TEST REPORT

UL 2743

Portable Power Packs

Report Number.	HK2201220106-SR
Date of issue	2022-04-20
Total number of pages	65 pages
Testing Laboratory	Shenzhen HUAK Testing Technology Co., Ltd.
Testing location	1-2/F., Building B2, Junfeng Zhongcheng Zhizao Innovation Park, Heping, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China
Applicant's Name	RENOGY New Energy Co., Ltd.
Address	Room 624-625, Taicang German Overseas Students Pioneer Park, 66 Ningbo East Road, Taicang Economic Development Zone, China
Test specification	
Standards	UL 2743:2020
Test procedure	Verification report
Non-standard test method	N/A
Test Report Form No	UL2743A
TRF originator	HUAK
Master TRF	Dated 2021-06
General disclaimer:	
The test results presented in this report relate only to the object tested.	
Test item description	LITHIUM IRON PHOSPHATE DEEP CYCLE BATTERY
Trademark	N/A
Manufacturer	RENOGY New Energy Co., Ltd.
Address	Room 624-625, Taicang German Overseas Students Pioneer Park, 66 Ningbo East Road, Taicang Economic Development Zone, China
Model and/or type reference	DBT12100LFP-SA
Rating(s)	Input: 12.8VDC, 50A Output: 12.8VDC, 100A

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Testing procedure and testing location:			
☒	**Testing Laboratory:**	Shenzhen HUAK Testing Technology Co., Ltd.	
Testing location/ address .....:		1-2/F., Building B2, Junfeng Zhongcheng Zhizao Innovation Park, Heping, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China	
☐	**Associated Testing Laboratory:**		
Testing location/ address .....:			
Tested by (name + signature).....:		Paco Zhang	Paco zhang
Approved by (name + signature).....:		Dendi Wei	Dendi Wei
☐	**Testing procedure: TMP/CTF Stage 1:**		
Testing location/ address .....:			
Tested by (name + signature).....:			
Approved by (name + signature).....:			
☐	**Testing procedure: WMT/CTF Stage 2:**		
Testing location/ address .....:			
Tested by (name + signature).....:			
Witnessed by (name + signature) .....:			
Approved by (name + signature).....:			
☐	**Testing procedure: SMT/CTF Stage 3 or 4:**		
Testing location/ address .....:			
Tested by (name + signature).....:			
Witnessed by (name + signature) .....:			
Approved by (name + signature).....:			
Supervised by (name + signature).....:			

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Copy of marking plate:

LITHIUM IRON PHOSPHATE DEEP CYCLE BATTERY
Model: DBT12100LFP-SA
Input: 12.8VDC, 50A
Output: 12.8VDC, 100A
Capacity: 12.8VDC, 100Ah, 1280Wh
Charging temperature range: 0°C~50°C,
Discharge temperature range: -10°C~60°C
RENOGY New Energy Co., Ltd.
Made in China
YYMM

Note:
-The marking of signal words “CAUTION”, “WARNING” and “DANGER” shall be in letters not less than 2.4mm (3/32 inch) high.

“YYMM” means the manufacture date Year and Month.

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Summary of testing:

The tested model was complied with the test standard UL 2743: 2020.

The report is only evaluated the device intended to use in non-hazard location. Additional evaluation relating to hazard location shall be considered according to National Electrical Codewhen fire or explosion hazardsmay exist due to the accumulation of combustible dustsunder abnormal operating conditions.

Particulars: test item vs. test requirements:

Equipment mobility	:	LITHIUM IRON PHOSPHATE DEEP CYCLE BATTERY
Operating condition	:	Continuous
Mass of equipment (kg)	:	12.1

Test case verdicts

Test case does not apply to the test object	:	N/A
Test item does meet the requirement	:	P(ass)
Test item does not meet the requirement	:	F(ail)

Testing

Date of receipt of test item	:	2022-03-21
Date(s) of performance of test	:	2022-03-21 to 2022-04-20

General remarks

The test result presented in this report relate only to the object(s) tested.
This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.
”(see Enclosure #)" refers to additional information appended to the report.
"(see appended table)" refers to a table appended to the report.
Throughout this report a point is used as the decimal separator.

General product information:

This product is LITHIUM IRON PHOSPHATE DEEP CYCLE BATTERY for normal used.

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
1	**Scope**		
1.1	These requirements cover portable and movable power packs provided with one or more batteries, electrochemical capacitors, or electrochemical capacitor modules. If provided with a battery, the battery shall be either a lead acid or lithium ion battery. The power packs are provided with one or more inputs and one or more outputs. For power packs provided with a booster function, the power packs are used for providing a temporary power source to a depleted land vehicle battery, rated 24 V dc maximum, to provide emergency starting power.		P
1.2	These requirements cover power packs suitable for outdoor use, temporary outdoor use, or indoor use only. Outdoor use packs are intended to be used outdoors with no restrictions. Temporary outdoor use packs are intended to be used outdoors in limited wet conditions and always stored indoors. Indoor use only packs are intended to be stored indoors and used indoors and are not intended to be used outdoors at any time. A power pack with a booster function is not considered indoor use only under any conditions.	Indoor and outdoor use	P
1.3	These requirements cover power packs provided with additional systems such as an air compressor (tankless type) for inflating tires or other inflatable items, or with a light to act as warning lights to oncoming traffic, as a flashlight, or the like. These functions are also powered by the internal battery.		P
1.4	These requirements cover the power pack options such as lights, voltmeters, internal air compressor assemblies, associated gauges, inverters, vehicle adapters, and internal batteries, as well as the charging of the internal batteries, when these options are integral to the power pack.		P
1.5	These requirements do not cover wiring or cabling used in the recharging function of electric vehicle recharging equipment.		N/A
2	**Units of Measurement**		N/A
3	**Components**		N/A
4	**Referenced Publications**		N/A.
5	**Glossary**		N/A
	CONSTRUCTION		
6	**General**		P
6.1	If the operation and maintenance of a power pack by the user involves a risk of injury to persons, a risk of electric shock, or a risk of fire, means shall be provided to reduce the risk. When evaluating a power pack, consideration shall be given to reasonably foreseeable misuse of the product.		P
6.2	Power packs intended for use within a repair facility, and marked as such as indicated in 69.4, shall be provided with instructions containing the statement in 74.3 and shall be marked as shown in 70.18. Power packs that are not intended for use in a repair facility shall be marked in accordance with 70.19.	Notintended for use within a repair facility	N/A

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
6.3	Outdoor use power packs shall be evaluated for all environmental considerations addressed by this Standard and are intended to be used and stored either outdoors or indoors. Temporary outdoor use power packs shall be evaluated for exposure to rain, shall be marked in accordance with 70.19 and 70.20, and shall be provided with instructions in accordance with 74.5. Indoor use only power packs shall be marked in accordance with 70.21 and shall be provided with instructions in accordance with 74.6. Indoor use only packs need not comply with the environmental considerations in 7.5.		P
6.4	For power packs not marked in accordance with 70.22, the device shall be subjected to the Vibration Test, Section 51.		P
7	**Frame and Enclosure**		P
7.1	General		P
7.1.1	An enclosure of a power pack shall be formed and assembled so that it has the strength and rigidity necessary to resist the abuses to which it may be subjected, without increasing the 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.		P
7.1.2	A power pack shall be provided with an enclosure suitable for the application. The enclosure shall house all live parts that may increase the risk of fire, electric shock, or injury to persons under any condition of use. This requirement does not apply to the power supply cord, the output leads, or outputterminals.		P
7.1.3	If an electrical instrument, such as a meter, forms part of the enclosure, the face or the back of the meter, or both together, shall comply with the requirements for enclosures.		P
7.1.4	The enclosure for a power pack provided with an internal lead acid battery shall be ventilated to permit dispersion of gases from the internal battery during normal use and charging. See 7.4.		N/A
7.1.5	Enclosures for power packs shall comply with the requirements for environmental considerations in 7.5.		N/A
7.2	**Metallic enclosures**	No Metallic enclosures	N/A
7.2.1	Enclosures constructed of metallic materials shall be subjected to the Strength of Enclosure Tests, Section 55.		N/A
7.2.2	A metallic enclosure shall have a thickness not less than that specified in Tables 7.1 and 7.2		N/A
7.2.3	Metallic enclosures, if not constructed of a material that is corrosion resistant, shall be provided with corrosion protection in accordance with Corrosion Protection, Section 10.		N/A
7.3	Nonmetallic enclosures		P
7.3.1	In addition to the performance tests specified in this Standard, the factors to be considered when evaluating the suitability of a polymeric enclosure include the requirements in 7.3.2 through 7.3.4.		P
7.3.2	The enclosure material shall have a minimum flame rating of V-1 in accordance with 8.1.	V-0 material used	P

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
7.3.3	The enclosure material shall have a minimum Relative Thermal Index (RTI) value that exceeds the maximum temperature observed on the material during operation but no less than 80°C (176°F) for packs intended to be stored in the trunk or passenger compartment of a vehicle. If an RTI value that exceeds the maximum temperature observed on the material during operation, but is lower than 80°C (176°F), is used, the power pack shall be marked in accordance with 70.22 and provided with instructions as shown in 74.7.	RTI: 85°C	P
7.3.4	A conductive coating applied to a nonmetallic surface such as the inside surface of an enclosure, shall be evaluated in accordance with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, and Evaluation of Properties of Polymeric Materials, CAN/CSA C22.2 No. 0.17, 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.	No such coating	N/A
7.3.5	An adhesive used to secure parts of an enclosure shall comply with the requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, and Evaluation of Properties of Polymeric Materials, CAN/CSA C22.2 No. 0.17.	No such adhesive used	N/A
7.3.6	Enclosures of molded or formed nonmetallic materials shall be constructed so that any shrinkage or distortion of the material over time will not allow for the user to contact live parts at hazardous voltage or hazardous energy levels. Compliance is determined by the Mold Stress Test, Section 56.	Tested and complied	P
7.3.7	Enclosures constructed of nonmetallic materials shall be subjected to the Strength of Enclosur Tests, Section 55.	Tested and complied	P
7.4	Openings in enclosures	Indoor and outdoor use	P
7.4.1	Power pack enclosures shall not allow the entrance of water in accordance with 7.5		P
7.4.2	A probe as illustrated in Figure 7.1, when inserted through an opening, shall not touch any uninsulated live part that can cause electric shock	Test pin cannot touch any live part	P
7.4.3	Thermoplastic covering an opening for user servicing, such as replacement of a pilot lamp, and that reduces the risk of unintentional contact with a live part involving a risk of electric shock shall be evaluated as an enclosure It shall be reliably retained in place	No user servicing parts	N/A
7.4.4	An uninsulated live part at hazardous voltage or hazardous energy levels shall be located or enclosed so that protection against unintentional contact is provided.	No such parts	N/A
7.4.5	A door or cover that provides access to a live part at hazardous voltage or hazardous energy levels shall be securely held in place so that it can be opened or removed only by using a tool	Tested and complied	P

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
	Exception: A door or cover that provides access to a live part that is not at hazardous voltage or hazardous energy levels shall be securely held in place, but need not be secured so that it is necessary to use a tool to open or remove it		N/A
7.4.6	The door or cover of an enclosure shall be hinged or attached in an equivalent manner if it provides access to an overload-protective device, the functioning of which requires renewal, or if it is necessary to open the cover in connection with the operation of the protective device. A door or cover providing access to a fuseholder shall be tight-fitting and shall be positively held closed		N/A
	Exception: A hinged cover is not required if the only overload-protective devices enclosed are:		N/A
	a) Connected in control circuits, provided the protective devices and the circuit loads are within the same enclosure;		N/A
	b) Rated 2 amperes or less for loads not exceeding 100 volt-amperes;		N/A
	c) Extractor fuses having an integral enclosure; or		N/A
	d) Fuses connected in a low-voltage limited energy circuit.		N/A
7.4.7	The operating handle of a circuit breaker, an operating button of a manually operable protector, the capped portion of an extractor-type fuseholder, or a similar part may project outside the enclosure.	No such parts	N/A
7.5	Environmental considerations	Indoor and outdoor use	P
7.5.1	The enclosure of an outdoor use or temporary outdoor use power pack shall be constructed to exclude a beating rain in accordance with 7.5.2.		P
7.5.2	All outdoor use or temporary outdoor use power packs shall be subjected to the Rain Test, Section 60.	Tested and complied	P
7.5.3	A gasket employed in a power pack in order to comply with 7.5.1 shall be tested in accordance with Accelerated Aging of Gaskets, Sealing Compounds, and Adhesives, Section 62.		P
7.5.4	A nonmetallic enclosure for an outdoor use power pack shall be judged on the basis of the effect of exposure to ultraviolet light and water in accordance with the applicable tests in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, Evaluation of Properties of Polymeric Materials, CAN/CSA C22.2 No. 0.17. Temporary outdoor use power packs need not comply with this requirement.		P
8	**Flammability of materials**		P

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
8.1	Nonmetallic materials used for enclosures shall have a minimum flammability rating of V-1 in accordance with the requirements in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, and Evaluation of Properties of Polymeric Materials, CAN/CSA C22.2 No. 0.17. As an alternative, finished enclosures may be tested in accordance with the 20 mm end-product flame test in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, and Evaluation of Properties of Polymeric Materials, CAN/CSA C22.2 No. 0.17. Metallic materials used for enclosures are considered to comply without further evaluation, except magnesium shall not be used for enclosure materials.	V-0 Material	P
8.2	Nonmetallic materials used for internal parts within the overall enclosure shall be rated V-2 minimum	V-0 Material	P
	Exception No. 1: The internal insulating system of components where component requirements exist need not comply with this requirement		N/A
	Exception No. 2: A small part, gasket, or other nonmetallic part that is located such that it cannot propagate flame from one area to another within the equipment, and is not located in close proximity to uninsulated live parts, is not required to comply with this requirement		N/A
8.3	Nonmetallic materials located outside the enclosure, and not used to complete the enclosure, are considered decorative parts. These parts shall be rated HB minimum.		N/A
8.4	Printed wiring board materials shall be rated V-1 minimum.	V-0 PCB used	P
8.5	For the requirements outlined in 8.2 – 8.4, the flammability rating of the material shall be provided as part of the material rating or the flammability rating may be determined in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, and Evaluation of Properties of Polymeric Materials, CAN/CSA C22.2 No. 0.17.		P
9	**Assembly**		P
9.1	An uninsulated live part shall be secured to the base or surface so that it is prevented from rotating or shifting in position as the result of normal stresses, if such movement results in a reduction of spacings below the minimum values indicated in Spacings, Section 29.	No such uninsulated live part	N/A
9.2	A component such as a control switch, lampholder, or connector, shall be mounted securely and shall be prevented from turning by means other than friction between surfaces.		P
9.3	With reference to 9.2, a switch is not required to be mounted as described in 9.2, if all of the following conditions are met:		N/A
	a) The switch is a plunger or other type that does not tend to rotate when operated. A toggle switch is considered to be subject to forces that tend to turn the switch;		N/A

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UL 2743			
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	b) The means for mounting the switch makes it unlikely that operation of the switch will loosen it;		N/A
	c) Spacings are not reduced below the minimum values indicated in Spacings, Section 29, if the switch rotates; and		N/A
	d) Operation of the switch is by mechanical means rather than by direct contact by persons.		N/A
9.4	With reference to 9.2, a lampholder of the type in which the lamp cannot be replaced, such as a sealed neon pilot or indicator light, is not required to be mounted in accordance with 9.2, if rotation cannot reduce spacings below the minimum values indicated in Spacings, Section 29	No such parts	N/A
9.5	A small stem mounted device having a single hole mounting means may be prevented from rotating by a properly applied lock washer		N/A
10	**Corrosion protection**		P
11	**Supply connections**		P
11.1	General		P
11.1.1	Power packs are intended to be connected to the power supply circuit in order to recharge the internal battery, electrochemical capacitors, or electrochemical capacitor modules. Additionally, outputs of the power pack may be powered when the pack is connected to the supply circuit.		P
11.1.2	Power packs shall be provided with one or more of the following input options:	See below	P
	a) Cord and plug connection, rated at 240 V ac maximum, 60 Hz;		N/A
	b) Photovoltaic panel or device with inverter;		N/A
	c) Vehicle adapter, rated 12 V dc maximum;		N/A
	d) USB input port (can also act as output port); or		P
	e) Cables for charging from a vehicle battery rated up to 24 V dc maximum.		N/A
11.2	Flexible cord connection	Not flexible cord connection	N/A
11.2.1	General		N/A
11.2.1.1	For flexible cord connections, the power pack shall be connected to the power supply circuit by means of a flexible cord and an attachment plug. The flexible power cord shall be either a detachable or non-detachable type. For devices intended for use with a detachable cord set, the cord set need not be provided with the device when the power pack is marked in accordance with 70.17 and the instructions are in accordance with 73.2.		N/A

