

Installation and Connection

(1) When the batteries are mounted in the equipment, exercise caution to insure easy checking, maintenance and battery replace ability. In addition, the batteries should be located in the lowest part of the equipment as possible. The Sealed Lead-Acid Batteries are designed for use in any position. But charging batteries in the upside down position should be avoided.

* When batteries are charged excessively in the upside-down position, leakage of electrolyte from the safety vents might occur.

(2) Study and test the material and shape of the battery connectors which form the interface between the batteries and the application, including life test.

* This interface is very important because it has a big influence on the battery characteristics.

(3) Set the batteries firmly, so they do not move freely in the equipment. This avoids unexpected vibration and /or shock.

* When the batteries are not set firmly, the batteries might be damaged or the conductivity at the connected portion might be decreased.

(4) Avoid locating the batteries near a heat generating device (such as a transformer).

* When the batteries are located near a heat generating device, the temperature of the batteries is raised resulting in short life and /or so called "thermal runaway".

* "Thermal runaway" is a phenomena that can occur when the batteries are charged at high constant voltage and /or at high temperature. The charging current gradually becomes large resulting in large amount of heat generating, and finally the batteries are destroyed by this heat generation.

(5) Do not locate the batteries near a device that may cause sparks (such as a switch and a fuse). And do not bring fire close to the batteries.

* The batteries may generate inflammable gas when they are charged excessively, and a spark could explode this gas.

(6) In applications requiring more than one battery, first make batteries mutual connections properly, and then connect the batteries strings with the charger or the load. Be careful to connect the + pole of the batteries to + terminal of either the charger or the load.

* If the polarity of the batteries, the charger and the load are not connected properly, explosion, fire and /or destruction of the equipment may occur. And, in some cases can cause injury to personnel.

(7) Provide enough insulation about lead wires between the batteries and the application.

* If this insulation is not enough, danger and /or damage due to heat generation arising from short circuit (or excess current), such as a burn, smoke or fire, may occur. And possible danger of electric shock can happen.

(8) Pay attention to the high voltage when a large number lot of batteries are connected in series (This produces high DC voltage).

(9) Do not bend the terminal tabs, and /or do not solder directly on them. Please consult our company when soldering can not be avoided.

(10) Turn off the switch of the circuit when connections between the batteries and the charger and /or the load.

(11) Do not put the batteries into airtight containers. Exhaust slits must be provided when putting the batteries in a container, bag, or the like.

* The batteries tend to generate inflammable gas if they are excess charge, and this gas can cause explosion.

Refresh Charge

The batteries should be charged before use. Conditions for refresh charge are as follows.

Charging method	Charging condition (at 77°F (25°C))
Constant voltage	Regulation range of controlled voltage:
	2V : 2.43V~2.50V ;
	4V : 4.87V~5.00V;
	6V : 7.30V~7.50V;
	8V : 9.73V~10.00V ;
	12V : 9.73V~10.00V;

	<p>Initial current: 0.1CA to 0.4CA Maximum charging time:24 hours * Short-time charge is allowed. Several batteries of the same model, under the same storage, can be charged in series. Otherwise they can be charged in separate groups.</p>
Constant current	<p>* Charging current: 0.1CA. * Charge time (hours) =[Amount of self-discharge (Ah) /0.1CA]×120% Note: Rough estimation of self-discharge; When the storage ambient is lower than 77°F(25°C) & time is clear, assume it as follows: Amount of self-discharge=[5% / month]×storage months * In any case, charge time for refresh must be shorter than 12 hours.</p>

* The batteries tend to lose a part of their capacity due to self-discharge during shipment and storage. Therefore this charging is necessary to get full capacity.

* Insufficient charge decreases capacity by lack of sufficient charge, and excess charge decreases capacity by damaging the batteries.

□ Daily Charge

(1) Study any new charging method and condition of the batteries which is not written in this specification.

* A proper charging method is necessary for safety, and getting full performance of the batteries.

(2) Do not charge the batteries in a place where there is direct sunshine.

* The temperature may increase abnormally high, and the batteries could be overcharged.

(3) Do not charge the batteries near a heater or the like where heat accumulation may occur.

(4) Charge the batteries for the time shown by the specification, or to the time when the charge indication lamp shows the end of charge.

* If the batteries are not charged sufficiently, their life may be shortened.

(5) Avoid charging fully charged batteries frequently, it will shorten life.

(6) Do not continue to charge the batteries over 24 hours in cyclic operation.

