

DELTA GEL SEALED LEAD ACID BATTERIES WITH CONTROL VALVES

NOMINAL TECHNICAL CHARACTERISTICS:

The nominal voltage of the battery U_{NOM} : $2.0 V \times m$, where m is the number of cells connected in series inside the battery. The nominal voltage is indicated on the case of each battery.

Nominal capacity $SNOM = C_n$, where n is the time of discharge. The time and final voltage of discharge are indicated exactly on each device.

NOMINAL DISCHARGE CURRENT $I_{NOM} = I_n$:

$$I_n = \frac{C_n}{n}$$



Observe the operating manual and keep it next to the battery. Only specialized qualified personnel are allowed to operate the battery.



No smoking! To avoid explosive and fire hazardous situations, it is forbidden to use open flames and hot objects. Avoid sparking near the battery.



Wear protective goggles and clothing when working with batteries! Observe safety precautions to prevent accidents.



If acid comes into contact with eyes or skin, rinse with plenty of clean water and obtain medical attention without delay. Clothes contaminated with acid should be washed immediately with plenty of water.



Avoid explosive and fire hazardous situations, as well as short circuits!



Caution! The rechargeable batteries are always under voltage. Do not place tools or foreign items on top of batteries. Avoid short circuits.



Electrolyte - an aqueous solution of sulfuric acid - is an aggressive substance! In normal operating conditions, contact with electrolyte is excluded. When the case is destroyed, there is a threat of electrolyte leakage. Using damaged batteries is strictly prohibited!



Rechargeable batteries are heavy. Be sure to place the batteries correctly during installation and operation. Do not put on the edge. Avoid dropping or beating of batteries. Use only suitable equipment for transportation.



CAUTION! - battery under voltage!

1. PUTTING IN OPERATION

Before putting the battery into operation, it is necessary to measure the voltage on the batteries in order to identify ones with short-circuited cells. All measurement results must be recorded in the battery log. It is also necessary to draw up an act of putting in operation, which may be required in the warranty case.

When putting a group of batteries into operation, it is necessary to provide an equalizing charge in accordance with p. 2.3.

It is also necessary to check all cells/units for mechanical damage, for the correct connection polarity and all threaded connections fastenings. Tightening torque for bolted

connection: M8 $10 Nm \pm 1 Nm$, M5.5 / M6 $8 Nm \pm 1 Nm$. Protective caps must be installed on the bores.

With the charger is turned off and the consumer is - disconnected, connect the battery to the rectifier equipment, observing the polarity. Switch on the charger and charge the battery in accordance with paragraph 2.2.

***WARNING!** Please note that combining old and new batteries, as well as batteries of different brands and series on the same circuit, may shorten the design life of the batteries.

2. OPERATION

When installing and operating stationary batteries, GOST R MEK 62485-2 - 2011 standart and regional rules and regulations should be observed. Operation of the battery is permissible in any position excepting upside down. After refilling the sulfuric acid solution, use the battery only in an upright position.

The batteries should be installed in such a way that the temperature difference between cells/units is not exceed $4 ^\circ C$.

2.1. DISCHARGE

- The limiting value of the final discharge voltage depends on the discharge current.
- Do not discharge below the preset final voltage.
- Do not allow the battery to discharge under the nominal capacity value.

***WARNING!**

More energy than the nominal value can be obtained by discharging the battery at low currents. With such discharge, the final discharge voltage should be higher. Discharging a battery at low currents without adjusting the voltage can result in a significant decrease in capacity and a shorten battery life.

To extract energy more than the nominal value of the battery is strictly prohibited!

- After a full or partial discharge, it is necessary to start charging the battery immediately.
- Storing the battery in a discharged state will lead to premature battery failure.

***WARNING!**

Remember that the electrolyte density decreases during discharge. With the decrease in the electrolyte density, its freezing point rises. Do not store batteries uncharged.

CAUTION!

For operation of the battery in a buffer or maintenance mode. After discharging in emergency mode, batteries should be charged to the voltage in the buffer mode (see paragraph 2.2). After reaching the voltage, apply an equalizing charge according to p. 2.3. After the equalizing charge, the battery turns to normal operation

mode.

2.2. CHARGE

Depending on the type of equipment, the battery can be charged under the following operation modes:

a) Maintenance mode and buffer mode. In these modes, consumers, DC power supply and the battery are always connected in parallel. In this case, the charging voltage is the battery operating voltage and the consumer equipment voltage at the same time.

In maintenance mode, the DC supply always provides maximum consumer current and battery charge. The battery supplies current only when the DC supply fails. The charge voltage measured at the battery terminals at $22\text{ °C} \pm 1\text{ °C}$ equals 2.25 V/cell.

