



## 2. REFERENCES

### 2.1 Applicable Publications

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest version of SAE publications shall apply.

#### 2.1.1 NFPA Publication

Available from the National Fluid Power Association, 3333 N. Mayfair Road, Suite 211, Milwaukee, WI 53222-3219, Tel: 414-778-3344, [www.nfpa.com](http://www.nfpa.com).

NFPA 30 Flammable and Combustible Liquids Code

#### 2.1.2 Federal Publication

Available from The Government Printing Office, [www.access.gpo.gov/nara/cfr](http://www.access.gpo.gov/nara/cfr).

40 CFR paragraph 86.115-78 Control of Emissions from New and In-Use Highway Vehicles and Engines

### 2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this document.

#### 2.2.1 SAE Publication

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), [www.sae.org](http://www.sae.org).

SAE J670e Vehicle Dynamics Terminology, latest revision

#### 2.2.2 Institute of Electrical and Electronic Engineers Publication

Available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, Piscataway, NJ 08854-1331, Tel: 732-981-0060, [www.ieee.org](http://www.ieee.org).

ANSI/IEEE 100 Standard Dictionary of Electrical and Electronic Terms, latest revision

#### 2.2.3 Japanese Electric Vehicle Society Publication

Available from Japanese Electric Vehicle Association, [evinfo@gw.jeva.or.jp](mailto:evinfo@gw.jeva.or.jp).

JEVS Z 805 Glossary of Terms Relating to Electric Vehicles, latest revision

#### 2.2.4 National Institute of Science and Technology (NIST) Publication

Available from National Institute of Standards and Technology, 100 Bureau Drive, Stop 1070, Gaithersburg, MD 20899-1070, Tel: 301-975-6478, [www.nist.gov](http://www.nist.gov).

For definitions of SI units of measurement - mass, EMF, current, power, etc.

#### 2.2.5 National Highway Traffic Safety Administration Publication

Available from The Government Printing Office, [www.access.gpo.gov/mara/cfr](http://www.access.gpo.gov/mara/cfr).

49 CFR Ch V, Section 571 Federal Motor Vehicle Safety Standards

### 2.2.6 SAND Publication

Available from Sandia National Laboratories, P.O. Box 5800, Albuquerque, NM 87185, [www.sandia.gov](http://www.sandia.gov).

SAND88-2852 \* UC-212 Glossary of Testing Terminology for Rechargeable Batteries, latest revision

### 2.2.7 USABC Publication

Available from USCAR, 1000 Town Center Drive, Suite 300, Southfield, MI 48075, Tel: 248-223-9000, [www.uscar.org](http://www.uscar.org).

USABC Test Procedures Manual, latest revision

## 3. ELECTRIC VEHICLE (EV) TERMINOLOGY

### 3.1 Active Material

The constituents of a cell that participate in electrochemical charge/discharge reactions. This does not include separators, current collectors, catalysts or supports.

### 3.2 Adequate Ventilation

As defined in NFPA 30, ventilation is adequate if it is sufficient to prevent accumulation of hydrogen vapor-air mixtures in concentrations over one-fourth of the lower flammability limit.

### 3.3 Air Clearance

The shortest distance through air between two conductive parts.

### 3.4 Aqueous Electrolyte Batteries

Batteries with water-based electrolytes.

### 3.5 Available or Deliverable Capacity

The total ampere-hours that can be withdrawn from a fully charged cell or battery under specified operating conditions such as discharge rate, temperature, age, stand time, etc.

### 3.6 Average Power (W)

Total energy withdrawn (or returned) from (or to) a battery divided by the time of discharge (or charge).

### 3.7 Average Voltage (V)

The ratio of the watt-hours to ampere-hours for a given discharge or charge. Also known as current weighted voltage.

### 3.8 Battery

Electrochemical cells electrically connected in a series and/or parallel arrangement.

### 3.9 Battery Auxiliaries

The components required to support the operation of a battery pack, such as a tray, watering subsystem, pumps or control electronics.

