MOLL Batterien GmbH
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Instructions

for the handling of lead batteries

To ensure safe handling of lead-acid batteries and to enjoy the full performance of the batteries throughout their life, the following instructions for use of the batteries must be strictly observed. MOLL Batterien GmbH accepts no liability for any consequences arising from non-compliance with these instructions.

1. General
    a. Lead batteries are subject to temperature-dependent self-discharge. The higher the temperature, the greater the self-discharge. As a rule of thumb, self-discharge doubles for every 10 °C rise in temperature.
    Excessively low states of charge, especially over longer periods of time, colloquially known as deep discharge, are harmful to lead batteries.
    b. The current acceptance of lead batteries is also temperature-dependent and increases with higher temperatures. Therefore, the charging voltage must be reduced at higher temperatures and increased at lower temperatures.
    c. To prevent damage to the lead batteries and to ensure that the product quality and functionality are maintained, the following instructions for storage, maintenance, charging and operation must be observed.

2. Storage (lead battery)
    a. Storage temperatures above 40°C are not permitted.
    b. Batteries must be protected from direct sunlight.
    c. Batteries must be stored in a clean and dry place.
    d. Cleaning must be done only with damp or antistatic cloth.
    e. Poles and terminals shall be protected from corrosion and treated with acid-free grease.
    f. Batteries shall be transported and stored in an upright position, protected from tipping and short-circuit.
    g. Outdoor storage is not permitted.
    h. The maximum storage period is 12 months.
    i. Storage without maintenance is inadmissible.
    j. FIFO (First In First Out) must be observed.
    k. Storage maintenance includes the open-circuit voltage test and any necessary recharging.
    l. Storage maintenance is to be documented in the following protocol:
    Protokoll-Nachweis-Standzeitpflege.xlsx .

3. Storage maintenance (lead battery)

3.1 Open-circuit voltage test

Open-circuit voltage tests are required in accordance with the following:

a. In the case of transport times longer than one week (collection from Moll to arrival at the customer), especially in the warm season or in the case of delivery to hot countries, an open-circuit voltage test must be carried out at the customer's premises on receipt of the goods (0-4 days after delivery).
b. At storage temperatures below 25 °C (mean room temperature), an open-circuit voltage test is required at least every 3 months storage time.

c. At storage temperatures higher than 25 °C (mean room temperature), an open-circuit voltage test is required at least every 2 months of storage time.
d. An open-circuit voltage test must be carried out before delivery to end customers.
e. Open-circuit voltage test after recharging:
The open-circuit voltage measurement shall be made no earlier than 6 hours and no later than 48 hours after the completion of the recharge.

3.2 Recharging

Requirement of a recharge and requirements for the recharge/charge:

a. The specifications refer to a 12V lead battery. For a 6V battery, halve the corresponding charge voltage, for a 2V cell, divide the corresponding charge voltage by 6.
b. A recharge is required for open-circuit voltages lower than 12.5 V. An exception is made for the open-circuit voltage test before delivery to the end customer. In this case, a recharge is already necessary at open-circuit voltages lower than 12.6 V.
Addition: The new product range "**HOT climate**" has a lowered operating electrolyte density. The limit of the open-circuit voltage for recharging should therefore be set 0.1V lower. This means 12.4 V for recharging and 12.5 V just before delivery.
Addition: The new product range "**AFB start|stop**" has an increased operating electrolyte density. The limit of the open-circuit voltage for recharging should therefore be set 0.1V higher. This means 12.6 V for recharging and 12.7 V just before delivery.

c. Charging requirements:

Procedure

When connecting the charger, first connect the positive terminal (+) of the battery to the positive terminal of the charger and then the negative terminal (-) of the battery to the negative terminal of the charger. The charger must not be switched on until the battery is fully connected. At the end of charging, switch off the charger before disconnecting it.

Charging current

The charging current should be at least 1/10 and max. 5/10 amps of the battery capacity in Ah. The information on the charging current is primarily intended for selecting and/or setting a suitable charger. The battery must always be charged with the specified charging voltages.

