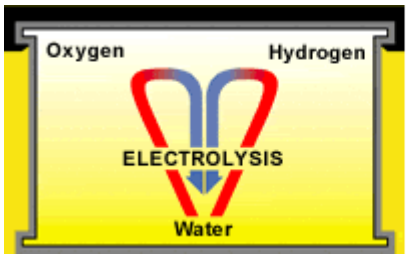
Maintenance-free, sealed battery system

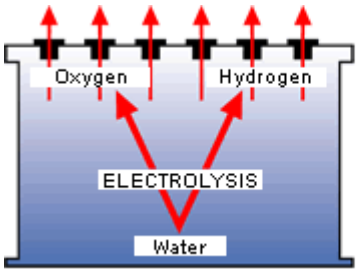
EXIDE Technologies developed ranges of product where the high reliability combines with very low gas emission and maintenance requirement: AGM, with absorbed electrolyte, and GEL, with gelled electrolyte.

AGM is the best starter battery and has a good behavior in cycling application as recreational vehicle and nautical applications.

GEL is the best as service battery, able to accept deep discharge condition, with no effect on recharge-ability.



EXIDE
Sealed system
with safety valves



Conventional wet battery
Release of
hydrogen
+ oxygen
+ acid vapours

The recombination principle

In the EXIDE AGM & GEL sealed battery system, the gases produced during charging are recombined back into water within the cells. This means that exceptionally clean and safe handling is guaranteed, because neither gases nor acid vapours are able to escape outside.

The EXIDE AGM & GEL are therefore completely maintenance-free.

Applications

- Solar applications, leisure and sports vehicles
- Forklift trucks, construction machinery
- Emergency and special vehicles (police, fire service, rescue services, DRK, THW...)
- Local buses, coaches
- Caravans, mobile homes
- Sailing boats, motorised yachts, motor boats

Charging method

Only units with the characteristic curves IU or IU_1, IU_2 and the following reference data should be used:

External charging of EXIDE AGM & GEL batteries:

- I phase with current intensities of between 10 and 30 A/100Ah (recommendation 1/10 of the battery capacity, e.g. 10 A for 100 Ah)
- U phase or U1 phase (main charging phase) with constant voltage between 14.1 and 14.4 V
- U2 phase (charge retention) with constant voltage of 13.8 V
- Charging times phase IU or IU1 at least 12 hrs, changeover point for U_2 phase after 12-16 hrs

Charging with on-board generator:

- With 12 V system 14.1 to 14.4 V regulator voltage
- With 24 V system 28.2 to 28.8 V regulator voltage

With solar system:

- 14.2 V constant

Technical features, advantages, uses / application EXIDE AGM & GEL

Technical features	Advantages	Uses / application
Sealed battery system with recombination facility	**Absolutely maintenance-free** **Clean and environ-mentally friendly** **No release of acid vapours** **Extremely low gassing**	**No need to top up water, no maintenance costs** **Higher capacity reserves** **Risk-free use internally**
Lead/calcium alloy on positive and negative plate	**Constant cold-start performance over the entire service life** **Minimal self-discharge**	**Reliable starting** **For vehicles left out of use for prolonged periods, seasonal use**
Thick plates with mechanically reinforced positive earth	**Extremely high cyclical strength**	**Long life with frequent charging and discharging**
Acid contained in gel	**Leak-proof** **Permitted angle of inclination up to 180∞** **Low discharge-resistant** **No acid coating**	**No acid leaks, even if the casing is broken** **Operational in extreme positions** **Badly run-down battery can be charged up again within 4 weeks** **Solar applications**
Sturdy construction	**High vibration resistance**	**Building site and off-road vehicles**

Installation

Switch off all power-consuming equipment, and connect the earth/ground/chassis cable last of all. Take care to ensure that the battery and its connections are secure.

Your EXIDE battery is supplied from the manufacturer ready for use!

➨ CAUTION:

In spite of the extremely small amount of gassing from your EXIDE battery, please pay attention to the following:

- Do not use hermetically sealed battery containers.
- There should be no spark-producing switches, relays or the like situated in the immediate vicinity of the battery.