### 3.10 Battery Cell

An assembly of at least one positive electrode, one negative electrode, and other necessary electrochemical and structural components. A cell is a self-contained energy conversion device whose function is to deliver electrical energy to an external circuit via an internal chemical process.

### 3.11 Battery Controller/Management System

Electronic components needed to provide communications between the battery pack and other vehicle components. It may also monitor and/or control other battery functions (watering, temperature, electrolyte flow, etc.). It may also provide an operator interface.

### 3.12 Battery Module

A grouping of interconnected cells in a single mechanical and electrical unit. Also known as battery monobloc.

### 3.13 Battery Pack

Interconnected battery modules that have been configured for a specific energy storage application.

### 3.14 Battery System

Completely functional energy storage system consisting of the pack(s) and necessary ancillary subsystems for physical support, thermal management, and electronic control.

### 3.15 Battery System Components

The components comprising a traction battery system in an electric vehicle. These include the battery modules, interconnects, venting systems, battery restraint devices, electronic controls, and the battery box or container that holds the individual battery modules.

### 3.16 Battery System Density (kg/L)

Battery system mass divided by battery system volume.

### 3.17 Battery System Mass Fraction

Ratio of battery system weight to gross vehicle weight.

### 3.18 Battery Volume (L)

The volume of the battery. Cell, module, pack, or system should be specified, and should include the usable volume displaced.

### 3.19 Battery Weight (KG)

The weight of the battery. Cell, module, pack, or system.

### 3.20 Breakdown

The failure of the dielectric of an insulation due to the effects of an excessive electric field and/or physical or chemical deterioration of the dielectric material.

### 3.21 $C_N$ (Ah)

The capacity in ampere-hours obtained from a battery discharged at a constant current to an end-of-discharge condition (discharge cutoff voltage) in N hours.  $C_N$  is established once and is not adjusted through the battery's life.

### 3.22 $C_N$ Hour Rate

The constant current at which a fully charged battery can be discharged to its discharge cut-off voltage in N hours.

### 3.23 C/N Rate (A)

The capacity of the battery divided by the discharge time in hours that yields that capacity.

### 3.24 Calendar Life (years)

The length of time a battery can undergo some defined operation before failing to meet its specified end-of-life criteria.

### 3.25 Capacity {C} (Ah)

The total number of ampere-hours that can be withdrawn from a fully charged battery under specified conditions.

### 3.26 Charge (Verb)

Conversion of electrical energy into chemical potential energy within a cell achieved by applying a direct current to the cell.

### 3.27 Charge Connector

A conductive or inductive device that establishes an electrical connection to the electric vehicle for the purpose of charging and information exchange.

### 3.28 Charge Profile

Schedule used for charging a cell or battery, usually defined by voltage, current, and time.

### 3.29 Charge Rate (A)

The current during charge of a cell or battery. See also finishing charge rate, float charge, and trickle charge.

### 3.30 Charger (Battery)

The component that supplies the power required for battery charging.

### 3.31 CI

See constant current charging.

### 3.32 CI/CV

A constant current charge followed by a constant-voltage charge.

### 3.33 Chassis Ground

The conductor used to connect the non-current-carrying metal parts of the vehicle high voltage system to the vehicle ground system.

### 3.34 Conductive

Having the ability to transmit electricity through a physical path (conductor).

### 3.35 Connection Cycles

Refers to connect and disconnect cycles of connectors. One insertion and withdrawal operation is a connection cycle.

### 3.36 Connector

A component which terminates conductors for the purpose of providing connection and disconnection to a suitable mating component.

### 3.37 Constant Current Charging or Discharging (CI)

The charging or discharging of a cell or battery at a constant rate of current flow.

### 3.38 Constant Voltage Charging (CV)

The charging of a cell or battery by applying a constant voltage while allowing the current to vary.

### 3.39 Contact

The part of a switch, relay or connector that carries current.

### 3.40 Contact Force (N)

The force which two contacts exert against each other in the closed position under specified conditions.

### 3.41 Contact Resistance ( $\Omega$ )

The electrical resistance of a single mated set of contacts under specified conditions.