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
11.2.1.2	For power packs intended for use in a repair facility, a detachable flexible cord shall be provided with a means to insure that the flexible cord cannot be inadvertently detached during use		N/A
	Exception: A device intended for use in a repair facility that is provided with a means to insure that the appliance inlet on the device is inherently located at a height above 457 mm (18 inches) may also be provided with a detachable cord set without a means to insure inadvertent detachment, when the power pack is marked in accordance with 70.17 and the instructions are in accordance with 73.2.		N/A
11.2.1.3	A flexible cord shall have a voltage rating not less than the rated voltage of the equipment, and shall have an ampacity not less than the current rating of the equipment		N/A
11.2.1.4	The attachment plug shall have an ampacity not less than the rated current of the product or the actual current measured during the Power Input Test, Section 42, whichever is greater, and a voltage rating equal to the rated voltage of the product. If a product is adaptable for use on two or more different values of voltage by field alteration of internal connections, the attachment plug provided with the product shall be rated for the voltage for which the product is connected when leaving the factory		N/A
11.2.1.5	A flexible cord shall be Type G, SO, SJO, SJEO, SJTO, STO, or W, or a type at least equally serviceable for the particular application		N/A
11.2.1.6	The length of a flexible cord, including the attachment plug, shall not be less than 6 feet (1.8 m).		N/A
11.2.1.7	If a product incorporates a disconnecting means, such as an appliance inlet, the arrangement shall be such that no live parts will be exposed under any normal conditions		N/A
11.2.1.8	A permanently attached flexible cord shall exit the enclosure in an area that is not in close proximity to a hot spot or moving part		N/A
11.2.2	Strain Relief		N/A
11.2.2.1	Strain relief shall be provided on a non-detachable flexible cord to reduce the risk of mechanical stress being transmitted to terminals, splices, or interior wiring. See Strain Relief Test, Section 54. A knot in the flexible cord is not considered a form of strain relief.		N/A
11.2.2.2	A metal strain relief clamp or band provided in accordance with 11.2.2.1 shall be provided with auxiliary insulation over the cord if damage to the cord insulation results when the strain relief test is conducted without auxiliary insulation		N/A

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
11.2.2.3	Means shall be provided to prevent a flexible cord from being pushed into the equipment through the cord entry hole if such displacement would:		N/A
	a) Result in mechanical damage to the cord;		N/A
	b) Expose the cord to a temperature than that for which it is rated; or		N/A
	c) Reduce spacings, such as to a metal strain relief clamp, below the minimum values indicated in Spacings, Section 29.		N/A
	To determine compliance, the flexible cord shall be tested in accordance with the Push-Back Strain Relief Test, Section 54.2.		N/A
11.2.3	Bushings		N/A
11.2.3.1	At the point where a non-detachable flexible cord passes through an opening in the enclosure, there shall be a bushing or the equivalent that is secured in place, and that has a smooth, well rounded surface against which the cord may bear. An insulating bushing shall be provided, if the enclosure is of metal, or if the construction is such that the cord may be subjected to strain or motion. A bushing that complies with the applicable requirements in the Standard for Insulating Bushings, UL 635, is considered to comply with this requirement		N/A
11.2.3.2	A hole in porcelain, phenolic composition, or other non-conducting material, having a smooth, rounded surface, is considered to be equivalent to a bushing		N/A
11.2.3.3	A bushing of the same material as, and molded integrally with, a supply cord is acceptable if the built-up section is not less than 1/16 inch (1.6 mm) thick at the point where the flexible cord passes through the enclosure.		N/A
11.2.3.4	At a point of flexure, no additional flexible cords or wires shall be routed through a bushing or opening with the power supply cord.		N/A
11.3	External power supplies		P
11.3.1	As an alternative to flexible cord connections, the power pack may be provided with a DC voltage rated input connector intended for connection to the output of an external power supply		P

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Clause	Requirement – Test	Result – Remark	Verdict
11.3.2	The output rating of the external power supply shall be equal to or greater than the input rating of the power pack; and the output of the external power supply shall be a power source in accordance with the Standard for Information Technology Equipment – Safety – Part 1: General Requirements, UL 60950-1 and CAN/CSA C22.2 No. 60950-1, a Class 2 power source in accordance with the Standard for Class 2 Power Units, UL 1310, and Power Supplies With Extra Low Voltage Class 2 Outputs – General Instruction No. 1, CAN/CSA C22.2 No. 223, or a power source other than Class 2 in accordance with the Standard for Power Units Other Than Class 2, UL 1012, and CSA-C22.2 No. 107.2-01.	The output rating of the external power supply is equal to the input rating of the LITHIUM IRON PHOSPHATE DEEP CYCLE BATTERY	P
11.4	Vehicle adapters	No such vehicle adapters	N/A
11.4.1	A power pack intended for connection to an automobile cigar lighter receptacle shall be provided with a vehicle adapter that complies with the enclosure and input contacts requirements in the Standard for Vehicle Battery Adapters, UL 2089, and Power Supplies, CAN/CSA C22.2 No. 107.1. The connector plug shall incorporate a fuse or other protective device having a current rating not greater than 15 A.		N/A
	Exception: The protective device may be provided in the output cord of the vehicle adapter not more than 5 inches (127 mm) from the vehicle adapter enclosure		N/A
11.4.2	With reference to 11.4.1, if the fuse is user replaceable, the vehicle adapter shall be marked in accordance with 70.10. This marking shall appear adjacent to the fuseholder		N/A
11.5	Photovoltaic panels		N/A
11.5.1	Power packs provided with a photovoltaic panel as an input for charging the internal battery shall be provided with an inverter and/or a charge controller and shall be in accordance with the applicable requirements in the Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources, UL 1741; or with the applicable requirements in the Standard for Power Converters for Use in Photovoltaic Power Systems – Part 1: General Requirements, UL 62109-1.		N/A
12	**Output connections**		P
12.1	General		P
12.1.1	Power packs shall be provided with one or more outputs that terminate in a suitable connector or other connection means in accordance with the requirements in this Standard.		P
12.1.2	The output of the power pack shall include at least one of the output options shown in (a) – (d). Additional outputs are not restricted.		P
	a) Booster cable assemblies, see 12.2;	No such assemblies	N/A
	b) Receptacles, see 12.3;		N/A
	c) DC Connectors, see 12.4;		N/A
	d) Vehicle adapter sockets, see 12.5;		N/A

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
	e) USB Connectors, see 12.4.		P
12.2	Booster cables assemblies	No booster cables assemblies	N/A
12.2.1	General		N/A
12.2.1.1	Booster cable assemblies shall be detachable or non-detachable assemblies. Detachable assemblies shall comply with 12.2.1.2 and the applicable requirements in 12.2.2 and 12.2.3. Non-detachable assemblies shall comply with 12.2.1.3 and the applicable requirements in 12.2.2 and 12.2.3.		N/A
12.2.1.2	For detachable booster cable assemblies, the connector shall be in accordance with the Standard for Component Connectors for Use in Data, Signal, Control and Power Applications, UL 1977, and Special Use Attachment Plugs, Receptacles and Connectors, CAN/CSA C22.2 No. 182.3, or the connector shall be in accordance with the Standard for Automotive Battery Booster Cables, UL 1839 (middle connectors). The connector shall have a voltage and current rating that is the same as or higher than the output rating of the booster cable assembly.		N/A
12.2.1.3	For non-detachable booster cable assemblies, the cable shall be provided with strain relief in accordance with Section 11.2.2 and bushings shall be provided in accordance with Section 11.2.3.		N/A
12.2.2	Cables		N/A
12.2.2.1	The cable provided with the booster cable assembly shall comply with the applicable requirements for cables in the Standard for Automotive Battery Booster Cables, UL 1839		N/A
12.2.2.2	As an alternative to 12.2.2.1, the cable can be shown to comply with the requirements in 12.2.2.3 – 12.2.2.7, when the power pack is provided with a protection system for the cable assembly. The protection system shall provide output limiting such that a maximum current cannot be exceeded under normal or abnormal conditions and the maximum temperature of the cable insulation shall not be exceeded during the Normal Temperature Test, Section 47.		N/A
12.2.2.3	The conductors used within the cables shall:		N/A
	a) Comply with the requirements in the Standard for Appliance Wiring Material, UL 758, and either Equipment and Lead Wires, CAN/CSA C22.2 No. 127, or Appliance Wiring Material Products, CAN/CSA C22.2 No. 210; and		N/A
	b) Be suitably sized based on the rating of the output current associated with the booster function.		N/A
12.2.2.4	The final cable assembly shall be subjected to the Cold Bend Test, Section 67.		N/A
12.2.2.5	At all points where the cable enters the enclosure of the device or any other enclosure, excluding the cable connection to the clamp, the connection shall be subjected to a strain relief test as described in Section 54.		N/A

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
12.2.2.6	The conductors of a booster cable set employing parallel conductors shall be separated at each end to allow the jaw ends of the clamps to span a minimum distance of 920 mm (3 feet). For power packs provided with a safety circuit that prevents energy from being available at the booster clamps prior to connection and immediately upon disconnection, such that arcing and sparking is prevented at the battery terminals, the 920-mm minimum distance can be reduced. The safety circuit shall be subject to the requirements in Section 40, Safety Circuits and Control Circuits.		N/A
12.2.2.7	The cable shall be subjected to the Ampacity Test in Section 65		N/A
12.2.3	Clamps		N/A
12.2.3.1	The clamp provided with the booster cable assembly shall comply with the applicable requirements for clamps in the Standard for Automotive Battery Booster Cables, UL 1839		N/A
12.2.3.2	As an alternative to 12.2.3.1, the cable can be shown to comply with the requirements in 12.2.3.3 – 12.2.3.6, when the power pack is provided with a protection system for the cable assembly. The protection system shall provide output limiting such that a maximum current cannot be exceeded under normal or abnormal conditions and the maximum temperature of the cable insulation shall not be exceeded during the Normal Temperature Test, Section 47		N/A
12.2.3.3	The clamp bodies shall be fabricated from nonmetallic materials and these materials shall have a flame rating of HB minimum		N/A
12.2.3.4	The clamps shall be subjected to the Cold Drop Test using a conditioning temperature equal to the manufacturer's lower ambient temperature rating. See 68.2.		N/A
12.2.3.5	The clamps shall be subjected to the Dielectric voltage-withstand test, Section 68.3		N/A
12.2.3.6	The clamp shall be subjected to the Secureness test , Section 68.4		N/A
12.3	Receptacles		N/A
12.3.1	Receptacles provided as an output on power packs shall be rated 120 Vac, 20 A maximum, and shall consist of a double blade, ungrounded configuration, and shall be of a NEMA type receptacle that is in accordance with the Standard for Attachment Plugs and Receptacles, UL 498, and General Use Receptacles, Attachment Plugs and Similar Wiring Devices, CAN/CSA C22.2 No. 42.		N/A

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
	Exception: Polarized receptacles rated 120 Vac, 20 A maximum, and consist of grounding configurationmay be acceptable provided the power source (integrated battery pack, etc) has no conductirve connections to AC output circuit or any other branch circuit, and potential involving risk of electrical shock shall not exist between ground and the grounded circuit contact, terminal, or lead. Compliance shall be checked by inspection and by neutral-to-ground potential and leakage current measurement. The potential shall not exceed 42.4 Vpk at no-load and full-load conditions, or the leakage current determined in accordance with Section 46, Leakage Current Test, shall not exceed 0.5 mA.		N/A
12.3.2	Markings shall be provided that indicate the maximum rating of the receptacle to the user. This marking shall be permanent		N/A
12.4	DC output connectors and USB connectors		P
12.4.1	Power packs provided with USB connections as an output shall incorporate connectors that are in accordance with the Standard for Component Connectors for Use in Data, Signal, Control, and Power Applications, UL 1977, and Special Use Attachment Plugs, Receptacles and Connectors, CAN/CSA C22.2 No. 182.3.		P
12.4.2	DC output connectors provided as an output shall incorporate connectors that are in accordance with the Standard for Component Connectors for Use in Data, Signal, Control, and Power Applications, UL 1977, and Special Use Attachment Plugs, Receptacles and Connectors, CAN/CSA C22.2 No. 182.3.		N/A
12.4.3	A circuit supplied by a single source of supply, consisting of a battery or power supply with an isolating transformer, need not be investigated if:		N/A
	a) The open circuit potential or no-load output of the source is not more than 30 volts DC or 21.2 volts peak;		N/A
	b) The current available to the circuit is limited so that the current under any condition of load, including short circuit, is not more than 8 amperes; and		N/A
	c) The power available is not more than 240 VA.		N/A
12.5	Vehicle adapter sockets		N/A
12.5.1	Adapter sockets provided as an output on a power pack, for connecting products with a standardized vehicle adapter connector, shall comply with 12.5.2		N/A
12.5.2	The cable, if provided, shall be suitable for the voltage and ampacity of the output rating. The cable shall be in accordance with the Standard for Appliance Wiring Materials, UL 758, and either Equipment and Lead wires, CAN/CSA C22.2 No. 127, or Appliance Wiring Material Products, CAN/CSA C22.2 No. 210.		N/A
12.5.3	A circuit supplied by a single source of supply, consisting of a battery or power supply with an isolating transformer, need not be investigated if:		N/A

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
	a) The open circuit potential or no-load output of the source is not more than 30 volts DC or 21.2 volts peak;		N/A
	b) The current available to the circuit is limited so that the current under any condition of load, including short circuit, is not more than 8 amperes; and		N/A
	c) The power available is not more than 240 VA		N/A
13	**Grounding**	No grounding	N/A
13.1	General		N/A
13.1.1	A product shall have a provision for grounding in accordance with 13.1.2 – 13.2.2 that is reliably connected when the unit is connected to the mains power source. The means for grounding may be contained within a separate or integral power supply that has been shown to comply with the applicable requirements for power supplies. In this case, no further evaluation of grounding is needed		N/A
	Exception: Double insulated products are not required to comply with Section 13. See Double Insulated Products, Section 14		N/A
13.1.2	All exposed dead metal parts, that are likely to become energized, shall be reliably connected to the means for grounding.		N/A
13.1.3	The equipment grounding conductor of the power supply cord may be used for grounding		N/A
13.1.4	The grounding conductor of a supply cord shall be secured to the metallic enclosure of the product by means of a separate screw or other equivalent means, intended for that purpose only, that is not likely to be removed during any servicing operation not involving the power supply cord. Solder alone shall not be used for securing the grounding conductor. Servicing as mentioned in this requirement include repair of the product by a qualified service person.		N/A
	Exception: Products with no exposed dead metal parts need not comply with 13.1.4.		N/A
13.1.5	The grounding conductor and the dead metal parts shall be conductively connected to the grounding member of an attachment plug. The grounding member shall be fixed.		N/A
13.1.6	A separable connection, such as that provided by an attachment plug and a mating connector or receptacle, shall be such that the equipment grounding connection is made before and broken after the supply conductors		N/A
13.1.7	The grounding terminal, intended solely for the connection of an equipment grounding conductor, shall be capable of securing a conductor of the size necessary for the application. A connection device that depends on solder alone shall not be provided for connecting the equipment grounding conductor		N/A

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
13.1.8	A wire binding screw or pressure wire connector intended for the connection of an equipment grounding conductor shall be located so that it is unlikely to be removed during servicing of the power pack.		N/A
13.1.9	A screw used to secure the grounding conductor to the frame shall engage the metal by at least two full threads. The metal thickness shall not be less than 0.050 inch (1.27 mm) thick. The metal may be extruded to increase the effective thickness. Only the supply cord grounding conductor shall be secured by the grounding screw.		N/A
13.1.10	A stud and nut combination used to secure the grounding conductor to the frame shall be secured to the frame by welding the stud in place. The ground conductor shall be connected first and be in contact with the frame and secured in place by a dedicated nut and lock washer. Other bonding jumpers may be connected to the stud, but they shall be connected above the main ground connection and secured by separate nut and lock washers		N/A
13.1.11	With reference to the requirement in 13.1.2, the following dead metal parts are not considered likely to become energized:		N/A
	a) A small metal part, such as an adhesive attached foil marking, a screw, a handle, and the like, that is:		N/A
	1) On the exterior of the enclosure and separated from all electrical components by grounded metal, or 2) Electrically isolated from all electrical components.		N/A
	b) A panel, cover, or other metal part that is isolated from all electrical components by a barrier of vulcanized fiber, varnished cloth, phenolic composition, or other moisture resistant insulating material not less than 1/32 inch (0.80 mm) thick and securely mounted in place, and		N/A
	c) A panel, cover, or other metal part that does not enclose uninsulated live parts and is electrically isolated from other electrical components.		N/A
13.1.12	The main grounding path shall not include a trace on a printed wiring board.		N/A
13.2	Grounding identification		N/A
13.2.1	The surface of the insulation on a grounding conductor of a flexible cord shall be green with or without one or more yellow stripes, and no other lead shall be so identified		N/A
13.2.2	The unit shall be marked at the point of grounding connection to the enclosure or frame with the Symbol ⏚ (IEC 60417 No.5019).		N/A
14	**Double insulated products**	The product was not directly connected to the mains.	N/A

