

# **OPERATING INSTRUCTION**

**Maintenance-free Sealed Lead-acid Battery**

<b>Contents</b>	
Contents.....	1
1. Battery storage.....	2
2. Use circumstances.....	2
3. Use conditions.....	2
4. Assembly of batteries.....	2
4.1 Open box and check.....	2
4.2 Notice before assembly.....	2
4.3 Assembly and connection.....	3
5. Use of battery.....	3
5.1 Supplement charge.....	3
5.2 Discharge.....	4
5.3 Capacity discharging test.....	4
5.3.1 Off-system test method.....	4
5.3.2 On-system test method.....	5
5.3.3 Check-aimed discharge test method.....	5
5.3.4 Judgment on laggard battery.....	6
5.4 Charge.....	6
5.4.1 Float charge.....	6
5.4.2 Equalize charge.....	7
5.4.3 Cycle use charge.....	7
5.4.4 Notes during charging.....	8
6. Battery maintenance.....	9
6.1 Cleanness.....	9
6.2 Inspection and maintenance.....	9
6.2.1 Inspection items of each month:.....	9
6.2.2 Inspection items per quarter.....	10
6.2.3 Inspection item per year.....	10
6.3 Basic requirement on maintenance.....	11
7. Exchange of Batteries:.....	11
7.1 Exchange judgments:.....	12
7.2 Exchange time.....	12
8. Cautions:.....	12

LEOCH sealed lead acid battery is shipped with charge, handle the battery according to the following instructions before use:

### 1. Battery storage

※If the battery has high temperature or poor ventilation during storage and delivery, the self-discharge will be increased. So, keep good ventilation and keep away from fire, flame, heat supply etc.

※When keep the battery, take it off from the charger and load and keep it in the dry and cool place.

※After storing for a long time, please charge the batteries before use.

### 2. Use circumstances

※Temperature range: Charge 0~40℃; Discharging -20~55℃; Storage -15~50℃;

※No fire, flame and heat supply near the battery;

※Avoid the heat supply and direct sunshine place;

※Avoid the humid and soggy place;

※After storing for a long time, please charge the batteries before use.

### 3. Use conditions

※Parallel connection: recommend within 4 groups;

※Multilayer assembly: temperature among layers should be controlled within 3℃;

※Heat dispersing: keep around 20mm inter Cell;

※Ventilation: ensure the volume concentration of released hydrogen smaller than 0.8%;

※Best ambient temperature: 5~35℃;

※Float use: limited current $\leq 0.3C_{10}A$ , voltage 2.23~2.27V/Cell, at 25℃;

※Mix use of batteries: disallow the mix use of new and old batteries, batteries from different manufacturers, if ask to mix use, please contact us.

### 4. Assembly of batteries

#### 4.1 Open box and check

※Handling: Forbid the force on the terminal, avoid the affect to the sealed part; Avoid the upside down, throw or impact of battery; Absolutely avoid metal wire such as steel rope etc. to prevent the short circuit.

※Inspection: packaging、appearance of battery——no damage;

※Count check: battery quantity、spare parts——full;

※Reference: catalogue、assembly drawing、notice.

#### 4.2 Notice before assembly

※If no abnormality after check, assemble the batteries in the designated place such as battery chamber;

※If assemble the batteries in the battery chamber, try to place them in the rock bottom of battery chamber;

※Avoid assembling the batteries near the heat supply such as transformer place;

※As battery may cause flammable gas during storage, avoid closing with the unit which produce flame such as fuse when assembly.

※Before connecting, clear the terminals to make it present metal brightness.

※Be care that conductive material and battery positive and negative terminal form short circuit.

※When multi batteries are used together, connect the batteries correctly firstly, then connect the battery with charger or load. In this circumstance, battery positive should be connected with the positive terminal of charger or load and negative connect with negative terminal. If the battery isn't connected with charger correctly, the charger will be damaged, so make sure that the connection is made correctly.

※Don't give extreme force on the terminals when connecting, every connecting nut and screw should be tighten, please refer to the torque as table 1.

Table 1: Suggested torque table

Range	M5	M6	M8
Torque	3.1~4.2N·m	3.9~5.4N·m	11~14.7N·m

### 4.3 Assembly and connection

※Pack the metal assembly tool such as spanner with insulation tape;

※Connect the batteries first, then connect the battery group with charger or load;

※When multi-group batteries are parallel connected, connect in series first and then parallel connect;

※To ensure good ventilation, the batteries per row should keep around 20mm inter-distance;

※Before connection, clear the battery terminals to make it present metal brightness;

※Before and after connection, paste certain antirust such as Vaseline on the surface of battery post;

※After assemble batteries, test the whole voltage of the battery group and if ok, then with load.

