TCT

Certificate of Compliance

Certificate No.	:	TCT190729E005C
Applicant	:	Shenzhen Vigor Power Battery Co., Ltd
Address	:	3rd Floor, No.1 Building, Yongfa Industrial Zone, Yanchuanchaoyang Road, Songgang Town, Baoan District, Shenzhen, China
Manufacturer	:	Shenzhen Vigor Power Battery Co., Ltd
Address	:	3rd Floor, No.1 Building, Yongfa Industrial Zone, Yanchuanchaoyang Road, Songgang Town, Baoan District, Shenzhen, China
Product	:	Lithium Ion Battery
Model No.	:	3480-1800mAh-14.8V-80C, 43126-6000mAh-7.4V-60C, 37126-3000mAh-7.4V-40C, 3496-2800mAh-11.1V-40C, 3462-1500mAh-14.8V-80C, 43126-7000mAh-40C-11.1V, 2096-1200mAh-7.4V-20C, 20122-1200mAh-11.1V-20C, 3462-1500mAh-11.1V-80C, 3496-2200mAh-11.1V-40C, 43126-4000mAh-40C-14.8V, 43126-5200mAh-40C-7.4V, 43126-5500mAh-40C-11.1V, 5220122-2400mAh-11.1V-20C
Trade mark	:	FCONEGY

The above products have been tested by us with listed standards and found in compliance with the council EMC 2014/30/EU. It is possible to use CE marking to demonstrate the compliance with this EMC.

Test standards:	Report(s) Number	Issued By	Issued Date
EN 61000-6-3:2007+A1:2011+AC:2012 EN 61000-6-1:2007	TCT190729E005	TCT	Aug. 08, 2019

The statement is based on a single evaluation of one sample of above mentioned products. It does not imply an assessment of the whole production and does not permit the use of the test lab logo.

CE

Tomsin

Tomsin/Senior Engineer

Aug. 08, 2019

SHENZHEN TCT TESTING TECHNOLOGY CO., LTD. TCT

Shenzhen TCT Testing Technology Co.,Ltd.
Hotline: 400-6611-140 Tel: 86-755-27673339 Fax: 86-755-27673332 Http://www.tct-lab.com

MSDS Report

Prepared For :	Ningbo New Luster Trading Limited 1608Room, 16FL,China Citic Bank Building,36# Zhenming Rd, Ningbo City, 315010 China .
Product Name:	Car Emergency Starting Power
Model :	K4, J13, K8, J12, J8, J10
Rated:	12V 20000mAh
Prepared By :	Shenzhen EZT Testing Technology Co., Ltd. 3F, Zhongchuang Business Center, No.70 Xihuan Avenue, Matian Street, Guangming District, Shenzhen City, Guangdong Province, China.
Report No.:	EZT20220214009MR

Written by: Andy Yan Approved by: Steve

Inspected by: Calvin Date: 2022.02.14

Material Safety Data Sheet

Section 1- Chemical Product & Company Identification

Product Name: Car Emergency Starting Power

Manufacture: Shenzhen Xinlijie Technology Co., Ltd.

Address: 312, Huashang International Building, No.183, Longhuan 2nd Road, JingLong Community, Longhua Street, Longhua Distirct, Shenzhen City.

Contact Person: Ms Tracy Wong

Telephone: 13777101318

E-mail: info@tvluster.com

Section 2- Composition/information on Ingredients

Hazardous Ingredients (Chemical Name)	Concentration or concentration ranges (%)	CAS Number
Lithium Cobalt Dioxide (LiCoO2)	25%~35%	12190-79-3
Graphite (C)	15%~20%	7782-42-5
Polyvinylidene	1%~5%	24937-79-9
Acetylene Black	0.5%~3%	1333-86-4
Aluminum(AL)	21%~23%	7429-90-5
Copper(Cu)	10%~11%	7440-50-8
Electrolyte	10%~15%	623-53-0/ 21324-40-3

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Section 3- Hazards Summarizing

Danger sort: N/A

Routes of entry:

1. Eyes and Skin – When leaking, the electrolyte solution contained in the battery irritates to ocular tissues and the skin.
2. Inhalation － Respiratory (and eye) irritation may occur if fumes are released due heat or an abundance of leaking batteries.
3. Ingestion – The ingestion of the battery can be harmful. Content of open battery can cause serious chemical burns of mouth, esophagus and gastrointestinal tract.

Health harm:

Exposure to leaking electrolyte from ruptured or leaking battery can cause:

1. Inhalation－Burns and irritation of the respiratory system, coughing, wheezing, and shortness of breath.
2. Eyes－Redness, tearing, burns. The electrolyte is corrosive to all ocular tissues.
3. Skin－The electrolyte is corrosive and causes skin irritation and burns.
4. Ingestion－The electrolyte solution causes tissue damage to throat and gastrointestinal track.

Environment harm: Not necessary under conditions of normal use.

Explosion danger: The battery may be explosive at high temperature (above 150℃) or exposing to the fire.

Section 4- First Aid Measures

Skin contact: Not anticipated. If the battery is leaking and the contained material contacts the skin, flush with copious amounts of clear water for at least 15 minutes.

Eye contact: Not anticipated. If the battery is leaking and the contained material contacts eyes, flush with copious amounts of clear water for at least 15 minutes. Get medical attention at once.

Inhalation: Not anticipated. If the battery is leaking, remove to fresh air. If irritation persists, consult a physician.

Ingestion: Not anticipated. If the battery is leaking and the contained material is ingested, rinse mouth and surrounding area with clear water at once. Consult a physician immediately for treatment.

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Section 5- Fire Fighting Measures

Unusual Fire and Explosion Hazards: Battery may explode or leak potentially hazardous vapors subject to: exposed to excessive heat (above the maximum rated temperature as specified by the manufacturer) or fire, over-charged, short circuit, punctured and crushed.
Hazardous Combustion Products: Fire, excessive heat, or over voltage conditions may produce hazardous decomposition products. Damaged batteries can result in rapid heating and the release of flammable vapors.
Extinguishing Media: Dry chemical type extinguishers are the most effective means to extinguish a battery fire. A CO_2 extinguisher will also work effectively.
Fire Fighting Procedures: Use a positive pressure self-contained breathing apparatus if batteries are involved in a fire. Full protective clothing is necessary. During water application, caution is advised as burning pieces of flammable particles may be ejected from the fire.

Section 6- Accidental Release Measures

The material contained within the battery would only be released under abusive conditions. In the event of battery rupture and leakage, collect all the released materials that are not hot or burning in an appropriate waste disposal container while wearing proper protective clothing and ventilate the area. Placed in approved container and disposed according to the local regulations.

Section 7- Handling and Storage

Handling:
1. Batteries are designed to be recharged. However, improperly charging a battery may cause the battery to flame. When charging the battery, use dedicated chargers and follow the specified conditions.
2. Never disassemble or modify a battery.
3. Do not immerse, throw, and wet a battery in water.
4. Should a battery unintentionally be crushed, thus releasing its contents, rubber gloves must be used to handle all battery components. Avoid the inhalation of any vapors that may be emitted.
5. Short circuit causes heating. In addition, short circuit reduces the life of the battery and can lead to ignition of surrounding materials. Physical contact with to short-circuited battery can cause skin burn.
6. Avoid reversing the battery polarity, which can cause the battery to be damaged or flame.
7. In the event of skin or eye exposure to the electrolyte, refer to Section 4, First Aid Measures.

Storage:

1. Batteries should be separated from other materials and stored in a noncombustible, well ventilated, sprinkler-protected structure with sufficient clearance between walls and battery stacks. Do not place batteries near heating equipment, nor expose to direct sunlight for long periods.
2. Do not store batteries above 45℃or below –10℃. Store batteries in a cool (about 20±5℃) in a long time, dry and ventilated area that is subject to little temperature change. Elevated temperatures can result in reduced battery cycle life. Battery exposure to temperatures in excess of 60℃will result in the battery venting flammable liquid and gases.
3. Keep batteries in original package until use and do not jumble them.

Section 8 - Exposure Controls/Personal Protection

Engineering Controls: Keep away from heat and open flame.

Ventilation: Not necessary under conditions of normal use. In case of abuse, use adequate mechanical ventilation (local exhaust) for the battery that vent gas or fumes.

Respiratory Protection: Not necessary under conditions of normal use. If battery is burning, leave the area immediately. During fire fighting fireman should use self-contained breathing, full-face respiratory equipment. Fires may be fought but only from safe fire fighting distance, evacuate all persons from the area of fire immediately.

Eye Protection: Not necessary under conditions of normal use. Use safety glasses with side shields if handling a leaking or ruptured battery.

Body Protection: Not necessary under conditions of normal use. Use rubber apron and protective working in case of handling a leaking of ruptured battery.

Protective Gloves: Not necessary under conditions of normal use. Use chemical resistant rubber gloves if handling a leaking or ruptured battery.

Others: Use good chemical hygiene practice. Wash hands thoroughly after cleaning-up a battery spill caused by leaking battery. No eating, drinking, or smoking in battery storage area.

Section 9- Physical and Chemical Properties

Physical State	Form: Solid	
	Color: White	
	Odour: Monotony	
Change in condition:		
pH, with indication of the concentration		Not applicable
Melting point/freezing point		Not available.
Boiling Point, initial boiling point and Boiling range:		Not available.
Flash Point		Not available.
Upper/lower flammability or explosive limits		Not available.
Vapor Pressure:		Not applicable
Vapor Density: (Air = 1)		Not applicable
Density/relative density		Not available.
Solubility in Water:		Insoluble
n-octanol/water partition coefficient		Not available.
Auto-ignition temperature		130°C
Decomposition temperature		Not available.
Odout threshold		Not available.
Evaporation rate		Not available.
Flammability (soil, gas)		Not available.
Viscosity		Not applicable

Section 10 – Stability and Reactivity

Stability: Stable

Conditions to Avoid: Do not heat, throw into fire, disassemble, short circuit, immerse in water or overcharge, etc.

