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Normes ULC



ANSI/CAN/UL/ULC 2580:2022

JOINT CANADA-UNITED STATES
NATIONAL STANDARD

STANDARD FOR SAFETY

Batteries for Use In Electric Vehicles



SCC FOREWORD

National Standard of Canada

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UL Standard for Safety for Batteries for Use In Electric Vehicles, ANSI/CAN/UL/ULC 2580

Third Edition, Dated March 11, 2020

Summary of Topics

This revision of ANSI/CAN/UL/ULC 2580 dated June 28, 2022 includes the following changes:

- ***Added an exception for use of orange cable or sleeving on systems of 60 Vdc or higher in [10.2](#).***
- ***Clarified the use and triggering method for internal short circuit trigger cells in [C2.1.1](#) and [C2.1.2](#).***

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

The revised requirements are substantially in accordance with Proposal(s) on this subject dated October 8, 2021 and March 25, 2022.

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MARCH 11, 2020

(Title Page Reprinted: June 28, 2022)

1

ANSI/CAN/UL/ULC 2580:2022

Standard for Batteries for Use In Electric Vehicles

First Edition – October, 2011

Second Edition – December, 2013

Third Edition

March 11, 2020

This ANSI/CAN/UL Safety Standard consists of the Third Edition including revisions through June 28, 2022.

The most recent designation of ANSI/UL 2580 as an American National Standard (ANSI) occurred on June 28, 2022. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, Preface or SCC Foreword.

This standard has been designated as a National Standard of Canada (NSC) on June 28, 2022.

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Documents

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CONTENTS

Preface	7
---------------	---

INTRODUCTION

1 Scope	11
2 Components	11
3 Units of Measurement	11
4 Undated References	11
5 Reference Publications	11
6 Glossary	14

CONSTRUCTION

7 Non-Metallic Materials	19
8 Metallic Parts Resistance to Corrosion	20
9 Enclosures	21
10 Wiring and Terminals	21
11 Spacings and Separation of Circuits	22
12 Insulation Levels and Protective Grounding	23
13 System Safety Analysis	24
14 Protective Circuits	25
15 Cooling/Thermal Management Systems	26
16 Cells (Battery and Electrochemical Capacitor)	26
17 Manufacturing and Production Line Testing and Production Quality	28

PERFORMANCE

18 General	29
19 Determination of Potential for Fire Hazard	30
20 Important Test Considerations	30
21 Single Fault Conditions	31
22 Test Results	31
23 Determination of Toxic Emissions	32
24 Tolerances	33

ELECTRICAL TESTS

25 Overcharge Test	33
26 Short Circuit Test	34
27 Overdischarge Protection Test	35
28 Temperature Test	35
29 Imbalanced Charging Test	36
30 Dielectric Voltage Withstand Test	36
31 Isolation Resistance Test	37
32 Continuity Test	38
33 Failure of Cooling/Thermal Stability System Test	38

MECHANICAL TESTS

34 Rotation Test	39
35 Vibration Endurance Test	39
36 Shock Test	40



37	Drop Test.....	41
38	Crush Test	42

ENVIRONMENTAL TESTS

39	Thermal Cycling	43
40	Salt Spray Test.....	43
41	Immersion Test.....	44
42	External Fire Exposure Test	44

TOLERANCE TO INTERNAL CELL FAILURE TESTS

43	Single Cell Failure Design Tolerance.....	45
43.1	General.....	45
43.2	Single cell failure design tolerance (lithium ion)	45
43.3	Single cell failure design tolerance (other technologies)	46

MARKINGS

44	Markings.....	47
----	---------------	----

INSTRUCTIONS

45	Instructions	48
----	--------------------	----

ANNEX A (NORMATIVE) Standards for Components

A1	Component Standards	50
----	---------------------------	----

ANNEX B (NORMATIVE) Test Program for Secondary Lithium Cells

B1	General.....	52
B2	Tests.....	52
B2.1	Vibration Test	52
B2.2	Shock Test.....	52
B2.3	Drop Test.....	53
B2.4	Crush Test	53
B2.5	Heating Test.....	53
B2.6	Temperature Cycling Test.....	53
B2.7	External Short Circuit Test.....	53
B2.8	Overcharge Test.....	53
B2.9	Forced Discharge Test.....	54
B2.10	Projectile Test.....	54
B3	Test Samples and Results Criteria	56