In the buffer operation mode, the DC supply cannot provide the maximum load current from the consumers. The load current temporarily exceeds the nominal DC supply power. The battery takes over these temporary load peaks. This means that the battery does not have a constant full charge value. Therefore, the charging voltage is set at 2.27 V per cell. The readings are valid at a temperature of $22\text{ °C} \pm 1\text{ °C}$ (as agreed with the manufacturer).

b) Cyclic mode (charge/discharge)

When operating in cyclic mode, the consumer is powered only by the battery. This operating mode depends on the system operation modes, charge/discharge modes and must be agreed with the manufacturer. In this mode, the charging voltage should not exceed 2.35 V per cell.

CAUTION!

For all charging modes, the minimum charging current cannot be less than 10% of the nominal capacity.

2.3. EQUALIZING CHARGE

Taking into account possible deviations of the cell voltages from the median value of the group operating voltage, appropriate measures, for example, an equalization charge, should be taken.

This charging mode is used after a deep discharge or chronic undercharge of the battery.

The mode requires charging with a constant voltage of no more than 2.4 V per cell for no longer than 24 hours.

The charging current at the initial moment should not exceed 10% of C_n (over the charging, the current decreases).

If the maximum surface temperature of the batteries exceeds 50 °C , the charging should be stopped or operating mode should be switched to maintenance mode in order to reduce the temperature.

During the operation of the batteries, both in the buffer and in the cyclic modes, it is necessary to provide an equalizing charge of the battery at least once every 6 months. This will minimize the likelihood of premature failure of cells/batteries due to undercharging caused by changes in internal resistance during group operation.

CAUTION!

Recommended for battery in buffer mode.

After discharging in emergency mode, the batteries should be charged up to the maintenance mode voltage (standby use) (see p. 2.2). After reaching the voltage,

apply an equalizing charge according to p. 2.3. After the equalizing charge, the battery turns to normal operation mode.

2.4. CHARGE CURRENTS

When charging the battery, currents should not exceed 30% of C_{nom} .

2.5. TEMPERATURE

The recommended operating temperature range for lead-acid batteries is $22\text{ °C} \pm 1\text{ °C}$.

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

Temperature rise up to $+60\text{ °C}$ is prohibited. This shortens the service life many times over. It is recommended to avoid using batteries at temperatures above 45 °C .

Storing batteries below the freezing point of the electrolyte will damage the batteries. The freezing point of the electrolyte in fully charged batteries is about -60 °C . As the battery discharges, the freezing point of the electrolyte rises: at 70% battery charge, the freezing point will reach about -25 °C . Keeping the battery in a discharged state at low temperatures will damage it.

*WARNING!

When the battery is discharged, sulfuric acid is consumed, therefore the density of the electrolyte decreases. A low discharge rate reduces the density of the electrolyte. Any slight decrease in the density of the electrolyte at negative temperatures will lead to the formation of water crystallization points (micro ice crystals).

During installation, batteries should be installed with a temperature gap of 10-20 mm. Without temperature gap, batteries can be locally overheated, and failure may occur. When operating a group of batteries connected in series, the difference between temperatures in the group should not exceed 4 °C .

2.6. CHARGING VOLTAGE DEPENDING ON TEMPERATURE

To provide the maximum battery life, it is recommended to use chargers with temperature compensation for the charging voltage. When the temperature changes within the range from $+15\text{ °C}$ to $+25\text{ °C}$, the use of temperature compensation of the charging voltage is optional.

If the temperature significantly deviates from the indicated values, a correction of the charge voltage is required according to the formula:

$$U_{T_1} = U_{T_0} + (T_1 - T_0) \times U_{T-\text{КОМПЛЕКС}}$$

where U_{T_0} is the recommended charging voltage for the considered mode (buffer or cyclic) at normal temperature T_0 , for which the nominal capacitance parameters are indicated;

U_{T1} - charging voltage at a temperature T_0 different from normal;

$U_{T-complex}$ - the value of the temperature compensation voltage for a specific operating mode of the battery (buffer or cyclic).

Temperature compensation of voltage is $5mV/(cell \times ^\circ C)$ for cyclic mode and $3.3mV/(cell \times ^\circ C)$ for other modes.

When batteries are operated as a part of an automated system, it is allowed to use thermal compensation when the temperature deviates from $22^\circ C$ for each degree.

2.7. ELECTROLYTE

The electrolyte is an aqueous solution of sulfuric acid.

Observe precautions!

