Li-Ion Batteries
Facts You Need To Know

Manufacturer batteries are essential because of the battery's mini-onboard computer and the sensor within the equipment. The sensor in the equipment is set to recognize the manufacturer's battery. Generic or other brands of batteries can cause the equipment not to acknowledge that there is a battery and the incorrect percentage of the charge. Please see pages 3 and 4 for more information.

eGPS SOLUTIONS

Information Sourced from:

[1] https://www.electricity-magnetism.org/electric-battery/degradation-rechargeable-batteries/
[2] https://www.large.net/news/94u43mq.html

Introduction

In this article, we will discuss Lithium-Ion Batteries (Li-Ion Batteries). They require specific maintenance and care when handled and in use. Like car batteries, equipment batteries have a limited lifespan and, after a certain point, are no longer effective at receiving a full charge or supplying the correct amount of current to the machine in question.

If your equipment has issues not explained by other causes, it can signify that the batteries are at the end of their lifecycle. The following are typical signs of current spikes or bad cells that have come to our attention; some are machine-specific, and others are more generic and affect a broad spectrum of equipment types. ***Note that this list is evolving as more issues come to light, and the list does not cover all cases.*** All information about the care and maintenance has been sourced from reputable sites and battery manufacturers.

This article aims to inform you about the risks of using old batteries and what to look for in your machine's performance. It also will detail the care and maintenance to maximize your batteries' lifespan. While batteries are relatively expensive due to the components they are made of, it is better to replace a battery every three to five years than have a costly repair bill later on.

Observed indicators of bad batteries

#1 Battery Corrosion

The battery has corrosion on the exterior or discolored areas around or on the terminals. Corrosion is a poor conductor of electricity. Meaning that even if the battery is fully charged, the equipment is not performing effectively.

Do not ignore battery corrosion, as it can cause the battery and contacts from conducting correctly and potentially harm the instrument. Corrosion is not always a sign of a bad battery but indicates something may be wrong. Also, if accompanied by dark spots on the contacts, that can mean the battery is misfiring and harming the instrument.

#2 Discolored Contacts

Both batteries and contacts in the instrument can become discolored and corroded with prolonged use. Again, while not a sign that batteries are expired, the instrument's performance may be affected if not corrected. See the picture below for an example.

#3 Battery Age

The age of your batteries. Each battery has an estimated life of two to three years or 300 to 500 charge cycles (electricity-magnetism.org) [1]. Every time a battery is put on charge, no matter how much much life or little of a charge left, it is considered 1 life cycle by the battery's internal circuitry. After this point, the battery may start causing issues within the operating system that other problems cannot explain.

Reference: Charge cycle per battery

Times on the Charger per Week	Weeks in the Year	Cycles per Year	Cycles per 2 Years	Cycles per 3 Years
1	52	52	104	156
2	52	104	208	312
3	52	156	312	468
4	52	208	416	624

1 (1) charge = (1) life cycle

#4 Data Collectors

In Data Collectors, the typical signs that the batteries are old and need to be replaced are:

- The Data collector is not taking charges; it shows a full battery while on the charger, then drops power quickly once disconnected.
- It loses power soon after being fully charged and after being set up in the field.
- The data collector is losing information or getting corrupted data.
- Configurations are changed: no Bluetooth instrument selected, different instrument settings, the network switched from the Internet to Work, etc.
- The system only loads two bars and stops loading the operating system.
- The system will not power down; it keeps cycling to load the operating system.

#5 Total Station and Robotics

In Total Stations and Robotic Systems, battery issues can present as:

- Angular Issues – Skipping by degrees randomly.
- Prism offset being changed – Distancing Errors.
- Keyboard Information lost – Reprogramming of critical functions (Topcon)
- In the instrument, an electrical buzzing was heard, causing angular and distance problems.
- Battery level solid when working in angular mode – Drops to one bar or low battery message when going to Measure.
- System Crashes – Message: “No OS found”; operating system not recognized when trying to power on.
- System booting but goes to a blank screen / no Windows chime; we can hear the touch panel and keyboard clicks – Processor / main board damaged.

