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Definitions and Precautionary Labels for Lead-Acid Industrial Storage Batteries

NEMA

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION ■ 2101 L STREET, N.W., WASHINGTON, D.C. 20037

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Introduction

The purpose of these definitions is to provide for a common understanding among manufacturers, consumers and technical persons in writing specifications, and trade and scientific articles pertaining to lead-acid industrial storage batteries.

The primary aim has been to express for each term a meaning which is generally accepted in the United States of America. Numerous glossaries, including foreign sources, have been reviewed. Whenever possible, definitions have been generalized so that new methods and materials may be used.

To assure a meaningful publication, copies were sent during the draft stage to a number or organizations in the private sector having an interest in these terms. The response indicated concurrence with the draft, and no proposed revisions were received.

It is recognized that this glossary does not include all terms pertinent to the industry. Some terms, though still technically correct, have not been included since the practice defined or items described are not in current use.

It is the desire of the Industrial Storage Battery Section of NEMA to further this work by establishing contact with organizations engaged in writing standards for industrial storage batteries. The ultimate purpose is to expand or revise this publication, if necessary, so that definitions will be available which are accepted and in common use by the storage battery industry and all associated groups who find it necessary to define this product.

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Foreword

These standards have been developed by the Industrial Battery and Charger Section of NEMA which periodically reviews them for any revisions necessary to keep them up-to-date with advancing technology. Comments or recommended revisions are welcome and should be submitted to:

Manager, Engineering Department
National Electrical Manufacturers Association
2101 L Street, N.W., Suite 300
Washington, D.C. 20037

Purpose

The purpose of this standards publication is to provide for a common understanding among manufacturers, consumers and technical persons in writing specifications and trade and scientific articles pertaining to lead-acid industrial storage batteries.

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Section 1
DEFINITIONS

(Approved as NEMA Standards 1-14-1971.)

ACTIVE MATERIALS (storage battery)

The materials of the plates which react chemically to produce electric energy when the cell discharges and which are restored to their original composition, in the charged condition, by oxidation and reduction processes produced by the charging current.

NEMA Standard 11-18-1982.

AMBIENT TEMPERATURE

Ambient temperature is the temperature of the surrounding medium that comes into contact with the device or equipment.

NEMA Standard 11-18-1982.

AMPERE-HOUR CAPACITY (storage battery)

The number of amperes hours which can be delivered under specified conditions as to temperature, rate of discharge, and final voltage.

NEMA Standard 11-18-1982.

AMPERE-HOUR EFFICIENCY (storage cell, storage battery)

The ampere-hour efficiency of a storage battery is the electrochemical efficiency expressed as the ratio of the ampere-hours, output to the ampere-hours input required for the recharge.

NEMA Standard 11-18-1982.

AVERAGE VOLTAGE

The average voltage of a storage battery is the average value of the voltage during the period of charge or discharge.

BATTERY (primary or secondary)

A battery consists of two or more cells electrically connected for producing electric energy. Common usage permits this designation to be applied also to a single cell used independently.

See "Portable Battery"
"Stationary Battery"
"Storage Battery"

NEMA Standard 11-18-1982.

BOOST CHARGE (quick charge)

A partial charge, usually at a high rate for a short period.

NEMA Standard 11-18-1982.

CABLE CONNECTOR

The cable connector of a storage battery is a length of insulated cable terminating at each end in a casting or a lug and used to connect one cell to another.

Cable connectors differ from terminal connectors in that they are used between cells rather than as a connection between terminal and external circuits. (The term "jumper" is sometimes used; however, "jumper" is generally recognized as a temporary connection.)

CAPACITY

See "Ampere-hour Capacity"
"Rated Capacity"
"Service Capacity"
"Watthour Capacity"

CELL

See "Counter Electromotive Force Cells"
"Emergency Cells"
"End Cells"
"Pilot Cell"
"Storage Cell"

CELL CONNECTOR (storage cell)

A cell connector is an electric conductor used for carrying current between adjacent storage cells.

NEMA Standard 11-18-1982.

