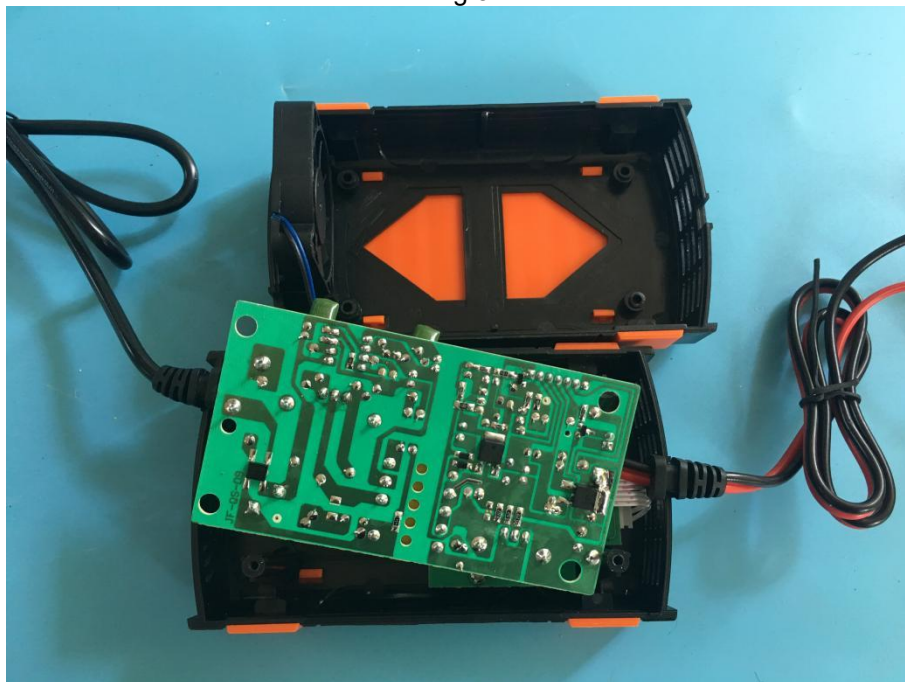


Fig.6

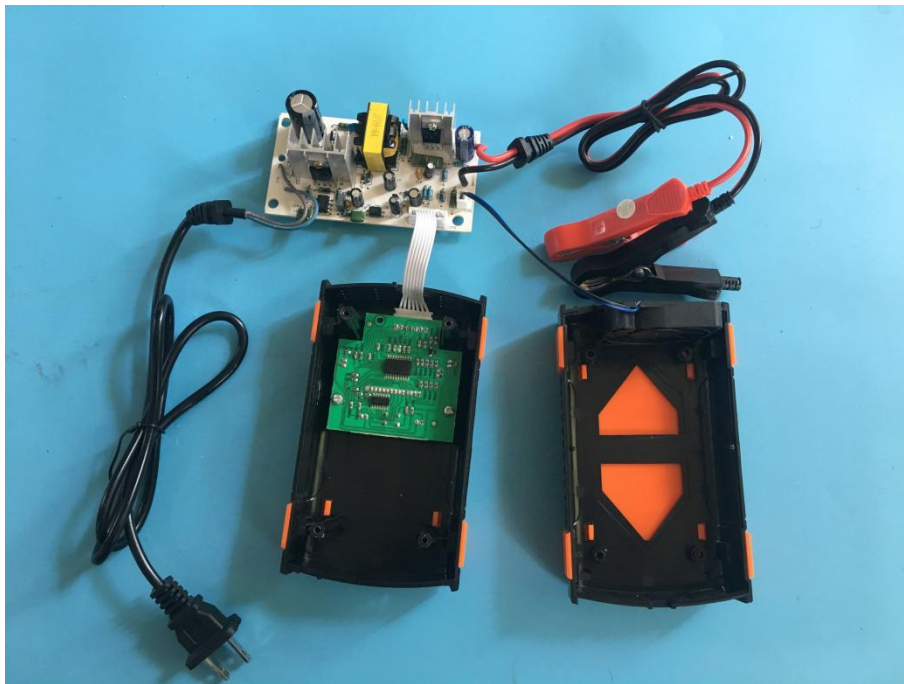


Fig.7

