Device Storage Best Practices

Best practices for storing and maintaining your Hamilton Medical devices, including environmental considerations, power and battery requirements, and management of oxygen sensors.

Table 1. Device storage requirements

	HAMILTON-C1/T1/MR1	HAMILTON-C2/C3	HAMILTON-C6	HAMILTON-G5/S1
Temperature	-20°C to 60°C (-4°F to 140°F), in original packaging*	-20°C to 60°C (-4°F to 140°F), in original packaging	-20°C to 60°C (-4°F to 140°F), in original packaging	-10°C to 60°C (14°F to 140°F), in original packaging
Atm. Pressure	**HAMILTON-C1:** 620 to 1100 hPa **HAMILTON-T1:** 376 to 1100 hPa **HAMILTON-MR1:** 700 to 1100 hPa	620 to 1100 hPa	620 to 1100 hPa	700 to 1100 hPa
Rel. Humidity	10% to 95%, noncondensing	10% to 95%, noncondensing	10% to 95%, noncondensing	5% to 85%, noncondensing
Notes	* If the storage temperature is outside of the operational temperature range, the device **must** cool down or warm up for 10 minutes at a temperature of 20°C (68°F).			

Table 2. Battery specifications, recharge time, maintenance schedule, replacement schedule and requirements, storage environment[f]

	HAMILTON-C1/T1/MR1 High capacity Li-ion Rev 04/05 PN 369108	HAMILTON-C2/C3 High capacity Li-ion Rev 04 PN 369106	HAMILTON-C6 Li-ion Rev 00 PN 369130	HAMILTON-G5/S1 Internal lead acid battery	HAMILTON-G5/S1 Extended Li-ion battery pack PN 159144
Capacity/Energy	6.7 Ah / 72 Wh	6.8 Ah / 98 Wh	5.0 Ah / 72 Wh	15 Ah	6.6 Ah
Typical operating time[a]	**1 bat:** 4 h **2 bat:** 8 h[b]	**1 bat:**[c] 3.5 h / 2.4 h **2 bat:**[c] 7 h / 5 h	**1 bat:** 1.5 h **2 bat:** 3 h	1 h	1 h
Recharge time[d] (approx.)	**1 bat:** 4 h **2 bat:** 7 h[b]	**1 bat:** 2.25 h **2 bat:** 4.5 h	1 bat: 2.5 h **2 bat:** 5 h	15 h	7 h
Maintenance schedule	**Every 6 months:** To recharge batteries, plug ventilator into primary power for at least 4 hours.[e] Recharging temperature range is 0°C to 45°C.	**Every 6 months:** To recharge batteries, plug ventilator into primary power for at least 4 hours.[e] Recharging temperature range is 0°C to 45°C.	**Every 6 months:** To recharge batteries, plug ventilator into primary power for at least 4 hours.[e] Recharging temperature range is 0°C to 45°C.	**Every 3 months (1250 hrs):** Verify that batteries can hold a charge by unplugging the vent from power, and verifying that, after 10 min, the batt. symbol (INT or EXT) is still green. Recharging temperature range is 0°C to 55°C (for the internal battery), 0°C to 45°C for the external battery.	
	Annually and when error rate ≥ 5%: Calibrate batteries using the external battery charger (PN 369104, 369136). Follow the instructions provided.				
Replacement required[f]	Based on various factors: The state of health (SoH) calculation, age of the battery, how long the battery has been in use. For details, see the ventilator *Service Manual*.				
Storage conditions	The batteries tolerate storage between -20°C to 60°C, ≤ 85% relative humidity.	The batteries tolerate storage between -20°C to 50°C, ≤ 85% relative humidity.	The batteries tolerate storage between -20°C to 50°C, ≤ 85% relative humidity.	The batteries tolerate storage between -20°C to 40°C, ≤ 85% relative humidity. Optimally, < 30°C.	The batteries tolerate storage between -20°C to 40°C, ≤ 85% relative humidity. Optimally, < 30°C.
	Optimal storage conditions are between 5°C and 21°C (41°F and 69.8°F), ≤ 85% rel. humidity. Extended exposure to temperatures below -20°C and above +45°C will degrade battery performance and life.				

[a] The actual operating time depends on battery age and on how the battery is used and recharged, as well as display brightness. To ensure maximum battery life, maintain a full charge and minimize the number of complete discharges.
[b] The HAMILTON-T1/MR1 support the use of two batteries.
[c] The first time value shown is for battery use with the HAMILTON-C2; the second time value is for battery use with the HAMILTON-C3.
[d] For completely discharged batteries, inside the ventilator while plugged into primary power. You can also use the external charger; charge times may be reduced.
[e] Recharge batteries in the ventilator while plugged into primary power or use the external battery charger (PN 369104, 369136). Follow the recharging instructions provided with the device and battery.
[f] For full specifications, see the ventilator Operator's Manual.

