Service Bulletins & Tips
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Common Service Topics - This issue's service topic covers some of the basic factors that go into choosing the right battery charger for an application.

Tips from the Experts - Charger options are explained.

New Document Search Feature - Lester Electrical continues to build its home on the web by adding a document search engine.

Recently Added Service Documents - A listing of service documents that have been added to the Service Topics page at LesterElectrical.com

COMMON SERVICE TOPICS

Choosing the Correct Charger

Choosing the correct charger for a battery system promotes maximum battery performance and life, problem free operation for both the charger and equipment, and avoids the costly mistake of ruining a battery. The focus of our discussion will be on applications that utilize ferroresonant or SCR regulated battery chargers, such as those used on golf cars, floor-care equipment, and platform lifts, to name a few. This discussion does not address special applications, which includes, but isn't limited to, extreme ambient temperatures (below 50 or above 110 degrees F), battery types other than deep cycle wet flooded lead-acid or sealed lead-acid/gel, opportunity/rapid charging (short charge time(s) available) and maintenance/stand-by applications. If there are any questions regarding the proper charger for an application, please contact the Lester Electrical for assistance.

If an application is to replace an existing charger, the electrical specifications on the charger being replaced can provide the needed information. For a new application, there are six key points of information needed to select the proper charger:

- Battery type (flooded or sealed),
- AC line voltage and frequency,
- Battery system voltage rating,
- Battery system ampere-hour (A-H) rating,
- The type, size and color of the DC connector,
- UL/CUL and CSA Listed Chargers

Battery Type

Ferroresonant chargers are designed to charge deep cycle flooded wet lead-acid battery systems only. If the application requires a sealed type of battery, which is commonly required in hospitals, an SCR regulated charger must be chosen in order to obtain the correct charge characteristics required to charge the battery properly. If the end-user believes they may switch to a sealed lead-acid or gel battery in the future, which may be due to safety or maintenance issues, an SCR regulated charger should be purchased. Most SCR regulated chargers are capable of properly charging both flooded wet lead-acid and sealed lead-acid/gel types of deep cycle batteries.

AC Line Voltage and Frequency

Determine the AC line voltage available for the charger. Keep in mind, larger battery systems require higher charge rates that may exceed the power available from lower AC voltage circuits. Once the required charge rate and voltage for a battery system has been

determined, the total wattage can be calculated to determine what AC line voltage is needed (Ohm's Law: Voltage multiplied by Amperage = Wattage). For example, if a 36 volt battery system requires a 60 amp charge rate, multiply the voltage and amperage to determine the wattage (36 X 60 = 2160). Because chargers are not 100% efficient an allowance must be made for the losses in converting AC to DC. To allow for AC voltage variances, power factor and efficiencies that vary by charger design, allow for a 20% loss minimum. The total wattage required is the calculated wattage added to the calculated loss (2160 + 432 = 2592 total watts). A typical 120 volt AC circuit can supply only 1200 watts, per UL, which requires this application to use either a 208 or 230 volt AC voltage circuit minimum.

A charger's sensitivity to the line frequency depends on the design of the charger. In North America, 60 hertz is utilized but many countries around the world utilize 50 hertz. Make sure the AC line frequency where the charger is to be used matches the frequency rating of the charger. A mismatch may cause damage to both the charger and battery.

Battery System Voltage Rating

The voltage rating of a battery system can be determined by adding the number of cells in each battery multiplied by the number of batteries connected in series. For rating purposes a nominal value of 2.0 volts per cell is assigned to each cell. Example: a battery system contains six batteries that have three cells each (6 X 3 = 18 cells), at 2.0 volts per cell the battery system voltage is 36 volts. Batteries connected in parallel do not increase the voltage rating of the battery system but do increase the capacity rating of the battery system.

Battery System Ampere-Hour (A-H) Rating

The ampere-hour rating of the battery system dictates the output charge rate that is required from a charger. Knowing the correct ampere-hour rating of a battery system is essential. If there are questions regarding the A-H rating, obtain the charging specifications from the battery manufacturer's web site or contact your battery supplier.

The maximum output current from the charger, known as the start rate, should be around 10% of the total ampere-hour rating of the battery. However, the larger the capacity of the battery the higher the start rate allowed. Battery systems near 300 ampere-hours have specified charging rates of 10 to 15 percent, while large heavy-industrial batteries commonly specify 16 to 20 percent of the total A-H rating. There is more of a range permitted when choosing a start rate for a battery than the finish rate. The time available for charging and expected depth of discharge are factors to consider when selecting a start rate. A charger with too low a start rate will result in a battery never being fully charged which, in turn, results in poor battery performance and loss of life. Due to the various methods used to rate battery capacities, always contact the manufacturer or dealer if in doubt.