Incompatibility: None during normal operation. Avoid exposure heat, open flame and corrosives.

Hazardous Polymerization: Will not occur.

Hazardous Decomposition Products: The battery may release irritative gas once the electrolyte leakage

Section 11 – Toxicological Information

The battery does not elicit toxicological properties during routine handling and use. If the battery is opened through misuse or damage, discard immediately. Internal components of cell are irritant and sensitization.

Irritancy: The electrolytes contained in this battery can irritate eyes with any contact. Prolonged contact with the skin or mucous membranes may cause irritation.

Sensitization: No information is available.

Teratogenicity: No information is available.

Carcinogenicity: No information is available.

Mutagenicity: No information is available.

Reproductive toxicity: No information is available.

Section 12-Ecological Information

1. When properly used and disposed, the battery does not present environmental hazard.
2. The battery does not contain mercury, cadmium, or lead.
3. Do not let internal components enter marine environment. Avoid releasing to water ways, wastewater or ground water.

Section 13 – Disposal Considerations

1. Disposal of the battery should be performed by permitted, professional disposal firms knowledgeable in Federal, State or Local requirements of hazardous waste treatment and hazardous waste transportation.
2. The battery should be completely discharged prior to disposal and/or the terminals taped or capped to prevent short circuit. When completely discharged it is not considered hazardous.
3. The battery contains recyclable materials. Recycling options available in your local area should be considered when disposing of this product, through licensed waste carrier

Section 14 – Transport Information

According to PACKING INSTRUCTION 965 ~ 967 of IATA DGR 63th Edition for transportation, the special provision 188 of IMDG (inc Amdt 38-16). The batteries should be securely packed and protected against short-circuits. Examine whether the package of the containers are integrate and tighten closed before transport. Take in a cargo of them without falling, dropping, and breakage. Prevent collapse of cargo piles. Don't put the goods together with oxidizer and chief food chemicals. The transport vehicle and ship should be cleaned and sterilized before transport. During transport, the vehicle should prevent exposure, rain and

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high temperature. For stopovers, the vehicle should be away from fire and heat sources. When transported by sea, the assemble place should keep away from bedroom and kitchen, and isolated from the engine room, power and fire source. Under the condition of Road Transportation, the driver should drive in accordance with regulated route, don't stop over in the residential area and congested area.

(a) UN number

3480&3481

(b) UN Proper shipping name

LI BATTERIES (including lithium ion batteries) or;
LI BATTERIES CONTAINED IN EQUIPMENT or LI BATTERIES PACKED WITH EQUIPMENT (including lithium ion batteries)

(c) Transport hazard class(es)

9

(d) Packing Instruction (if applicable)

965 II/ IB, 966 II, 967 II

(e) Marine pollutant (Yes/No)

No

(f) Transport in bulk (according to Annex II of MARPOL 73/78 and the IBC Code)

No information available.

(g) Special precautions

No information available.

Section 15 – Regulatory Information

The transport of rechargeable lithium-ion batteries regulated by the united nations as detailed in the "model Regulations on the transport of dangerous Goods Ref. ST/SG/AC.10/1 Defined by UN in the "Recommendations on the transport of Dangerous Goods Chapter 38.3 Manual of Tests and Criteria Ref. ST/SG/AC/ 10/11 sixth revised edition 2015". The Lithium-ion Cells and the battery Packs may or may not be assigned to the UN No. 3480 Class-9 that is restricted for transport.

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Section 16 – Additional Information

The information above is believed to be accurate and represents the best information currently available to us. however, concorde makes no warranty of merchantability or any other warranty, express or implied, with respect to such information, and we assume no liability resulting from its use. users should make their own investigations to determine the suitability of the information for their particular purposes. although reasonable precautions have been taken in the preparation of the data contained herein, it is offered solely for your information, consideration and investigation. this material safety data sheet provides guidelines for the safe handling and use of this product; it does not and cannot advise on all possible situations, therefore, your specific use of this product should be evaluated to determine if additional precautions are required. The data/information contained herein has been reviewed and approved for general release on the basis that this document contains no export controlled information.

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Sample Photos

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*** END OF MSDS***

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Test Report issued under the responsibility of:

TEST REPORT
UL 2743
STANDARD FOR SAFETY Portable Power Packs

Report Reference No. ..... :	STL2023S1120100R-S1
Tested by(+signature) ..... :	Sunny
Approved by(+signature) ..... :	Barry
Date of issue ..... :	2023-11-20
Total number of pages ..... :	60 pages
Testing Laboratory ..... :	**Shenzhen STL Testing Technology Co., Ltd.**
Testing location ..... :	Unit C, 4F, Building A, ShengHengji Industrial Park, No. 137 FuYuan 1 Road, Heping Community, Fuyong Street, Baoan District, Shenzhen, China
Applicant's name ..... :	**guangzhouyidengshangmaoyouxiangongsi**
Address ..... :	huaduquxinhuajiedaoxinhuacunxinhuadatangbianqianjiesanxiang1 guangzhoushi guangdongsheng
Manufacturer's name ..... :	**Shenzhen Xinlijie Technology Co., Ltd.**
Address ..... :	611, Floor 6, Building F, Yuxing Science And Technology Industrial Park, 3rd Industrial Zone, Gushu 2nd Road, Nanchang Community, Xixiang Street, Shenzhen, Guangdong, CN
Test specification:	
Standard ..... :	UL 2743 2nd Edition, July 3, 2018 Complete Document UL Standard for Safety Portable Power Packs
Test procedure ..... :	UL 2743
Non-standard test method ..... :	N/A
Test Report Form No. ..... :	TR_UL2743 B
Test Report Form(s) Originator ..... :	UL
Master TRF ..... :	Dated 2021-02
Test item	
Description ..... :	Car jump starter
Trade Mark ..... :	N/A
Model/Type reference ..... :	J16
Model differences ..... :	/
Ratings ..... :	Start Current :600A Peak Current:4000A Output:5V⎓2A Input: 5V⎓2A Batter capacity:29800MAh

Possible test case verdicts:	
- test case does not apply to the test object..... :	N/A
- test object does meet the requirement..... :	P (Pass)
- test object does not meet the requirement..... :	F (Fail)
Testing..... :	
Date of receipt of test item..... :	2023-11-13
Date (s) of performance of tests..... :	2023-11-13 to 2023-11-20

General remarks:

The test results presented in this report relate only to the object tested.

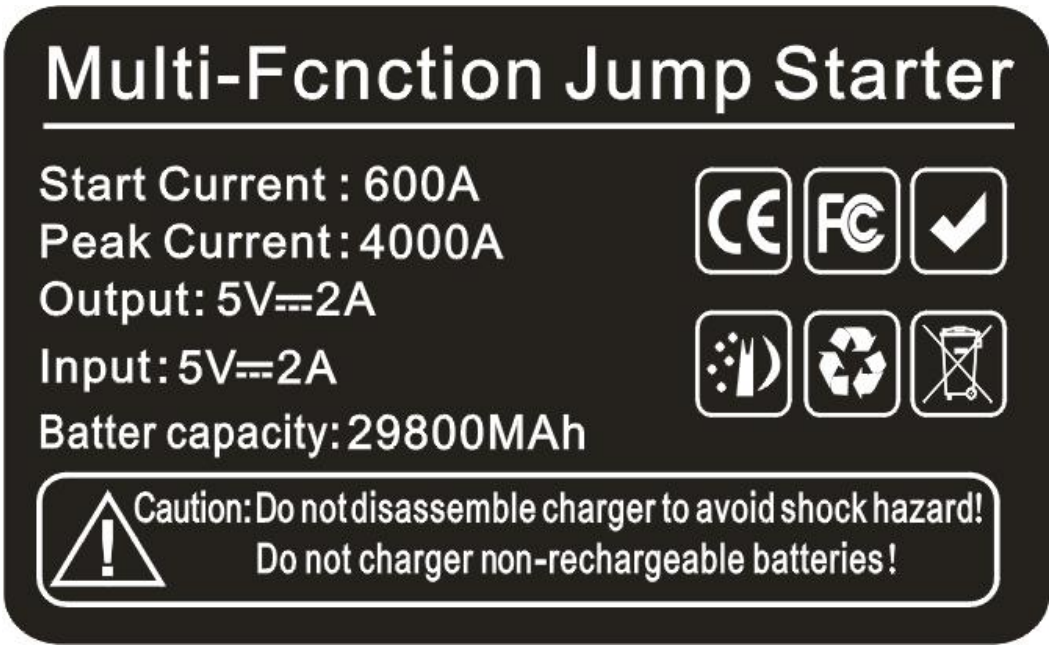
This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.

"(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 comma (point) is used as the decimal separator.

Copy of Marking plate ***(marking will be the one finally provided on product for selling)***



Manufacturer:Shenzhen Xinlijie Technology Co., Ltd.

Address:611, Floor 6, Building F, Yuxing Science And Technology Industrial Park, 3rd Industrial Zone, Gushu 2nd Road, Nanchang Community, Xixiang Street, Shenzhen, Guangdong, CN

Remarks

The use of certification marks on a product must be authorized by the respective certification bodies that own these marks.

