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Instructions for Use

Motive Power (Traction) Batteries with Positive Tubular Plates

PzS and PzB, HydroSave Batteries

Rating Data

1. Nominal capacity C_5	: See battery label
2. Nominal voltage	: 2.0 V x number of cells
3. Discharge current	: C_5/5h
4. Final discharge voltage	: 1.7 V x number of cells
5. Nominal electrolyte density*	: 1.29 g/ml at 30˚C
6. Rated temperature	: 30˚C
7. Nominal electrolyte level	: upper step of plug**

* will be reached within the first 10 cycles
** see picture in point 3.1

Safety Instructions

Read the instructions carefully and place them close to the battery.

Work on batteries to be carried out by skilled personnel only!

Use protective glasses, protective gloves and apron when working on batteries. Pay attention to the accident prevention rules as well as EN 50272-3 and EN 50110-1.

No smoking!

Do not expose batteries to naked flames, glowing embers or sparks, as it may cause an explosion.

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Clothing contaminated by acid should be washed in water.

Risk of explosion and fire.
Caution: Metal parts of the battery are always under voltage. Do not place tools or other metal objects on the battery!
Avoid short circuits!

Electrolyte is highly corrosive.

Batteries and cells are heavy.
Ensure secure installation!
Use only suitable handling equipment e.g. lifting gear in accordance with VDI 3616.

Dangerous voltage!

Batteries with this symbol can be recycled.

Treat batteries as special waste.
Do not mix them with other industrial or household waste. Recycling can be achieved through a recognized company for battery recycling or by returning them to the manufacturer, depending on the agreement you have made.

Disregarding the operation instructions, repair with non-original parts or using additives for the electrolyte will render the warranty void.

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1. Commissioning Filled and Charged Batteries

For commissioning of unfilled batteries see separate instructions. The battery should be inspected to ensure it is in perfect condition. The charger cables must be connected to ensure a good contact, paying attention to the polarities. Otherwise battery, vehicle or charger could be damaged. The tigheting torque for all the connector bolts must be 25±2 N·m.
The level of the electrolyte must be checked after removing the plugs. Plugs should be removed only by using the appropriate tool to avoid damage. In case aqua filling plugs are installed the use of the appropriate tool helps to avoid hitting the floating body and cause damage in the floating mechanism . If the level is below the top of the separator, it must first be topped up to the upper level of the separator with purified water (DIN 43530 part 4). The battery is then charged as in point 2.2. After charging, the electrolyte should be topped up to the nominal level with purified water.

2. Operation

The standard which applies to the operation of traction batteries is EN 50272-3: “Safety requirements for secondary batteries and battery installations. Traction batteries” and provides requirements on safety aspects associated with the installation, use, inspection, maintenance and disposal of batteries.

2.1 Discharging

Be sure that all ventilation openings of the battery container, compartment or cover are not blocked, so suitable ventilation of the battery is achieved. Do not connect or disconnect the battery socket under discharging or charging. To achieve battery's optimum life, operating discharges of more than 80% of the rated capacity should be avoided (deep discharge). This corresponds to an electrolyte density of 1.14 g/ml at the end of the discharge. Discharged batteries must be recharged immediately and must not be left discharged. This also applies to partially discharged batteries.

2.2 Charging

Only direct current must be used for charging. All charging procedures in accordance with DIN 41773 and DIN 41774 are permitted. Connect only the battery assigned to a charger, suitable for the size of battery, in order to avoid overloading of the electric cables and contacts and prevent unacceptable gassing and escaping of electrolyte from the cells. In the gassing stage the current limits given in EN 50272-3 must not be exceeded. If the charger was not purchased together with the battery it is best to have its suitability checked by the charger’s supplier. When charging, proper provision must be made for venting of the charging gases. The removable covers provided for the battery must be removed prior to charging so that the explosive mixture of gases loses its flammability due to adequate ventilation. The vent plugs should stay on the cells and remain closed. With the charger switched off connect up the battery, ensuring that the polarity is correct (positive to positive, negative to negative). Then switch on the charger. When charging, the temperature of the electrolyte rises by about 10˚C, so charging should only begin if the electrolyte temperature is below 45˚C. The electrolyte temperature of batteries should be at least +10˚C before charging otherwise a full charge will not be achieved. A charge is finished when the electrolyte density and the battery voltage have remained constant for two hours.

