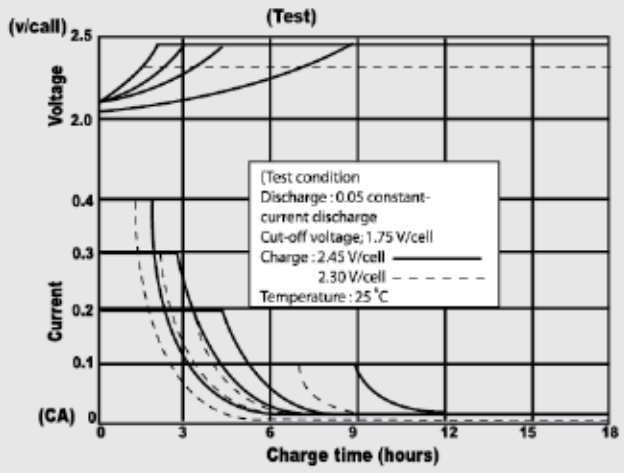
Charging Procedures

Charging

Charge characteristics (constant voltage-constant current charging) of SLA batteries are exemplified below.

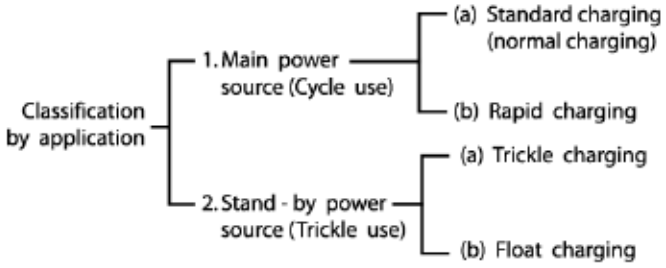
Example of constant-voltage charge characteristics by current



In order to fully utilize the characteristics of SLA batteries, constant-voltage charging is recommended

Methods of Charging the Sealed Lead-Acid Battery

For charging the sealed lead-acid battery, a well-matched charger should be used because the capacity or life the battery is influenced by ambient temperature, charge voltage and other parameters.



(1) Main Power cycle use

Cycle use is to use the battery by repeated charging and discharging in turn.

(a) Standard charging (Normal charging)

For common applications of the battery, the constant voltage charge method is advantageous as it allows the battery to exert full performance.

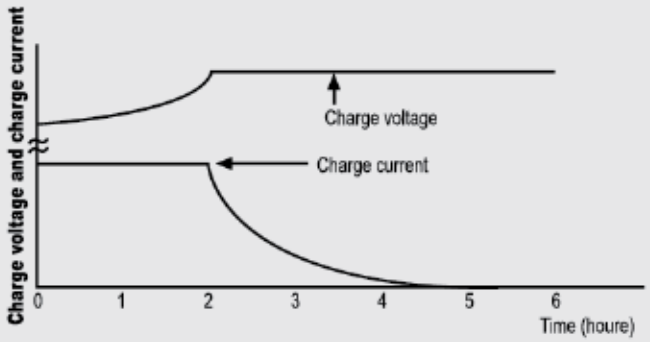
• Constant voltage charging method

This method is to charge the battery by applying a constant voltage between the terminals. Whene the battery is charged by applying a voltage of 2.45 V per cell (unit battery) at a room temperature of 20C to 25 charging is complete whene the charge current continues to be stable for three hours. Sealed lead-acid batteries can be overcharged without constant voltage control. Whene the battery is overcharged, the water in the electrolyte isdecomposed by electrolysis to generate more oxygen gas than what can be adsorbed by the negative electrode. The electrolyte is charged to exygen gas and hydrogen gas, and lost from the battery system. As the quantity of electroyte is reduced, the chemical reactions of charge and discharge become inefficient and hence the battery performance is severely deteriorated. Therefore, exact voltage control and proper charging time in constant voltage charging areessential for securing the expected life of the battery. Charging methods are dependent on battery applications, and the applications are roughly classified into main power application and stand-by/back-up power applications.