### 3.42 Control Pilot

A conductor that is connected to the equipment ground through the control circuitry on the vehicle. It performs several functions, including assurance that the vehicle is present and connected, start/stop control, charging area ventilation requirements, supply equipment current rating, and provides for the continuous monitoring of the presence of the equipment ground.

### 3.43 Coulombic (Ampere-Hour) Efficiency

The ampere-hours removed from a cell or battery during a discharge divided by the ampere hours required to restore the initial capacity.

### 3.44 Coupler

A device connected to the electric vehicle supply equipment that transfers power to the electric vehicle for charging the energy storage system and permits the exchange of information between the electric vehicle and the electric vehicle's supply equipment (see Charge Connector and EV Connector).

### 3.45 Current Collector

The part of an electrode that conducts electrons.

### 3.46 Cutoff Voltage (V)

The battery voltage at which charge or discharge is terminated.

### 3.47 CV

See constant voltage charging.

### 3.48 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. The depth of discharge (or percentage of capacity) associated with each cycle must be specified.

### 3.49 Cycle Life

The number of cycles, each to specified discharge and charge termination criteria, under a specified charge and discharge regime, that a battery can undergo before failing to meet its specified end-of-life criteria.

### 3.50 Deep Discharge

A qualitative term indicating the withdrawal of a significant percentage of capacity (typically, 80% or more).

### 3.51 Depth of Discharge (%)

The number of ampere hours withdrawn from a battery or cell divided by its rated capacity at the test current and temperature and expressed as a percentage.

### 3.52 Derived Peak Power (W)

An estimate of the maximum power capability of a cell or battery calculated from the results of power profile tests specified by the Dynamic Capacity Test (SAE) and the Dynamic Stress Test (USABC).

### 3.53 Discharge

Conversion of chemical energy into electrical energy within a cell or battery by the passage of direct current.

### 3.54 Discharge Profile

Schedule used for cell or battery discharge that follows a particular current, voltage or power versus time sequence.

### 3.55 Discharge Rate (A)

The current during discharge of a cell or battery.

### 3.56 Discharge Segment

A contiguous subsection of a discharge regime.

### 3.57 Discharge Step

A change from one power level to another in a discharge regime.

### 3.58 Discharge Voltage Limit

The minimum voltage permitted under load during specified performance tests.

### 3.59 DOD

See depth-of-discharge.

### 3.60 Driving Profile

A vehicle speed-versus-time schedule that is used to test vehicle and battery characteristics.

### 3.61 Dynamic Capacity Test (DCT)

A variable-power discharge test developed by SAE to simulate the expected duty cycle of an electric vehicle battery.

### 3.62 Dynamic Stress Test (DST)

A variable-power discharge test developed by USABC to simulate the expected duty cycle of an electric vehicle battery.

### 3.63 Electric Vehicle (EV)

A vehicle powered solely by energy stored in an electrochemical device.

### 3.64 Electric Vehicle Supply Equipment (EVSE)

The conductors, including the ungrounded, grounded, and equipment grounding conductors, the electric vehicle connectors, attachment plugs, and all other fittings, devices, power outlets, and other components intended to deliver energy to an electric vehicle.

### 3.65 Electrode

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

### 3.66 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.

### 3.67 End of Life

When a cell or battery fails to meet specified capacity or power performance criteria under specified test criteria.

### 3.68 Energy Capacity

See energy output.

### 3.69 Energy Density (Wh/L)

The rated energy of a battery (Wh) divided by the total battery volume (L). Also known as volumetric energy density.

### 3.70 Energy (Watt-Hour, Round Trip) Efficiency (%)

The energy delivered by a cell or battery during a discharge divided by the total energy required for restoration of the initial capacity.

### 3.71 Energy Output (Wh)

The total watt-hours that can be withdrawn from a fully charged battery under specified operating conditions (such as temperature, rate, age, stand time, and discharge cutoff criteria).

### 3.72 Equalization

The process of restoring all cells in a battery or pack to approximately the same state-of-charge.

### 3.73 Equipment Ground (Grounding Conductor)

A conductor used to connect the non-current-carrying metal parts of the EV supply equipment to the system grounded conductor, the grounding electrode conductor, or both at the service equipment.