Summary of testing:

This test report shows that submitted sample(s) have been evaluated and tested to comply with applicable standard requirements in Standard for Portable Power Packs, UL 2743-2018, 2nd Edition, dated July 3, 2018.

When determining the test conclusion, the Measurement Uncertainty of test has been considered.

Amendment history: None *(or other…)*

Tests performed (name of test and test clause):

--	Test clause	Test item
☒	42	Power Input Test
☒	43	Normal Charging Operation Test
☒	44	Lithium Charging System Test
☐	45	Capacitor Discharge Test
☐	46	Leakage Current Test
☒	47	Normal Temperature Test
☒	48	Dielectric Voltage Withstand Test
☐	49	Leakage Current Following Humidity Conditioning
☒	50.2	Abnormal Operation – Output Short Test
☒	50.3	Abnormal Operation – Reverse Polarity of Booster Cables
☒	50.4	Abnormal Operation – Component Faults
☐	50.5	Abnormal Operation – Relay and Solenoid Burnout
☐	50.6	Abnormal Operation – Printed Wiring Board Abnormal Test
☐	50.7	Abnormal Operation – Disconnected Fan Test
☐	50.8	Abnormal Operation – Blocked Ventilation Test
☒	50.9	Abnormal Operation – Overcharging Test
☒	50.10	Abnormal Operation – Internal Battery Reverse Polarity Test
☐	51	Vibration Test
☐	52	Ground Continuity
☐	53.2	Overload – Overload of Switches and Controls Test
☐	53.3	Overload – Overload of Protection Devices
☐	53.4	Overload – Overload of Interlocks
☒	54.1	Strain Relief Test
☒	54.2	Push-back Strain Relief Test
☒	55.2	Impact Test
☒	55.3	Drop Test
☐	56	Mold Stress Test
☐	57	Strength of Handles Test
☐	58	Stability Test
☐	59	Hydrostatic Strength Test

☐	60	Rain Test
☐	61	Tests on Insulating Materials
☐	62	Accelerated Aging of Gaskets, Sealing Compounds, and Adhesives Test
☐	63	Metallic Coating Thickness Test
☐	64	Permanency of Wrapped Hang Tag Marking
☐	65	Power Pack Ampacity Test
☐	66	Back Feed Test
☐	67	Cold Bend Test
☒	68.2	Clamp Tests – Cold Drop Tests
☒	68.3	Clamp Tests – Dielectric Voltage-withstand Test
☒	68.4	Clamp Tests – Secureness Test

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict

1	**Scope**		**-**
1.1	For portable and movable power packs provided with one or more batteries (either lead acid or lithium ion battery) or electrochemical capacitor modules.		P
	Power packs to provide emergency starting power (rated 24 V maximum).	Max. 12V	P
1.2	Power packs suitable for outdoor use, suitable for temporary outdoor use, or suitable for indoor use only	Indoor used only	N/A
	Power pack with a booster function shall not be considered indoor use only	No such function	N/A
1.3	Additional systems (air compressor, flashlight, etc)	Flashlight	P
1.4	Functions covered in this standard		P
1.5, 1.6	Requirements not covered		**N/A**
2	Unit of measurement		P
3	Components		P
4	Reference publications		--
5	Glossary		--
	Construction		P
6, 6.1	**General**		--
6.2	Instruction and marking were provided for power packs intended for use within a repair facility		P
	Marking was provided for power packs not intended for use in a repair facility		P
6.3	Outdoor use power packs shall be evaluated for all environmental considerations	Indoor used only	N/A
	Temporary outdoor use power packs shall be evaluated for exposure to rain, and be suitably marked and instructed.		N/A
	Marking and instruction for Indoor use only power packs		P
6.4	Vibration test was performed		P
7	**Frame and Enclosure**		--
7.1, 7.1.1	General		P
7.1.2	Power pack shall be provided with an enclosure suitable for the application		P
7.1.3	Electrical instrument forming part of the enclosure, the face or the back of the meter, or both together, shall comply with the requirements for enclosure		P
7.1.4	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		N/A
7.1.5	Enclosures for outdoor use power packs shall comply with the Environmental requirements		N/A
7.2	**Metallic enclosures**		-

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
7.2.1	Enclosures constructed of metallic materials shall be subjected to the Strength of Enclosure Tests, Section 55.		P
7.2.2	A metallic enclosure shall have a thickness not less than that specified in Tables 7.1 and 7.2		P
7.2.3	Metallic enclosures shall resist to corrosion (section 10)		P
7.3	**Nonmetallic enclosures**		-
7.3.1	General	Plastic enclosure	P
7.3.2	Enclosure material shall have a minimum flame rating of V-1	V-0 enclosure	P
7.3.3	Relative Thermal Index (RTI) value was not less than 80 ºC		P
7.3.4	Conductive coatings on nonmetallic inner surface shall be evaluated per UL746C and CSA C22.2 No. 0.17.		N/A
7.3.5	Adhesive used to secure parts of an enclosure shall comply with UL746C and CSA C22.2 No. 0.17.		N/A
7.3.6	Enclosure was subject to Mold Stress Test (Section 56)		P
7.3.7	Enclosure was subject to Strength of Enclosure Test (Section 55)		P
7.4	**Openings in enclosures**		-
7.4.1	Outdoor use power pack enclosures shall not allow the entrance of water in accordance with 7.5	Indoor used only	N/A
7.4.2	Accessibility of uninsulated live part (tested with Fig. 7.1 Articulate probe)		N/A
7.4.3	Thermoplastic covering an opening for user servicing shall be reliably retained in place		N/A
7.4.4	Access to uninsulated live part at hazardous voltage or hazardous energy levels shall be prevented.		N/A
7.4.5	Door or cover for live part at hazardous voltage or hazardous energy levels shall be securely held in place		N/A
7.4.6	Door or cover for renewal of over-current protective device		N/A
7.4.7	Handle or button may project outside the enclosure		N/A
7.5	**Environmental considerations**		-
7.5.1	Outdoor use or temporary outdoor use power pack shall be constructed to exclude a beating rain in accordance with 7.5.2.	Indoor used only	N/A
7.5.2	Power pack was subject to Rain Test (section 60)		N/A
7.5.3	Power pack was subject to Gasket test (section 62)		N/A
7.5.4	Nonmetallic enclosure for outdoor use power pack shall comply with requirements of exposure to ultraviolet light and water per UL746C and CSA C22.2 No. 0.17.		N/A
8	**Flammability of Materials**		-

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
8.1	Nonmetallic materials used for enclosures shall have a minimum flammability rating of V-1	V-0 enclosure	P
	As an alternative, finished enclosures may be tested in accordance with the 20 mm end-product flame test, UL746C and CSA C22.2 No. 0.17.		N/A
	Magnesium shall not be used for enclosure materials		N/A
8.2	Other than small part, nonmetallic materials used for internal parts within the overall enclosure shall be rated V-2 minimum.		P
8.3	Decorative parts shall be rated HB minimum		N/A
8.4	Printed wiring board materials shall be rated V-1 minimum		P
8.5	Determination of flammability rating of the material per UL94, UL746C and CSA C22.2 No. 0.17.		N/A
9	**Assembly**		-
9.1	General		N/A
9.2, 9.3	Switch shall be securely mounted by means other than friction between surfaces		N/A
9.4	Securement of non-replaceable lampholder		N/A
9.5	Small stem mounted device having a single hole mounting means secured by lock-washer.		N/A
10	**Corrosion Protection**		-
10.1	Metal shall be used in combinations that are galvanically compatible		P
10.2	Hinges and other attachments shall be resistant to corrosion		P
10.3, 10.4	Exceptions		P
10.5	A metallic enclosure shall be protected against corrosion as specified in 10.6-10.15		P
10.6	Copper, bronze, brass containing not less than 80 percent copper, or stainless steel may be used without additional protection against corrosion		P
	Sheet, extruded, or cast aluminum, die-cast zinc, and other metals shall be of a grade or alloy known to be resistant to atmospheric corrosion, shall be subjected to tests, or shall be additionally protected against corrosion.		N/A
10.7	Corrosion protection for enclosure of cast iron or malleable iron at least 1/8 inch (3.2 mm) thick		N/A
10.8	Unless suitability of a paint can be determined by consideration of its composition, corrosion tests are required		N/A
10.9	Corrosion protection for enclosure of sheet steel less than 0.126 inch (3.20 mm) thick if zinc-coated or 0.123 inch (3.12 mm) thick		N/A
10.10	Corrosion protection for enclosure of zinc coated steel 0.0126 inch (3.20 mm) thick or thicker or an enclosure of uncoated sheet steel 0.123 inch (3.12 mm) thick or thicker		N/A

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
10.11	Clause 10.10 also apply to an enclosure of zinc-coated sheet steel 0.056 inch (1.42 mm) thick or thicker and an enclosure of uncoated sheet steel 0.053 inch (1.35 mm) thick or thicker		N/A
10.12, 10.13	Test of other finishes, including paints, metallic finishes, and combinations		N/A
10.14	A hot-dipped, mill-galvanized A60 (alloyed) coating or an annealed zinc coating that is bent or similarly formed after annealing and that is not otherwise required to be painted, shall be painted in the bent or formed area if the bending or forming process has damaged the zinc coating		N/A
10.15	Verification test of the thickness of coatings (Section 63)		N/A
11	**Supply Connections**		-
11.1, 11.1.1	General		P
11.1.2	Input options for portable power packs shall be:		-
	a) Cord and plug connection, rated at 240 V ac maximum, to and/or 60 Hz;		N/A
	b) Photovoltaic panel or device with inverter;		N/A
	c) Vehicle adapter, rated 12 V dc maximum; or		N/A
	d) USB input port (can also act as output port).		P
	e) Cables for charging from a vehicle battery rated up to 24 V dc maximum		P
11.2	Flexible cord connection		N/A
11.2.1.1	Type of flexible cord		N/A
11.2.1.2	Flexible cord of power packs intended for use in a repair facility		N/A
11.2.1.3	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	Voltage and Ampacity rating of attachment plug		N/A
11.2.1.5	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 1.8 m (6 feet).		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	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

