

Technical terms - glossary

A ■ **Absorption phase**
 The second stage in a modern 3-step+ charging process. Batteries are charged from around 80% up to 100% during this stage. Voltage is somewhat lower than the gas voltage of the battery, which is 2.4 Volt per cell at 25 °C (or 14.4 Volt for a 12 Volt and 28.8 Volt for a 24 Volt battery). The absorption phase follows the bulk phase and is, in turn, followed by the float phase.

■ **ABYC standards**
 The American Boat & Yacht Council is a non-profit organisation that represents American builders. It sets standards and gives recommendations for nautical equipment (including electrical equipment) on pleasure vessels with the



goal of enhancing safety. The ABYC therefore issues certification for products.

■ **AGM battery**
 Battery in which the electrolyte (a mix of water and sulphuric acid) is largely absorbed in glass fibre matting. As these batteries are entirely maintenance-free and do not normally produce gas, they can be fitted anywhere and ventilation is usually unnecessary. Thanks to their construction, AGM batteries can be swiftly discharged while providing a very powerful current. This makes them highly suitable for systems that require high levels of current, such as bowthrusters, winches and engine starting.

■ **Alarm contact**
 A contact in a battery charger or inverter that will be activated when an external or internal malfunction occurs.

■ **Alternating current (AC)**
 AC is the electricity that for example comes out a socket in your home. Other terms used for AC include shore power, generator power or inverter power. AC voltage changes polarity with a given frequency: In Europe, for instance, the polarity of the electrical voltage is reversed 50 times per second. The supply therefore has a frequency of 50 Hertz (Hz).

■ **Amps (A)**
 The unit that measures the current following through a circuit. The current can be calculated by dividing the voltage by the resistance of the consumer. A resistance of 6 Ohm and voltage of 12 Volt gives a current of 2 amps.

■ **Amp-hour (Ah)**
 The unit that denotes the capacity of a battery, calculated by multiplying current in amps by the duration of the discharge in hours. For example: If a battery delivers a current of 5 amps in 20 hours with the voltage constantly above 10.5 Volt, this amounts to $20 \times 5 = 100$ Ah. The capacity of a battery usually depends on the amount of lead and battery acid it contains.

B ■ **Battery**
 Converts chemical energy into electrical power and vice versa. The nominal voltage of a battery is 2 Volt, and higher voltages are achieved by connecting several batteries in series. For instance, six 2 Volt batteries can be combined to provide a nominal voltage of 12 Volt.

■ **Battery acid**
 An electrolyte that consists of water and sulphuric acid. The specific gravity of battery acid in a charged battery varies between 1.28 and 1.30.

■ **Battery charger**
 Used to charge batteries. Its capacity should be at least 15 to 25% of the battery capacity with a wet battery and max. 30% with an AGM battery, up to 50% with a gel battery and up to 100% with a Lithium Ion battery.

■ **Battery Management System**
 A natural phenomenon of Li-ion batteries is the natural imbalance between stronger and weaker cells. In the charging process, one or more cells will reach their maximum charge level faster due to this imbalance, while others do not get fully charged. The lower cells will be discharged faster, causing the battery to be empty sooner due to under-voltage and so reducing the lifespan of the battery. To prevent this, Mastervolt Lithium Ion batteries are equipped with a Battery Management System that automatically compensates for the imbalance between the cells and increases the lifespan and the total capacity of the battery.

■ **Battery monitor**
 Indicates battery status. Mastervolt offers two different models: The conventional BTM-III provides information about charge and discharge current, battery voltage, number of amp-hours consumed and time remaining before recharging becomes necessary. The modern MasterShunt gives extensive information on current, voltage, historical data and information on usage. It is easy to connect to the MasterBus network and with command-based events you can program the system entirely to your wishes.

■ Bulk phase

The first stage in a modern 3-step+ charging system. The output current of the battery charger is 100% during this stage, while voltage depends on the power remaining in the battery. The bulk phase is followed by the absorption phase.