ANNEX C (INFORMATIVE) Cell Failure Methods

C1	General.....	57
C2	Replicating Internal Cell Failures through Internal Defects.....	57
C2.1	Single cell conductive contamination	57
C2.2	Single cell separator defect	57
C2.3	Internal heater application.....	58
C3	Replicating Internal Cell Failures Through Application of External Stress	58
C3.1	External heater application.....	58

C3.2 External indentation without casing/surface penetration	58
C3.3 Nail penetration through cell casing	59
C3.4 Single cell short circuit	60
C3.5 Single cell overcharge	60

ANNEX D (NORMATIVE) Alternative Test Program for Secondary Lithium Cells

D1 General.....	61
D2 Preconditioning and Capacity Check	61
D2.1 Preconditioning	61
D2.2 Capacity check	61
D3 Tests.....	62
D3.1 Short-circuit test.....	62
D3.2 Overcharge Test	62
D3.3 Crush test.....	62
D3.4 Impact test.....	63
D3.5 Shock test	65
D3.6 Vibration test.....	65
D3.7 Heating test	65
D3.8 Temperature cycling test.....	65
D3.9 Low pressure (altitude simulation) test	66
D3.10 Projectile test	66
D4 Test Samples and Results Criteria.....	68

ANNEX E (NORMATIVE) Electrochemical Potentials

No Text on This Page

Preface

This is the Third Edition of ANSI/CAN/UL/ULC 2580, Standard for Safety for Batteries for Use In Electric Vehicles.

UL is accredited by the American National Standards Institute (ANSI) and the Standards Council of Canada (SCC) as a Standards Development Organization (SDO). ULC Standards is accredited by the Standards Council of Canada (SCC) as a Standards Development Organization (SDO).

This Standard has been developed in compliance with the requirements of ANSI and SCC for accreditation of a Standards Development Organization.

This ANSI/CAN/UL/ULC 2580 Standard is under continuous maintenance, whereby each revision is approved in compliance with the requirements of ANSI and SCC for accreditation of a Standards Development Organization. In the event that no revisions are issued for a period of four years from the date of publication, action to revise, reaffirm, or withdraw the standard shall be initiated.

Annex [A](#), Annex [B](#), Annex [D](#), and Annex [E](#) are identified as Normative, as such, form mandatory parts of this Standard.

Annex [C](#), identified as Informative, is for information purposes only.

In Canada, there are two official languages, English and French. All safety warnings must be in French and English. Attention is drawn to the possibility that some Canadian authorities may require additional markings and/or installation instructions to be in both official languages.

This joint American National Standard and National Standard of Canada is based on, and now supersedes, the Second Edition of UL 2580 and the First Edition of CAN/ULC-S2580-13.

Comments or proposals for revisions on any part of the Standard may be submitted at any time. Proposals should be submitted via a Proposal Request in the On-Line Collaborative Standards Development System (CSDS) at <https://csds.ul.com>.

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This Edition of the Standard has been formally approved by the UL Standards Technical Panel (STP) on Batteries for Use in Electric Vehicles, STP 2580.

This list represents the STP 2580 membership when the final text in this standard was balloted. Since that time, changes in the membership may have occurred.

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International Classification for Standards (ICS): 29.220; 43.120

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This Standard is intended to be used for conformity assessment.

The intended primary application of this standard is stated in its scope. It is important to note that it remains the responsibility of the user of the standard to judge its suitability for this particular application.

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INTRODUCTION

1 Scope

1.1 These requirements cover electrical energy storage assemblies such as battery packs and combination battery pack-electrochemical capacitor assemblies and the subassembly/modules that make up these assemblies for use in electric-powered vehicles as defined in this standard.

1.2 This standard evaluates the electrical energy storage assembly's ability to safely withstand simulated abuse conditions and prevents any exposure of persons to hazards as a result of the abuse. This standard evaluates the electric energy storage assembly and modules based upon the manufacturer's specified charge and discharge parameters at specified temperatures. It does not evaluate the assembly's interaction with other control systems within the vehicle.

1.3 This standard does not evaluate the performance or reliability of these devices.

1.4 This standard does not include requirements for the evaluation of batteries for light electric vehicles such as electrical assist bicycles, wheel chairs, electric scooters and similar devices as defined in UL/ULC 2271.