CHARGE (storage battery)

The conversion of electric energy into chemical energy within the cell or battery. This restoration of the active materials is accomplished by maintaining a unidirectional current in the cell or battery in the opposite direction to that during discharge; a cell or battery which is said to be charged is understood to be fully charged.

See "Boost Charge (quick charge)"
"Constant-current Charge"
"Constant-voltage Charge"
"Equalizing Charge"
"Floating"
"Freshening Charge"
"Initial Charge"
"Modified Constant-voltage Charge"
"Reversal"
"Taper Charge"
"Trickle Charge"
"Two-rate Charge"

NEMA Standard 11-18-1982.

CHARGED AND DRY

Charged and dry is the condition of a storage battery when it is assembled with charged and dried plates, dry separators, and with no electrolyte.

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CHARGED AND WET

Charged and wet is the condition of a storage battery when it is filled with electrolyte and is fully charged.

CHARGING PLUG (connector)

Charging plug is half of a terminal device on the ends of the positive and negative terminal connectors of a storage battery. The connection is readily made to the load or charging circuit , each of which is equipped with a charging receptacle.

NEMA Standard 11-18-1982.

CHARGING RATE (storage battery)

The current expressed in amperes at which a battery is charged.

See "Finishing Rate"

NEMA Standard 11-18-1982.

CHARGING RECEPTACLE

A charging receptacle is half of a terminal device on the ends of the positive and negative terminal connectors of a storage battery.

CLOSED—CIRCUIT VOLTAGE (working voltage) (battery)

The voltage at its terminals when a specified current is flowing.

NEMA Standard 11-18-1982.

CONNECTORS

See "Cable Connector"
"Cell Connector"
"Terminal Connector"

CONSTANT-CURRENT CHARGE

A constant-current charge of a storage battery is a charge in which the current is maintained at a constant value.

CONSTANT-VOLTAGE CHARGE

A constant-voltage charge of a storage battery is a charge in which the voltage at the terminals of the battery is held at a constant value.

COUNTER ELECTROMOTIVE FORCE CELLS (counter cells)

Cells of practically no ampere-hour capacity used to oppose the battery voltage.

NEMA Standard 11-18-1982.

COVER (cell)

The cover of a storage battery is the lid of an enclosed cell.

CUT-OFF VOLTAGE (final voltage)

The prescribed voltage at which the discharge is considered complete. (The cut-off or final voltage is usually chosen so that the useful capacity of the battery is realized. The cut-off voltage varies with the type of battery, the rate of discharge, the temperature and the kind of service. The term "cut-off voltage" is applied more particularly to primary batteries, and final voltage to storage batteries.)

NEMA Standard 11-18-1982.

CYCLE

The cycle of a storage cell or battery is the discharge and subsequent charge of the cell or battery to restore the initial conditions.

DEAD TOP

Dead top is the top surface of a cell or battery, except for the cell filling vents and battery terminals, which has been completely covered by some insulating medium to precent accidental short circuits.

DISCHARGE (storage cell)

Discharge of a storage battery is the conversion of the chemical energy of the battery into electrical energy.

See "Local Action"

NEMA Standard 11-18-1982.

DROP

See "Gravity Drop"
"IR Drop"

DRY CHARGED

See "Charged and Dry"

EFFICIENCY (storage battery)

The ratio of the output of the cell or battery to the input required to restore the initial state of charge under specified conditions of temperature, current rate and final voltage.

See "Ampere-hour Efficiency"
"Volt Efficiency"
"Watthour Efficiency"

NEMA Standard 11-18-1982.

ELECTROLYTE (component of a cell)

An electrolyte is a conducting medium in which the flow of electric current takes place by the migration of ions. (The electrolyte for a lead-acid storage cell is an aqueous solution of sulfuric acid.)

See "Filling Gravity"
"Gravity Drop"
"Nominal Gravity"
"Specific Gravity of Electrolyte"

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ELEMENT (storage cell)
The positive and negative groups with separators, or separators and retainers, etc., assembled for one cell.
NEMA Standard 11-18-1982.

