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Section I:

Safe and Reliable Use of ZOLL Monitor/Defibrillators and Battery Packs

Safe and reliable use of ZOLL's Monitor/Defibrillator system in emergency medical situations requires appropriately trained personnel, an adequate number of Battery Packs and battery chargers, and the implementation of an effective Battery Management Program.

Battery reliability is a common concern among medical care professionals who use resuscitation equipment. Battery related problems are the most common cause of defibrillator failures according to the FDA Defibrillator Working Group.¹

Conscientious professionals want to avoid problems and operate their resuscitation devices safely. ZOLL has developed these Battery Management Program materials to provide important technical information, communicate standard practices to users and address important safety considerations related to all ZOLL battery operated lifesaving or life-sustaining equipment. As with any life saving system, back up procedures must be in place in the event of unexpected device or battery failure.

First and foremost is safety. It is important to understand that ***all*** Battery Packs ***will*** wear out. Knowing this, safety conscious hospitals and EMS providers must develop a program to:

- Ensure that adequate battery power is available when and where needed;
- Identify and eliminate worn out Battery Packs;
- Train staff to understand the key elements in the use and care of Battery Packs to prevent failure during clinical use.

This section provides the following information to assist you:

Part 1: Establishing a Safe Battery Management Program provides guidelines for developing and implementing an organized Battery Management Program.

Part 2: Achieving Optimal Battery Pack Performance discusses the “Do’s and Don’ts” in using the Battery Packs.

Part 3: Battery Management Support Materials describes the materials available to aid in developing an organized Battery Management Program.

¹ JAMA.:264 (8):1019-1025 1990

Part 1:

Establishing a Safe Battery Management Program

Develop and follow an organized Battery Management Program

Safe and reliable use of the ZOLL Monitor/Defibrillator system requires a well designed Battery Management Program to ensure that adequate battery power is always available.

The key steps are:

- ***Obtain adequate equipment***

Obtain a sufficient number of Battery Packs and battery chargers to ensure that an adequate supply of fully charged Battery Packs is available at all times.
- ***Assign a responsible individual***

Assign a responsible individual to oversee all aspects of the program and educate other users.
- ***Establish Battery Pack exchange and charging intervals***

Identify use patterns and establish appropriate Battery Pack exchange and charging intervals.
- ***Ensure sufficient spare Battery Pack availability***

Ensure that a fully charged spare Battery Pack is kept immediately available with each Monitor/Defibrillator at all times. The availability of more than one spare Battery Pack is recommended in cases where prolonged or repeated use of the device may be required, such as long transport situations.
- ***Develop backup procedures***

Develop backup procedures (e.g. CPR) to maintain appropriate life support in the event of an unexpected device or Battery Pack failure until another Battery Pack or device is obtained.
- ***Test Battery Packs regularly***

Test Battery Packs regularly as part of your Battery Management Program. The appropriate testing schedule depends on the age of the Battery Pack and the frequency and type of use. As the Battery Pack ages, testing should be scheduled more often since battery degradation will occur more rapidly at the end of battery life. At a minimum, ZOLL recommends that new Battery Packs be tested every three months and more frequently as they get older.

Part 2:

Achieving Optimal Battery Pack Performance

“Do’s and Don’ts” in using Battery Packs

The following general practices will ensure the longest life from Battery Packs:

DO charge Battery Packs completely.

When a Battery Pack exchange is required, place a fully charged Battery Pack in the Monitor/Defibrillator.

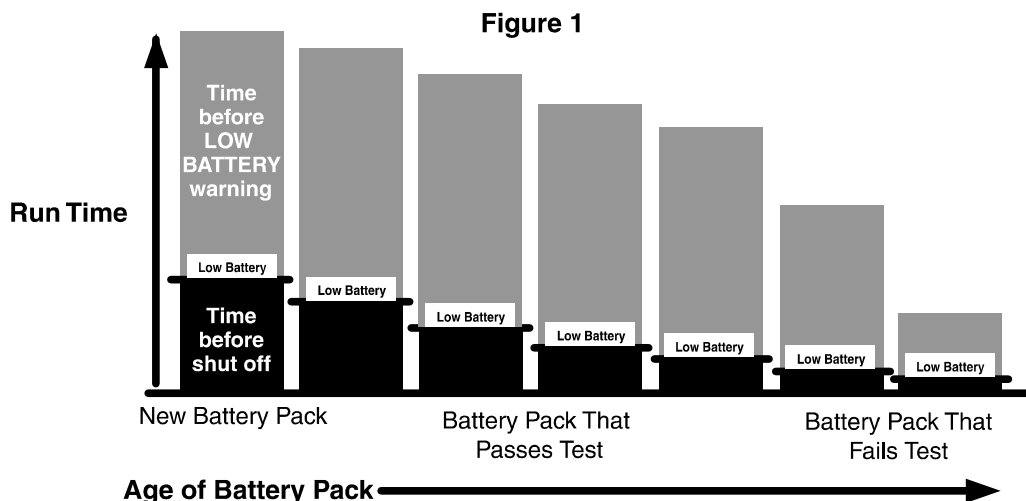
If use of a partially charged Battery Pack is required, it may result in a very short Monitor/Defibrillator run time. If a partially charged Battery Pack is used, a full charge is recommended before its next use. Repeated use after partial charging will quickly diminish the Battery Pack’s capacity, thereby shortening its life.

