



Information Sheet #39

Battery Charging Systems Recommended for Standby Generator Sets

Your Reliable Guide for Generator Maintenance

1.0 Introduction:

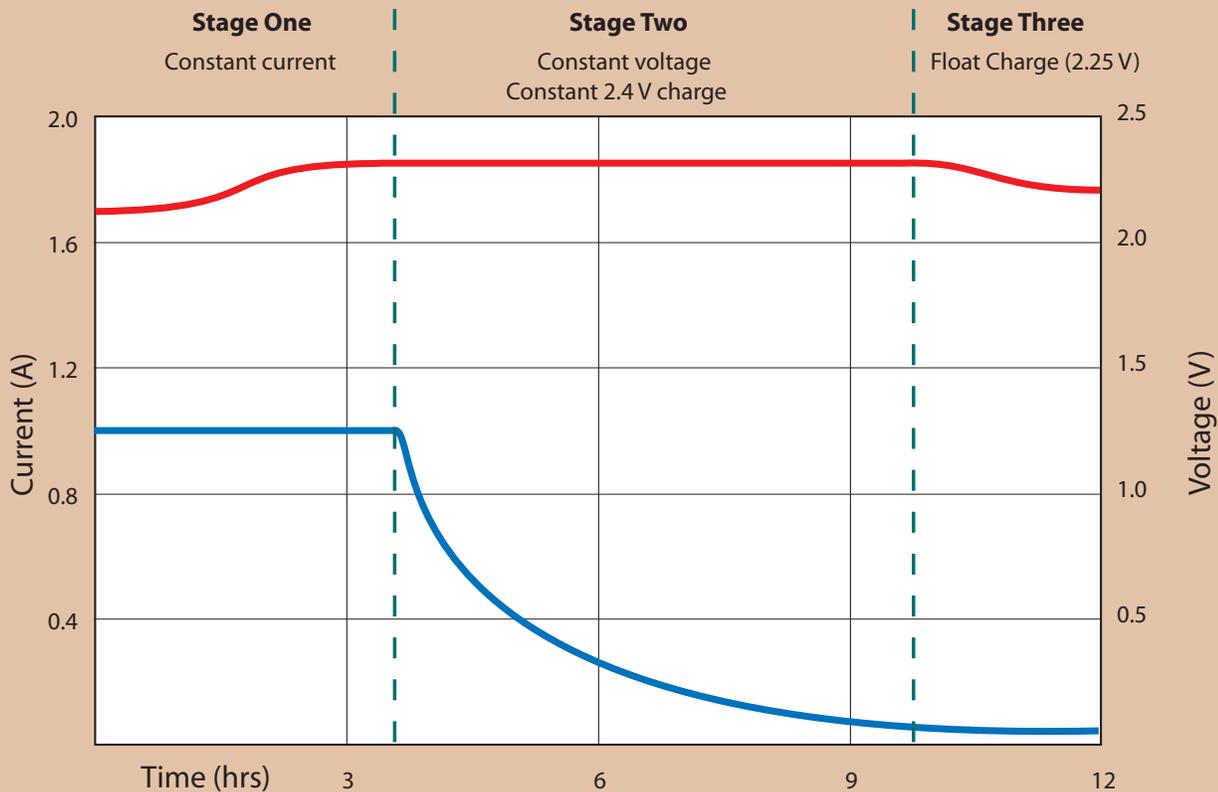
Starter batteries are used to crank most emergency generator sets. The prime mover uses either a 12- or 24- volt starter motor. Battery failure is one of the most common reasons emergency generator sets fail to start.

This information sheet discusses the type of chargers used and the various charging modes.

2.0 NFPA 110 Regulations for battery chargers in a standby application:

In a standby application, the generator set is stationary most of the time, running only for exercise periods or during a power outage. The engine-mounted charging alternator on a standby set normally will not run sufficiently to ensure the starter batteries are charged for rapid and reliable starting.

Diagram 1 Charge Stages for Lead-acid Battery



The auto battery charger reads the battery's state of charge and adjusts the volts and current output through the three stages of charge.

