

Nickel-iron storage battery FL 400 P

Installation and operation manual

Significant guidelines

- Avoid direct flame or sparks near storage batteries under any circumstances, especially during charging.
- Avoid smoking while manipulating with storage battery.
- Use rubber gloves, long-sleeved outfit, proper safety spectacles or protective mask for the purpose of protection.
- Electrolyte is harmful to skin and eyes. In case of skin or eye contact immediately wash with ample amount of water. In case of eye damage immediately wash eyes with water and seek medical advice.
- Before operating storage battery, take off all the rings, watches and other objects with metallic parts.
- Use insulated instruments.
- Avoid static electricity and take measures to protect against electric shock.
- For drainage of electrostatic charging, which may be accumulated on outfit and/or instruments, touch the grounded part before starting operation of storage battery.

1. Acceptance of delivered products

Unpack storage battery immediately upon receipt.

Do not turn packaging upside down.

- Storage batteries are usually delivered filled and discharged.
- If a storage battery has been delivered unfilled and discharged, then it is needed to be filled with electrolyte before installation. Open the valves and fill the cells.

2. Storing

Store a battery in dry, clean, cool (0°C to +30°C) and well-ventilated premises at open rack.

Do not store batteries in direct sunlight or at high temperature.

- Elements are not filled and discharged.
- It is recommended to store elements not filled and discharged.
- Elements may be stored for many years in such conditions.
- Elements are filled and discharged.
- If elements are stored filled, one needs to charge them completely before placing in storage.
- Filled and charged elements may be stored for no longer than 12 months as from the date of shipment.
- At delivery in wooden boxes, they should be opened before placing of batteries in storage. One needs to take off the box top and packaging material from the top of the elements.

3. Installation

3.1. Wiring

Make sure that the elements are connected together with polarity compliance. One should connect storage battery with load using nickel-plated cable terminals. Suggested fastening torques of connecting nuts:

$$M_{20} = 32 \pm 5 \text{ N}\cdot\text{m}$$

Attachment fittings and terminals must be protected against corrosion by coating with thin-film rust-preventive oil.

3.2. Electrolyte for elements

- If elements are delivered not filled and discharged.

Use table 2 in order to choose electrolyte properly.

Open valves and fill elements with electrolyte up to "MAX" marking.

Wait for 4-24 hours and, if needed, pour more electrolyte before putting storage battery into service.

- If elements are delivered filled and discharged.

Check the electrolyte level. It should be not more than by 10 mm less than top marking "MAX". If the level is lower, add distilled or deionized water.

4. Putting into service

Strongly prohibited unless approved by the manufacturer

- change of the layout
- replacement of cells and connectors supplied in set with another ones.

Make sure that this procedure is carried out under conditions of sufficient ventilation. Proper commissioning is of high importance. It is preferable to perform constant-current charging.

If limiting current is lower than the value specified in the table 1, perform charging over proportionally longer period of time.

- Elements primed on-site or stored for more than 6 months should be:
 - charged for 10 hours at current equal to 0,2 C5 A (recommended);
 - or for 30 hours at voltage equal to 1,6 V per element and at current no more than 0,2 C5 A;
 - discharged at current equal to 0,2 C5 A down to voltage equal to 1,0 V per element. Do not allow long-term storage of discharged battery with electrolyte (not more than 1-2 days);
 - charged according to the following section.
- Elements filled and charged at manufacturing plant, and stored for less than 6 months should be:
 - charged for 10 hours at current equal to 0,2 C5 A (recommended),
 - Electrolyte refill after putting into service: one needs to wait 4 hours after operation. Check the electrolyte level and bring it to upper marking by adding:
 - distilled or deionized water

5. Charging modes

- Uninterrupted parallel operation with occasionally occurring battery discharge. Suggested charging voltage (+20°C to +25°C):

In case of two-step charging:

- trickle charge
1,50 - 1,55 V per element,
 - forced charge 1,6 - 1,65 V per element.
- High voltage would ensure raising charging rate and efficiency.
- In case of one-step charging: 1,55 - 1,6 V per element.

6. Periodic maintenance

- Keep storage battery clean using only water. Do not use wire brushes or any solvents. Vent plugs may be rinsed with clean water, if needed.

