Managing Batteries in Medical Devices

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Even with the best of care, a battery only lives for a defined number of years. There is no distinct life span, and the health of a battery rests on its genetic makeup, environmental conditions and user patterns. Battery manufacturers are aware of performance loss over time, but there can be a disconnect with battery expectations. Runtimes are almost always estimated with a perfect battery delivering 100 percent capacity, a condition that only applies when the battery is new. While a dropped phone call on a consumer product is only a mild inconvenience, an unexpected power loss in a medical, can be more devastating.

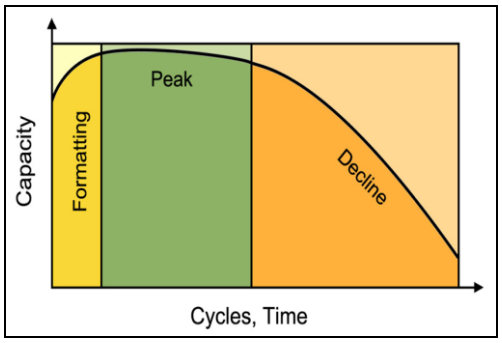
Batteries are a common cause of failure in medical equipment and should be checked as part of in-house maintenance. The Cadex battery analyzer assures that all batteries meet the desired performance criteria for the assigned mission. Well maintained batteries save money in that each pack can be used with full confidence to the eventual retirement

Incoming Inspection

Battery care begins with incoming inspections. Return packs that do not meet the performance criteria. The open circuit voltage of a lead acid battery should be 2.10V/cell; the capacity of nickel- and lithium-based batteries should be between 90 and 100 percent.

Field Preparation

Lead acid batteries do not perform at peak capacity when new but only reach full performance after 20-50 cycles. Nickel-based batteries may need priming; lithium-ion should deliver the full capacity when new. Return packs that fall below the specified capacity.

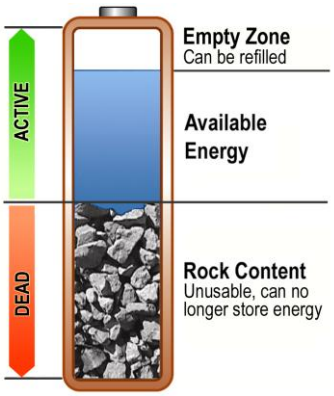


Periodic Capacity Check

A battery should be treated like any other medical device. While date stamping offers an alternative to analyzing batteries, this method does not guarantee performance because some packs fail before the expiry date, but most last longer. Batteries in constant use have more wear-and tear than those less used. Capacity is the leading health indicator, and the Cadex battery analyzers give a clear assessment of battery performance.

Retirement

Battery capacity decreases with usage and time. Medical staff may be unaware of the capacity fade and continues using batteries that are weak. Replace a battery when the capacity drops to 70 or 80% and restoration is not possible. Do not retire batteries too soon, as this increases operational cost and raises environmental concerns. Use Cadex battery analyzers to predict the correct replacement time.



From BPW3

Maintaining Fleet Batteries

A battery analyzer assures that fleet batteries meet the minimum performance standards. The device also helps to restore low performers, if such a service is possible with the battery types in question. In addition, a battery analyzer supervises the all-important function of a timely replacement at the end of a productive life. Manufacturers of portable equipment support battery maintenance because well-performing batteries reflect positively on the equipment,
a win-win situation for both manufacturer and user.

Many battery analyzers come with PC application software. With BatteryShop™ (by Cadex), for example, the PC becomes the command center and all functions are processed through the keyboard, as well as other input devices. Clicking the mouse on any of the 2,000 batteries listed in the database configures the analyzer to the correct setting, eliminating the need for further programming. The user has the liberty to add, remove and edit the batteries listed should the specification change.

