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BATTERY CHARGER SELECTION - By George Chmielewski

The intent of this article is to provide an overview of all the details that need to be known before the correct Lester Electrical battery charger can be recommended for a specific application.

Nobody makes a "one-size-fits-all" charger. Most Lester Electrical battery chargers are intended for use with deep cycle lead acid batteries, wet or sealed, with at least 25 amp-hour capacity.

Here are six questions that need to be answered to select the correct charger:

1. **BATTERY SYSTEM VOLTAGE**. What is the voltage of the battery system?

2. **BATTERY TYPE.** What type are the batteries?

3. **BATTERY SIZE**. What size are the batteries?

4. **CHARGER START CURRENT & TIME**. How much time is allotted to perform a charge cycle?

5. **CHARGER AC LINE VOLTAGE & FREQUENCY**. What is the available incoming line AC voltage and frequency?

6. **ONBOARD OR SHELF MOUNT**. Will the charger be used mounted onboard a machine or will it rest stationary on a shelf?

Voltage

Battery chargers are voltage specific. If you have a 48-volt battery system you MUST use a 48-volt charger. The electronic controller in the charger that turns the charger on or off is programmed to let the charger run until the voltage of the batteries rises to a predefined level.

The predefined battery industry standard level for flooded wet lead acid batteries is 2.6 volts per cell maximum. A 48 volt battery system has 24 cells, so 24 X 2.6 volts = 62.4 volts maximum on-charge measured voltage.

The standard voltage for sealed lead acid batteries is a maximum of 2.38 volts per cell, or 57.12 volts.

If you were to connect a 36-volt charger to a 48 volt wet battery system and it somehow started it would allow the charger to run and raise the voltage to 46.8 volts (2.6 volts X 18 cells). A full charge for a wet 48-volt battery is at or near 62.4 volts. Your 48-volt battery system will never become fully charged if you use a charger that is rated less than your battery system voltage.

If you were to connect a 60-volt charger to a 48-volt system and it somehow started it would allow the charger to run to 78 volts (2.6 volts X 30 cells). Your 48 volt battery system will be overcharged and damaged beyond repair if you use a charger that is rated for more than your battery system voltage.

Most, but not all of our chargers have automatic voltage detection and will turn off if connected to the wrong voltage battery. They also have a maximum run time clock and will turn off if an over-voltage situation is detected.

Type

There is zero tolerance for error here; you MUST know the battery type to avoid potential battery damage. There are generally two types of deep cycle lead acid batteries: wet, and sealed. The charge algorithm and maximum voltage required by each type of battery is different. For a detailed explanation click here:
http://www.lesterelectrical.com/news/newsletters/2006feb01.PDF

Wet batteries have removable, vented screw caps that allow you to add water as needed. This type of battery is also referred to as a ‘flooded’ battery. Sealed batteries do not have removable screw caps – you cannot add water to a sealed battery. Sealed batteries are known under a variety of acronyms such as Maintenance Free, AGM, VRLA, GEL and others.

The most common mistake we encounter is the customer who switches from wet batteries to sealed and continues to use their original Lestronic II charger to charge them. The popular Lestronic chargers we have made since the early 60’s work superbly with wet batteries but will overcharge sealed batteries. We make a wide variety of chargers that work with both types of batteries.

Size

The size of a battery is measured by its ‘ampere-hour capacity’. Amp-hour capacity is the size and limit of the available electrical energy a battery can store and deliver to drive the motor of the wheel chair, scissors lift, golf cart, or other electrical device.

To understand the concept of amp-hour capacity you can compare the size (amp-hour capacity) of the battery to the size (gallons/liters) of the fuel tank in a car. A 500 amp-hour battery will power a piece of electrical equipment 5 times farther than a 100 amp-hour battery will.

The size of the battery is a very critical factor when choosing a battery charger. The general rule of thumb is to have the start current of the charger to be approximately 10% of the size of the battery. For a 100 a-h battery the charger would then provide 10 amperes of DC start current (.10 X 100 = 10). This will produce the ideal output to achieve the desired 8-hour charge cycle for a normally discharged battery.

Wheel chair batteries range between 30 to 100 a-h. Golf carts, light industrial trucks, scissors lifts and floor cleaning equipment batteries vary between 140 to 300 a-h. Large industrial vehicles, forklifts, and stationary battery arrays may have batteries larger than 2,000 a-h. The light duty battery in your car is about 50 a-h.