EMERGENCY CELLS
End cells which are held available for use exclusively during emergency discharges.
NEMA Standard 11-18-1982.

END CELLS (storage battery)
Cells that may be cut in or cut out of the circuit for the purpose of adjusting the battery voltage.
NEMA Standard 11-18-1982.

END-TO-END
End-to-end is the configuration of a storage battery in which the plate edges of adjacent cells face each other.

EQUALIZING CHARGE
An equalizing charge of a storage battery is a prolonged charge, usually at the finishing rate or less, to correct any inequalities of voltage and specific gravity which may have developed between the cells during service.

FILLING GRAVITY
Filling gravity is the specific gravity of the sulfuric acid used to fill a cell or battery.

FINAL VOLTAGE
See "Cut-off Voltage"
NEMA Standard 11-18-1982.

FINISHING RATE (storage battery)
The rate of charge expressed in amperes to which the charging current for some types of lead batteries is reduced, near the end of charge, to prevent excessive gassing and temperature rise.
NEMA Standard 11-18-1982.

FLAME ARRESTOR VENT
A cell-venting device which prevents the propagation of an external flame into the cell.
NEMA Standard 11-18-1982.

FLOATING
A method of operation for storage batteries in which a constant voltage is applied to the battery terminals sufficient to maintain an approximately constant state of charge.
See "Trickle Charge"
NEMA Standard 11-18-1982.

FRESHENING CHARGE
The freshening charge of a storage battery is a charge given to charged and wet batteries in storage or during inactive periods to replace losses due to local action and to insure that every cell is brought periodically to a full state of charge.

GASSING
The evolution of gases from one or more of the electrodes during electrolysis.
NEMA Standard 11-18-1982.

GRAVITY
See "Filling Gravity"
"Nominal Gravity"
"Specific Gravity of Electrolyte"

GRAVITY DROP
Gravity drop of a storage battery is the change in the specific gravity of the electrolyte upon discharge of the cell.

GRID
A grid is a framework employed in a storage cell for supporting the active material and conducting the electric current.

GROUND
A ground is a conducting connection, either intentional or accidental, between an electrical circuit or equipment and earth, or to some conducting body which serves in place of the earth.

GROUP
A group is an assembly, in a storage cell, of plates of the same polarity connected in parallel.

INDICATOR
See "Level Indicator"

INITIAL CHARGE
An initial charge is the charge given to a new storage battery before putting it into service.

INITIAL TEST TEMPERATURE
The initial test temperature for a storage battery is the average temperature of the electrolyte in the battery cells at the beginning of discharge.
NEMA Standard 11-18-1982.

INITIAL VOLTAGE (battery)
The closed-circuit voltage at the beginning of a discharge. It is usually taken after current has been flowing for a sufficient period of time for the rate of change of voltage to become practically constant.
NEMA Standard 11-18-1982.

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INTERNAL RESISTANCE

The internal resistance is the resistance within a cell or battery to the flow of electricity.

IR DROP

The IR drop in a cell is equal to the product of the current passing through the cell and the resistance of the cell.

JAR

A jar is the container which houses the element and electrolyte of a storage cell.

LEVEL INDICATOR

The level indicator of a storage battery is a float or reference mark which indicates the electrolyte level within a cell.

LIFTING EYE

A lifting eye is an opening, usually circular, provided for lifting the storage battery.

LOCAL ACTION (self discharge)

Local action in a battery is the loss of otherwise usable chemical energy by spontaneous currents within the cell or battery regardless of its connections to an external circuit.

MODIFIED CONSTANT-VOLTAGE CHARGE (storage battery)

A modified constant-voltage charge of a storage battery is a charge in which the bus voltage of the charging circuit is held substantially constant, but a fixed resistance is present in the battery circuit which results in an increase in voltage at the battery terminals as the charge progresses.

NEMA Standard 11-18-1982.

NEGATIVE PLATE (storage cell)

The negative plate of a storage cell consists of the grid and active material to which current flows from the external circuit when the battery is discharging.

