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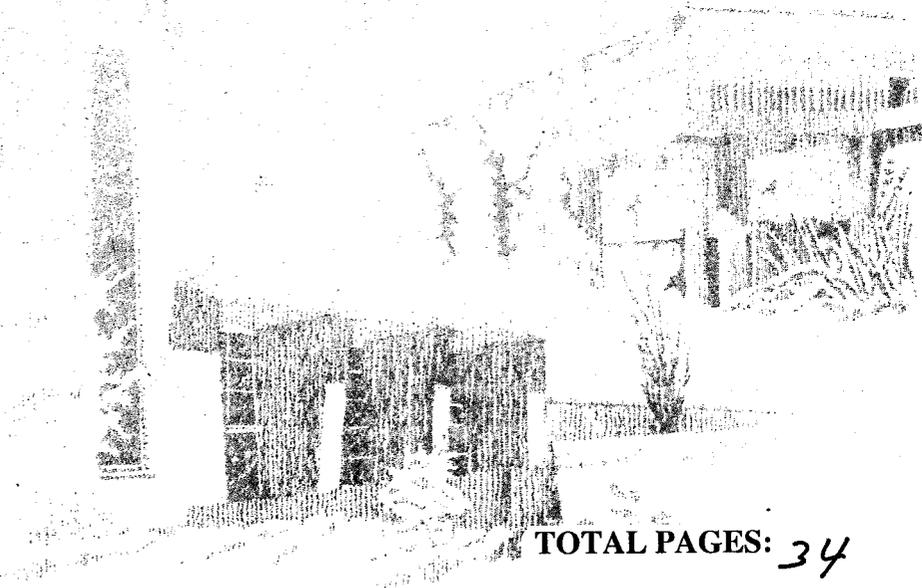
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## Glossary of Testing Terminology for Rechargeable Batteries

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## **Glossary of Testing Terminology for Rechargeable Batteries**

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### **Abstract**

The Battery Test Working Task Force was formed in 1983 for the purpose of coordinating the evaluation of developmental rechargeable batteries by DOE-funded labs. The Task Force developed this glossary of testing terminology to improve the accuracy of communication and to permit meaningful comparisons of test results. It consists of a section of technical terms and a separate section of programmatic phrases and acronyms. The glossary emphasizes terms related to electric vehicle batteries due to the significant development and testing activities in this area.

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# **Glossary of Testing Terminology for Rechargeable Batteries**

## **INTRODUCTION**

In early 1983, the U.S. Department of Energy (DOE) assembled the Battery Test Working Task Force to coordinate rechargeable battery evaluation activities at various government laboratories. Technical personnel from Argonne National Laboratory, Fort Belvoir, the Jet Propulsion Laboratory, Sandia National Laboratories, and the Aerospace Corporation formed the Task Force. During the initial meetings, it was obvious that many terms used by the group had uncertain meanings. It was found that some test results were being reported ambiguously because of the terminology problem.

As a remedy, a glossary of testing terminology was compiled and reviewed by the Task Force. Several sources were consulted for appropriate definitions. Certain definitions were modified to conform to correct usage. In other cases, new terms were developed to describe accurately battery characteristics or testing methods. A few terms were determined to be ambiguous, and their use was discouraged.

During the last several years, the membership of the Task Force has changed significantly. New members from the Idaho National Engineering Laboratory and Tennessee Valley Authority have contributed new terms or suggested revisions to existing definitions. A preliminary version of the glossary was distributed to industrial and DOE experts for review and comment, and many valuable suggestions were contributed. The Task Force reviewed the revised glossary several times before approving it in late 1987.

This glossary consists of two parts:

- The first part, Glossary of Technical Terms, defines technical terms related to battery testing.
- The second part, Glossary of Programmatic Terms, defines and explains programmatic terms and acronyms.

Certain terms, such as capacity, are used in combination with qualifiers that alter the meaning of the basic term. These words have been grouped together under the basic term to show clearly the distinction between the various meanings. There is an emphasis on terms related to electric vehicle batteries because of the significant effort in this area.