Your EXIDE AGM & GEL is ABSOLUTELY MAINTENANCE-FREE!!

During the entire battery lifetime there is no need for you to check the acid level, grease the terminal posts or top up with distilled water.

These benefits are a result of the sealed construction of the EXIDE AGM & GEL. But that also means: you must **never open** the battery! Otherwise the battery would be destroyed by oxidation.

For the case if your battery is installed where an external charger is necessary:

"Absolutely maintenance-free" does not mean that you can neglect your EXIDE AGM & GEL battery as far as charging with the charger is concerned! Correct recharging (IU-charge characteristic) is the only way to preserve the performance benefits of your EXIDE AGM & GEL for a prolonged time.

Technological advantages

As a result of its future-proofed technology with an immobilised gel electrolyte, your EXIDE AGM & GEL is not only absolutely maintenance-free but also

- **absolutely electrolyte-tight**
- **vibration-resistant**
- **extremely low gassing**
- **cycling-proof**
- **permitted angle of inclination up to 180 degrees**
- **deep-discharge-proof (recharge after a maximum of 4 weeks)**

What you need to know!

Every accumulator is an electric current storage device with a limited capacity. The difference compared to electricity from a mains socket is that the energy taken out of the battery must be 100% returned to it again! Insufficient recharge leads to a "negative charge balance". Problems up to premature failure of the battery can be expected.

As a rule, the lighting generator is the only available accessory for recharging the battery while underway. However, the lighting generator and solar panel are only **supporting charging devices**.

100 % recharge is possible only with a suitable charger operated via an external mains supply. That's the reason why conscious and economical use of the energy supply should be as self-evident as the conserving use of natural resources (drinking water etc.): **No battery yields an inexhaustible supply!**

➨ HINT:

Make an energy balance for all electricity-consuming equipments on board. This allows you to check the amounts of energy used each day and which must therefore be supplied to the battery again.

Example calculation for a refrigerator:

Power 42 Watts (W): **Voltage** 12 Volts (V)
= current 3.50 Amperes (A)
x duration of use/day in hours (h), e.g. 8 h
= required capacity in Ampere-hours (Ah) e.g. 28 Ah

- Following this example, you can determine the total capacity needed for all of the electricity-consuming equipments on board by addition (you will find the power data in Watts on rating plates, lamp holders etc.).
- Multiply the total Ah value determined by the safety factor of 1.3 (it is much higher for conventional batteries) and you will know what effective capacity the battery used should have. If your on-board network is under-supplied, a more powerful EXIDE GEL battery and/or an additional power supply battery will help.

Therefore:

The highest standards of reliability and economy are imposed in professional use, e.g. buses for local public transport. The recommendation in order to keep the EXIDE AGM & GEL in a good state of charge at all times is:

recharge at least 1x per week!

The following recommendations apply for use in the leisure and sports area:

- Always start your journey with a **fully charged battery!**
- During the holiday, **use every opportunity** to recharge the battery via the built-in on-board charging equipment!
- After the end of the journey, it is essential that the battery is **charged via the on-board charger equipment for longer than 12 hours**, since as a rule the battery is not fully recharged even during prolonged mobile use (return journey).
- **Before prolonged periods out of use**, e.g. the winter break, **the battery must again be fully charged for longer than 12 hours**. Then disconnect the positive terminal post!

What you must pay attention to!

External charging:

Charge with an unsuitable charger, e.g. one that switches off after reaching a charging voltage of 14.1 – 14.4 V, leads to severe sulphating of the battery plates and thus to battery "starvation".

The correct charging technique:

Characteristic curve IU or IU_oU_1, i.e. "I" phase at a minimum $^1/_{10}{}^{th}$ of the battery capacity as the charging current (e.g. 8 A for a 80Ahs battery).