NEMA Standard 11-18-1982.

NEGATIVE TERMINAL

The negative terminal of a battery is the terminal toward which positive electric charge flows in the external circuit from the positive terminal when the cell discharges.

NOMINAL GRAVITY

Nominal gravity is the specific gravity of the electrolyte selected for the determination of the rated capacity of the storage battery when it is fully charged and correctly leveled.

NOMINAL VOLTAGE

The nominal voltage of a lead-acid storage battery is 2.0 volts multiplied by the number of cells.

OPEN CIRCUIT VOLTAGE

The open circuit voltage of a battery is the voltage at its terminals when no appreciable current is flowing.

PASTED (FAURÉ) PLATE

A pasted plate of a storage cell consists of a grid filled with active material applied as a paste.

PILOT CELL (storage battery)

A selected cell whose condition is assumed to indicate the condition of the entire battery.

NEMA Standard 11-18-1982.

PLANTÉ PLATE (storage cell)

A formed lead plate of large area, the active material of which is formed in thin layers at the expense of the lead itself.

NEMA Standard 11-18-1982.

PLATES

See "Negative Plate"
"Pasted (Fauré) Plate"
"Planté Plate"
"Positive Plate"
"Tubular Place"

POLARITY (battery)

An electrical condition determining the direction in which current tends to flow on discharge. By common usage the discharge current is said to flow from the positive electrode through the external circuit.

NEMA Standard 11-18-1982.

POLARIZATION (battery)

The change in voltage at the terminals of the cell or battery when a specified current is flowing, and is equal to the difference between the actual and the equilibrium (constant open-circuit condition) potentials of the plates, exclusive of the internal resistance drop.

NEMA Standard 11-18-1982.

PORTABLE BATTERY

A storage battery designed for convenient transportation.

NEMA Standard 11-18-1982.

POSITIVE PLATE (storage cell)

The grid and active material from which current flows to the external circuit when the battery is discharging.

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POSITIVE TERMINAL (battery)

The positive terminal of a battery is the terminal from which the positive electric charge flows through the external circuit to the negative terminal when the cell discharges.

NOTE: The flow of electrons in the external circuit is to the positive terminal and from the negative terminal.

NEMA Standard 11-18-1982.

QUICK CHARGE

See "Boost Charge"

RACK

A rack is a supporting framework for stationary storage batteries.

See "Shock-protected Rack"

RATED CAPACITY

The rated capacity of a storage battery is the number of ampere-hours and/or watthours which it is capable of delivering when fully charged and under specified conditions of temperature, rate of discharge, final voltage, and specific gravity.

RATED VOLTAGE

Rated voltage is the voltage to which operating and performance characteristics of apparatus and equipment are referred.

RETAINER

A retainer is a storage cell is any material which is used to prevent the loss of active material from the positive plate.

REVERSAL (storage battery)

A change in normal polarity of the cell or battery.

NEMA Standard 11-18-1982.

SEALING COMPOUND

Sealing compound is any material which is used to seal a storage cell cover to the jar.

SELF DISCHARGE

See "Local Action"

SEPARATOR (storage cell)

A spacer employed to prevent metallic contact between plates of opposite polarity within the cell.

NEMA Standard 11-18-1982.

SERVICE CAPACITY (cell or battery)

The electric output (expressed in ampere-hours, watt-hours or similar units) on a service test before its working voltage falls to a specified cut-off voltage.

NEMA Standard 11-18-1982.

SERVICE LIFE

The service life of a storage battery is the period of useful service under specified conditions. It is usually expressed as the time period or number of cycles which elapse before the ampere-hour capacity falls to a specified percentage of the rated capacity.

NEMA Standard 11-18-1982.

SERVICE WEIGHT

Service weight is the weight, in pounds, of a fully charged industrial truck battery with the electrolyte at its normal level. (It is useful in determining if sufficient counterweight is available on high lift trucks.)

SEISMIC-PROTECTED RACK

A rack which is used to protect the storage battery during seismic-type disturbances.