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
14.1	A device may be provided with a system of double insulation that complies with the requirements in the Standard for Double Insulation Systems for Use in Electrical Equipment, UL 1097, in lieu of a means for grounding.		N/A
14.2	In addition to complying with 14.1, the system of double insulation shall comply with the requirements in this outline		N/A
14.3	A product shall be marked as being a suitable double insulated product, see Figure 14.1. All such products shall not be provided with a means for grounding		N/A
15	**Current Carrying Parts**		P
15.1	A current carrying part shall be of silver, copper, a copper alloy, stainless steel, or other material suitable for the application. Ordinary unplated iron or steel shall not be used for current carrying parts	All the current carring parts are use suitable material for the application	P
16	**Internal Wires**		P
16.1	Mechanical protection		P
16.1.1	Wiring and connections between parts of equipment shall be protected or enclosed so that the conductor insulation is not exposed to contact with any rough, sharp, or moving part	Internal wires were well secured and routed so that not touch rough or sharp parts.	P
16.1.2	Insulated wiring accessible through an opening in an enclosure is considered to be protected as required in 16.1.1 if the opening complies with Openings in enclosures, 7.4. Internal wiring not so protected may be acceptable if it is so secured within the enclosure that it is not likely to be subjected to stress or mechanical damage.	No such wires	N/A
16.1.3	An opening in the frame or enclosure through which insulated wires pass shall be provided with a smooth, well rounded bushing or shall have smooth, well rounded surfaces upon which the wires may lie	No wires through openings or enclosures	N/A
16.1.4	Insulated wires, complying with the requirements for Separation of Circuits, Section 17, may be bunched and passed through a single smooth opening in a wall within the enclosure		P
16.2	Wiring insulation		P
16.2.1	The internal wiring of power packs shall be of a type rated for the application, when considered with respect to the temperature and voltage involved, with respect to its exposure to oil and grease, and with respect to other conditions of service to which it is subjected		P
16.2.2	The insulation of wiring used in a high voltage circuit shall have a flame retardant rating of VW-1in accordance with the requirements in the Reference Standard for Electrical Wires, Cables, and Flexible Cords, UL 1581		P

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
16.2.3	Sleeving, tape, and tubing used for insulation on wires shall be rated for the voltage and temperature involved		P
16.3	Splices and connections		P
16.3.1	Splices and connections shall be mechanically secure and provide electrical contact. A soldered connection shall be made mechanically secure before being soldered		P
16.3.2	Equipment subjected to vibration shall be provided with lock washers or other means to mechanically secure wire binding screws and nuts. A twist on type connector shall be additionally secured to the wires by means of at least two layers of tape. Tape used for this means shall be evaluated for its intended application and comply with the Standard for Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape, UL 510, and PVC Insulating Tape, CAN/CSA C22.2 No. 197.		P
16.3.3	A splice shall be provided with insulation equivalent to that of the wires connected if spacing between the splice and other metal parts is not maintained		P
16.3.4	The insulation on a splice may consist of a minimum of two layers of tape when the voltage involved is less than 250 volts. When evaluating the splice insulation consideration is to be given to such factors as its dielectric properties, heat resistance, and moisture resistance. Tape shall not be wrapped over a sharp edge		P
16.3.5	If internal wiring is stranded, loose strands of wire shall not contact other uninsulated live parts of opposite polarity or dead metal parts. At a wire binding screw, this may be accomplished by using upturned lugs, a cupped washer, barriers, or other means to hold the wires under the head of the screw. Other means of retaining the loose stranded internal wiring in position are use of a pressure terminal connector, soldering lug, or crimped eyelet		P
16.3.6	Aluminum conductors, insulated or uninsulated, used as internal wiring, such as for interconnection between current carrying parts, shall be terminated at each end by a method that is acceptable for the combination of metals involved at the connection point	Not Aluminum conductors	N/A
16.3.7	With reference to 16.3.6, a wire binding screw or a pressure terminal connector used as a terminating device shall be rated for use with aluminum under the condition involved – for example, temperature, heat cycling, vibration, and the like		N/A
16.3.8	Insulation of internal wiring consisting of coated fabric, thermoplastic, or other types of tubing is to be considered with respect to electrical, mechanical, and flammability properties of the material		P
17	**Separation of circuits**		P

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
17.1	Conductors of different circuits operating at different potentials shall be separated or segregated from each other unless each conductor is provided with insulation rated for the highest potential involved		P
17.2	An insulated conductor shall be positioned so that it cannot contact an uninsulated live part of a different circuit		P
17.3	Segregation of insulated conductors may be accomplished by clamping, routing, or a means that maintains permanent separation from insulated and uninsulated live parts and from conductor of a different circuit.		P
17.4	A barrier used to separate or segregate internal wiring shall have the mechanical strength for the application, and it shall be reliably held in place.		P
18	**Insulating Materials**		P
18.1	Insulating materials, used in circuits other than low-voltage, limited-energy circuits, shall be porcelain, phenolic composition, or other similar material, and shall be evaluated in accordance with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, and Evaluation of Properties of Polymeric Materials, CAN/CSA C22.2 No. 0.17.		P
18.2	Ordinary vulcanized fiber may be used for insulating bushings, washers, separators, and barriers, but shall not be used as the sole support for uninsulated live parts if shrinkage, current leakage, or warpage is likely to result in a risk of fire, electric shock, or injury to persons		P
18.3	A thermoplastic material shall not be used for the sole support of live parts unless it complies with all of the following:		P
	a) Mechanical strength; b) Rigidity; c) Resistance to heat; d) Resistance to flame propagation; e) Dielectric withstand; and f) Resistance to abnormal heat.		P
19	**Compressors**		P
19.1	General		P
19.1.1	Air compressor assemblies provided with power packs, and housed within the overall power pack enclosure, shall comply with the requirements in 19.2 and 19.3. Air compressors supplied with the power pack, but as a separate unit shall be evaluated in accordance with the Standard for Motor-Operated Air Compressors, Vacuum Pumps, and Painting Equipment, UL 1450, and Motor Operated Appliances (Household and Commercial), CAN/CSA C22.2 No. 68.		P
19.2	Motors and thermal protection		N/A

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
19.2.1	A motor shall be acceptable for the application, and shall be capable of handling the maximum normal load of the power pack without creating a risk of fire, electric shock, or injury to persons		N/A
19.2.2	A motor winding shall resist the absorption of moisture. Film coated wire used for motor windings is not required to be additionally treated to prevent moisture absorption. Fiber slot liners, cloth coil wraps, and similar moisture absorptive materials are to be provided with impregnation or otherwise treated to prevent moisture absorption		N/A
19.2.3	A motor shall be provided with a thermal protector as described in 19.2.4		N/A
19.2.4	With reference to 19.2.3, thermal protection shall be evaluated in accordance with the Standard for Thermally Protected Motors, UL 1004-3, and Motors With Inherent Overheating Protection, CAN/CSA C22.2 No. 77.		N/A
	Exception No. 1: A thermally protected motor which drives a fully enclosed oil-less and tankless air compressor, or inflator, evaluated in accordance with the Standard for Motor-Operated Air Compressors, Vacuum Pumps, and Painting Equipment, UL 1450, and Motor Operated Appliances (Household and Commercial), CAN/CSA C22.2 No. 68.		N/A
	Exception No. 2: A motor intended to move air only, by means of an air moving fan that is integrally attached, keyed, or otherwise fixed to the motor, is required to have locked rotor protection only.		N/A
	Exception No. 3: A linear style pump is required to have locked rotor protection only.		N/A
19.2.5	The thermal protector shall have a current and voltage rating not less than the load that it controls		N/A
19.3	Parts subject to pressure	No such parts	N/A
19.3.1	A part of the power pack that is subject to pressure during normal or anticipated abnormal operation shall withstand, without rupture, a pressure corresponding to five times the maximum pressure that can be developed by the system.		N/A
19.3.2	In the event that a test is required to determine whether a part complies with the requirement in 19.3.1, two samples of the power pack are to be subjected to the Hydrostatic Strength Test, Section 59. Prior to the test, parts molded of polymeric material are to be conditioned in an air circulating oven for 7 hours at a temperature of 70°C (158°F) or 10°C (18°F) higher than the maximum temperature measured on the part under normal load, whichever is greater. The samples are to be removed from the oven and allowed to cool to room temperature prior to the test.		N/A
20	**Capacitors and Electrochemical Capacitor Modules**		N/A
20.1	Capacitors		N/A

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
20.1.1	A capacitor connected from one side of the line to the enclosure of a product shall have a capacitance rating of not more than 0.10 µF, or the power pack shall be subjected to the Capacitor Discharge Test, Section 45.		N/A
20.1.2	If a product employs a combination consisting of a rectifier and an electrolytic capacitor, no risk of fire, electric shock, or injury to persons shall result when either the rectifier or the capacitor is short-circuited.		N/A
20.1.3	Under both normal and abnormal conditions of use, a capacitor employing a liquid dielectric medium more flammable than askarel shall not expel the dielectric medium when tested in accordance with the performance requirements of this Standard.		N/A
20.2	Electrochemical capacitor modules		N/A
20.2.1	Electrochemical capacitor modules are allowed in power packs to provide the booster cable output. The electrochemical capacitor module shall comply with the requirements in the Standard for Electrochemical Capacitors, UL 810A, as well as the requirements in 20.2.2 – 20.2.4		N/A
20.2.2	Electrochemical capacitor modules shall be provided with a means to monitor the voltage at the input of the module and shall shut down the power to the module if the voltage exceeds the voltage rating of the module. Any appropriate means is allowed, but any software or programmable components associated with this protection means shall be evaluated for reliability		N/A
20.2.3	Electrochemical capacitor modules shall have temperatures of the module continuously monitored during any defined operating condition and the module shall be shut down if the temperature exceed the rated temperature of the module or individual capacitor in the module. Any appropriate means is allowed, but any software or programmable components associated with this protection means shall be evaluated for reliability		N/A
20.2.4	Means shall be provided such that the capacitor module shall not be allowed to discharge while the charging voltage is applied. Any attempt to jump start a vehicle while the power pack is plugged in shall be prohibited by the power pack itself. Any appropriate means is allowed, but any software or programmable components associated with this protection means shall be evaluated for reliability		N/A
21	**Resistors**	No such resistor used	N/A
21.1	The assembly of a power resistor, such as a wire wound type requiring a separate support, shall be reliable. The resistor shall be prevented from loosening or rotating by a means other than friction between surfaces.		N/A
21.2	An assembly employing lock washers may be considered to comply with 21.1		N/A

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
22	**Lampholders**	No lampholders	N/A
22.1	The screw shell of a lampholder shall be connected to a conductor that is intended to be connected to the grounded conductor of the power supply circuit		N/A
22.2	A lampholder shall be designed or installed so that uninsulated live parts, other than a screw shell, are not exposed to inadvertent contact by persons removing or replacing the lamp in normal service		N/A
22.3	If the lampholder is supplied from an LVLE circuit, the requirements in 22.1 and 22.2 do not apply		N/A
23	**Transformers**		N/A
23.1	Transformers provided as part of a power pack, shall comply with one of the following:		N/A
	a) Standard for Specialty Transformers, UL 506;		N/A
	b) Standard for Dry-Type General Purpose and Power Transformers, UL 1561; or		N/A
	c) Standard for Low Voltage Transformers – Part 1: General Requirements, UL 5085-1 and CAN/CSA C22.2 No. 66.1, and one of the following:: 1) Standard for Low Voltage Transformers – Part 2: General Purpose Transformers, UL 5085-2 and CAN/CSA C22.2 No. 66.2; or 2) Standard for Low Voltage Transformers – Part 3: Class 2 and Class 3 Transformers, UL 5085-3 and CAN/CSA C22.2 No. 66.3.		N/A
24	**Switches and Controls**		P
24.1	A switch or other control device shall be suitable for the application and shall have current and voltage ratings not less than those of the circuit that it controls when the power pack is operated as intended.		P
24.2	A primary circuit switch that controls an inductive load having a power factor less than 75 percent, such as a transformer, and that does not have an inductive rating, shall be rated not less than twice the full load current rating of the load, or the switch shall be investigated for this application		N/A
24.3	A switch or other control device not having an inductive rating that is connected in a transformer secondary circuit shall comply with the Normal Temperature Test, Section 47, and with the Overload of switches and controls test, Section 53.2.		N/A
24.4	Unless rated for the application, a switch or other device that controls a motor and is not interlocked so that it will not break the locked rotor motor current shall be subjected to the Overload of switches and controls test, Section 53.2, based on the locked rotor current of the motor.		N/A

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
24.5	A switch that controls a tungsten-filament lamp shall have a tungsten-filament lamp current rating not less than the maximum current it will control		N/A
	Exception: A switch having a tungsten-filament lamp current rating less than the maximum current it will control but rated 3 amperes or more may be used to control a 15-watt or smaller lamp		N/A
24.6	A switch shall not disconnect the ground conductor of a circuit unless the switch simultaneously disconnects all other conductors.		N/A
24.7	If unintentional operation of a switch results in a risk of injury to persons, the actuator of the switch shall be located or guarded so that such operation is unlikely. The actuator of a switch may be guarded by recessing, ribs, barriers, or the like		N/A
25	**Printed Wiring Boards**		P
25.1	A printed wiring board shall comply with the requirements in the Standard for Printed Wiring Boards, UL 796, and have a minimum flammability classification of V-1.	V-0, complied with UL 796	P
25.2	A resistor, capacitor, inductor, or other part that is mounted on a printed wiring board to form a printed wiring 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, normal operation, or servicing of the power pack.		P
25.3	Consideration is to be given to a barrier or partition that is part of the power pack assembly and that provided mechanical protection and electrical insulation for a component connected to a printed wiring board.		P
26	**Interlocks**	No interlocks	N/A
26.1	An interlock required to reduce the risk of electric shock or injury to persons shall comply with 26.2 – 26.6.		N/A
26.2	The interlock device shall not be defeated readily without:		N/A
	a) Damaging the equipment; b) Making wiring connections or alterations; c) Using other than ordinary tools; or d) Using materials other than those readily available. Adhesive tape, string, or conventional extension cord sets are identified as readily available.		N/A
26.3	The interlock device shall be such that during normal operation and user servicing:		N/A

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
	a) The interlock is not defeated by improper disassembly, for example removal of the wrong screws during removal of the cover; b) The cover in which the interlock is mounted shall not be rotated by its own weight about the interlock axis perpendicular to the cover during any stage of its removal or replacement, if such rotation gives access to a live part, or damages the interlock or cover; c) The act of removal or replacement of the interlocked cover shall not subject the user to unintentional contact with live parts; d) The interlocked cover is not capable of being readily misapplied to result in a risk of electric shock; and e) The equipment is marked in accordance with 70.17.		N/A
26.4	If two momentary contact switches must be operated to energize the power pack, the arrangement shall be spaced from each other and from live parts so that, if the means are operated simultaneously by one individual, contact with live parts shall not occur		N/A
26.5	With reference to 26.3(c), parts that are recessed more than 2-1/2 inches (64 mm) from the edge of the cabinet opening, normally in the plane of the cover, are excluded when determining that the act of removal or replacement of a cover will subject the user to unintentional contact with live parts		N/A
26.6	An interlock shall comply with Overload of Interlocks, Section 53.4		N/A
27	**Overload Protection Devices**		P
27.1	An overcurrent or thermal protective device shall be suitable for the application		P
27.2	An automatic reset device used to comply with 27.1 shall be cycled through 200 operations. At the end of the 200 operations, the device shall be able to perform its intended function with no additional risk of fire, electric shock, or injury to persons. See Overload of protection devices, Section 53.3		P
27.3	A fuse involving a risk of electric shock shall be in accessible:		N/A
	a) To the user from outside the enclosure, and b) To the user during any user servicing.		N/A
27.4	A fuse that can be serviced by the user shall be secured in a fuseholder that is constructed and installed such that no uninsulated live parts will be accessible to contact by persons removing or replacing the fuse. The power pack shall be marked in accordance with 70.10. This marking shall be adjacent to the fuse		N/A

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
27.5	The screw shell of a plug fuseholder and the accessible contact of an extractor type fuseholder shall be connected to the load.		N/A
28	**Internal battery**		P
28.1	General		P
28.1.1	Connections to the terminals of the internal battery shall be secure. The connection means shall not allow the connection to loosen during normal operation to the point where the connection is lost, or where arcing or overheating may occur		P
28.1.2	Internal batteries provided as part of power packs shall be lead acid, in accordance with 28.2, or lithium-ion, in accordance with 28.3	Lithium-ion battery	P
28.1.3	If the internal battery is removable by the user, the battery pack shall be keyed or provided with a means to prevent inadvertent reverse polarity connections when replacing the battery pack. If the battery pack is not provided with this means of prevention, then the power pack is subjected to the test in 50.10	Not removableby the user	N/A
28.2	Lead acid batteries	Not such battery	N/A
28.2.1	A lead acid battery shall comply with the requirements in the Standard for Standby Batteries, UL1989.		N/A
28.2.2	The power pack shall provide a means of reverse polarity protection or the test of 50.3 shall be performed.		N/A
28.2.3	The power pack shall provide short circuit protection for the battery or the test of 50.2 shall be performed		N/A
28.2.4	The power pack shall provide a means to prevent overcharge of the battery or the test of 50.9 shall be performed		N/A
28.2.5	The battery shall be subjected to the Normal Operation Charging Test, Section 43		N/A
28.3	Lithium-ion batteries		P
28.3.1	A lithium-ion battery cell shall comply with the requirements in the Standard for Lithium Batteries, UL 1642, or the Standard for Secondary Cells and Batteries Containing Alkaline or Other Non-Acid Electrolytes – Safety Requirements for Portable Sealed Secondary Cells, and for Batteries Made From Them, for Use in Portable Applications, UL 62133 and CAN/CSA E62133.		P
28.3.2	The power pack shall provide a means of reverse polarity protection or the test of 50.3 shall be performed.	The construction of the battery pack provide the reverse polarityprotection	N/A
28.3.3	The power pack shall provide short circuit protection for the battery or the test of 50.2 shall be performed.	Test performed, no hazards after test	P