## 5. Use of battery

### 5.1 Supplement charge

During the delivery and storage, the battery will lose part of the capacity due to self discharge, so please supplement charge before use; If stop using temporarily during use, please supplement charge termly;

Supplementary charge according to the table below before use;

Table 2: The time interval of supplementary charge and storage temperature

Storage temperature	Time interval of supplementing charge	Supplementing charge way
20℃ or less	Every 9 months	a) Charging at a constant voltage of 2.23~2.27V/Cell and an initial current less than 0.3 C <sub>10</sub> A for 2~3 days;
20℃~30℃	Every 6 months	b) Charging at a constant current of 0.3C <sub>10</sub> A and a constant voltage of 2.35~2.45V/Cell for 10~16 hours;
30℃~40℃	Every 3 months	c) Charging at a constant of 0.1C <sub>10</sub> A for 8~10 hours; 3 options for choice.

Note: Current value C is rated capacity of battery.

For example: rated capacity of 12V100AH battery is 100AH, 0.1C<sub>10</sub>A=0.1×100=10A;

Charge voltage: 12V battery is 2.25×6=13.50V, 6V battery is 2.25×3=6.75V

### 5.2 Discharge

※The maximum allowable discharge current does not exceed the value below:

Discharge current  $I \leq 1C_{10}A$ , continuous discharge;

Discharge current  $I \leq 3C_{10}A$ , discharge time  $T \leq 2min$ ;

Discharge current  $I \leq 6C_{10}A$ , discharge time  $T \leq 10s$ .

※Final discharge protective voltage as below:

Table 3: Final discharge voltage

Discharge current	Final discharge voltage (V/Cell)	Remark
0.2C <sub>10</sub> A or less	1.80	a) Current value C is rated capacity;
0.2~0.5C <sub>10</sub> A	1.75	
0.5~1.0C <sub>10</sub> A	1.70	b) Current discharge rate should be not less 0.05C <sub>10</sub> A.
Above 1.0C <sub>10</sub> A	1.60	

Noted: a) Do not let terminal voltage drop to the above specified value; b) Do not storage after discharge, please supplementary charge immediately

### 5.3 Capacity discharging test

Usually, below listed test method is optional for regular capacity test.

#### 5.3.1 Off-system test method

a) Keep the battery group for 1 hour from the system after full charge, adopt the outer fake load connect method and proceed the discharge test at 10hours discharging rate under the ambient temperature  $25 \pm 5^\circ C$ .

b) Terminal voltage, ambient temperature, time should be tested before discharging.

c) Terminal voltage, discharging current, room temperature should be tested and recorded during the discharging period. Testing interval is 1 hour, discharging current must not exceed 1% of the stipulated data. Terminal voltage of the battery and room temperature should be tested and recorded during the discharging period. Test interval is 1 hour. They should be tested at any moment at the final discharging period, so that to make certain the time to reach the discharging end point voltage.

d) Discharging current multiplied by discharging time makes the capacity of the battery. When battery discharge at 10hour discharging rate, if the temperature is not 25℃, then it should be calculated according to the below formula on the base of the capacity obtained in the test.

$$C_e = C_r / (1 + K(t - 25^\circ\text{C})) \dots\dots\dots(A)$$

In this formula, t refers to the temperature; K-refers to the temperature modulus (K=0.006/℃ when discharging at 10H discharging rate, K=0.008/℃ when discharging rate is 3H. K=0.01/℃ when discharging rate is 1H.

e) Battery should be recharged by 1.2 times of the original after finishing discharge.

### 5.3.2 On-system test method

a) In the direct current power system, adjust the out-put voltage of the inverter to protection voltage (e.g. 46V), battery supply the power to the load, then find out and test the battery which with the lowest voltage, and worst capacity.

b) Open the inverter and charge the battery, then keep 1hour after full charge.

c) Proceed test at 10hour discharging rate on the worst battery found out in a). Terminal voltage, temperature, discharging time, and room temperature should be tested and recorded before and after the test. Take note at the interval of 1hour. Notes should be taken at any moment when the final voltage is coming, so that to record the discharging time correctly.

d) Discharging current \* discharging time= capacity of the battery group. If the room temperature is not 25℃, the capacity should be calculated according to the formula in (A).

e) After finishing the test, charge the battery in a supplementary way so that to recover it's capacity.

f) Draw the discharge curve according to the test data.

