



## BM PRO DEFINITIONS | VOLTAGE V. STATE OF CHARGE MEASUREMENTS

### STATE OF CHARGE

'State of Charge' is the equivalent of a fuel gauge for the battery pack in a battery electric vehicle. This may include a hybrid vehicle, or plug-in hybrid electric vehicle.

The state of charge process allows individuals to compare the amount of energy left in a battery to how much energy the battery had when it was full. This indicates how long the battery can perform without needing a recharge.

Normally this is defined in a percentage for reference, but it can often be confusing as the state of charge measurement reference is often defined as a current capacity, instead of a rated capacity. This is a shortcut to avoid the complexity of determining age-related capacity adjustments which are often ignored.

### VOLTAGE

Voltage, or electromotive force, is a quantitative expression of the potential difference in charge between two points in an electrical field. Usually the greater the voltage, the greater the flow of electrical current through a conducting medium. A possible medium could be a motor vehicle. Voltage can be direct or alternating, with direct voltage maintaining the same polarity at all times. An alternating voltage reverses the polarity direction periodically.

### THE RELATIONSHIP BETWEEN THE TWO

The basic relationship between the two is that the voltage of the battery cell can be used for calculating State of Charge. Results can often vary depending on the actual voltage level, temperature, discharge rate and the age of the cell, so compensation for these factors must always be provided to formulate a decent accuracy.

Here is an example of typical voltages vs State of charge:

State of Charge	12 Volt battery	Volts per Cell
100%	12.7	2.12
90%	12.5	2.08
80%	12.42	2.07
70%	12.32	2.05
60%	12.20	2.03
50%	12.06	2.01
40%	11.9	1.98
30%	11.75	1.96
20%	11.58	1.93
10%	11.31	1.89
0	10.5	1.75

Many batteries are sealed, which makes it impossible to use a Hydrometer (often considered a more accurate form of reading) and therefore, we rely on voltage. Hence, making the voltage reading an important step in understanding how much state of charge a vehicle has overall.