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
28.3.4	The power pack shall provide a means to prevent overcharge of the battery or the test of 50.9 shall be performed	Test performed, no hazards after overcharge	P
28.3.5	The battery shall be subjected to the Normal Operation Charging Test, Section 43.	Tested and complied	P
28.3.6	The power pack shall be subjected to the Lithium-Ion Charging System Test, Section 44	Tested and complied	P
29	**Spacings**		N/A
29.1	Spacings between hazardous live parts of opposite polarity, and between hazardous live and dead metal parts shall not be less than specified in Table 29.1. If an uninsulated hazardous live part is not rigidly secured in position by means other than friction between surfaces, or if a movable dead metal part is in proximity to an uninsulated hazardous live part, the construction shall be such that at least the minimum spacings are maintained. See 29.2.		N/A
	Exception No.1, No.2 or No.3		N/A
29.2	The spacing requirements in Table 29.1 do not necessarily apply to the inherent spacings of a component or assembly of a power pack. This includes switches, fuses, transformers, attachment plugs, and similar components or assemblies. Such spacings shall comply with the requirements for that component or assembly in question, where actual spacing requirements exist.		N/A
29.3	In a low voltage, limited energy secondary circuits, spacings of live parts in-between or live parts to grounded dead metal are not specified		N/A
29.4	Epoxy or equivalent material may be used to reduce spacings when all of the following are met:		N/A
	a) Spacings of a minimum 0.8 mm (1/32 inch) are maintained prior to application of the encapsulant;		N/A
	b) There are no significant voids in the encapsulant;		N/A
	c) The encapsulant is a minimum 0.8 mm (1/32 inch) thick;		N/A
	d) The area of reduced spacing, with the encapsulant applied, complies with the Dielectric Voltage Withstand Test, Section 48; and		N/A
	e) The encapsulant temperature during the Normal Temperature Test, Section 47, does not exceed 65°C (117°F) rise [based on an assumed operating ambient rating of 25°C (77°F)] or 90°C (194°F) limit (when tested at an ambient rating of greater than 25°C).		N/A
	Exception: When the encapsulant is suitable for use at a higher operating temperature, the temperature shall not exceed the material temperature rating.		N/A

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
29.5	As an alternative to the spacing requirements of Table 29.1, the spacing requirements in the Standard for Insulation Coordination Including Clearance and Creepage Distances for Electrical Equipment, UL 840, and Insulation Coordination, CAN/CSA C22.2 No. 0.2, may be used. The spacing requirements of UL 840 and CAN/CSA C22.2 No. 0.2 are not to be used for spacings to a dead metal enclosure. In determining the pollution degree and overvoltage category, the end use application is to be considered and may modify those characteristics given in 29.6 and 29.7.		N/A
29.6	Power packs are considered to be used in a pollution degree 3 environment. Hermetically sealed or encapsulated enclosures, or coated printing-wiring boards in compliance with the Printed Wiring Board Coating Performance Test of the Standard for Insulation Coordination Including Clearance and Creepage Distances for Electrical Equipment, UL 840, and Insulation Coordination, CAN/CSA C22.2 No. 0.2, are considered pollution degree 1.		N/A
29.7	It is anticipated the equipment will be rated overvoltage category II or overvoltage category I as defined in the Standard for Insulation Coordination Including Clearance and Creepage Distances for Electrical Equipment, UL 840, and Insulation Coordination, CAN/CSA C22.2 No. 0.2.		N/A
29.8	In order to apply clearance B spacings, control of overvoltage shall be achieved by providing an overvoltage device or system as an integral part of the product		N/A
29.9	For the purpose of power packs covered by these requirements, all printed-wiring boards are considered to have a minimum comparative tracking index of 100 without further evaluation.		N/A
29.10	An insulating liner or barrier of material such as vulcanized fiber or thermoplastic employed in lieu of required spacings shall not be less than 0.71 mm (0.028 inch) thick and shall be so located or of such material that it is not adversely affected by arcing.		N/A
	Exception: Vulcanized fiber not less than 0.33 mm (0.013 inch) thick or mica not less than 0.165 mm (0.0065 inch) thick may be used:		N/A
	a) In conjunction with an air spacing of not less than 50 percent of the minimum through air spacing;		N/A
	b) Between a heat sink and a metal mounting surface, including the enclosure, of an isolated secondary circuit rated 50 Vrms or less.		N/A
29.11	Insulating material having a thickness less than that specified in 29.10 may be used if, upon evaluation, it is found to comply with the requirements for the application, and has a dielectric breakdown strength of not less than 5000 volts in the thickness used for 29.10 – 2500 volts in the thickness used for the Exception to 29.10 – as determined by Tests on Insulating Materials, Section 61.		N/A
29.12	Film coated wire is regarded as an uninsulated live part when spacings are being considered		N/A
30	**Inverters**		N/A

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
30.1	Inverters provided as part of the power bank shall be shown to comply with the applicable requirements in this outline. See 30.2		N/A
	Exception: Inverters that comply with the Standard for Power Units Other Than Class 2, UL 1012, and Power Supplies, CAN/CSA C22.2 No. 107.1, comply without further evaluation.		N/A
30.2	With reference to 30.1, specific attention should be given to: a) Printed-Wiring Boards, Section 25; b) Spacings, Section 29; c) Normal Temperature Test, Section 47; d) Dielectric Voltage Withstand Test, Section 48; and e) Abnormal Operation Tests, Section 50. Other requirements shall also apply as applicable.		N/A
31	**Charging functions**		N/A
31.1	Specialized packs that provide a charging function while connected to the source of supply that is intended to charge the external battery through the pack's booster cable assembly, or other output connection, shall have the charging circuits evaluated in accordance with the applicable requirements in the Standard for Battery Chargers for Charging Engine-Starter Batteries, UL 1236, and Battery Chargers, CAN/CSA C22.2 No. 107.2.	Not that type	N/A
	Protection Against Injury to Persons		
32	**General**		P
32.1	If the operation and maintenance of a power pack by the user involves a risk of injury to persons, means shall be provided to reduce the risk		P
32.2	When judging a power pack with respect to the requirement in 32.1, consideration shall be given to reasonably foreseeable misuse of the power pack		P
32.3	Whether a guard, a release, an interlock, or the like is required, and whether such a device meets the intent of the requirement, shall be determined from an evaluation of the complete power pack, its operating characteristics, and the likelihood of a risk of injury to persons resulting from a cause other than gross negligence. The evaluation shall include consideration of the results of breakdown or malfunction of any component, but not more than one component at a time, unless one event contributes to another. If the evaluation shows that breakdown or malfunction of a particular component can result in a risk of injury to persons, that component is to be investigated for reliability.		P
33	**Back Feed Protection**		P
33.1	Power packs shall be provided with back feed protection such that no current is passed through the device from the internal battery to the power supply input connections. Constructional features shall be provided to prevent this under normal operation and single fault condition. As an alternate means of determining compliance, the measurements in the Back Feed Test, Clause 66, can be performed.	Tested and complied	P

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
34	**Sharp edges**		P
34.1	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 to persons in normal maintenance or use	No such edges	P
35	**Strength of enclosure**		P
35.1	The enclosure shall be tested in accordance with the strength of enclosure test in Section 55	Tested and complied	P
36	**Attachments**		P
36.1	The functional attachments shall be evaluated together with the power pack	Tested and complied	P
37	**Stability**		P
37.1	A power pack shall be tested as described in Stability Test, Section 58. No overturn, or any risk/injury posed on persons as result of the test	Tested and complied	P
38	**Strength of handles**		P
38.1	A handle used to support or carry a product shall be subjected to the Strength of Handles Test, Section 57.		P
39	**Surface temperatures**		P
39.1	During the Normal Temperature Test, Section 47, the temperature of a surface that may be contacted by the user shall not be more than the value specified in Table 39.1. If the test is conducted at a room temperature of other than 25°C (77°F), the results are to be corrected to that temperature.	Tested and complied	P
40	**Safety circuits and Control Circuits**	No such circuits and control	N/A
40.1	Circuits that are provided to limit outputs, switch outputs, control operational functions and the like, are considered safety circuits or control circuits, if their failure to provide their intended function will result in a hazardous condition or a risk of fire, shock, or injury to the user. Circuits that are classified as safety circuits or control circuits shall be evaluated to the applicable requirements in the Standard for Automatic Electrical Controls – Part 1: General Requirements, UL 60730-1 and CAN/CSA C22.2 E60730-1.		N/A
Performance			
41	**General**		P

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
41.1	For tests involving the overall device, complete samples of the power pack are required. The battery provided in the power pack shall be fully charged or fully discharged as indicated in the individualtest. Unless otherwise stated, all tests are to be conducted at the rated input voltage and frequency for the power pack. For all electrical tests requiring connection to the branch circuit, the branch circuit shall be protected by a branch circuit protective device having a rating equal to the smallest rated receptacle to which the power pack could be connected. For tests where the internal battery is to deliver output power, the tests shall be performed with the output loaded to its maximum rating, unless otherwise specified.		P
41.2	Some tests may result in fire or explosion. It is therefore important that personnel be protected from the flying fragments, explosive force, sudden release of heat, chemical burns, intense light, and noise that may result from such explosions. The test area is to be well ventilated to protect personnel from possible harmful fumes or gases		P
41.3	Measurements of cell voltages during the tests of lithium-ion systems shall be made using a single pole resistive-capacitive low pass filter with a cut-off frequency of 5 kHz ±500 Hz. To determine if maximum charging voltages have been exceeded, the peak value of the voltage measured after this network shall be used. The measurement shall have a measurement tolerance within ±1 percent		P
41.4	The tests are made in a draught-free location and at an ambient temperature of 20 ±5°C (68 ±9°F), unless otherwise specified. All test samples shall be stabilized to the ambient temperature prior to the test. If the temperature attained by any part is limited by a temperature sensitive device, or is influenced by temperature, the room temperature is, in case of doubt, maintained at 23 ±2°C (73.4 ±3.6°F).		P
41.5	Currents measured during battery charging shall be average current with the averaging period of 1– 5 seconds.		P
41.6	The end of discharge voltages are 1.75 V/cell for lead acid batteries, and 2.5 V/cell for lithium-ion batteries, unless the cell manufacturer specifies a different voltage		P
42	**Power Input Test**	Tested and complied	P
42.1	The current input to a power pack shall not exceed 110 percent of the marked current rating of the power pack, when the power pack is operated under the conditions of maximum normal load		P
42.2	Maximum normal load shall consist of the maximum current draw while the power pack is operating in all possible modes. For example, this may include running an air compressor, while a light is on, and the internal battery is charging. Any load that can be operated at the same time shall be operated in order to obtain the maximum normal load.		P
43	**Normal Charging Operation Test**	Tested and complied	P
43.1	Charging a lithium-ion battery under normal conditions shall not exceed the specified operating region for charging of the cell		P

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
43.2	Compliance with 43.1 is checked by the following tests in 43.3 – 43.7		P
43.3	The battery is charged in accordance with the charging system instructions starting with a fully discharged battery. Testing is carried out at an ambient temperature of 20 ±5°C (68 ±9°F) and		P
43.4	All individual cell voltages, temperatures and the charging current (or multiple current measurements as in the case of parallel configurations unless analysis makes this unnecessary) are monitored.		P
43.5	For batteries employing series configurations, the test is to be repeated with a deliberately imbalanced battery. The imbalance is to be introduced into a fully discharged battery by charging one cell to approximately 50 percent of full charge		P
43.6	With reference to 43.5, if it can be demonstrated through testing and/or design evaluation that an imbalance less than 50 percent would actually occur in normal use, then this lower imbalance may be used. The following provides examples of testing and design		P
	An example for testing is repeated charging and discharging a battery in accordance with the manufacturer's instructions until its capacity has decreased to 80 percent of the rated capacity, using the imbalance at the end of the test.		P
	Those designs that employ circuitry intended for maintaining balance between cells in the battery pack. Systems with a small number of cells in series may be shown to exhibit limited imbalance in practice, if the product ceases to operate with a battery prepared with a smaller initial imbalance		P
43.7	Battery systems intended for use with power packs which may be left on, such as flashlights and fans shall additionally be tested with their battery discharged by allowing the appliance to remain "on" for at least 12 hours prior to recharging.		P
44	**Lithium Charging System Test**	Tested and complied	P
44.1	A sample of the power pack subjected to this test shall be considered to comply with this test provided none of the following has occurred		P
44.2	With reference to 44.1(b), charring is defined as a blackening of the medical gauze or cheesecloth caused by combustion. Discoloration of the medical gauze or cheesecloth caused by smoke is acceptable. Charring or igniting of the tissue paper, cheesecloth, or medical gauze from the shorting means in not considered a failure		P

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
44.3	With reference to 44.1(c), to determine if recharging is disabled, the battery shall be discharged by using the power pack to approximately a 50 percent charge, followed by an attempt to recharge the battery normally. There shall be no charging current after 10 minutes or after 25 percent of the nominal capacity has been delivered, whichever occurs firs		N/A
44.4	A sample of the power pack is to be placed on a soft wood surface covered by two layers of tissue paper. The sample is then to be covered by one layer of untreated 100 percent cotton medical gauze or cheesecloth. The power pack is to be operated as specified in the operating instructions in each of the abnormal conditions described in (a) – (d). The cumulative stress resulting from successive tests on electronic circuits or the battery is to be avoided. Additional samples may be used as necessary. As result of testing, there shall be no evidence of damage to the cell vent	No vent	N/A
	Components in the charging circuit are faulted as described in 44.6, one at a time, if the outcome of such a fault is uncertain based upon analysis. For each fault condition introduced, the state of the battery before charging is as follows		N/A
	If the test of Section 43, Normal Charging Operation Test, is conducted with an imbalance of less than 50 percent, a series configured battery is to have a deliberate imbalance as established in 44.6; or		N/A
	If the test of Section 43, Normal Charging Operation Test, is conducted with an imbalance of less than 50 percent due to the function of circuit(s), and if a single fault of any component within that circuit (s) is shown to result in the loss of that function, then a series configured battery is to be charged with a deliberate imbalance. The imbalance is to be introduced into a fully discharged battery by charging one cell to approximately 50 percent of full charge		N/A
	With a fully charged battery connected to the charger, a short is to be introduced to the charging system across a component or between adjacent PCB tracks at a location expected to produce the most unfavorable results to evaluate the effect of back-feed from the battery. For a charger with a cord that connects to the battery, the short is to be introduced at the point likely to produce the most adverse effects. The resistance of the short shall not exceed 10 mΩ		N/A
44.5	During the tests of 44.4, each cell voltage is to be continuously monitored to determine if it has exceeded the limit conditions. Venting of the cells is to be permitted. The test is to be continued until the sample under test experiences a failure as described in 44.1, returns to room temperature or, if neither of these, until at least 7 hours or twice the normal charging period has elapsed, whichever is longer		P

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
44.6	Fault conditions for components as required by 44.4 shall be as follows		P
	Short-circuit of any two terminals of an electronic component, other than a monolithic integrated circuit. This fault is not applied between the two circuits of an optocoupler		P
	Failure of a monolithic integrated circuit or other circuits that cannot be assessed by the fault conditions (a) – (d). All possible output signals are considered under fault conditions within the integrated circuit. Components such as thyristors and triacs are not subjected to this fault condition		P
45	**Capacitor Discharge Test**		N/A
45.1	A power pack provided with filtering capacitors, or other primary capacitors, rated in excess of 0.10μF and connected between one side of the line and ground, shall be subjected to the Capacitor Discharge		N/A
45.2	The device is to be connected to a supply source of rated voltage at 60 Hz. The output is to be connected to a suitable load such that rated current is drawn from the output of the device. A storage oscilloscope is to be connected across the point of disconnection of the supply		N/A
45.3	The device is to be connected to the source of supply and energized. The power is to then be removed and the resulting discharge curve for the stored charge on capacitors is to be measured and captured on the oscilloscope. The value of the stored charge shall decay to less than 37 percent of its initial value within 1 second		N/A
45.4	The test is to be repeated with all switches in all possible positions and combinations		N/A
46	**Leakage current Test**		N/A
	A power pack shall be tested in accordance with 46.2 – 46.7. Leakage current shall not be more than 0.5 mA		N/A