While a glossary is not the kind of document that can be read from cover to cover, the best way to utilize it may be to glance through the definitions and note those that are new or have unexpected meanings. Then, when using the terms, you can review those words to insure that they are being used accurately. For example, a commonly misused term is *energy density*, when

*specific energy* is intended. If new terms are developed, or existing definitions could be improved, please contact a member of the Task Force (see page 25). This is expected to be a "living" document and will be updated as necessary.

The following conventions are used in this glossary:

1. Terms marked with an asterisk (\*) are ambiguous; their use is discouraged.
2. Unless otherwise specified, the term *battery* used in these definitions can refer to a cell, battery, or battery system.
3. Letters enclosed in brackets ( ) are commonly used abbreviations.
4. Letters enclosed in parentheses are typical units for the term.

## GLOSSARY OF TECHNICAL TERMS

acceleration power (kW)	The battery power required to accelerate an electric vehicle from zero to a specified speed in a specified time. The battery voltage must be maintained above a specified minimum. For example, 50 kW may be required when a vehicle is accelerated from 0 to 80 km per hour in 20 seconds, with battery voltage maintained above 70% of the open-circuit voltage during the 50-kW discharge.
active materials	The constituents of a cell that participate in the electrochemical charge/discharge reactions.
anode*	The electrode in an electrochemical cell at which oxidation takes place. During charge, the positive terminal of the cell is the anode. During discharge, the negative terminal of the cell is the anode.
aqueous batteries	Batteries with water-based electrolytes.
available acceleration power (kW)	<p>The power that can be obtained from a battery and used to accelerate an electric vehicle under the following specified conditions:</p> <ul style="list-style-type: none"><li>• the time interval for the test (usually 30 s)</li><li>• a maximum current or minimum battery voltage during the test</li><li>• the condition of the battery, such as depth of discharge and temperature.</li></ul> <p>For example, a battery may have an available acceleration power of 50 kW for a 30-s duration. This value was measured with a maximum allowable current of 400 A (or a minimum battery voltage equal to 2/3 of the open-circuit voltage). Battery temperature was 30°C and the depth of discharge was 80%.</p>
available acceleration power density (W/L)	The ratio of the available acceleration power from a cell, battery, or battery system, to its volume.
available capacity	See <i>capacity</i> .
average power (kW)	Total energy withdrawn (or returned) from (or to) a cell or battery divided by the time of discharge (or charge). May also be specified for test regimes that include both charge and discharge.
average voltage (V)	The ratio of the watt-hours delivered to the ampere-hours delivered for a given discharge or charge. Not a simple average of voltage over time.
battery	Electrochemical cells electrically connected in a series and/or parallel arrangement.

battery auxiliaries	Components required by a battery system external to the electrochemical cell(s), such as a tray, watering subsystem, or pumps.
battery management subsystem	System that monitors and/or controls some or all battery functions (charge, watering, temperature, discharge, electrolyte flow, etc.). It may also provide an operator interface.
battery module	A grouping of interconnected cells that are treated as a single mechanical and electrical unit.
battery pack	The parts of a battery system that are physically contained in an enclosure that can be moved as a single unit.
battery package density (kg/L)	Battery system weight divided by battery system volume.
battery subsystem	See <i>battery auxiliaries</i> .
battery system	The battery plus all battery auxiliaries except the charger.
battery system mass fraction	Ratio of battery system weight to gross vehicle weight.
battery volume (L)	The volume of the battery. Cell, battery, or battery system should be specified.
battery weight (kg)	The weight of the battery. Cell, battery, or battery system should be specified.
C rate	See <i>hour rate</i> .
$C_i$	See <i>capacity</i> .
capacity (C) (Ah)	Generally, the total number of ampere-hours that can be withdrawn from a fully charged cell or battery under specified conditions.
available capacity (Ah)	The total number of ampere-hours that can be withdrawn from a fully charged cell or battery for a specific set of operating conditions including discharge rate, temperature, age, stand time, and discharge termination criteria.
$C_i$ (Ah)	The capacity in ampere-hours obtained from a battery discharged at a constant current such that a specified minimum voltage is reached in precisely $i$ hours. $C$ is established once and is not adjusted as it changes with time.
deliverable capacity	See <i>available capacity</i> in this section.
energy capacity*	See <i>energy output</i> .