2 Components

2.1 Except as indicated in [2.2](#), a component of a product covered by this Standard shall comply with the requirements for that component. See Annex [A](#) for a list of Standards covering components generally used in the products covered by this Standard. A component shall comply with the Standards of CSA or UL Standards as appropriate for the country where the product is to be used.

2.2 A component is not required to comply with a specific requirement that:

- a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard; or
- b) Is superseded by a requirement in this standard.

3 Units of Measurement

3.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information. The values given in SI (metric) units shall be normative.

4 Undated References

4.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

5 Reference Publications

5.1 Throughout this standard, the CSA and ULC standard references apply to products intended for use in Canada, while the UL standard references apply to products intended for use in the United States. Combined references are commonly separated by a slash ("/").

5.2 The following standards are referenced in this standard, and portions of these referenced standards as identified in this standard may be essential for compliance.

ASTM Standards

ASTM D4490, *Standard Practice for Measuring the Concentration of Toxic Gases or Vapors Using Detector Tubes*

ASTM D4599, *Standard Practice for Measuring the Concentration of Toxic Gases or Vapors Using Length-of-Stain Dosimeters*

Canada Motor Vehicle Safety Standards (CMVSS)

Document No. 305, *Motor Vehicle Safety Regulations (C.R.C., c. 1038) Electrolyte Spillage and Electrical Shock Protection (Standard 305)*

CSA Group Standards

CAN/CSA-C22.2 No. 0.17, *Evaluation of Properties of Polymeric Materials*

CSA-C22.2 No. 0.2, *Insulation Coordination*

CAN/CSA-C22.2 No. 94.2, *Enclosures for Electrical Equipment, Environmental Considerations*

CAN/CSA-C22.2 No. 60950-1, *Information Technology Equipment Safety – Part 1: General Requirements*

Federal Motor Vehicle Safety Standards

FMVSS 49 CFR 571 305, *Electric-Powered Vehicles: Electrolyte Spillage and Electrical Shock Protection*

IEC Standards

IEC 60068-2-27, *Environmental Testing – Part 2-27: Tests – Test Ea and Guidance: Shock*

IEC 60068-2-30, *Environmental Testing – Part 2-30: Tests – Test Db: Damp Heat, Cyclic (12 h + 12 h Cycle)*

IEC 60068-2-52, *Environmental Testing – Part 2: Tests – Test Kb: Salt Mist, Cyclic (Sodium Chloride Solution)*

IEC 60417, *Graphical Symbols for Use on Equipment*

IEC 60812, *Analysis Techniques for System Reliability – Procedure for Failure Mode and Effects Analysis (FMEA)*

IEC 61025, *Fault Tree Analysis (FTA)*

IEC 61508, *Functional Safety of Electrical/Electronic/Programmable Electronic Safety-Related Systems (all parts)*

IEC 62061, *Safety of Machinery – Functional Safety of Safety-Related Electrical, Electronic and Programmable Electronic Control Systems*

IEC 62660-2, *Secondary lithium-Ion Cells for the Propulsion of Electric Road Vehicles – Part 2: Reliability and Abuse Testing*

IEC TR 62660-4, *Technical Report for Secondary Lithium-Ion Cells for the Propulsion of Electric Road Vehicles – Part 4: Candidate Alternative Test Methods for the Internal Short Circuit Test of IEC 62660-3*

IEEE Standards

IEEE 1625, *Rechargeable Batteries for Multi-Cell Mobile Computing Devices*

IEEE 1725, *Rechargeable Batteries for Cellular Telephones*

ISO Standards

ISO No. 7010, *Graphical Symbols – Safety Colours and Safety Signs – Registered Safety Signs*

ISO 6469-1, *Electrically Propelled Road Vehicles – Safety Specifications – Part 1: Rechargeable Energy Storage System (RESS)*

ISO 13849-1, *Safety of Machinery – Safety-Related Parts of Control Systems – Part 1: General Principles for Design*

ISO 26262, *Road Vehicles – Functional Safety (all parts)*

NEMA Standards

NEMA 60529, *Degrees of Protection Provided by Enclosures (IP Code)*

National Institute for Occupational Safety and Health (NIOSH) Standards

NIOSH Manual of Analytic Methods

NFPA Standards

NFPA 70, *National Electrical Code*

Occupational Safety and Health Administration (OSHA) Standards

OSHA Evaluation Guidelines for Air Sampling Methods Utilizing Spectroscopic Analysis

