

UNDERWRITERS LABORATORIES INC. CERTIFICATION REQUIREMENT DECISION

This Certification Requirement Decision is prepared by UL LLC. It is normative for the applicable UL Product Certification Program(s); however, it is currently not part of the UL Standard(s) referenced below.

Product Category (CCN): FKIS, FKIS7

Standard Number: UL 2272

Standard Title: Standard for Electrical Systems for Personal E-Mobility Devices

Edition Date: November 21, 2016

Edition Number: 1

Section / Paragraph Reference: 9, 16, 24, 26, 27, 28

Subject: Clarification of Requirement for Personal E-mobility Device Powered by Lead-Acid Battery

DECISION:

9 Enclosures

9.1 General

9.1.5 For personal e-mobility devices powered by lead acid batteries, openings in the enclosure shall be constructed to prevent accumulation of flammable gases that could lead to a hazardous condition from concentrations of hydrogen gas due to electrolysis of aqueous electrolytes greater than 25% of the LFL of hydrogen (equivalent to 1% concentration in a volume of air). Ventilation openings shall have a minimum opening area of:

$$A=0.005NC_5 \text{ (cm}^2\text{)}$$

Where:

A = Total cross sectional area of ventilation holes required (cm²)

N = Number of cells in battery

C_5 = Capacity of battery at the 5-h rate (Ah)

Exception No. 1: The area of ventilation openings can be reduced if it can be demonstrated that there is sufficient ventilation within the device to prevent hydrogen accumulations above 25% of the LFL of hydrogen during overcharging test and imbalanced charging test. If this exception is used to determine the compliance, a gas monitor suitable for detecting 25% of the lower flammability limit (LFL) of the hydrogen is to be used to measure the concentration of hydrogen during the overcharge test and imbalanced charging test. A minimum of two sampling locations where concentrations may occur such as at vent openings or vent ducts shall be used for taking measurements.

16 Protective Circuits and Safety Analysis

16.1 The personal e-mobility device's protective circuitry shall maintain the cells within their specified operating region for charging and discharging through the life of the device. If cell specified operating limits are exceeded, the protective circuitry shall limit or shut down the charging or discharging to mitigate excursions beyond specified operating limits. Compliance is determined through a review of the cell specifications and safety analysis of 16.2 and through the testing of this standard. If applicable to the

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personal e-mobility device design, the analysis and testing needs to evaluate the overcharge protection control's ability to mitigate overcharge due to regenerative charging during use. Chargers with standardized output connectors (e.g. USB connectors, 3-pin round dc "aviation" connectors that may result in the use of unspecified chargers shall not be considered as a reliable control to prevent an overvoltage or overcurrent condition.

16.1.1 Since it is not practical to monitor and control individual cells of a monobloc battery, personal e-mobility device's using lead-acid batteries as the power source shall protect the batteries from overcharge through voltage protection and from overheating through either current protection or temperature protection or both.

16.5 Devices relied upon for critical safety as noted in 16.4(a) - (b) shall minimally comply with the applicable Environmental Stress tests described in Sections 9 - 22 of the Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991, or fully comply with appropriate functional safety requirements below. Devices solely relied upon for critical safety as noted in 16.4 (c) shall fully comply with appropriate functional safety requirements in one of the following standards as appropriate to the design of the electronic and software protection scheme:

- a) The Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991, or the Standard for Safety Functions Incorporating Electronic Technology, CSA-C22.2 No. 0.8, and the Standard for Software in Programmable Components, UL 1998;
- b) The Standard for Automatic Electrical Controls for Household and Similar Use - Part 1: General Requirements, UL 60730-1 or CAN/CSA-E60730-1; and
- c) The Standard for Functional Safety of Electrical/Electronic/Programmable Electronic Safety-Related Systems - Part 1: General Requirements, IEC 61508-1, and all parts.

Exception: For lead acid batteries, this requirement does not apply.

24 Overcharge Test

24.2 A fully charged sample is to be discharged at a 0.2 C constant discharge rate or a higher discharge rate permitted by the cell manufacturer to the manufacturer's specified EODV. The DUT is then subjected to a constant current charging at the cell manufacturer's maximum specified charging rate and under a single fault condition in the charging protection circuitry that could lead to an overcharge condition. Protective devices that have been determined reliable may remain in the circuit as noted in 20.5. For information purposes, temperatures are to be monitored on the cell/module where temperatures may be highest. The output control circuitry of external chargers with standardized output connectors (e.g. USB connectors, standardized round dc "aviation" connectors) that may result in the use of unspecified chargers shall not be considered as a reliable control to prevent an overcharging condition, and for this test, the charger shall be replaced with a power supply capable of delivering 110% of the specified upper limit charging voltage during the test. Voltages on cells/cell blocks are to be monitored during the test and for lead acid batteries, voltages on the batteries are to be monitored.

24.3 The test is to be continued until the voltage has reached 110% of the specified upper limit charging voltage or the maximum obtainable charging voltage (if the 110% of specified upper limit charging voltage cannot be reached due to remaining protection circuitry), and monitored temperatures return to ambient or steady state conditions and an additional 2 h has elapsed, or explosion/fire occur. If the DUT is operational after the test, it shall be subjected to a minimum of one charge/discharge cycle at the cell manufacturer's maximum specified values per Section 22, Post Test Cycle. The test shall be followed by an observation period per 20.7.