Online

Sealed Lead-Acid Batteries

GENERAL TECHNICAL HANDBOOK
&
HANDLING PRECAUTIONS

CE

CONTENTS

1.RANGE OF ONLINE SEALED LEAD ACID BATTERIES

Online Sealed lead acid batteries provide a full range of power.
MICRO series is rated at 20 hour discharge rate and has designed life time of 3-5 years.
OL models are suitable for a wide range of general applications, including security and U.P.S.
OLU models are specially designed for U.P.S. and other high-power applications. OLU autonomy is 10%~30% more than our normal OL series. The percentage difference in autonomy is more significant for higher rates of discharge.

MICRO series ranges from 6V1.3AH to 6V12AH and 12V1.3AH to 12V26AH..
MEDIUM series ranges from 12V40AH to 12V100AH.

2. DESCRIPTION OF ONLINE SEALED LEAD ACID BATTERIES

2.1 BATTERY PROPERTIES

Online Sealed Lead Acid Batteries (SLA battery) are an advanced and economic rechargeable battery. They have several properties which differ from other types of batteries:

- Maintenance free - As it is valve-regulated, and sealed, the acid is trapped inside, so refilling it is not needed, it is also leak proof.
- High Power-To-Weight Ratio - **Online** SLA batteries can provide much more power in comparison to their weight. For example, 6V and 12V MICRO series battery capacity ranges form 1.3AH to 26AH, weight range only from 0.3 to 9.5 kg.
- No Memory Effect - Some batteries, e.g: nickel-cadmium batteries, will become conditioned to provide less power after repetitious short usage/discharge
- Low Self Discharge - The self-discharge rate for **Online** SLA batteries is about 2-3% per month at room temperature compared with 20-30% for other common battery systems.
- Long Service Life – The use of thick calcium grids ensure **Online** SLA batteries have a long service life.
- High Discharge Rate - Since the internal resistance is low, the battery can provide a high rate of discharge.
- Wide Operating temperature Range - **Online** SLA battery capacity is rated at 20°C and will operate from -15°C (5°F) to +50°C (122°F) when it is fully charged. Ambient temperature is 20°C, service life will be more efficient between 15°C and 25°C.
- Ease of shipment - It is classified as a dry battery and is acceptable to be shipped on passenger and cargo aircraft.

2.2 APPLICATIONS

Many kinds of product use **Online** SLA batteries as they are convenient, reliable and have an outstanding service life and capacity. Applications can be classified as Cyclic Use, Standby Use and Solar Cell Generation. Here are some examples:-

For ***Standby Use***

- Emergency lighting equipment
- Fire alarm and security systems
- Uninterruptable power supply
- Telecommunication equipment
- Electric equipment and telemeter equipment

For ***Cyclic Use***

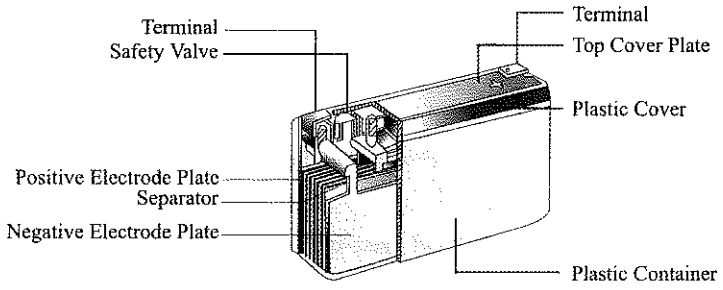
- Lighting equipment
- Wireless lawn mowers, vacuum cleaners and washing machines
- Toys and consumer electronics
- Portable power tools, measuring and medical equipment
- Portable video cameras
- Portable personal computers

For ***Solar Cell Generation***

- Garden lighting
- Portable power station

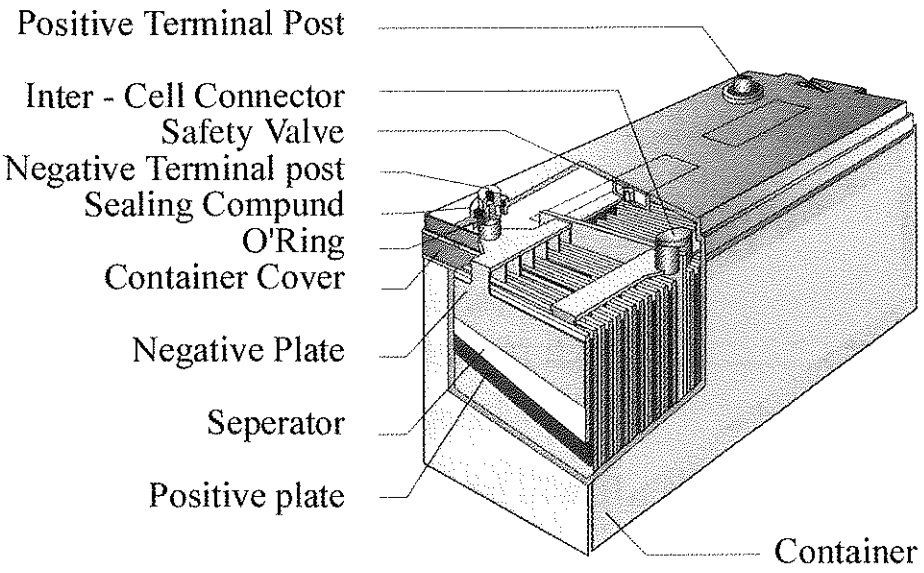
2.3 BATTERY CONSTRUCTION

Figure 1 - Construction of MICRO Series (6V models)



MICRO 12V models have same construction, but with 6 cells.

Figure 2 - Construction of MEDIUM series (12V)

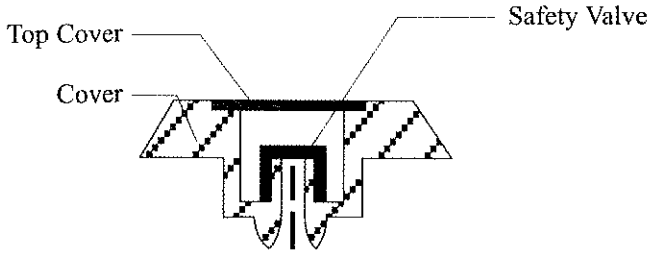


1. **Positive Electrode Plates**
   Positive plates are made of lead-calcium alloy with special chemical formula.

