BATTERY PASSPORT AND OPERATING MANUAL

ASTERION SEALED LEAD ACID BATTERIES WITH REGULATING VALVES

1. INTRODUCTION

Sealed batteries do not require topping up the distillate throughout the entire service life. Sealing of batteries is carried out by using a valve that relieves excess gas pressure in the battery to prevent deformation of the battery. Opening the lid and sealing valve is strictly forbidden, and leads to damage to the battery.

Rated battery voltage:

$$U_{nom} = U \times m$$

where U=2 V/cell – voltage each battery cell; m – number of series connected cells, are included in the battery. The rated voltage is marked on the battery case.

Rated battery discharge current:

$$I_{nom} = \frac{C_{nom}}{t},$$

где I_{nom} – rated battery discharge current, A; C_{nom} – rated battery capacity, A*h; t – discharge duration, h.

2. SAFETY REQUIREMENTS

General safety requirements must be observed according the standards of IEC 62485-1:2015 during installing and operating batteries.

The risk of electrical shock! Follow this operating manual and keep it near battery. Only qualified personnel are allowed to operate.

No smoking! To avoid explosive and fire hazard situations, the use of open flame, soldering or sparks near the battery is prohibited.

To avoid explosive and fire hazard situations as short circuits!

Attention! Batteries are always live. Do not place tools or objects on the top of batteries. Do not short circuit.

Use safety glasses when working with batteries! Observe safety precautions to prevent accidents.

Electrolyte – an aqueous solution of sulfuric acid – an aggressive substance! In normal use, contact with electrolyte is excluded. When the case is destroyed, the possibility of leakage of electrolyte. Using damaged batteries is strictly prohibited!

If acid gets into eyes or skin, rinse with plenty of water and seek medical attention immediately. Acid-contaminated clothing should be washed immediately with plenty of water.

Batteries have significant weight. Ensure proper battery placement during installation and operation. Do not put on the edge. To avoid the falls and shock battery. For transportation use only the means intended for this.

3. COMMISSIONING

During installation, batteries must be installed with a temperature gap of 10-20 mm. In the absence of a temperature gap, local overheating of the batteries is possible, which can lead to their failure.

Before commissioning, it is necessary to check all batteries/ group of batteries for mechanical damage, for the correct polarity of the connection and the strength of fastening of all threaded connections.

When operating a group of series-connected batteries, the difference between their temperatures in the group should not exceed 4 °C.

Tightening torque for bolted connection:

Connection type	Tightening torque
M5,5/M6	8 Nm ± 1 Nm
M8	10 Nm ± 1 Nm
OPzS, OPzV	12 Nm ± 1 Nm

Protective caps must be installed on the boron.

With the charger turned off and the consumer disconnected, connect the battery to the rectifier equipment according to the polarity. Turn on the charger and charge the battery in accordance with section 4.2 and 4.4.

When commissioning a group of batteries, battery equalization must be carried out in accordance with section 4.3.

Note. Remember that the combined use of old and new batteries, as well as batteries of different brands and series in the same circuit, can shorten the design life of the batteries.

4. OPERATION

When installing and operating batteries, the standards IEC 62485-2:2010 and the regional rules and regulations must be observed.

Battery operation is permissible in any position except turned upside down.

To avoid direct sunlight during operation.

Caution! When using the battery, it is necessary to charge it at least 1 time per day or after each use, even with a short idle time.

It is not allowed to operate the battery in malfunctioning equipment!

4.1 Discharge

The limiting value of the final discharging voltage depends on the discharge current. Do not discharge below a specified value for the final voltage. The battery should not be allowed to discharge more than the rated capacity.

Note. By discharging the battery with low currents, you can get more energy than the nominal value. With such a discharge, the final discharging voltage should be higher. If you discharge the battery with low currents without adjusting the voltage, this can lead to a significant reduction in capacity and shortened battery life.

It is strictly forbidden to take energy more than the nominal value of the battery energy!

After a full or partial discharge, you must immediately begin to charge the battery. Storing a battery in a discharged state leads to its premature failure.

Note. Remember that when discharged, the density of the electrolyte decreases. With a decrease in the density of the electrolyte, its freezing temperature rises. Do not store batteries at low temperatures.

4.2 Charge

Do not charge in a confined space to prevent disturbance of normal heat exchange with the environment. Overheating of the battery may cause it to swell.

When charging, batteries should not deviate from a vertical position in any direction by more than 90 °.

If the maximum temperature of the batteries exceeds 45 °C, the charge should be stopped or switched to the floating mode to reduce the temperature.

Depending on the type of equipment, a charge can be made under the following battery operating conditions:

a) Floating mode

b) Buffer mode

In these modes, consumers, DC power and battery are always connected in parallel. In this case, the charging voltage is simultaneously both the voltage of the battery and the voltage of the consumer equipment.