SAE Standards

SAE ARP4761, *Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment*

SAE J1739, *Potential Failure Mode and Effects Analysis in Design (Design FMEA), Potential Failure Mode and Effects Analysis in Manufacturing and Assembly Processes (Process FMEA)*

SAE J2380, *Vibration Testing of Electric Vehicle Batteries*

SAE J2464, *Electric and Hybrid Electric Vehicle Rechargeable Energy Storage System (RESS) Safety and Abuse Testing*

UL Standards

UL 50E, *Enclosures for Electrical Equipment, Environmental Considerations*

UL 94, *Tests for Flammability of Plastic Materials for Parts in Devices and Appliances*

UL 583, *Electric-Battery-Powered Industrial Trucks*

UL 746B, *Polymeric Materials – Long Term Property Evaluations*

UL 746C, *Polymeric Materials – Use in Electrical Equipment Evaluations*

UL 810A, *Electrochemical Capacitors*

UL 840, *Insulation Coordination Including Clearances and Creepage Distances For Electrical Equipment*

UL 969, *Marking and Labeling Systems*

UL 991, *Tests for Safety-Related Controls Employing Solid-State Devices*

UL 1642, *Lithium Batteries*

UL 1973, *Batteries for Use in Light Electric Rail (LER) Applications and Stationary Applications*

UL 1989, *Standby Batteries*

UL 1998, *Software in Programmable Components*

UL 2054, *Household and Commercial Batteries*

UL 2251, *Plugs, Receptacles and Couplers for Electric Vehicles*

UL/ULC 2271, *Batteries for Use in Light Electric Vehicle (LEV) Applications*

UL 60730, *Automatic Electrical Controls for Household and Similar Use – Part 1: General Requirements*

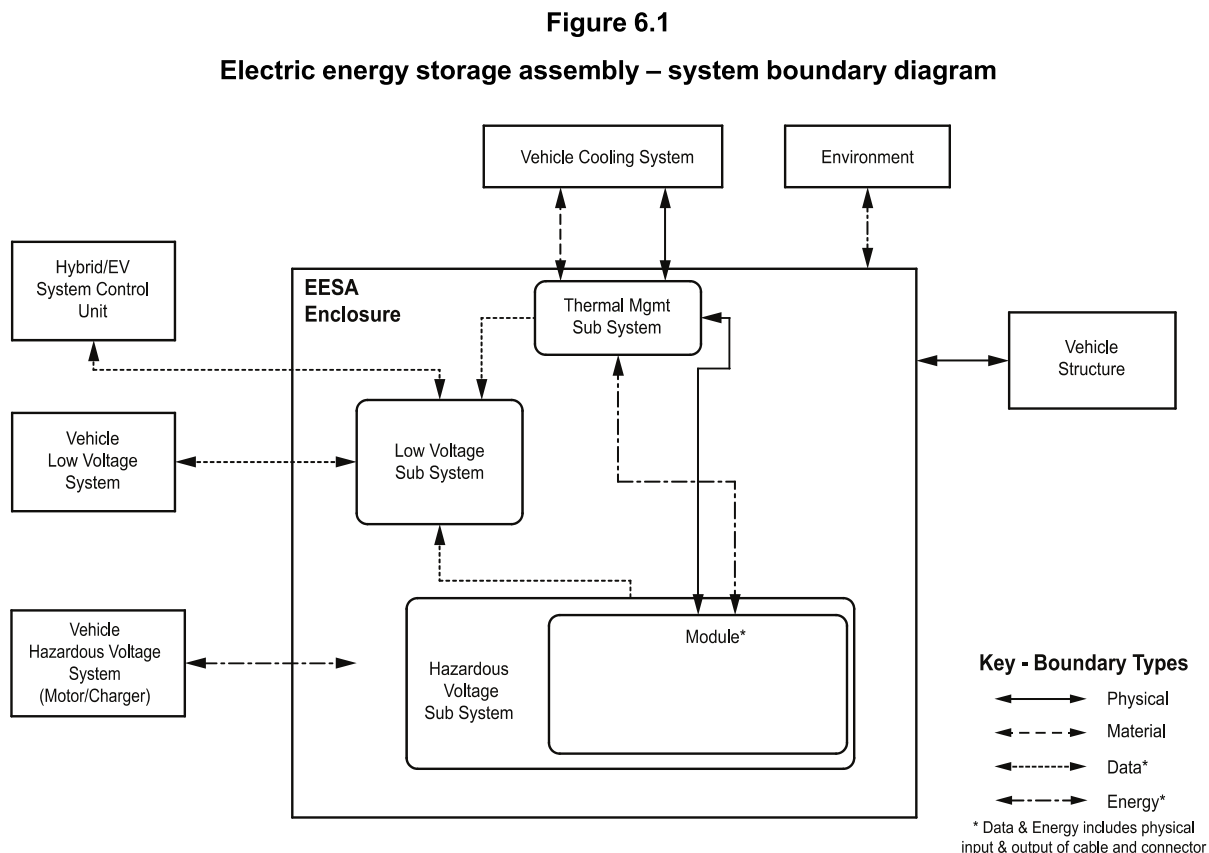
UL 60950-1, *Information Technology Equipment Safety – Part 1: General Requirements*

