

Application Note

Lithium Ion Battery Management and Safety Practices

Introduction

The following information is valid for the M4605A and M4607A lithium ion batteries used in the Philips IntelliVue and Avalon monitoring product families.

Lithium ion technology is the state-of-the-art in DC energy storage and has been widely adopted to meet the demand for more power and longer operating times. Lithium ion batteries store a large amount of energy in a small, lightweight package, so you can carry less and do more for a longer period of time.

Our lithium ion batteries are designed to provide the following characteristics:

- **Built-in fuel gauge** - intelligence enables the battery to estimate its current state of charge. Convenient battery power indicators illuminate to show you the state of charge as a percentage of a fully-charged battery.
- **Safe and reliable** - redundant safety features in the batteries protect the batteries and their users.
- **Quick charging** - lithium ion batteries can quickly charge to their full capacity because they do not require an overnight trickle charge.
- **Tolerant of partial charging** - because lithium ion batteries are tolerant of partial charging, there is no effect on battery life when patient care requires you to suspend charging and use the battery before it is fully charged.

Batteries are a consumable item, and their age and condition will impact the operation of the products they power. Lithium ion technology is a relatively new battery chemistry. While our batteries have been designed and manufactured using the best safety techniques available, it is important to understand and follow proper and safe practices for

use, storage, battery lifetime management and **disposal** of lithium ion batteries in order to reduce any residual risk.

We strongly recommend that you implement the following battery management practices. Failure to follow safe practices may result in bodily injury and/or property damage.

Use and Handling

Use only Philips batteries of the type indicated in your patient monitor's Instructions for Use. These specially designed, high performance batteries are the only ones that have been verified for safe and effective use with the monitors.

Always use the batteries in accordance with the instructions in your patient monitor's Instructions for Use.

Battery Care

Battery care begins when you receive a new battery and continues throughout the life of the battery. The table below lists battery care activities and when they should be performed.

Activity	When to Perform
Perform a visual inspection.	Before inserting a battery into the monitor
Charge the battery.	Upon receipt, after use, or if a low battery state is indicated. To optimize performance, a fully (or almost fully) discharged battery should be charged as soon as possible.

Activity	When to Perform
Condition the battery	When the “battery requires maintenance” symbol appears
Store the battery in a state of charge in the range of 20% to 40%.	When not in use for an extended period of time.

Refer to your patient monitor’s Instructions for Use for details on how to perform battery care activities, including charging and conditioning. We recommend use of the Philips M8043A Battery Charger which automatically performs the correct charge or conditioning process and evaluates the capacity when fully charged.

Handling Precautions

Lithium ion batteries store a large amount of energy in a small package. Use caution when handling the batteries; misuse or abuse could cause bodily injury and/or property damage.

- Do not short circuit - take care that the terminals do not contact metal or other conductive materials during transport and storage
- Do not crush, drop or puncture - mechanical abuse can lead to internal damage and internal short circuits which may not be visible externally
- Do not apply reverse polarity
- Do not expose batteries to liquids
- Do not incinerate batteries or expose them to temperatures above 60°C (140°F)
- Do not attempt to disassemble a battery.

If a battery has been dropped or banged against a hard surface, whether damage is visible externally or not:

- discontinue use
- dispose of the battery in accordance with the disposal instructions

Storage

When storing batteries, make sure that the battery terminals do not come into contact with metallic objects, or other conductive materials.

If batteries are stored for an extended period of time, they should be stored in a cool place, ideally at 15°C (60°F), with a state of charge of 20% to 40%. Storing batteries in a cool place slows the aging process.

The batteries should not be stored at a temperature outside the range of -20°C (-4°F) to 60°C (140°F).

Do not store batteries in direct sunlight.

Stored batteries should be partially charged to 20% to 40% of their capacity every 6 months. They should be charged to full capacity prior to use.

Note: Storing batteries at temperatures above 38°C (100°F) for extended periods of time could significantly reduce the batteries’ life expectancy.

Battery Lifetime Management

The lifetime of a Lithium Ion battery depends on the frequency and duration of use. When properly cared for, the useful life is approximately 3 years or 500 charge-discharge cycles, whichever comes first. In addition, experience indicates that the incidence of failure may increase with battery service life due to the accumulated stresses of daily use. We therefore strongly recommend that lithium ion batteries be replaced after 3 years or 500 charge-discharge cycles.

The age of a lithium ion battery begins at the date of manufacture. To see the date of manufacture and the number of charge-discharge cycles:

1. Select the battery symbol on the patient monitor screen.
2. Select the appropriate Battery pop-up key.
3. If necessary, select the Battery pop-up key again to view the battery details.

The date of manufacture and the number of charge-discharge cycles are listed with other battery data on the screen.

Disposal

Discharge the batteries and insulate the terminals with tape before disposal. Dispose of used batteries promptly and in accordance local recycling regulations.