- 1) Battery charged at a constant current to set voltage
- 2) As the battery saturates the current will reduce
- 3) Float charge compensates for battery self-discharge

— Charge voltage
— Charge current

To fulfill our commitment to be the leading supplier in the power generation industry, the Kelly Generator & Equipment, Inc. teams ensures they are always up-to-date with the current power industry standards as well as industry trends. As a service, our **Information Sheets** are circulated on a regular basis to existing and potential power customers to maintain their awareness of changes and developments in standards, codes and technology within the power industry.

The installation information provided in this information sheet is informational in nature only and should not be considered the advice of a properly licensed and qualified electrician or used in place of a detailed review of the applicable National Electric Codes, NFPA 99/110 and local codes. Specific questions about how this information may affect any particular situation should be addressed to a licensed and qualified engineer and/or electrician.



Diagram 2 - Typical Auto Battery Charger

NFPA 110 Auto Battery Charger Specifications	
1	Level 1 return fully discharged battery to ampere-hour rating within 24 hours
2	Level 2 as above but within 36 hours
3	Operates without manual intervention
4	Ammeter and DC voltmeter
5	Marked with allowable range of battery unit capacity, nominal amps and volts and data to define replacement batteries
NFPA 110 Test Requirements	
6	Weekly battery inspection including electrolyte levels or battery voltage
7	Monthly recording of specific gravity
8	Each inspection to visually check all terminal connections are clean and tight

To ensure the battery is adequately charged while the generator set is stationary, a separate static battery charging system is recommended. NFPA 110 schedule calls for inclusion of an automatic charger system that operates without any manual intervention.

“It shall be capable of delivering energy into a fully discharged battery without damaging the battery. It will be capable of returning the fully discharged battery to its ampere-hour rating within 24 hours for Level 1 installations and 36 hours for Level 2. DC ammeter and DC voltmeter within 5 percent of range must be fitted. The charger must be permanently marked with allowable range of battery unit capacity, nominal output current and voltage, and sufficient battery-type data to allow replacement batteries to be obtained.”

3.0 Various stages of charge applied to a starter battery:

Generator sets are most commonly supplied with lead-acid batteries. They are more economical, have lower self discharge and are rugged. Nickel cadmium batteries are chosen for longer life, a high discharge rate, faster charge rate and when there is an extended temperature range. Both have three stages of charge from discharged state to maintenance of charge in a fully charged battery. (See Diagram 1 for a lead acid battery)

First Stage Constant Current - For a discharged battery, the charger applies a higher current and charges the battery to 70% of full charge.

Second Stage Topping Charge - After reaching 70% of capacity, the charger switches to topping charge mode to bring the battery to 100% of charge.

Third Stage Float Charge - Both lead-acid and NiCad batteries will self discharge over time, with NiCad discharging the fastest. Float charge is applied when the battery is fully charged. Just enough current and voltage is applied to maintain the battery in a fully charged condition without excessively charging the battery. Float charge can be supplied for an unlimited time.

4.0 Recommended battery charger:

Whatever the battery used, achieving a full charge and maximum battery life requires the charger to be able to transition through the three stages of charge.

An automatic battery charger is the preferred type of charger - An auto-charger can be supplied as a wall mounted unit or even installed in the transfer switch. 12-and 24-volt static automatic battery chargers operate from the AC utility supply. Automatic float/ equalizer type systems are strongly recommended for the most reliable and consistent performance. The multistage charger will automatically switch among the three stages of charge to maximize charge time and keep the battery fully charged. Predetermined values can be adjusted to tailor the system to specific batteries. (See Diagram 2)

5.0 Equalise charge for reconditioning a battery:

After the top off stage, the battery cell voltage will be at the float level, (2.28 volts for a lead-acid). A higher equalise voltage at 2.43 volts is used to restore all the plates to an equal voltage. If the auto charger detects float voltage has fallen below the required level it will switch to equalise charge. Temporarily elevating charging voltage above the normal float voltage for equalisation is acceptable for short periods if the battery has sufficient electrolyte.



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