



JOINT CANADA-UNITED STATES
NATIONAL STANDARD

STANDARD FOR SAFETY

ANSI/CAN/UL-9540:2016, Energy Storage Systems and Equipment



ANSI/UL 9540-2016



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UL Standard for Safety for Energy Storage Systems and Equipment, UL 9540

First Edition, Dated November 21, 2016

Summary of Topics

The First Edition of the Standard for Energy Storage Systems and Equipment, UL 9540, has been issued to reflect the latest ANSI and SCC approval dates, and to incorporate the proposals dated November 13, 2015 and July 1, 2016.

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated November 13, 2015 and July 1, 2016.

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NOVEMBER 21, 2016

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UL 9540

Standard for Energy Storage Systems and Equipment

First Edition

November 21, 2016

This ANSI/CAN/UL Safety Standard consists of the First Edition.

The most recent designation of ANSI/UL 9540 as an American National Standard (ANSI) occurred on November 21, 2016. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, Preface or SCC Foreword.

This standard has been approved as a National Standard of Canada (NSC) by the Standards Council of Canada (SCC).

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Preface (UL)

This is the First Edition of the ANSI/CAN/UL 9540 Standard for Safety for Energy Storage Systems and Equipment.

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

This ANSI/CAN/UL 9540 Standard for Safety is under continuous maintenance, whereby each revision is ANSI/CAN approved upon publication. If no revisions occur, the initiation of the review of this Standard will commence within 5 years of the date of publication.

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.

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

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This Edition of the Standard has been formally approved by the UL Standards Technical Panel (STP) on Energy Storage Systems and Equipment, STP 9540.

This list represents the STP 9540 membership when the final text in this standard was balloted. Since that time, changes in the membership may have occurred.

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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 energy storage systems that are intended to receive electric energy and then to store the energy in some form so that the energy storage system can provide electrical energy to loads or to the local/area electric power system (EPS) up to the utility grid when needed. The types of energy storage covered under this standard include electrochemical, chemical, mechanical and thermal. The energy storage systems equipment (constructed either as one unitary complete system or as matched assemblies that when connected are the system) may include equipment for charging, discharging, control, protection, power conversion, communication, controlling the system environment, air, fire detection and suppression system, fuel or other fluid movement and containment, etc. The system may contain other ancillary equipment related to the functioning of the energy storage system.

1.2 The systems covered by this standard include those intended to be used in a standalone mode (e.g. islanded) including "self-supply" systems to provide electric energy and those used in parallel with an electric power system or electric utility grid such as "grid-supply" systems, or applications that perform multiple operational modes.

1.3 Requirements for installation, with the exception of installation manuals and documents for installation provided with the system that are integral to the tested system are outside the scope of this standard. The installation instructions indicate that the energy storage systems are to be installed in accordance with the national and local electrical codes and other applicable codes. This standard assumes that the final installation of the energy storage system will be performed by qualified service personnel in accordance with the applicable installation instructions, installation practices and national installation codes. Energy storage systems are intended for installation subject to approval by the Authority Having Jurisdiction.

2 Components

2.1 A component/subsystem of a product covered by this standard shall comply with the safety requirements for that component/subsystem. See Appendix A for a list of standards covering components generally used in the products covered by this standard. A component shall comply with the CSA and/or UL standards as appropriate for the country where the product is to be installed.

3 Units of Measurement

3.1 Values and their respective units of measurement that are stated without parentheses constitute the requirement of the standard and those in parentheses constitute explanatory or approximate information.

4 Undated References

4.1 Any undated reference appearing in the requirements of this standard shall be interpreted as referring to the latest edition of the reference, including all revisions and amendments.

5 Normative References

5.1 The following standards are referenced in this standard, and portions of these referenced standards may be essential for compliance. Energy storage systems covered by this standard shall comply with the referenced installation codes and standards as appropriate for the country where the energy storage system is to be used. When the energy storage system is intended for use in more than one country, the energy storage system shall comply with the installation codes and standards for all countries where it is intended to be used.