■ BV approval

Bureau Veritas is a French classification society for shipping, passenger vessels and some large yachts. The requirements in terms of safety and functionality are stringent and approval is required by



many insurance companies. Most Mastervolt equipment exceeds BV's rigorous standards.



■ Cable losses

A loss of voltage resulting from the resistance of the cable. The losses also depend on the current flow.

■ CE marking

Marking placed on a product by manufacturers or importers to declare that it meets EU safety, health and environmental requirements. These requirements are derived from European product directives, which have been incorporated into the national legislation of most EU member states. The CE mark therefore shows compliance with a law and is not informal advice. It should be visible on the outside of equipment and suppliers have to make available a declaration stating which requirements of the CE marking the equipment meets.



All Mastervolt equipment exceeds these rigorous standards.



■ Charge voltage

Voltage used to charge batteries. On average, it amounts to 14.4 Volt or 28.8 Volt during the absorption phase and 13.25 Volt and 26.5 Volt during the float phase, both at 25 °C.

■ Combi

A device that combines a battery charger, an inverter and a transfer system in one.

■ Cos phi or power factor

Specifies in AC systems the degree to which current is out of phase with voltage: The lower this value, the larger the discrepancy. In a heating element, for instance, the current is in phase with the voltage, so the cos phi is 1. In a motor, however, there is a divergence, and cos phi tends to be 0.8 or sometimes 0.6. The lower the cos phi, the more current is required to supply a given amount of power.

■ Current

The flow of electrons through a circuit. Electric current is measured in amps.

■ Cycle

The theoretical discharging of a battery from 100% to 0% ,and recharging back from 0% to 100% in one cycle. Twice discharging to 50% and fully recharging is also one cycle, as is four times discharging to 75% and fully recharging again. This is all theory however: In practice a battery is discharged not more than 50%.

D ■ **Digital Switching**
 Digital Switching is a Mastervolt innovation that radically simplifies installation, configuration, control and monitoring of onboard electrical systems. This CAN-based platform is proven in the automotive industry and is fully compatible with most A-brand navigation systems. It offers you a range of luxurious and comfortable options, including remote control.

■ **DIP switch**
 A tiny switch usually found on a printed circuit board and used to set the various functions of Mastervolt equipment.

■ **Direct current (DC)**
 Current that only flows in one direction, such as that in a battery, solar panel, alternator or battery charger.

■ **DNV approval**
 Det Norske Veritas is a Norwegian classification society for professional shipping and offshore activities. The requirements in term of safety and functionality are very strict, and approval is required by many insurance companies. Most Mastervolt equipment easily satisfies DNV's stringent standards.



E ■ **Earth**
 The electric no-load potential, also called reference potential. The negative pole of a battery is often connected to the steel chassis of a vehicle or boat, which then serves as the earth. In US English the term grounding is used.

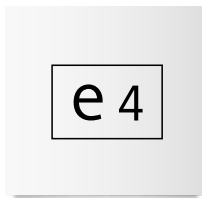
■ **Earth leakage switch**
 Monitors the onboard supply for electrical leakage, switching it off when leakage exceeds 30 milli-amps.

An earth leakage switch protects you against an electric shock in the event of contact with a live component.

■ **Efficiency**
 The efficiency of a power source is expressed in percentage terms (%). A device with an efficiency of 90%, for instance, has 100% power at the beginning and 90% at the end. The 10% that is lost is primarily transformed into heat. The higher the efficiency of an inverter, the longer the batteries will last.

■ **Electrolyte**
 The liquid in batteries, composed of a mixture of sulphuric acid and water. Its specific gravity is 1.280-1300 in a charged battery and 1.100 in a discharged one.