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
11.2.2	Strain relief		N/A
12.2.2.1	Strain relief to be provided on a non-detachable flexible cord		N/A
	Knot in flexible cord shall not be used.		N/A
12.2.2.2	Auxiliary insulation for metal strain relief clamp or band		N/A
12.2.2.3	Means shall be provided to prevent a flexible cord from being pushed into the equipment. (Test by Push-Back Strain Relief test, section 54.2)		N/A
11.2.3	Bushings		N/A
11.2.3.1	Provided at the point where a non-detachable flexible cord passes through an opening in the enclosure.		N/A
	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 1.6 mm (1/16 inch) 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
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;		P
	The output of the external power supply shall be complying with UL/CSA 60950-1, UL1310 / CSA C22.2 No. 223, or UL1012 / CSA C22.2 No. 107.1		P
11.4	Vehicle adapters		P
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 UL2089 and CSA C22.2 No. 107.1.		P
	The connector plug shall incorporate a fuse or other protective device having a current rating not greater than 15 A		P

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
	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.		P
11.4.2	If the fuse is user replaceable, the vehicle adapter shall be marked in accordance with 70.10.		N/A
	This marking shall appear adjacent to the fuseholder		N/A
11.5	Photovoltaic panels	No photovoltaic panels	N/A
11.5.1	Power packs provided with a photovoltaic panel shall be provided with an inverter complying with UL1741 or UL62109-1		N/A
12	**Output Connections**		-
12.1.1	Power packs shall be provided with one or more outputs that terminate in a suitable connector or other connection means		P
12.1.2	The output of the power pack shall include at least one of the output options		-
	a) Booster cable assemblies, see 12.2;		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
	e) USB Connectors, see 12.4.		P
12.2	Booster cable assemblies		N/A
12.2.1.1	Booster cable assemblies shall be detachable or non-detachable assemblies.		N/A
12.2.1.2	For detachable booster cable assemblies, the connector shall be in accordance with UL 1977 / CSA C22.2 No. 182.3 or the Standard for Automotive Battery Booster Cables, UL 1839 (middle connectors).		N/A
	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 and bushings		N/A
12.2.2	Cables		N/A
12.2.2.1	The cable provided with the booster cable assembly shall comply with UL1839		N/A
12.2.2.2	As an alternative, when the power pack is provided with a protection system for the cable assembly, cable can be shown to comply with the requirements in 12.2.2.3 – 12.2.2.7		N/A
	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

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
12.2.2.3	The conductors used within the cables shall comply with UL758 and CSA C22.2 No. 127 or CSA C22.2 No. 210.		N/A
	shall 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
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 3 ft (920 mm).		N/A
	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 3 foot span distance can be reduced.		N/A
	The safety circuit shall be subject to the requirements in Section 40.		N/A
12.2.2.7	The cable shall be subjected to the Ampacity Test in Section 65		N/A
12.2.3	Clamps		P
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		P
12.2.3.2	As an alternative, 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.		P
	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.		P
12.2.3.3	The clamp bodies shall be fabricated from nonmetallic materials and these materials shall have a flame rating of HB minimum.		P
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		P
12.2.3.5	The clamps shall be subjected to the Dielectric voltage-withstand test, Section 68.3		P
12.2.3.6	The clamp shall be subjected to the Secureness test, Section 68.4		P
12.3	Receptacles		N/A

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
12.3.1	Receptacles provided as an output on power packs shall be rated 120 V ac, 20 A maximum, and shall consist of a double blade, ungrounded configuration, NEMA type receptacle that is in accordance with UL 498 and CAN/CSA C22.2 No. 42		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 UL1977 and 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 UL1977 and CSA C22.2 No. 182.3.		P
(UL1977, cl. 1.2)	Classification of connector (Type 0, 1A, 1B, 2, 3, 4, 5)	Output connectors were tested with appliance.	P
(UL1977, cl. 7)	Insulation materials (base or body), RTI and flammability ratings per table 7.1		P
(UL1977, cl. 8)	Current-carrying parts		P
(UL1977, cl. 9)	Grounding and dead-metal part		N/A
(UL1977, cl. 10)	Assembly		N/A
(UL1977, cl. 11)	Spacings (min. 1.2mm for device <250V, or min. 3.2mm for device >=250V)		N/A
(UL1977, cl. 12)	Performance (table 12.1) Remark: for connector device intended to serve as disconnect device, 200 cycle of overload test shall be performed and followed by temperature and dielectric strength test.		N/A

Test	Section	Connector Type						
		Type 0	Type 1A	Type 1B	Type 2	Type 3	Type 4	Type 5
Accelerated aging	13	O	O	O	O	O	O	O
Mold stress relief[a]	14	X	X	X	X	X	X	X
Overload[b]	15	–	O	O	O	O	N	N
Temperature[b]	16	Y	Y	X	X	X	X	X
Dielectric voltage-withstand[b]	17	–	X	X	X	X	X	X
Resistance to arcing[b,c]	18	–	O	O	O	O	N	N
Conductor secureness	19	O	O	O	O	O	O	O
Flammability	20	OA	OA	OA	OA	OA	OA	OA
Grounding impedance	21	O	O	O	O	O	O	O

X – Required
Y – Required if device has an assigned current rating.
O – Optional for some devices. Refer to test description for details.
OA – Optional for all devices.
N – Not permitted.
[a] See the Exception to 14.1.
[b] For female devices intended for current interruption the overload, temperature, dielectric voltage-withstand and resistance to arcing tests shall be performed in sequence using the same test specimens.
[c] The resistance to arcing test may be performed on a separate set of specimens. See 18.2.

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
(UL1977, cl. 23.4)	A device intended exclusively for disconnecting use shall be marked “Not for current interrupting” or “For disconnecting use only” or with an equivalent statement. This marking shall be located on the device, or in or on the smallest unit container or carton.		N/A
12.4.3	Circuit need not be investigated (open circuit voltage <30Vdc or 21.2Vpk; output current limited to 8A; and available power <240VA)		N/A
12.5	Vehicle adapter sockets		N/A
12.5.1, 12.5.2	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 CSA C22.2 No. 127 or CSA C22.2 No. 210.		N/A
12.5.3	Circuit need not be investigated (open circuit voltage <30Vdc or 21.2Vpk; output current limited to 8A; and available power <240VA)		N/A
13	**Grounding**		-
13.1.1	A product shall have a provision for grounding when the unit is connected to the mains power source	No grounding.	N/A
	Exception: Double insulated products are not required		N/A
13.1.2-13.1.12	General requirements for grounding		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**		-
14.1	A device may be provided with a system of double insulation that complies with the requirements of UL 2097		N/A
14.2, 14.3	Double insulation marking		N/A
15	**Current Carrying Parts**		-
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		P
16	**Internal Wiring**		-
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		P

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
16.1.2	Protection of insulated wiring		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.		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		N/A
16.2	**Wiring insulation**		N/A
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		N/A
16.2.2	The insulation of wiring used in a high voltage circuit shall have a flame retardant rating of VW-1		N/A
16.2.3	Sleeving, tape, and tubing used for insulation on wires shall be rated for the voltage and temperature involved		N/A
16.3	**Splices and connections**		N/A
16.3.1	Splices and connections shall be mechanically secure and provide electrical contact.		N/A
	A soldered connection shall be made mechanically secure before being soldered.		N/A
16.3.2	Equipment subjected to vibration shall be provided with lock washers or other means to mechanically secure wire binding screws and nuts.		N/A
	A twist on type connector shall be additionally secured to the wires by means of at least two layers of tape.		N/A
	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 CSA C22.2 No. 197		N/A
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.		N/A
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.		N/A
	Tape shall not be wrapped over a sharp edge.		N/A
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.		N/A
16.3.6	Aluminum conductors used as internal wiring, shall be terminated at each end by a method that is acceptable for the combination of metals involved at the connection point		N/A

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
16.3.7	wire binding screw or a pressure terminal connector used as a terminating device shall be rated for use with aluminum under the condition involved		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		N/A
17	**Separation of Circuits**		-
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	Class III	N/A
17.2	An insulated conductor shall be positioned so that it cannot contact an uninsulated live part of a different circuit.		N/A
17.3	Segregation of insulated conductors (method)		N/A
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		N/A
18	**Insulating Materials**		-
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 UL 746C and CSA C22.2 No. 0.17.		N/A
18.2	Use of ordinary vulcanized fiber		N/A
18.3	Thermoplastic material shall not be used for the sole support of live parts		N/A
19	**Compressors**		-
19.1, 19.1.1	General 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.		N/A
	Air compressors supplied with the power pack, but as a separate unit shall be evaluated in accordance with UL 1450 and CAN/CSA C22.2 No. 68.		N/A
19.2	**Motors and thermal protection**		-
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.		N/A
	Film coated wire used for motor windings is not required to be additionally treated to prevent moisture absorption.		N/A
	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

