



*The Nerv Centr SoloPack™, the lightest weight MOTS rechargeable military battery currently in its class, has a small form factor and is compatible with existing kit such as NATO ammo pouches.*



## BATTERY BASICS

### Battery Terms & What They Mean

Although battery terms may seem confusing, many of them are simply different ways of saying the same thing, and they are all inter-related.

#### CAPACITY = “HOW BIG IS YOUR GAS CAN?”

Capacity is the main spec seen on a number of batteries. It's simple - the more capacity, the longer the powered equipment will run. Basically it comes down to how much energy is stored in the battery, just like a gas can. Like a gas can, two batteries that are the same physical size can have different capacities, similar to filling one can with gasoline and one can with jet fuel, one has more stored energy. Capacity is measured in Amp Hours (Ah for short) or Watt Hours (Wh for short). A 1Ah battery can supply 1 Amp for 1 Hour. Similarly a 5Ah battery can supply 5 Amps for 1 hour. The 5Ah battery is 5 times “bigger” than the 1Ah battery. The number one question with batteries is “How long will it last?”. This is where capacity comes in. If the device draws 0.2A and you have a 5Ah battery powering it, then the math is simple:



$$\frac{5 \text{ Amp Hours}}{0.2 \text{ amps}} = 25 \text{ Hours}$$

#### WATT HOURS (Wh) = CAPACITY, MORE OF THE SAME

Watt Hours (Wh) is another way of representing capacity and is actually more indicative of the total stored **energy**. A 12 volt car battery with 10Ah of capacity will have more energy than a 1.5 Volt “D Cell” alkaline battery with 10Ah of capacity. Watt hours is just Volts X Capacity (Ah).

$$12 \text{ Volts} \times 10\text{Ah} = 120 \text{ Watt Hours}$$

A 120 Watt Hour car battery will have more energy than a 15 Watt Hour D-Cell even though they have the same number of Ah. Most equipment specify their power draw as Watts. Watt Hours work in exactly the same way as capacity and answers the same question: “How long will it last?” Even the math is the same.

If the device is a 2 Watt GPS and the battery has an 80 Wh, then:

$$\frac{80 \text{ Watt Hours}}{2 \text{ Watts}} = 40 \text{ Hours}$$



## ENERGY DENSITY = “ROCKET FUEL OR GASOLINE”

Energy density is a term used to describe batteries. It's usually used to compare different batteries and is really a “Bang for Your Buck” number as it represents efficiency. The best way to think of it is to think in terms of fuels. The bang from lighting a can of rocket fuel is substantially bigger than the bang from lighting a can of diesel. Everyone wants a smaller, lighter battery and energy density is the number they look at. They don't want to carry around a 2 pound battery when a half pound version has the same capacity. There are two ways to look at energy density, either through weight or volume depending on what matters most for the application.

### ENERGY DENSITY—WATT HOURS PER KILOGRAM (Wh/Kg)

Energy density is simply the amount of energy (in Wh) divided by the weight. This number is used if the weight burden of the battery is the most important factor. Generally the metric form (Wh/Kg) is even used in the United States. The military uses this term in RFPs, RFIs and BAAs, though the total battery weight is usually given in pounds.

$$\frac{80 \text{ Watt Hours}}{0.42 \text{ Kg}} = 190.4 \text{ Wh/Kg}$$

### ENERGY DENSITY—WATT HOURS PER LITRE (WH/L)

Energy density is simply the amount of energy divided by the volume of the battery. You would use this number if the size of the battery is the most important factor. Again, in the USA the metric form is generally used.

#### CAPACITY

- Measured in Amp Hours (shown as Ah) or Watt Hours (Wh)
- More Watt Hours = More Capacity
- 1Ah = 1 Amp for 1 Hour, 5Ah = 5 Amps for 1 Hour
- Runtime (Hours) = Capacity (Ah) / Load (Amps)
- Runtime (Hours) = Capacity (Wh) / Load (Watts)

#### ENERGY DENSITY

- Measured in Watt Hours / Kg or Watt Hour / Litre
- Bigger number = More efficient

#### SOC

- State of Charge
- Usually shows % of battery charge relative to new battery
- Works like a gas gauge on a car



## STATE OF CHARGE (SOC) = FUEL GAUGE

State of charge is the same as the gas gauge in any car. It indicates how much fuel is left in the tank. SOC is usually measured in percent capacity remaining. The display will sometimes show the exact percentage remaining or only a few lights to show you are between certain ranges.

Ironically, the actual SOC display is typically called a “gas gauge” or “fuel gauge”. How fast the gauge empties is dependant on a few factors, mostly temperature and load. The gauge will get to empty faster when the batteries are cold.

The gauge will also get to empty faster under heavy use and heavy loads, just like flooring your car down the highway, you can almost watch the gauge move from full to empty and it's the same with batteries.

Most military batteries show the absolute State of Charge. This is the % of charge remaining based on when the battery was brand new. We've all had drills or other power tools that, over time, would not hold as much charge; most batteries run into this problem. By making the display show the absolute state of charge, you can see when your battery has degraded to the point that it needs to be replaced. If released from the charger and the display still only shows 80%, it is time for a new battery. It also shows the actual % of energy that is in the battery to eliminate situations where you may have more runtime than you actually do.

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