■ **E-marking**
 A standard that indicates whether the relevant equipment can be used on vehicles such as ambulances and fire engines. In order to qualify for an E-marking, equipment has to satisfy strict requirements in terms of safety, EMC and suitability. Most Mastervolt battery chargers and inverters comply with these requirements.



■ **EMC**
 Short for Electro-Magnetic Compatibility, EMC indicates how much, if any, electromagnetic interference a device may produce and whether it is sensitive to electromagnetic interference from the outside. A good example is that of a battery charger and a microwave oven. The microwave is not allowed to produce more interference than determined by the EMC standard, and the battery charger may not be affected by the interference generated by the microwave. Naturally, the opposite also holds true. Requirements in terms of EMC are established within the CE framework. Mastervolt equipment exceeds these strict requirements.

■ **E-Propulsion**
 Electrical propulsion is growing in popularity and is compulsory in an increasing number of sailing and nature areas. A hybrid version is also available, allowing you to choose whether to sail using a diesel engine or electric motor.

F ■ **Float phase**
 The final step in a modern 3-step+ charging process. Although the batteries are fully charged during this phase, they receive a maintenance charge, while the onboard DC circuit is supplied with power. Charge voltage is 2.25 Volt per cell or 13.25 Volt for 12 Volt batteries and 26.5 Volt for 24 Volt ones at an ambient temperature of 25 °C.

■ **Forced inverter**
 A function on the Mass Systemswitch. At the push of a button, a part of the onboard consumers are powered from the batteries via the inverter, while the battery charger stays connected to power. The power intake of the battery charger can be regulated via the system panel, up to the point where the maximum for the AC fuse has been reached. The advantage of this system is that heavy-duty consumers such as hair dryers are powered via the inverter and cannot therefore overload the AC fuse. When such consumers are connected to the inverter, consumption from the batteries is usually higher than the battery charger can supply. This is rarely a problem as major consumers are usually used for a short time and the consumption measured in Ah tends to be low. After the consumer has been switched off the battery charger will recharge the battery automatically.

■ Frequency

The number of times per second that alternating current changes direction, expressed in Hertz (Hz).

G

■ Galvanic isolation

A situation where two circuits are electrically connected without their grounding or earth coming in contact. Galvanic isolation is best achieved by means of a transformer.

■ Gas voltage

The voltage level at which a battery starts producing gas. At an ambient temperature of 20 °C, the gas voltage is 2.4 V per cell or 14.4 V for a 12 V battery and 28.8 V for a 24 V one.

■ Gel battery

Batteries where the electrolyte (mix of water and sulphuric acid) is absorbed in a gel. As they are entirely maintenance free and rarely produce gas, gel batteries can be fitted anywhere. Extra gas extraction is not necessary. Gel batteries are highly suitable for lighting and as onboard service batteries, and can be charged very quickly thanks to their special construction. With normal use the lifespan of a 12 Volt gel battery is between six and seven years. For the 2 Volt traction gel version, 10 to 15 years is not uncommon. A gel battery is very suitable for (deep) cycle usage.

■ GL approval

Germanischer Lloyd is a German classification society for professional marine vessels. The requirements in



terms of safety and functionality are very strict and this approval is often necessary for insurance purposes.

H

■ Hertz (Hz)

Unit that measures frequency, i.e. the number of times per second that an alternating current (AC) changes direction. In Europe this is 50 Hz, and in the USA 60 Hz.

■ High-frequency (HF) switch technology

This technology allows incoming alternating current to be rectified into direct current over a diode bridge. The resulting DC voltage is chopped into parts with a high frequency by means of an electronic switch that is turned on and off quickly. This creates a simulated alternating current with a high frequency, 35 kHz (35,000 Hertz) for instance. This AC can be converted to a higher or lower voltage via a very small transformer. The higher the frequency, the smaller the transformer can be. Mastervolt uses HF switch technology in all its equipment, offering major benefits in terms of compactness, weight and efficiency. Another advantage is that you say goodbye to the irritating hum of a transformer.