gross capacity (Ah)	The cumulative ampere-hours removed from a battery operated on a test profile that can include regenerative braking or other source charging.
net capacity (Ah)	The gross capacity less any ampere-hours returned to the battery from, for example, regenerative braking or other charging.
rated capacity (Ah)	The manufacturer's specification of the total number of ampere-hours that can be withdrawn from a fully charged cell or battery for a specified discharge rate, temperature, and discharge cutoff voltage.
residual capacity (Ah)	The number of ampere-hours that can be discharged from a cell or battery at a specified discharge rate and temperature after it has been exposed to specified conditions such as driving-profile or open-circuit stand tests.
theoretical capacity (Ah)	The capacity of a cell's active material, assuming 100% utilization.
cathode*	The electrode in an electrochemical cell at which reduction takes place. During charge, the negative terminal of the cell is the cathode. During discharge, the positive terminal of the cell is the cathode.
CCOV (V)	See <i>charge cutoff voltage</i> .
cell	An assembly of at least one positive electrode, one negative electrode, and other necessary electrochemical and structural components. It is used to store and provide electrical energy.
charge	Conversion of electrical energy into chemical potential energy within a cell by the passage of a direct current.
charge cutoff voltage (CCOV) (V)	The cell or battery voltage at which charge is terminated.
charge profile	Schedule used for charging a cell or battery. For example:
CI	See <i>constant current charging</i> .
CV	See <i>constant-voltage charging</i> .
CI/CV	A constant current charge followed by a constant-voltage charge.  See also <i>finishing charge rate</i> , <i>float charge</i> , and <i>trickle charge</i> .
charge rate (A)	The current applied to a cell or battery to restore its available capacity. This current is commonly expressed in terms of the rated capacity of the cell or battery. (continued)

charge rate (continued)	For example, the 10-hour charge rate of a 500-ampere-hour cell or battery (rated at the 5-hour discharge rate) is expressed as
	$\frac{\text{rated capacity}}{\text{charge time}} = \frac{500 \text{ ampere-hours}}{10 \text{ hours}}$ $= 50 \text{ amperes} = C_5/10 \text{ rate.}$
chassis dynamometer	A laboratory power absorption unit capable of partially simulating the road operation of a vehicle. See <i>dynamometer</i> .
CI	See <i>constant current charging</i> .
CI/CV	See <i>charge profile</i> .
constant current charging or discharging (CI)	The charging or discharging of a cell or battery at a controlled, constant rate of electron flow.
constant-voltage (potential) charging (CV)	The charging of a cell or battery by applying a constant voltage while allowing the current to vary.
coulombic efficiency	See <i>efficiency</i> .
coup de fouet	See <i>voltage depression</i> .
current (A)	The rate of flow of electrons in a circuit. Also called rate.
current collector	A part of an electrode that conducts electrons. It may also serve as a structural support for the electrode.
current density (mA/cm <sup>2</sup> )	The current per unit electrode area. Determined by dividing the charge or discharge current by the total geometric area of the positive or negative electrode.
cutoff voltage* (V)	The cell or battery voltage at which charge or discharge is terminated.
CV	See <i>constant-voltage charging</i> .
cycle	The period commencing from the start of one charge/discharge to the start of the next charge/discharge where said period includes discharge time, open-circuit time, and charge time.
cycle life	The number of cycles, to a specified discharge termination criteria, such as depth of discharge, under a specified charge and discharge regime, that a cell or battery can undergo before failing to meet its specified capacity or efficiency performance criteria.
DCOV (V)	See <i>discharge cutoff voltage</i> .