Batteries fitted with airlift system:
Please verify that the airlift system is in good operating condition before beginning the recharge process. Do not recharge a battery with a damaged system. Contact your charger’s supplier for further details. The air pipe should never be removed during charging.

2.3 Equalizing Charge

Equalizing charges are used to safeguard battery's life and to maintain its capacity. They are necessary after deep discharges, repeated opportunity recharges and charges to an IU characteristic curve. Equalizing charges are carried out following normal charging. The charging current must not exceed 5 A/100 Ah of rated capacity (End of charge: when there is no further increase of cell voltage within 2 hours). **Watch the temperature**!

2.4 Temperature

An electrolyte temperature of 30˚C is specified as the rated temperature. Higher temperatures shorten the life of the battery, whilst lower temperatures reduce the available capacity. The upper temperature limit is 55˚C and is not acceptable as an operating temperature.

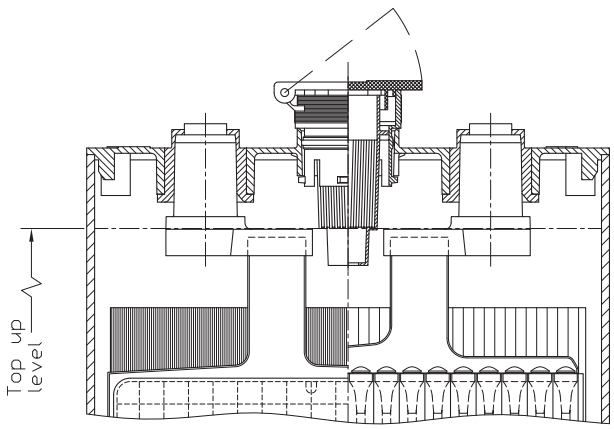
2.5 Electrolyte

The rated electrolyte density is related to a temperature of 30˚C and the nominal electrolyte level in the cell in fully charged condition. Higher temperatures reduce the electrolyte density, whilst lower temperatures increase it. The temperature correction factor is -0.0007 g/ml per ˚C, e.g. an electrolyte density of 1.28 g/ml at 45˚C corresponds to an electrolyte density of 1.29 g/ml at 30˚C.

3. Maintenance

3.1 Daily

Charge the battery after every discharge. Towards the end of charge the electrolyte level should be checked and if necessary topped up to the specified level with purified water.



Do not fill the battery with electrolyte. The electrolyte level must not fall below the anti-surge baffle or the top of the separator.
In the case of HydroSave batteries with electrolyte level sensors, the illuminated lamp should be observed daily. See relevant instructions of electrolyte level sensor. Fill-in with water immediately after the lamp blinks red. Check the electrolyte level (visual inspection by opening the vent plug or by the position of the float indicator of the aquamatic plug) and top-up with demineralised water at the end of the charge. The level sensor monitors a selected pilot cell. This means that attention should be paid to the rest of the cells according to the additional instructions under "3.3 Monthly Maintenance".

3.2 Weekly
Visual inspection after recharging for signs of dirt and any mechanical damage should be made. If the battery is charged regularly with an IU characteristic curve an equalizing charge must be carried out (see point 2.3).

3.3 Monthly
At the end of the charge, the voltages of all cells should be measured and recorded, with the charger switched on. After charging is completed, the electrolyte density and temperature in all cells should be measured and recorded. If significant changes from earlier measurements or differences between the cells are found, further testing and maintenance by our Service Dept. should be requested.

3.4 Annually
In accordance with EN 1175-1, at least once per year, the insulation resistance of the truck and the battery must be checked by an electrician. The tests on the insulation resistance of the battery must be conducted in accordance with EN 1987-1. The insulation resistance of the battery shall be at least 50Ω multiplied by the nominal battery voltage, in compliance with EN 50272-3. For batteries up to 20 V nominal voltage the minimum value is 1000 Ω.
Batteries fitted with airlift system:
During the annual maintenance, check the correct operation of the air pump.