US Department of Defense (DOD) Standards

MIL-STD-1629A, *Procedures for Performing a Failure Mode, Effects, and Criticality Analysis*

6 Glossary

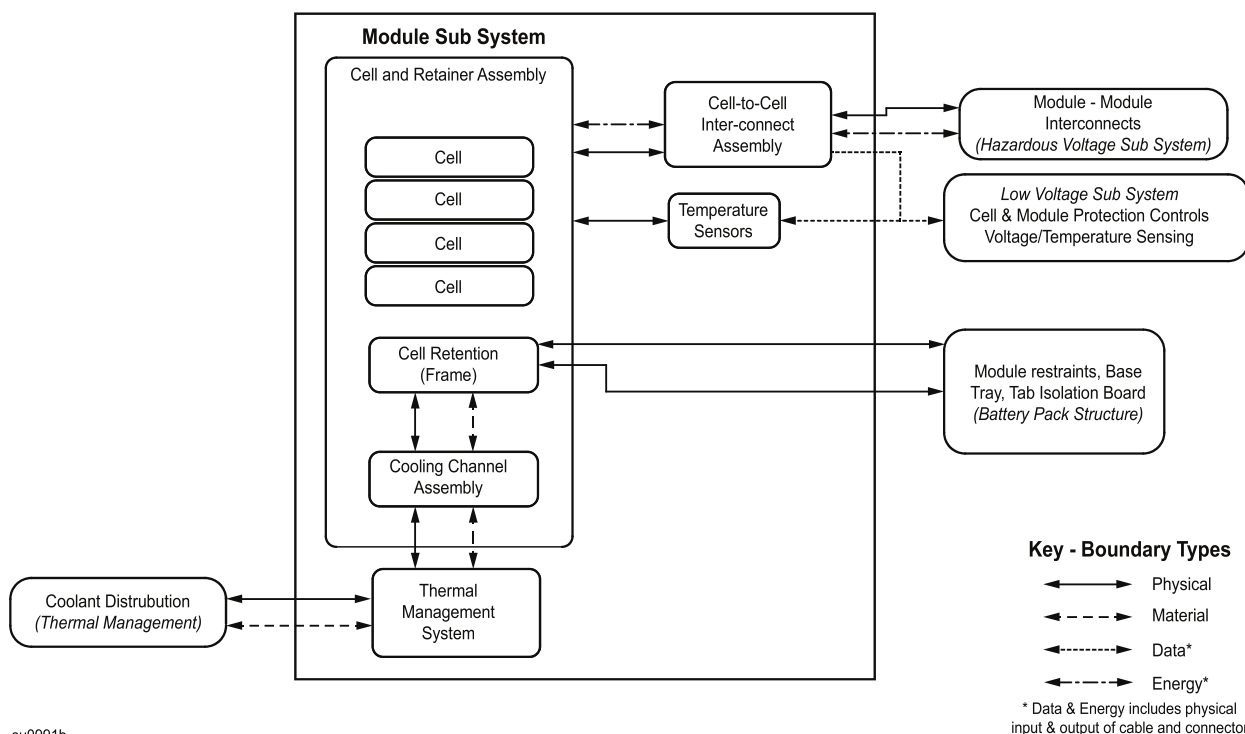
6.1 BATTERY PACK – Batteries that are ready for use in a electric powered vehicle, contained in a protective enclosure, with protective devices, with a battery management system, and monitoring circuitry, with or without cooling systems. See [Figure 6.1](#).