### 3.74 EV Charging System

The equipment required to condition and transfer energy from the constant frequency, constant voltage supply network to the direct current, variable voltage EV traction battery bus for the purpose of charging the battery and/or operating vehicle electrical systems while connected.

### 3.75 EV Connector

Off-board component used to interface with the vehicle-mounted EV inlet to supply power and provide communication interface.

### 3.76 EV Inlet

Vehicle-mounted component which interfaces with the EV connector to receive power and provide communication interface (also called a charge port).

### 3.77 Failure Criteria

Specific cell or battery performance characteristics that indicate the cell or battery can no longer perform its intended function.

### 3.78 Federal Urban Driving Schedule (FUDS)

The Environmental Protection Agency (EPA) urban dynamometer driving schedule, as defined in 40 CFR, paragraph 86.115-78. A velocity-versus-time profile defined by the EPA to test for vehicle emissions and city fuel economy.

### 3.79 Finishing Charge Rate (A)

The current specified for completing the charging of a cell or battery that is nearing the fully charged condition.

### 3.80 Flame Arrestors

Devices located at the outlet(s) of a battery venting system designed to prevent damage of the battery system from an external spark or flame that could ignite gases within the battery system under normal operating conditions.

### 3.81 Float Charge

Charging a cell or battery at a fixed voltage for extended periods of time to obtain or maintain the fully charged condition.

### 3.82 Formation

The initial charging process during which cell or battery active material are transformed into the constituents required for proper electrochemical operation.

### 3.83 Gassing

The evolution of gas from one or both of the electrodes in a cell.

### 3.84 Gradeability

The maximum percent grade which the vehicle can traverse for a specified time at a specified speed at a specified weight.

### 3.85 High Voltage

Any wiring system which contains one or more circuits operating between 60 V DC or AC RMS and 600 V DC or AC RMS.

### 3.86 Inductive Charging System

A charging system that transfers power across a two part transformer and rectifies that power into DC voltage to the batteries.

### 3.87 Insertion Force (N)

The force required to fully insert a set of mating components.

### 3.88 Internal Impedance (ohm)

A measure of the opposition to alternating current flow under specified conditions.

### 3.89 Internal Resistance (ohm)

A measure of the opposition to direct current flow

### 3.90 Level 1 Charging

A charging method that allows an electric vehicle to be connected to the most common grounded receptacle (e.g., in the USA, 120 VAC Nominal, 60 Hz, 15A, 1-phase).

### 3.91 Level 2 Charging

A charging method that utilizes dedicated electric vehicle supply equipment in either private or public locations. In the USA, the maximum power supplied for level 2 charging is 208 or 240 VAC Nominal, 60 Hz, 40A, 1-phase or 3-phase.

### 3.92 Level 3 Charging

A charging method that utilizes dedicated electric vehicle supply equipment to provide DC energy from an appropriate off-vehicle charger to the electric vehicle. In the USA, the maximum power supplied for level 3 charging equipment should be in the range of 25 KW to 160 KW, 208 to 600 VAC Nominal, 60 Hz, 3-phase.

### 3.93 Minimum Discharge voltage

See Discharge Voltage Limit.

### 3.94 Module

See battery module.

### 3.95 Negative Electrode

Of the two electrodes composing a cell, the electrode at which the associated half-cell reaction has the lower potential. It is negative in voltage compared to the other electrode of the cell. It is the electrode at which oxidation occurs during discharge of the cell.

### 3.96 Net Ampere-Hours (Ah)

For a discharge test including both negative (discharge) and positive (regen) current or power steps, the difference between the Ah removed from the battery during discharge steps and the Ah returned to the battery during regen steps, regardless of battery charge acceptance.

### 3.97 Nominal Operating Voltage (V)

The voltage of a battery, as specified by the manufacturer, discharging at a specified rate and temperature.

### 3.98 Nonaqueous Electrolyte Batteries

Cells or batteries with electrolytes that are not water based, such as those with molten salts or organic electrolytes.

### 3.99 Nonvented Batteries

A hermetically sealed battery comprised of one or more rechargeable cells that has no provision for venting, or the addition of water or electrolyte, or for the external measurement of specific gravity.

