

Technical Data Bulletin



#178 —Maintenance and Care of 3M™ Powered Air Purifying Respirator (PAPR) Batteries

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This Technical Data Bulletin supersedes TDB #130, TDB #144, TDB #151 and TBD #169

Introduction

Batteries are a key component of a Powered Air Purifying Respirator (PAPR) system since they provide a relatively light weight, mobile power source to run the motor blower. There are a variety of battery chemistries available to PAPR manufacturers. The battery chemistries offered by 3M have been selected to meet the needs of our customers while providing adequate power to the PAPR system to meet regulatory requirements.

What is a Battery?

A battery cell consists of a positive and negative terminal. Electrons collect on the negative terminal of the battery. Inside the battery, a chemical reaction produces the electrons. There is a wide variety of chemistries used to produce the chemical reaction. The speed of electron production by the chemical reaction (the battery's internal resistance) controls how many electrons can flow between the terminals. Electrons must travel from the negative to the positive terminal for the chemical reaction to take place. Once connection occurs, the reaction starts. Chemistries that are reversible are used in re-chargeable batteries and irreversible chemistries are

used in non-rechargeable batteries.

3M PAPR Batteries/Chargers

3M™ PAPR Battery Packs are designed to deliver consistent power over a long life. Current cell chemistries used in 3M PAPR battery packs are rechargeable nickel cadmium, nickel metal hydride, and non-rechargeable lithium manganese dioxide.

3M PAPR Battery Packs	Charger
GVP-111	GVP-112
Adflo™ Battery 15-1099-07	Smart Chargers: 15-0099-08 (1 unit) 15-0099-08N6 (multiple)
BP-15 (Nickel Metal Hydride battery)	Smart Chargers: BC-210
BP-17IS (NiCd Intrinsically Safe) 007-00-15 (NiCd – Airmate) 520-01-02 (NiCd - Airstream)	Smart Chargers: 520-03-73 (1 unit) 520-03-72 (5 unit) 520-01-61 (10 unit) In Canada: 520-01-61SGL (1 unit) 520-01-61F1V (5 unit)
3M Discontinued Products	Charger
520-01-17	Smart Chargers:
520-01-15	520-03-73 (1 unit)
520-01-18	520-03-72 (5 unit)
520-01-06	520-01-61 (10 unit)
520-01-44	In Canada: 520-01-61SGL (1 unit) 520-01-61F1V (5 unit)

Some general important considerations for using PAPR batteries are listed here. More specific considerations are listed below in sections dedicated to specific battery chemistries.

- Always read and follow the *User Instructions* that accompany the battery and charger.
- Use only the 3M charger specified for that model battery pack.
- Battery capacity may be reduced if used in high temperature environments (above 120°F ambient) or near radiant heat sources.
- With the exception of the BP-15/BC-210, avoid leaving batteries on ‘Smart Chargers’ for more than 2 weeks. Although these chargers shift to a trickle charge when the battery’s capacity is reached they do not turn off. Continuous trickle charging generates

heat causing premature deterioration of battery cells. The BP-15 battery can be left on the BC-210 charger indefinitely because the BC-210 charger actually shuts down for periods of time.

- All 3M PAPR batteries can be charged any time during the discharge cycle. Battery memory (also known as voltage depression) is not a significant factor.

Do not allow water to enter the battery housing. Water will damage the battery assembly. Batteries can be cleaned with a damp cloth and mild detergents. Solvents and strong detergents may damage the battery case.

Nickel Cadmium (NiCd) Batteries

NiCd chemistry has been used in PAPR batteries for many years. It is extremely durable. Each 3M NiCd battery pack model provides up to 500 charge/discharge cycles. However, the life of 3M NiCd battery packs will be significantly reduced when they are exposed to high heat over an extended period of time. In addition to the recommendations above, these maintenance guidelines should be followed to maximize battery life.

- Running the batteries down completely (less than 1 volt output) or “deep discharging” will damage the battery cells and will not improve capacity.
- Always charge 3M NiCd battery packs at a temperature of 77° F (25° C) or less. At higher temperatures, the battery pack may not accept a full charge. If a battery pack

feels hot, let it cool ½-hour before charging. Do not charge multiple battery packs in an enclosed cabinet without ventilation.

