UNDERSTANDING NICAD BATTERIES

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NiCad batteries have long been used in portable air sampling pumps due to their lightweight, high power output and ability to provide hundreds of charge/discharge cycles. NiCad® batteries also have limitations that must be understood in order to optimize their performance. A good battery maintenance program will assure consistent reliable service from personal monitoring pumps like the Gilian® HFS-513, LFS-113, BDX II, GilAir -3, GilAir 5, or GilAir II.

NiCad batteries will perform best if completely charged and completely discharged with each use and if they do not see long periods of nonuse. In the real world scenario of personal monitoring pumps, this is usually not the case. Eight hour samples are not always possible and there could be weeks, or even months, between air monitoring surveys.

The life expectancy of a NiCad ® battery varies with the type of use, but a pump used regularly (i.e., two or three times per week) should have a life expectancy of about 300 charge/discharge cycles. Age and long periods of nonuse can diminish this number, but an even longer battery life (e.g., 500 cycles) is not uncommon for pumps that are used often. Sensidyne provides the table below as a guide for battery life expectancy.

Pump Usage Rate	Weekly Use	Estimated Battery Life
High	40–60 hours	1–1.5 years
Medium	20–30 hours	1.5–2.5 years
Low	< 20 hours	2.5 years

There are many factors that affect the performance of NiCad® batteries. For example, they will discharge faster on a hot day than on a cooler day. NiCad ® batteries discharge faster if the pump is working against higher back pressures than if is working against flow resistance. In general, most pumps used in typical industrial settings and at typical sampling back pressures encountered when following traditional NIOSH sampling methods are designed to run eight hours after a 14–16 hour charge.

NiCad® batteries tend to develop a 'memory' if used for less than the eight hour run time designed into personal monitoring pumps. For example, a pump used repeatedly for four hour samples may not run for eight hours on the first eight hour attempt. To erase the memory, the pumps should be put through one or two charge/discharge cycles. This may be accomplished by physically running the pump to stall (ideally with a sampling filter in place) to obtain a deep discharge, followed by overnight charging on a standard battery charger, or by discharging and charging through a battery maintenance system, like the Gilian ® BMS II Charging/Diagnostic System. The advantages of these battery maintenance systems are that they allow discharging cycles to occur unattended, and only exercise the batteries without putting extra wear and tear on the pump itself.

Batteries may be stored long term (over thirty days) on the trickle charge setting of the Universal Charging System or the BMS II Charging/Diagnostic System. However, caution must be taken when using an older BMS system (i.e., BMS-200 or BMS-100B) because the older BMS system does ***not*** have a true trickle charge. The older BMS system uses a ***pulsed charge***, which charges the battery at a reduced rate once the normal charge mode has fully charged the battery.

This pulsed charge mode charges the battery at a faster rate than a true trickle charge and must be limited to periods of four days (96 hours) to prevent overcharging (and overheating). The pulsed charge mode charges the battery at full charge voltage on a duty cycle (i.e., a rapid on-off cycle).

A trickle charge is normally accomplished by charging at a reduced voltage, a method used by both the Gilian ® Universal and new BMS II Charging Systems. Keep in mind the difference between the two methods and the time limitation on the pulsed charged mode of the older BMS system.

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Batteries may be stored away from the charger for long periods of time (> 30 days), *but they should be fully charged first.* Cycle the batteries once or twice prior to use to bring their run time back to eight hours. Pump batteries used regularly for the full eight hour sampling period usually don't require cycling. However, it is a good idea to cycle these batteries after every ten uses just to ensure that deep discharges are occurring once in a while.

Regular charge/discharge cycling is *not harmful*, and may actually improve the reliability of the batteries. In the worst case, over-cycling may consume a small percentage of the 300–500 lifetime cycles, however, improved battery reliability should more than offset any loss of total cycle life. Some users like to maintain spare batteries by placing them into use on a rotating basis.

It is important to use only the charger or charging system designed for the specific pump in use. It is equally important to observe the recommended charging times. Charging systems like the Gilian ® Universal Charging System or the BMS II Charging/Diagnostic System are ideal for battery maintenance because the automatically switch to trickle charge once the battery has been fully charged.

Never attempt to alter a charging system or make internal repairs to a battery pack. Unauthorized repairs to battery packs will void the warranty, not to mention any intrinsic safety certifications. Also, batteries should never be charged in a hazardous areas that have the potential to produce explosive atmospheres. While the battery pack is made to be intrinsically safe, the charger or charging system is not, and could provide a spark that causes an explosion.

Use a battery maintenance record log regularly to determine when batteries should be replaced. The log should include date of purchase and a record of use, including run time and charging or cycle/charging descriptions. Batteries should be assigned a serial number for logging reference, especially if spare battery packs are being placed into service on a rotating basis.

In review, consider the following points in designing your battery maintenance program:

1) NiCad batteries perform best if completely charged and completely discharged with every use. A charge/discharge cycling between partial charge uses will enhance battery performance,

2) NiCad® batteries can develop a memory if used repeatedly for short samples. They can also become lazy after long periods of nonuse. A deep discharge followed by a full charge (or two such cycles) will correct these problems.

3) Depending upon frequency of use, a battery pack should last about 300 to 500 charge/discharge cycles.

4) The Gilian® BMS II Battery Maintenance System allows regular charge/discharge cycling without running the pump. It incorporates true trickle charge technology. However, on older BMS systems the pulse charge mode is used and batteries cannot be left in that mode for more than 96 hours without over charging.

5) Batteries should be fully charged before long term storage.

6) Use only charging systems designed for the specific product being charged. Do not attempt unauthorized repairs to battery packs or chargers.

7) Do not attempt charging in hazardous potentially explosive atmospheres. While the battery packs are designed to be intrinsically safe, the chargers are not.

8) A maintenance record log for battery packs will help to improve battery maintenance and predict battery life expectancy.

For further information on battery maintenance for personal monitoring pumps, contact the Sensidyne Customer Service Group or Service Department.

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