Start Current & Time

We stated that our conservatively chosen charger for a 100 a-h battery would deliver 10 amperes of DC current to the battery resulting in a charge time of 8 hours. Suppose this is too long for our demanding application and that we want to shorten this as much as possible. How fast can we charge batteries?

The one-word limiting factor is "heat". Charging a battery involves not much more than allowing an electrical current to flow through them. This current flow causes chemical changes inside the battery that restore the batteries ability to maintain and store electrical energy -- we'll spare you the exact details of this Electro-chemical process. This current flow also causes the battery temperature to increase.

If you want to charge the batteries faster you simply increase the current output of the charger. At some point the charger output will exceed the ability of the battery to endure this heat. This is the thermal limit of the battery, and this is also why it would be wise to observe the 10% rule.

The actual temperature limit of a battery varies depending on the claims of the battery manufacturer, but an industry accepted standard is that the electrolyte within a battery should not rise above 115° F (46.1° C) with a starting electrolyte temperature of 85° F (29.4° C). Additionally, all OEM battery manufacturers state that you should not charge their batteries when the ambient temperature exceeds 120° F.

What about low output chargers? Again, try to stay close to the 10% rule.

We have customers who displease us greatly by using our 25 to 40 amp output chargers for their 900+ a-h forklift batteries, a practice we strongly discourage. The consequence of using under-powered chargers is twofold:

1. The charger outputs high current for too long and becomes too hot. We consider this to be misuse.
2. The charger does not have enough current flow to eliminate stratification within the battery.

When these chargers arrive for warranty we can retrieve specifics of the past charge cycles from the memory chip in the controller that has recorded all of the data and proof that we need to deny warranty.

Charger AC Line Voltage & Frequency

The AC line voltage available at electrical outlets in North American (Mexico, Canada, and America) is 115 to 120+ volts and the frequency at these same outlets is 60 Hz, or 60 cycles per second.

The predominant voltage and frequency available in Europe, Asia, Africa, South America, Australia, and much of the rest of the world is 230 volts at 50 Hz. To access a detailed list of exactly what is available in a given country click here:
http://www.r-e-d-inc.com/internat/internat.htm

We make "World" chargers that work well in any country and we make chargers that are voltage and frequency specific. If you need a charger for an overseas or export application you will need to know what AC voltage and frequency is available in that country.

Because of the variety (20+ at last count) of AC plugs used worldwide we do not provide or include these plugs for our export chargers. Some of these plugs are unique and can only be sourced in that country.

We have had calls from customers who bought one of our chargers from E-Bay or some other source who say their charger seems to run hot and does not want to turn off. We learn that these customers bought export chargers intended and designed for 230 volts AC input at 50 Hz or other non-domestic AC supply. These are typically overstock OEM chargers that have found their way to a reseller by means of an auction. They will not work in North America, nor can they be inexpensively converted to do so. Caveat emptor.

Onboard or Shelf Mount

The controllers in some of our chargers will not allow the charger to restart a new charge cycle unless the DC connection to the batteries is momentarily disconnected. All of our UL/CSA approved chargers are designed this way, as are the majority of our shelf mounted (portable) chargers. If one of these chargers is permanently mounted onto a vehicle by attaching the DC output wires directly to the pack, then one of these wires will have to be momentarily disconnected to allow the charger to reset to begin a new charge cycle.

These chargers are denoted as numbers 1, 2, or 3 in the “NOTES” heading of our price list (keep in mind this is a partial listing of our chargers):
http://www.lesterelectrical.com/products/2006Price_List.PDF

Summary

Understanding batteries and chargers requires some knowledge of basic electrical principles and concepts. In this article we have kept this technically challenging subject as simple as possible. If you can fill in the blanks for all six of these questions you will have done very well. If not please feel free to contact us for clarification.

NEW CUSTOMER SERVICE MANAGER - Meet Bob Haahr

Bob Haahr has been appointed the newly created position of Customer Service Manager. Bob most recently was an Area Manager for our Printed Circuit Board and Electronic Assembly department. He has been with Lester Electrical for over 5 years and previously held various positions at Isco and Husqvarna lawn and turf products. While at Isco, Bob was the Customer Service Manager for the Environmental Division for 13 years and he spent 6 years as Director of Manufacturing. His duties at Husqvarna included Information Systems Manager and Inventory Control and Production Manager. His new responsibilities will include supervising our Technical Service Department and Sales Coordinators. Bob will also be taking on process improvement projects and return/repair order processing. He will be reporting directly to Ken Jeffcoat, Lester Electrical's Director of Marketing & Sales.