### 5.3.3 Check-aimed discharge test method

In order to control the estimated capacity of the battery group at any time, it is necessary to proceed on the check-aimed discharge test.

a) In DC power supply system, adjust the output voltage of the rectifier to protection voltage (for example 46V), and the battery supply electricity to communication load. Terminal voltage, temperature, room temperature and discharge time of the single battery should be tested and recorded before and after the battery discharging, until 30-40% of the rated capacity is released.

b) Supplementary charge the battery after finish discharging, the charged value should be 1.2times of the discharged value.

c) Draw discharge curve according to the notes, and keep record for comparing with future test.

### Marks:

1) Off-system test method is not recommended for UPS system battery group.

2) When operating the on-system test method and check-aimed capacity test, if the tested UPS equipment equipped with discharge performance itself, the test performance of discharging should be opened. If it is without discharge test performance, its Ac input should be cut off before process the discharge test.

### Notes:

1) The above mentioned capacity test are the most frequently used in daily maintenance, but whatever method is used, it is very important to keep proceeding the system during the test period. Therefore, before processing the test, we should investigate whether there is plan to stop electricity and the standby generator should be ready to work at any time.

2) Apply multimeter, inner-resistant instrument, conductance instrument to make a defend test before the capacity discharge test.

3) In order to make sure that accuracy of the capacity test, professional on-system test instrument and fake load should be adopted.

### 5.3.4 Judgment on laggard battery

Terminal voltage of the laggard battery is lower, so it should be tested under the discharging condition. If the terminal voltages are lower on the average during the three continuing discharging cycle test, it can be judged as the laggard battery of the group. Equalizing charge should be proceeded when laggard battery is available.

## 5.4 Charge

### 5.4.1 Float charge

■ Charge parameter

Charge voltage: 2.23~2.27V/Cell (25℃, recommend 2.25V/Cell)

The maximum charge current:  $0.3C_{10}A$

Temperature compensation coefficient:  $-3mV/^\circ C \cdot Cell$  ( taking  $25^\circ C$  as base point)

Total variation range of charge voltage:  $\pm 0.02V/Cell$

★Note:

a) Every batteries voltages of a battery group have a little difference at the beginning of use, half year later they become consistent.

b) Effect by too high float voltage or too low float voltage as below :

※Too high for a long time (overcharge): life shortened;

※Too low for a long time (not charge enough): Can not meet load or make battery voltages inconsistent and the battery group capacity will drop accordingly and life is shortened.

#### 5.4.2 Equalize charge

■ Charge parameter

Charge voltage:  $2.35\sim 2.40V/Cell$  ( $25^\circ C$ , recommend  $2.35V/Cell$ )

The maximum charge current:  $0.3C_{10}A$

Temperature compensation coefficient:  $-4mV/^\circ C \cdot Cell$  ( taking  $25^\circ C$  as base point)

Total variation range of charge voltage:  $\pm 0.02V/Cell$

Condition of dropping out the equalizing charge: Reference data of dropping out of the equalizing charge is usually set as  $0.01C_{10}A$ , multiplied the group No of the battery when it's parallel connection.

★Notes:

This step is may be omitted when it is normal float charging, in case of the below condition is emergent, equalizing charge can be considered:

- Capacity released exceed 20% of the rated capacity.
- Storage period is more than 3 months.
- There is single cell with float voltage below than  $2.18V/cell$ .
- Float charging for 3-6months or there is battery laggard in voltage.
- Operating more than 1 year under float charging.
- Supplementary charge the battery after installation and before using.
- Equalizing charge the battery after the capacity test.

#### 5.4.3 Cycle use charge

■ Charge parameter

Charge voltage:  $2.40\sim 2.50V/Cell$  ( $25^\circ C$ , recommend  $2.45V/Cell$ )

The maximum charge current:  $0.3C_{10}A$

Temperature compensation coefficient:  $-5mV/^\circ C \cdot Cell$  ( taking  $25^\circ C$  as base point)

Total variation range of charge voltage:  $\pm 0.02V/Cell$

Supplementary charge capacity is 110%~130% of discharge capacity, ambient temperature is below  $5^\circ C$ , if do not know how many discharge capacity, please refer to the following table to supplementary charge:

Table 4: Supplementary charge

Ambient temperature ( $^\circ C$ )	Charge voltage (V/Cell)	Charge time (h)
5	2.31	7
	2.46	4
20	2.25	7
	2.40	4
35	2.21	7
	2.34	4

★Note:

1) Charge time is the time when terminal voltage reaches value as the above table shows during charging at a constant  $0.3C_{10}A$  or less.

2) If the charge time is over the time as above table, it will cause over charge, which will shorten the life of the batteries; if the charge time is less than the time as above table, the batteries will can not meet the normal capacity.

#### 5.4.4 Notes during charging

※Charging current at the end of charging is over  $0.05C_{10}A$ , which may result in permanent damage on battery appearance and battery life, please pay more attention to charging voltage.