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6.2 CAPACITOR PACK – Electrochemical capacitors that are ready for use in a electric powered vehicle, contained in a protective enclosure, with or without protective devices, cooling systems, and monitoring circuitry. See [Figure 6.2](#).

Figure 6.2
Module – Boundary Diagram



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6.3 CAPACITY, RATED (C_n) – The total number of ampere-hours that can be withdrawn from a fully charged battery at a specific discharge rate to a specific end-of-discharge voltage (EODV) at a specified temperature as declared by the manufacturer.

6.4 CASING – The container that directly encloses and confines the electrolyte and electrodes of a cell or electrochemical capacitor.

6.5 CELL – The basic functional electrochemical unit (sometimes referred to as a battery) containing an electrode assembly, electrolyte, separators, container, and terminals. It is a source of electrical energy by direct conversion of chemical energy.

6.6 CELL, CYLINDRICAL – A cell format with a rigid case that has straight parallel sides and a round cross section.

6.7 CELL, POUCH – A cell format with a flexible laminate case that is typically a prismatic shape, and that can have its tabs on the same side or on opposite sides of each other.

6.8 CELL, PRISMATIC – A cell format with a rigid case that has a rectangular shape.

6.9 CHARGING – The application of electric current to battery or capacitor terminals, which results in a Faradic reaction that takes place within the battery that leads to stored electro-chemical energy or in the case of the capacitor, due to electrical charge being stored without a chemical reaction taking place. For electric vehicle applications, charging of the electric energy storage assembly can occur through one or more of the following methods:

- a) Regenerative braking which utilizes energy from regenerative brakes.
- b) Off board charging which utilizes an ac to dc charger, a dc charger, or an inductive charger external to the vehicle.
- c) On board charging which utilizes a charger on the vehicle to convert the ac mains supply to dc for charging. Charge energy can be provided external to vehicle or by an on board generator (termed Extended Range EV).

6.10 CHARGING, CONSTANT CURRENT (CC) – Charging mode where current is held constant while charging voltage is allowed to vary within defined parameters.

6.11 CHARGING, CONSTANT VOLTAGE (CV) – Charging mode where voltage is held constant while charging current is allowed to vary within defined parameters.

6.12 DUT – Device under test.

6.13 ELECTRIC ENERGY STORAGE ASSEMBLY (EESA) – A battery pack, electrochemical capacitor pack or combination battery/electrochemical capacitor pack that provides electric energy for electric vehicle motive power. This assembly can include the cooling and ventilation systems and battery management systems. See [Figure 6.1](#).

6.14 ELECTRIC POWERED VEHICLE – An on-road or off-road vehicle that uses electricity from batteries or other electric energy storage assemblies as a source of energy for motive power. Electric powered vehicles cover, but are not limited to, road passenger vehicles and heavy duty off road vehicles such as industrial trucks.

6.15 ELECTROCHEMICAL CAPACITOR – An electric energy storage device where electrical charge is typically stored as a result of non-Faradaic reactions at the electrodes. (A subset of electrochemical capacitors referred to as an "asymmetric" type have non-Faradaic reactions at one electrode and Faradaic reactions at the other electrode.) The unique porous surface of the electrodes increases the surface area for holding charge resulting in much larger capacitance and energy density. Electrochemical capacitors differ from common electrolytic capacitors in that they employ a liquid rather than a solid dielectric with charge occurring at the liquid-solid interface of the electrodes when a potential is applied. Some other common names for an electrochemical capacitor are "double layer capacitor", "ultra capacitor", "electrochemical double layer capacitor" and "super capacitor".

6.16 ENCLOSURE – The protective outer cover of the electric energy storage assembly that provides mechanical protection to the assembly's contents.

6.17 END-OF-DISCHARGE VOLTAGE (EODV) (Cell) – The voltage, under a specified load, of the cell at the end of discharge. The EODV may be specified by the manufacturer, as in the case of a voltage-terminated discharge typical for lithium ion chemistries.

6.18 EODV MONITORING (Cell) – EODV monitoring is typically provided at the pack/electric energy storage assembly level by the battery management system.

6.19 EXPLOSION – A violent release of energy that produces projectiles or a pressure wave from the DUT and results in DUT contents being forcibly expelled through a rupture in the enclosure or casing.

6.20 FIRE – The sustained combustion of the DUT's contents as evidenced by flame, heat and charring or other damage of materials.

6.21 **FULLY CHARGED** – An electric energy storage assembly, pack, module or cell which has been charged to its full state of charge (SOC) as specified by the manufacturer.