In floating mode, the DC source always provides maximum consumer current and battery power. The battery only supplies current when the DC source fails.

In the buffer mode, the direct current source cannot provide the return of the maximum load current from the consumers. The load current temporarily exceeds the rated power of the DC source. The battery takes over these temporary load maxima. This means that the battery does not have a constant full charge.

Floating/buffer charging voltage, measured at the battery terminals, is shown in Table 1.

Table 1

Model	The voltage at the battery terminals, V/cell, at 20 °C	The voltage at the battery terminals, V/cell, at 25 °C
All models OPzS, OPzV	2.25	2.23
All models FT-M, FTS-X	2.30	2.27
All models DTM I, DTM-L, HR, HR-W, HRL-X, HRL-W, GEL, GX, CGD, STC, GSC	2.30	2.27
All models DT, DTM	2.32	2.30

After an emergency activation and network recovery, the battery goes into charge mode. The charge values are shown in Table 2.

Table 2

Model	Charging voltage V/cell, at 20 °C	Charging voltage V/cell, at 25 °C
All models OPzS, OPzV	2.35	2.33
All models FT-M, FTS-X	2.40	2.38
All models DTM I, DTM-L, HR, HR-W, HRL-X, HRL-W, GEL, GX, CGD, STC, GSC	2.37	2.35
All models DT, DTM	2.47	2.45

c) Cyclic mode

When working in a cyclic mode, the consumer receives power only from the battery. This mode of operation depends on the characteristics of the operating modes of the system, charge/discharge modes and must be agreed with the manufacturer.

Before using the battery in cyclic mode, it must be fully charged! If the batteries are used in a cyclic mode in a group of series-connected batteries, it is necessary to carry out either a battery equalization according the section 4.3 or charge each battery separately.

During cyclic mode operation in a group of several series-connected batteries, unbalance may occur over time, i.e. the battery will have a different voltage. To prevent this, it is recommended that once every three months, the open circuit voltage of each battery is checked after a full charge by disconnecting the batteries from the charger.

In this mode, the charging voltage should not exceed the values given in Table 3.

Table 3

Model	Charging voltage in cyclic mode, V/cell, at 20°C	Charging voltage in cyclic mode, V/cell, at 25°C
All models OPzS, OPzV	2.35	2.33
All models FT-M, FTS-X	2.40	2.38
All models DTM I, DTM-L, HR, HR-W, HRL-X, HRL-W, GEL, GX, CGD, STC, GSC	2.37	2.35
All models DT, DTM	2.47	2.45

Caution! Batteries cannot be discharged below 1.8 V/cell in cyclic mode.

4.3 BATTERY EQUALIZATION

Due to possible deviations of the cell voltages from the median value of the operating voltage in the group, appropriate measures should be taken, for example, to carry out equalizing charge.

This charge mode is carried out after a deep discharge or after a chronic undercharging of the battery. The mode provides a charge with a constant voltage of no more than 2.4 V/cell for no longer than 48 hours.

In certain case battery equalization voltage can be more 2.4 V/cell.

For all models of the OPzV series, the battery equalization voltage is 2.35 V/cell. The battery equalization is completed if the consumption current remains unchanged for 2 hours. The charging current at the initial moment of time should not exceed a predetermined percentage (see Table 4) of C_{nom} (the current decreases over time).

If the maximum battery temperature exceeds 45 °C, the charge should be stopped or switched to the maintenance mode to reduce the temperature.

Caution! Recommendation for the batteries in buffer modes.

After a discharge in emergency mode, the batteries should be charged to the voltage of the buffer mode (see section 4.2). After reaching the voltage, apply a battery equalization according to clause 4.3. After equalization, the batteries are returned to normal operation.

4.4 Charging currents

When charging the battery, the currents should not be higher than the values indicated in Table 4:

Table 4

Model	Maximum charging current, % by C_{nom}
All models DT, DTM, DTM I, DTM-L, HR, HR-W, HRL, HRL-W, FT-M, FTS-X, STC, CGD	30%
All models GEL, GX, GSC, OPzS, OPzV	20%
All models CGD	50-100%*

* Charging with currents from 50% to 100% is possible by monitoring of battery temperature up to 25°C.

Caution! The recommended charging current value is optimal. A deviation to the lower side is allowed, while the value of the charging current should not be less than 10% of the nominal capacity. Exceeding of the maximum charging current leads to damage to the battery.

4.5 Operation temperature

The recommended operating temperature range of lead-acid batteries is 20-25 °C.

High temperatures (over 30 °C) significantly reduce battery life. Lower temperatures reduce the ratings (rated capacity, current and discharge time, etc.).