2. **Negative Electrode Plates**
   Negative plates are made of lead-calcium alloy with special chemical formula.

3. **Separator**
   The glass-fibre separator in **Online** SLA batteries is made with advanced technology - This high porosity of the separator retains adequate electrolyte for the reaction with the active material of the plates.

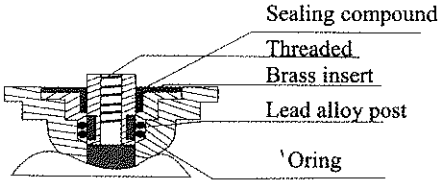
4. **Safety Valve**
   The valve system, which operates from 1 psi to 6 psi (0.07-0.43kg /cm2) is designed to release excess gas and keep the internal pressure within the optimum range of safety. It protects the negative plates from contamination from oxygen in the air. Valve are 100% visually inspected during battery production.



If the internal pressure is increased to an abnormal level during overcharge, the safety valve will be opened to release gas. This eliminates the danger of rupture. Once it has opened, it automatically closes in preparation for a future excessive increase in pressure.

5. **Terminal**
   Depending on the battery model in MICRO series, the terminals may be Fasten type or bolt-and-nut type. Terminals of MEDIUM series are bolt-and-nut type or 6mm stud.

Construction of threaded-insert stud



6. **Case**
   For 6V, and 12V batteries, standard containers are manufactured from flame retardent ABS plastic resin. Each 6V battery has 3 cells, and each 12V battery has 6 cells.

7. **Epoxy**
   The ABS plastic cover and container are sealed by a special epoxy made in Japan that is acid resistant.

2.4 ELECTROCHEMICAL PROCESS

(A) Chemical reaction formula during charge and discharge:

$$\underset{\substack{\text{(Lead Dioxide)}\\ \text{Positive}\\ \text{Active}\\ \text{Material}}}{PbO_2} + \underset{\substack{\text{(Sulfuric Acid)}\\ \text{Electrolyte}}}{2H_2SO_4} + \underset{\substack{\text{(Lead)}\\ \text{Negative}\\ \text{Active}\\ \text{Material}}}{Pb} \underset{\text{Charge}}{\overset{\text{Discharge}}{\rightleftharpoons}} \underset{\substack{\text{(Lead Sulfate)}\\ \text{Positive}\\ \text{Active}\\ \text{Material}}}{PbSO_4} + \underset{\substack{\text{(Water)}\\ \text{Electrolyte}}}{2H_2O} + \underset{\substack{\text{(Lead Sulfate)}\\ \text{Negative}\\ \text{Active}\\ \text{Material}}}{PbSO_4}$$

In this reaction, charging and discharge are reversed with high efficiency. Electrical energy used during discharge will be regained by recharging.

(B) In the final stage of charging or under overcharge:
Oxygen gas generation - Oxygen generates at the positive plate:

Reaction (1)

$$\underset{\text{(Water)}}{2H_2O} \rightleftharpoons \underset{\text{(Oxygen)}}{O_2} + \underset{\text{(Hydrogen ions)}}{4H^+} + \underset{\text{(Electrons)}}{4e^-}$$

(B) Oxygen gas absorption - Oxygen generated from the positive plate converts to the surface of the negative plate, and absorption takes place:

Reaction (1)

$$\underset{\text{(Water)}}{2H_2O} \rightleftharpoons \underset{\text{(Oxygen)}}{O_2} + \underset{\text{(Hydrogen ions)}}{4H^+} + \underset{\text{(Electrons)}}{4e^-}$$

The above reactions of generation and absorption can be expressed as follows:

Reaction (2)

$$\underset{\text{(Lead)}}{2Pb} + \underset{\text{(Oxygen)}}{O_2} + \underset{\text{(Sulfuric Acid)}}{2H_2SO_4} \longrightarrow \underset{\text{(Lead Sulphate)}}{2PbSO_4} + \underset{\text{(Water)}}{2H_2O}$$

Since oxygen gas generated in the final stage of charging is absorbed by the negative plate, there is no increase in internal pressure.

(C) Overcharge or abnormal charge: However, when the battery is overcharged or when charging is conducted at less than the specific temperature, the amount of oxygen gas generated by reaction (1) cannot be fully-absorbed by reaction (2). So the internal pressure increases and the safety valve activates.

The gas including hydrogen generated (along with oxygen) at the negative plate during excessive overcharge will be released.

NEGATIVE PLATE

Reaction (3)

$$\underset{\text{(Hydrogen ions)}}{2H^+} + \underset{\text{(Electrons)}}{2e^-} \longrightarrow \underset{\text{(Hydrogen)}}{H_2}$$

It should be noted that when the safety valve functions, electrolyte is consumed and performance deteriorates. To prevent or reduce this, it is important that charging should be conducted under recommended conditions without overcharging.

3. CHARGING CHARARCTERISTICS

3.1 CHARGING METHODS

There are four charging methods:-

3.1.1 Constant Voltage Charging

Charging at constant vol tage is the most suitable and commonly used method for charging ***Online*** batteries. The charger voltage must be stabilized in a narrow range and with a device to suppress the initial current to less than 0.3C. The initial current limitation can be a accomplished by a constant-current regulator, a properly designed output-voltage from the power transformer, or by designing the overall impedance of the circuit (such as using a current regulating resistor). During the final stage of charge, the current decreases automatically. Fig. 1 & 2 show constant voltage charger circuits provided with constant voltage function, composed of transformers, transistors, silicon diodes, IC's, etc.

