

A Word about Sensor Charging and Battery Care

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Many customers ask about sensor life, routine charging, and what to expect as the sensors age.

Equinosis sensors are made with Lithium Polymer batteries currently manufactured by PowerStream. Lithium Polymer is a higher quality subset of a broader class of Lithium-ion (Li-ion) batteries. The component used has a specified life of 500 cycles - where after 500 cycles, greater than 70% of initial capacity is retained during laboratory testing conditions. However, in the field, "cycle" is an elusive term as it depends on several factors. And 500 is even more elusive as that is a lower specification limit. So, the average life is believed to be somewhere above 1000 cycles, with a fair degree of variability. The mean failure cycle is not published by battery manufacturers.

But it is important to recognize that one "cycle" can produce many "recharges". The term "cycle" is considered a "full" discharge and recharge. Unlike other batteries (e.g. Nickel cadmium), Li-ion batteries should not be fully discharged; hence, a recharge from a state less than fully discharged is not a full "cycle". If properly cared for, a typical sensor can survive several thousand recharges from states less than fully discharged.

What affects battery life and what can you do about it?

1. **Temperature.** Li-ion batteries are rated to work at much higher temperature than other batteries. However, the battery will degrade when stored or used at high temperatures. Similarly, extremely low charging temperature can damage the battery too. Therefore,
 - a. Charge – at temperatures between 5 – 45C (41 – 113 F)
 - b. Do NOT charge below 0 C (32 F)
 - c. Store in a cool place.
2. **Charging.** As mentioned, the number of cycles is a key factor; however, operation at the extremes (fully charged/fully discharged) also degrades the life. Therefore,
 - a. **Avoid using the sensors to full discharge.** Charge when they get in the Red zone.
 - b. **Avoid leaving your sensors fully charged - i.e. "topped off". Charge them up, and then remove them from the charging station.** It is typical of batteries to discharge naturally over time, even if the device being powered is off and not in use. The loss of charge over the course of a month is only 1.5%; so, your sensors are likely to not completely discharge before their next use if taken off the charger. **Storing sensors on an energized charging station in a hot place should be avoided!**
3. **Age.** With time, the batteries will eventually degrade. But this a very small contributor compared to temperature and charging behavior.

As time and, more importantly, cycles are amassed, the charge capacity will decrease gradually and linearly

to about 80% of the original capacity. The degradation then will fall much more rapidly until it's unusable.

As the use time starts to drop more rapidly, you will have an indication that you are approaching end of life. Because of the variability in the batteries, expect to see one sensor begin running out of charge well before the others.

Other tips about sensor usage

1. **New sensors should provide approximately 3-4 hours of collection time (time spent collecting and transferring live data).** This will, in most scenarios, provide a full day of use. Collection of data will drain the battery more rapidly than sitting in an idle state (being turned on and not connected and collecting data). However, some battery power is still consumed in an idle state, so there is an automatic shut off timer on the sensors to preserve battery life.
2. **Automatic Timed Shut Off.** Equinosis sensors have an onboard timer that will turn the sensors off if they remain on and in an idle state (on but "disconnected" from the program) for a certain period. This auto shut off will occur in 30 minutes unless the batteries are very low, in which case they will shut off sooner.
3. **If you do not want your sensors to turn off,** you can set up a mock trial, let the sensors stream for a few seconds, then discard the trial data after stopping collection (select discard and disconnect from the drop-down menu), and the timer will be reset. You can also connect to the sensors, but not initiate a trial. However, before you collect your next trial, you should disconnect and reconnect to the sensors, as the Bluetooth connection may have been broken during that wait time and data collection may not be initiated properly upon selecting "start". This method will also consume more battery power than the sensors remaining on but not "connected".
4. While uncommon, if a sensor exhibits unexpected behavior, such as shutting off and not turning back on when the sensor is known to be fully charged, place the sensor on the charger for a few minutes and try again. If the problem persists, contact **Equinosis support**.