TERMINAL CONNECTIONS IN CHARGERS by Bill Fahl - Quality Manager

Lester Electrical recognizes the extreme importance of connections and splices in high current applications. Through a variety of process controls and education of our employees, we have assured that this is rarely the “weak link” in our products.

Most people with a basic understanding of electricity know that a loose connection will only get worse as resistance located at the connection point gets greater over time. This can be attributed to crimping processes that are not performed properly or connections that are not tight enough. In order to assure the integrity of Lester products, we have instituted the following approaches and controls.

Pull Testing – every crimping operation performed at Lester Electrical has a sample pulled and tested on a machine that measures the force necessary to invalidate the crimp. A minimum amount of pull (measured in pounds) is exerted on the sample part, with a minimum value of acceptability. This equipment is in turn calibrated to NIST standards. Furthermore, wires assemblies purchased from outside undergo a similar processBefore being accepted into Lester stock.

Soldering – Wiring with high current applications is soldered after a representative sample has been pull tested.. This assures that the splice point between the wire and the terminal is minimized for the possibility of resistance at that critical junction.

Bolted Connections – Lester Electrical requires all electrical connections to be tightened with a specific torque. The torque value selected is based on the size and type of hardware being used. This equipment is included in a rigorous in-house calibration program.

Quick Disconnect Style Terminals – This style of terminal connection is dependent on education and technique. We assure our products through in-house education and independent assessment of the process by the operators watching each other, and QA personnel performing regular audits of the activities.

CIRCUIT BOARD ASSEMBLY AT LESTER ELECTRICAL - by Bob Haahr

Most Lester Electrical battery chargers have some type of electrical circuitry to control the charge of a battery. The early chargers used a simple mechanical timer and controlled the length of charge cycle by using the timer. The later designs use electronics to control and monitor the charge going to your battery.

In the electronic timers, printed circuit boards, or PCBs, are used to mechanically support and electrically connect electronic components using conductive pathways, or traces, etched from copper laminated onto a non-conductive material. At Lester Electrical we use fiberglass as a substrate for our circuit boards. After populating the board with electronic components, printed circuit assembly is formed.

Originally, every electronic component had wire leads, and the PCB had holes drilled for each wire of each component. The components' leads were then passed through the holes and soldered to the PCB trace. This method of assembly is called through-hole construction.   With the development of board lamination and etching techniques, this concept evolved into the standard printed circuit board fabrication process in use today. Automated insertion equipment could insert the components into the circuit boards and soldering could be done automatically by passing the board over a ripple, or wave, of molten solders in a wave-soldering machine. Most of our timer kits are manufactured using the through-hole technologies.

Example of Through Hole Processing

Surface Mount Technology or SMT was developed in the 1960s, the processes gained momentum in Japan in the 1980s and became widely used globally by the mid 1990s. Components were mechanically redesigned to have small metal tabs or end caps that could be directly soldered to the surface of the PCB. Components became much smaller and component placement on both sides of the board became far more common with surface mounting than through-hole mounting, allowing much higher circuit densities. Surface mounting lends itself well to a high degree of automation, reducing labor cost and greatly increasing production rates. Modern electronic devices including cell phones, digital cameras, computers, and IPODs would not be as small, reliable or inexpensive without surface mount technology.

Example of SMT Process

Often, through-hole and surface-mount construction must be combined in a single PCA because some required components are available only in surface-mount packages, while others are available only in through-hole packages. The MC3 timer kit is a combination or hybrid circuit design.

After a PCB is assembled it is inspected, tested and calibrated to specifications required for the specific charger the timer kit is going into. Most circuit boards are individually serialized and the board is verified on the final assembly line to be the correct type, part number, and that is has passed all required testing, before putting the timer kit into the charger.

PCBs intended for extreme environments often have a conformal coat, which is applied by dipping or spraying after the components have been soldered. The coat prevents corrosion and leakage currents or shorting due to condensation. Modern conformal coats are usually dips of dilute solutions of silicone rubber, polyurethane, acrylic, or epoxy. Some of the newer timer kits such as the MC3 and SCR charger timers use potting to protect the electronics on the circuit board.