Fig. 1 FOR 6VOLT BATTERIES

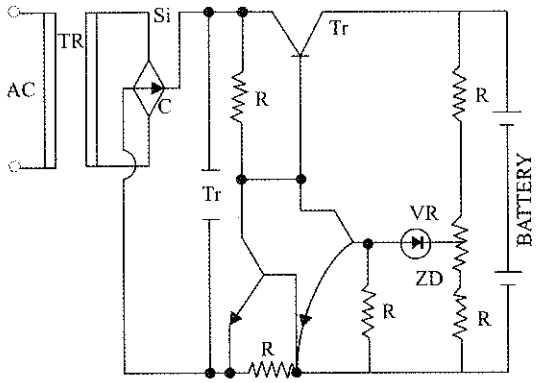
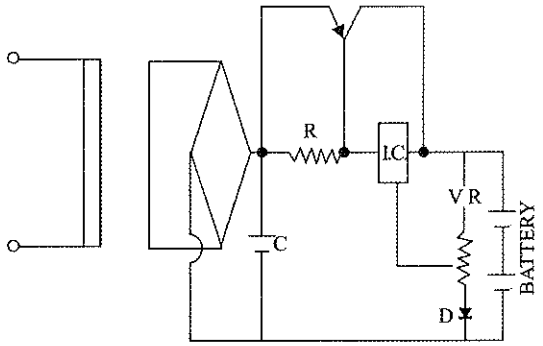


Fig. 2 FOR 12VOLT BATTERIES



It is desirable for the charger to be temperature-compensated. For more details, please refer to section 3.5.

3.1.2 Constant Current Charging

It is an effective method for supplementary charging of many batteries at one time in series during storage, but the charging time must be strictly controlled. If the charging is continued at the same rate for an extended period of time after the battery reached a fully-charged state, battery voltage rises excessively, water decomposes, heat generates, and a severe overcharge may occur resulting in heavy damage to the battery. For a maximized life, it is not recommended to repeatedly use constant current charging for refreshing batteries.

3.1.3 Taper-current Charging

In this system, the charging current drops gradually as the charging proceeds. It shall be accompanied by using a power transformer with a secondary voltage which is considerably higher than the battery voltage and a suitably high-resistance in the circuit for current limitation. A charging cut-off circuit should be incorporated in the charger to prevent overcharge. It can then be utilized in industrial uses for charging multiple numbers of batteries and for trickle charging system.

3.1.4 Two-step Combination Charging

This method employs two steps of charging. It can be constant current-constant current, constant current-constant voltage, etc. The switching from the first step to the second can be carried out by a battery voltage sensor, time control, or charge current sensor.

3.2 CHARGING APPLICATION TIPS

Battery life is affected by the charger's performance and the battery's operating conditions. Charger selection depends on the battery usage which may be cycle use or standby use (either under trickle charge or float charge operation). Please refer to Table 1.

Table 1. Charging method & battery application

<table>
<tr><td>Application</td><td colspan="2">Standby / Backup use</td><td>Standby use</td><td>During Storage</td></tr>
<tr><td>Charging Method</td><td>I
Trickle Charge Operation</td><td>II
Float Charge Operation</td><td>III
Cyclic Charge Operation</td><td>IV
Refresh Charge During Storage</td></tr>
<tr><td rowspan="3">Constant Voltage Charging</td><td colspan="2">Regulation range of controlled voltage (20°C,68°C;F)
:- 6V Batteries : 6.75V to 6.9V
:- 12V Batteries : 13.5V to 13.8V</td><td colspan="2">Regulation range of controlled voltage (20°C,68°C;F)
:- 6V Batteries : 7.2V to 7.5V
:- 12V Batteries : 14.4V to 15.0V</td></tr>
<tr><td>This method can provide a short-time charge</td><td>The charge's current capacity must be big enough to maintain the specified charging voltage during float</td><td colspan="2">Short-time charge allowed
Same model batteries, under the same storage, can be charged in series, otherwise they should be recharged in separate groups</td></tr>
<tr><td colspan="4">The charge voltage must be stabilized. Otherwise, battery may be overcharged or discharged. The charger should be temperature compensated when using battery in a wide range of ambient temperature</td></tr>
<tr><td>Constant Current Charging</td><td>Not Recommended</td><td>Not Recommended</td><td>Not Recommended</td><td>Charging current:-Approx. 0.1C
Charging time Control is strictly recommended. Otherwise, charge may occur.
No temperature compensation is needed.</td></tr>
<tr><td>Tapered Current Charging</td><td>Not Recommended</td><td>Not Recommended</td><td>Not Recommended</td><td>Not Recommended</td></tr>
<tr><td>Two-Steps combination charging</td><td>Two-step constant current charge is highly recommended1) approx. 0.4C at the first step.2)0.002C-0.005C at the second step A time control or a charging voltage detection device is required to transfer from the first step to the second</td><td></td><td></td><td></td></tr>
<tr><td colspan="5">Note: C rate in the table refer to current as a percentage of nominal capacity
Example: For model OL7.2-12 (7.2AH)
0.3C = 0.3x 7.2A = 2.16Amp</td></tr>
</table>

3.2.1 Trickle-charge standby application

Under standby use, batteries are normally kept in fully-charged condition, and serve as a power supply to the load when AC power fails. Under trickle charge operation, AC power is normally supplied for operating the equipment, while charging the batteries which are not connected to the load. If the AC power fails, a relay circuit connects the batteries to the load and battery power is supplied. A two-rate charger or a constant voltage charger can be used.

3.2.2 Float-charge standby application

In this system, the load and the battery are connected in parallel with the rectified power source. This system requires only a constant voltage charger, regardless of the power consumption by the load. As the regulated voltage of a float charger is very close to the open circuit voltage of the battery, major fluctuation in charge voltage may cause battery discharges while on float. Therefore, in general, battery life in float charge is shorter than in trickle charge.

3.2.3 Cyclic application

Cyclic use requires protection against excessive charge and discharge, because the battery may be operated under unfavourable conditions by inexperienced users.

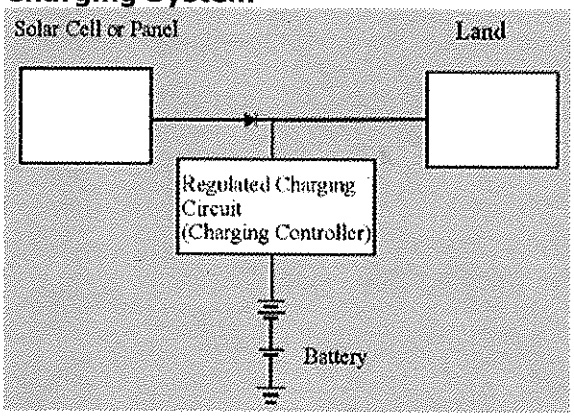
3.2.4 Refresh charge during storage

Constant voltage charge or constant current charge with limited time can be used.