### 3.100 Open Circuit After Charge {OCAC} (h)

The period during which the battery is placed on open-circuit following a charge.

### 3.101 Open Circuit After Discharge {OCAD} (h)

The period during which the battery is placed on open-circuit following a discharge.

### 3.102 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.

### 3.103 Operating Temperature (°C)

The temperature range in which a component is designed to operate under normal conditions.

### 3.104 Overcharge (Ah)

The amount by which the charge in ampere-hours exceeds the ampere-hours removed on the previous discharge from a fully charged condition.

### 3.105 Overcurrent Protection Device

A fuse, circuit breaker, intelligent contactor, or other device placed in an electrical circuit to provide current overload protection.

### 3.106 Pack

See battery pack.

### 3.107 Peak Power (W)

The maximum power obtainable from a cell or battery for a specified period of time when discharged at constant current (or power), generally determined as a function of depth of discharge.

### 3.108 Peak Power Density (W/L)

The peak power available from a cell or battery divided by its volume.

### 3.109 Performance Degradation

The extent to which the battery system is unable to meet the original performance specification or rating established for the battery.

### 3.110 Peukert Curve

A plot of the logarithm of discharge current versus the logarithm of discharge time to a specified end-of-discharge voltage.

### 3.111 Polarization (Battery) {V}

The electrical potential deviation from equilibrium open-circuit voltage caused by the passage of current in a cell or battery.

### 3.112 Positive Electrode

Of the two electrodes comprising a cell, the electrode at which the associated half-cell reaction has the higher potential. It is positive in voltage relative to the other electrode of the cell. It is the electrode at which reduction occurs during discharge of the cell.

### 3.113 Power Continuous (W)

A power level characteristic of a battery providing constant power for constant-speed vehicle operation.

### 3.114 Power Density (W/L)

The rated power of the battery (W) divided by the total volume of the battery (L). Also known as volumetric power density.

### 3.115 Power-to-Energy Ratio {P/E}

Ratio of the peak power obtained under specified conditions, such as depth-of-discharge, to the energy output obtained under specified discharge conditions.

### 3.116 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.

### 3.117 Propulsion System

The combination of the powertrain and energy supply system.

### 3.118 Ragone Curve

A plot of 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.

### 3.119 Range (km)

The maximum distance that an electric vehicle can travel on a single battery charge over a specified driving cycle. Alternatively, the distance reached when a specified minimum level of performance or other characteristic (such as battery depth of discharge) is attained.

### 3.120 Rate (A)

The constant current at which the battery will discharge in 3 h from full capacity to 100% depth of discharge.

### 3.121 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 set of test conditions such as discharge rate, temperature, discharge cutoff voltage, etc.

### 3.122 Rated Current (A)

Current level (or levels) in amperes at which a device is designed to operate for a specified duty cycle.

### 3.123 Rated Open-Circuit Voltage (V)

The manufacturer's specification for the open-circuit voltage of a fully charged cell or battery.

### 3.124 Rated Power (KW)

The manufacturer's specification of power capability for a cell or battery under specified conditions

### 3.125 Rated Voltage (V)

Voltage range at which a device is designed to operate.

### 3.126 Recharge Factor

The inverse of the coulombic efficiency, expressed as a ratio, for a cycle.

### 3.127 Reference Performance Tests (RPT)

A set of tests to be performed periodically to monitor performance degradation during life-cycle testing.

### 3.128 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.

### 3.129 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.

### 3.130 Sealed Battery

An enclosed battery comprised of one or more rechargeable cells which has provision for pressure release venting but no provision for the addition of water, electrolyte, or the external measurement of electrolyte specific gravity.

### 3.131 Secondary Cell or Battery

A cell or battery capable of being charged and discharged repeatedly. Also known as a rechargeable cell or battery.

### 3.132 Self-Discharge

The process by which the available capacity of a cell or battery is spontaneously reduced by undesirable chemical reactions or electrical short circuits within the cell.

### 3.133 Separator

A cell component placed between the negative and positive electrodes, which acts as an electrical insulator and an ionic conductor.