Caution! It is advisable to avoid battery operation at temperatures above 45 °C. Raising the temperature to +60 °C is unacceptable – this greatly reduces the service life. At a temperature of 60 ° C irreversible destruction of the battery occurs!

Intensive operation and high energy consumption from the battery at ambient temperatures below 15 °C reduces the efficiency of the lead-acid battery. For example, when the operating temperature decreases by 5 °C, the distance covered by equipment, operating from the battery, may decrease by up to 50%.

When the battery is discharged, sulfuric acid is consumed, as a result, the density of the electrolyte decreases. The freezing temperature of the electrolyte in fully charged batteries is about -60 °C. As the battery discharges, the freezing temperature of the electrolyte increases: at a 70 percent level of battery charge, the freezing temperature will be about -25 ° C.

A high degree of discharge reduces the density of the electrolyte. Any slight decrease in the electrolyte density at low temperatures will lead to the formation of centers of water crystallization (the formation of microcrystals of ice).

Freezing leads to the constructive death of the battery: even if the case remains intact, the plates are damaged under the influence of the formed ice. The battery fails, it is not a warranty case.

Do not allow the battery to discharge during many hours at negative temperatures, this mode can be regarded as storage in an uncharged state at negative temperatures.

When operating a group of series-connected batteries, the difference between their temperatures in the group should not exceed 4 °C.

4.6 Dependence of the charging voltage on temperature

To achieve maximum battery life, it is recommended to use chargers with temperature compensation function for charging voltage.

When the temperature changes from + 15 °C to + 25 °C, the use of temperature compensation of the charging voltage is optional.

If the temperature noticeably deviates from the indicated values, an adjustment of the charging voltage by the formula is required:

$$\mathbf{U_1 = U_0 + (T_1 - T_0) \times k}$$

Где U_1 – charging voltage with temperature compensation, V; U_0 – charging voltage under standard temperature T_0, °C; T_1 – measured temperature, °C; T_0 – standard charging temperature, °C; k – temperature correction factor, mV/°C/cell.

Temperature compensation of voltage is 5 mV/(element x °C) for cyclic mode and 3.3 mV/(element x °C) for other modes.

When batteries are operating as part of an automated system, temperature compensation is introduced when the temperature deviates from the values shown in Table 2 for each degree.

5. MAINTENANCE

To prevent surface leakage, the battery must be dry and clean. Battery cleaning should be carried out in compliance with safety precautions in accordance with IEC 62485-2:2010, as well as regional and departmental standards.

The plastic parts of the batteries, especially the case, must be cleaned of dust and dirt without the addition of cleaning agents.

Caution! Do not allow water to enter the enclosure to prevent a short circuit.

At least 1 time in 3 months (when operating in floating modes), it is necessary to measure and record in the battery record book:

- voltage on the battery,
- voltage of individual battery/group of batteries,
- surface temperature of individual battery/group of batteries,
- temperature in the battery room.

If possible, conductivity measurements should be carried out regularly. Annually should be measured and recorded in the battery log:

- voltage of all individual battery/group of batteries,
- surface temperature of all individual battery/group of batteries,
- temperature of the room.

Visual inspection should be carried out annually:

- strength of the connection nodes (check threaded connections for a fixed fit),
- installation and placement of the battery,
- ventilation systems.

6. BATTERY CHARGING/DISCHARGING TEST (SDT)

Battery charging/discharging test is carried out in order to determine the residual capacity. SDT consists of five stages:

1. Discharging with nominal parameters (if the nominal capacity is specified at C10, then the discharge parameters will be as follows: 10-hour discharging current, cut-off voltage 1.8 V/cell);
2. Charging with battery equalization parameters (charging current 10-30% of the nominal capacity, charging voltage – 2.4 V/cell);
3. Pause (from 1 hour to 24 hours);
4. Discharging with nominal parameters (if the nominal capacity is specified at C10, then the discharge parameters will be as follows: 10-hour discharge current, discharge termination voltage 1.8 V / cell);
5. Charging with battery equalization parameters (charging current 10-30% of the nominal capacity, charging voltage – 2.4 V/cell).

The temperature of the DCT must correspond to the declared temperature of the battery.

It is recommended to conduct DCT every six months, but at least once a year.

7. RECHARGING BATTERIES IN STORAGE

During storage, it is recommended to recharge batteries in accordance with Table 5.

Table 5

Storage temperature	Period
30-40°C	Every 3 months
25-30°C	Every 6 months
20-25°C	Every 9 months
<20°C	Every 12 months

Caution! All charges carried out at normal temperature 20-25°C (see Tables 1,2,3).

9. TESTS

Tests should be carried out in accordance with standard IEC 60896-21:2004.