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
19.2.3, 19.2.4	A motor shall be provided with a thermal protector complying with UL2111 or UL1004-3 and 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 UL 1450 and 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**		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	Test requirements (Mold-stress relief followed by Hydrostatic Strength Test, Section 59)		N/A
20	**Capacitors and Electrochemical Capacitor Modules**		-
20.1	**Capacitors**		N/A
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	Product with combination consisting of a rectifier and an electrolytic capacitor		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 in this standard.		N/A
20.2	**Electrochemical capacitor modules**		N/A
20.2.1	The electrochemical capacitor module shall comply with the requirements in 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.		N/A
	Any appropriate means is allowed, but any software or programmable components associated with this protection means shall be evaluated for reliability.		N/A

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
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.		N/A
	Any approriate 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.		N/A
	Any attempt to jump start a vehicle while the power pack is plugged in shall be prohibited by the power pack itself.		N/A
	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**		-
21.1, 21,2	The assembly of a power resistor shall be reliable. The resistor shall be prevented from loosening or rotating by a means other than friction between surfaces (for example by employing lock washers)		N/A
22	**Lampholders**		-
22.1	The screw shell of a lampholder shall be connected to 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	Lampholder supplied from an LVLE circuit		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 UL 5085-2 and CAN/CSA C22.2 No. 66.2 (General purpose transformers) or UL 5085-3 and CAN/CSA C22.2 No. 66.3 (Class 2 and Class 3 transformers).		N/A
24	**Switches and Controls**		-
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.		N/A

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
24.2	Primary circuit switch that controls an inductive load having a power factor less than 75 percent, 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	Switch or other device that controls a motor and is not interlocked 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
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 grounded conductor of a circuit		N/A
	Exception: A switch may disconnect the ground conductor provided it cannot disconnect the ground conductor without first disconnecting the ungrounded 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.		N/A
25	**Printed Wiring Boards**		-
25.1	Printed wiring board shall comply with UL 796, and have a minimum flammability classification of V-1.		P
25.2, 25,3	Components mounted on a printed wiring board 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
26	**Interlocks**		-
26.1	General		N/A
26.2	The interlock device shall not be defeated readily		N/A
26.3	During normal operation and user servicing:		N/A
	a) The interlock is not defeated by improper disassembly;		N/A
	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;		N/A

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
	c) The act of removal or replacement of the interlocked cover shall not subject the user to unintentional contact with live parts;		N/A
	d) The interlocked cover is not capable of being readily misapplied to result in a risk of electric shock; and		N/A
	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**		-
27.1	An overcurrent or thermal protective device shall be suitable for the application.		N/A
27.2	Automatic reset device 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.		N/A
27.3	Fuse involving a risk of electric shock shall be inaccessible		N/A
27.4	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.		N/A
	The power pack shall be marked in accordance with 70.10.		N/A
	This marking shall be adjacent to the fuse.		N/A
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**		-
28.1	General		P
28.1.1	Connections to the terminals of the internal battery shall be secure.		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.		P

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
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.		N/A
	If the battery pack is not provided with this means of prevention, then the power pack is subjected to the test in 50.10.		P
28.2	**Lead acid batteries**		-
28.2.1	A lead acid battery shall comply with 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**		-
28.3.1	A lithium-ion battery cell shall comply with UL 1642, or UL 62133 / 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.		P
28.3.3	The power pack shall provide short circuit protection for the battery or the test of 50.2 shall be performed.		P
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.		P
28.3.5	The battery shall be subjected to the Normal Operation Charging Test, Section 43.		P
28.3.6	The power pack shall be subjected to the Lithium-Ion Charging System Test, Section 44.		P
29	**Spacings**		-
29.1	Spacings between live parts of opposite polarity, and between live and dead metal parts shall not be less than specified in Table 29.1		N/A
	Exception No. 1: Spacings between traces on a printed wiring board need not comply with Table 29.1 if the printed wiring board complies with the Printed wiring board abnormal test, 50.6.		N/A
	The requirements specified in 50.6 do not substitute for the minimum required spacings between the printed wiring board foils and dead metal parts or the spacings between the primary and secondary board as specified in Table 29.1.		N/A
	Exception No. 2: This requirement does not apply to spacings complying with 29.5 – 29.9.		N/A
	Exception No. 3: This requirement does not apply to spacings complying with 29.10 and 29.11.		N/A

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
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.		N/A
29.3	In a low voltage, limited energy secondary circuit, spacings between live parts of opposite polarity and between a live part and dead metal that is grounded are not specified		N/A
29.4	Epoxy or equivalent material may be used to reduce spacings		N/A
	a) Spacings of a minimum 1/32 inch (0.8 mm) 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 1/32 inch (0.8 mm) 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 (45°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
29.5	As an alternative, the spacing requirements in UL 840 and CAN/CSA C22.2 No. 0.2 may be used.		N/A
	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.		N/A
29.6	Power packs are considered to be used in a pollution degree 3 environment.		N/A
	Hermetically sealed or encapsulated enclosures, or coated printing wiring boards in compliance with the Printed Wiring Board Coating Performance Test in UL 840 and 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 UL 840 and 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

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
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 0.028 inch (0.71 mm) thick and shall be so located or of such material that it is not adversely affected by arcing.		N/A
29.11	Insulating material having a thickness less than that specified in 29.10		N/A
29.12	Film coated wire is regarded as an uninsulated live part when spacings are being considered		N/A
30	**Inverters**		-
30.1, 30,2	General Inverters provided as part of the power pack shall be shown to comply with the applicable requirements in this standard		N/A
	Exception: Inverters that comply with the Standard for Power Units Other Than Class 2, UL 1012 and CAN/CSA C22.2 No. 107.1, comply without further evaluation		N/A
31	**Charging Functions**		-
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 UL 1236 and CAN/CSA C22.2 No. 107.2.		P
	PROTECTION AGAINST INJURY TO PERSONS		-
32	General		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.		P
	Constructional features shall be provided to prevent this under normal operation and single fault condition.		P
34	Sharp Edges		P
35	Strength of Enclosure		P
36	Attachments		P
37	Stability		N/A
38	Strength of Handles		N/A
39	Surface Temperatures (Table 39.1)		P
40	Safety Circuits and Control Circuits		P

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
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 per UL 60730-1 and CAN/CSA C22.2 E60730-1.		P
	PERFORMANCE		
41	General		P
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 individual test. 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

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
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		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		P
43.1	Charging a lithium-ion battery under normal conditions shall not exceed the specified operating region for charging of the cell.		P
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: a) If the power pack is recommended to be operated at a minimum temperature lower than 4° C (39.2° F), the test is also conducted at that minimum temperature plus 0/minus 5 ° C (plus 0/minus 9 ° F); or b) If the appliance is recommended to be operated at a maximum temperature greater than 40° C (104° F), the test is also conducted at that maximum temperature plus 5/minus 0 ° C (plus 9/minus 0 ° F).		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. Cells shall not experience conditions outside their specified operating region for charging (e.g. limits of voltage and current). Below is an example result of such analyses. The charging current for each branch of a parallel connection would not need to be monitored, if the maximum deliverable current of the charger did not exceed the maximum charging current of a single cell.		P

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
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: a) 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. b) 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		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: a) There has been no explosion during this test; b) No charring or burning of the medical gauze, cheesecloth or tissue paper has resulted; and c) The cells shall not have exceeded the upper limit charging voltage by more than 150 mV or, if they have, then the charging system shall be permanently disabled from recharging the battery.		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
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 first.		P

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
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.		P
	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: 1) A series configured battery is to have a deliberate imbalance. The imbalance is tobe introduced into a fully discharged battery by charging one cell to approximately 50 percent of full charge; 2) 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 3) A single cell or parallel only configuration battery is to be fully discharged.		P
	b) 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. c) For a battery with a series configuration, all cells are to be at approximately 50 percent charge except for one which is shorted. The battery is to then be charged. d) 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.		P

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
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
44.6	Fault conditions for components as required by 44.4 shall be as follows: a) Open-circuit at the terminal of any component; b) Short-circuit of capacitors, unless they are certified EMI capacitors; c) 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; d) Failure of triacs in the diode mode; and e) 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 0.10 µF and connected between one side of the line and ground, shall be subjected to the Capacitor Discharge Test.		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
46.1	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

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
46.2	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
46.3	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
46.4	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: a) The measured ratio V 1 /I 1 with sinusoidal voltages is to be as close as feasible to the ratio V 1 /I 1 calculated with the resistance and capacitance values of the measurement instrument shown in Figure 46.2. b) The measured ratio V 3 /I 1 with sinusoidal voltages is to be as close as feasible to the ratio V 3 /I 1 calculated with the resistance and capacitance values of the measurement instrument shown in Figure 46.2. V 3 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

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: a) With switch S 1 open, the power pack is to be connected to the measurement circuit. Leakage current is to be measured using both positions of switch S 2 , and with the product switching devices in all their normal operating positions. b) Switch S 1 is then to be closed, energizing the product. Within 5 seconds, the leakage current is to be measured using both positions of switch S 2 and with the product switching devices in all their normal operating positions. c) Leakage current is to be monitored until thermal stabilization. Both positions of switch S 2 are to be used in determining this measurement. Thermal stabilization is to be obtained by operation as in the Normal Temperature Test, Section 47. d) The leakage current is also to be monitored with switch S 1 open while the product is at operating temperature and while cooling.		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		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.		N/A
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

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 theTolerances on Initial Values of EMF versus Temperature tables in the Standard Specification and Temperature- Electromotive Force (emf) Tables for Standardized Thermocouples, ASTM E230.		P
47.1.9	When using the change-of-resistance method, the windings are to be at room temperature at the start of the test, and the temperature rise of a winding is to be calculated using the formula:		N/A
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