American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

ASHRAE 62.1

Ventilation for Acceptable Indoor Air Quality

American Society of Mechanical Engineers (ASME) Codes

ASME B31 (all applicable parts)

Power Piping

ASME BPVC

Boiler and Pressure Vessel Code

CSA Group Standards

C22.1

Canadian Electrical Code, Part I Safety Standard for Electrical Installations

CAN/CSA-C22.2 No. 0

General Requirements – Canadian Electrical Code, Part II

C22.2 No. 0.15

Adhesive Labels

CAN/CSA-C22.2 No. 0.17

Evaluation of Properties of Polymeric Materials

C22.2 No. 0.2

Insulation Coordination

C22.2 No. 0.8

Safety Functions Incorporating Electronic Technology

C22.2 No. 14

Industrial Control Equipment

C22.2 No. 94.2

Enclosures for Electrical Equipment, Environmental Considerations

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C22.2 No. 100
Motors and Generators

C22.2 No. 107.1
General Use Power Supplies

C22.2 No. 139
Electrically Operated Valves

CAN/CSA-C22.2 No. 60079-2
Explosive Atmospheres – Part 2: Equipment Protection By Pressurized Enclosure "p"

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

CAN/CSA-C22.2 No. 60529
Degrees of Protection Provided By Enclosures (IP Code)

CSA FC 1
Fuel Cell Technologies – Part 3-100: Stationary Fuel Cell Power Systems – Safety

CAN/CSA-C22.2 No. 62282-3-100
Fuel Cell Technologies – Part 3-100: Stationary Fuel Cell Power Systems

CSA B51
Boiler, Pressure Vessel, and Pressure Piping Code

CSA B52
Mechanical Refrigeration Code

CSA B149.1
Natural Gas and Propane Installation Code

CSA Z462
Workplace Electrical Safety

CSA Z662
Oil and Gas Pipeline Systems

CAN/CSA-E60730-1
Automatic Electrical Controls for Household and Similar Use – Part 1: General Requirements

Institute of Electrical and Electronics Engineers (IEEE) Standards Association

IEEE C2
National Electrical Safety Code

IEEE 693
Recommended Practice for Seismic Design of Substations

IEEE 1547
Interconnecting Distributed Resources with Electric Power Systems

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IEEE 1547.1

Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems

International Electrotechnical Commission (IEC) Standards

IEC 60068-2-52

Environmental Testing Part 2: Tests – Tests Kb, Salt Mist, Cyclic (Sodium Chloride Solution)

IEC 60417 Database

Graphical Symbols for Use on Equipment

IEC 60529

Degrees of Protection Provided by Enclosures (IP Code)

IEC 60812

Analysis Techniques for System Reliability – Procedures for Failure Mode and Effects Analysis (FMEA)

IEC 60980

Recommended Practices for Seismic Qualification of Electrical Equipment of the Safety System for Nuclear Generating Stations

IEC 61025

Fault Tree Analysis (FTA)

IEC 61508 (all parts)

Functional Safety of Electrical/Electronic/Programmable Electronic Safety-Related Systems

International Standards Organization (ISO) Standards

ISO 7010

Graphical Symbols – Safety Colours and Safety Signs – Registered Safety Signs

ISO/IEC 31010

Risk Management – Risk Assessment Techniques

National Electrical Manufacturers Association (NEMA)

NEMA Z535.1

Safety Colors

NEMA Z535.2

Environmental and Facility Safety Signs

NEMA Z535.3

Criteria for Safety Symbols

NEMA Z535.4

Product Safety Signs and Labels

NEMA Z535.5

Safety Tags and Barricade Tape (for Temporary Hazards)

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NEMA Z535.6

Product Safety Information in Product Manuals, Instructions, and Other Collateral Materials

National Fire Protection Association (NFPA) Codes and Standards

NFPA 1

Fire Code

NFPA 70

National Electrical Code

NFPA 70E

Electrical Safety in the Workplace

NFPA 79

Electrical Standard for Industrial Machinery

NFPA 497

Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas

NFPA 550

Guide to the Fire Safety Concepts Tree

NFPA 551

Guide for the Evaluation of Fire Risk Assessments

North American Electric Reliability Corporation (NERC)

PRC-024-1

Generator Frequency and Voltage Protective Relay Settings

Occupational Safety and Health Standards (OSHA)

29 CFR 1910.1200

Toxic and Hazardous Substances

UL Standards

UL 50E

Enclosures for Electrical Equipment, Environmental Considerations

UL 252

Compressed Gas Regulators

UL 429

Electrically Operated Valves

UL 746C

Polymeric Materials – Use in Electrical Equipment Evaluations

UL 840

Insulation Coordination Including Clearances and Creepage Distances For Electrical Equipment

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UL 842

Valves for Flammable Fluids

UL 991

Tests for Safety-Related Controls Employing Solid-State Devices

UL 1741

Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources

UL 1971

Signaling Devices for the Hearing Impaired

UL 1973

Batteries for Use in Light Electric Rail (LER) Applications and Stationary Applications

UL 1998

Software in Programmable Components

UL 2200

Stationary Engine Generator Assemblies

UL 60730-1

Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements

UL 60950-1

Information Technology Equipment – Safety – Part 1: General Requirements

ULC Standards

ULC/C842

Guide for the Investigation of Valves for Flammable and Combustible Liquids

US Department of Defense (DOD) Standards

MIL-STD-1629A

Procedures for Performing a Failure Mode, Effects, and Criticality Analysis

6 Glossary

6.1 For the purpose of this standard, the following definitions apply.

6.2 ARC FLASH BOUNDARY – The area within which a hazardous arc could occur, and which requires the use of special protective equipment (PPE). See 10.8.