Labeling each fleet battery with a permanent ID number simplifies logistics and traceability. A printer connected to PC BatteryShop™ generates these labels in bar code format. The user simply scans the label, which in turn configures the analyzer and retrieves the performance history for review. Besides capacity readings and service dates, purchasing date, vendor information and pricing can also be entered. Figure 9-31 illustrates the battery scan, service and data examination.

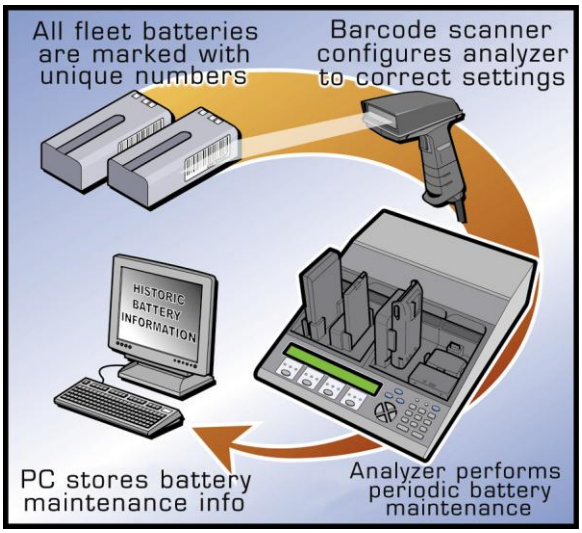


Figure 9-31:
Fleet battery management

Labeling each battery with a unique number simplifies battery service. Swiping the barcode label reveals the history of the battery.

Courtesy of Cadex

Another tracking method for fleet batteries is attaching a removable label that shows the battery information at a glance between services, as illustrated in Figure 9-32. The system is self-governing in that all batteries must regularly be serviced as part of quality control. This is made possible by providing a time period between the last service and the new date due. With this information on hand, the prudent battery user only picks a battery that has been serviced and meets this quality assurance (QA) test protocol. Setting up the maintenance system is simple and managing it requires only about 30 minutes per day.

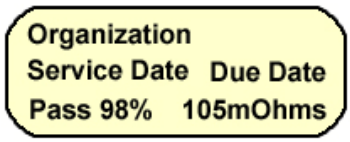


Figure 9-32: Sample of removable battery label

The label shows battery information at a glance and includes name of organization for traceability, capacity in percent, as well as past and future service dates.

Setting up a battery maintenance system requires a battery analyzer that is capable of printing battery stick-on labels. The analyzer should also offer a program that automatically restores nickel-based batteries if the set capacity threshold cannot be met. Cadex analyzers meet these requirements and go one step further by offering adjustable capacity target settings to select the minimum performance criteria for the given operation.

Most fleet operations use 80 percent as their battery pass/fail criterion. Increasing the threshold to 85 percent tightens the performance tolerance but passes fewer batteries; lowering the settings extends service life but offers less stringent performance standards. When choosing the setting, the organization must ensure that the lowest-level battery in the fleet is able to fulfill its assigned duty. Figures 9-33, 9-34 and 9-35 illustrate the battery label system.

Rechargeable batteries do not die suddenly but gradually get weaker with time. A service every one to three months offers plenty of confidence that all batteries will meet the minimum required capacity and last through the shift with some energy to spare.

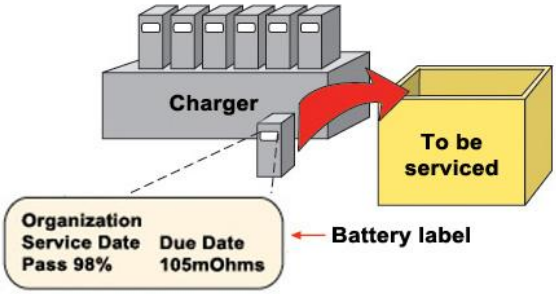


Figure 9-33:
Sorting batteries for servicing

When taking a battery from the charger, the user checks the service date, and if expired the battery is placed in the “To be serviced” box.

