simpliphi POWER

Power. On Your Terms.

PHI 1.3™ Battery

INSTALLATION MANUAL

Optimized Energy Storage & Management for Residential & Commercial Applications Utilizing Efficient, Safe, Non-Toxic, Energy Dense Lithium Ferrous Phosphate (LFP) Chemistry

SimpliPhi Your Energy Security and Independence

and gain control of your own power.

SimpliPhi helps you manage your power as a personal resource. Anytime. Anywhere. SimpliPhi energy storage optimizes integration of any power generation source – solar, wind, generator – on or off grid and protects your home and mission-critical business functions from power outages and intermittency. SimpliPhi storage technology eliminates operating temperature constraints, toxic coolants and the risk of thermal runaway and fire. Safe lithium ferrous phosphate. No cobalt. No hazards.

SimpliPhi's battery technology utilizes the industry's most environmentally benign chemistry combined with proprietary architecture and power electronics (BMS) that eliminate the need for cooling or ventilation to create products that provide energy security and resiliency – all with a 98% efficiency rate.

SimpliPhi Power offers proprietary, commercially available energy storage and management systems that are safe, non-toxic, reliable, durable, efficient, highly scalable, and economical over the lifetime of the PHI 1.3 kWh Battery.

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1.0 – Important Safety Information

1.1 – Safety Instructions

1. Before using the PHI 1.3 Batteries, read all instructions and cautionary markings on the PHI 1.3 Batteries, and all appropriate sections of this manual.
2. PHI 1.3 Batteries must be fully charged before commissioning. Failure to do so will void the Warranty.
3. Use of accessories not recommended or sold by the manufacturer may result in a risk of fire, electric shock, or injury to persons and will void the Warranty.
4. Verify system settings are in compliance with the PHI 1.3 Battery Warranty and this PHI 1.3 Battery Installation Manual (which take precedence). Violating Warranty conditions specified in these documents will void the Warranty on the PHI 1.3 Batteries.
5. Consult the Integration Guide for Inverter Charge Controller programming settings for relevant warnings and notices. Violating Warranty conditions specified in those Inverter Integration Guides will void the Warranty on the PHI 1.3 Batteries, not just the inverter equipment. Consult SimpliPhi Power technical support regarding any inconsistencies with other referenced documents.
6. Although each PHI 1.3 Battery contains an internal BMS with circuitry that protects the PHI 1.3 Battery cells from overcharge, over-discharge and extreme load amperage, the PHI 1.3 Batteries must always be installed with appropriate inverter charge controller settings and power electronics to protect the PHI 1.3 from open PV voltage and other high voltage charging sources. Do not attempt to replace existing power electronics without SimpliPhi's written approval. Failure to adhere to installation protocol will void the Warranty.
7. Verify polarity at all connections with a standard volt meter before making final electrical connections and energizing the system. Reverse polarity at the PHI 1.3 Battery terminals will void the Warranty and destroy the PHI 1.3 Batteries.
8. PHI 1.3 Batteries pose some risk of shock or sparking during the installation and initial wiring and connection process. This is consistent with all other battery-based storage formats. Make sure the equipment is turned off before installing cables with mating connectors to the equipment, prior to making final connections to the batteries, in order to minimize the risk of shock or sparks during the installation and commissioning of the system.
9. To avoid a risk of fire and electric shock, make sure that existing wiring is in good condition and that wire is not undersized. Do not operate the unit with damaged or substandard wiring.
10. Do not operate if the PHI 1.3 Battery has been damaged in any way during shipping or otherwise.
11. Only use a SimpliPhi approved LFP battery charger if ancillary charging is required before installation, testing or troubleshooting. Failure to use a SimpliPhi approved LFP battery charger will damage the PHI 1.3 Battery and void the Warranty.
12. To reduce the chance of short-circuits, always use insulated tools when installing or working with this equipment.
13. Remove personal metal items such as rings, bracelets, necklaces, and watches when working with electrical equipment.

1.2 – Safety & Protective Features

This section covers general safety information regarding PHI Batteries, safety information related to charging PHI Batteries at temperatures below freezing, the PHI Battery Management System (BMS), and information about the PHI Battery Connection Terminals.

1.2.1 – General Safety Information

PHI 1.3 Batteries do not vent any harmful gasses, and do not require special ventilation or cooling.

PHI 1.3 Batteries are not capable of thermal runaway. If the cells are severely damaged due to physical abuse incurred outside of warranted specifications, which can cause electrolyte leakage

and other failures, as with any PHI Battery, the electrolyte can be ignited by an open flame. However, unlike other lithium ion batteries (LCO) there are no hazardous or toxic materials in the electrolyte or the material components of PHI 1.3 Batteries. See MSDS for chemical analyses (Appendix A).