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
46.1	All accessible conductive parts are to be tested for leakage currents. Leakage currents from these parts are to be measured to the grounded supply conductor individually as well as collectively if simultaneously accessible, and from one part to another if simultaneously accessible. A part is considered to be accessible unless it is guarded by an enclosure that has been evaluated for protection against the risk of electric shock. Conductive parts are considered to be simultaneously accessible if they can be readily contacted by one or both hands of a person at the same time. These measurements do not apply to terminals operating at voltages that are not considered to involve a risk of electric shock. If all accessible conductive parts are bonded together and connected to the grounding conductor of the power supply cord, the leakage current can be measured between the grounding conductor and the grounded supply conductor		N/A
46.2	If a conductive part other than metal is used for an enclosure or part of an enclosure, leakage current is to be measured using a metal foil with an area of 10 by 20 cm (4 by 8 inches) in contact with the surface. If the conductive surface has an area less than 10 by 20 cm (4 by 8 inches), the metal foil is to be the same size as the surface. The metal foil is to conform to the shape of the surface but is not to remain in place long enough to affect the temperature of the product		N/A
46.3	A typical measurement circuit for leakage current with the ground connection open is illustrated in Figure 46.1. The measurement instrument is defined in Figure 46.2. The meter that is actually used for a measurement need only indicate the same numerical value for a particular measurement as would the defined instrument; it need not have all the attributes of the defined instrument. Over the frequency range 20 Hz to 1 MHz with sinusoidal currents, the performance of the instrument is to be as follows		N/A
46.4	The measured ratio V1/I1 with sinusoidal voltages is to be as close as feasible to the ratio V1/I1 calculated with the resistance and capacitance values of the measurement instrument shown in Figure 46.2		N/A
	The measured ratio V3/I1 with sinusoidal voltages is to be as close as feasible to the ratio V3/I1 calculated with the resistance and capacitance values of the measurement instrument shown in Figure 46.2. V3 is to be measured by the meter M in the measuring instrument. The reading of meter M in RMS volts can be converted to MIU by dividing the reading by 500 ohms and then multiplying the quotient by 1,000. The mathematic equivalent is to multiply the RMS voltage reading by 2		N/A

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
46.5	Unless the measurement instrument is being used to measure leakage current from one part of the power pack to another, it is to be connected between accessible parts and the supply conductor connected to ground.		N/A
46.6	A sample of a product is to be tested for leakage current starting with the as received condition –the as received condition being without prior energization, except as may occur as part of the production line testing. The supply voltage is to be adjusted to rated voltage.		N/A
46.7	The test sequence is to be as follows, with reference to the Figure 46.1 measurement circuit:		N/A
	With switch S1 open, the power pack is to be connected to the measurement circuit. Leakage current is to be measured using both positions of switch S2, and with the product switching devices in all their normal operating positions		N/A
	Switch S1 is then to be closed, energizing the product. Within 5 seconds, the leakage current is to be measured using both positions of switch S2 and with the product switching devices in all their normal operating positions		N/A
	Leakage current is to be monitored until thermal stabilization. Both positions of switch S2 are to be used in determining this measurement. Thermal stabilization is to be obtained by operation as in the Normal Temperature Test, Section 47		N/A
46.8	Normally a sample will be subjected to the entire leakage current test, as specified in 46.7, without interruption for other tests. With the concurrence of all those concerned, the leakage current test may be interrupted to conduct other nondestructive tests		N/A
47	**Normal Temperature Test**	Tested and complied	P
47.1	General		P
47.1.1	A power pack, when tested under the conditions of maximum normal load as described in 47.2 shall not reach a temperature high enough to cause a risk of fire, to damage any materials used, or exceed the temperature rises specified in Table 47.1. See Section 39, Surface Temperatures		P
47.1.2	A thermal or overload protective device shall not open the circuit during the Temperature Test		P
47.1.3	All values of temperature rise in Table 47.1 are based on an assumed ambient temperature of 40°C (104°F)		P
47.1.4	For this test, the test voltage shall be the same as the rated voltage of the power pack		P

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
47.1.5	A power pack shall be operated for a duration that is reasonable in comparison to its normal use. For example, when charging the internal battery, the duration of the charging function is complete when the battery is fully charged. See 47.2.		P
47.1.6	With reference to tests that are to be continued until thermal stabilization is obtained, thermal stabilization is considered to exist when three successive readings taken at intervals of 10 percent of the previously elapsed test duration, but not less than 5 minute intervals, indicate no change in temperature		P
47.1.7	Coil winding temperatures are to be measured by thermocouples or by using the change-of- resistance method		P
47.1.8	Thermocouples are to consist of wires not larger than 24 AWG (0.21 mm^2) and not smaller than 30 AWG (0.05 mm^2). Whenever reference temperature measurements by thermocouples are necessary, thermocouples consisting of 30 AWG iron and constantan wire and a potentiometer-type instrument are to be used. The thermocouple wire is to conform with the requirements specified in the Tolerances on Initial Values of EMF versus Temperature tables in the Standard Specification and Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples, ASTM E230		P
47.2	Maximum normal load		P
47.2.1	Maximum normal load is considered to be the load that approximates as closely as possible the most severe conditions of normal use. It is not a deliberate overload except as the conditions of actual use are likely to be somewhat more severe than the maximum load conditions that are recommended by the manufacturer of the power pack. A product having features not contemplated in these test procedures may be tested as necessary to meet the intent of these requirements		P
47.2.2	A power pack may consist of separate components or assemblies such as lights, air compressors, internal battery, and the like. Each of these assemblies will create a load for the product. All functions that can be performed, and all assemblies that can be operated, at that same time are to be operated in order to create the maximum load. This would include turning on all lights, charging the internal battery, running the air compressor, and the like.		P
47.2.3	For a power pack that contains provisions for eliminating specific functions when others are in process the maximum normal load shall take this into account. In addition, the means for controlling such load balancing shall be investigated for reliability		P

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
47.2.4	The unit shall be designed to minimize the allowable inrush current from the vehicle battery when jump starting. The unit shall be able to accept the maximum allowable inrush current from the clamp leads for at least 10 seconds with no damage to the power pack		P
47.2.5	If the unit is provided with an inverter with AC output, the inverter should be able to operate if clamps are applied to external DC source		N/A
47.3	Power pack ampacity temperature test		P
47.3.1	When conducting the Power Pack Ampacity Test of Section 65, the Power Pack Ampacity Temperature Test is also to be conducted. The Power Pack Ampacity Test is to be conducted for a duration of 25 seconds, or whatever duration is allowed by the inherent functionality of the battery pack, at the end of duration the output of the power pack is to be turned "off". During this time, the temperatures of the battery and all internal affected components including cables are to be recorded and shall be within the limits specified in Table 47.1. Additionally, the temperatures of the clamps are to be monitored from the start of the test and continuing through 2 minutes after the current is turned "off". At no time during this test shall the temperatures exceed those in Table 47.2		P
48	**Dielectric Voltage Withstand Test**	Tested and complied	P
48.1	While in a well-heated condition, a power pack shall withstand for 1 minute without breakdown the application of a 60 Hz essentially sinusoidal potential of:		P
	1000 volts plus twice the maximum rated voltage or		N/A
	500 volts		P
48.2	To determine if the power pack complies with the requirements in 48.1, the power pack is to be tested using a 500 volt-ampere or larger capacity transformer, the output voltage of which can be varied. The applied potential is to be increased from zero until the required test level is reached, and is to be held at that level for 1 minute. The increase in applied potential is to be at a substantially uniform rate as rapid as is consistent with correct identification of its value by a voltmeter		P
49	**Leakage current following humidity conditioning**		N/A
49.1	A power pack shall comply with the requirements for leakage current in Section 46, Leakage Current Test, following exposure for 48 hours to air having a relative humidity of 88 ±2 percent at a temperature of 32 ±2°C (90 ±4°F)	Low voltage no requirements	N/A

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
49.2	To determine whether a product complies with the requirement in 49.1, a sample of the power pack is to be heated to a temperature just above 34° C (93° F) to reduce the likelihood of condensation of moisture during conditioning. The heated sample is to be placed in the humidity chamber and is to remain for 48 hours		N/A
49.3	Following the conditioning, the sample is to be tested as described in the Leakage Current Test, Section 46, while either in the humidity chamber or immediately after removal of the conditioned sample from the humidity chamber. For each test condition, the maximum leakage current is to be recorded and the test is to be discontinued when the leakage current stabilizes or decreases		/A
50	**Abnormal operation test**	Tested and complied	P
50.1	General		P
50.2	Output short test	Tested and complied	P
50.3	Reverse polarity of booster cables		N/A
50.4	Component faults	Tested and complied	P
50.5	Relay and solenoid burnout		N/A
50.6	Printed wiring board abnormal test		P
50.7	Disconnected fan test		N/A
50.8	Blocked ventilation test		N/A
50.9	Overcharging test	Tested and complied	P
50.10	Internal battery reverse polarity test	Tested and complied	P
51	**Vibration test**		P
51.1	Cells shall not catch fire nor explode during or immediately following the Vibration Test		P
51.2	The Vibration Test shall consist of vibration for 4 hours at a frequency of 22 cycles per second with a displacement of 6.4 mm (1/4 inch) in a vertical plane. The unit is to be mounted as intended during the test		P
52	**Ground continuity**		N/A
52.1	The resistance between the point of connection of the equipment-grounding means at or within the product and any other point in the grounding circuit of the product shall not be more than 0.1Ω as determined by an ohmmeter or other equivalent means		N/A

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
52.2	If unacceptable results are observed with an ohmmeter, a low voltage current source can be employed. With the low voltage current source, an alternating current of 25 A (for 15 A maximum rated products) from a power supply of 12 V or less is to be passed for one minute minimum. The current shall be passed from the point of connection of the equipment grounding means to the metal part in the grounding circuit under test. The resulting drop in potential is to be measured between the two points		N/A
53	**Overload tests**		P
53.1	General		N/A
53.2	Overload of switches and controls test		N/A
53.3	Overload of protection devices		P
53.4	Overload of interlocks		N/A
54	**Strain Relief Test**		P
54.1	General		P
54.1.1	The strain relief means provided on a flexible cord shall withstand for 1 minute without displacement a direct pull of 156 N (35 pounds) applied to the cord, with the connections within the power pack disconnected. At the point of disconnection of the conductors, there shall be no movement of the cord as to indicate that stress on the connections would have resulted from the pull force.		P
54.1.2	A 15.9-kg (35-pound) weight is to be suspended from the cord and supported by the power pack so that the strain relief means is stressed from any angle the construction of the power pack permits		P
54.2	Push-back strain relief test		N/A
54.2.1	To determine compliance with 11.2.2.3, a product shall be tested in accordance with 54.2.2 without occurrence of any of the conditions specified in 11.2.2.3 (a) – (c)		N/A
54.2.2	The supply cord or lead is to be held 25.4 mm (1 inch) from the point where the cord or lead emerges from the product and is then to be pushed back into the product. When a removable bushing which extends further than 25.4 mm (1 inch) is present, it is to be removed prior to the test. When the bushing is an integral part of the cord, the test is to be carried out by holding the bushing. The cord or lead is to be pushed back into the product in 25.4-mm (1-inch) increments until the cord buckles or the force to push the cord into the product exceed 26.7 N (6 pounds-force). The supply cord or lead within the product is to be manipulated to determine compliance with 11.2.2.3		N/A
55	**Strength of enclosure tests**	Tested and complied	P
55.1	General		P

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
55.1.1	A power pack shall be tested as described in 55.2 and 55.3. Following these tests, the power pack shall		P
	Not permit a probe, as illustrated in Figure 7.1, to contact an uninsulated live part that may involve a risk of electric shock		P
	Comply with the Dielectric Voltage Withstand Test, Section 48, with the potential applied between live parts and accessible dead metal parts		P
55.1.2	The test in 55.3 is to be performed on a power pack weighing less than 19 kg (40 pounds) and provided with one or more handles for carrying the product		P
55.2	Impact test		P
55.2.1	Two samples of the power pack are to be subjected to the Impact Test. The first sample is tested in the as-received condition. The second sample is to be conditioned in a cold chamber at 0°C (32°F) for 4 hours. The sample is to be removed from the cold chamber and immediately subjected to the impact described in 55.2.2. During handling of the sample, gloves are to be worn to minimize heat transfer		P
55.2.2	An enclosure, guard, or cover is to be subjected to an impact of 6.78 N-m (5 foot-pounds) on any surface that may be subjected to an impact during intended use. The impact is to be produced by dropping a steel sphere, 50.8 mm (2 inches) in diameter and weighing approximately 0.535 kg (1.18 pounds), from a height of 1.30 m (51 inches). For surfaces other than the top, the steel sphere is to be suspended by a cord and allowed to swing as a pendulum dropping through a vertical distance of 1.30 m (51 inches). The impact shall be applied one time to each surface that is exposed to a blow during any condition of intended use		P
55.3	Drop test		P
55.3.1	Two samples of the power pack are to be subjected to this test. The first sample is to be tested in the as-received condition. The second sample is to be conditioned in a cold chamber at 0°C (32°F) for 4 hours. The sample is to be removed from the cold chamber and immediately subjected to the impact described in 55.3.2. During handling of the sample, gloves are to be worn to minimize heat transfer. Following the test, the power pack shall be in accordance with 55.1.1 (a) – (c)		P
55.3.2	The sample is to be dropped three times from a height of 0.9 m (3 feet) to strike a concrete surface in the positions most likely to produce adverse results		P
56	**Mold stress test**	Tested and complied	P
56.1	One sample, consisting of the complete equipment or the complete enclosure, is to be subjected to this test		P

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
56.2	The sample is to be placed in an air circulating oven at a temperature equal to 10 degrees higher than the maximum temperature observed on the enclosure during the temperature test, but not less than 80°C (176°F) or 70°C (158°F) if marked in accordance with 70.22. The sample is to be conditioned in the oven for 7 hours		P
56.3	After the conditioning, the sample shall not show any signs of distortion, deterioration, shrinkage, warping, or softening that would allow access to hazardous live parts		P
57	**Strength of handles test**		P
57.1	A handle used to lift or carry a power pack shall withstand a force of four times the weight of the power pack without breakage of the handle, its securing means, or that portion of the enclosure to which the handle is attached		P
57.2	To determine whether a power pack complies with the requirements in 57.1, a force equal to four times the weight of the power pack is to be uniformly applied over a 76-mm (3-inch) width at the center of the handle, without clamping. The load is to be started at zero and is to be gradually increased so that the test value will be attained in 5 to 10 seconds and maintained at that value for 1 minute. If more than one handle is provided on a power pack and the power pack cannot be carried by one handle alone, the force is to be distributed between the handles. The distribution of forces is to be determined by measuring the percentage of the weight of the power pack sustained by each handle with the power pack in the normal carrying position. If a power pack is furnished with more than one handle and can be carried by one handle only, each handle shall withstand the total force		P
58	**Stability test**	Tested and complied	P
58.1	Under conditions of normal use, a power pack shall not become physically unstable to the degree that it poses a risk of injury to persons.		P
58.2	A power pack shall not tip over but shall return to its normal at rest position when		P
58.3	A power pack is not to be energized during this test. The test is to be conducted under conditions most likely to cause the power pack to overturn		P

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
58.4	With reference to the requirements in 58.2, for a power pack that is constructed so that while being tipped through an angle of 10 degrees, a part or surface of the power pack not normally in contact with the horizontal supporting surface touches the supporting surface before the power pack has been tipped through an angle of 10 degrees, the tipping is to be continued until the surface or plane of the surface of the power pack originally in contact with the horizontal supporting surface is at an angle of 10 degrees from the horizontal supporting surface		P
59	**Hydrostatic strength test**		N/A
59.1	A hydrostatic strength test is to be conducted by filling the pressure confining portion of the sample with water so as to exclude all air, connecting the sample to a hydraulic pump, gradually increasing the pressure to the specified test value, and holding it for a period of 1 minute. As a result of the test, the pressure confining portion of the sample shall withstand without rupture a test pressure of five times the maximum pressure developed by the system, or five times the rated pressure of the power pack's air compressor, whichever is greater		N/A
59.2	Prior to the test, parts molded of polymeric material are to be conditioned in an air circulating oven for 7 hours at a temperature of 70° C (158° F) or 10° C (18° F) higher than the maximum temperature measured on the part under normal load, whichever is greater. The samples are to be removed from the oven and allowed to cool to room temperature prior to the test		N/A
60	**Rain test**		P
60.1	The following Rain Test shall be performed on all power packs that are designated outdoor use or temporary outdoor use		P
60.2	Enclosures shall have no water higher than the lowest hazardous live part inside the enclosure at the conclusion of this test or the power pack shall be subject to the Leakage Current Test in accordance with clauses 46.2 – 46.7	No hazardous live parts	N/A
60.3	The rain test apparatus is to consist of three spray heads mounted in a water supply pipe rack as illustrated in Figure 60.1. The spray heads are to be constructed in accordance with the details illustrated in Figure 60.2. The water pressure for all tests is to be maintained at 34.5 Pa (5 psig) at each of the spray heads. The distance between the center nozzle and the product is to be 1.5 m (5 feet). The product is to be brought into the focal area of the three spray heads in the position intended during use. The spray is to be directed at a 45 degree angle from the vertical toward the product. The total exposure is to be for 1 hour		P