3.2.5 Solar-powered Charging

Battery can be an indispensable component of any solar powered system.

Fig. 3 Block diagram of a Solar-powered Charging System



Naturally, in a case where the output of the solar array may exceed the capacity of the battery, or where weather conditions are such that there is potential for overcharging the battery, it is recommended to apply an appropriate regulated circuit between the solar panels and the battery.

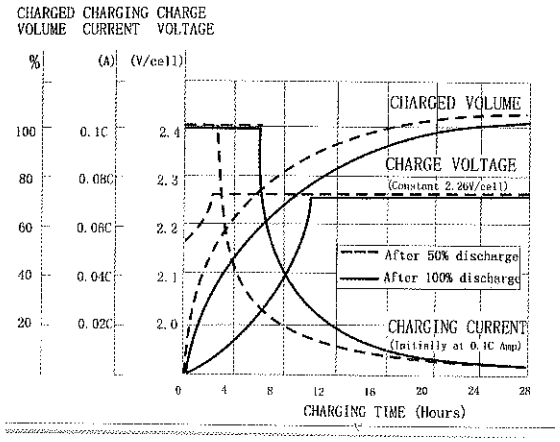
Online Batteries can be charged by the solar array using a regulated circuit as shown in Figure 3.

As the system is exposed to direct sunlight, usually a highly reflective, heat-resistant surface material is needed.

It is desirable for the charger to be temperature-compensated. For more details, please refer to section 3.5.

3.3 FLOAT CHARGE CHARACTERISTICS

Fig. 4 Constant voltage charge characteristics at initial charge current of 0.1CA and constant voltage of 2.26V per cell at 20°C, 68°F

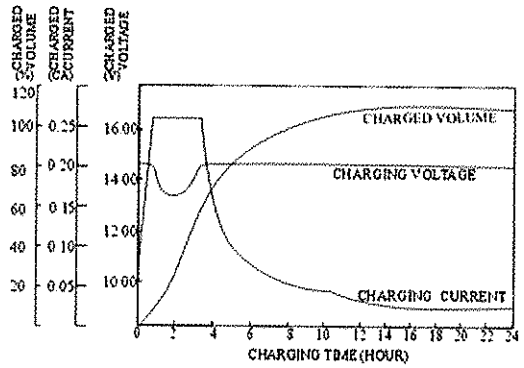


The time required to complete the charging varies by the discharge depth, initial charge current and temperature. As shown in Figure 4, charging a fully-discharged battery by 0.1CA initial current and constant voltage of 2.26V per cell at 20°C will need about 24 hours. However, under float charge, ***Online*** battery has no limitation on initial charge current, so increasing the initial charge current will shorten the charging time.

3.4 RECOVERY CHARGE AFTER DEEP DISCHARGE

Battery will be subjected to deep discharge or overcharge when it is discharged below our specified cut-off voltage. Battery life would be shortened and it requires a longer charging period than normal. From Fig.5, please note that as a result of high internal resistance, the charging current acceptable during initial stage of charging will be quite small, but will increase after more than 30 minutes when the internal resistance has been overcome. Then normal charging characteristics resume. Battery capacity may be recovered, but may be less than full capacity, if internal chemical combination is damaged.

Fig. 5 Recovery charge after over-discharge



Deep Discharge Conditions:-

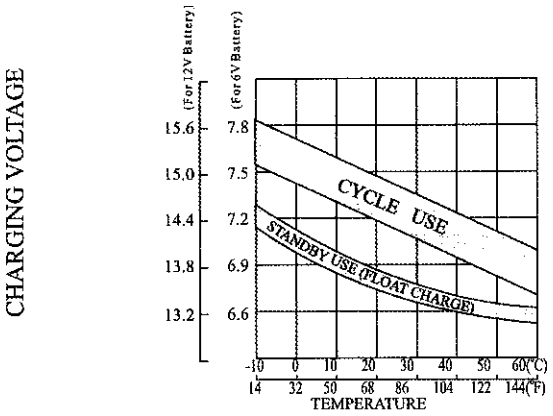
- 0.25CA, 14.5V constant voltage charging for 24 hours.
- Deep discharge with 2 ohm resistor for 24 hours.
- Stored for 30 days in open circuit in open circuit condition.
- Ambient temperature: 20°C (68°F)

3.5 INITIAL CHARGE CURRENT LIMIT

A discharged battery will accept a high charging current at the initial stage of charging. But a continuously high charging-current can cause abnormal internal heating which may damage the battery. Therefore, it is necessary to limit the initial charging current to 0.3C or below, under constant voltage charge in cyclic application.
Under constant-voltage charge, the ***Online*** battery is designed so that it will not accept more than 2C Amp, even when the available charging current is higher than the recommended limit. Moreover, the charging current will then continue to fall to a relatively small value. Normally no current limit is required for standby applications with recommended constant-voltage charge. But excessive charging current may break the internal connection mechanically.

3.6 TEMPERATURE COMPENSATION

Fig. 6 Relationship between charging voltage and temperature



Electrochemical activity in a battery increases when temperature rises and conversely decreases when temperature falls. Therefore, when temperature rises, the charging voltage should be reduced to prevent overcharge. And when temperature falls, it should be increased to avoid overcharge. Generally, use of a temperature-compensated charger is recommended in order to attain optimum service life. The temperature recommended compensation factors for 6V ***Online*** batteries are -10mV°C (for standby use) and -15mV/°C (for cyclic use), when temperature is not 20°C/68°F. Fig. 6 shows the relationship between temperature and charging voltage in both standby and cyclic applications.

4. DISCHARGE CHARARCTERISTICS

4.1 DISCHARGE CHARACTERISTICS AT DIFFERENT DISCHARGE RATE

Ampere hour capacity of the battery depends on the discharge rate being used. The ***Online*** battery MICRO series is rated at a 20 hour discharge rate which is defined as the nominal capacity or 100% capacity point, while the MEDIUM series is rated at a 10 hour discharge rate. Final voltage is 1.75V per cell.