deep discharge	A qualitative term indicating the withdrawal of a significant percentage of capacity (50 percent or more).
deliverable capacity	See <i>available capacity</i> (under capacity).
depth of discharge (DOD) (%)	The ratio of the ampere-hours discharged from a cell or battery at a given rate to the available capacity under the same specified conditions.
derived peak power (kW)	An estimate of the maximum power capability of a cell or battery calculated from the results of power profile tests.
discharge	Conversion of chemical potential energy into electrical energy within a cell by the passage of direct current.
discharge cutoff voltage (DCOV) (V)	The cell or battery voltage at which discharge is terminated. It is generally a function of discharge rate.
discharge profile	Schedule used for cell or battery discharge that follows a particular current (or power) versus time sequence. Recharge segments may be included.
discharge rate (A)	The current during discharge of a cell or battery. This can be expressed in amperes, but more commonly it is normalized to rated capacity (C), and expressed as $C_i/X$ , where $i$ is the hour rate for the rated capacity, and $X$ is a time specification, usually in hours. For example, the 10-hour discharge rate of a 500-ampere-hour cell or battery (rated at the 5-hour discharge rate) is expressed as  $\frac{\text{rated capacity}}{\text{charge time}} = \frac{500 \text{ ampere-hours}}{10 \text{ hours}}$ $= 50 \text{ amperes} = C_5/10 \text{ rate.}$
DOD	See <i>depth of discharge</i> .
drivetrain	The elements of a propulsion system (such as motor, transmission, axle, and wheels) that produce and transmit mechanical power to the drive wheels of a vehicle.
drivetrain efficiency	The mechanical output energy from the drivetrain divided by the electrical energy input to the drivetrain.
driving profile	A vehicle speed-versus-time schedule that is used to test vehicle and battery characteristics.
duty cycle	The operating schedule of a cell or battery consisting of factors such as charge and discharge rates, depth of discharge, and length of time in the standby mode.
dynamometer	A device that measures the mechanical power output of a rotating machine and converts the mechanical work into another form of energy.

efficiency (%)

coulombic (ampere-hour) efficiency (%)

The ratio of the useful output to the input:

The ratio of the ampere-hours removed from a cell or battery during a discharge to the ampere-hours required to restore the initial capacity:

$$\frac{\text{ampere-hours discharged}}{\text{ampere-hours charged}} = \frac{\int_0^{t_d} i_d dt}{\int_0^{t_c} i_c dt}$$

where  $i_d$  and  $i_c$  are the discharge and charge currents, respectively, and  $t_d$  and  $t_c$  are the discharge and charge times, respectively.

voltaic efficiency (%)

The ratio of average voltage during discharge of a cell or battery to the average voltage during charge with the prior or subsequent restoration of an equivalent capacity.

energy (watt-hour, round trip) efficiency (%)

The ratio of the energy delivered by a cell or battery during a discharge to the total energy required to restore the initial state-of-charge:

$$\frac{\text{ampere-hours discharged}}{\text{ampere-hours charged}} = \frac{\int_0^{t_d} i_d v_d dt}{\int_0^{t_c} i_c v_c dt}$$

where  $v_d$  and  $v_c$  are the discharge and charge voltages, respectively,  $i_d$  and  $i_c$  are the discharge and charge currents, respectively, and  $t_d$  and  $t_c$  are the discharge and charge times, respectively. The watt-hour efficiency is equal to the product of the voltaic and coulombic efficiencies. This is sometimes referred to as the *round trip efficiency*. Round trip energy efficiencies should specify whether they include energy losses resulting from self-discharge, auxiliary equipment (parasitic losses), or cell equalization.

electrode

The conducting body that contains active materials and through which current enters or leaves a cell.

electrolyte

The medium that provides ion transport between the positive and negative electrodes of a cell. It may participate directly in the charge/discharge reactions.