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
60.4	After the exposure, the outside of the enclosure is to be dried with a towel and the enclosure is to be opened. The product is to be inspected for the presence of water in accordance with		P
61	**Tests on insulation material**		N/A
61.1	As required by 29.11, insulating material shall be subjected to this test and shall withstand without electrical breakdown the potential indicated in 61.2.		N/A
	Exception No. 2: An insulating system consisting of N multiple layers of any thickness need not be tested in accordance with 61.2 if all possibilities of N-1 [N minus 1] layers withstand double the test potential defined in the Dielectric Voltage Withstand Test, Section 48, and applied as described in 61.2. “N” must be a minimum of 2 layers		N/A
61.2	The insulating material is to be placed between two opposing electrodes. The electrodes are to be cylindrical brass or stainless steel rods 1/4 inch (6.4 mm) in diameter with edges rounded to a 0.8 mm (1/32 inch) radius. The upper moveable electrode is to weigh 50 ±2 grams (1.76 ±0.07 ounces) to exert sufficient pressure on the specimen to provide good electrical contact. The test potential shall be as indicated in the Dielectric Voltage Withstand Test, Section 48, and is to be maintained for 1 second		N/A
62	**Accelerated aging of gaskets, sealing compound, and adhesive test**		N/A
62.1	The requirements in 62.2 – 62.6 apply to gaskets and sealing compounds employed to make an enclosure raintight or rainproof as determined by the Rain Test, Section 60. The requirements in 62.7 apply to an adhesive used to secure a gasket		N/A
62.2	Neoprene and rubber gasket materials shall have physical properties as specified in Table 62.1 before and after accelerated aging under the conditions specified in Table 62.2		N/A
62.3	Foamed neoprene and foamed rubber gasket materials shall be subjected to accelerated aging under the conditions specified in Table 62.2. The material shall not harden or otherwise deteriorate to a degree that affects its sealing properties		N/A
62.4	Thermoplastic gasket materials shall be subjected to accelerated aging under the conditions specified in Table 62.2. A thermoplastic material shall not deform or melt, or otherwise deteriorate to a degree that will affect its sealing properties. A solid polyvinyl chloride material shall have physical properties as specified in Table 62.1 before and after the accelerated aging		N/A

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
62.5	Tensile strength and elongation are to be determined using the test methods and apparatus described in Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension, ASTM D412		N/A
62.6	A sealing compound is to be applied to the surface it is intended to seal. For a temperature rise not exceeding 35°C (63°F), a representative sample of the surface with the sealing compound applied is to be conditioned for 7 days in an air oven at 87.0 ±1.0°C (189.0 ±1.8°F). The sealing compound shall not melt, become brittle, or otherwise deteriorate to a degree that will affect its sealing properties as determined by comparing the aged sample to the unaged sample		N/A
62.7	For a gasket secured by an adhesive and subject to a temperature rise not exceeding 35°C (63°F), a sample of the gasket secured to the mounting surface by the adhesive is to be exposed for 72 hours to each of the following conditions:		N/A
62.8	The temperature rises specified in this Section correspond to the maximum temperature rise measured on the gasket during the Temperature Test. A material other than those specified in this Section shall be non-absorptive and it, and all materials having a higher temperature rise, shall provide the resistance to aging and temperatures for the application		N/A
63	**Metallic coating thickness test**		N/A
63.1	As required by 10.15, the method for determining the thickness of a protective coating is described in 63.2 – 63.9		N/A
63.2	The solution used for the test is to be made from distilled water and is to contain 200 grams per liter (26.7 ounces per gallon) of American Chemical Society (ACS) reagent grade chromic acid (CrO3) and 50 grams per liter (6.7 ounces per gallon) of ACS reagent grade concentrated sulfuric acid (H2SO4). The latter is equivalent to 27 milliliters per liter of ACS reagent grade concentrated sulfuric acid, specific gravity 1.84, containing 96 percent of H2SO		N/A
63.3	The test solution is to be contained in a glass vessel such as a separatory funnel with the outlet equipped with a stopcock and a capillary tube having an inside bore of 0.64 mm (0.025 inch) and a length of 139.7 mm (5.5 inches). The lower end of the capillary tube is to be tapered to form a tip, the drops from which are about 0.025 milliliters each. To preserve an effectively constant level, a small glass tube is to be inserted in the top of the funnel through a rubber stopper and its position is to be adjusted so that, when the stopcock is open, the rate of dropping is 100 ± 5 drops per minute. If desired, an additional stopcock may be used in place of the glass tube to control the rate of dropping		N/A

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
63.4	The sample and the test solution are to be kept in the test room long enough to acquire the temperature of the room, which is to be noted and recorded. The test is to be conducted at an ambient temperature of 21 – 32°C (70 – 90°F)		N/A
63.5	Each sample is to be cleaned before testing. All grease, lacquer, paint, and other nonmetallic coatings are to be removed using solvents. Samples are then to be thoroughly rinsed in water and dried with clean cheesecloth. Care is to be exercised to avoid contact of the cleaned surface with the hands or any foreign material		N/A
63.6	The sample to be tested is to be supported 17.8 – 25.4 mm (0.7 – 1 inch) below the orifice, so that the drops of solution strike the point to be tested and run off quickly. The surface to be tested is to be inclined about 45 degrees from horizontal		N/A
63.7	The stopcock is to be opened and the time in seconds until the dropping solution dissolves the protective metal coating exposing the base metal is to be measured. The end point is the first appearance of the base metal recognizable by a change in color		N/A
63.8	Each sample of the test lot is to be subjected to the test at three or more points, excluding cut, stenciled, and threaded surfaces, on the inside surface and at an equal number of points on the outside surface, at places where the metal coating may be expected to be the thinnest. On an enclosure made from pre-coated sheets, the external corners that are subjected to the greatest deformation are likely to have thin coatings		N/A
63.9	To calculate the thickness of the coating being tested, select from Table 63.1 the thickness factor for the temperature at which the test was conducted and multiply by the time in seconds required to expose base metal as described in 63.7		N/A
63.10	Zinc metallic coating thickness may also be measured as follows		N/A
64	**Permanency of wrapping hang tag marking**	No such marking	N/A
64.1	Following the test described in 64.2 – 64.5, the marking shall be considered permanently affixed when there is no indication of the results shown in (a) – (d). Manipulation of the hang tag, such as straightening by hand, is allowed when determining compliance with these requirements		N/A

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
64.2	Nine samples of a hang tag are to be tested as described in 64.5. Each sample is to consist of a length of cable to which the hang tag has been attached in the intended manner. If the hang tag is secured by an adhesive, the test is to be conducted no sooner than 24 hours after application of the hang tag. Three samples are to be tested as received; the additional samples are to be conditioned as described in and 64.4 prior to testing		N/A
64.3	Three samples are to be conditioned for 240 hours in an air-circulating oven maintained at a uniform temperature of 87.0 ±1.0°C (188.6 ±1.8°F). Following removal from the oven, the samples are to remain at a temperature of 23.0 ±2.0° C (73.4 ±3.6° F) and a relative humidity of 50 ±5 percent for 30 minutes before testing		N/A
64.4	Three additional samples are to be conditioned for 72 hours at a temperature of 32.0 ±2.0°C (89.6±3.6° F) and a relative humidity of 85 ±5 percent. The samples are to be tested within 1 minute after exposure		N/A
64.5	Each sample cable with attached hang tag is to be tightly suspended and clamped at each end in a vertical plane with the attachment plug or fitting pointing upward. A 22.2 N (5-lb) force is to be applied for 1 minute at the uppermost corner of the tag farthest from the cable and within 6.4 mm (1/4 inch) of the vertical edge of the hang tag. The force is to be applied vertically downward in a direction parallel to the major axis of the cable.		N/A
65	**Power pack ampacity test**		N/A
65.1	A lead-acid power pack with a booster function shall be subjected to the Power Pack Ampacity Test for 10 seconds. Lead acid batteries are to be loaded such that the constant output voltage is 7.2 volts. For Lithium-Ion powered units with protection circuitry, the Power Pack Ampacity Test is to be conducted for 5 seconds and the battery packs may be loaded to the lowest constant output voltage that the battery pack will allow, and this constant voltage will also be included with the battery pack's rating, along with the time duration of the ampacity output. The ampacity is to be recorded for the duration of the test. At the end of the test, the ampacity is to be recorded and this shall be the power pack's ampacity rating. The Power Pack Ampacity Temperature Test, see 47.3, is to be conducted at the same time as the Power Pack Ampacity Test, but note it is continued longer than to obtain the ampacity rating		N/A
66	**Back feed test**	Tested and complied	P

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
66.1	Under both normal operation and single fault conditions, the voltage present at the input connections when the power pack is not connected to the power source shall not exceed 60 V dc, and the available current shall not excUeeLd C3.5OmPA		P
66.2	power pack with a fully charged internal battery is to be subjected to the Back Feed Test. The input connection is to be connected to suitable meters to measure the voltage and current available at the input connection point when the power pack is disconnected from the power source. Following these measurements, component faults are to be simulated, one at a time, and the measurements are to be repeated. All component faults required to determine compliance are to be performed. In all cases, the values measured for voltage and current shall not exceed the limits in 66.1		P
67	**Cold bend test**		N/A
67.1	As directed in 12.2.2.4, samples of the cable shall be subjected to the Cold Bend Test described in 67.2. There shall be no evidence of cracks on the inside or outside surfaces after the test has been completed		N/A
67.2	The specimens and the appropriate mandrel, as specified in Table 67.1, are to be cooled for a period of 4 hours at the manufacturer's recommended lower ambient temperature. After this cooling period, the specimens are to be wound onto the mandrel for six complete turns. The winding is to be done at a rate of about 3 seconds per turn, and successive turns are to be in contact with one another. The test is to be performed in the cold chamber where space and mounting means are available in the chamber. Where this is not practical, it is appropriate to remove a specimen and a mandrel from the test chamber and perform the test outside the chamber. In either case, the winding is to be completed within 30 seconds of the time that the cold chamber is opened.		N/A
68	**Clamp tests**		N/A
68.1	General		N/A
68.1.1	The applicable clamp tests shall be performed as described in 12.2.3.4, 12.2.3.5, and 12.2.3.6		N/A
68.2	Cold drop test		N/A
68.2.1	Following exposure to this test, there shall not be significant deterioration of physical properties of the integrally coated insulation as determined by a visual examination for the presence of cracks, peeling, deformation, eroding, excessive wear, or other imperfections of the insulating material that result in exposing the surface of the metal clamp.		N/A

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
68.2.2	Three samples of the insulated clamp are to be subjected to a low-temperature exposure for one hour consisting of a conditioning temperature based on its lower ambient rating as indicated in 12.2.3. The samples are then to be dropped 1500 mm (5 feet) onto a concrete surface. Following this exposure, the samples are to be subjected to the Dielectric Voltage-Withstand Test in 68.3		N/A
68.3	Dielectric voltage-withstand test		N/A
68.3.1	Samples of the insulated clamp are to be subjected to this test with no indication of dielectric breakdown		N/A
68.4	Secureness test		N/A
68.4.1	The connection between cable and clamp shall be intact with no broken insulation after the test of 68.4.2		N/A

MARKING			
69	**General**		P
69.1	A product shall be legibly and permanently marked with:		P
	a) The manufacturer's name, trade name, trademark, or other descriptive marking by which the organization responsible for the product may be identified; b) A distinctive model number or the equivalent; c) The electrical rating; d) The operating temperature range as specified by the manufacturer; and e) The date or other dating period of manufacture not exceeding any three consecutive months	See copy of marking plate	P
	Exception: The date of manufacture may be abbreviated; or may be in a nationally accepted conventional code or in a code affirmed by the manufacturer, provided that the code: a) Does not repeat in less than 10 years; and b) Does not require reference to the production records of the manufacturer to determine when the product was manufactured.		N/A
69.2	When a manufacturer produces or assembles a power pack at more than one factory, each finished power pack shall have a distinctive marking, to identify it as the product of a particular factory.		N/A
69.3	With reference to 69.1 and the Cautionary Markings, Section 70, the markings shall be legible and permanent. These markings shall be:	See copy of marking plate	P

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
	a) Molded, die-stamped, paint stenciled, stamped or etched metal that is permanently secured; b) Pressure sensitive label complying with the applicable requirements for indoor and outdoor use labels in the Standard for Marking and Labeling Systems, UL 969, at the indicated temperature rating, up to 70°C (158°F) on the specified surface; or c) A hang tag applied to a hose or cord, provided the hang tag complies with the requirements in the Permanency of Wrapped Hang Tag Marking Test, Section 64.		P
69.4	Power packs intended to be used or marketed for use in repair facilities, the power pack shall be marked “suitable for use in a repair facility.”	Not for that purpose	N/A
70	**Cautionary markings**		P
70.1	A product having a hidden or unexpected risk of injury to persons shall be marked to inform the user of the risk.	See copy of marking plate	P
70.2	A cautionary marking shall be permanent and legible, in accordance with 69.3, and shall be located on a permanent part of the product		P
70.3	A cautionary marking intended to instruct the operator shall be legible and visible from the position normally assumed by the operator when starting the product or from the position normally assumed or the specific operation involved. Other such markings for servicing or making settings and adjustments shall be legible and visible to the individual when such work is being done		P
70.4	A marking intended to inform the user of a risk of injury to persons shall be prefixed by a signal word “CAUTION,” WARNING,” or “DANGER.” The marking shall be in letters not less than 3/32 inch (2.4mm) high. The signal word shall be more prominent than any other required marking on the product		P
70.5	The literature accompanying a package containing a basic product and attachments intended to be marketed as a complete unit shall indicate what attachments are intended for use with the basic product if use of such attachments may expose the user to a risk of injury		P
70.6	An attachment that is packaged and marketed separately from the basic product and recommended by the manufacturer for use on the basic product shall be marked to identify the basic product with which it is intended to be used. The identification shall appear in at least one of the following locations:	Not separately	N/A
	a) On the attachment; b) On the package housing the attachment; c) In the instruction book for the basic product; or d) In information furnished with the attachment.		N/A

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
70.7	For components or assemblies used in power packs, such as air compressors, internal batteries, and the like, specific cautionary markings may exist on the enclosure or body of these components are assemblies and which may not be visible to the user once installed in the power pack. If the risk is not removed or reduced due to the installation of this component or assembly in the power pack, then the cautionary marking appearing on the component or assembly shall be repeated on the power pack		N/A
70.8	A compartment involving a risk of electric shock and housing no user serviceable parts shall be marked where readily visible during any approach to servicing. The marking shall consist of the word “CAUTION” and the following or equivalent: “Risk Of Electric Shock, Do Not Remove Cover. No User Serviceable Parts Inside. Refer Servicing to Qualified Service Personnel.”		N/A
70.9	The locations and type designations of user serviceable components shall be marked on the power pack where the marking will be readily visible during servicing of the components, unless replacement of the component by a different type cannot result in a risk of fire, electric shock, or injury to persons	No user serviceable components	N/A
70.10	There shall be a replacement marking adjacent to a user accessible fuse or fuseholder if the fuse is used to reduce the risk of fire or electric shock. The marking shall be located where it will be readily visible during replacement of the fuse, and shall consist of the word “CAUTION” and the following or equivalent: “For Continued Protection Against Risk Of Fire, Replace Only With Same and rating of fuse.” If the fuse is soldered in place and is perceptible during user servicing, the marking shall, in addition to the above, include the following wording or the equivalent: “Refer Replacement To Qualified Service Personnel”.		N/A
70.11	A power pack that contains an internal battery that is to be charged shall be marked with the word “WARNING” and the following or equivalent:		P
	a) Do not overcharge the internal battery – See Instruction Manual. b) Do not smoke, strike a match, or cause a spark in the vicinity of the power pack. c) Only charge the internal battery in a well ventilated area.		P
70.12	A power pack shall be plainly marked with the word “CAUTION” and the following or the equivalent: “Risk of Electric Shock. Connect only to properly grounded outlets.”		N/A

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
70.13	A power pack shall be plainly marked with the word “CAUTION” and the following or the equivalent: “Risk of Injury To Persons. Do not use this product if the power cord or the battery cables are damaged in any way.		N/A
70.14	For polarity identification, one clamp shall be black and the other clamp shall be a contrasting color, other than white at each end of the battery booster cable set. In addition, the contrasting color clamps shall be marked “+” and “POS” or “POSITIVE”, the black clamps shall be marked “−” and “NEG” or “NEGATIVE.”		N/A
70.15	Instructions pertaining to the proper use and connection of the battery cables shall appear on the power pack and as written instructions in the Operating Instructions provided with the product		P
70.16	Power packs which incorporate an interlock device complying with Section 26, Interlocks, shall be marked where readily visible by any personnel attempting to defeat the interlock. The marking shall include the word “WARNING” and the following or the equivalent: “Risk of Electric Shock. This cover is provided with an interlock. Do not defeat its purpose or attempt to service without removing cover completely.” The general location of the interlock shall also be indicated.		N/A
70.17	With reference to 6.2, the power pack shall be marked with the word “WARNING” and the following or the equivalent: “Risk of Explosion. This equipment has arcing or sparking parts which should not be exposed to flammable vapors. This equipment should be located at least 457 mm (18 inches) above the floor when used in a repair facility.”	Not intended for use within a repair facility	N/A
70.18	With reference to 6.2, a power pack that is not intended to be used in a repair facility shall be marked with the word “CAUTION” and the following or the equivalent: “This device is not intended for use in a commercial repair facility.”		P
70.19	With reference to 6.3, temporary outdoor use power packs shall be marked with the word “CAUTION” and the following or the equivalent: “This device is intended to be stored indoors when not in use. This device shall not be stored or left outdoors when not in use.”		P
70.20	With reference to 6.3, temporary outdoor use power packs shall be marked with the word “CAUTION” and the following or the equivalent: “This device is intended for temporary use outdoors and reasonable care should be exercised when using this device in wet conditions.”		P
70.21	With reference to 6.3, indoor use only devices shall be marked “DANGER” and the following or the equivalent: “This device is intended to be used indoors only. Do not use outdoors.”		N/A
70.22	With reference to 6.4 and 7.3.3, products with an enclosure RTI rating less than 80°C shall be marked with the word “WARNING” and the following or the equivalent: “Risk of Electric Shock and Risk of Fire. This device is not to be stored in a vehicle.		N/A