■ Hydrogen gas

Highly explosive gas mixture of hydrogen and oxygen formed during the charging of wet batteries with an unsuitable charger. Extra ventilation prevents concentrations from becoming too high.

I

■ IEC approval

The International Electrotechnical Commission (IEC) is headquartered in Geneva, Switzerland, and develops general standards for the safety of electrical components and equipment. Although it proposes standards, the IEC is not responsible for their enforcement, which is usually carried out by independent test laboratories.



■ Inductive loads

These loads are, for example, the motors in air conditioning systems and diving compressors. They cause the current to flow out of phase with the voltage, a phenomenon also known as phase shift. The degree is indicated by a value, cos phi or power factor, which ranges from 0 to 1 and is inversely proportionate to the size of



the lag. In a heating element (which is resistive load), current flows in step with voltage and $\cos \phi$ is 1. In a motor, however, there will be a lag, as indicated by the typical value of 0.8 - or sometimes 0.6 - for $\cos \phi$. The lower the $\cos \phi$, the greater the lag, and the more current is necessary to supply a given level of power.

■ **Inverter**

Converts 12, 24 or 48 Volt battery power to alternating current at 230 V/50 Hz (or 120 V/60 Hz). This allows appliances such as computers, microwave ovens and TVs to be powered without the need for a grid connection or generator.

■ **Isolation transformer**

Converts shore power voltage to a higher, lower or equal value to ensure that there is galvanic isolation between the shore power connection and the onboard electrical system. This prevents corrosion and increases safety.

■ **Kilowatt (kW)**

Unit for electrical power equivalent to 1000 Watt. Ten 100-Watt light bulbs consume one kilowatt.

■ **Kilowatt-hour (kWh)**

One kW of electricity used in one hour. This is the most common measurement of power consumption.

■ **LED (light emitting diode)**

Electronic light with very low power consumption. LEDs are generally available in many different colours and sizes. Mastervolt uses them as signal lights on battery chargers and inverters. The latest generation of LEDs can be used as lights as well and are very low in use of energy.

■ **Lithium Ion battery**

Lithium Ion batteries have a high energy density and are perfect for cyclic applications. Compared to traditional lead acid batteries, Lithium Ion batteries offer savings of up to 70% in volume and weight, while the number of charging cycles is three times as large. Another major benefit of the Mastervolt Lithium Ion battery is that it is equipped with an integrated Battery Management System, which automatically compensates for any imbalance between the cells to guarantee a longer battery lifespan.

■ **Lloyd's approval**

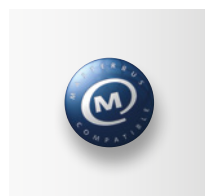
Lloyd's Register of Shipping is a British classification society for yachts, professional shipping, drilling platforms, etcetera. Numerous insurance companies require large vessels to be approved by



Lloyd's. This means that the vessel and the onboard equipment have to satisfy stringent requirements.

■ **MasterBus**

MasterBus is Mastervolt's advanced standard for data communication and integration of Mastervolt components within your electric system. Advantages include complete system integration, easy operation and monitoring, and simple



installation with fewer cables. A MasterBus network can be easily extended in a later stage.

■ **NiCad batteries**

Containing nickel and cadmium, this type of battery is unsuitable for use on boats due to the high charge voltage required. NiCad batteries will soon be banned because of their cadmium content. N.B. All NiCad batteries are considered to be chemical waste.

■ **No-load consumption**

Power consumed by an inverter when it is not powering any equipment. This is just a few Watts with modern Mastervolt inverters and Combis. The lower the no-load consumption, the less power is used by the inverter.



■ **Ohm**

Unit for electrical resistance, indicated

by the symbol Ω . The electrical resistance of an electrical conductor is the opposition to the passage of an electric current through that conductor.

