OPERATING INSTRUCTIONS

STATIONARY VENTED LEAD ACID BATTERIES **OPzS, OPzL and OGi**

Assembly and CE-marking by..... Number of cells/blocks:

..... date..... .....

Commissioning by..... date..... Type:.....

WARNINGS

	Observe operating instructions and position them within sight of the battery! Work only on batteries under instruction of skilled personnel!
	When working on batteries wear safety glasses and protective clothing! Comply with accident prevention rules as well as with DIN VDE 0510, VDE 0105 part 1!
	No smoking! Do not expose the battery to an open flame, a glowing fire or sparks as explosion and fire hazards exist.
	Acid splashes in the eyes or on the skin must be washed out or off with plenty of water. Then see a doctor immediately. Clothing exposed to acid should be washed out with water without delay.
	Explosion and fire hazard due to explosive gases escaping from the battery. Caution! Metal parts of the battery are always live, therefore do not place items or tools on the battery! Avoid short circuits!
	The electrolyte (diluted sulphuric acid) is extremely corrosive.
	Block batteries or cells are heavy! Ensure secure installation! Only use suitable transport equipment!
	Dangerous voltages !
	Used batteries with this symbol are reusable goods and must be returned to the recycling process. Used batteries which are not returned to the recycling process must be disposed of as special waste in accordance with all the regulations. 

1. Commissioning of filled and charged batteries

Before commissioning all cells/blocks must be inspected for mechanical damage. Assemble the cells/blocks in accordance with their polarity. If necessary, the contact surface of the poles and the connectors have to be cleaned. The connectors have to be firmly seated by tightening the terminal screws M 10 with a torque of 22 Nm.

Check the electrolyte level in all cells. If necessary top up with purified water as specified under DIN 43 530 part 4 all cells having lower level of electrolyte. Be aware that the electrolyte level will increase during charging.

Connect the battery to the DC power supply, with the charger switched off, battery fuses removed and the load disconnected, ensuring that the polarity is correct: Positive terminal of the battery to the positive terminal of the charger.

Switch on the charger and charge as per point 2.2. The first charge must be monitored to ensure that limits are not exceeded and that no unacceptable temperatures occur. When charging is finished switch off the charger or switch over to operating voltage, as per point 2.3.

2.0 Operation

For the operation of stationary battery installations DIN VDE 0510 part 1+2 apply.

2.1 Discharging

Discharge capacities, currents and voltages are specified in 6. Never discharge the battery below the specified final voltages. No more than the specified capacities are to be discharged. Charge immediately after discharge as well as partial discharge.

2.2 Charging

Charging must only be carried out with direct current. Charging procedures with their limit values may be employed as under

DIN 41 773: IU - characteristic

DIN 41 774: W - characteristic

DIN 41 776: I - characteristic.

The limits for charging currents and the ripple currents (see 2.6) must not be exceeded.

The commissioning charging of a filled and charged battery can be made as follows:

a) Using chargers with IU characteristics at an increased voltage of (2.33 - 2.40 V) x number of cells with automatic switching to the float voltage see 2.3a standby operation). The complete charging time will be minimum 12 h.

b) Using chargers having a boost charging stage (W characteristic or I characteristic) with the load switched off up to the final charging voltage of (2.60 - 2.75 V) x number of cells. The charging must be monitored and switched off when the fully charged state is reached, or switched over to float charging as per 2.3a. The charging time is about 6 - 8 hours.

c) Using chargers with IU characteristics with float voltage (see 2.3.a). Full capacity finally will be obtained after the first discharge cycle. About 95 % of the capacity is available after one week.

The fully charged state is reached when the cell voltages and the specific density of the electrolyte have not risen for a period of 2 hours.

2.3 Standby operation / buffer operation

In this case, the load, the DC power supply and the battery are connected permanently in parallel. Thereby the charging voltage is the operational voltage of the battery and also the system voltage.

a) During **standby operation (float)** the DC power supply is always able to provide the maximum load current and the battery charging current. The battery only supplies current, if the DC power supply fails. The charge voltage at 20°C must be set for OPzS and OGi at (2,23V x number of cells)+- 1% and for OPzL (2,25V x number of cells)+- 1% measured at the batteries' terminals.

b) During **buffer operation** the DC power supply is not always able to provide the maximum load current. The load current temporarily exceeds the rated current of the DC power supply. During this time the battery supplies current. The battery is not always fully charged. Depending on the load, the charge voltage should be set at (2,25 to 2,30V) x number of cells.