INSTRUCTIONS

TRF No. UL2743A

UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
71	**General**		P
71.1	A product shall be provided with legible installation instructions, operation instructions, and instructions pertaining to a risk of fire, electric shock, or injury to persons associated with the use of the product. Also, user maintenance instructions and moving and storage instructions associated with the use of the product by the end user shall be included	Provided	P
71.2	The instructions mentioned in 71.1 shall be:		P
	a) In separate manuals, or b) Combined in one or more manuals when the instructions pertaining to a risk of fire, electrical shock, or injury to persons are separated in format and emphasized to distinguish them from the rest of the text.	Combined in one manual	P
71.3	An illustration is allowed with a required instruction to clarify the intent but shall not replace the written instruction.		P
71.4	The following items shall be entirely in upper case letters or shall be emphasized to distinguish them from the rest of the text:		P
	a) The headings for the installation, operation, user maintenance, and moving and storage instructions; b) The heading for the instructions pertaining to a risk of fire, electric shock, or injury to persons; and c) The opening and closing statements of the instructions specified in 72.3 – “IMPORTANT SAFETY INSTRUCTIONS” and “SAVE THESE INSTRUCTIONS,” or the equivalent.		P
71.5	Unless otherwise indicated, the text of the instructions in 72.3 and 72.4 shall be in the words specified or words that are equivalent, clear, and understandable. Substitution of the signal word “DANGER” for “WARNING” is allowed when the risk associated with the product is such that a situation exists which, if not avoided, will result in death or serious injury.		P
72	**Instructions Pertaining to Risk of Fire, Electric Shock, or Injury to Persons**		P
72.1	Instructions pertaining to a risk of fire, electric shock, or injury to persons shall warn the user of reasonably foreseeable risks and state the precautions to be taken to reduce such risks. Such instructions shall be preceded by the heading “INSTRUCTIONS PERTAINING TO RISK OF FIRE, ELECTRIC SHOCK, OR INJURY TO PERSONS” or the equivalent		P
72.2	Numbering of the items in the list in 72.3 and including other instructions pertaining to a risk of fire, electric shock, or injury to persons that the manufacturer determines to be necessary and that do not conflict with the intent of the instructions are acceptable		P

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
72.3	The instructions pertaining to a risk of fire, electric shock, or injury to persons shall include those items in the following list that are applicable to the product. The statement "IMPORTANT SAFETY INSTRUCTIONS" or the equivalent shall precede the list, and the statement "SAVE THESE INSTRUCTIONS" or the equivalent shall either precede or follow the list. The word "WARNING" shall be entirely in upper case letters or shall be emphasized to distinguish it from the rest of the text		P
	IMPORTANT SAFETY INSTRUCTIONS		P
	WARNING – When using this product, basic precautions should always be followed, including the following:		P
	a) Read all the instructions before using the product. b) To reduce the risk of injury, close supervision is necessary when the product is used near children. c) Do not put fingers or hands into the product. d) Use of an attachment not recommended or sold by power pack manufacturer may result in a risk of fire, electric shock, or injury to persons. e) To reduce risk of damage to the electric plug and cord, pull the plug rather than the cord when disconnecting the power pack. f) Do not use a battery pack or appliance that is damaged or modified. Damaged or modified batteries may exhibit unpredictable behavior resulting in fire, explosion or risk of injury. h) Do not operate the power pack with a damaged cord or plug, or a damaged output cable. h) Do not disassemble the power pack, take it to a qualified service person when service or repair is required. Incorrect reassembly may result in a risk of fire or electric shock. i) To reduce the risk of electric shock, unplug the power pack form the outlet before attempting any instructed servicing. j) WARNING – RISK OF EXPLOSIVE GASES. 1) WORKING IN VICINITY OF A LEAD ACID BATTERY IS DANGEROUS. BATTERIES GENERATE EXPLOSIVE GASES DURING NORMAL BATTERY OPERATION. FOR THIS REASON, IT IS OF THE UTMOST IMPORTANCE THAT YOU FOLLOW THE INSTRUCTIONS EACH TIME YOU USE THE POWER PACK. 2) To reduce risk of battery explosion, follow these instructions and those published by battery manufacturer and manufacturer of any equipment you intend to use in vicinity of the battery. Review cautionary marking on these products and on engine.		P

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
	k) PERSONAL PRECAUTIONS 1) Consider having someone close enough by to come to your aid when you work near a lead-acid battery. 2) Have plenty of fresh water and soap nearby in case battery acid contacts skin, clothing, or eyes. 3) Wear complete eye protection and clothing protection. Avoid touching eyes while working near battery. 4) If battery acid contacts skin or clothing, wash immediately with soap and water. If acid enters eye, immediately flood eye with running cold water for at least 10 minutes and get medical attention immediately. 5) NEVER smoke or allow a spark or flame in vicinity of battery or engine. 6) Be extra cautious to reduce risk of dropping a metal tool onto battery. It might spark or short-circuit battery or other electrical part that may cause explosion. 7) Remove personal metal items such as rings, bracelets, necklaces, and watches when working with a lead-acid battery. A lead-acid battery can produce a short-circuit current high enough to weld a ring or the like to metal, causing a severe burn.		P
	l) When charging the internal battery, work in a well ventilated area and do not restrict ventilation in any way. m) Under abusive conditions, liquid may be ejected from the battery; avoid contact. If contact accidentally occurs, flush with water. If liquid contacts eyes, additionally seek medical help. Liquid ejected from the battery may cause irritation or burns. n) Do not expose a power pack to fire or excessive temperature. Exposure to fire or temperature above 130°C may cause explosion. The temperature of 130°C can be replaced by the temperature of 265°F. o) Have servicing performed by a qualified repair person using only identical replacement parts. This will ensure that the safety of the product is maintained. p) Attach output cables to a battery and chassis as indicated below. Never allow the output clamps to touch one another. 1) Instructions shall include step by step directions for the proper use of the booster function detailing the correct steps to connect and disconnect the booster cables to the battery. 2) Each step shall be a different numbered item. SAVE THESE INSTRUCTIONS		P
72.4	The instructions pertaining to a risk of fire, electric shock, or injury to persons, or the installation instructions shall include the appropriate items if applicable.		P
73	**Installation instructions**		P

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict
73.1	Installation instructions shall contain all the information needed to install the product for use as intended, and shall be preceded by the heading “INSTALLATION INSTRUCTIONS” or the equivalent		P
73.2	The installation instructions shall contain complete instructions concerning the proper selection of the detachable power supply cord to be used with power packs marked in accordance with 70.17		P
74	**Operating Instructions**		P
74.1	Operating instructions shall contain all the information needed to operate the product as intended, and shall be preceded by the heading “OPERATING INSTRUCTIONS” or the equivalent		P
74.2	Instructions in relation to operating that appear in the instructions pertaining to a risk of fire, electric shock, or injury to persons, are not required to be repeated here; but a reference to those instructions shall be included here		P
74.3	With reference to 6.2, the Operating Instructions for a power pack shall contain statements informing the user not to place the power pack on the floor, or at a height less than 457 mm (18 inches) above the floor, during use in a repair facility		N/A
75	**User Maintenance Instructions**		P
75.1	Instructions for user maintenance shall include explicit instructions for all cleaning and servicing that are intended to be performed by the user, and shall be preceded by the heading “USER MAINTENANCE INSTRUCTIONS” or the equivalent		P
76	**Moving and Storage Instructions**		P
76.1	If moving or storage of the product is able to result in damage to the product that could result in a risk of fire, electric shock, or injury to persons during subsequent use, the instructions shall describe the proper moving and storage procedure, and shall be preceded by the heading “MOVING AND STORAGE INSTRUCTIONS” or the equivalent.		P
Appendix A	**Safety Marking Translations**		Info.

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict

29.1	Table: spacings					N/A
clearance and creepage distance at/of:	Up (V)	U r.m.s. (V)	Through air distance (mm)	cl (mm)	required dcr (mm)	Over surface distance (mm)

Note:

1) The basic insulated secondary wire can not touch AC circuit
2) T1 core was considered as the AC circuit

42	TABLE: Input test						P
U (V)	I (A)	I rated (A)	P (W)	P rated (W)	Fuse No	I fuse (A)	Condition/status
12.8	49.8	50	--	--	--	--	Charging the internal battery (fully discharged battery)

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict

47.1	TABLE: maximum temperatures		P
	test voltage (V)	See below	—
	t_{amb1} (°C)	40.0	—
	t_{amb2} (°C)	40.0	—
maximum temperature T of part/at::		T (°C)	allowed T_{max} (°C)
Charge fully discharged battery, charge only			
PCB		75.8	130
Internal wire		59.2	200
Cell body		54.7	Ref.
Enclosure inside		53.6	80

47.1	TABLE: maximum temperatures		P
	test voltage (V)	See below	—
	t_{amb1} (°C)	40.0	—
	t_{amb2} (°C)	40.0	—
maximum temperature T of part/at::		T (°C)	allowed T_{max} (°C)
Charging and discharging with fully charged battery			
PCB		78.5	130
Internal wire		65.1	200
Cell body		64.9	Ref.
Enclosure inside		63.2	80

48	Table: Dielectric voltage withstand test	P
test voltage applied between:	test voltage (V)	breakdown Yes / No
Unit input to DC output	500	No
Unit input to plastic enclosure with metal foil	500	No
Unit input to dead metal part (fixing screws)	500	No
supplementary information		
Note: Test voltage a.c., 60Hz, 1minute. Ur is the highest rated voltage		

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UL 2743			
Clause	Requirement – Test	Result – Remark	Verdict

50	TABLE: Abnormal operating tests		P
Ambient temperature (°C)		25°C if not mentioned	—
Power source for EUT: Manufacturer, model/type, output rating		See page 2	—

Component No.	Abnormal Condition	Supply voltage, (V)	Test time (ms)	Fuse no.	Fuse current, (A)	T-couple	Temp. (°C)	Observation
D1	S-C	12.8VDC	10 mins	--	--	--	--	The appliance can't work, no harzard, no broken
U2	S-C	12.8VDC	10 mins	--	--	--	--	The appliance can't work, no harzard, no broken
R1	S-C	12.8VDC	10 mins	--	--	--	--	The appliance can't work, no harzard, no broken
Battery	S-C	12.8VDC	10 mins	--	--	--	--	The appliance can't work, no harzard, no broken
Battery	Over-charge	12.8VDC	7h 35mins	--	--	--	--	No hazard, no explosion and no charring or burning of the gauze or tissue paper

Supplementary information:

58	TABLE: Stress relief test			P
Part/Location	Material	Oven Temperature (°C)	Duration (h)	Observation
Completed sample	Plastic enclosure	70	7	No damaged, the hazardous parts cannot be touched

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-Appendix 1: Photo document.

Photo 1: Overall view

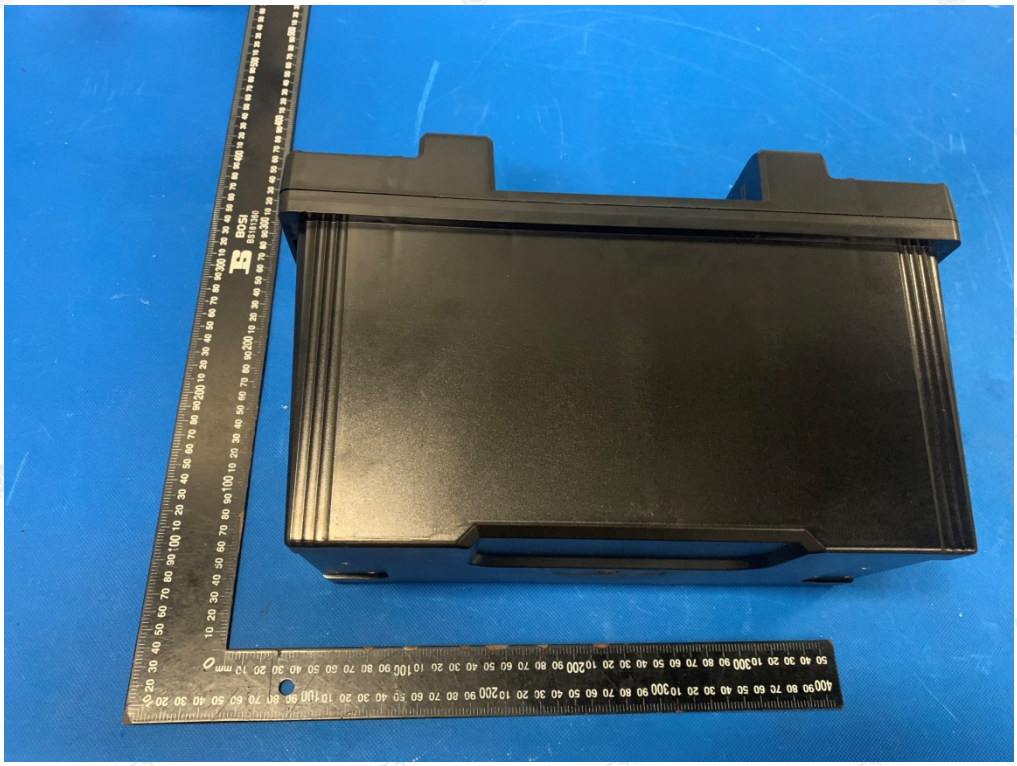

Photo 2: Overall view

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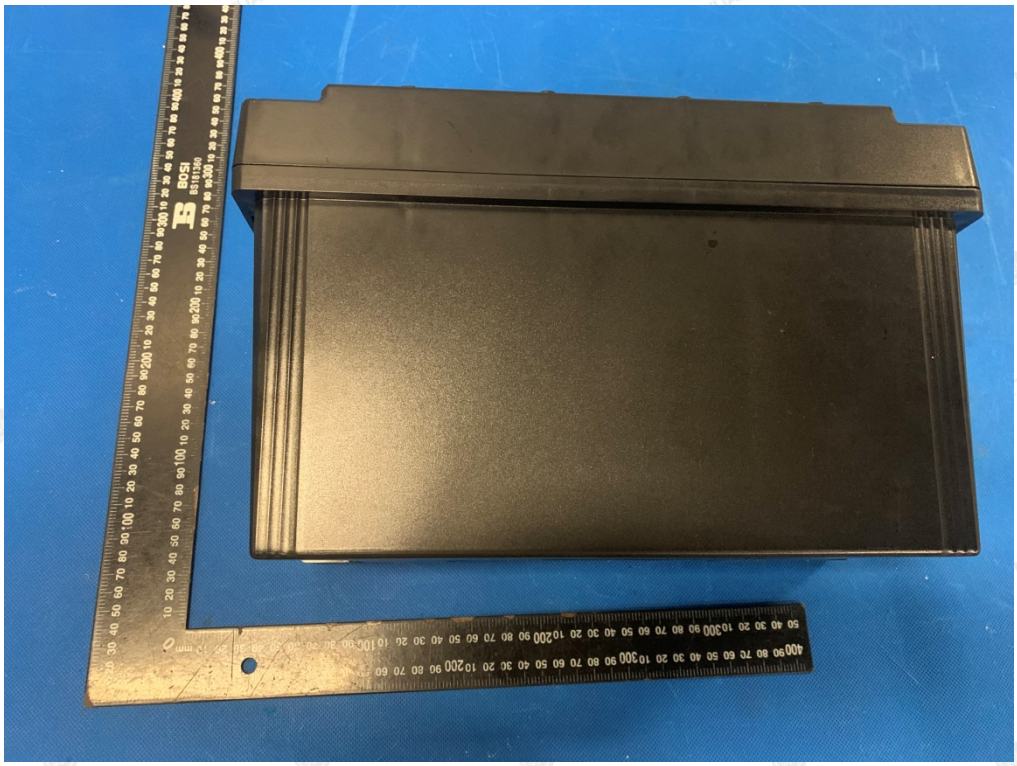