■ **Ohm's law**

Gives the relationship between voltage (U), current (I) and resistance (R). In formula terms this is expressed as $U = I \times R$.

If two of the three values are known, the third can be calculated.

■ **Overload**

A concept related to the safety of an inverter, generator or power connection. A fuse, for instance, ensures against overload. All Mastervolt inverters have electronic protection against overload.



■ **Parallel connection**

In a parallel connection the current can flow through multiple circuits. By parallel connecting batteries (positive to positive, negative to negative), the capacity of the battery set is increased, while voltage stays the same. For example, while two 12V/55Ah batteries connected in parallel have a voltage of 12 Volt, the capacity is $55 + 55 = 110$ Ah.



■ **Peak power**

The maximum current that can be supplied by an inverter for short periods of time. This is often necessary, as electric motors can consume up to ten times their nominal power when starting up. Mastervolt inverters can deliver a high peak current, often reaching two to three times their nominal capacity.

■ **Peukert**

The name of a German scientist who in 1897 observed that a battery supplies progressively less power as the discharge current increases. Peukert created a formula that gives the number of amp-hours a battery can supply at a given discharge current and time. Mastervolt battery monitors all take Peukert's law into account, ensuring that you always have a correct overview of your battery's status.

■ **Power Sharing**

This concept is related to the performance of the charger part of a Combi when connected to the grid or a generator. It involves the automatic power intake regulation of the battery charger when the power is very low.

As soon as the power fuse is in danger of being overloaded, the battery charger automatically reduces its output current so that tipping of the power fuse will be prevented.

■ **Power Support**

A feature found in the Mass Combi Ultra. Power Support ensures that the power supply to onboard consumers will be partially powered from the batteries if the power is in danger of becoming overloaded. It is activated after the battery charger's output has been reduced to zero via the power sharing system in the Combi.

R

■ **Recombination technology**

Used in AGM and gel batteries to make sure that the gas (oxygen and hydrogen) generated by charging is recombined into water. This means that the batteries can be entirely maintenance free and sealed.

■ **RRR approval**

The Russian River Register sets standards for products and manufacturers in terms of quality, safety and environmental friendliness. Only products certified

by the RRR are allowed onboard vessels sailing on the country's inland and coastal waters.



■ **RS approval**

The Russian Maritime Register of Shipping sets standards that products and manufacturers must meet in order

to be allowed onboard vessels flying the Russian flag within Russian territorial waters (seas and inland waters). The institute is also responsible for related inspections.

S

■ **Self-discharging**

The decrease in the capacity of a battery that occurs when no load is connected. A wet battery loses 1% per day, an AGM battery and gel battery 2% per month and a Lithium Ion battery less than 3% per month. The higher the ambient temperature, the more self-discharging will occur. Current leakage due to intense pollution

or humidity between the poles can also cause a higher level of self-discharging, so you should always keep the top of your batteries clean and dry.

■ **Semi-traction battery**

A semi-traction battery has fewer but thicker plates in each cell, compared to starter batteries. Semi-traction batteries supply a relatively lower starter current, but can be discharged more often and to a greater extent (200 to 500 full cycles). This kind of battery is highly appropriate for the combined function of starter/service battery.

■ **Series connection**

A series connection (the positive pole of each battery is connected to the negative pole of the next) increases the voltage of the total battery set. For example, when two 12 Volt batteries with a capacity of 55 Ah each are connected in series, the total voltage of the set will be $12 + 12 = 24$ Volt, while total capacity remains 55 Ah.

■ **Sine wave**

The alternation of voltage can be graphically indicated by a sine wave. This consists of a line that follows a wave pattern around a horizontal axis, which represents the passage of time and also the points at which voltage is zero. Once the line has traced one entire wave above the time axis and one entire wave below, a whole sine wave has been outlined.

■ **Square millimetre (mm²)**

Unit in which cable diameters are measured. With a direct current system of 12 or 24 Volt, three amps should correspond to one mm² of cable thickness. For 230 Volt systems allow 8 amps for each mm². Both for a maximum length of 3 metres.