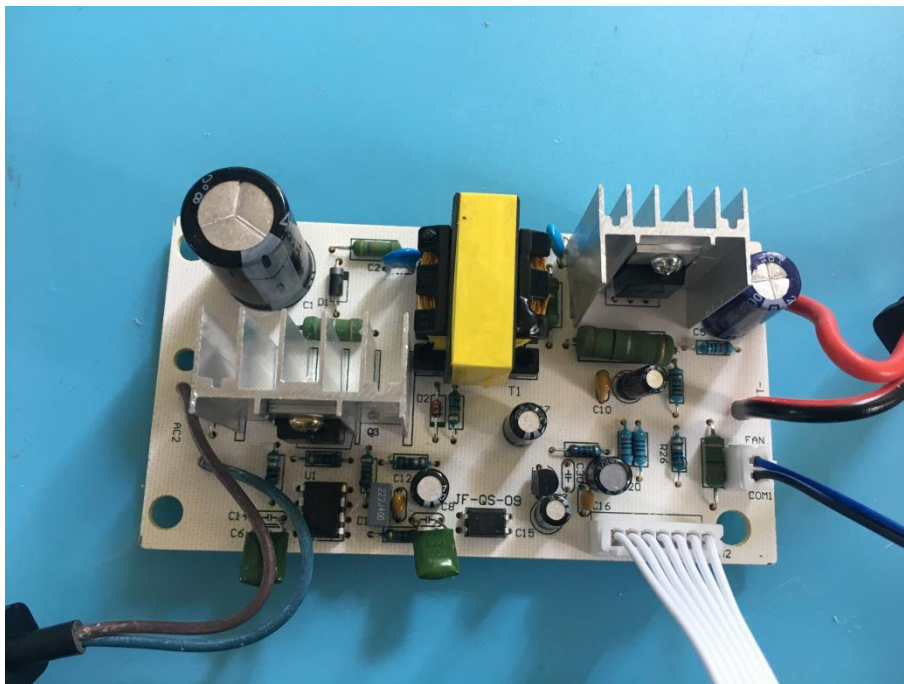


Fig.8

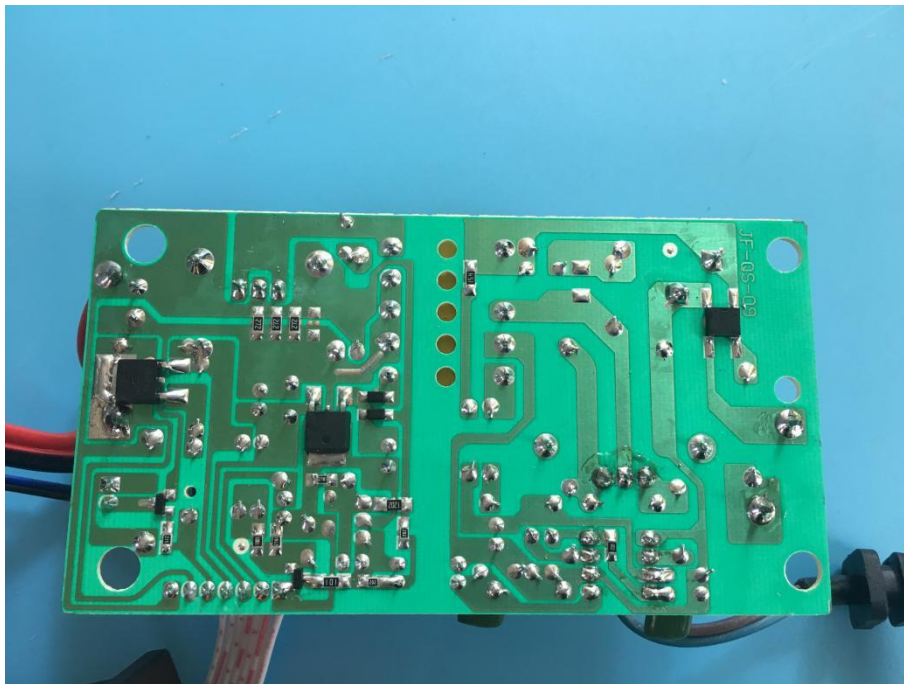


Fig.9