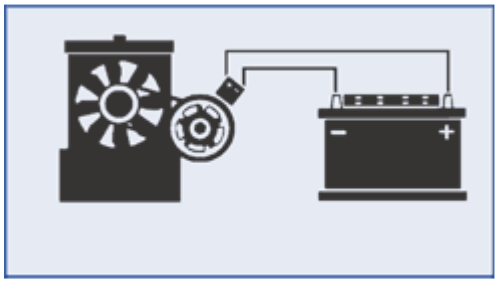
After reaching the charging voltage of 14.1 – 14.4 V, switchover to the "U" phase (main charging phase) at 14.1 – 14.4 V takes place. The total charging time must be at least 12 hours, even if the battery was only slightly discharged. After that the charger can be switched off (= IU characteristic curve) or switched over to float charge (IU_oU_1).

The voltages mentioned above apply for a 12 V on-board electric system. The data is doubled for a 24 V on-board electric system.

Your alternative charging configurations

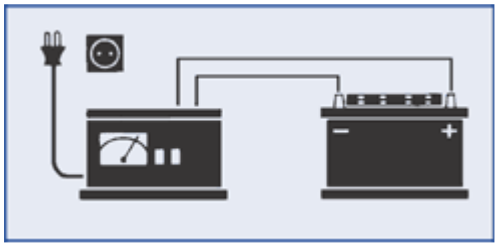
The voltage values stated in each case are set-point values for the voltage at the battery terminals.

Permitted charging voltage



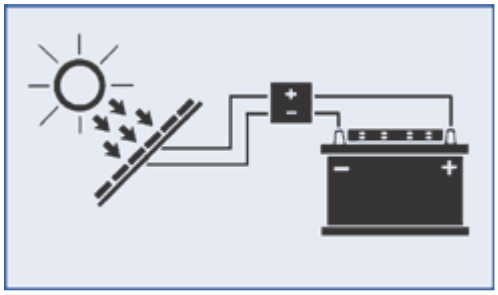
Generators with controllers

- 14.1 to 14.4 V for 12 V
- 28.2 to 28.8 V for 24 V



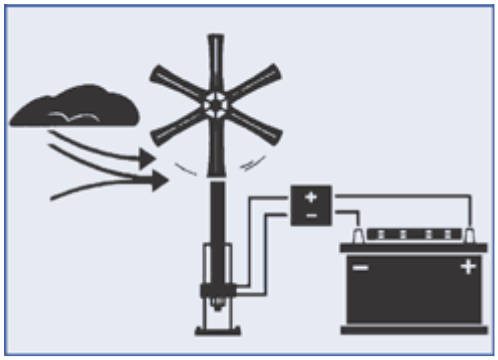
2. Chargers
(according to the data quoted above)

- 14.1 to 14.4 V for 12 V
- 28.2 to 28.8 V for 24 V



3. Solar panels
(with appropriate voltage regulators)

- 14.2 V constant



4. Wind or wave generators
(with appropriate voltage regulators)

- 14.2 V constant

What can cause the power supply battery to fail?

1. Negative charging balance ⇨capacity loss ⇨battery failure

- insufficient charging time (less than 12 hours) via the on-board charger
- insufficient recharge via the lighting generator because of low voltage (voltage losses in the on-board electricity system or faulty / incorrectly set voltage controller)
- faulty charger
- unsuitable charger
- negative energy balance caused by too many retrofitted electricity-consuming equipments, i.e. the energy consumption is larger than the capacity charged in

2. Deep discharge
Possible causes of deep discharge:

- consuming equipments not switched off
- leakage discharge in the milliampere region in spite of the main switch being switched off, e.g.
  – caused by an electromagnetic isolation valve in the heating system
  – caused by a solar controller (output)
  – caused by the on-board control panel
  – caused by silent consumers (e.g. clock, signal lamps, LED displays)

Example:
Silent consumers can have a current consumption of approx. 55 milliamperes. This means that approx. 1.32 Ah is taken from the battery during one day. Thus a fully charged 80 Ah on-board battery will be completely discharged after about 2 months.