Replacement required when FCC < .8 DC or ≥ 1.1 DC AND/OR the battery is 3 years or older AND/OR the battery has undergone 400 or more charge cycles

Table 3. Battery storage and recharging recommendations

Battery storage recommendations

By following these guidelines, you maximize the life span of your batteries.

- **Never store batteries in a discharged state!** Fully charge them before storage.
- Fully charge batteries when you first receive them.
- Recharge batteries every 6 months.
- Store the battery in a place free from vibration, dust, direct sunlight, excessive moisture and corrosive gasses.
- Store between 5°C and 21°C (41°F and 69.8°F), ≤ 95% rel. humidity.
- Storage temperatures should not exceed 25°C. Sustained temperatures above 45°C can degrade battery life.
- Do not store near a heat source (+80°C or higher).
- Do not store where batteries can get wet.
- Do not store batteries together with metal objects (such as wires, hair pins, and the like).

Battery recharging recommendations

Failure to follow recommendation can lead to battery damage including over-current issues, acid leakage, overheating, smoke emission, and/or combustion.

- To recharge the battery, use the battery charger (PN 369104) and carefully follow the documented procedures.
- If the recharging operation fails to complete even when the specified recharging time has elapsed, immediately stop further recharging.
- Do not connect to an electrical outlet, vehicle cigarette lighter, and the like.
- Do not recharge the battery near fire or environment above 45°C.
- Do not connect the positive (+) and negative (-) terminals with a metal object such as a wire.
- The positive (+) and negative (-) terminals are arranged in a particular orientation. Do not force the connection if you cannot easily connect the battery terminals to the battery charger or other equipment.

Table 4. O2 sensor storage and maintenance requirements

	Galvanic O2 sensor PN 396200, 396008, 396009	Paramagnetic O2 sensor PN 160169	Paramagnetic O2 sensor PN 159715
Storage temperature	Between 5°C and 15°C (41°F and 59°F)	Between 5°C and 15°C (41°F and 59°F)	Between -30°C and 70°C (-22°F and 158°F)
Preventive maintenance/ Replacement	Replace annually or if depleted, whichever comes first. See ventilator *Operator's Manual*.	Test and calibrate annually or every 5000 hours, whichever comes first. Replacement is only required in case of damage or defect. All service is performed by Hamilton Medical technical service personnel.	

Best practices for storing devices while *connected* to primary power

Follow these guidelines for storing your devices connected to primary power.

- Disconnect the ventilator from power and run the ventilator on battery power for a few hours every couple of weeks.

  If this is impractical, due to location and/or number of devices, consider disconnecting and running the ventilators quarterly.
- Ensure the storage environment meets the requirements listed in Tables 2, 3, and 4 of this *Quick Reference*.

Best practices for storing devices *disconnected* from primary power

Follow these guidelines for storing your devices disconnected from primary power.

- Periodic use of the batteries can extend the battery life time; it provides the batteries a calibration cycle each time they are recharged.
- Connect the ventilator to primary power for 1 hour every week. Be sure to disconnect it afterward.
- Follow the maintenance practices noted in Tables 2, 3, and 4 of this *Quick Reference*.
- Ensure the storage environment meets the requirements listed in Tables 2, 3, and 4 of this *Quick Reference*.

Preparing the device for use if the battery has been completely depleted

Follow these guidelines to recharge your batteries and bring your device into use if the batteries have been completely discharged.

- **Never store batteries in a discharged state!** Fully charge them before storage.
- To recharge the battery, either use the external battery charger or place the battery in a ventilator plugged into primary power to charge and calibrate the battery.

  If the battery fails to charge, it is likely defective and must be replaced.
- In the event the battery is defective, the ventilator may generate an alarm indicating the battery must be replaced.

Preparing devices for use after extended storage

Follow these guidelines to prepare your devices for use after having stored them for some time. If the batteries are depleted, see the section below.

- **Check the batteries before use.** If the battery gives off a bad odor, has melted, is discolored or deformed, leaks electrolyte fluid, or appears in any way abnormal or damaged at any time, remove it from the equipment and from service.
- **Fully charge and calibrate the battery(ies) before use.**
- Follow the maintenance practices noted in Tables 2, 3, and 4 of this *Quick Reference*.
- Perform any required maintenance tasks listed in the **Preventive maintenance** table in the ventilator *Operator's Manual*.

  For example, replacing the fan and air intake filters, potentially replacing the HEPA filter, replacing the O2 sensor.
- Clean and disinfect the ventilator following the instructions in the **Maintenance** chapter of the ventilator *Operator's Manual*.
- Follow your institution's protocol for bringing devices into service.

Storage guidelines for the HAMILTON-T1 with the Pelican case

If you store the HAMILTON-T1 Mil in the Pelican case, follow the same guidelines as for storing a ventilator *connected to primary power* or *disconnected from primary power*, as appropriate.

No special handling is required.

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