Electricity: How does it work?

As electricity cannot be seen, smelled or heard (when all is well), it is a technology that can be more difficult to grasp than, say, mechanical engineering or architecture. Nevertheless, over the past century we have come to increasingly rely on electrical energy. It only takes a power cut for us to all realise how much we depend on electricity for our luxury, safety and comfort.

The luxury, safety and comfort we take for granted at home and at work is also appreciated onboard a yacht or in a camper. The same goes when working in locations with no connection to a power plant, including on tugboats, Rhine barges or during road works.

For more than 20 years, Mastervolt has specialised in supplying reliable electrical power in places without utility facilities. To offer a better understanding of our products, let us first give a short explanation of the main terms.

Voltage and current provide power

The main activity of Mastervolt is power conversion. And the main variable that can be converted in the field of electricity is voltage. The electrical voltage is the potential difference between two points in an electrical circuit.

We distinguish two types of voltage: Alternating Current (AC) and Direct Current (DC). Voltage is expressed in Volt (V), and AC frequency is expressed as Hertz (Hz), the rate at which voltage alternates.

■ ***Alternating Current*** (voltage) is the electricity that comes out of home sockets and is used for most appliances. In Europe this is 230 V 50 Hz, in the USA 120 V or 240 V 60 Hz.

■ ***Direct Current*** is supplied by a battery or solar panels. Batteries are vital because they offer a practical possibility to store electrical energy. Battery voltages are commonly 12 V or 24 V. Another possibility is 48 V, which is usually exclusive to electric propulsion.

While direct current is stored in batteries, we actually need alternating current to power our household appliances. This requires conversion from DC voltage to AC voltage.

Another term we use is ■ ***current (I)***, measured in ■ ***amps (A)***.
Current 'flows' through the onboard wiring when there are electric appliances in use. The amount of current that flows through the wiring can vary greatly (depending on the connected load and used voltage). This is why the correct cable thickness is so important – overheating electric wires can have serious consequences.

A river in which water is flowing, a wire that conducts electrical current, or a cyclist biking against the wind...
All experience resistance.

In the field of electricity, this ■ ***resistance (R)*** is indicated in ■ ***Ohm (Ω)***.
Resistance is important because it causes losses in the form of heat, that we need to take into account. Voltage loss takes place in wires and if not dealt with, there will be insufficient voltage at the end of the wire to power the appliance we want to use.

The mentioned variables all provide ■ ***power (P),*** which is expressed in ■ ***Watt (W).*** Every electric device refers to its output in Watt; microwaves of 900 W, light bulbs of 60 W, generators of 4000 W and washing machines of 2500 W.

To keep the terminology and discussion simple, we refer to kilowatts (kW), in which 1000 W equals 1 kW. To link consumption to a consumption period, we use a time unit in which electrical power is generated or consumed, namely one hour. Together they make kilowatt hours (kWh).

Formulas

The relationship between these units is expressed in formulas that represent the 'laws' of electricity.

V = potential difference expressed in voltage (V)
I = current in units of amps (A)
R = resistance in units of Ohm (Ω)
P = power in units of Watt (W)

Ohm's Law is the most important formula. V = I x R
Voltage [V] = current [I] x resistance [R]

Because we often use the term power, the formula below is frequently used to determine power: **P = V x I**
Power [P] = voltage [V] x current [I]