Frequent use of partially charged batteries requires reassessment as to whether enough Battery Packs are in service.

DO change Battery Packs when “LOW BATTERY” warning occurs.

The “Low Battery” warning will ultimately lead to Monitor/Defibrillator shut down. As batteries age, the run time between “Low Battery” warning and Monitor/Defibrillator shut down will progressively diminish. Older batteries may provide very little run time between “Low Battery” warning and Monitor/Defibrillator shut down. Therefore, when the “Low Battery” warning occurs, a fully charged Battery Pack should be installed as soon as possible.

Figure 1 illustrates the effect of lowered battery capacity on the Monitor/Defibrillator operating time remaining after “LOW BATTERY” warning.



 ***DO test Battery Packs regularly.***


Your organization must determine and implement an appropriate testing schedule. Adherence to this schedule is crucial to identifying Battery Packs that have reached end of life and should be removed from use. Battery Packs subjected to repeated short discharge and charge cycles may lose their capacity quickly. Battery Packs used this way should be tested more frequently.

 ***DO implement a means of indicating the charge status of Battery Packs.***

It is important to visibly distinguish Battery Packs that are charged from those that are not. Establish a system for visually indicating whether a Battery Pack is charged and ready for use or is in need of charging. ZOLL can provide you with Battery Pack Status Labels for this purpose, or you can use labels or methods of your own.

 ***DO exchange your Battery Packs regularly.***

Select the appropriate Battery Charging and Exchange card based on the battery charger(s) your facility is using. Battery Packs should be exchanged once per shift or once per day depending on their use.

 ***DO carry a fully charged spare Battery Pack at all times.***

- ⊘ ***DON'T remove a partially charged Battery Pack from the battery charger.***

If a partially charged Battery Pack is used, a full charge is recommended before its next use. Repeated use after partial charging will quickly diminish the battery's capacity, thereby shortening its life.

- ⊘ ***DON'T store Battery Packs in a discharged state.***

Battery Pack capacity will diminish if left in a discharged state for extended periods.

- ⊘ ***DON'T assume a shift check of the Monitor/Defibrillator verifies adequate Battery Pack run time.***

Your Monitor/Defibrillator should be tested daily to verify the readiness of the device. This test, however, does not verify adequate charge state or capacity of the Battery Pack and may leave the Monitor/Defibrillator with inadequate run time.

If the device shows a "LOW BATTERY" warning during testing, the Battery Pack should be replaced and recharged.

- ⊘ ***DON'T place Battery Packs charged with a Base PowerCharger^{4x4}, a PowerCharger or a PD 4420C (constant current chargers) into the PD 4420 or Single Battery Charger (constant voltage charger) without providing a rest period of at least 12 hours.***

This will result in damage to the Battery Packs.

- ⊘ ***DON'T charge Battery Packs at temperature extremes.***

ZOLL recommends charging Battery Packs at or near normal room temperature (15°C to 35°C or 59°F to 95°F).

Part 3:

Battery Management Program Support Materials

The following describes support materials available from ZOLL to aid in developing an organized Battery Management Program.

- ***Battery Pack and Battery Charger Recommendation Chart*** is provided to assist you in determining your system requirements.
- ***Battery Pack Charging & Exchange*** cards are designed so that staff can quickly review the recommended procedures for charging and exchanging Battery Packs. Select and post the appropriate Battery Pack Charging & Exchange card(s) based on the battery charger(s) your facility is using.
- ***Battery Pack Testing*** card is designed to provide quick review of the procedures for proper testing of Battery Packs. Select the appropriate Battery Pack Testing card(s) based on the battery charger(s) your facility is using.
- ***Battery Pack Testing Record Label*** * (optional) can be placed on top of the Battery Pack by those users who find this location more convenient for recording Battery Pack test results.
- ***Battery Pack Status Label*** ** (optional) contains a colored slide which the operator moves to the green or red position to signify whether the Battery Pack is charged, or is being placed in use and should no longer be considered fully charged.
- ***Battery Pack Status Label*** card provides instructions for your staff on the use of the Battery Pack Status Label.

* ***Battery Pack Testing Record Label (Reorder # 8004-0029)*** is available upon request through ZOLL Customer Service.