6.3 DUT – Device under test.

6.4 ELECTRIC POWER SYSTEM (EPS) – Equipment or facilities that are downstream of the technology generating electric power that are associated with the transmission and distribution of that power to electrical loads.

6.5 ENERGY STORAGE (ES) SYSTEM – Equipment that receives electrical energy and then provides a means to store that energy in some form for later use in order to supply electrical energy when needed. See Figure 6.1. The energy storage system may utilize one of the following technologies:

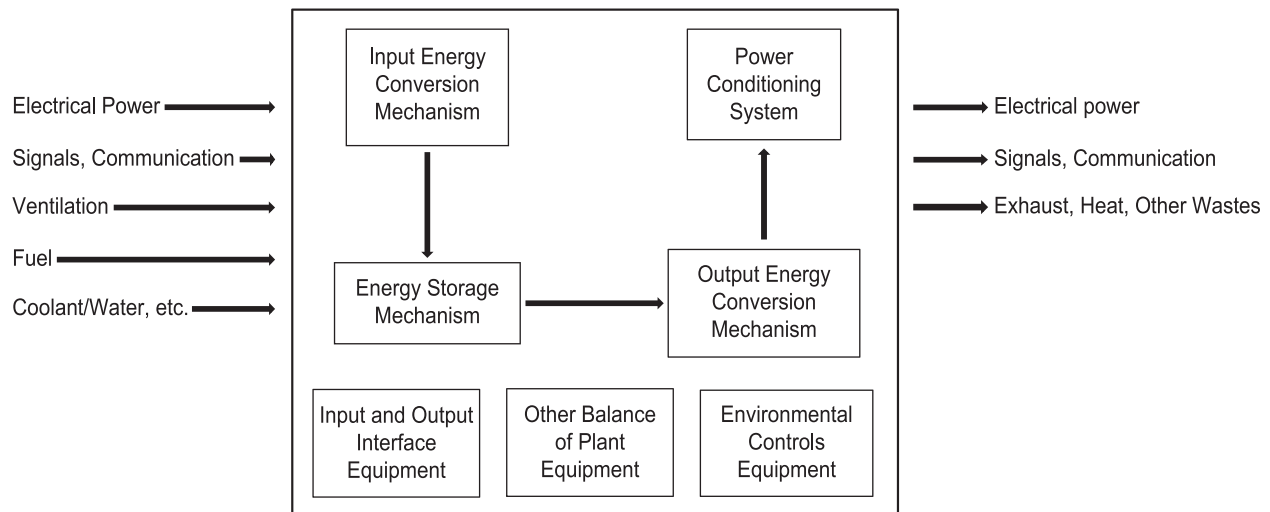
a) ELECTROCHEMICAL ENERGY STORAGE SYSTEM – Consists of a secondary (rechargeable) battery, electrochemical capacitor, flow battery or hybrid battery-capacitor system that stores electrical energy and any associated controls or devices that can provide the stored electric energy upon demand.

b) CHEMICAL ENERGY STORAGE SYSTEM – Consists of hydrogen storage, the hydrogen generator to supply the hydrogen for storage, and a fuel cell power system to provide electric energy upon demand.

c) MECHANICAL ENERGY STORAGE SYSTEM – Consists of a mechanical means to store energy such as through compressed air, pumped water or fly wheel technologies and associated controls and systems, which can be used to run an electric generator to provide electric energy upon demand.

d) THERMAL ENERGY STORAGE SYSTEM – Consists of a system that uses heated fluids such as air as a means to store energy along with associated controls and systems, which can be used to run an electric generator to provide electrical energy upon demand.

Figure 6.1
Block Diagram of Electrical Energy Storage System



su2184a

Examples:

Technology	Input Energy Conversion Mechanism	Energy Storage Mechanism	Output Energy Conversion Mechanism
Electrochemical	Charger	Battery System	Converter
Chemical	Water Electrolysis Hydrogen Generator	Hydrogen Storage	Combustion Generator Fuel Cell
Mechanical	Air Compressor	Flywheel	Motor Generator
Thermal	Heat Pump	Thermal Storage	Heat Generator or Heat Exchanger

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