6.22 **FULLY DISCHARGED** – An electric energy storage assembly, pack, module or cell, which has been discharged to its end-of-discharge voltage (EODV) as specified by the manufacturer.

6.23 **HAZARDOUS ENERGY** – Available power level of 240 VA or more, having a duration of 60 s or more, or a stored energy level of 20 J or more, at a voltage of 2 V or more.

6.24 **HAZARDOUS VOLTAGE** – Voltage exceeding 30 Vrms/42.4 Vpeak or 60 V dc.

6.25 **INSULATION LEVELS** – The following are levels of electrical insulation:

a) **BASIC INSULATION** – A single level of insulation to provide basic protection against electric shock. Basic insulation alone may not provide protection from electric shock in the event of a failure of the insulation.

b) **DOUBLE INSULATION** – Insulation comprising both basic insulation and supplementary insulation.

c) **FUNCTIONAL INSULATION** – Insulation that is necessary only for the correct functioning of the equipment. Functional insulation by definition does not protect against electric shock. It may, however, reduce the likelihood of ignition and fire.

d) **REINFORCED INSULATION** – Single insulation system that provides a degree of protection against electric shock equivalent to double insulation under the conditions specified in this standard. The term "insulation system" does not imply that the insulation has to be in one homogeneous piece. It may comprise several layers that cannot be tested as basic insulation and supplementary insulation.

e) **SUPPLEMENTARY INSULATION** – Independent insulation applied in addition to basic insulation in order to reduce the risk of electric shock in the event of a failure of the basic insulation.

6.26 **LEAKAGE** – A condition where liquid electrolyte escapes through the opening of a designed vent as well as through a rupture or crack or other unintended opening and is visible external to the device under test.

6.27 **LIMITED POWER CIRCUIT** – A circuit supplied by a power source that meets SELV limits and whose power and current are further limited in accordance with UL 2054. A limited power source is equivalent to a Class 2 circuit in accordance with Article 725 of the NFPA 70. A similar concept to limited power is the term "low-voltage limited energy" (LVLE) as defined in Section 16 of UL 583.

6.28 **LITHIUM ION CELL** – A rechargeable cell where electrical energy is derived from the insertion/extraction reactions of lithium ions between the anode and the cathode. The lithium ion cell has an electrolyte that typically consists of a lithium salt and organic solvent compound in liquid or gel or solid form and has either a hard metal casing or a flexible polymeric pouch casing.

6.29 **MANUFACTURING PRODUCTION LINE TESTING** – Testing at the manufacturer's facilities used as a manufacturing check of their production. Depending upon the testing, it either can be a 100% production test, or can be a periodic check or sampling of production. This testing is sometimes referred to as routine testing.

6.30 **MAXIMUM WORKING VOLTAGE** – The highest voltage to which the insulation or component under consideration is or can be subjected to when the equipment is operated under conditions of normal use.

6.31 **MODULE** – A subassembly consisting of a group of cells or electrochemical capacitors connected together either in a series and/or parallel configuration (sometimes referred to as a block) with or without protective devices and monitoring circuitry. A module is a component of an electric energy storage assembly. See [Figure 6.2](#).

6.32 **MONOBLOC BATTERY** – A multi-cell battery design that contains a common pressure vessel construction, a single vent line assembly, and shared hardware.

6.33 **MOSOC** – Maximum Operating State of Charge.

6.34 **NICKEL CELL** – A general term for a nickel cadmium or nickel metal hydride rechargeable cell that has a nickel hydroxide positive electrode and either a cadmium metal or metal hydride negative electrode and that has a liquid alkaline (i.e. KOH) electrolyte.

6.35 **NORMAL OPERATING REGION** – That region of voltage, current, and temperature within which a cell or electrochemical capacitor can safely be charged and discharged repetitively throughout its anticipated life. The manufacturer specifies these values, which are then used in the safety evaluation of the device and may vary as the device ages. The normal operating region will include the following parameters for charging and discharging as specified by the manufacturer:

a) **CHARGING TEMPERATURE LIMITS** – The upper and lower limits of temperature, specified by the manufacturer for charging of the cell/capacitor. This temperature is measured on the casing.

b) **DISCHARGE TEMPERATURE LIMITS** – The upper and lower limits of temperature, specified by the manufacturer for discharging the cell/capacitor. This temperature is measured on the casing.

c) **END OF DISCHARGE VOLTAGE** – Refer to [6.17](#).

d) **MAXIMUM CHARGING CURRENT** – The maximum charging current in the normal operating region, which is specified by the cell/capacitor manufacturer. This value may vary with temperature.

e) **MAXIMUM DISCHARGING CURRENT** – The maximum discharging current rate, which is specified by the cell/capacitor manufacturer.

f) **UPPER LIMIT CHARGING VOLTAGE** – The highest charging voltage limit in the normal operating region specified by the cell/capacitor manufacturer. This value may vary with temperature.