3. BATTERY SERVICE AND CONTROL

The battery must be dry and clean to avoid surface current leakages. Battery should be cleaned in compliance with safety measures provided in the GOST R MEC 62485-2 - 2011 standart, as well as in the regional and departmental standards. The plastic parts of the batteries, especially the housing, must be cleaned of dust and dirt without use of cleaning agents.

Do not allow water to enter the housing in order to avoid short circuits.

Keeping the surface of the batteries clean eliminates the negative impact associated with the flow of parasitic currents.

At least once every 3-6 months (when operating in maintenance mode), it is necessary to measure and record in the battery log the following:

- battery voltage,
- voltage of in cells/units,
- surface temperature of cells/units,
- temperature in the battery room.

If the surface temperature of different cells/units varies by more than $4^\circ C$, the battery life will be significantly reduced.

Where possible, conduct regular conductivity measurements of the batteries.

The following should be measured and recorded in the battery log annually:

- voltage in all cells/units,
- surface temperature of all cells/units,
- room temperature.

Visual inspection of the following should be carried out annually:

- connection points (check the threaded connections for the fitting immobility),
- installation and location of batteries, ventilation systems.

The control and testing cycle should be performed in accordance with the internal regulations

3.1. CONTROL AND TESTING CYCLE

The control and testing cycle is performed in order to determine the residual capacity. The control and testing cycle includes three stages:

1. Charging mode with constant voltage of cyclic mode, no longer than 21 hours.
2. Discharge mode up to nominal voltage by nominal current.
3. Provide a full charge and turn the battery to normal operation mode.

3.2. REGULATORY CHARGE

Preventive charges of stored batteries should be performed periodically.

At a storage temperature of $20^\circ C$, recharging should be performed every 9 months. Charging with constant voltage of cyclic mode. Charging time should not exceed 24 hours.

At a storage temperature between $20^\circ C$ and $30^\circ C$, recharging should be performed every 6 months. Charging with constant voltage of cyclic mode. Charging time should not exceed 16 hours. At a storage temperature between $30^\circ C$ and $40^\circ C$, recharging should be performed every 3 months. Charging with constant voltage of cyclic mode. Charging time should not exceed 10 hours.

CAUTION!

All charges should be performed at a normal temperature of $20-25^\circ C$.

4. TESTS

Tests should be performed in accordance with GOST R MEC 60896-21-2013 standart. Tests for nominal capacity by express testers are inconsistent and will not be considered a claim.

5. MALFUNCTIONS

If you detect a malfunction of the battery or charger, you should immediately contact the service department of the equipment manufacturer. Records in the battery log, according to p. 3, will help to avoid many problems and facilitate troubleshooting

6. STORAGE AND DECOMMISSIONING OF BATTERIES

If the cells/units have been stored or decommissioned for a long period of time, they should be fully charged in a dry room at a temperature of $20^\circ - 25^\circ C$ after 9 months from the manufacturing date or from the previous charging date. If the temperature range of the battery storage changes, the charging interval may decrease. During the storage period of the battery, no more than 2 recharges are permissible. The service life

starts from the moment of putting into operation or after the second "refreshing" charging. Storage of discharged battery at low temperatures will damage the battery.

When battery is taken out of service for storage, it must be fully charged. Storage in an uncharged state is forbidden. This will damage the battery, and this damage will not be covered by the warranty.

Avoid direct sunlight during storage and use. During the storage period, it is recommended to perform an equalizing charge once every 12 months, according to p. 2.3.

***WARNING!**

A maximum of two additional charges can be performed during the storage period. Then it is recommended to use the battery in maintenance mode. It is strictly forbidden to store batteries in a discharged state.

7. TRANSPORTATION

Sealed batteries that are not damaged are not considered dangerous goods during transportation if they are reliably protected against short circuits, rolling, overturning or damage, if suitably stacked and secured on pallets and if there are no any hazardous acid substances at the external side of the items prepared for shipment.

CAUTION! It is important to observe the precautions during loading and transportation!

8. ADDITIONAL INFORMATION

Strictly follow local rules and regulations concerning battery use. Testing and checking of batteries is permissible only in accordance with GOST R MEC 60896-21-2013 standart. Checking the battery capacity and internal resistance with the use of instruments is allowed only in order to test the homogeneity of the battery.

Capacity values obtained with the use of "analyzers" or "express testers" cannot be accepted as a reason for claims.

9. SERVICE LIFE

Battery life is designed according to the manufacturer's documentation. There are several factors that determine the battery service life in maintenance and cycling modes. In cyclic operation mode, the battery service life is considered the number of cycles. For cyclic operation mode, the discharge level is the determining factor of service life. The number of cycles for batteries will be different depending on the discharge level in cyclic mode.