• Constant - voltage and constant - current charging method

This method is to charge the battery by controlling the current at 0.4 CA and controlling the voltage at 2.45V/per cell (unit battery) at a room temperature of 20 C to 25 C.Proper charging time is 6 to 12 hours depending on discharge rate.

Constant - voltage and constant -current charge characteristics



(b) Rapid charging

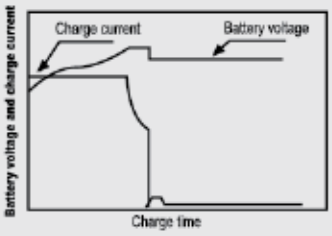
When rapidly charging the battery. A large charge current is required in a short time for replenishing the energy which has been discharged. Therefore, some adequate measures such as the Control of current is required to prevent overcharging when the rapid charging is complete. Basic requirements for rapid charging are as fallows:

- Sufficient charging should be made in a short time for fully replenishing the amount discharged.
- Charge current should be automatically controlled to avoid overcharge even on prolonged charging.
- The battery should be charged adequately in the ambient temperature range of 0C to 40 C
- Reasonable cycle life of charge/ discharge should be secured. Typical methods to control charging so as to satisfy the above Requirements follow.

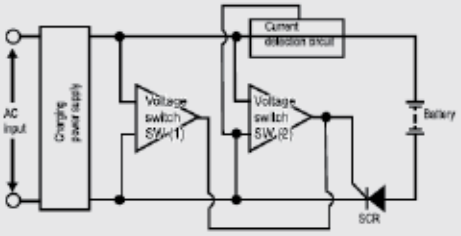
• Two - step constant voltage charge control method

Two-step constant voltage charge control method uses two constant-voltage devices. At the initial stage, the battery is charged by the first constant voltage devices SW(1) of high setup voltage (set-up for cycle charge voltage). When the charge current, the value of which is detected by the current detection circuit,has reduced to the preset value, the device is switched over to the second SW(2) of low set-up voltage (setup for trickle charge voltade). This method has the advantage that the battery in trickle use can be charged in A comparatively short time for the next discharge

Charge characteristics of the two-step constant voltage Control charger



Block diagram of the two-step constant voltage control charger



(1) Stand-by / black-up use (Trickle use)

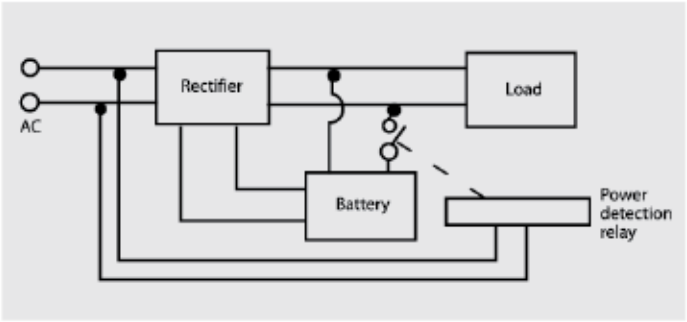
The application load is supplied with power from AC sources in normal state. Stand-by/back-up use is to maintain the battery system at all time so that it can supply power to the load in case the AC input is disrupted (such as a power failure). There are two methods of charging for this use.

(a) Trickle charge (Compensating charge)

Trickle charge

In this charge system, the battery is disconnected from the load and kept charge with a small current only for compensating self discharge while AC power is alive. In case of power failure, the battery is automatically connected to the load and battery power is supplied. This system is applied mainly as a spare power source for emergency equipment. In this use. If rapid recovery of the battery after discharge is required, it is necessary to consider the recovery charge with a comparatively large current followed by trickle charge, or alternative measures. While the type and capacity of the battery is determined by the back-up time and the load (current Consumption) during power failure, some reserve power should be taken into account considering such factors as ambient temperature, capability of the charge and depth of discharger.