- Check electrolyte level. Do not allow this level to drop lower than minimal mark by no means. Use only distilled or deionized water for refill. Refill rate is determined by practical consideration. Note: after filling of storage battery with electrolyte of required sort – at plant or at putting into service – periodic inspection of electrolyte density is not needed. Proper understanding of density measurement results is complicated and may result in errors.

- Check tightness of all attachment fittings biyearly.

Attachment fittings and terminal nuts must be protected against corrosion by coating with thin-film rust-preventive oil.

- Check charging voltage. If storage battery is connected in-parallel, it is highly essential that suggested charging voltage should remain at the permanent level. Charging voltage must be checked at least once a year.

High water consumption by storage battery generally indicates incorrect voltage setting of charging device.

The batteries operated with a constant voltage of up to 1.55V shall be equalized at least once a year with the following mode:

- 8-hour charge by a current of 0.2C (20% of the rated capacity).

The voltage higher than 1.7V per cell shall be met between a 7 th and 8 th hour of the charging.

- Uninterrupted 4-hour discharge by a current of 0.2C (20% of the rated capacity) to the voltage of 1V per cell.

Additional equalizing might be requested if a discharge rate is met before 4th hour. The equalizing is considered completed if the same discharge rate is met within two consequential cycles.

The temperature of the electrolyte in the cell should not exceed 45 °C. The starting temperature of the electrolyte when charging should not exceed 25 °C.

7. Replacement of electrolyte

In most cases of fixed storage batteries use, electrolyte efficiency remains for a whole service life of storage battery. However, at operation of storage battery under specific conditions, carbonation of electrolyte may occur; in such cases, it is sufficient to replace electrolyte in order to restore normal operation. In order to replace electrolyte in these elements, one should use electrolyte according to the table 2. Electrolyte must be replaced when carbonation level reaches the value more than 75 g/l.

It is also recommended to replace electrolyte at storage battery depletion (discharge at current 0,2 C5 A - 0,25 C5 A down to voltage equal to 0 V per element). Not to leave the deeply discharged cells more than 24 hours.

8. Environment

All life-expired storage batteries must be recycled in order to protect the environment.

Table 1

Basic specifications of storage battery FL 400 P

Parameter	Unit of measurement	Value
Rated capacity	Ah	400
Rated voltage of storage battery	V	1,2
Overall dimensions of storage battery	mm	171x174x372
Output terminal diameter	mm	20
Distance between outputs	mm	100x94
Nominal charging rate: Current Time	A h	100 8
Nominal discharging rate: Current Time	A h	80 5
Operating temperatures range	°C	-20 to +40
Note. Specified electrical specifications are achieved during tests using methods of technical specifications for storage batteries, which were not in operation, with no more than 90 days from the date of manufacture.		

Table 2

Electrolyte used for filling in storage batteries must conform to the table.

Ambient temperature, °C	Used electrolyte	Sort, grade	Density, kg/m ³ (g/cm ³)	Amount of water, l
				per 1 kg of solid alkali
-20 to +40	Technical aqueous potassium hydroxide solution with addition of technical lithium hydroxide (10±1 g/l)	Solid, top and first grade. Top-grade solution.	1200±10 (1,20±0,01)	3,3

Instruction manual for electrolyte preparation.

To prepare 1 liter of electrolyte ($\rho = 1,2 \text{ kg/l}$) you need:

1. Stainless steel, glass or plastic (resistant to alkalis) container
2. Solution mixer or you can mix it manually using the glass stick or stainless steel instrument
3. Scales
4. Gloves, glasses, apron.
5. Potassium hydroxide – 0,285 kg.
6. Lithium hydroxide (monohydrate) – 0,01 kg.
7. Distilled water – 0,9 kg.

Step by step instruction:

1. Put 0,9 kg water in to the container.
2. Put 0,285 kg of potassium hydroxide in to the water. It will start to heat up.
3. Mix the solution. (careful)
4. Put 0,01 kg of the lithium hydroxide while the solution is still hot.
5. Mix the solution until everything will be dissolved.
6. Wait until the temperature of the solution will fall to ambient. Now it is ready.