■ **Soft start**

Device used to reduce the inrush current of transformers and motors.

■ **Stand-by mode**

In this mode the inverter emits a small pulse instead of the usual 230 Volt output. It detects when an appliance is switched on and the inverter automatically switches on, supplying 230 Volt until the output current falls below a pre-set value. When there is little or no output current, this means that no load is connected and the inverter switches back to stand-by. This system saves a great deal of energy.

■ **Starter battery**

Mainly used to start engines. Although these batteries can deliver a high current, they should not be excessively or too frequently discharged and are therefore not appropriate for lighting purposes. AGM batteries are ideal to serve as starter battery and limited cyclic use.

T ■ **Temperature correction**

If the battery temperature is lower than 25 °C, the charge voltage should be adjusted upwards. When higher, the charge voltage needs to be reduced. This temperature correction is 30 mV per °C for a 12 Volt battery and 60 mV per °C for a 24 Volt one. While this may seem insignificant, it is essential to ensure a long battery life.

■ **Temperature sensor**

A temperature sensor should be attached to the battery so that the charger can optimise charge voltage with respect to the battery temperature. The charge voltage depends on the battery temperature (see also Temperature correction).

■ **Traction batteries**

Used for propulsion, powering equipment and inverters, etc. They can be discharged often and completely, and in a gel version are highly suitable for onboard use. Wet cell batteries are only appropriate for forklifts, etc.

■ **Transfer system**

A (frequently automatic) system used to switch between multiple power sources, such as grid, generator and inverter.

■ **3-Step+ charging**

A modern charging technology that has been extended with an extra step in Mastervolt equipment, the Plus phase.

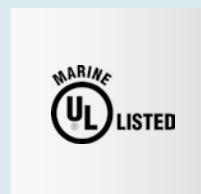
The three steps are:

- Bulk, where the charger supplies maximum power.
- Absorption, during which the charger delivers maximum charge voltage and the battery is charged from around 80% to 100%.
- Float, used for battery maintenance and delivering power to connected equipment.

The 'plus' phase is an automatic one-hour bulk phase once every 12 days when the battery is not being used.

U ■ **UL approval**

An American certification provided by Underwriters



Laboratories that is similar to the European CE-mark and mainly focused on safety issues.

V ■ **Volt (V)**

Unit in which electric potential (voltage) is measured.

■ **Volt-amps (VA)**

Unit for measuring electrical power.

■ **Voltage ripple**

A voltage ripple is a small alternating current on top of a direct current, which results in a DC voltage that is not entirely smooth but ripples slightly. While a battery delivers pure direct current without any ripple, this is not always the case with a battery charger. In an old-fashioned battery charger, 50% of the voltage will contain ripples.

A large voltage ripple shortens the lifespan of a battery, which needs to be charged with direct (not alternating) current. In addition, a voltage ripple can interfere with onboard audio, navigation and communications systems. Mastervolt battery chargers supply a flat DC voltage with no more than 0.3% of ripple voltage.

W

■ **Watt (W)**

Unit that measures the rate of energy, calculated by multiplying Volts by amps.

■ **Watt-hour (Wh)**

Measure of electrical power in time. One watt-hour of electricity is equal to one Watt of power consumed over one hour. A 10-Watt light bulb uses 10 Watt-hours of electricity in one hour (see also kWh).

QUOTE

"Oyster aims to provide the best customer service in the industry. This is only possible if their key suppliers have similar aims and can provide the service and support that Oyster owner's have become accustomed to. Mastervolt have to date displayed such dedication to service, supporting Oyster yachts around the world. Mastervolt is willing to go that extra mile to provide the service and support which stand Oyster apart."

PETER INGRAM, TECHNICAL MANAGER
OYSTER YACHTS, UNITED KINGDOM