NEMA Standard 11-18-1982.

SIDE-TO-SIDE

Side-to-side is the configuration of a storage battery in which the plate faces of adjacent cells face each other.

SPECIFIC GRAVITY OF ELECTROLYTE

The specific gravity of an electrolyte is the ratio of the weight of a given volume of electrolyte to the weight of an equal volume of water at a specified temperature.

STATIONARY BATTERY

A storage battery designed for service in a permanent location.

NEMA Standard 11-18-1982.

STORAGE BATTERY (secondary battery or accumulator)

A battery consisting of two or more storage cells electrically connected for producing electric energy. Common usage permits this designation to be applied also to a single storage cell used independently.

NEMA Standard 11-18-1982.

STORAGE BATTERY, LEAD-ACID

A lead-acid storage battery is a storage battery in which the electrodes are made of lead and the electrolyte consists of a solution of sulfuric acid.

STORAGE CELL (secondary cell or accumulator)

A galvanic cell for the generation of electric energy in which the cell, after being discharged, may be restored to a fully charged condition by an electric current flowing in a direction opposite to the flow of current when the cell discharges.

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TAPER CHARGE

A taper charge is one during which a storage battery is initially charged at a high charge rate which tapers down to a low rate.

TEMPERATURE

See "Ambient Temperature"
"Critical Temperature"
"Initial Test Temperature"

TEMPERATURE COEFFICIENT OF CAPACITY

The temperature coefficient of capacity of a storage cell or battery is the change in delivered capacity (ampere-hour or watthour capacity) per degree relative to the capacity of the cell or battery at a specified temperature.

TEMPERATURE COEFFICIENT OF ELECTRO-MOTIVE FORCE

The temperature coefficient of electromotive force of a storage cell or battery is the change in open-circuit voltage per degree relative to the electromotive force of the cell or battery at a specified temperature.

TERMINALS (storage battery, storage cell)

The terminals are the parts of a storage battery to which the external circuit is connected.

NEMA Standard 11-18-1982.

TERMINAL CONNECTOR

A terminal connector of a storage battery is an electrical conductor for carrying current from the battery to the external circuit.

TRAY

A tray of a storage battery is a container for one or more storage cells.

TRICKLE CHARGE

A continuous charge at a low rate approximately equal to the internal losses and suitable to maintain the battery in a fully charged condition.

NOTE: This term is also applied to very low rates of charge suitable not only for compensating for internal losses, but to restore intermittent discharges of small amount delivered from time to time to the load circuit.)

See "Floating"

NEMA Standard 11-18-1982.

TUBULAR PLATE

A tubular plate of a storage cell is a plate in which the active material is contained in porous tubes, each tube having a centrally located grid.

TWO-RATE CHARGE

A two-rate charge of a storage battery is one in which two different charge rates are used, the first being higher than the second. The rate is usually changed from high to low when the battery starts gassing.

VENT

See "Flame Arrestor Vent"

NEMA Standard 11-18-1982.

VOLTAGE

See "Average Voltage"
"Closed-circuit Voltage"
"Final Voltage"
"Initial Voltage"
"Nominal Voltage"
"Open Circuit Voltage"
"Rated Voltage"

VOLT EFFICIENCY

The volt efficiency of a storage battery is the ratio of the average voltage during the discharge to the average voltage during the recharge.

WATTHOUR CAPACITY

The watthour capacity of a storage battery is the number of watthours which can be delivered under specified conditions as to temperature, rate of discharge and final voltage.

WATTHOUR EFFICIENCY

The watthour efficiency of a storage battery is the energy efficiency expressed as the ratio of the watthours output to the watthours of the recharge.

WORKING VOLTAGE

See "Closed-circuit Voltage"

Recommendation for Battery Water for Lead-acid Industrial Storage Batteries

Requirements	Maximum Allowable Impurities (ppm)
Total Solids	350.0
Fixed Solids	200.0
Organic and Volatile Matter	150.0
Iron	4.0
Chloride	25.0
Ammonia as NH_4	5.0
Nitrites as NO_2	10.0
Nitrates as NO_3	10.0

Authorized Engineering Information 5-17-1972.