Without periodic charging, a NiCd battery in storage loses up to 1 % of its charge each day. Batteries subjected to prolonged storage (longer than 12 months) may lose their capacity to hold a full charge. Battery capacity can be checked by running the PAPR motor/blower unit for eight hours and checking that the required airflow is maintained. Several charge/run-down cycles may restore battery capacity.

Nickel Metal Hydride (NiMH) Batteries

NiMH chemistry has developed into an attractive alternative to battery chemistries that use more toxic and less stable materials. 3M currently offers this technology in several of our PAPR systems. In addition to the recommendations above, these maintenance guidelines should be followed to maximize battery life.

- Storage should be in dry conditions (less than 85% relative humidity). Recommended storage temperatures for the batteries are -4° to 115° F (-20° to 45° C). Storage of the battery outside of this range will shorten the usable life of the battery.
- New batteries should be charged immediately upon receipt. New batteries may require three charge/discharge cycles prior to attaining full capacity.
- Depleted batteries should be recharged immediately after use to help maintain

the battery cell function. The battery should be allowed to go to full charge before next use.

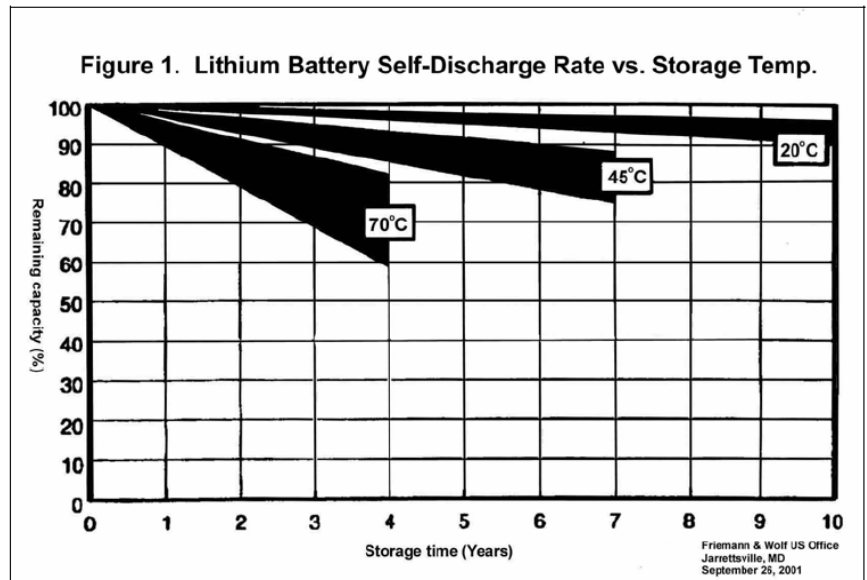
- 3M NiMH batteries provide up to 400 charge/discharge cycles. The life of 3M NiMH batteries will be significantly reduced when they are exposed to high heat over an extended period of time.
- Always charge NiMH batteries at the temperature range specified in the applicable *User Instructions* – typically between 50° F (10° C) and 90° F (32° C). Beyond this range, the battery may not accept a full charge. If a battery feels hot, let it cool for 1/2 hour before charging. Do not stack batteries together or on top of charger when charging. Do not charge in an enclosed cabinet. Heat from chargers and batteries must be allowed to dissipate. If the chargers sense the batteries are too hot they will go into a standby mode until the battery has cooled.
- Storage of batteries - NiMH batteries stored at room temperature lose approximately 1- 2% of their charge per day after charging. The rate of self-discharge will increase as storage temperature increases. NiMH batteries should not be allowed to go into a deep discharge state (less than 10% charge). Batteries not intended for immediate use should be charged upon receipt and placed on a recharge schedule per the *User Instructions*.