Possible consequential damage:
Despite recharging, only a fraction of the theoretical charge capacity remains available for withdrawal. In the worst case, the battery is already destroyed by a short-circuit in one of the battery cells.

Correct energy precautions

In contrast to conventional batteries, which can survive only 1 – 2 days in a deeply discharged condition, your EXIDE AGM & GEL battery tolerates deep discharge up to a maximum of 4 weeks!

Thereafter it should be charged for at least 48 hours at 14.1 – 14.4 V.

- always switch off consuming equipment that is not needed!
- take silent consumers into account when calculating the energy consumption!
- recharge the battery for at least 48 hours after a deep discharge!

Self-discharge
(independent of continuous consumers of electricity):The loss of power of an EXIDE AGM & GEL through self-discharge is extremely small: at 20 – 25° C it loses 0.1% of the battery capacity/day. However, the self-discharge increases remarkable as the temperature rises: at 35° C it is 0.7%/day, i.e. 7 times more!

Summer use
In summer the higher self-discharge as a result of the temperature, combined with continuously consuming equipments **without** recharging via the on-board charging system, can lead to deep discharge of the battery particularly quickly.

Therefore we recommend:
- Recharging once per month

BASIC PRINCIPLE: Fully recharge of the battery and disconnection of the positive terminal before any prolonged idle period.

CHECKLIST Causes of failure:

The causes of failures often lie in the on-board electric system, and you can easily trouble-shoot them and correct them yourself. If problems arise, you should check the following points in particular:

- charging voltage at the battery terminals too low (below 14.1 V)
- faulty lighting generator
- excessive charging voltage (over 14.4 V) caused by a faulty voltage controller (excessive charging voltage leads to destruction of the battery)
- slack vee belts
- oxidised or loose connection terminals
- faulty switching relay of an electricity-consuming equipment
- short circuit in the on-board electrical system

- leakage currents in the on-board electrical system

To check the battery condition, it is advisable to carry out an open circuit voltage measurement as described on the following page.

Measurement of the open circuit voltage (OCV)

The measurement of the open circuit voltage is a simple and effective method for checking the condition of the battery. "OCV" is understood to mean the voltage of the charged battery in a quiescent state, without any current being supplied or drained. As a rule a built-in voltmeter is present for this measurement in mobile homes and boats. If this is not available, an external instrument can be purchased at very small cost from a specialist dealer.

➡ The measurement should take place 24 hours after the last charge at the earliest. The battery must not be loaded in the meantime, i.e. no current must be drained.

Quiescent voltage in V	State of charge in %
>12.8	100
12.55	75
12.3	50
12.2	25
<12.0	0

Enlarging the on-board electrical system

If it is necessary to retrofit a second battery for the on-board electrical system, then the following basic rules apply:

Combination	Connected in series	Connected in parallel
Wet battery + VRLA battery	**not possible!**	**possible,** with isolation relay
AGM + AGM battery GEL + GEL battery	**possible!**	**possible!**
New battery + old battery	**possible,** with a maximum age difference of 1 year	**possible,** with a maximum age difference of 1 year
Large + small battery	**not possible!**	**possible,** if the connection cable cross-sections are the same (capacity ratio up to 1:3)

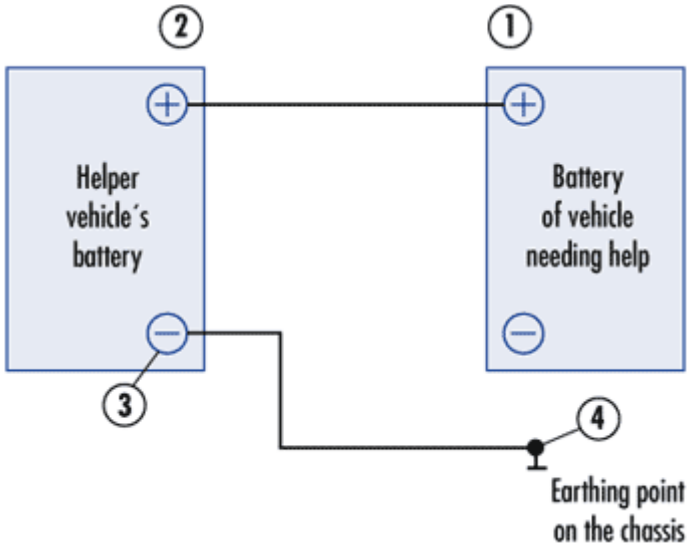
➡ **Check the capacity of the charger equipment!**
Rule of thumb: At least $^{1}/_{10}^{th}$ of the battery capacity is needed, plus consuming equipments in use during the charging process.