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
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
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
47.2.6	A 12 volt DC output (cigarette lighter) shall be tested with 15A output to temperature stabilization, without risk of damage to unit.		P
47.2.7	Air compressors shall be tested under the following conditions with the internal battery fully charged: a) Locked-rotor; b) By operation with output under rated load based on the marked duty cycle provided by the manufacturer. If no marked duty cycle is provided, then the air compressor shall be tested by filling a 10-gallon air tank, with a duty cycle of 5 minutes on, 1 minute off; and c) Continuous running unit with end of air-fill hose sealed. For the condition in (c), the pressure shall be monitored and utilized for application of Section 59, Hydrostatic Strength Test, applied to the compressor and all hoses subject to pressure.		N/A
47.2.8	For power packs that allow outputs to be powered while the pack is connected to the source of supply, the test shall be performed with all allowable outputs loaded until thermal stabilization. For packs where the output can only be powered by the internal battery, the test duration shall be determined based on the batteries capability of maintaining the supply current as is discharges.		P
47.3	Power pack ampacity temperature test		P

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
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		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: a) 1000 volts plus twice the maximum rated voltage between: 1) The primary circuit and dead metal parts; 2) The primary and secondary circuits; 3) Secondary circuits operating above 50 V and dead metal parts; and 4) Secondary circuits operating above 50 V and secondary circuits operating below 50 V. b) 500 volts between: 1) Secondary circuits operating below 50 volts and dead metal parts, and 2) Secondary circuits operating below 50 volts and other secondary circuits operating below 50 V. Exception: The ac potentials shown above may be replaced with a dc potential equal to 1.414 times the ac potential for this test.	500V	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

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
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).		N/A
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 under the conditions specified in 49.1		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.		N/A
50	Abnormal Operation Tests		P
50.1	General		-
50.1.1	A power pack shall not emit flame or molten metal or become a risk of fire, electric shock, or injury to persons when subjected to the tests specified in 50.2 – 50.1 0. Separate samples are to be used for conducting each test, unless using a sample for more than one test is agreeable to all concerned.		P
50.1.2	Following each test, the Dielectric Voltage Withstand Test specified in Section 48 is to be conducted.		P
50.1.3	With reference to 50.1.1, a risk of fire, electric shock, or injury to persons exists when: a) Flame, burning oil, or molten metal is emitted from the enclosure of the power pack as evidenced by ignition, glowing, or charring of the cheesecloth or tissue paper; or b) The insulation breaks down when tested in accordance with 50.1.2 or hazardous live parts are made accessible.		P
50.1.4	During these tests, the device is to be placed on a softwood surface covered with a white tissue paper and a single layer of cheesecloth is to be draped loosely over the entire enclosure. The cheesecloth is to be untreated cotton cloth running 26 – 28 m 2 /kg (14 – 15 square yards per pound), and having, for each 6.45 cm 2 (1 inch 2), a count of 32 threads in one direction and 28 in the other direction.		P

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
50.1.5	The supply circuit is to have branch circuit overcurrent protection, the size of which equals 1 25 percent of the input current rating (20 ampere minimum), except where this value does not correspond with the standard rating of a fuse or circuit breaker, the next higher standard device rating shall be used. The rated voltage and frequency are to be used for this test.		N/A
50.1.6	Each test is to be continued until further change as a result of the test condition is reduced significantly. When an automatically reset protector functions during a test, the test is to be continued for 7 hours. When a manual reset protector functions during a test, the test is to be continued until the protector is operated for 10 cycles using the minimum resetting time, and not faster than 10 cycles of operation per minute. The following are examples of acceptable test terminations: a) Opening or shorting of one or more components such as capacitors, diodes, resistors, solid state devices, printed wiring board traces, or similar devices. b) Opening of the intended branch circuit overcurrent protection device described in 50.1.5. c) Opening of an internal fuse.		N/A
50.2	Abnormal Operation – Output Short Test		P
50.2.1	The power pack is to be tested as described in 50.2.2. The device shall comply with the requirements in 50.1.1.		P
50.2.2	With reference to 50.2.1, fuses and other protective devices provided as part of the power pack are to remain in the circuit. The output connections of the power pack are to be short-circuited at the connector and the power pack connected to a source of supply adjusted to its rated voltage. The test is to be continued until the internal protection opens or constant temperatures are obtained. When an automatically reset protector or a manually reset protector ends the test, the test is to be continued as indicated in 50.1.6.		P
50.2.3	If the power pack is provided with an output cable, then the short shall also occur at the end of the cable in order to judge that cables ability to withstand the fault for the duration.		P
50.2.4	If the power pack is provided with an on/off switch which is used to control an output, the test shall be conducted with that switch opened and closed.		P
50.3	Abnormal Operation – Reverse Polarity of Booster Cables		N/A
50.3.1	A power pack with a booster function is to be tested in accordance with 50.3.2. The power pack shall comply with the requirements in 50.1.1.		N/A

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
50.3.2	With reference to 50.3.1, fuses and other protective devices provided as part of the power pack are to remain in the device. The output booster cable connections of the power pack are to be reverse connected to a fully charged battery. The test is to be continued until the internal protection opens or constant temperatures are obtained. When an automatically reset protector or a manually reset protector ends the test, the test is to be continued as indicated in 50.1.6.		N/A
50.3.3	If the power pack is provided with a switch that controls the booster cable output function, the test shall be conducted with that switch opened and closed.		N/A
50.4	Abnormal Operation – Component Faults		P
50.4.1	A component, such as a capacitor, diode, solid state device, resistor, or similar component, connected in the power pack are to be short- or open-circuited, any two terminals one at a time, during any condition of operation including start-up. This test is not required where circuit analysis indicates that no other component or portion of the circuit is overloaded. At the end of each component fault condition, the power pack shall comply with the requirement in 50.1.1.		P
50.5	Abnormal Operation – Relay and Solenoid Burnout		N/A
50.5.1	An electromagnetic relay or a solenoid having an open coil construction is to be tested by blocking the armature or the plunger in the de-energized position. The test shall be continued until constant temperatures are obtained or for 7 hours maximum. The test results shall comply with 50.1.1.		
50.6	Abnormal Operation – Printed Wiring Board Abnormal Test		P
50.6.1	To comply with Exception No. 1 to 29.1, a printed-wiring board is to be tested as described in 50.6.2 – 50.6.5.		P
50.6.2	During this test, if a printed-wiring board trace opens, the gap is to be electrically shorted and the test continued until ultimate results occur. This procedure applies to each occurrence. If the circuit is interrupted by the opening of a component other than described in 50.6.3, the test is to be repeated two more times using new components as necessary.		P
50.6.3	Operation of an overcurrent protective device other than the branch circuit overcurrent protective device is allowed.		P
50.6.4	A sample of the power pack employing a printed-wiring board is to be connected to its rated supply voltage. A foil trace is to be short-circuited to each of its adjacent traces that do not have the spacing specified in Table 29.1, one at a time.		P

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
50.6.5	The test is to be continued for 1 hour or until one of the conditions described in 50.1 .3 occurs. However, if at the end of 1 hour no condition described in 50.1.3 occurs, but indications are that such a condition may eventually occur, the test is to be continued until ultimate results are obtained (usually 7 hours).		P
50.7	Abnormal Operation – Disconnected Fan Test		N/A
50.7.1	A device having forced ventilation is to be operated with the fan disconnected. For a device having more than one fan, the test is to be conducted with each fan disconnected, one at a time, or with two or more fans disconnected, if they are controlled or powered by the same connection. If part of the circuitry senses a disconnected fan and shuts down the unit, the circuitry shall be bypassed to allow operation with the fans disconnected or the circuitry shall be evaluated for suitability of this protective function.		N/A
50.8	Abnormal Operation – Blocked Ventilation Test		N/A
50.8.1	A power pack provided with ventilation openings for allowing air flow to cool internal components shall be subjected to this test. The vents are to be blocked, and the unit is to be operated at maximum normal load, as defined in 47.2. The test is to continue until constant temperatures are obtained or for 7 hours maximum. During the test, the power pack shall comply with 50.1.1.		N/A
50.9	Abnormal Operation – Overcharging Test		P
50.9.1	Power packs shall withstand abusive overcharging without risk of fire or explosion when tested in accordance with 50.9.2.		P
50.9.2	The battery is to be placed on a soft wood surface covered by two layers of tissue paper and one layer of untreated 100 percent cotton medical gauze and charged at a rate of 10 times the manufacturer’ s recommended rate for the battery for 1.25 hours or at the maximum output that is available from an external source provided with the pack. There shall be no explosion and no charring or burning of the gauze or tissue paper. Charring is defined as a blackening of the gauze caused by combustion. Discoloration of the gauze caused by smoke is acceptable. Venting of the cells is acceptable.		P
50.10	Abnormal Operation – Internal Battery Reverse Polarity Test		P
50.10.1	For power packs with removable internal batteries that are not keyed or otherwise prevented from being connected incorrectly, the test of 50.10.2 is to be carried out and the pack shall comply with 50.1.1.		P

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
50.10.2	During this test, fuses and other protective devices provided as part of the power pack are to remain in the device. Two samples are to be tested. The first sample is to be tested by connecting a fully discharged internal battery in reverse polarity and then attempting to charge the internal battery with a normal charging cycle. The second sample is to be tested by connecting a fully charged internal battery in reverse polarity and then attempting to use the pack under the conditions of maximum normal load. In both cases, the test is to be continued until the internal protection opens or constant temperatures are obtained. When an automatically reset protector or a manually reset protector ends the test, the test is to be continued as indicated in 50.1.6.		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 0.1 Ω as determined by an ohmmeter or other equivalent means.		N/A
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		N/A
53.1	General		N/A
53.1.1	The overload tests in 53.2 – 53.4 are required as applicable.		N/A
53.2	Overload – Overload of Switches and Controls Test		N/A