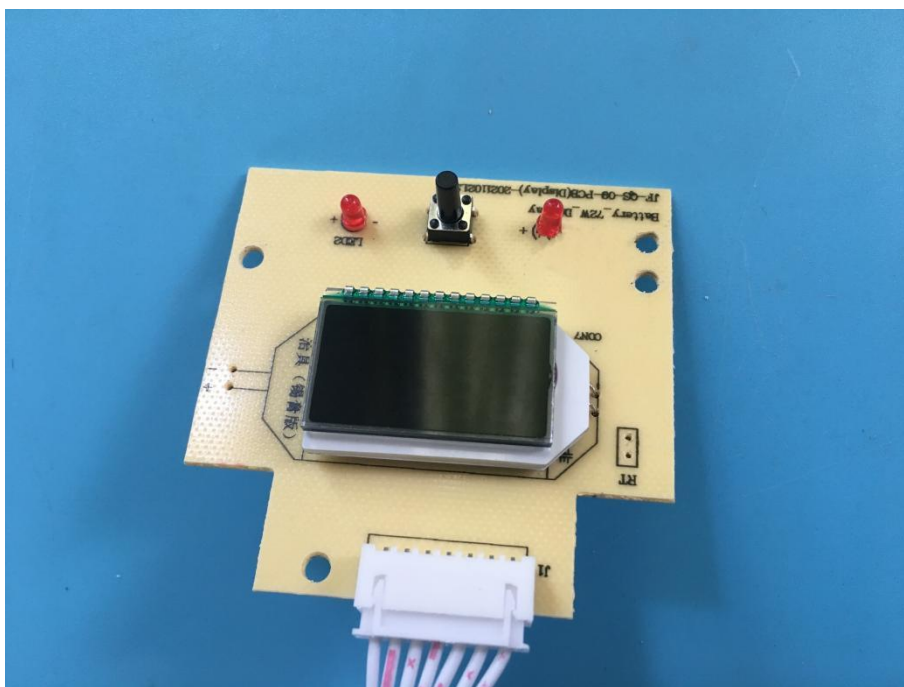


Fig.10

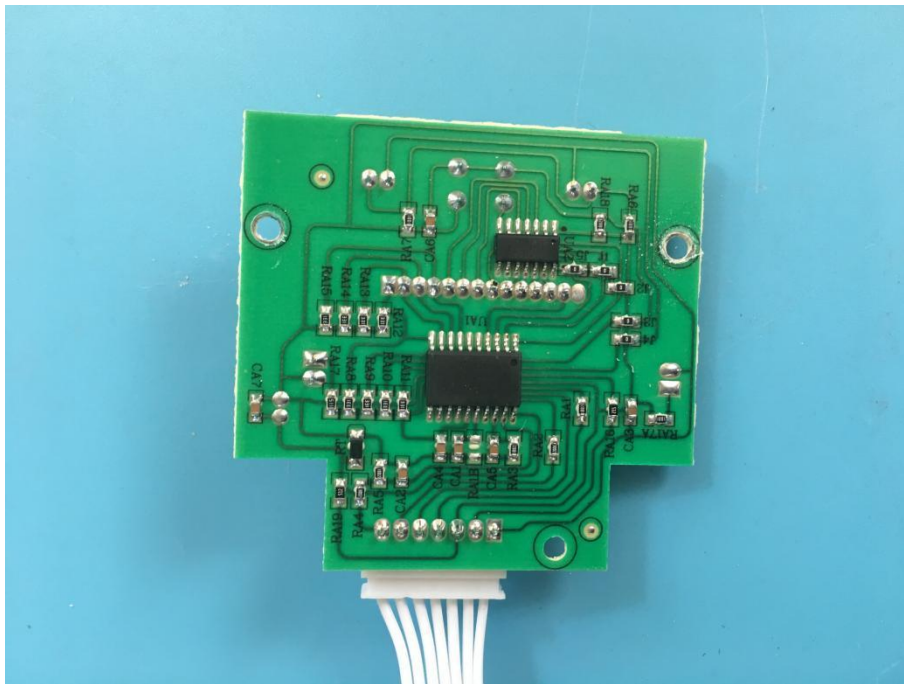


Fig.11

****END OF THE REPORT****