2.4 Recharging

After a discharge the battery can be recharged at the operating voltage (see 2.3a). To reduce the charging time the recharging can be carried out at (2,33V to 2,40V) x number of cells with automatic reduction to the voltage under 2.3a. The recharging times are dependent on the charging procedure selected and on the charging current available; as a rule they run to 12 - 24 hours at charging currents between $2 \bullet I_{10}$ - $0,5 \bullet I_{10}$.

2.5 Equalising Charge

After deep discharge or after inadequate recharging, equalising charge is necessary. These can be carried out as follows:

a) at an increased voltage of (2.33 - 2.40 V) x number of cells up to a maximum of 72 hours.

b) at currents according to the I or W characteristic (see 2.6).

Because it is possible to exceed the permitted load voltages, appropriate measures must be taken, e.g. switch off the load.

On exceeding the maximum temperature of 55°C, charging must either be stopped or proceed with reduced current or be switched to float charge to allow the temperature to drop. The equalising charge is completed when the electrolyte densities, and the single cell voltages no longer increase within 2 hours.

2.6 Charging Currents

The charging current is not limited until the battery voltage has reached the gassing voltage of 2,40V x number of cells. Thereafter the charging current has to be limited:

Limits on charging currents above 2,40V x number of cells per 100Ah nominal capacity

Charging Process	charging current	Cell Voltage
I-Characteristic	5.0 A	2.60 - 2.75 V/c
W-Characteristic	7.0 A 3.5 A	at 2.40 V/c at 2.65 V/c

During recharging up to 2.40 V/cell the effective value of the AC ripple current may reach temporarily maximum 20 A / 100 Ah nominal capacity. After recharging and at float charge in standby operation or buffer operation the effective value of the AC ripple current must not exceed 5 A / 100 Ah nominal capacity.

2.7 Battery temperature

All technical data apply for the nominal temperature of 20^{O}C. The ideal operating temperature range is 20^{O}C ± 5 K. The recommended operating temperature range is 10^{O}C to 30^{O}C. Higher temperatures reduce the working life. Lower temperatures reduce the available capacity. Exceeding the temperature limit of 55 ^{O}C is not permissible.

2.8 Temperature-related charging voltage

A temperature-related adjustment of the charging voltage within monthly averaged battery temperatures of 10°C to 30°C is not necessary. Below 10°C in the monthly average the charging voltage should be increased (-0,005V/K per cell) for a faster recharging. Above 30°C in the monthly average the charging voltage may be reduced (-0,004V/K per cell) to reduce water decomposition and corrosion.

2.9 Electrolyte

The electrolyte is diluted sulphuric acid. The rated specific density of the electrolyte in the fully charged state is based on 20°C and the "MAX" electrolyte level with a maximum deviation +- 0,01kg/l.

Higher temperatures reduce the density of the electrolyte, lower temperatures increase it.

The temperature correction factor is -0,0007 kg/l per K.

Examples:

Electrolyte density 1.23 kg/l at + 35 ^{O}C corresponds to 1.24 kg/l at + 20 ^{O}C. Electrolyte density 1.247 kg/l at + 10 ^{O}C corresponds to 1.24 kg/l at + 20 ^{O}C.

3. Battery Maintenance

To avoid leakage currents and the associated risk of fire keep the battery dry and clean. Cleaning with clear water, no solvents, no detergents. Avoid electrostatic charges.

If the electrolyte level has dropped to the „MIN“ mark , purified water as specified under DIN 43 530 Part 4 (maximum conductivity 30 µS/cm) must be used to top up the electrolyte level to the „MAX" mark.

To be measured and listed every 6 months:

- battery voltage
- the voltage of some cells/bloc batteries (pilot cells)
- the temperature of the electrolyte in some cells/bloc batteries (pilot cells).

Every 12 months:

- The voltages and densities/temperatures of the electrolyte in all cells/blocks have to be measured and listed.
- Connectors, racks and the ventilation have to be checked.

Should the float charge voltage in single cells deviate more than +0,10V or -0,05V from the average value (see 2.3), the customer service should be called.

A service contract with us is recommended.

4. Testing

Tests must be conducted according to DIN 43 539 Part 1 and 4 and IEC 896 - 1.

Special test instructions, e. g. to prove operational safety in accordance with DIN VDE 0107 and DIN VDE 0108 must be observed.

5. Storage and taking out of operation

If filled lead acid accumulators are to be taken out of operation for a longer period of time, they must be placed fully charged in a dry, frost-free room. To avoid damage periodical equalising chargings (every 6 weeks) or permanent float charging have to be made.

6. Transport

Cells and batteries have to be transported upright to avoid spillage of acid. Poles have to be covered to avoid short circuits. If so packed batteries are no dangerous goods according to the instructions for dangerous goods on road and on rail (GGVS and GGVE).