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
53.2.1	Unless known to be evaluated for the application, a switch or other control device shall perform acceptably when subjected to an overload test consisting of 50 cycles of operation making and breaking the load. For this test, the load may be the actual load applied in the product, or if this is unknown, the load shall be based on the rating of the switch or control device. As a result of this overload test there shall be no electrical or mechanical breakdown of the device, undue burning or pitting of the contacts, or opening of the fuse in the grounding connections.		N/A
53.2.2	To determine whether a switch or other control device complies with the requirements in 53.2.1, the power pack is to be connected to a supply circuit of rated frequency and the maximum rated voltage (or a fully charged power pack). The load for the device under test is to be the same as that which it is intended to control in regular service. During the test, accessible dead metal parts of the power pack are to be connected to ground through a 3-ampere plug fuse. The device is to be operated at a rate of not more than 10 cycles per minute, except that a faster rate of operation may be employed if agreeable to those concerned.		N/A
53.3	Overload – Overload of Protection Devices		N/A
53.3.1	An overload protective device is to be cycled through 200 operations of make and break action. The device is to be connected to the voltage present in the end product and the current load is to be adjusted to be equal to the maximum load seen by the device in the end product. The device is to be cycled at 10 cycles per minute, or faster if all involved agree. At the end of the 200 cycles, the device shall be able to operate as intended.		N/A
53.4	Overload – Overload of Interlocks		N/A
53.4.1	53.4.1 The contact of the safety interlock switch or relay is to be subjected to an overload test consisting of 50 cycles of operation at the rate of 6 to 10 cycles per minute, making and breaking 150 percent of the current imposed in the application, except that where a contact switches a motor load, the test is to be conducted with the rotor of the motor in a locked condition. After the test, the switch or relay shall still be functional.		N/A
54	Strain Relief Test		P
54.1	Strain Relief Test		P

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
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 1 1.2.2.3, 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		P
55.1	General		P
55.1.1	A power pack shall be tested as described in 55.2 and 55.3. Following these tests, the power pack shall: a) Not permit a probe, as illustrated in Figure 7.1, to contact an uninsulated live part that may involve a risk of electric shock; b) Comply with the Dielectric Voltage Withstand Test, Section 48, with the potential applied between live parts and accessible dead metal parts; and c) Not have a permanent distortion of a metallic enclosure that reduces spacings below the minimum values, as specified in Spacings, Section 29.		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

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
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		P
56.1	One sample, consisting of the complete equipment or the complete enclosure, is to be subjected to this test.		P
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

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
57	Strength of Handles Test		N/A
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.		N/A
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.		N/A
58	Stability Test		N/A
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.		N/A
58.2	A power pack shall not tip over but shall return to its normal at rest position when: a) Tipped through an angle of 10 degrees from an at rest position on a horizontal surface; or b) Placed on an inclined plane inclined at an angle of 10 degrees from the horizontal.		N/A
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.		N/A
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.		N/A
59	Hydrostatic Strength Test		N/A

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
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		N/A
60.1	The following Rain Test shall be performed on all power packs that are designated outdoor use or temporary outdoor use.		N/A
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.		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.		N/A
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 60.1. Exception: For Rainproof only, units may instead be subjected to the Leakage Current Test as the pass/fail criteria in accordance with 46.2 – 46.7.		N/A
61	Tests on Insulating Materials		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

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
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
61.3	With reference to Exception No. 1 to 61.1, insulation may be of a generic material type specified in Table 61.1 where the layer(s) of each generic material is of a minimum thickness such that all layers collectively are greater than or equal to the minimum thickness required (T):		N/A
62	Accelerated Aging of Gaskets, Sealing Compounds, and Adhesives 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
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

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
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: a) A temperature of 100.0 ±1.0° C (212.0 ±1.8° F); b) Immersion in distilled water at a temperature of 23.0 ±1.0° C (73.0 ±1.8° F); and c) A temperature of minus 10.0° C (14.0 ±1.8° F). The force required to peel the gasket from its mounting surface after exposure shall not be less than 50 percent of the value determined using an unconditioned sample, but not less than 0.04 kg/mm (2 pounds per inch) of gasket width.		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 (CrO 3) and 50 grams per liter (6.7 ounces per gallon) of ACS reagent grade concentrated sulfuric acid (H 2 SO 4). The latter is equivalent to 27 milliliters per liter of ACS reagent grade concentrated sulfuric acid, specific gravity 1 .84, containing 96 percent of H 2 SO 4		N/A

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
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
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

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
63.10	Zinc metallic coating thickness may also be measured as follows: a) By x-ray in accordance with the Standard Test Method for Measurement of Coating Thickness by X-Ray Spectrometry, ASTM B568; b) By eddy-current in accordance with the Standard Practice for Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Testing Methods, ASTM E376; or c) By weight of coating in accordance with the Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings, ASTM A90.		N/A
64	Permanency of Wrapped Hang Tag Marking		P
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. a) Tearing at any point for more than 1.6 mm (1/16 inch); b) Movement of the tag more than 1 2.7 mm (1 /2 inch) along the length of the cable; c) Shrinkage, wrinkling, cracking, or other deformation that renders the marking illegible; or d) Visible curling or loosening around the edges of a tag with an adhesive back.		P
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 64.3 and 64.4 prior to testing.		P
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 (1 88.6 ±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.		P
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.		P

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
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.		P
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		N/A
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 exceed 3.5 mA.		N/A
66.2	A 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.		N/A
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

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
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		P
68.1	General		P
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		P
68.2	Clamp Tests – Cold Drop Tests		P
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.		P
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 1 2.2.3. 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.		P
68.3	Clamp Tests – Dielectric Voltage-withstand Test		P
68.3.1	Samples of the insulated clamp are to be subjected to this test with no indication of dielectric breakdown.		P
68.3.2	A 500 volt, 60 Hz potential is to be applied between: a) The connector and foil wrapped around the handle of the clamp; b) The connector and the assembly rivet; and c) The connector and the clamp spring.		P
68.4	Clamp Tests – Secureness Test		P
68.4.1	The connection between cable and clamp shall be intact with no broken insulation after the test of 68.4.2.		P

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
68.4.2	The clamp is to be secured in a manner that allows the cable to hang freely in a downward position. A weight equal to 2 times the weight of the power pack is to be applied to the cable and supported by the cable for 10 minutes. At the end of the 10 minutes, the connection and insulation is to be observed.		P
	Marking		-
	In Canada, safety markings are required in English and French.		P
69	**General**		-
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;		P
	b) A distinctive model number or the equivalent;		P
	c) The electrical rating;		P
	d) The operating temperature range as specified by the manufacturer;		P
	e) The date or other dating period of manufacture not exceeding any three consecutive months, or date code		P
69.2	Distinctive marking to identify a particular factory when a manufacturer produces or assembles a power pack at more than one factory		N/A
69.3	Markings shall be legible and permanent		P
	a) Molded, die-stamped, paint stenciled, stamped or etched metal that is permanently secured;		P
	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 and CAN/CSA C22.2 No. 0.15, at the indicated temperature rating, up to 70°C (158°F) on the specified surface; or		N/A
	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.		N/A
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."		N/A
	Cautionary Markings		-
70	General		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.		P
70.2	A cautionary marking shall be permanent and legible, and shall be located on a permanent part of the product.		P

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
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.		P
	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.”		P
	The marking shall be in letters not less than 3/32 inch (2.4 mm) high.		P
	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.		N/A
70.7	Cautionary markings for components or assemblies used in power packs		N/A
70.8	Caution marking for cover or compartment involving a risk of electric shock and housing no user serviceable parts		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		N/A
70.10	Replacement marking for user accessible fuse or fuseholder		N/A
70.11	Marking for power pack contains an internal rechargeable battery		N/A
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
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	polarity identification of clamps.		P
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

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
70.16	Caution markings for power packs which incorporate an interlock device complying with Section 26		N/A
70.17	Caution markings for power pack used in a repair facility		N/A
70.18	Caution markings for power pack not used in a repair facility		N/A
70.19	Caution marking for temporary outdoor use power packs		N/A
70.20, 70.21	Caution marking for indoor use only devices		N/A
70.22	Caution marking for products with an enclosure RTI rating less than 80 oC		N/A
	Instructions		-
71.1, 71.2	General		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;		P
	b) The heading for the instructions pertaining to a risk of fire, electric shock, or injury to persons; and		P
	c) The opening and closing statements of the instructions specified in 72.3 – “IMPORTANT SAFETY INSTRUCTIONS” and “SAVE THESE INSTRUCTIONS,” or the equivalent.		N/A
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**		-
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

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
72.4	The instructions pertaining to a risk of fire, electric shock, or injury to persons, or the installation instructions shall include the following items if applicable. If the following instructions are included in the installation instructions, a reference to these instructions shall be included in the list mentioned in 72.3 as a separate item. The headings and the word “WARNING” shall be entirely in upper case letters or shall be emphasized to distinguish it from the rest of the text. (GROUNDING INSTRUCTIONS)		P
73	**Installation Instructions**		-
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 70.18.		N/A
74	**Operating Instructions**		-
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	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 18 inches (457 mm) above the floor, during use in a repair facility.		N/A
74.4	Instruction include:		-
	a) Instructions regarding battery charging, temperature limits for appliance and battery use and storage, and the recommended temperature range for charging.		P
	b) A warning shall be provided against modifying or attempting to repair the power pack except as indicated in the instructions for use and care.		N/A