### 3.134 Service Life (years or cycles)

A general term that describes the length of time a battery can remain in service. Service life can be specified in terms of either time or duty cycles.

### 3.135 Short-Circuit Current (A)

The current delivered when a supply source is short-circuited (i.e., the positive and negative terminals are directly connected with a low-resistance conductor), e.g., a cell, battery, or pack.

### 3.136 Specific Energy (Wh/kg)

The discharge energy capacity of the battery divided by the battery system mass under specified discharge conditions.

### 3.137 Specific Gravity

The density of a substance divided by the density of pure water, both at specified temperatures.

### 3.138 Specific Power (W/kg)

The rated power divided by the cell or battery mass.

### 3.139 State of Charge (SOC) (%)

Obtained by subtracting the depth of discharge from 100.

### 3.140 Temperature Coefficient

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.

### 3.141 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.

### 3.142 Trickle Charge (A)

Low-rate charging current applied to a battery to maintain full charge, cause electrolyte stirring, or compensate for self-discharge.

### 3.143 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.

### 3.144 Valve Regulated Battery

See sealed battery.

### 3.145 Voltaic Efficiency (%)

The average voltage during discharge of a cell or battery divided by the average voltage during charge required to restore the initial capacity.

## 4. HYBRID ELECTRIC VEHICLE (HEV) TERMINOLOGY

### 4.1 All Electric Range

The distance a vehicle can drive in all electric mode without engaging the Hybrid Power Unit (HPU) on a specific cycle.

### 4.2 Cooperative Regenerative Braking

Maximizes energy recovery by actively controlling the friction braking in coordination with the regenerative braking system.

### 4.3 Equivalent Electric Range – Charge Depleting Range

During charge-depleting, blended operation, the equivalent all-electric range that could be driven if the vehicle had all-electric capability. It is calculated by the ratio of fuel consumption in charge-depleting to charge-sustaining modes multiplied by the charge-depleting range in blended mode. The blended mode is a PHEV charge-depleting operating mode where the HPU and the RESS provide the motive power required to drive. The HPU may not always be operating, but the motive power is shared between the HPU and the RESS throughout the charge-depleting range.

### 4.4 Hybrid

A vehicle with two or more energy storage systems both of which must provide propulsion power – either together or independently.

### 4.5 Hydraulic Hybrid

A hybrid vehicle where hydraulic fluid is used as the coupling between propulsion elements and energy storage.

### 4.6 Hybrid Power Unit (HPU)

A non-RESS Energy propulsion system (Internal Combustion Engine, Fuel Cell, etc)

### 4.7 Maximum Propulsion Power

Maximum power available simultaneously from all power sources.

### 4.8 Parallel Hybrid

A hybrid vehicle which has multiple propulsion systems that can be operated independently or together.

### 4.9 Plug-In Hybrid (PHEV)

A hybrid vehicle with the ability to store and use off-board electrical energy in the RESS.

#### 4.10 Power Assist

A hybrid mode in which the HPU power output is augmented by energy drawn from the RESS.

#### 4.11 Start/Stop

Engine is automatically turned off when power demand is zero or negative, such as during vehicle stop, and then restarted automatically. This is sometime referenced in the industry as a Micro Hybrid.

#### 4.12 Series Hybrid

A hybrid vehicle in which both sources of energy go through a single propulsion device.

#### 4.13 Regenerative Braking

A conversion of vehicle retardation force into energy stored in the RESS. Also known as "regen" braking.

#### 4.14 RESS (Rechargeable Energy Storage System)

Any energy storage system that has the capability to be charged and discharged. (example: batteries, capacitors, and electro mechanical flywheels)

#### 4.15 RESS Available Energy

Energy available at the connection point of the RESS to the system.

#### 4.16 RESS Driving

Ability to drive the vehicle using only the Energy from the RESS

#### 4.17 RESS Launch

Capability to launch the vehicle using only the Energy from the RESS.

#### 4.18 Vehicle to Grid Connection (V2G)

Concept that allows bi-directional Energy exchange between the vehicle and grid.