Fig. 7 Discharge Characteristic Curves at various rate (at 20°C, 68°F) for MICRO series

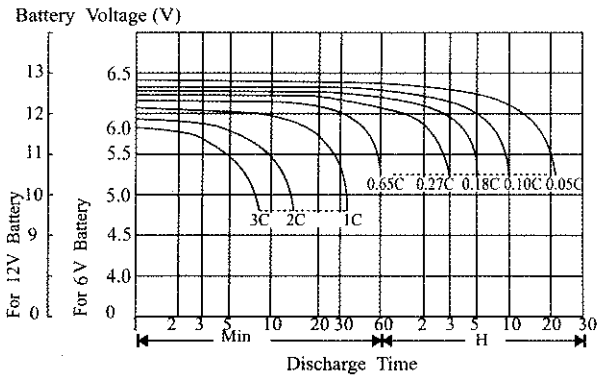


Fig. 8 Discharge Characteristic Curves at various rates (20°C, 68°F) for MEDIUM series

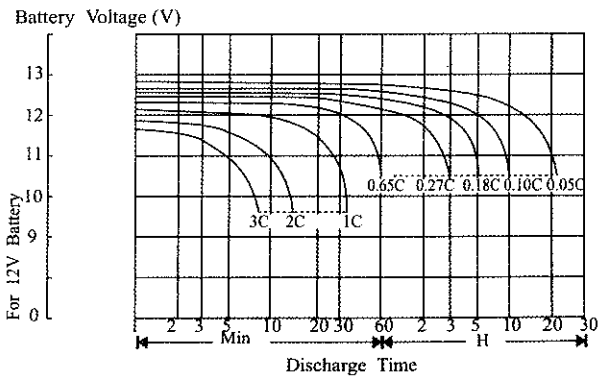


Fig. 7 & Fig. 8 show the discharge performance at various discharge rates. When the loading on the battery is increased, the available capacity drops.

4.2 FINAL DISCHARGE VOLTAGE

Table 2. Discharge current and final discharge voltage

Discharge Current (A)	Final Discharge Voltage	
	For 6V battery	For 12V battery
(A) < 1.0C5 25	5.25V	10.5V
(A) ≥ 1.0C4 8	4.8V	9.6V

Table 2 shows the lowest final discharge voltage at various discharge current

The battery should never be discharged to less than the pre-determined final discharge voltage. Otherwise, over discharge may result. Internal chemical combination is damaged, chemical reaction and hence the battery capacity will be reduced. Also, repeated over-discharge may cause failure to recover capacity even by charging.
Battery lifetime will be reduced. Each 6V battery has 3 cells, and each 12V battery has 6 cells. For example, when a OL 7.2-12 (12V 7.2AH) battery is discharged at 1.0°C (1X7.2=7.2AH), a cut-off device should be installed to cut-off discharge automatically when the discharge voltage/loading voltage reaches 9.6V (1.60V X 6 cells). This can protect the battery from over-discharge.

4.3 TEMPERATURE EFFECT ON DISCHARGE CAPACITY

Fig. 9 Temperature and discharge capacity

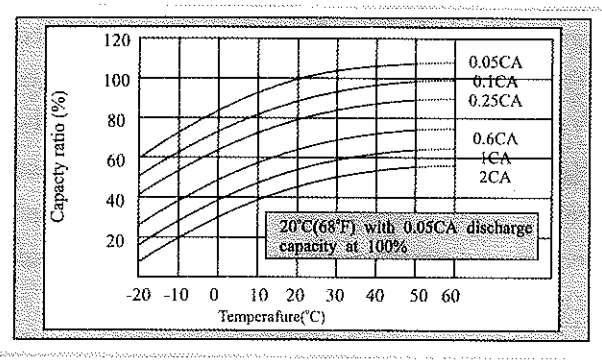


Fig. 9 shows the temperature effects. Increasing temperature increases the capacity ratio.

Avoid operating the battery below -15°C (5°F) or beyond 50°C (122°F), since this may damage the battery even though it may still operate.

4.4 INTERNAL RESISTANCE CHANGE

Fig. 10 Internal resistance change

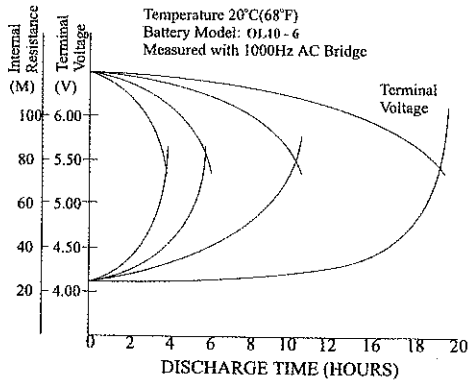


Fig 10 shows the internal resistance of a **Online** battery measured through a 1000Hz AC bridge.

Internal resistance of an ***Online*** battery is the smallest when the battery is charged completely and it increases slowly when discharge progresses, but rapidly at the final stage of discharge. It will be observed that the internal resistance decreases slowly when the discharge is terminated.

5. STORAGE

5.1 SELF DISCHARGE

Fig. 11 Self discharge charact eristics

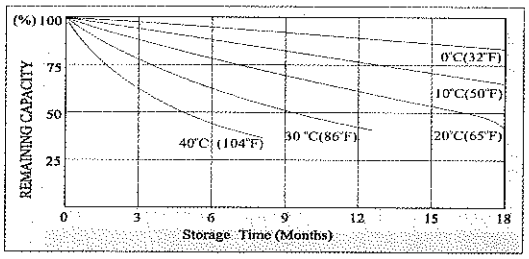


Fig. 11 shows the relation between the storage time at various temperatures and the remaining capacity.
Self-discharge rate of an ***Online*** battery is approximately 3% per month when batteries are stored at an ambient temperature of 20°C (68°F). The self-discharge rate varies with temperatures.

Fig. 7 & Fig. 8 show the discharge performance at various discharge rates. When the loading on the battery is increased, the available capacity drops.

5.2 SHELF LIFE

Shelf life is the life of a battery when stored in the unused condition. Generally, lead sulphate is formed on the negative plates which are referred to as "sulphation" when a lead acid battery is stored in a discharged condition for an extended period of time.
Higher temperatures will accelerate sulphation. Since the lead sulphate acts as an insulator, sulphation decreases the battery charge acceptance.