The output current from the charger when nearing the end of a charge cycle, known as the finish rate, must be sufficient to keep the batteries gassing. The minimum charge rate that will still produce gassing is about 2 amperes per 100 A-H of battery capacity. Keeping within 2 to 4 percent of the total A-H rating of the battery system will provide proper charging of the battery. Larger heavy industrial batteries often have finish rate specifications near five percent per 100 A-H, which is the result of higher internal losses within the battery.

Sealed lead-acid and gel batteries do not specify a finish rate but instead specify a maximum voltage. The maximum voltage specification provided by battery manufacturers is usually given as a volts-per-cell value. This is a critical charging specification, which if exceeded will cause battery damage and failure within a short period of time. Again, contact the battery manufacturer or dealer to obtain this specification, if unknown, to avoid a potentially costly mistake.

DC Connectors

There are a wide variety of DC connectors used on chargers but a few have become

standard in many markets. In order for the charger to mate to the equipment, the proper type, ampere rating, and, in some cases, color must be determined. Always inspect the connector on the equipment for signs of damage, heating, or excessive wear before ordering a charger. This will provide the opportunity to order a replacement plug/receptacle for the equipment when ordering the charger, if needed. Failure to replace a faulty plug/receptacle can lead to poor charger and equipment performance, damage or a potential fire hazard. See more discussion on this topic in the "Tips from the Experts" section below.

UL/CUL, CSA Listed Chargers

Make sure of the requirements regarding the location that the charger will be used. Many hospitals, airports, schools, convalescence homes, and government buildings require the electrical equipment to have an agency listing. Within the United States choose a UL listed charger or a CUL/CSA listed charger if the location is in Canada.

Factory Assistance

Do not make assumptions or compromises when selecting a charger for an application. Like a healthy diet, the correct amount of charge feeding a battery will provide maximum performance and life. The sales and service staff at Lester Electrical are available to provide support if any doubt or concerns regarding an application should arise.

Glossary of Battery and Charger Terms

Battery Ampere-Hour Rating (A-H)

This battery rating provides the amount of energy that a battery is capable of storing. An ampere-hour rating provides how much current the battery can deliver for how long. Keep in mind, this rating is not how much useable energy the battery has. For maximum battery life it is recommended to discharge a battery to only 80% of it's rating, example: a 180 A-H rated battery has 144 A-H of useable energy. The rate of discharge and temperature of the batteries will greatly affect the ampere-hour rating of a battery. A higher rate of discharge and/or colder temperatures will decrease the A-H rating of a battery and vise-versa. Depending on the size of the battery and market it is used in will dictate the hour scale used to rate the battery. The twenty hour rate is the most common overall but five, six and eight hour rates are more common for the large heavy-industrial types of batteries commonly used in large forklifts. Following are some examples of ampere-hour ratings:

A battery supplying 75 amps for 6 hours = 450 A-H
A battery supplying 6 amps for 20 hours = 120 A-H

Batteries in Series

A series connected battery string is when the positive (+) terminal of one battery is connected to the negative (-) terminal of the next battery. The leads that connect the equipment to the battery system for power are attached to the remaining positive and negative terminals at the ends of the series string. Batteries connected in series increase the battery system's voltage rating, example: four six volt batteries connected in series have a voltage rating of 24 volts, four twelve volt batteries connected in series have a voltage rating of 48 volts.

Batteries in Parallel

Parallel connected batteries are when all positive (+) terminals of the batteries are connected together by a common cable and all negative (-) terminals of the batteries are connected together by a common cable. Adding batteries in parallel does not change the voltage rating of the battery system and remains the same as the voltage rating of a single battery or string of batteries. When adding additional batteries in parallel the capacity rating of the batteries are added. If a 100 ampere-hour battery is attached in parallel to another 100 ampere-hour battery, the capacity has doubled and the battery system is now rated at 200 ampere-hour.

Ferroresonant Charger

A charger design that utilizes a coil on the transformer (inductance) connected to a capacitor (capacitance) that are matched to oscillate at the charger's rated AC line

frequency, typically 50 or 60 hertz. The oscillating circuit produces an invisible magnetic field that encompasses the transformer. This magnetic field provides regulation of the charger's output when fluctuations in the AC line voltage occur, +/- 10% at the start and +/- 1% at the finish. The output charge current starts at a high value and tapers to a low value. As the batteries become charged and increase in voltage the output current is reduced as it approaches the end of the charge cycle. This type of charger is designed for use with deep cycle flooded wet lead-acid batteries only and will over-charge sealed lead-acid/gel types of batteries.