end-of-charge voltage (EOCV) (V)

The cell or battery voltage when charge is terminated.

end-of-discharge voltage (EODV) (V)	The cell or battery voltage when discharge is terminated.
end of life	The stage at which the cell or battery meets specific failure criteria. <i>See failure criteria.</i>
energy capacity	<i>See energy output.</i>
energy density (Wh/L)	The ratio of energy output from a cell, battery, or battery system to its volume. Not the same as specific energy.
energy efficiency	<i>See efficiency.</i>
energy output (Wh)	The total number of watt-hours that can be withdrawn from a fully charged cell or battery. The energy output varies with temperature, rate, age, stand time, and discharge cutoff voltage.
EOCV	<i>See end-of-charge voltage.</i>
EODV	<i>See end-of-discharge voltage.</i>
equalization	The process of restoring all cells in a battery to an equal state-of-charge. This can consist of a prolonged charge or a complete discharge to a shorted condition, depending on the battery technology.
failure criteria	Specific cell or battery performance characteristics that indicate the cell or battery can no longer perform its intended duty cycle.
final voltage*	<i>See discharge cutoff voltage.</i>
finishing charge rate (A)	The current specified for completing the charging of a cell or battery that is nearing the fully charged condition.
float charge	Charging a cell or battery at a fixed voltage for extended periods of time to obtain or maintain the fully charged condition.
flowing electrolyte batteries	Batteries having at least one liquid electrolyte stored outside the cell(s). Circulation of this liquid to the cell(s) is required. The electrolyte may contain active materials.
formation	The initial charging process, during manufacture or installation, by which cell or battery active materials are transformed into the species required for proper electrochemical operation.
gassing	The evolution of gas from one or both of the electrodes in a cell.
gradeability (%)	The maximum percent grade that a vehicle can traverse at a specified speed for a specified time. The gradeability limit

gradeability (continued)	is the maximum grade upon which a vehicle can start on and ascend.
grid	The framework for a plate or electrode that supports or retains the active materials and acts as a current collector.
gross capacity	See <i>capacity</i> .
gross vehicle weight (GVW) (kg)	Manufacturer's rating for maximum vehicle operating weight.
GVW	See <i>gross vehicle weight</i> .
high-rate discharge	A qualitative term indicating a discharge rate that is usually greater than the $C_i/1$ rate, e.g., $2C_i$ rate, where $i$ is an integer denoting the rate at which $C$ was determined.
high temperature batteries	Batteries requiring an operating temperature much higher than ambient temperature (i.e., greater than $100^{\circ}\text{C}$ ).
hour rate (h)	The charge or discharge current of a cell or battery expressed in terms of the length of time a new, fully charged cell or battery can be discharged at a specific current before reaching a specified end-of-discharge voltage. For example, the 10-hour rate for discharging a 500-ampere-hour cell (rated at the 5-hour rate) would be 50 amperes. See <i>charge rate</i> or <i>discharge rate</i> .
internal impedance (ohm)	The opposition to the flow of an alternating current at a particular frequency in a cell or battery at a specified state-of-charge and temperature.
internal resistance (ohm)	Opposition to direct current flow in a cell or battery. Its value may vary with the current, state-of-charge, age, and temperature. It is the sum of the ionic and electronic resistances of the cell components.
load bank	An energy-consuming device for discharging cells or batteries.
maximum power*	See <i>peak power</i> .
memory	A temporary loss of available cell or battery capacity because of repetitive cycling to less than 100 percent depth of discharge.
module	See <i>battery module</i> .
motive power cell or battery	A cell or battery that is intended to power electrically operated mobile equipment (e.g., electric vehicles or fork lift trucks) and is designed to be operated in a repetitive deep-discharge regime at intermittent, high discharge rates.
NAM	See <i>negative active material</i> .