4. Care of the Battery
The battery should always be kept clean and dry to prevent tracking currents. Any liquid in the battery tray must be cleaned and disposed of as prescribed. Damage to the insulation of the tray should be repaired after cleaning, to ensure that the insulation value complies with EN 50272-3 and to prevent tray corrosion. If it is necessary to remove cells, it is recommended to call our Service Dept.

5. Storage
If batteries are taken out of service for extended periods of time, they should be stored in a fully charged condition in a cool, dry room (temperature from 0˚C to 30˚C). To ensure that the battery is protected from sulphation, the following charging methods are available:
1. a monthly equalizing charge as in point 2.3
2. float charging at a charging voltage of 2.27 V x the number of cells. The storage time should be taken into account when considering the life of the battery.

6. Malfunctions
If malfunctions are found on the battery or the charger, our Service Dept. should be notified immediately. The measurements taken in point 3.3 will facilitate fault finding and their elimination. A service contract with us is a good way to detect and prevent potential problems in advance.

7. Diagnosis and Problem Solving
7.1 Reduction of Vehicle Power
Damaged cell: After charging, the cell voltages should be above 2.1 V and the electrolyte density between 1.27 and 1.30 g/ml. If a single cell voltage is below 2.0 V and its electrolyte density below 1.20 g/ml, the cell should be considered damaged. In this case, contact our Service Dept.
Damaged charger: If the electrolyte density of all cells after charging is below 1.27 g/ml, the charger may have a defect. Charge again and check its functionality or contact our Service Dept.
Frequent electrolyte overspilling: Reduction of electrolyte density may be caused by overspilling. Please consult the relevant points of the present instructions of use for correct filling.
Damaged or loose connections between cells or at the battery's end poles: A loose inter-cell connection reduces the cell voltage substantially, generating heat and destroying the connector and/or the cell. Measure cell voltages under load (e.g. lifting system of the forklift) and check all connections.
Damaged battery socket: Battery sockets may wear out by mechanical abuse and excessive heat. Prompt replacement is required.

7.2 Low Insulation Value due to Defective Battery Container Coating
Mechanical impacts and/or excessive overspillage of electrolyte may cause a low insulation value of the battery. In case the battery tray needs repair or replacement contact our Service Dept.

7.3 High Temperature (>55°C) after Charging
During battery charging, temperature raises by 10˚C. If it is more:
- at least one cell has a low voltage and the charger overcharges the battery
- the charger is defected or has a defect setting of safety cut-offs.

Frequent overcharging reduces service life of the battery.

7.4 Battery Explosion
At the end of charging the battery emits hydrogen. To avoid risk of explosion, the battery room has to be properly ventilated according to EN 50272-3. No flames or sparks should be near the battery. For better ventilation the cover of the battery compartment has to be open during charging. In case of explosion, inspect all the battery cells for structural damages and replace damaged cells. Contact our Service Dept.

7.5 Fire in the Battery
All active parts in a battery are insulated for their life cycle. Due to poor electrical contact of the terminal cables or inter-cell connectors, mechanical wear out of the terminal cables or creeping currents on top of the cells may cause intense heating or even fire. Shut-off power immediately. After extinguishing the fire, the battery has to be carefully inspected and damaged parts must be replaced. Contact our Service Dept.

8. Automatic Water Filling System
8.1 Benefits
Use of the Automatic Filling System ensures that the battery's electrolyte level is maintained at its nominal value. The charging gasses escape through ventilation openings of the refilling plugs.

8.2 Operation
Each cell is equipped with an automatic water filling plug that consists of a valve and a float and controls the topping up process to maintain the optimal electrolyte level. The valve allows the flow of water into each cell and the float seals the valve when the correct electrolyte level has been reached. The filling plug shows a white dot, if the float has sealed the valve. The electrolyte density may be measured by opening the plug cover and inserting the hydrometer probe through the plug's relevant opening. For a fault-free operation of the water refilling system, please consult the instructions below.