※The used charger should have degressive automatic constant voltage device, please contact us if use other kind of charger.

※If the ambient temperature is not  $25^\circ C$ , temperature supplementary should be applied on the voltage, formula is  $U = U_{25^\circ C} - K \times (T - 25)$

T—ambient temperature; K—temperature supplementary modulus

※Judgment on charge end point, Usually, if the battery charge can meet any one of the below listed condition, it can be regarded as the charge end point.

a) Charged value is not less than 1.2 times of the released value.

b) The current is less than  $0.005C_{10}A$  ( $C_{10}$ =rated capacity of the battery) during the final period of

charging.

c) The current is steady for 5 hours during the final period of charging.

## 6. Battery maintenance

### 6.1 Cleanness

- Keep the battery surface and its working circumstance clean and dry.
- Keep battery clean and avoid static condition.
- Clean battery with wet cloth, no organic solvent such as gasoline, alcohol etc. or clothes with such substance is used to clean battery.

### 6.2 Inspection and maintenance

To better understand the operation of battery and equipment also to prevent battery damage during inspection, please periodically inspect the battery and record it.

#### 6.2.1 Inspection items of each month:

Items	content	standard	maintenance
①Total float charging voltage of battery group	Measure output end voltage of positive and negative end of battery group with voltage meter.	1 tested data comply with the data displayed on the meter and meet the voltage standard under the temperature 2.The error of float charge voltage after temperature supplementary is $\leq \pm 50\text{mV}$	1.If data attained by testing is various from the standard, the tested data is prevail. 2. For those adjusted by monitor module and still can't reach the allowed error range after module adjustment, repair is to be applied or send them back to factory.
②Appearance of the battery	Inspect if battery case and cover bulge, leakage or damage or not.	Normal	Find out the reasons if exist abnormal appearance
	Inspect if there is dust or stain	clear	Clean the dust and stain with wet cloth.
	Inspect if the harness and terminal etc with rust or not.	Without rustiness	Clean the rust, change the harness and paste antirust.
③Temperature of the battery	Test the temperature of the terminal and battery surface by infrared thermometer.	Under 35℃	Find out the facts if the temperature is higher than standard value, and proceed on relevant operation.
④connection	Check there is any loosen bolt/screw by spanner or not	Fastness(please refer to the table of torque	Tighten the loosen bolt/screw in time
	Check the clearance of the connection cable and terminals	Without appearance of erosion	Take out the connection cable and clear it in water if it is light erosion, if it is serious, please replace the cable, and clear the connection point by steel brush before tightening.

⑤check safety valve(2V series)	Shake the valve lightly by right hand, so that to check the valve is fixed steadily or not.	Valve is fixed steadily without loose.	please tighten the valve if there is appearance of loosen.
	Cover the valve with bubble liquid so that to check if the valve can exhaust the gas without any trouble or not.	staggered air bubble appears	The frequent appearance of open and close the valve is abnormal, in case happens, please replace the valve, at the same time, please check the water lost status of the battery..
⑥ switch the power supply	Cut off the AC power supply and invert to UPS or DC power supply.	AC power supply switch into UPS or DC power supply smoothly.	correct the potential difference

#### 6.2.2 Inspection items per quarter

Items	Contents	Standards	Maintenance
①Float voltage of each battery	Measure the end voltage of each battery in battery group.	Float voltage value after temperature equalization $\pm 50\text{mV}$	If float voltage is over standard value, please equalization charge the battery group after discharging them and then float charge them for 1-2 month, please contact us if still have any departure.
②Repair batteries which with laggard single cell	1、Equalization charge of the battery group: charge the battery at upper limit voltage and last more than 10H, 3times of discharge cycle is necessary when case is serious. 2、On-line repair of single cell: Connect the activation meter or charger with the laggard battery and charge the single cell.	The difference of float charge voltage between single cell in a group of battery should meet the below standard: 2V series 90mV 6 V series 240mV 12 V series 480mV	Single cell should be replaced if it fails in repair.
③Activation charge and discharge	Charge and discharge the battery by one cycle, then charge the battery by the lower limit of the equalization voltage.	About 30% of the rated capacity is released.	Proceed this text on the batteries which float charge more than 6months but without discharge.

#### 6.2.3 Inspection item per year

Items	Contents	Standards	Maintenance
①Checking and discharge test	Cut off AC power supply, discharge battery with load, and discharging 30%~40% rated capacity.	Battery voltage should be over 1.90V/Cell after discharging.	If battery voltage is lower than standard value, please equalization charge the battery group after discharging and then float charging it for 1-2 month, please contact us if still have any departure.