negative active material (NAM)	The active materials that compose the negative electrode.
negative electrode	Of the two electrodes composing a cell, the electrode with an excess of electrons; it is negative in voltage compared to the other electrode of the cell.
net capacity	See <i>capacity</i> .
nominal operating voltage (V)	The average voltage of a cell or battery discharging at a specified rate and temperature.
nonaqueous batteries	Cells or batteries that do not contain water, such as those with molten salts or organic electrolytes.
OCAC	See <i>open circuit after charge</i> .
OCAD	See <i>open circuit after discharge</i> .
OCV	See <i>open-circuit voltage</i> .
open circuit after charge (OCAC) (h)	The period during which the battery is placed on open circuit following a charge.
open circuit after discharge (OCAD) (h)	The period during which the battery is placed on open-circuit discharge following a discharge.
open-circuit voltage (OCV) (V)	The voltage of a cell or battery at a specified state-of-charge and temperature in the absence of charge or discharge current. It varies with the length of time following a charge or discharge. See also <i>rated open-circuit voltage</i> .
overcharge (Ah)	The amount by which the charge ampere-hours exceed the ampere-hours removed on the previous discharge, sometimes expressed in terms of percentage. Occasionally, this excess is normalized to the rated capacity.
oxidation	A chemical process that results in the release of electrons by an electrode's active material.
pack	See <i>battery pack</i> .
PAM	See <i>positive active material</i> .
peak power (kW)	The power obtained from a cell or battery when discharged at constant current. The current is chosen so that discharge is started at 50 percent of the open-circuit voltage measured at the prevailing depth of discharge. The discharge is conducted at constant current for a short period of time (15 to 30 seconds), and the power is calculated based on the current and the average discharge voltage. The depth of discharge of the cell or battery at the start of the test must be specified.

peak power density (W/L)	The ratio of the peak power available from a cell or battery to its volume. See also <i>specific peak power</i> .
Peukert curve	Plot of the logarithm of the discharge current versus the logarithm of discharge time to a specified end-of-discharge voltage.
polarization (V)	The deviation from equilibrium open-circuit voltage caused by the flow of current in a cell or battery.
positive active material (PAM)	The active material composing the positive electrode.
positive electrode	Of the two electrodes composing a cell, the electrode with a deficiency of electrons; it is positive in voltage compared to the other electrode of the cell.
power density (W/L)	The ratio of the rated power available from a cell or battery to its volume. See <i>specific power</i> .
power profile test	A cell, battery, or battery system charge/discharge test that uses a sequence of different power levels applied for a defined time duration to simulate battery operation in a vehicle. For example, power profile tests have been derived from the FUDS and the J227aD driving profile tests.
power-to-energy ratio ( $h^{-1}$ )	Ratio of the peak power obtained under specified conditions, such as depth of discharge, to the energy output obtained under specified discharge conditions.
powertrain	The elements of a propulsion system that convert electrical energy from a battery to mechanical energy at the wheels of a vehicle. It includes all drivetrain components plus an electrical power inverter and/or controller, but not the battery system.
propulsion system	The combination of the powertrain and battery system, which converts stored electrical energy into mechanical energy in a vehicle.
Ragone curve	Plot of the specific energy as a function of the continuous specific power at which the battery is discharged. Originally defined as the set of curves ranging between the high-power design and the high-energy design for a particular technology.
range (km)	The maximum distance that an electric vehicle can travel on a single battery charge over a specified driving cycle or other specified driving conditions. Alternatively, the distance reached when a specified minimum level of performance or other characteristic (such as battery depth of discharge) is attained.