** ***Battery Pack Status Label (Reorder # 8004-0030)*** is available upon request through ZOLL Customer Service.

Section II:

Battery Pack and Battery Charger Recommendations

- Review the ***Battery Pack and Battery Charger Recommendation Chart*** and select the application which best fits your intended use of the Monitor/Defibrillator.
- Obtain the recommended equipment based on the intended use of each device (Battery Packs and battery chargers).
- The ***Battery Pack and Battery Charger Recommendation Chart*** is based on one Monitor/Defibrillator. For each additional Monitor/Defibrillator, refer to the appropriate column to adjust the number of Battery Packs and battery chargers needed by your facility.
- Inservice your staff and follow the recommended battery exchange interval.
- The ***Battery Pack and Battery Charger Recommendation Chart*** provides minimum recommended guidelines. Review your requirements with your ZOLL Representative. The chart assumes that the Monitor/Defibrillator and battery chargers are located in working proximity. Depending upon your testing needs and equipment distribution, additional battery chargers and Battery Packs may be required.

Note: As the intended use of the Monitor/Defibrillator may change over time, it is important to periodically reevaluate your needs.

Section III:

Battery Pack Charging and Exchange

- Select the appropriate **Battery Pack Charging and Exchange** card(s) based on the battery charger(s) your facility is using.
- Establish the Battery Pack exchange interval that best fits the needs of your facility (Once per day or Once per shift). Consult Section II to determine the appropriate exchange interval.
- Write the appropriate exchange interval, (Once per day or Once per shift), in the space provided on the **Battery Pack Charging and Exchange** card(s) you have selected.
- Post the **Battery Pack Charging & Exchange** card(s) next to each battery charger for quick reference.

Notes:

If you have a PD 4420 battery charger, check the serial number on the bottom of the unit. If the serial number ends with a “C”, use the **PD 4420C Battery Pack Charging & Exchange** card.

When using a PowerCharger, users should have access to a PD 4420C or a Base PowerCharger^{4x4} for periodic Battery Pack testing and additional charging capabilities.

Fully charged Battery Packs, when placed in a Base PowerCharger^{4x4} with Auto Test, will **not** be tested automatically. Press the “TEST” button to initiate testing of **fully charged** Battery Packs.

Section IV:

Battery Pack Testing and Testing Record Label

- Select the ***Battery Pack Testing*** card(s) corresponding to the battery charger(s) your facility is using.

Review the selected testing card(s) and determine if the ***Battery Pack Testing Record Label*** is to be used.

Obtain an appropriate supply of ***Battery Pack Testing Record Labels*** (***Reorder # 8004-0029***) from ZOLL Customer Service and apply to the top of each Battery Pack.

Follow the instructions on the ***Battery Pack Testing*** card for testing procedures and use of the ***Battery Pack Testing Record Label***.

- Determine an appropriate Battery Pack testing schedule based on use.

Adherence to this schedule is crucial to identifying Battery Packs that have reached end of life and should be removed from use. Battery Packs subjected to repeated short discharge and charge cycles may lose their capacity quickly. Battery Packs used this way should be tested more frequently.

As the Battery Pack ages, testing should be scheduled more often since Battery Pack degradation will occur more rapidly near the end of Battery Pack life. At a minimum, ZOLL recommends that new Battery Packs be tested every three months and more frequently as they get older.

The more frequently you test your Battery Packs, the less likely you are to experience inadequate Monitor/Defibrillator run time.

Post the ***Battery Pack Testing*** card next to each battery charger for quick reference.

Note: If you do not choose to use the ***Battery Pack Testing Record Label***, a testing label is provided on the bottom of each Battery Pack. Follow the Battery Pack testing procedure on the selected ***Battery Pack Testing*** card, recording the date and results of the test on the bottom label.

Section V:

Battery Pack Status Label

- Review the information on the ***Battery Pack Status Label*** card and determine if this label is to be used.
- Obtain an appropriate supply of ***Battery Pack Status Labels (Reorder # 8004-0030)*** from ZOLL Customer Service and apply one to each Battery Pack.
- Follow the instructions on the ***Battery Pack Status Label*** card for its use.
- Post the ***Battery Pack Status Label*** card next to each battery charger for quick reference.

Note: If you do not choose to use the ***Battery Pack Status Label***, you should establish an alternative system for visibly indicating whether a Battery Pack is charged and ready for use or is in need of charging. Your instructions should be posted next to each battery charger for quick reference.