(7) Avoid parallel charge in cyclic operations.

* Parallel charge in cyclic applications may shorten the service life of the batteries, by causing unbalance in charge /discharge of the batteries connected in parallel.

□ Discharge

(1) The cut-off voltage of discharge varies higher or lower depending upon the discharge current. The relationship between the discharge current and the recommended cut-off voltage is shown in "Discharge characteristics". Do not discharge the batteries lower than this recommended cut-off voltage.

* When the batteries are discharged lower than this cut-off voltage, they may be over discharged and may be damaged in performance.

(2) It is important to avoid over discharge, and charge the battery immediately after discharge.

* Even if the discharge of the batteries are stopped before the batteries reach the recommended cutoff voltage, the batteries may be deteriorated if they are not charged after discharge and are stored.

* If a circuit (or device) for preventing over discharge (and weak current as well) is not provided for the equipment, the batteries may be over discharged and may not recover their capacity after charge.

* When the batteries are stored in the discharged state, they may be have difficultly recharging due to the increase in the internal resistance.

□ Check and Maintenance

It is advisable to periodically to do check and maintenance.

(1) Measure the total voltage of the batteries during trickle charge (or float charge). If the charge equipment provides a irregular (incorrect) read-out, be sure to investigate the reason behind any deviations from the specified voltage range.

* When the total voltage is lower than the specified voltage, the batteries may lose their capacity by lack of sufficient charge. And when the total voltage is higher than the specified voltage, the batteries may lose their capacity by damage due to overcharge, and may suffer from "thermal runaway".

(2) Check the batteries for any sign of irregularities in appearance. If any damage such as a crack and deformation, or electrolyte leakage is found on the case, cover, etc., the batteries must be replaced with a new one. Also, clean the batteries if these are found dirty due to dirt and dust.

* If the batteries with irregular appearance continue to be used, decrease of capacity, leakage of electricity, smoke and /or fire may occur.

□ Exchange of the Batteries

- (1) Exchange the batteries from current ones to the new ones, when there is any abnormality in appearance or characteristic of the batteries. When the batteries are connected in series, the batteries in one string should be exchanged at once.
- (2) Exchange the batteries to new ones before they are used for the expected years in trickle charge (or float charge) below 77°F(25 °C) around them. The interval of this exchange should be shortened by temperature increase of every 50°F(10°C).

* The batteries are deteriorated depending on the duration time of charge and the increase of the temperature when they are used in trickle charge (or float charge). Especially at the temperature higher than around 104°F(40°C), the life of the batteries becomes very short.

□ Storage

- (1) Store the batteries in a stable position, and away from any metallic or other conductive material including dropping material.
- (2) Store the batteries starting from the fully charged state.
- (3) When storing the batteries, be sure to remove them from the equipment, or disconnect them from the charger and the load. Keep them in a place where the temperature is sufficiently low.

* When the equipment that incorporates the batteries does not have a circuit (or device) that prevents over discharge (including week current), if the batteries are stored without being removed (not being disconnected from the equipment), the batteries may be over discharged and may not recover their capacity after charge.

* If the batteries are not stored at low ambient temperature, their self-discharge increases and their performance is deteriorated. And if they are stored in a place where dew condenses, their terminals may be corroded.

- (4) Charge the batteries, at least once, every six months during storage below 77°F(25°C). Use the charging method which is shown in "Charging Methods", tab1. The interval of this charge must be shortened to half by temperature rising of every 50°F(10°C).

* Their self-discharge increases twice by temperature rising of every 50°F(10°C). If they are stored for long time at discharged state, their capacity may not recover by recharging after storage.

* If the batteries are stored for long time (1-2 years at around room temperature), the capacity may not be recovered fully. In this case. charge the batteries longer than ordinary charge by 12-15hours at the condition of the cyclic operation.

- (5) They should be used as quickly as possible.

* The batteries gradually deteriorate even during storage.

□ Transportation

- (1) Handle the batteries carefully to avoid injuries. They are heavy and must be handled properly.
- (2) Avoid moisture or rain on the batteries.

* If the terminals of the batteries are wetted by rain, they may be corroded.

- (3) Keep the batteries up in the upright position while in transportation. Avoid abnormally strong shock and /or vibration on the batteries.

* If the batteries are transported in an abnormal position, or abnormally strong shock and /or vibration are applied to them ,they may be destroyed and deteriorated in performance characteristics.