SCR Regulated Charger

An SCR regulated charger design utilizes SCRs (Silicon Controlled Rectifier) to convert AC to DC, instead of diodes as found in a ferroresonant charger. The use of SCRs as rectifiers allow the charger to regulate both the charge current and voltage applied to the batteries. The ability to regulate the amount of voltage applied to a battery system makes this charger compatible with deep cycle sealed lead-acid and gel batteries. Sealed batteries require that the voltage output by the charger be kept below a specified voltage to avoid gassing. Most SCR regulated chargers also have the ability to charge flooded wet lead-acid batteries as well. Because this type of charger can maintain a high charge rate throughout most of the charge cycle, it can recharge a battery in about the same amount of time as a ferroresonant charger with a 20% higher output current rating.

TIPS FROM THE EXPERTS

Charger Options Explained

Most end users are able to identify the charger model they own or use. What is more difficult, however, is identifying what "Option" number the charger is. Historically, Lester Electrical has used a two digit "dash number" to designate what option number a charger has. Typically the dash number refers to cord or plug options. In some cases, the dash number refers to a charger that has been slightly modified for a specific OEM customer. These modifications may include a specific plug, a specific case color, or a non-standard DC cord length. Unfortunately, not all options are available across all product lines. One of the most frequently asked question of the Service Department is, "What DC plug do I have on my charger?" This question is usually followed up with, "What dash number does this correspond to?" Hopefully, this section will help clear up some of those questions.

We offer a variety of plug designs that have evolved and been accepted by customers and manufacturers of power equipment.

The Anderson SB© series of plugs vary in size to meet current flow expectations. Although the gray, yellow, and red SB-175 plugs are identical in size, they will only mate with a plug of the same color. Each color plug has a unique shape to the face of the housing. Make certain the plug you choose is of the same size and color as on the machine. Three common Anderson plugs are shown below in Figures 1, 2, and 3.

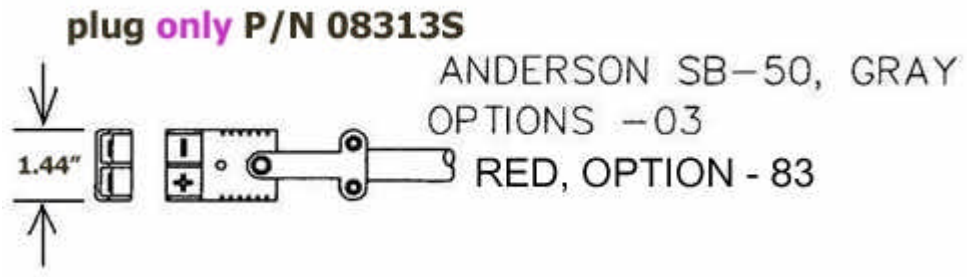

Figure 1 - Anderson SB50, Lester P/N 08313S

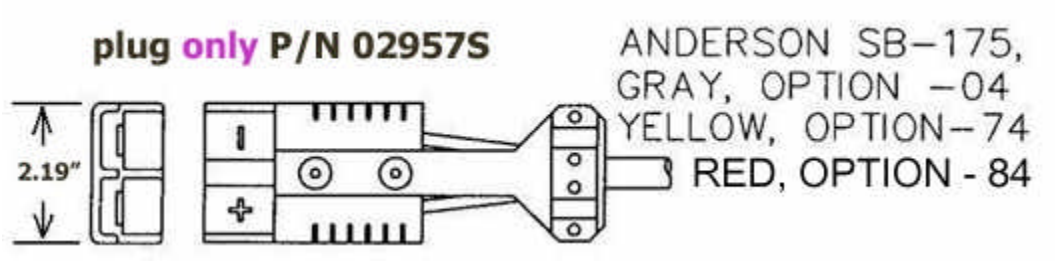

Figure 2 - Anderson SB175, Lester P/N 02957S

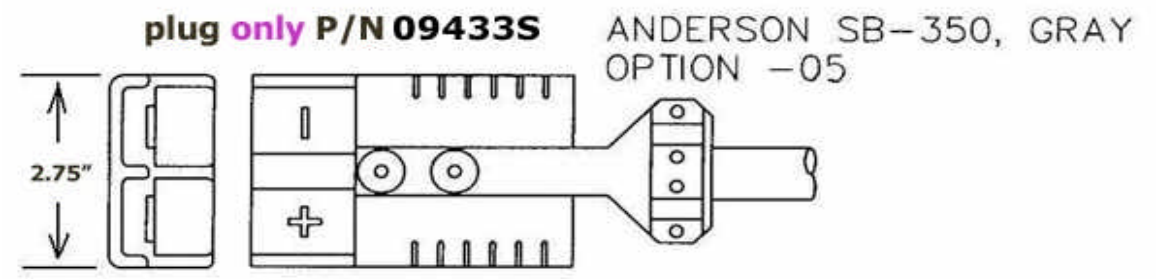

Figure 3 - Anderson SB350, Lester P/N 09433S

To order a matched set of Anderson plugs, simply order two of the same part number. Although they appear to be identical, they are designed to mate when one plug is oriented 180° to the other. The plugs come with a variety of bushings to accommodate various wire sizes and will require soldering. Our complete cord sets that include these plugs are crimped and soldered.