6.36 **PROTECTIVE COMPONENTS, ACTIVE** – Devices provided to prevent hazardous conditions that require electrical energy in order to operate. An example of an active control would be a battery management system (BMS).

6.37 **PROTECTIVE COMPONENTS, PASSIVE** – Devices provided to prevent hazardous conditions that do not require electrical energy in order to operate. An example of a passive protective device would be a fuse.

6.38 **ROOM AMBIENT** – Considered to be a temperature in the range of $25 \pm 5^{\circ}\text{C}$ ($77 \pm 9^{\circ}\text{F}$).

6.39 **RUPTURE** – A mechanical failure of the DUT's enclosure/casing from either internal or external causes, that results in spillage and/or exposure of internal contents of the DUT, but does not result in projectiles and violent energy release such as occurs during an explosion.

6.40 **SAFETY CRITICAL CIRCUITS/COMPONENTS** – Those circuits or discrete components that are relied upon for safety as identified in the safety analysis of [Section 13](#).

6.41 SODIUM NICKEL CHLORIDE CELL – A rechargeable cell that has a sodium negative electrode, a positive electrode that consists of nickel, nickel chloride and sodium chloride and a ceramic beta alumina electrolyte. The normal operation of the cell is within a temperature range of 270°C – 350°C (518°F – 662°F) so that the active materials are in a molten state and to ensure ionic conductivity.

6.42 STATE OF CHARGE (SOC) – The available capacity in an electrical energy storage assembly, pack, module or cell expressed as a percentage of rated capacity.

6.43 THERMAL RUNAWAY (CELL) – A condition where an increase in temperature of the cell results in exothermic reactions that further increases the cell temperature due to increased reactions within the cell. A thermal runaway often leads to a destructive result such as a fire or explosion when the heat cannot be safely dissipated.

6.44 TOXIC GAS RELEASE (CRASH/NONOPERATIONAL LEVELS) – A release of vapor of an identified toxic substance that is categorized as an Emergency Response Planning Guidelines (ERPG) level 2.

a) ERPG-2 defines this as: "The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action." Methods for determination of this limit are outlined in Section [23](#).

6.45 TOXIC GAS RELEASE (OPERATIONAL LEVELS) – A release of vapor that results in a concentration of an identified toxic substance in excess of the Occupational Safety and Health Administration (OSHA) 8-h time-weighted-average (TWA) permissible exposure limit, which corresponds to the National Institute of Safety and Health (NIOSH) 10-h per day 40-h per week permissible exposure limit. Methods for determination of this limit are outlined in Section [23](#). In addition, the toxic substance concentration levels should not exceed the NIOSH short term exposure limits (STELs) or ceiling limits.

6.46 VEHICLE, OFF ROAD – A motorized conveyance that is not intended for transporting persons and/or objects on public roads including the highway systems. Examples of such devices would be industrial trucks, farming equipment, construction equipment.

6.47 VEHICLE, ON ROAD – A motorized conveyance that is intended for transporting persons and objects on public roads including the highway systems. Examples of such devices would be passenger autos, trucks, buses, etc.

6.48 VENTING – A condition when the cell electrolyte and/or battery solvent is emitted as vapor, smoke or aerosol from a designed vent or through a sealing edge.

6.49 VOLTAGE, NOMINAL – A specified operating potential of a battery at its fully charged state.

CONSTRUCTION

7 Non-Metallic Materials

7.1 The materials employed for enclosures shall comply with the applicable enclosure and insulation requirements outlined in CAN/CSA-C22.2 No. 0.17 / UL 746C, Path III of the table for Enclosure Requirements, Table 4.1, except as modified by this standard.

7.2 Polymeric materials employed for enclosures shall have a minimum flame rating of V-1 in accordance with CAN/CSA-C22.2 No. 0.17 / UL 94.