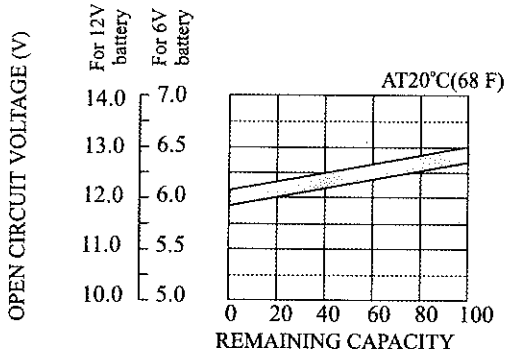
Table 3. Shelf life at various temperatures

Temperature	Shelf Life	
0° (32°F) to 20° (68°F) 21° (70°F) to 30° (86°F) 31° (88°F) to 40° (104°F) 41° (108°F) to 50° (122°F)	12 months 9 months 5 months 2.5 months	Table 3 shows that battery shelf life will be reduced when stored at higher temperatures.

Limited use (a few days) at a temperature outside the ranges recommended above will adversely affect the service life.
Prolonged use of batteries at elevated temperatures will reduce the shelf life expectancy.
Batteries should be kept in a cool, dry place, at 20°C~25°C.

5.3 REMAINING CAPACITY MEASUREMENT (BY OPEN CIRCUIT VOLTAGE)

Fig. 12 Open circuit voltage Vs Remaining capacity



The approximate remaining capacity of an ***Online*** battery can be empirically determined from Fig. 12.

5.4 SUPPLEMENTARY CHARGE / REFRESH CHARGE

During storage, supplementary charging is needed when the remaining capacity is 80% or less. Table 4 shows the recommended supplementary charge interval and method under different storage temperatures. Sometimes, supplementary charging shall be repeated until capacity is recovered to the pre-storage capacity. When open-circuit voltage falls below 6.0V / 12.0V at 20°C and due to self-discharge during extensive storage, supplementary charging may fail to recover the capacity. However, storing batteries at 15°C or below will give a shelf life of over 12 months before supplementary charging is necessary.

Table 4 Supplementary Charge Interval and Charge Method Storage Temperatures

Storage Temperature	Recommended Supplementary Charge Interval	Supplementary Charge Method
Below 20°C(<68°F)	Every six months	16-24 hours with a constant voltage of 2.275 V/ cell
20°C to 30°C(68°F to 86°F)	Every three months	5-8 hours with a constant voltage of 2.34 V/ cell
Over 30°C(>86°F)	Storage to be avoided	5-8 hour with a constant current of 0.05CV

6. SERVICE LIFE

6.1 CYCLE SERVICE LIFE

The most important factor is the depth of discharge which has a reverse effect on cycle service life.
Fig.13

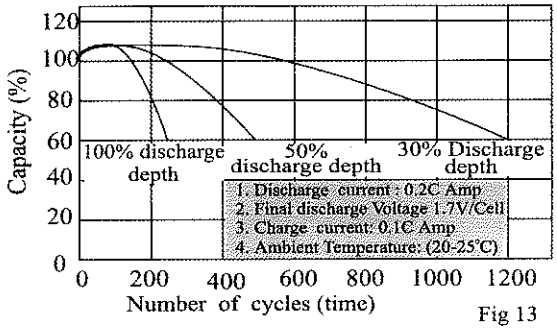


Fig 13

Fig. 13 shows the effects of depth of discharge on cyclic life.
The discharge capacity has the trend to increase in the initial stage of the cycle and it reaches the maximum at about 50 cycles.

6.2 TRICKLE/ FLOAT SERVICE LIFE VOLTAGE

Fig 14 shows temperature effect on float life of the **MICRO** series. The **Online** battery is designed to operate in float / standby use up to 5 years on the basis of accelerated tests.
Fig 15 shows temperature effect on accelerated float service life of the **MEDIUM** series batteries.

Fig. 14 Float service life of MICRO series

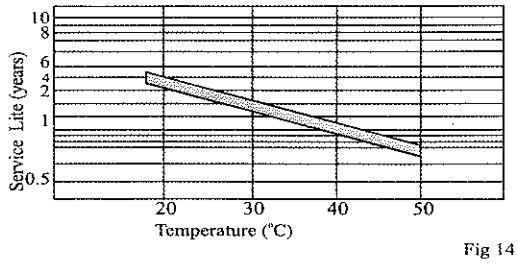
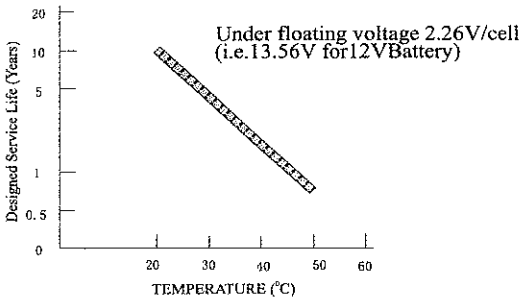
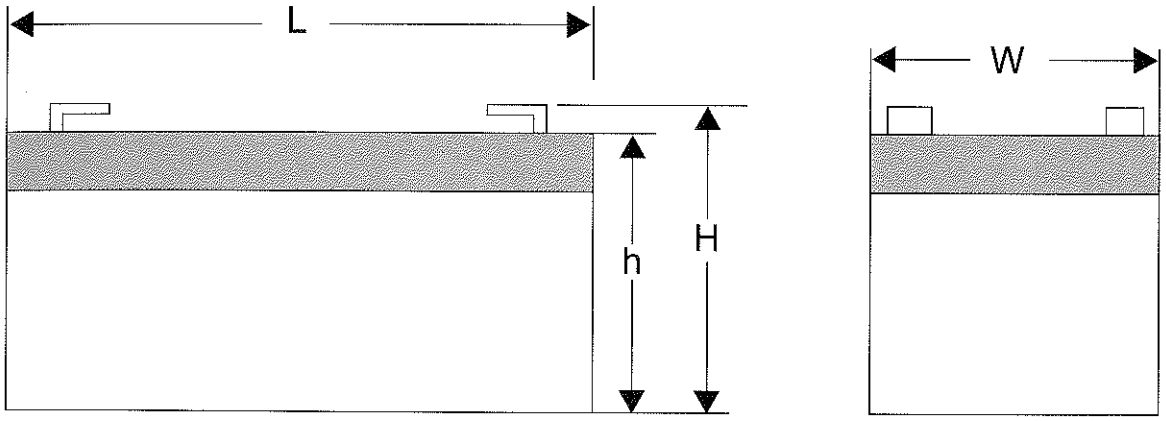