1.2.2 – Charging at Temperatures Below Freezing

It is important to take necessary steps to determine the temperature of the PHI 1.3 Battery prior to charging the battery, as the battery may otherwise be adversely impacted.

CAUTION: Do not attempt to charge the PHI 1.3 Battery below 32° F (0° C). Although cold temperatures do not harm PHI 1.3 Batteries, attempts to charge at subfreezing temperatures can adversely affect SOH and cycle life, and will void the Warranty. If the PHI 1.3 Battery must be charged below 32° F (0° C), the rate of charge must be at no more than 5% of the PHI 1.3 Battery's rated capacity (C/20).

CAUTION: Only use a SimpliPhi approved LFP charger if ancillary charging is required before installation, testing or troubleshooting. Failure to use a SimpliPhi approved LFP charger will damage the PHI 1.3 Battery and void the Warranty.

1.2.3 – Battery Management System (BMS)

PHI 1.3 Batteries are manufactured utilizing Lithium Ferrous Phosphate (LFP) cells, which are produced under exclusive patented licensed technologies, as well as proprietary materials, architecture, assembly methods and battery management system (BMS). This assures the highest grade and quality, longest cycle-life, greatest efficiency and freedom from material impurities, toxicity and hazardous risk.

Each PHI 1.3 Battery contains circuitry that protects the Lithium Ferrous Phosphate cells from overcharge, over-discharge and extreme load amperage. If the values specified are exceeded, the protective circuitry will shut down the flow of electricity to/from the PHI 1.3 Batteries. In some cases, this will result in the need to re-initialize an inverter charger. Often, inverter system settings will be saved within the inverter memory storage and will not need to be reset. This is not an absolute standard but is common amongst most inverter chargers and should be anticipated if the PHI 1.3 Batteries go into a state of self-protection and shut down the flow of electricity. Refer to SimpliPhi's inverter integration guides for inverter charge controller settings or contract the inverter manufacturer directly.

1.2.4 – PHI 1.3 Battery Connection Terminals

The PHI 1.3 Batteries are equipped with SB50 Anderson connectors.

- 12V connections are YELLOW
- 24V connections are RED

CAUTION: Do not reverse polarity. It will void the Warranty. Use a volt meter to check polarity before connecting terminals.

1.3 – Explosive Gas Precautions

This equipment is not ignition protected. To prevent fire or explosion, do not install this product in locations that require ignition-protected equipment. This includes any confined space containing vented batteries, or flammable chemicals such as, natural gas (NG), liquid petroleum gas (LPG) or gasoline (Benzine/Petrol). Do not install in a confined space with machinery powered by flammable chemicals, or storage tanks, fittings, or other connections between components of fuel or flammable chemical systems.

2.0 – Product Description

2.1 – Overview

The PHI 1.3 kWh 60 Amp deep-cycle Lithium Ferro Phosphate (LFP) Battery is optimized with proprietary cell architecture, power electronics, BMS and assembly methods. It is modular, light-weight and scalable. The PHI 1.3 Battery provides power security and seamless integration of renewable and traditional sources of energy in conjunction with or independent of the grid: net zero, peak shaving, emergency back-up, portable and mobile.

2.2 – Specifications

Please review Table 1.0 below for PHI 1.3 Battery specifications, including physical dimensions, Warranty period, and technical data.

Table 1.0 - PHI 1.3 Battery Specifications

PHI 1.3™	12V	24V
DC Voltages – Nominal	12.8V	25.6V
Amp Hours	105 Ah	52 Ah
Rated kWh Capacity @ C/2	1.3 kWh	
Max Discharge Current	60 Amps (10 mins)	
Max Contin. Disch. Current	40 Amps	26 Amps
Max Contin. Charge Current	40 Amps	26 Amps
DC Voltage Range[1]	10 to 14.4	20 to 28.8
Depth of Discharge[1]	up to 100%	
Operating Efficiency	98%	
Operating Temp[1]	-4° to 140°F (-20° to 60°C)	
Charge Temp[1]	32° to 120°F (0° to 49°C)	
Self-Discharge Rate	<1% loss per month	
Cycle Life	10,000+ (@80% DOD)	
Memory Effect	None	
Dimensions	11.25 x 9.25 x 6.25 inches/0.37 cu ft (23.495 x 28.575 x 15.875 cm/0.010m^3)	
Warranty Period	5 years	
Weight	33 lbs (15 kg)	

Notes:

- 1. Max operating conditions. Refer to Warranty for recommended conditions.
- Specifications are typical/nominal @ 25°C. Subject to change without notice.
- There is less than 1% loss of energy during charging.

3.0 – Pre-Installation

The information within this section covers pre-installation procedures & considerations, namely, PHI 1.3 Battery performance parameters to be aware of during the design process, as well as guidance on system sizing.