- Prolonged storage of battery packs (greater than three months) without regular recharge, may damage the battery pack cells.
 - The BP-15 battery pack may remain connected to the charger for an extended period of time. This is the recommended storage method for maximum battery performance. The 3M™ Smart Battery Charger BC-210 will sense when the battery pack BP-15 reaches full charge and stop charging the battery. Periodically it will shift into a trickle charge to ‘top off’ the battery.
 - The Adflo™ battery pack may remain on the charger for several days after completion of charging but for maximum battery life disconnect the charger after a full charge has been received. The Adflo battery pack should be recharged per the Adflo™ *User Instructions* to maintain battery performance.
- You can check battery capacity by running the PAPR motor/blower unit with appropriate filters/cartridges in place and the airflow indicator installed and recording the time until the airflow falls below six cubic feet per minute.

Lithium Manganese Dioxide Battery

3M offers a non-rechargeable lithium battery 520-04-57 that

is NIOSH approved with several Breathe Easy PAPR assemblies (refer to NIOSH approval label for list of approved combinations). This battery is used primarily by first responders/receivers. The non-rechargeable lithium battery is expected to provide 12 hours of service when new. During storage at room temperature, it will lose approximately 1% of its charge per year, as indicated by Figure 1. Therefore, a battery stored at 20° C (68° F) for 10 years will lose up to 10% of its charge. Because the lithium battery is non-rechargeable and has a long shelf-life, there is no need for periodic battery charging and testing. Note: the discharge rate increases significantly at higher storage temperature. The acceptable temperature range for storage of lithium batteries is -40° C (-40° F) to 70° C (158° F). Exceeding this temperature range may cause permanent damage to the battery.



Disposal

Damaged or worn-out batteries should be disposed of in accordance with local, state and federal regulations at an approved hazardous waste recycling or disposal facility following guidance of applicable 3M *User Instructions*. 3M participates in the RBRC program which provides for 3M™ PAPR batteries to be dropped off (free of charge) at participating recycling collection sites. Please dispose of batteries according to federal, state and local regulations. Please contact the Battery Recycling Information Hotline at 1-800-822-8837 for proper disposal instructions. (www.rbrc.org)

PAPR Battery Management

The purpose of a PAPR battery management system is to assure a reliable supply of fully charged and functioning batteries to respirator users and to maximize the service life of batteries through proper maintenance procedures. Correct battery management can help enhance worker productivity and reduce battery replacement costs. Battery management systems should be tailored to the specific needs of each work site and will vary depending on the number of respirators in use, availability of personnel and workspace, equipment contamination, and other factors. Most successful systems fit into one of the two general outlines below.

End-User Battery Management

This system places the responsibility for battery management on the individual respirator user. Each user is assigned a battery. The user connects the battery to a charger at the end of each work shift and disconnects it at the beginning of the next shift. Batteries can be charged in small, ventilated lockers equipped with outlets or in a central charging area. If a central charging area is used, clearly marking batteries or segregating batteries by work shift will help avoid accidental use of uncharged batteries. A reserve of replacement batteries should be stocked and

maintained in a charged state to replace damaged or worn-out batteries.

Central Battery Management

This system places responsibility for battery management on one or more trained individuals at the facility. These individuals frequently have overall responsibility for respirator cleaning and management. Central battery management becomes more efficient with larger numbers of respirator users. It saves workers time and minimizes battery damage from improper charging. Users exchange their discharged batteries for freshly charged batteries at their convenience.

Battery age and service history can be tracked by serial number, if desired.

Contacting 3M

For more information about 3M respirator systems, visit the 3M Occupational Health and Environmental Safety Division web site at: www.3M.com/OccSafety or contact a Technical Service Representative:

- In the United States, call 1-800-243-4630
- In Canada, call 1-800-267-4414

For more information, please contact:

In the U.S., contact:

Customer Service

1-800-328-1667

Technical Assistance

1-800-243-4630

Internet

www.3M.com/occSafety

For other 3M products

1-800-3M HELPS

In Canada, contact:

3M Canada Company, OH&ESD

P.O. Box 5757

London, Ontario N6A 4T1

Customer Service

1-800-265-1840

Technical Assistance (Canada only)

1-800-267-4414

Internet

www.3M.com/CA/occSafety

Technical Assistance In Mexico

01-800-712-0646

5270-2255, 5270-2119 (Mexico City only)

Technical Assistance In Brazil

0800-132333