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Section 2
PRECAUTIONARY LABELS

2.1 STATIONARY APPLICATIONS

2.1.1

DANGER - EXPLOSION

Can cause blindness or severe injury. Protect eyes when working around battery. Sparks, flames or cigarettes can cause explosion. Tools and loose connections can cause sparks.

IMPORTANT

Follow written instructions when servicing or charging. Do not remove flame arrestor vent cap. Provide adequate ventilation when charging.

2.1.2

ACID - POISON

Can cause severe burns. Contains sulfuric acid. In case of contact, flush immediately and thoroughly with water. Obtain prompt medical attention when eyes are affected.

2.2 MOTIVE POWER APPLICATIONS

2.2.1

DANGER - EXPLOSIVE

Can cause blindness or severe injury. Protect eyes when working around battery. Sparks, flames or cigarettes can cause explosion. Tools and loose connections can cause sparks.

IMPORTANT

Follow written instructions when servicing or charging. Provide adequate ventilation when charging.

2.2.2

ACID - POISON

Can cause severe burns. Contains sulfuric acid. In case of contact, flush immediately and thoroughly with water. Obtain prompt medical attention when eyes are affected.

2.3 COLORS

Vivid red Munsell Notation 7.5R 4.0/14 should be the predominant visual color for the signal words. Black, white, or metallic may be used for contrast. These colors may be used either for the lettering or the background.

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NEMA STANDARDIZATION

The purpose of NEMA Standards, their classification and status are set forth in certain clauses of the NEMA Bylaws, which are quoted below:

Purpose of Standards

National Electrical Manufacturers Association Standards are adopted in the public interest and are designed to eliminate misunderstandings between the manufacturer and the purchaser and to assist the purchaser in selecting and obtaining the proper product for its particular need. Existence of a National Electrical Manufacturers Association Standard does not in any respect preclude any member or nonmember from manufacturing or selling products not conforming to the standard.

(Bylaw—Art. V, Sec. 1)

Definition of a Standard

A standard of the National Electrical Manufacturers Association defines a product, process or procedure with reference to one or more of the following: nomenclature, composition, construction, dimensions, tolerances, safety, operating characteristics, performance, rating, testing, and the service for which they are designed.

(Bylaw—Art. V, Sec. 2, Subsection A)

Dimensions

Where dimensions are given for interchangeability purposes, alternate dimensions satisfying the other provisions of the standards publication may be capable of otherwise equivalent performance.

(NEMA Policy Memorandum 84-2, dated June 7, 1984)

Classes of Standards

National Electrical Manufacturers Association Standards are of two classes:

1. NEMA Standard, which relates to a product commercially standardized and subject to repetitive manufacture, which standard has been approved by at least 90 percent of the members of the Subdivision eligible to vote thereon;
2. Suggested Standard for Future Design, which may not have been regularly applied to a commercial product, but which suggests a sound engineering approach to future development, which standard has been approved by at least two-thirds of the members of the Subdivision eligible to vote thereon.

(Bylaw—Art. V, Sec. 2, Subsection B)

Authorized Engineering Information

Authorized Engineering Information consists of explanatory data and other engineering information of an informative character not falling within the classification of NEMA Standard or Suggested Standard for Future Design.

(Bylaw—Art. V, Sec. 6, 1st Sentence)

Official Standards Proposal

An Official Standards Proposal is an official draft of a proposed standard which is formally recommended to an outside organization(s) for consideration, comment and/or approval.

(Bylaw—Art. V, Sec. 4, Subsection A)

Identification of Status

Standards in NEMA Standards Publications are identified in the foreword or following each standard as "NEMA Standard" or "Suggested Standard for Future Design." These indicate the status of the standard. These words are followed by a date which indicates when the standard was adopted in its present form by the Association.

The material identified as "Authorized Engineering Information" and "Official Standards Proposal" is designated similarly.

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