***WARNING!**

The discharge level is determined by the final discharge voltage, discharge time and discharge current.

In maintenance operation mode, the battery service life is considered the number of years. Service life will be affected by several factors. The general factors are the

operating temperature and the presence of temperature compensation (see p. 2.6), the absence of micro cycles and timely maintenance (see p. 2.3, 3).

***WARNING!**

The service life specified in the documentation is the quoted value assuming absolute operation without micro cycles.

10. SPECIAL FEATURES OF DELTA DTM 1 BATTERIES

DELTA lead-acid batteries of the DTM 1 series are manufactured using AGM technology (electrolyte absorbed in a glass fiber separator), are equipped with VRLA valves and an LCD display, which shows the status of the battery: voltage, capacity and number of days in operation. When the battery is low, an automatic alarm is triggered to alert the user to perform timely maintenance.

10.1. USE

Due to their high performance characteristics, batteries are recommended for use in various uninterruptible power systems, including precise electrical devices (submersible and circulation pumps and boilers for heating systems), for emergency power supply and in other electrical devices.




Features and functions:

- Built-in electronic chip provides the possibility of real-time monitoring of the battery charge level; when the charge or the capacity level is low - the battery sends alarms about it. Moreover, the period of the battery operation is automatically recorded.
- The top of the battery is equipped with a removable cover that can be easily opened. Under the removable cover there are 6 reserve containers with distillate, these containers can be used to extend the battery life.
- A special active formula has been used in the manufacture of the lead plates of the battery, which provides longer battery service life.
- The positive lead plate of the battery is made of high purity grade alloy, which improves corrosion resistance.
- 100% of batteries undergo technical quality control before shipment, which ensures a stable and long-lasting quality guarantee.

10.2. LCD MONITOR

The LCD monitor shows the battery state. Display

1. Charge level + voltage;
2. Charge level + period of operation (number of days).

№	BATTERY STATE		INDICATION
	CHARGE	FLICKERING	
1		-	Charge <10%
2		-	30% <Charge <60%
3		-	60% <Charge <90%

4		-	Charge <90%
5		Keeps flickering every second	Battery charge tends to 0%, battery charge required!
6		Keeps flickering every second	Charge voltage too high. The battery is being recharged

Press the PUSH button to check the battery operating life.

Also use the PUSH button to switch between the two modes showing “Battery Charge Level and Voltage” and “Battery Charge Level and Life”.

The battery has two states: active and inactive.

The battery is inactive when shipped from the factory. Flickering letters (“E, F”) indicate inactive state; no record of the number of days in operation is displayed and there is no audible warning.

To put the battery in active mode, press the PUSH button and hold it for 10 seconds to start the battery. The countdown of the number of days in operation starts automatically from the beginning of the battery usage, the flickering letters (“E.F”) disappear, the number of days is set to 1 and begins to increase by one per day until it reaches 1999 days.

Operating time recoding is irreversible and the data is retained when the battery is discharged.

LCD screen maintenance.

1.1.3 Protect the screen from damages by hard materials.

1.2 Keep the screen dry and clean.

1.3 Regularly check the battery parameters shown on the display

1.4. Pay attention to the audio alarm, if any.

1.5 Service the battery promptly when the alarm appears.

10.3. REFILLING WITH SULFURIC ACID SOLUTION

In order to extend the battery service life, you can add 10% sulfuric acid solution. The battery service life until the moment of refilling of the solution included in the delivery depends on the intensity of use and environmental conditions.

When the battery is operated in a cyclic mode, at a temperature not exceeding 25 °C, it is recommended to refill the electrolyte after 400 days of operation.

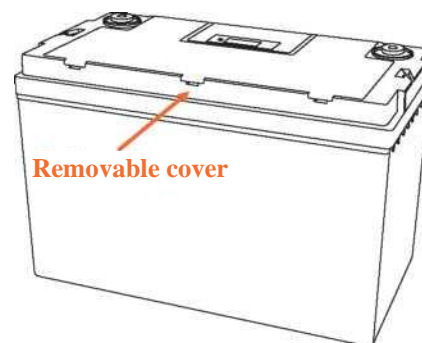
If the battery is operated in the constant floating charge mode at the UPS without triggering, at a temperature not higher than 25 °C, then the solution should be refilled after 600 days of operation.

When the battery is operated in a combined mode, the sulfuric acid solution should be refilled after 500 days of operation.