rate	See <i>current</i> .
rated capacity	See <i>capacity</i> .
rated open-circuit voltage (V)	The manufacturer's specification for the open-circuit voltage of a fully charged cell or battery.
rated power (kW)	The manufacturer's specification of the discharge power capability of a cell or battery.
recharge factor	The inverse of the coulombic efficiency, expressed as a ratio, for a cycle.
reduction	A chemical process that results in the acceptance of electrons by an electrode's active material.
regenerative braking	The recovery of some fraction of the energy normally dissipated in braking into energy to be stored in a battery, flywheel, or other energy storage device.
residual capacity	See <i>capacity</i> .
reversal	Forced discharge of a cell or battery to the point that the cell's electrical terminals change polarity and beyond the point where the active material can usefully deliver energy.
round trip efficiency	See <i>efficiency</i> .
secondary cell or battery	A cell or battery capable of charging and discharging repeatedly (i.e., rechargeable cell or battery).
self-discharge	The process by which the available capacity of a cell or battery is spontaneously reduced by undesirable chemical reactions or electronic short circuits within the cell.
separator	A cell component placed between the negative and positive electrodes that acts as an electronic insulator and an ionic conductor.
short-circuit current (A)	That current delivered when a cell or battery is short-circuited (i.e., the positive and negative terminals are directly connected with a low-resistance conductor).
SOC	See <i>state-of-charge</i> .
specific acceleration power (W/kg)	Acceleration power divided by the battery system weight.
specific available acceleration power (W/kg)	The ratio of the available acceleration power of a cell, battery, or battery system to its weight.
specific energy (Wh/kg)	The ratio of energy output to battery weight. Varies with rate of discharge.

specific gravity	The ratio of the density of a substance to the density of pure water, both at specified temperatures.
specific peak power (W/kg)	The ratio of peak power to the cell, battery, or battery system weight.
specific power (W/kg)	The ratio of rated power to the cell or battery weight.
standard capacity test	A set of 12 charge/discharge cycles that provides available capacity values at three different rates. These values can be used to correlate and compare test results for similar batteries obtained at different laboratories.
state-of-charge (SOC) (%)	One hundred minus the depth of discharge (100-DOD).
subcycle	The portion of the cycle that contains just one of the periods, such as charge, discharge, OCAD, or OCAC.
sustained hill-climbing power test	An evaluation procedure intended to quantify the ability of a battery to maintain a sustained power level required by a typical electric vehicle for hill climbing. The test result is reported as the maximum depth of discharge at which a battery will support a six-minute, 45-W/kg discharge.
sustained power (kW)	See <i>available acceleration power</i> .
temperature coefficient of capacity	The ratio of the change in available capacity because of a battery temperature change (per degree Celsius) relative to the available capacity at a specified temperature.
throughput (Wh)	Total energy output provided by a battery over its life. It is the sum of all the energy delivered over all the discharges that the battery has provided.
traction cell or (battery)	See <i>motive power cell or battery</i> .
trickle charge	Low-rate charging current applied to a battery to maintain full charge, cause electrolyte stirring, or compensate for self-discharge.
utilization (%)	The percentage by weight of the limiting active material present in an electrode, cell, or battery that is electrochemically available for discharge at useful voltages.
vehicle test weight (kg)	Weight of a vehicle under test. This is usually the vehicle weight plus a specified weight to account for a driver and payload.
voltaic efficiency	See <i>efficiency</i> .
voltage depression	A transient voltage drop at the start of discharge of a fully charged cell or battery, with a subsequent recovery.