10. TROUBLESHOOTING

If you detected a battery or charger malfunction, contact the supplier's service department. The supplier is not responsible for the consequences of the operation of a malfunction battery, as well as for the consequences of the operation of a serviceable battery in violation of the operating conditions. Records in the battery record book, according to section 5, will help to avoid many problems and facilitate troubleshooting.

11. BATTERY DECOMMISSIONING AND STORAGE

If the batteries are stored or decommissioned for a long time, they should be fully charged in a dry room at a temperature of +20 to +25 °C.

Batteries should be stored fully charged, on racks, in a vertical position, in a dry, cool, frost-free room at an ambient air temperature of +5°C to +20°C.

It is strictly forbidden to store batteries in a discharged state.

Never store batteries in a discharged state at sub-zero temperatures. The storage below the freezing point will damage batteries.

To avoid direct sunlight during storage. You have to charge batteries in storage periodically (see Table 5).

Note. A maximum of two recharges are allowed during the storage period. Then it is recommended to use the battery in floating mode.

12. TRANSPORTATION

Sealed and undamaged batteries are not dangerous goods to shipped if they are securely protected against short-circuiting, rolling, tipping or damage and if there are no traces of acid on the casing.

Batteries must be suitably stacked and secured on pallets.

Caution. It is important to take precautions during handling and transportation.

13. BATTERY DISPOSAL

A battery that has reached the end of its service life must be taken to a battery collection point for recycling.

14. NOTES

Battery testing and verification are allowed only in accordance with standard IEC 60896-21:2004. It is permissible to check the capacity and internal resistance of the battery with the help of devices only to control the uniformity of the batteries.

The value of capacity obtained as a result of «analyzers» or «express testers» cannot be accepted as a claim basis.

If an imbalance is detected, a battery equalization or a full charge of each battery should be performed separately as described in section 4.3.

There are special equalizing devices (purchased separately) by the supplier to ensure voltage uniformity of the batteries.

15. SERVICE LIFE

The design life of the battery is shown in Table 6, except for special series.

Table 6

Model	Service life
DT (up to 40 Ah including)	5 years
All models DTM	6 years
All models HR-W, HR (up to 26 Ah including)	8 years
DT (up to 100 Ah including)	7-10 years
DT (from 150 Ah)	10 years
All models DTM I, DTM-L, FT-M, GEL, HR (from 40 Ah including)	10-12 years
All models HRL-X, HRL-W, FTS-X	12 years
All models GX, CGD,	15 years
All models OPzS, OPzV, GSC, STC	20 years

In cyclic mode, the service life is the number of cycles. For cyclic mode, the determining factor in the service life is the depth of discharge. Depending on the depth of discharge during cyclic mode, the number of cycles for batteries will be different.

Note. The depth of discharge is determined by the end-of-discharging voltage, discharging time and discharging current.

When the battery is in floating mode, the service time is the number of years. The main factors affecting battery life are: operating temperature (see section 4.5), temperature compensation (see section 4.6), absence of micro-cycling and timely maintenance (see section 5).

16. ADDITIONAL INFORMATION

Sulfation of the battery's active mass

When discharging, the active mass is converted into lead sulfate. During charging, the reverse process occurs with the destruction of lead sulfate and the recovery of the active mass.

Crystalline indestructible lead sulfate is formed:

when a battery is stored and used in discharged condition,

when charged with less than 10% of the rated capacity,

when charged with more than the current recommended in the manual.

Sulfation of the active mass leads to a reduction in the service life and a significant decrease in the capacity of the battery.

17. WARRANTY

Warranty liability

The seller guarantees the performance of the battery during the warranty period in accordance with the operating instructions. The warranty period is calculated from the date of sale.

The warranty applies only to manufacturing defects.

The battery must be delivered to the warranty service clean, with a legible factory marking and a factory sticker.

The battery is not covered under warranty in the following cases:

- Absence of a warranty card or other proof of purchase date;
- Failure to comply with the requirements specified in this user manual;
- Mechanical damage to the battery pack;
- Use of the battery pack for purposes other than those for which it is intended;
- Structural failure of the battery;
- Severe loss of capacity (due to sulfation of the active mass);
- Deep discharge or overcharge of the battery;
- Drying out or boiling out of distillate due to improper operation;
- Decrease of the battery capacity during operation.

BATTERY WARRANTY CARD

ASTERION BATTERY

Product warranty is _____ month(s)

Model: _____

Sale date: _____

Production code: _____

Battery received, no mechanical damage. I have no claims to the appearance and equipment. I am informed with the rules of operation and warranty obligations and agree with them.

Customer: _____
Name, sign

The battery has been checked by the seller in the presence of the customer

Seller: _____
Name, sign

Stamp