### 5. FUNCTIONAL ARCHITECTURE DIAGRAMS

Hybrid Systems can be done in a variety of different configurations using the HPU, E-machine and Gearing. This section provides an overview of the major types in the market today, but does not cover all the possible configurations.

#### Power-Split:

A transmission providing continuously variable torque/speed ratios by the use of differential gearing connected with at least one electric motor-generator. Examples: 2008 Toyota Prius, 2008 Ford Escape Hybrid

#### Power-Split Mode:

A mechanical arrangement within a power-split transmission having a fixed linear combination of engine speed, output speed, and the speed of the motor-generator(s) that directly control(s) the speed ratio through the power-split.

Should the speed(s) of the controlling motor-generator(s) equal zero, this condition is a "mechanical point or mechanical ratio" of the system.

Mechanical Point or Mechanical Ratio:

A ratio at which one of the motor-generators that controls the speed ratio through the transmission has come to a stop, and therefore power is transmitted mechanically through the differential gearing, but not electrically through that motor-generator.

Power-Split design options:

Input split: The input is connected separately to differential gearing. The power flow through the transmission is split by using differential gearing at the input.

A Power-Split with gearing at the transmission input is shown here:

Output split: The output is connected separately to differential gearing. The power flow through the transmission is split by using differential gearing at the output. A Power-Split with gearing at the transmission output is shown here:

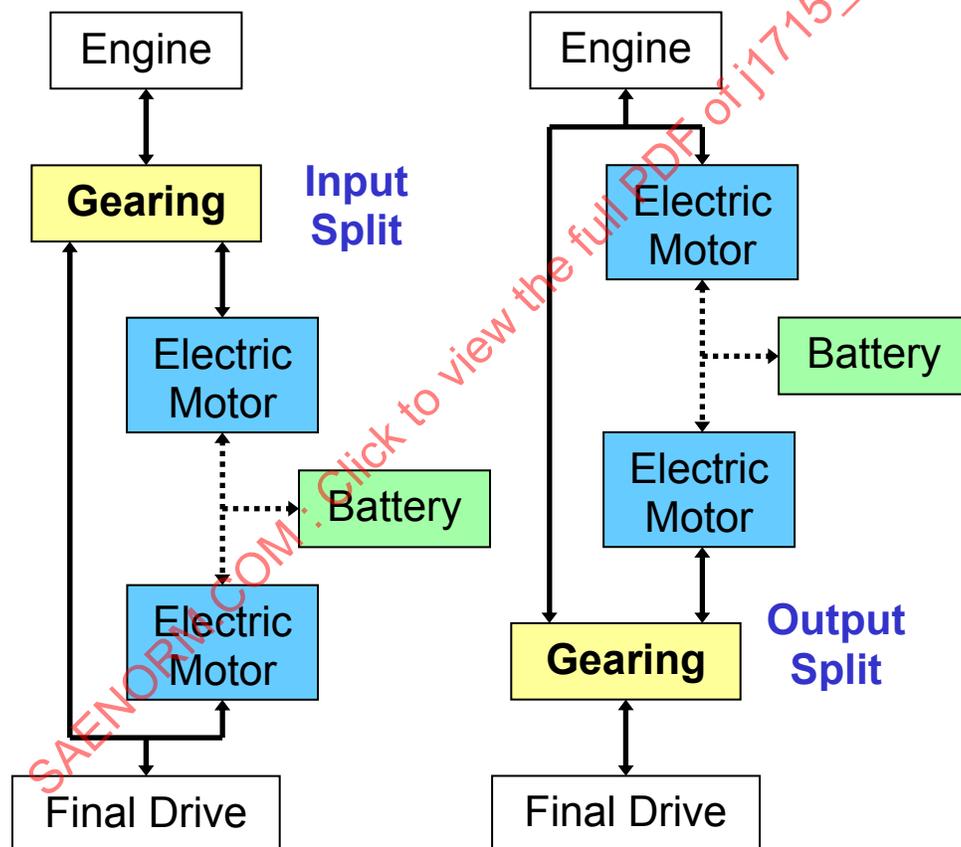


FIGURE 1