The yellow Lester plug (Figure 4, below) has a retractable shielded tip that prevents the possibility of the DC output blades shorting against an object. The gray rubber Lester plug (Figure 5, below) is of traditional design. Both have the "crowfoot" blade pattern, and both are offered only as an assembled, ready-to-install cord set. These plugs and cord sets are made and assembled in our plant.

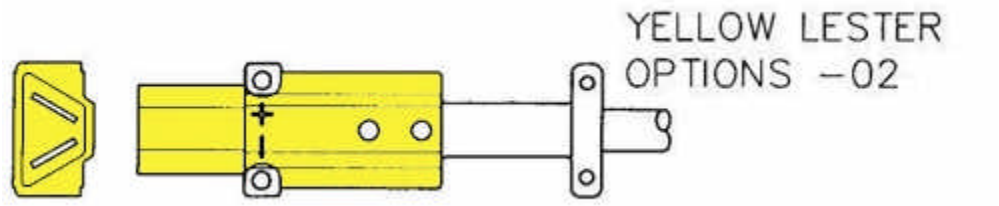

Figure 4 - Yellow Lester Plug, Lester P/N 08020S (cord set)

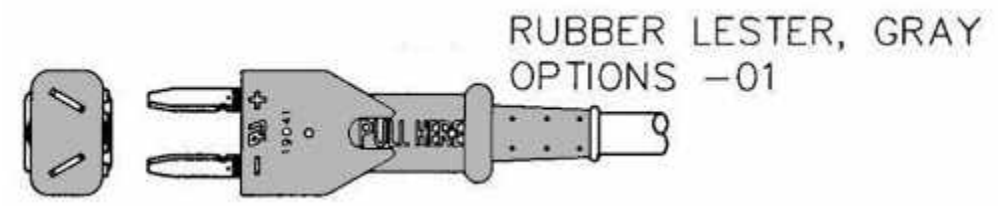

Figure 5 - Gray Lester Plug, Lester P/N 14973S (cord set)

Finally, the plugs illustrated in Figure 6 for E-Z-Go and in Figure 7 for Club Car are unique and proprietary to those manufacturers and replacements must be obtained from them. For details on pricing and availability for the E-Z-Go and/or Club Car plugs, please contact your local dealer.

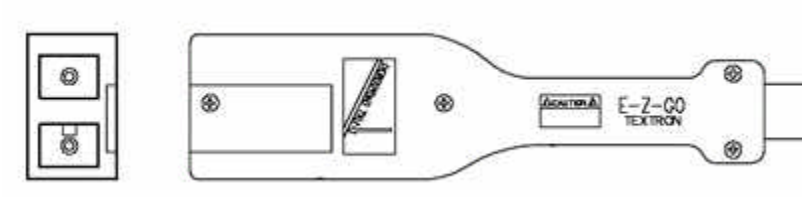

Figure 6 - Proprietary E-Z-Go plug.

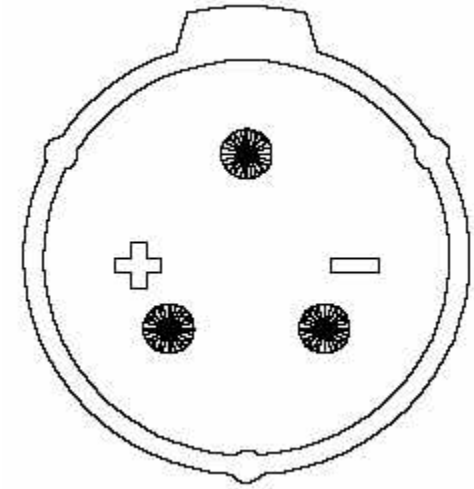

Figure 7 - Proprietary Club Car plug.

NEW DOCUMENT SEARCH FEATURE

Have you ever misplaced your charger manual? Have you ever needed a schematic or parts list? With Lester Electrical's new Document Search feature, these documents are only a couple of clicks away. All you need is access to the Internet and your five digit charger model number (see the July issue for help in determining your charger model). Visit LesterElectrical.com and click on the "Document Search" button on the left.

RECENTLY ADDED SERVICE DOCUMENTS

Since our last issue of Service Bulletins & Tips, we have added a couple more documents to our Service Topics page. We have incorporated some of the Tips From the Experts and Common Service Topics from previous editions of the newsletter and created separate PDF documents for those topics. We have also put another couple Troubleshooting guides on the site to aid our customers in diagnosing and repairing chargers. The new documents are:

Blown DC Fuse (43kb PDF)

Diode Testing (133kb PDF)

Lestronic II with Slide-In Timer Technician Service Guide (271kb PDF)

We will continue updating this portion of the Lester Electrical website, so check back often for updates.