Photo 3: Side view

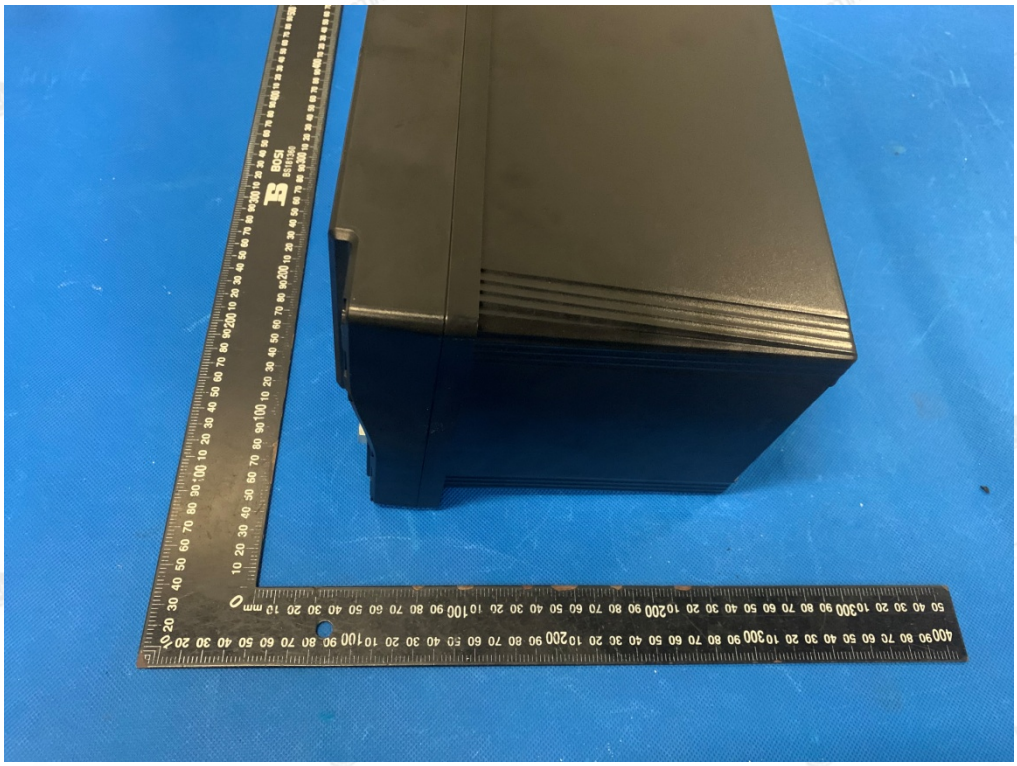

Photo 4: Side view

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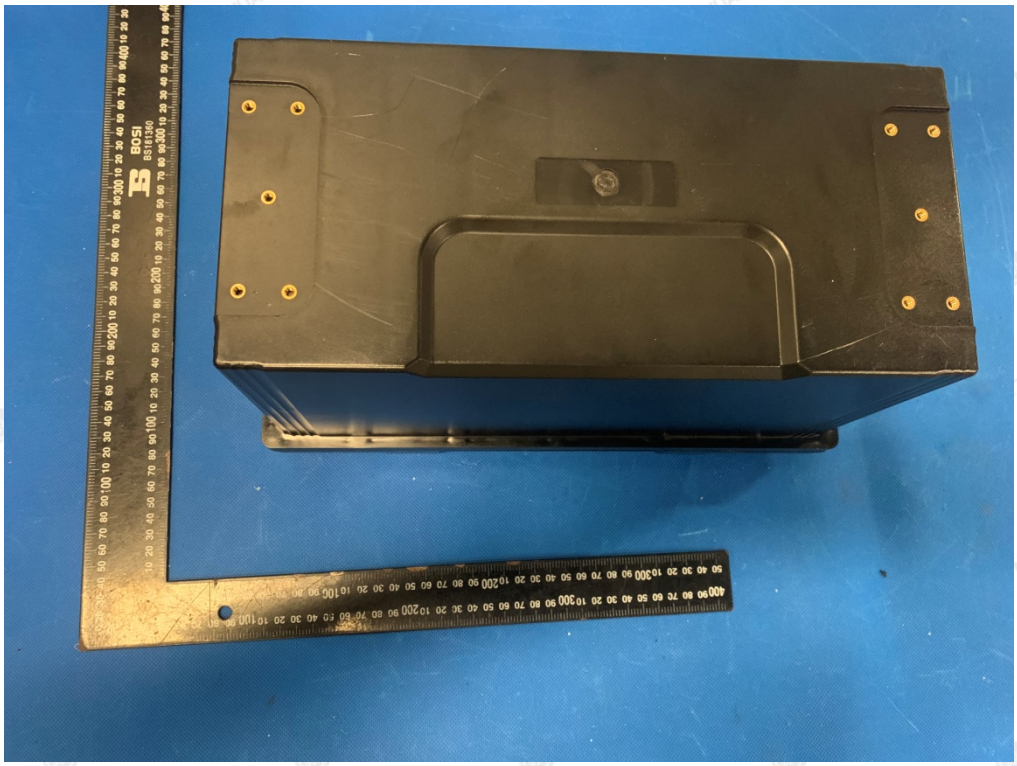

Photo 5: Side view

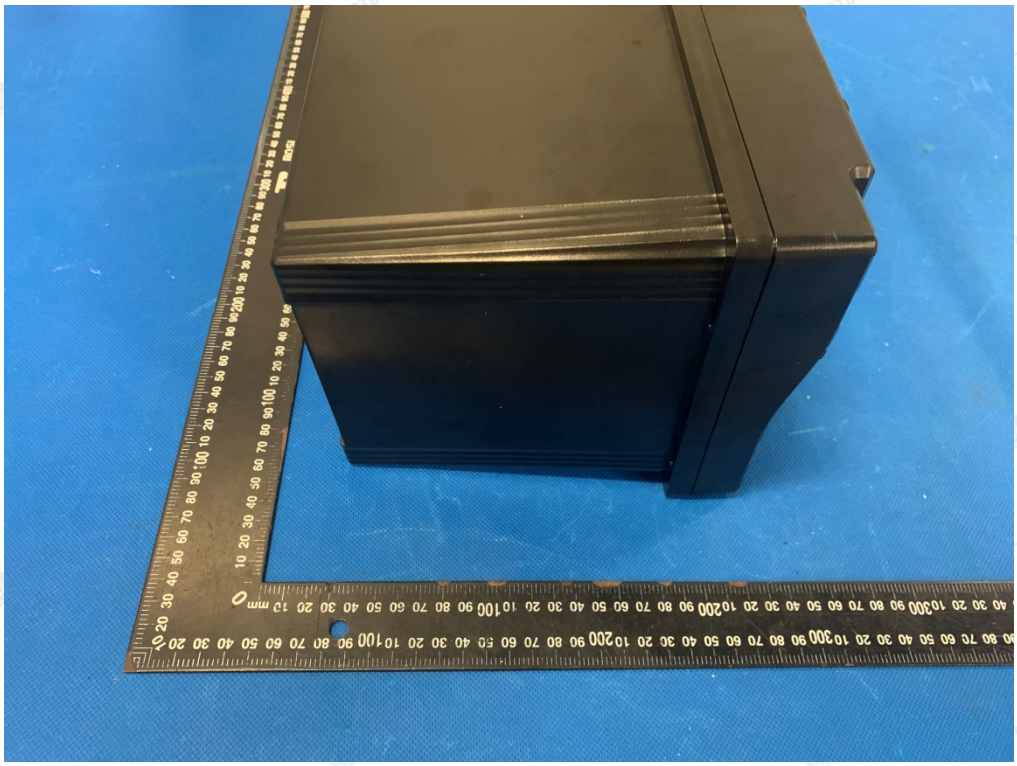

Photo 6: Side view

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Add: 1-2F., Building B2, Junfeng Zhongcheng Zhizao Innovation Park, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China

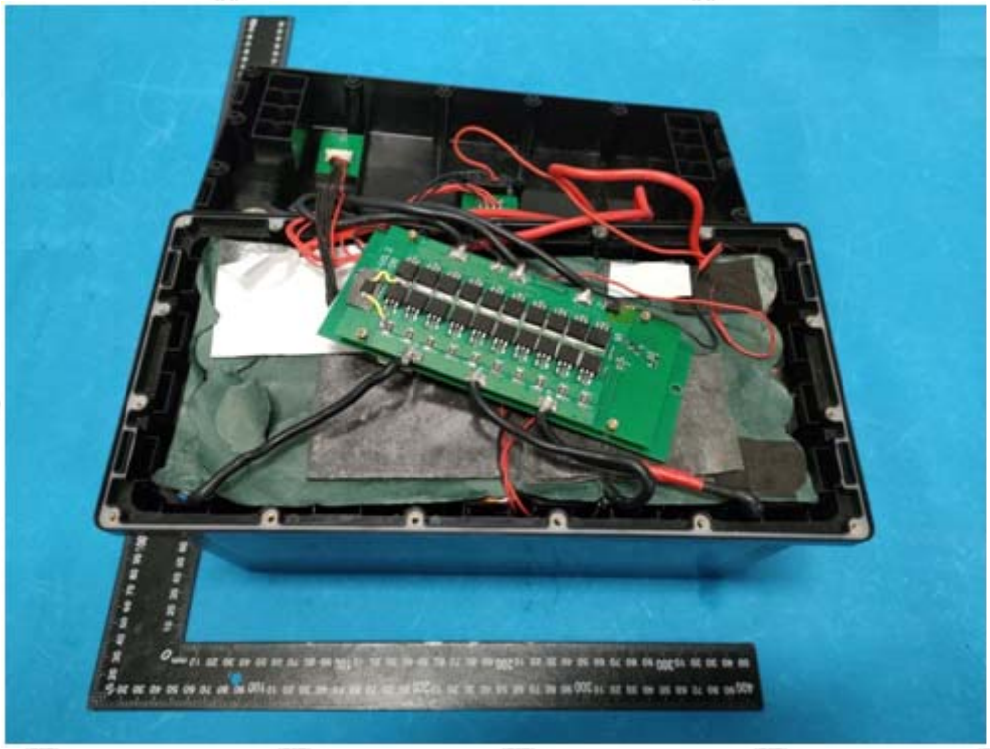

Photo 7: Internal view

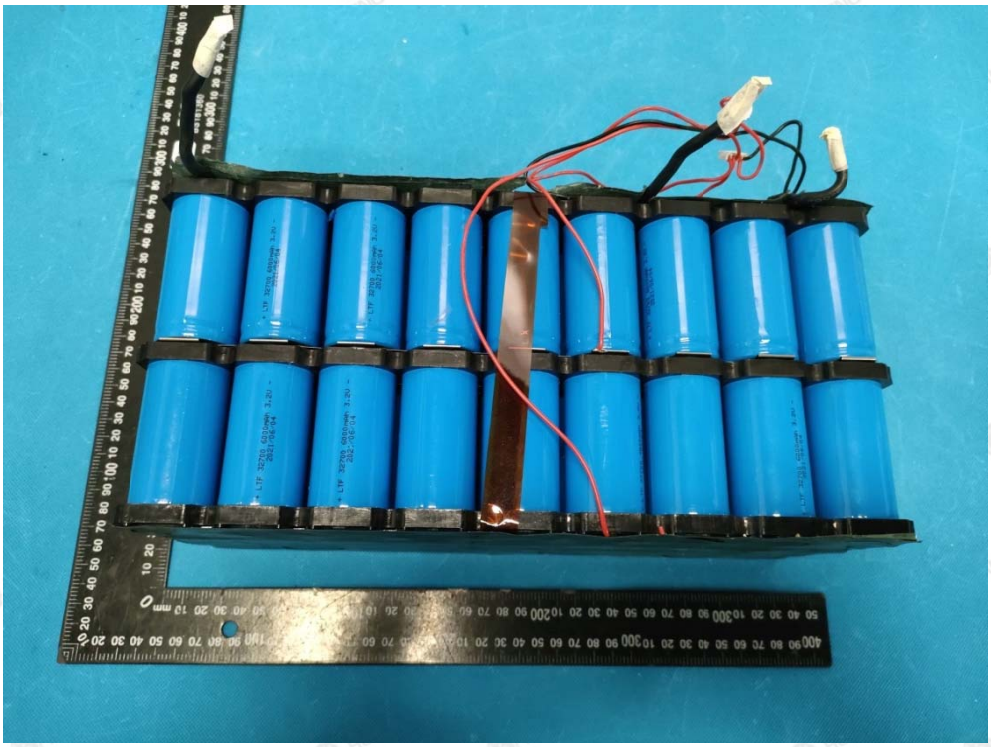

Photo 8: Battery view

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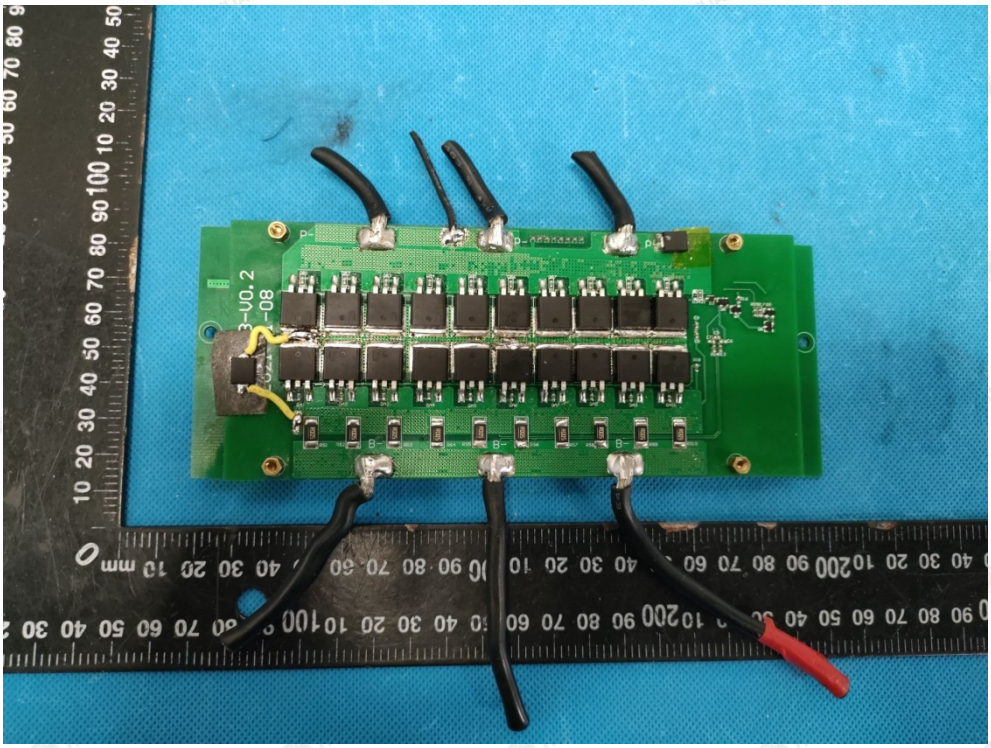

Photo 9: PCB view

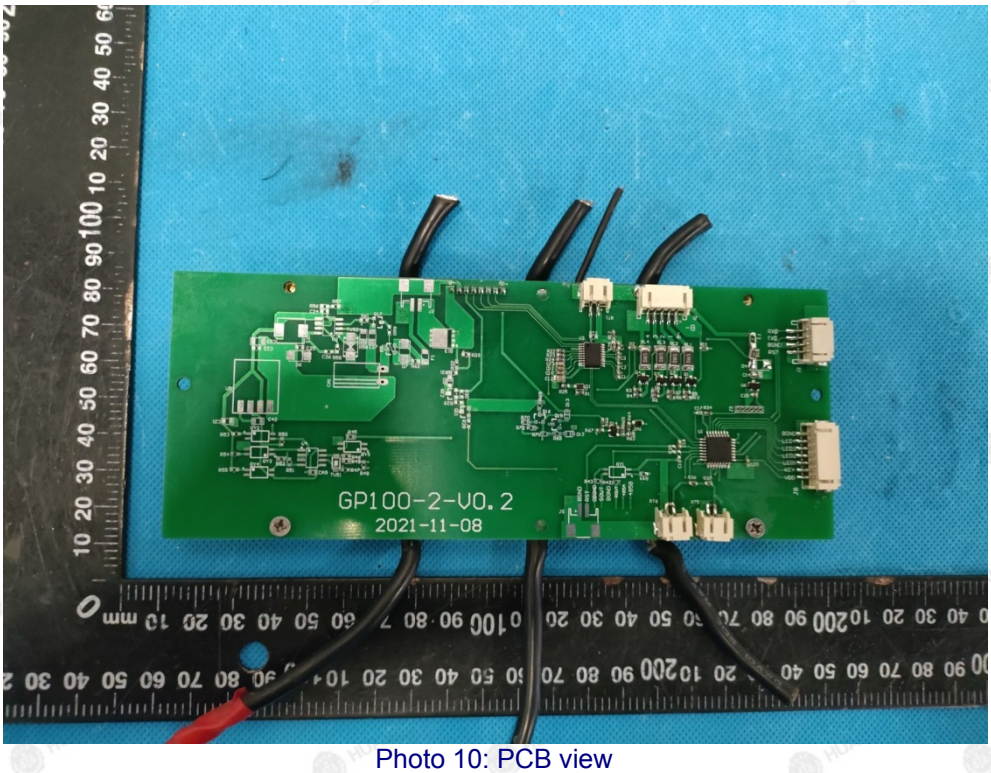

Photo 10: PCB view

----------End of test report----------

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