



## Proper Care Of Nickel-Cadmium Battery Packs

### Nickel-Cadmium Battery Pack

The following RAE Systems products can use Nickel Cadmium (Ni-Cd) battery packs:

MultiRAE Plus  
QRAE  
ToxiRAE II

In order to obtain the best performance from these battery packs, it is important to understand the characteristics and proper maintenance procedures of the Ni-Cd battery. This tech note describes a few tips on how to take care of the battery pack during normal operation, charging or storage of the battery pack.

### Battery Pack Long-Term Storage

Leaving the battery connected to the monitor for long periods of time (greater than one month) causes the battery to be excessively discharged. Excessive discharge could cause a decrease in battery capacity or shorten the cycle life. If you do not plan to use the monitor for a while, it is highly recommended to disconnect the battery pack from the monitor and store the battery pack in a cool place (10° C to 25° C).

After being stored for long periods of time, deactivation of reactant material inside the NiCd battery may cause a drop in battery capacity for the initial discharge. The normal capacity can be restored by discharging and recharging the battery several times.

When storing for longer than six months, it is recommended to recharge at least once every six months to prevent self-discharge from causing a drop in battery performance or electrolyte leakage.

### Normal Charging of the Battery Pack

The charging circuit of the MultiRAE Plus is built into the monitor. Connect the AC adapter (or the optional automotive charging adapter) to the DC jack on the MultiRAE Plus monitor. The display asks whether a discharge cycle is required, press [N/-] key, and the charging function begins. The display shows "Charging" and "Battery = x.x V." If a key is not pressed within 10 seconds, the charging begins automatically. The LED should be red in color when

charging. If the battery is fully charged, the LED changes from red to green. The red color indicates that the battery is being charged. The green color indicates that the battery is fully charged. The display also indicates "Fully charged." A completely discharged MultiRAE Plus monitor is charged to full capacity within 10 hours.

The charging circuit of the ToxiRAE is built into the charging station. Connect the AC adapter to the charging station. Place the Pocket PID into the slot of the charging station. The LED should be red in color when charging. If the battery is fully charged, the LED changes from red to green. The red color indicates that the battery is being charged. The green color indicates that the battery is fully charged. A completely discharged Pocket PID or a spare battery is charged to full capacity automatically within four hours.

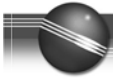
### Battery Pack Self-Discharge

The battery of the MultiRAE Plus or ToxiRAE unit is drained slowly even if the unit is turned off. This is due to the real-time clock device and sensor bias circuit still running while the unit is turned off. If the unit has not been charged for four to five days, the battery capacity will be low due to the self-discharge. As described in section "Battery Pack Long-Term Storage," leaving a battery self-discharged for a long period of time causes excessive discharge and a drop of battery capacity.

### Trickle-Charging the Battery Pack

The MultiRAE Plus also includes a trickle charging capability. After the battery is fully charged, the trickle charge circuit continues to operate in order to supplement the battery capacity, which is being lost due to self-discharge. A pulse-charging method is used to trickle-charge the battery. During each minute, the charging current is turned on for a few seconds to charge the battery. The duration of the charging pulse is determined by the amount of self-discharge. A typical charging pulse time is about five or six seconds.

This trickle charging circuit is designed to prevent over charging. Therefore, it is okay to leave the



monitor in the charger when it is not in use, so that it is fully charged and ready for immediate use.

**Important Note:** The trickle-charge code in V2.13 or earlier versions for MultiRAE Plus does not sufficiently supplement the battery capacity. Therefore, if the monitor has been left on the charger for more than one or two weeks, the battery capacity may still run low. Download the latest version of firmware (V2.14 or later) off of the RAE Systems website at [www.raesystems.com](http://www.raesystems.com) to correct this problem. If you are running an older version of firmware in the monitor, you can also correct this problem by disconnecting and reconnecting the charger every few days.

The trickle-charge circuit for ToxiRAE uses a continuous charging method at low charging current to prevent overcharge. It is okay to leave the monitor in the charger when it is not in use so that it is fully charged and ready for immediate use.

### Operating From the Battery Charger

The battery-charging circuit of MultiRAE Plus is designed so that the monitor can be operated from the charger indefinitely. When the monitor is turned on and the charger is connected, the charger will be turned on for 10 to 20 seconds in each minute. The “on” duration is automatically determined by the discharge rate so that the battery capacity can be maintained at a constant level.

The battery charger of ToxiRAE has a built-in time out timer. After the battery has been charged for four hours, it automatically reverts to trickle-charge mode. It does not switch back to fast-charging mode unless the unit is lifted from the charger and set down again to reset the timer. Therefore, the ToxiRAE will not

operate indefinitely if left turned on in the charger, but should operate 30 to 40% longer, compared to when it is not in the charger.

### Memory Effect and Battery Pack Deep Discharge

NiCd batteries are known to have a memory effect; that is, if the battery has been repeatedly discharged slightly (10 to 20%) and then recharged again, it gradually develops a memory effect and loses some of its capacity after a period of time. Such capacity loss can be recovered by performing a number of deep discharging and charging cycles.

To perform a deep discharge, connect the AC adapter to the DC jack on the MultiRAE Plus monitor. When the display asks whether a discharge cycle is required, press the [Y/+] key. The battery is fully discharged in a few hours and then automatically enters a recharge cycle.

For ToxiRAE, the charging station provides a means to manually deep-discharge the battery. Inside the opening of the charger, near one corner of the bottom plate, there is a small hole. Insert a pencil or a ballpoint pen to press a switch inside the hole. This sets the charging station into discharge mode and turns on the amber-colored LED. Place the ToxiRAE into the charging station, and the battery is fully discharged in a few hours. The charger then automatically switches from discharging mode to charging mode (the LED changes from amber to red) when the battery is fully discharged.

If frequent shallow battery-pack discharging is the typical mode of operation (e.g., using the monitor for half an hour each day), then it is recommended to deep-discharge the battery pack once every two or three weeks. This should recover any possible lost capacity due to memory effect.