Charging voltage

Standard charge (12 V batteries): 14.4 V at 25 °C
Fast charge (12 V batteries): 14.8 V at 25 °C

Explanation of charging current and charging voltage

The charging voltages are to be regarded as maximum permissible charging voltages. Falling below the specified charging voltage because the max. charging current is reached is

normal and permissible. This usually occurs at the beginning of the charging of empty to half-full batteries. This is referred to as IU charging, i.e. a charge in which there is a maximum permissible charge voltage and a maximum permissible charge current at the same time. The charger always increases/decreases the charging voltage until either the maximum charging current or the maximum charging voltage is reached.

Charging duration
Standard charging (12 V batteries): 12-24 hours
Fast charge (12 V batteries): 6-24 hours

Note: At increased temperatures, the charging time must be limited for safety reasons, see below!

Environmental conditions
Charging must be carried out in a well-ventilated place protected from direct sunlight. The battery must be in an upright position and not tiltable.

Permissible temperature range for standard charging:
5 °C ≤ battery temperature ≤ 55 °C

Recommended temperature range for standard charging:
5 °C ≤ battery temperature ≤ 40 °C

In case of increased temperature during charging (40 °C < battery temperature < 55 °C), the charging time must be limited to max. 6 hours for safety reasons!

If the temperature exceeds 55 °C, stop charging immediately!

Permissible temperature range for fast charging:
5 °C ≤ battery temperature ≤ 40 °C

Recommended temperature range for fast charging:
5 °C ≤ battery temperature ≤ 30 °C

In case of increased temperature during charging (30 °C < battery temperature < 40 °C), the charging time must be limited to max. 6 hours for safety reasons!

If the temperature exceeds 40 °C, stop charging immediately!

Temperature compensation
If the temperature deviates from 25 °C, the charging voltage must be adjusted.

At temperatures below 25 °C, the charging voltage must be increased by 24 mV/°C.
At temperatures higher than 25 °C, the charging voltage must be reduced by 24 mV/°C.
See also document "T-compensation".

Charging without temperature compensation is not recommended. If temperature compensation of the charging voltage is not possible, the permissible temperature range for charging is 5 °C ≤ battery temperature ≤ 35 °C, with a charging voltage of 14.4 V for 12 V batteries and a charging time of 12h-24h.

Charge monitoring
If the above instructions are followed, there should be no acid leakage from the battery. If acid leakage does occur, stop charging immediately, check the temperature and check the charger for adjustment and functionality.

Checking after charging
When the batteries are stored with correct storage care, there should be no noticeable drop in the electrolyte level. For safety reasons, the electrolyte level should be checked after charging (observe the external marking on the box or the optical level indicator in the lid). If the electrolyte level falls below the minimum, the battery must be replaced.

4. Hints for operation (lead battery))

Service life
Operating lead batteries at high temperatures leads to increased wear. The rule of thumb is that for every 10 °C increase in temperature, you can expect wear to double and service life to halve. This means in particular that in hotter countries or hot environments a reduced service life is to be expected.

Charging
When charging batteries, the charging instructions listed under point 3 must be observed.
During the charging of lead-acid batteries, gas is produced by the decomposition of water. The gas escapes, reducing the electrolyte level over time. If the charging voltage is not adapted to the temperature, the water consumption can also be expected to double for every 10 °C increase in temperature. In modern vehicles, the battery temperature is measured and the charging voltage is automatically adjusted depending on the temperature. See also the document "T-compensation".

Improper charging and/or charging of already damaged batteries may result in increased water loss. If the electrolyte level drops below the minimum, the battery must be replaced.

Maintenance
All MOLL car batteries are made in Ca/Ca technology. The water consumption of these lead acid

batteries is so low when used as intended, that refilling of water is not necessary during the normal service life. Most Moll truck batteries are not made in Ca/Ca technology, but so-called hybrid batteries (low antimony batteries).

In hotter countries and/or with so-called hybrid batteries (low-antimony batteries), which have a higher water consumption for technological reasons, water loss is often counteracted by topping up with water. In such cases, the professional topping up of water may provide a short-term remedy, but in the medium and long term this will damage the battery and cause it to fail prematurely. Hybrid batteries are therefore generally not suitable for use in hotter countries or hot environments.

Opening the batteries by unscrewing the screw plugs is not permitted for safety reasons. Refilling with water is not permitted.