Trickle charge system model



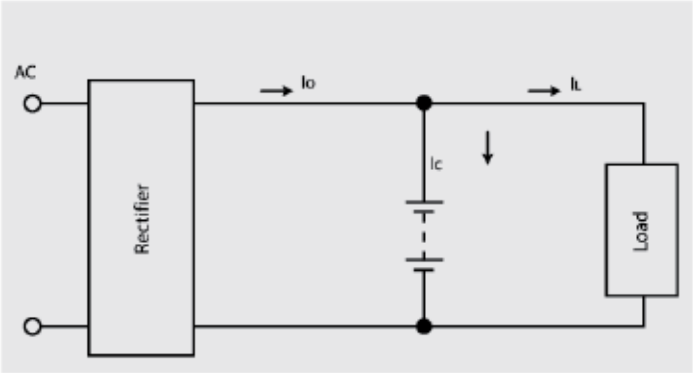
(Precautions on charging)

1. As the battery continues to be charged over a long period,a small difference in charging voltage may result in a significant difference in the battery life. Therefore, charge voltage should be controlled within a narrow range and with little variation for a long period.
2. As charge characteristics of the battery are dependent on temperature, compensation for temperature variation is required when the battery is used over a broad temperature range, and the system should be designed so that the battery and the charger are kept at the same temperature.

• Float charge

Float system is the system in which the battery and the load are connected in parallel to the rectifier, which should supply a constant-voltage current.

Float charge system model



In the above-illustrated model, output current of the rectifier is expressed as: $1_O = 1_C + 1_L$ where 1c is charge current and 1L is load current, Consideration should be given to secure adequate charging because, in fact, load current is not constant but irregular in most cases. In the float system, capacity of the constant-voltage power souce should be more than sufficient against the load. Usually, the rectifier capacity is set at the sum of the normal load current plus the current needed in order to charge the battery.

Charging Methods and Applications of SLA Batteries

Application/ Charging Method	Normal charging in 6 or more house; Constant voltage control	Two-step constant voltage control	Constant current control
Cycle use	Control voltage : 7.25V to 7.45V/6V battery 14.5V to 14.9V/12V battery Initial current : 0.4 CA or smaller		
Trickle use	Control voltage : 6.8V to 6.9V/6V battery 13.6V to 13.8V/12V battery	Initial charging with current of approx. 0.15 CA, followed by switching voltage to trickle charge	
Float use	Control voltage : 6.8V to 6.9V/6V battery 13.6V to 13.8V/12V battery Float charging compensates for load fluctuation		
Refresh charge (Auxiliary charge)*	When charging two or more batteries at a time, select only those which have been left under the same condition		Charging with current of approx, 0.1 CA
Application example	General uses, Cellular phones (bag phones), UPS, Lanterns, Electric tools	Medical equipment, Personal radios	

Note * Refresh (auxiliary) charge amount should be 120 to 130% of self-discharge amount. For details, please contact us.

(Precautions on charging)

1. (a) in constant voltage charging (cycle use): Initial current should be 0.4 CA or smaller (c:rated capacity)
   (b) in V-taper charge control system: Initial current should be 0.8 CA or smaller (c:rated capacity)
   (c) in constant voltage charging (trickle use): Initial current should be 0.15 CA or smaller (C: rated capacity)
2. Relatio between standard voltage value in constant voltage charging And temperature is given in the table.

Relation between standard voltage voalue in constant voltage Charging and temperature

		0°C	25°C	40°C
Cycle use	4V	5.1	4.9	4.7
	6V	7.7	7.4	7.1
	8V	10.2	9.8	9.5
	12V	15.4	14.7	14.2
Trickle use	4V	4.7	4.6	4.5
	6V	7.1	6.8	6.7
	8V	9.4	9.1	8.9
	12V	14.1	13.7	13.4