#6 GPS Systems GNSS

Recently, we encountered battery issues with GPS Systems:

- eGPS GNSS System has lost the satellite activation in the unit - had to connect to the system in a web browser to reactivate satellites.
- Mainboards have failed - improper current from the battery will crash the processor.
- GPS board failures, no satellites being tracked, resulting in costly repairs

Battery Maintenance

Batteries have a limited life and will lose their capacity to hold a charge; this is irreversible. The battery's lifespan is about two to three years or 300 to 500 charge cycles (electricity-magnetism.org)[1]. Li-Ion batteries also continue to discharge, aka self-discharge, when not in use or storage. The run time of your battery will vary depending on the equipment's configuration and the applications.

Charging

- Always follow the charging instructions provided with your product.
- Harming the battery can happen if the wall charger is not the same brand or a different equipment charger.
- For example, a total station robotic wall charger is used to charge a GNSS receiver battery: the specifications are less than required to apply a proper charge.
- The positive and negative ends must be the same.
- Output voltage and amperage match or exceed the manufacturer's specifications for the wall charger.
- Fast charging increases component changes, shortening battery lifespan. In addition, if a charger cannot detect when the battery is fully charged, then overcharging is likely, thus damaging it (large.net)[2].
- Certain systems are not recommended to charge over the weekends
- (1) charges = (1) lifecycles | every time a battery is put on charge, no matter how much or how little of a charge is left, it is considered 1 lifecyle by the battery's internal circuitry.

Reference: Charge Cycle per Battery

Times on the Charger per Week	Weeks in the Year	Cycles per Year	Cycles per 2 Years	Cycles per 3 Years
1	52	52	104	156
2	52	104	208	312
3	52	156	312	468
4	52	208	416	624
5	52	260	520	780

Depending on how the battery is used, and in the various equipment, results will not always be the same: see below:
1. Network and UHF rovers use significantly less power than a unit in UHF base mode so the system will not show signs of aging until closer to 450+ life cycles.

Storage

- On the Shelf, Li-Ion batteries only last two to three years (Large.net)[2]. It is crucial to ensure that the new battery pack is genuinely fresh. Even after the purchase, it is essential to check the status of the battery and use it correctly.
- Degradation of the battery is strongly temperature-dependent; room temperature is optimal for storage and has the least amount of degradation.
- Store batteries at temperatures between 5 and 20 C (41 F and 68 F) (electricity-magnetism.org)[1].
- Store your battery with a partial charge between 30% and 50% to lose the least self-discharge (electricity-magnetism.org)[1].

Handling Precautions

- Do not use a damaged battery.
- Do not disassemble, crush, or puncture a battery.

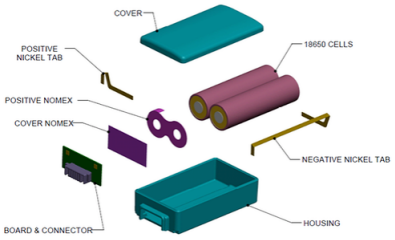
Additional Information

- Manufacturer batteries are essential because of the battery's mini-onboard computer and the sensor within the equipment. The sensor in the equipment is set to recognize the manufacturer's battery. Generic or other bands of batteries can cause the equipment not to acknowledge that there is a battery along with the incorrect percentage of a charge (large.net)[2].

- A Li-Ion battery is made of a voltage converter, voltage tap, regulator circuit, connector, battery charge monitor, and temperature sensors are all included in a battery pack for a protected cell. The additional circuitry creates a mini-onboard computer to manage the battery. Unfortunately, the extra material makes them more expensive than non-rechargeable batteries.

The diagram below illustrates the typical elements found in a rechargeable battery pack:

- Cells (Different form factors & chemistry types)
- BMS (Electronics to manage the battery)
- Connection System (Connector, pigtail, wires)
- Housing (Plastic, sheet metal, shrink, etc.)



- Using generic chargers can impact the battery's performance. Fast charging increases component changes, shortening battery lifespan. In addition, if a charger cannot detect when the battery is fully charged, it's likely to damage the battery.

Conclusion

The bottom line is that replacing batteries as needed will prolong the instrument's life, reduce costly repair bills, and avoid avoidable downtime saving your company time and money. Have a question? Please email us at info@egps.net.

Information Sourced from:

[1] *Degradation of rechargeable batteries due to cycling: Lifespan of Battery.* Electricity-Magnetism. (2022, September 25). Retrieved February 17, 2023, from https://www.electricity-magnetism.org/electric-battery/degradation-rechargeable-batteries/

[2] *What is the shelf life of lithium ion rechargeable battery introduction and storage?* Custom Lithium ion Battery Pack. (2022, February 14). Retrieved February 17, 2023, from https://www.large.net/news/94u43mq.html