BATTERY PACK AND BATTERY CHARGER RECOMMENDATION CHART

MONITOR/DEFIBRILLATOR APPLICATION	PREFERRED EQUIPMENT	ACCEPTABLE EQUIPMENT	WITH EACH ADDITIONAL MONITOR/DEFIBRILLATOR	BATTERY PACK EXCHANGE INTERVAL	COMMENTS
HOSPITAL CRASH CART <ul style="list-style-type: none"> Primary use on AC. Battery Packs for Emergency backup. 	PowerCharger 2 Battery Packs Minimum		<ul style="list-style-type: none"> Add a minimum of 2 Battery Packs. One Base PowerCharger^{4x4} can support most crash cart applications. 	Once Per Day	<ul style="list-style-type: none"> Recommend Base PowerCharger^{4x4} with AutoTest and spare Battery Packs for proper testing and charging. Initiate Manual Test on the Base PowerCharger^{4x4} with AutoTest upon return of each Battery Pack.
HOSPITAL/EMS INFREQUENT TRANSPORT <ul style="list-style-type: none"> Battery Pack use with device ON "LESS" than 2 hours per day. 	Base PowerCharger ^{4x4} with AutoTest 3 Battery Packs Minimum		<ul style="list-style-type: none"> Add a minimum of 3 Battery Packs. Each Base PowerCharger^{4x4} can support NO more than 4 Monitor/Defibrillators. 	Once Per Day	
		PD 4420C 3 Battery Packs Minimum	<ul style="list-style-type: none"> Add a minimum of 3 Battery Packs. Each PD 4420C can support NO more than 4 Monitor/Defibrillators. 	Once Per Day	
		PD 4420 4 Battery Packs Minimum	<ul style="list-style-type: none"> Add a minimum of 4 Battery Packs. Each PD 4420 can support NO more than 2 Monitor/Defibrillators. 	Once Per Day	<ul style="list-style-type: none"> Recommend Base PowerCharger^{4x4} with AutoTest or PD 4420C upgrade.
		PowerCharger 3 Battery Packs Minimum	<ul style="list-style-type: none"> Add a PowerCharger and a minimum of 3 Battery Packs. 	Once Per Day	<ul style="list-style-type: none"> Recommend Base PowerCharger^{4x4} with AutoTest and spare Battery Packs for proper testing and charging.
HOSPITAL/EMS FREQUENT TRANSPORT <ul style="list-style-type: none"> Battery Pack use with device ON "MORE" than 2 hours per day. 	Base PowerCharger ^{4x4} with AutoTest 6 Battery Packs Minimum		<ul style="list-style-type: none"> Add a minimum of 3 Battery Packs. Each Base PowerCharger^{4x4} can support NO more than 4 Monitor/Defibrillators. 	Once Per Shift	
		PD 4420C 6 Battery Packs Minimum	<ul style="list-style-type: none"> Add a minimum of 3 Battery Packs. Each PD 4420C can support NO more than 4 Monitor/Defibrillators. 	Once Per Shift	
EMS/AED <ul style="list-style-type: none"> Use of the device does not exceed once per week. 	Base PowerCharger ^{4x4} with AutoTest 3 Battery Packs Minimum		<ul style="list-style-type: none"> Add a minimum of 3 Battery Packs. Each Base PowerCharger^{4x4} can support NO more than 4 Monitor/Defibrillators. 	Once Per Day	
		PD 4420C 3 Battery Packs Minimum	<ul style="list-style-type: none"> Add a minimum of 3 Battery Packs. Each PD 4420C can support NO more than 4 Monitor/Defibrillators. 	Once Per Day	
		Single Battery Charger 3 Battery Packs Minimum	<ul style="list-style-type: none"> Add a Single Battery Charger and a minimum of 3 Battery Packs. 	Once Per Day	<ul style="list-style-type: none"> Single Battery Charger cannot test Battery Packs. A method for performing periodic testing is required.

ZOLL

Corporate Headquarters:

32 Second Avenue
Burlington, MA. 01803-4420
U.S.A
Telephone: (781) 229-0020
Toll Free: (800) 348-9011
Telefax: (781) 272-5578

Europe Regional Office

Kerkstraat 8
6669 DD Dodewaard
Netherlands
Telephone: + 31-488-41-1183
Telefax: + 31-488-41-1187

Latin America Regional Office

5720 NW 60th Street
Parkland, FL 33067
USA
Telephone: + 954-345-4224
Telefax: + 954-345-2648

Far East Regional Office

81 Excelsior Street
Lisarow 2250
NSW
Australia
Telephone: + 61-2-432-922-26
Telefax: + 61-2-432-922-26

ZOLL Medical U.K. Ltd.

European Authorized Representative
Gary Foster
Unit 13, Empress Business Centre
380 Chester Road
Old Trafford, Manchester M16 9EB
Telephone: + 44-161-877-2883
Telefax: + 44-161-877-2884

ZOLL Medical Deutschland GmbH

Schillingsrotter Str. 23
Deutschland
50996 Köln
Telephone: + 49-221-3989 340
Telefax: + 49-221-3989 336

Middle East/Africa Regional Office

PO Box 55320
Dubai
United Arab Emirates
Telephone: + 971-42-695056
Telefax: + 971-42-695047