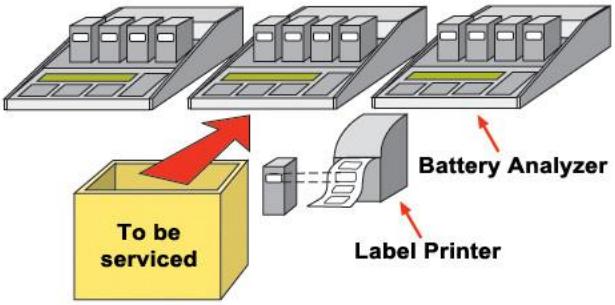


Figure 9-34:
Servicing expired batteries

The analyzers service the batteries and recondition them if low in capacity (only nickel-based batteries receive recondition). Passing batteries are relabeled showing capacity and the next service date.

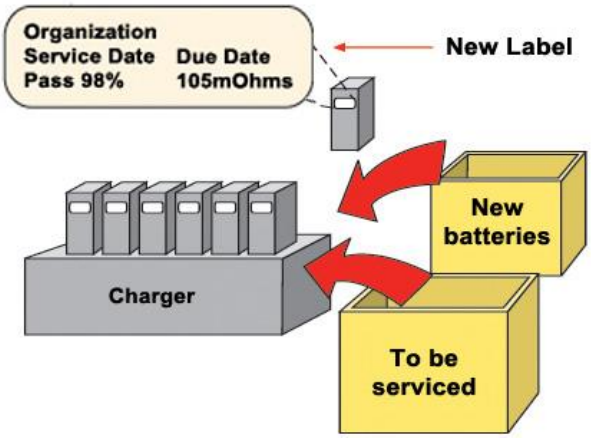


Figure 9-35:
Reinstating batteries

The failed batteries are removed from service and replaced with new packs. The new and serviced batteries go back into service by being charged.

All figures Courtesy of Cadex

Battery Test Systems

While battery analyzers are tools to service batteries; battery test systems provide multi-purpose test functions for research laboratories. Typical applications are life cycle testing and verifying cell balance in field imitation. Such tests can often be automated with a custom program. *Load capture* allows storing load signatures for playback simulations. Many battery test systems also control external load units and environmental chambers. Other uses of such systems are quality inspections and verifying warranty claims. Figure 9-36 illustrates a typical battery test system.

Figure 9-36:
Cadex C8000 Battery Test System

Four independent channels provide up to 10A each and 36V. Maximum charge power is 400W, discharge is 320W. The discharge power can be enhanced with external load banks.

Courtesy of Cadex

The alternate to a battery test system is a programmable power supply controlled by a computer. Such a platform offers flexibility but requires careful programming to prevent stress to the battery and possible damage or fire if an anomaly were to occur. A battery test system, such as the Cadex C8000, offers protected charge and discharge programs that identify a faulty battery and terminate a service safely. The system can be overridden to do destructive tests.

Simple Guidelines to Choosing a Battery Test System

- Similar to a medical test or the weather forecast, battery testers provide only estimations. No single instrument can do it all; several methods are needed to attain a full assessment.
- Most batteries keep a low internal resistance while the capacity drops gradually with age.
- Battery resistance provides only a snapshot and cannot provide the end-of-life prediction.
- Capacity is the leading health indicator but this measurement is difficult to estimate.
- A charge or discharge agitates the voltage and the battery needs several hours of normalize.
- Coulomb counting requires periodic calibration to keep accuracy.
- Battery management prevents surprise failure and allows for a scheduled retirement.
- Storefront battery testing provides on-site troubleshooting to verify performance.

About the Author
Isidor Buchmann is the founder and CEO of Cadex Electronics Inc. For three decades, Buchmann has studied the behavior of rechargeable batteries in practical, everyday applications, has written award-winning articles including the best-selling book “Batteries in a Portable World,” now in its third edition. Cadex specializes in the design and manufacturing of battery chargers, analyzers and monitoring devices. For more information on batteries, visit www.batteryuniversity.com; product information is on www.cadex.com.