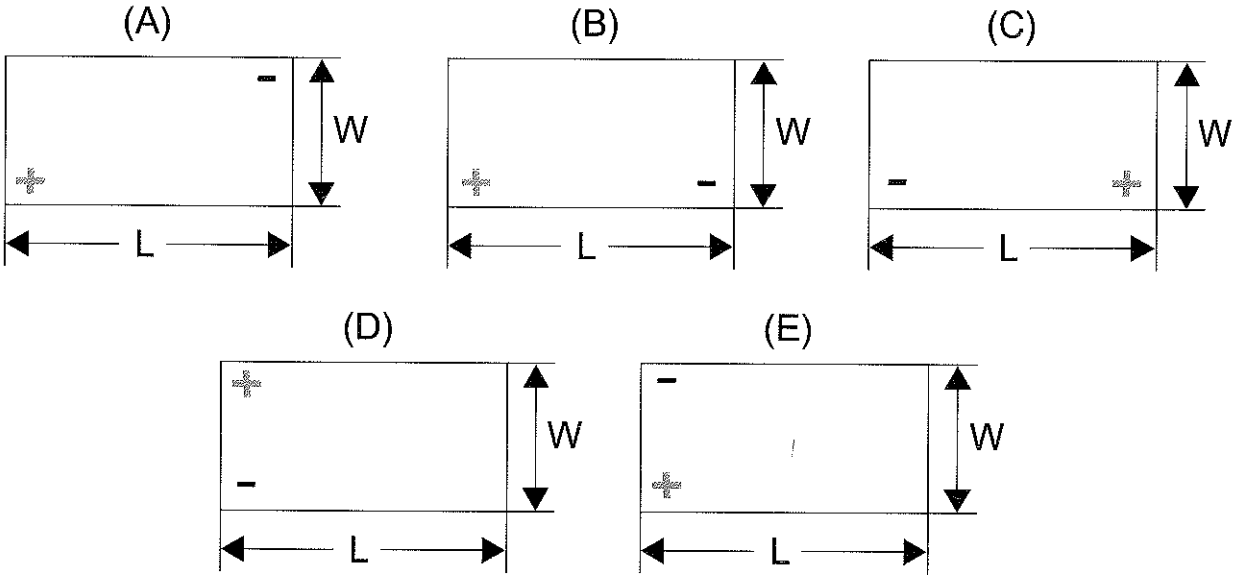
Fig 14

Fig. 15 Float service life of MEDIUM series



7. TERMINAL POSTION

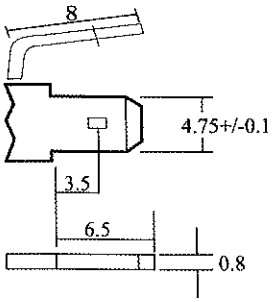




Lynteck Code	Model	Voltage	Capacity	Dimensions (mm) L	W	h	H	Approx. Weight	Terminal Position	Standard Terminal Type
LY11-030-15	OL1.3-6	6	1.3Ah	97±1	25±1	51±2	57±2	0.30 Kg	(B)	187A
LY11-033-18	OL3.3-6	6	3.3Ah	134±1	34±1	60±2	66±2	0.68 Kg	(B)	187E
LY11-034-19	OL4.2-6	6	4.2Ah	70±1	48±1	101±2	107±2	0.84 Kg	(A)	187E
LY11-038-23	OL10-6	6	10Ah	151±1	51±1	94±2	100±2	1.80 Kg	(B)	187E
LY11-039-24	OL12-6	6	12Ah	151±1	51±1	94±2	100±2	1.94 Kg	(B)	187E
LY11-042-19	OL1.3-12	12	1.3Ah	97±1	43±1	52±2	57±2	0.58 Kg	(E)	187A
LY11-044-21	OL2.2-12	12	2.2Ah	178±1	34±1	60±2	66±2	1.00 Kg	(B)	187E
LY11-045-22	OL3.3-12	12	3.3Ah	134±1	67±1	60±2	66±2	1.30 Kg	(D)	187E
LY11-046-23	OL4.2-12	12	4.2Ah	90±1	70±1	100±2	106±2	1.65 Kg	(B)	187E
LY11-047-24	OL7.2-12	12	7.2Ah	151±1	65±1	95±2	101±2	2.55 Kg	(D)	187E
LY11-048-25	OL12-12	12	12Ah	151±1	99±1	96±2	101±2	3.94 Kg	(D)	187E
LY11-049-26	OL18-12	12	18Ah	181±1	77±1	167±2	167±2	6.10 Kg	(C)	Bolt & Nut
LY11-050-27	OL26-12	12	26Ah	175±1 1	166±1	126±2	126±2	9.50 Kg	(C)	Bolt & Nut
LY11-059-28	OLU40-12	12	40Ah	197±2	166±2	170±2	170±2	13.00 Kg	N/A	6mm Stud
LY11-060-21	OLU65-12	12	65Ah	348±3	167±2	178±2	178±2	23.50 Kg	N/A	6mm Stud
LY11-061-22	OLU100-12	12	100Ah	330±2	172±2	215±2	223±2	32.00 Kg	N/A	6mm Stud

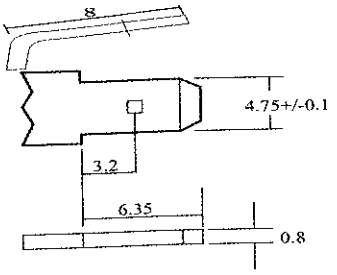
8.TERMINAL TYPE (+/- 1mm) with examples of common applicable models

F1 (Fasten Tab No.187E)