UL 2743			
Clause	Requirement + Test	Result - Remark	Verdict
74.5	Instruction for temporary outdoor use equipment		N/A
	a) The device shall be stored indoors and protected from the elements;		N/A
	b) The unit shall not be charged outdoors;		N/A
	c) When in use, steps should be taken to reduce the exposure to rain, sleet, snow, and the like.		N/A
74.6	Indoor use only power packs shall be provided with instructions stating that the device may only be used indoors and that no outdoor use in allowed under any conditions.		P
74.7	With reference to 7.3.3, products that are provided with a nonmetallic enclosure with an RTI rating less than 80oC shall be provided with instructions stating that the pack is not to be stored or kept in a vehicle.		N/A
75	**User Maintenance Instructions**		-
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**		-
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.		N/A

29	**Table: working voltage measurement**			N/A
Location		RMS voltage (V)	Peak voltage (V)	Comments
supplementary information:				

29	**TABLE: Spacings**						N/A
Clearance (cl) and creepage **distance** (cr) at/of/between:	U peak (V)	U r.m.s. (V)	Required cl (mm)	cl (mm)	Required cr (mm)	cr (mm)	
Supplementary information: Clearance = Through air spacing; Creepage distance = Over-surface spacing							

29	**TABLE: Distance through insulation measurements**					N/A
Distance through insulation (DTI) at/of:	U peak (V)	U rms (V)	Test voltage (V)	Required DTI (mm)	DTI (mm)	
Supplementary information:						

42	**Table: Input Test**					**P**
U (V)	**I (A)**	**Irated (A)**	**P (W)**	**Fuse #**	**Ifuse (A)**	**Condition/status**
5VDC	2	2.9	14.5	--	--	
Supplementary information:						

43	TABLE: Normal Charging Operation Test						P
Sample No.	Charging parameters		Charge ambient temp. °C	Max. temp. of cell °C	Max. charge Voltage of single cell (V)	Max. charge Current (A)	Comments
	V	A					
1	5	2	25	45.6	3.7	3.2	
Supplementary information:							

44	TABLE: Lithium Charging System Test							P
Sample No.	Comp. faulted	Charging parameters		Charge ambient temp. °C	Max. temp. of cell °C	Max. charge Voltage (V)	Max. charge Current (A)	Comments
		V	A					
2	C1 sc	12	1	25	55.7	3.7	6.4	
Supplementary information:								

47	TABLE: Temperature Test		P
Maximum measured temperature T of part/at::	**Measured temperature rise (K)**		**Limit (K)**
Conditions	Charging	Discharging	
Enclosure of power supply	44.5	--	95
DC connector	34.1	--	Ref.
Inductance	55.6	57.9	130
PCB near IC	60.1	63.2	130
Battery surface	40.5	42.3	60
Internal wire to battery	33.4	36.5	80
Plastic enclosure inside	36.7	37.2	60
Plastic enclosure outside	34.5	35.3	Ref.
Ambient	25.0	25.0	--
supplementary information:			

48	TABLE: Dielectric strength Test			P
Test voltage applied between:		Test voltage (V)	Breakdown Yes / No	Insulation resistance (Ω)
DC input to plastic enclosure		500	No	100
Supplementary information:				

50	TABLE: Abnormal Operation Test					P
Component No.	Fault	Supply voltage (V)	Test time	Fuse #	Fuse current (A)	Observation

R1	SC	5	10	--	--	Normal working
D1	SC	5	10	--	--	Unit shut down, no damage, no hazard
C9	SC	5	10	--	--	Unit shut down, no damage, no hazard
U1 pin 1-2	SC	5	10	--	--	Unit shut down, no damage, no hazard
Supplementary information:						

Critical components information:

Only following safety critical components were evaluated and/or tested, and were confirmed to comply with the standard requirements mentioned in this test report. Use of components not listed here may lead to non-compliance test results, and it's the sole responsibilities of the manufacturer to make sure all products should be produced in consistent way and only approved components can be used.

Object/part no.	Manufacturer/ trademark	Type/model	Technical data	Standard	Mark(s) of conformity
Battery pack	Various	Various	5V, 29800mAh	UL 1642	UL
Cell	Various	Various	5V,29800mAh	UL 1642	UL
PCB	SHENZHEN XSL PRINTED CIRCUIT BOARD CO LTD	XSL-D	V-0, 130°C	UL 796	UL E479201
Plastic Enclosure	CHI MEI CORPORATION	D-1000	V-0, 60°C	UL 94	UL E56070
Power supply	Shenzhen Xinlijie Technology Co., Ltd.	SYM-505A	Output:5VDC, 29800mA	UL	UL

Appendix: Photos

Fig.1

Fig.2

Fig.3

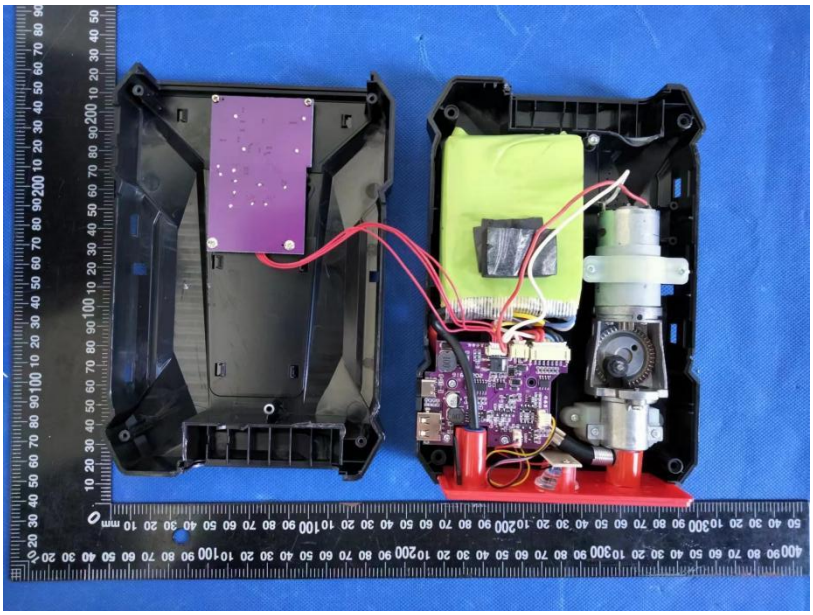


Fig.4

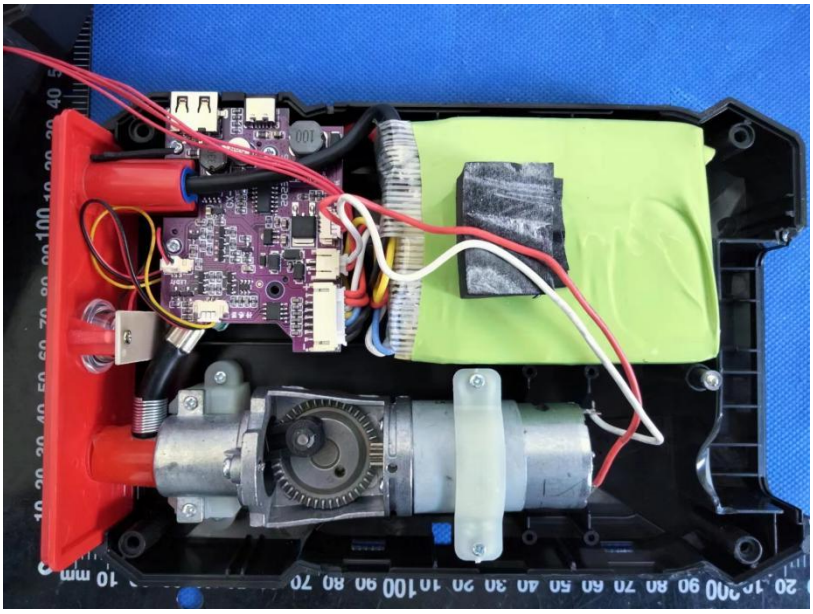


Fig.5

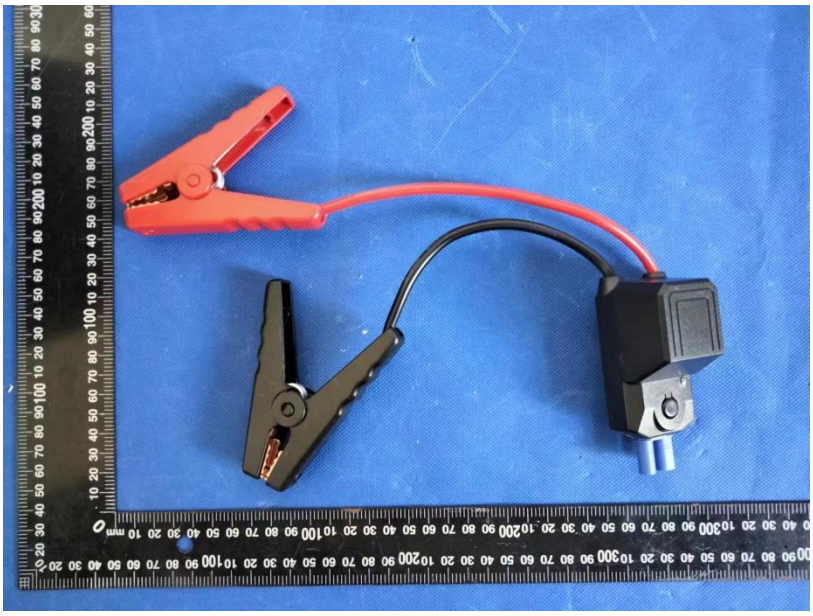


Fig.6

Fig.7

---End of report---