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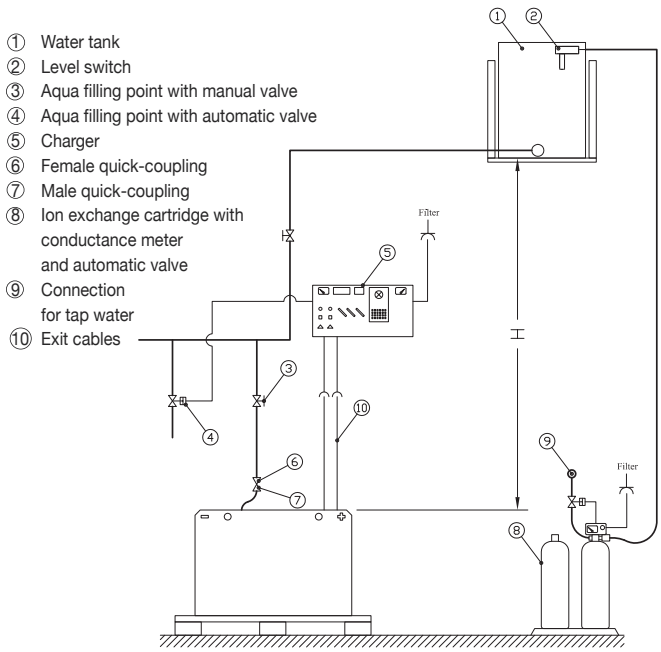
8.3 Manual or Automatic Connection

The battery should be topped up shortly before the end of charging (1 - 2h) to achieve a good mixing with the electrolyte and the correct level. Filling takes place, when the quick-coupling of the water tank is connected to the quick-coupling of the battery.

- If manual connection is used, the battery should only be connected to the water supply once per week to avoid overfilling.
- If the charger incorporates a watering function, the quick couplings of the battery and the charger are connected before charging and the water flow is controlled by the charger's PCB board which operates an electromagnetic valve.



8.4 Filling Time

The filling time depends on the battery's usage and its operating temperature. It takes in average a few minutes and can be checked by the plug's white level indicator. After filling, the connection to the water supply has to be closed.

8.5 Working Water Pressure

For a proper function of the automatic filling system, the water pressure should be between 0.2 and 0.6 bar. If gravity is used, the distance between the upper edge of the battery and the lower edge of the tank should be at least 2m.

8.6 Purity

The topping up water must be purified according to DIN 43530-4. The water used to refill the batteries must have a conductance of not more than 30 μS/cm. The tank and pipes must be cleaned before operating the system.

8.7 Piping System on the Battery

The piping system to the individual battery cells must follow the battery's electrical circuit. The system should not be modified in any way otherwise serious safety or operation problems may arise.

8.8 Operating Temperature

Operating automatic water filling System is not allowed in areas with an ambient temperature constantly below 0˚C.

8.9 Flow Control (optional)

A flow indicator, built into the water supply pipe of the battery, provides visual checking of the filling process. During filling, the water flow causes the built-in disc in the flow indicator to turn. When all the plugs are closed, the disc stops, thus indicating that the filling process is complete.

9. Airlift System

9.1 Benefits

The airlift system prevents stratification of the electrolyte in the battery cells and reduces charging times, reduces temperature increase during charging, reduces water loss and reduces the charging factor. The airlift system is essential in heavy duty applications with high operating temperatures.

9.2 Operation

The acid circulation is performed by air pressure, delivered in each cell of the battery. For this function, a membrane pump in the charger produces an air flow, which passes through hoses and special plugs and is guided into each cell. The air supply is adjusted in accordance to the number of cells in the battery. Optimum charging factor setting is 1.07.

9.3 Repair and Maintenance

If at the monthly electrolyte density check, some cells have lower electrolyte density, the overall condition of the air lift tubing has to be checked. Some chargers incorporate an alarm indication if the system does not perform properly. Some chargers switch over to the normal charging characteristic (charging factor 1.18 to 1.20), if leaks are detected. Faulty parts have to be replaced only by original parts to ensure correct function of the air lift system.

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