## GLOSSARY OF PROGRAMMATIC TERMS

ANL	Argonne National Laboratory.
ANL/ADL	Analysis and Diagnostic Laboratory at ANL. Includes the National Battery Test Laboratory (NBTL).
BEST Facility	Battery Energy Storage Test Facility for evaluating large, utility load-leveling batteries, operated by Public Service Electric and Gas Co., in Hillsborough Township, New Jersey.
DOE	United States Department of Energy.
DSEP	Dual-Shaft Electric Propulsion system technology developed by Eaton for lightweight van applications. <i>Dual-shaft</i> refers to a configuration in which the electric motor and transmission operate on separate parallel axes.
EHP	Division of Electric and Hybrid Propulsion, in the Office of Transportation Systems, at the U.S. Department of Energy.
Electric Vehicle Development Corporation (EVDC)	An organization supported by a number of electric utility companies to promote the commercial development of electric vehicles.
ELVEC	Electric/Hybrid Vehicle Simulation Program developed by JPL and General Research Corporation.
EPRI	Electric Power Research Institute.
ESD	Office of Energy Storage and Distribution at the U.S. Department of Energy.
ETV-1	Electric Test Vehicle-One, developed for DOE by Chrysler and General Electric. This is an experimental four-passenger vehicle with separately excited DC motor, transistorized armature and field controller, and improved lead-acid batteries by Johnson Controls, Inc., (Globe-Union).
ETV-2	Electric Test Vehicle-Two, developed for DOE by Garrett Corp. This is an advanced experimental four-passenger vehicle with a unique power system that incorporates a flywheel for improved acceleration capability. This vehicle also makes extensive use of composite materials in the body structure to minimize weight and increase range.
ETX-1	Electric Transaxle or first generation advanced single-shaft electric propulsion system technology development program. An electric propulsion system developed by Ford and General Electric for passenger car applications. Single-shaft refers to a configuration in which the electric motor and the transmission operate on a common axis. There were three

ETX-I (continued)	batteries evaluated in this program: an advanced lead-acid built by Lucas Chloride Electric Vehicle Systems, Ltd., a sodium/sulfur built by Ford Aerospace and Communications, and a zinc/bromine built by Exxon Research and Engineering Company.
ETX-II	Electric Transaxle or second generation single-shaft electric propulsion system technology development program. An electric propulsion system developed by Ford and General Electric for small van applications. It contains a single-shaft propulsion system (see <i>ETX-I</i> ) and an interior permanent magnet motor.
EV	Electric vehicle.
EVDC	See <i>Electric Vehicle Development Corporation</i> .
Federal Urban Driving Schedule (FUDS)	The Environmental Protection Agency (EPA) urban dynamometer driving schedule, as defined in 40 CFR (Code of Federal Regulations), paragraph 86.115-78. A velocity-versus-time profile defined by the EPA to test for vehicle emissions and city fuel economy. When used as a laboratory battery test, a vehicle must be specified in order to derive a power-versus-time profile from the velocity profile.
FUDS	See <i>Federal Urban Driving Schedule</i> .
HTV	Hybrid Test Vehicle, developed for DOE by General Electric. This is an advanced experimental hybrid vehicle utilizing a parallel powertrain with a DC separately excited motor and an on-off heat engine, improved state-of-the-art lead-acid batteries, and featuring extensive microprocessor control of all propulsion system functions.
HV	See <i>hybrid vehicle</i> .
hybrid vehicle (HV)	A vehicle that is powered by more than one source of energy, with one source being electricity.
IDSEP	Improved DSEP. Hypothetical propulsion system technology that assumes certain improvements in road load losses and drivetrain efficiencies compared to the DSEP.
IETV-1	Improved ETV-1. Hypothetical vehicle that assumes certain improvements in road load losses and drivetrain efficiencies compared to ETV-1.
INEL	Idaho National Engineering Laboratory.
JPL	Jet Propulsion Laboratory.
NBTL	National Battery Test Laboratory. See <i>ANL/ADL</i> .

SAE J227a

Society of Automotive Engineers Recommended Practice for Electric Vehicle Test Procedure. This procedure includes four specific driving cycles (A through D) as well as test procedures for range at steady speed, gradeability, acceleration, energy consumption, energy economy, and deceleration.

SFUDS

*See simplified FUDS.*

simplified FUDS  
(SFUDS)

A simplified battery test profile, developed by the EHP Battery Test Working Task Force, based upon the IDSEP vehicle driving the FUDS, i.e., SFUDS79.

SNL

Sandia National Laboratories.

TVA

Tennessee Valley Authority.

VDAS

*See versatile data acquisition system.*

versatile data acquisition system (VDAS)

A self-contained device in electric vehicles that monitors and records specific performance parameters under actual road conditions.

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