Applicable models:
6V 3.3 - 6V 12AH
12V 2.2 - 12V 12AH

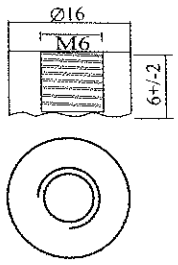
F2 (Fasten Tab No.187A)



Applicable models:
OL 1.3 - 12
OL 1.3 - 6

I1 (Threaded Insert terminal 6mm stud)

Bolt Type: M6



Applicable models:
OLU 10 - 12
OLU 65 - 12
OLU 100 - 12

9. HANDLING PRECAUTIONS AND APPLICATION TIPS

9.1 INSTALLATION CAUTIONS

1. Initial preparation before installation:-
   Verify no abnormalities on battery case (like crack or leakage)

2. Free air space must be provided between each battery. Recommended minimum space is 5~10mm (0.02~0.04 inches).

3. Choose a proper mounting place:-
   - Away from heat source (such as a transformer). Otherwise, battery temperature will be raised and shorten battery life.
   Optimal temperature is 20°C 68°F.
   - Located in the lowest part of the equipment
   - Away from device that may cause sparks (such as switch or fuse), because battery may generate inflammable gases during overcharge
   - Do not place near open flame
   - ***Online*** battery is designed to be used in any position, but charging in upside-down position should be avoided.
   Otherwise, leakage of electrolyte from safety vents may occur during excessive charge. Do not put batteries into airtight container(s) to release gas generated from excessive charge and avoid explosion.

4. Provide enough insulation on lead wires when connecting battery and the equipment.

5. Set the batteries firmly in the equipment. Otherwise, batteries may be damaged, or connection conductivity may be decreased due to shock. When batteries are used in vibration conditions, they should be mounted in an upright position and with a proper cushion for protecting vibration.

6. For applications requiring more than one battery, first make the inter-battery connections properly, then connect the batteries to the charger or the load. Before connection, switch off the circuit of the charger/load. Be careful to connect the positive (+) battery terminal to the (+) pole of the load/charger. Wrong connection will result in explosion, fire and /or damage of the charger/loading equipment and the battery.

7. Pay attention to the high voltage when a large number of batteries are connected in series. Be sure to wear rubber gloves before installation or maintenance.

8. If 4 or more battery groups are to be used in parallel connection, consult ***Online*** first.

9. Avoid mixed usage of batteries differing in capacity, manufacturer, storage or charge/discharge conditions. Batteries may be damaged after cycles due to difference in electrical characteristics.

9.2 CHARGE CAUTIONS

1. Do not charge batteries under direct sunshine or near heat generator. Otherwise, battery temperature may increase abnormally high and batteries could be overcharged.

2. Batteries shall be properly charged (to avoid insufficient charge or excess charge) for safety, full battery performance and optimum life. Please refer to the previous section about charging for details.

3. In cyclic operation, do not continue to charge battery over 24 hours to avoid battery overcharge and deterioration.

4. When designing the charger, take battery damage modes into consideration, and protection against short-circuits, and / or protection for the charger output.

9.3 DISCHARGE PRECAUTIONS

1. Do not discharge the batteries below our recommended final discharge voltage (cut-off voltage) shown in previous table to avoid over discharge. Pay attention to design a proper cut-off device.

2. Battery shall be charged immediately after use, even if discharge is cut-off before our recommended cut-off voltage. If batteries are not charged after discharge and then stored, they may deteriorate and become more difficult to be recharged, due to the increase in internal resistance.

9.4 STORAGE PRECAUTIONS

1. Store the battery in a stable position and store away from conductive material (like metallic or dropping material).

2. Disconnect the battery from the load/equipment before storage to avoid possible over-discharge or damage. Storage must be take place in a cool dry place to reduce self-discharge and to avoid terminal corrosion.

9.5 REFRESH CHARGE CAUTIONS

1. Batteries will have self-discharge during shipment and storage, therefore refresh the charge before putting into service to recover the capacity. Conditions and method to refresh the charge are mentioned earlier.

2. Refresh charge the battery during storage at least once every 6 months during storage below 20°C (68°F).
   Recharge method and time interval as previous table.

3. For batteries stored for a long time, their capacity may not be fully-recovered. If batteries are stored for say 1-2 years, they may need to be recharged by 12~15 hours more than normal.

9.6 REGULAR CHECK AND REPLACE PRECAUTIONS

1. Measure the total voltage of the batteries during float charge to see whether there is any abnormal deviation and investigate the situation.

2. When the batteries are connected in series, the batteries in one string should be exchanged / replaced together.

3. Replace the battery before shelf life ends at various temperatures. Please refer to previous table about shelf life.

9.7 TRANSPORTATION PRECAUTIONS

1. Handle the batteries carefully to avoid injuries.

2. Avoid moisture or rain on the batteries and cartons.

3. Transport the batteries in the upright position and avoid abnormally strong shock / vibration.

4. Do not lift a battery by its terminal. Otherwise, internal construction may be damaged and leakage may occur.

9.8 OTHER PRECAUTIONS

1. Clean battery with wet soft cloth. Never apply oil, polyvinyl chloride or organic solvents (like gasoline and paint thinner) to the battery. Otherwise, battery cover may be cracked / deform and acid leakage will result.
2. Do not disassemble the battery. Otherwise, sulphuric acid will flow out.
3. If sulphuric acid deposits on to the skin or cloth, wash immediately with water. If splashed into eyes, wash with a large amount of water and consult a doctor.
4. Avoid dusting by cloth duster or dry cloth (particularly chemical textile), as they will generate static electricity which is dangerous.
5. Wash your hands after handling battery.
6. Do not short the battery terminals.
7. Never dispose of a battery into fire.

NOTES TO BATTERY USERS

It is the responsibility of each battery user to ensure that their application product is adequately designed, safe and compatible with all conditions encountered during use, and conforms with existing standards and requirements. Like other famous battery manufacturers, information in this technical handbook is generally descriptive only and is not intended to imply any guarantee or warranty to individual batteries. Cell and battery are subject to modification without individual notice.

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Tel: 0906 711 2329

(calls charged at 50p per minute)

Online

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Company policy is one of continuous improvement,
we reserve the right to change specification without prior notice