Our recommendation: The faultless technical condition of your vehicle is the best pre-condition for safe, problem-free use. Have your vehicle maintained regularly by a professional engineer. A thorough vehicle check before starting your holiday will largely safeguard you against unpleasant surprises.

Correct jump starting . . .

1. Use the correct jump start cable for petrol engines and diesel engines.
2. The capacity of the starter battery delivering current (e.g. 45 Ah) must not be significantly less than that of the discharged starter battery.
3. Only batteries of the same nominal voltage (e.g. 12 V) can be connected together using the jump leads.
4. No bodywork contact must exist or be set up between the vehicles.
5. Sources of ignition (e.g. open flame, burning cigars, cigarettes or electric sparks) must be kept away from the starter batteries (danger of explosion).
6. Keep distance from the starter batteries (danger of chemical burns). The electrolyte of the discharged wet battery is liquid even at sub-zero temperatures.
7. The discharged starter battery must not be disconnected from its associated on-board electrical system during or for a jump-start.
8. Switch off the vehicles' ignitions before connecting the jump-start cable. Handbrakes must be set. With manual gearboxes, put the gear lever in the idle (disengaged) position, and with automatic gearboxes put the selector lever in the "P" position.
9. Lay the jump lead cables in such a way that the rotating parts in the engine compartment cannot touch them.
10. Connecting and disconnecting the jump lead cables:

a) Connecting
First of all connect the cable with red terminal clamps to the positive pole of the discharged starter battery (see Figure, Position 1) and then to the positive pole of the donor battery (see Figure, Position 2). Next connect the cable with black terminal clamps to the negative pole of the donor battery (see Figure, Position 3) and then to the vehicle chassis of the broken-down vehicle, e.g. to the earthing strap of some other bare metal point on the engine block (see Figure, Position 4) as far away as possible from the starter battery, to prevent ignition of any explosive gas mixture that may have been evolved.



b) Starting
After connecting the jump lead cables, the engine of the donor vehicle must be started and set to medium revolution speed. Next the engine of the broken-down vehicle is started. After each attempted start, which must not last longer than 15 seconds, a waiting time of at least 1 minute must be interposed. After successfully starting the engine of the broken-down vehicle, wait 2 to 3 minutes until it is running smoothly.

c) Disconnecting
Disconnect the jump lead cables in the reverse of the connection sequence: first remove the black terminal clamp from the earthing strap or engine block (see Figure, Position 4) of the broken-down vehicle. Then remove the other black terminal clamp from the negative pole of the donor battery (see Figure, Position 3). Next remove the two red terminal clamps in any order (see Figure, Position 1 and 2). When removing the jump lead cables, take care to ensure that they do not come into contact with the rotating parts of the engines.

Explanation of warning symbols

Obey instructions on the battery and/or in the instructions for use and in the vehicle operating instructions

Wear eye protection

Keep children away from acids and batteries

Risk of explosion:
– A highly explosive mixture of hydrogen and oxygen gases is evolved during battery charging, therefore:

Fire, sparks, open flames and smoking are prohibited:
– Avoid causing sparks when handling cables and electrical equipments!
– Avoid short-circuits!

Danger of chemical burns: battery acid is extremely corrosive, therefore:
– Wear protective gloves and eye protection

– Do not tilt batteries, acid can escape from the gas vent openings

Disposal:
– Hand in old batteries at a collection depot.