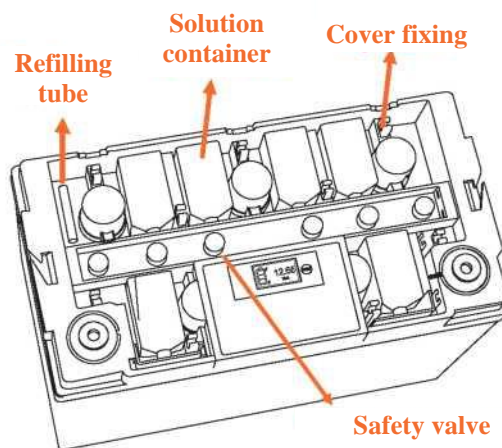
In cases where the operating temperature is exceeded (p. 2.5), the solution may need to be refilled earlier than indicated above.

IMPORTANT! The sulfuric acid solution can be refilled only once. Use only the solution supplied with the battery.

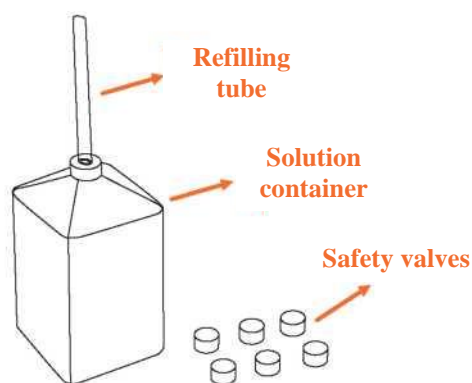
Step 1: Using a flat head screwdriver (or other flat metal object), lift the removable cover over the side holes



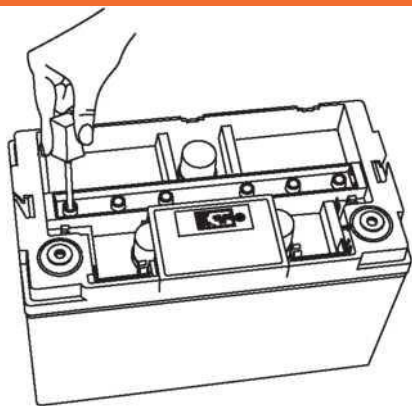
STEP 2: Take out 6 filling containers and remove 6 valve caps.



STEP 3: Connect the refilling tube to the container, then connect the other side of the tube to one of the safety valve ports.



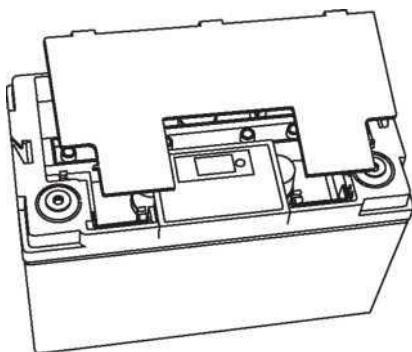
STEP 4: Squeeze the sulfuric acid solution out of the container carefully. Close the safety valve with the cover when refilling is complete.



STEP 5: Procedure with the second container is performed in the same way as described above.

IMPORTANT! The distillate should be refilled into all 6 cells in the ratio of one container to one cell.

STEP 6: When the filling is finished, make sure the cover is secure and well fixed.



CAUTION!

- After refilling the sulfuric acid solution, use the battery only in an upright position.
- There is no need to attach containers and tube back to the battery after use.
- Remember to close the valve caps again after refilling.
- Refilling the batteries with sulfuric acid solution must be carried out in ventilated premises.

STORAGE AND MAINTENANCE

WITHIN 3 MONTHS	WITHIN 3-6 MONTHS	OVER 6 MONTHS 1
Direct connection	Charge voltage limitation: $\leq 14.4V$	Charge voltage limitation: $\leq 14.4V$
	Charge current limitation $\leq 0.2C$	Charge current limitation $\leq 0.2C$
	Charging time: 2-3 hours	Charging time: 4-6 hours

IMPORTANT!

- The electrolyte contained inside destroys metal, cotton materials, stone. Use with care.
- Do not turn the battery upside down to avoid electrolyte leakage.
- When the batteries are charged, an electrolysis process takes place, as a result of which hydrogen and oxygen are generated. Under normal operating conditions, the gassing process is compensated by the recombination process. A small amount of hydrogen may concentrate inside the battery in a free state.
- DO NOT allow over-discharging of the battery, charge the battery in a timely manner after discharge.
- Disconnect the negative terminal of the battery if it has not been used for a long time.
- DO NOT check the battery charge level by short-circuiting the terminal.
- Check the terminals regularly and make sure the surface is clean to ensure good contact.
- Avoid / do not short-circuit the battery terminals. When moving the battery, do not pull on the terminals or wires, cause it will damage the cable or terminal.
- DO NOT knock on the terminal with a hammer during the battery installation
- Handle the battery with care and prevent shocks.