3.1 – PHI 1.3 Battery Performance Parameters and Sizing Calculations

PHI 1.3 Batteries are designed to operate at a continuous C/2 rate across a large operating temperature range, as seen in Table 1.0 above. The PHI 1.3 Batteries need no increase in sizing and no special compensations when determining the size of the energy storage and management system under the circumstances and conditions seen in Table 1.0 above. See specific inverter manufacturer program settings for optimizing system integration.

PHI 1.3 Batteries do not need to be de-rated unless running continuously at more than 50% capacity, at temperatures below 0 degrees Celsius, or above 49 degrees Celsius. To achieve higher, warrantied cycles of 10,000+, the PHI 1.3 Batteries are typically operated at 80% maximum Depth of Discharge. Please contact SimpliPhi Power Technical Support if alternative settings are desired. Please also refer to operating temperatures and inverter settings in Programming section.

3.2 – System Sizing for Your Installation

The number of PHI 1.3 Batteries should be specified in terms of total storage capacity before the initial installation based on the goals and objectives of the project. All PHI 1.3 Batteries are balanced during final production and testing stages. Following proper wiring guidelines ensures that a system will not require any manual balancing processes.

CAUTION: Do not combine PHI 1.3 Batteries with other brands or chemistries. This will void the Warranty.

CAUTION: Do not mix PHI 1.3 Batteries from different installations, clients or job sites. This will void the Warranty.

4.0 – Installation & Wiring

This section covers basic concepts of system configuration as well as how to increase storage capacity by wiring in parallel.

4.1 – Basic System Configuration Concepts

Safe and reliable installation requires trained and certified technicians. The following discussion of PHI 1.3 Battery configurations is a basic primer. Due to the variety of systems and components in the field, all possible scenarios are not covered. This is not the purpose of this section of the manual. Refer to professional installers regarding your system and its components and specifications. We encourage you or your installer to contact us with any specific questions for technical support. We are committed to working with you and your installation team to achieve a safe, reliable storage system that will provide years of maintenance free service.

4.1.1 – System Wiring Basics

Refer to published electrical wiring specifications and ratings. All wire should be an appropriate gauge and construction to handle the loads that will be placed upon it. Heavy gauge, high strand copper wire is the industry standard due to its stability, efficiency and overall quality. A qualified installer should understand this and must adhere to the industry standard and published electrical guidelines.

For all installations:

- Maintain identical wire lengths from each PHI 1.3 Battery terminal to the common bus.
- Use identical wire construction from each PHI 1.3 Battery terminal to the common bus.

All PHI 1.3 Batteries are designed to serve at a fixed voltage range in parallel arrangements for maximum available amperage and storage capacity. **PHI 1.3 Batteries are not designed to be arranged in series for increased voltage**. Series arrangements can result in damage to the PHI 1.3 Battery's protective circuitry and **will void the Warranty**.

4.1.2 – Increasing Storage Capacity & Simple Parallel Arrangements

Storage Capacity and total available **Amperage** is increased incrementally with the number of units in Parallel arrangements. The following illustration (**Figure 1.0**) shows two PHI 1.3 Batteries in **Parallel**. For example, assume that these are 24V PHI 1.3 Batteries.

Note: The overall Voltage range is not changed. The arrangement remains at 24 Volts, the available AH capacity (ability to provide 24 Volt power over time) has also been doubled with the addition of a second PHI 1.3 Battery. The available amperage from the system has been doubled. The same configuration should be applied to other parallel arrangements, whether they are 24V or 12V. See Figure 2.0.

CAUTION: PHI 1.3 Batteries are designed for parallel operation only. Do not arrange in series for increased voltage. Wiring in series will void Warranty.

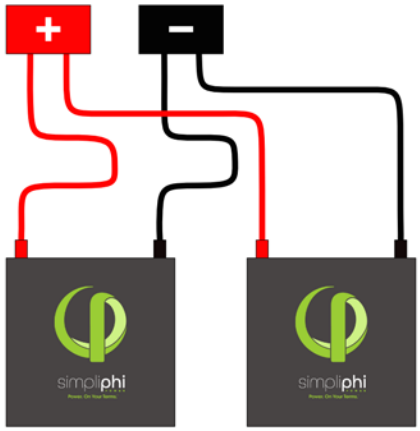

Figure 1.0 – Two PHI 1.3 Batteries in Parallel

Figure 1.0 represents two PHI 1.3 Batteries in Parallel. Wire lengths from PHI 1.3 Batteries should be **identical** in length and gauge in order to balance the load across (all) PHI 1.3 Batteries in the installation**. Identical wiring length is a critical feature of parallel power storage systems that must be adhered to throughout all parallel wiring instructions.**

Special attention should be paid for parallel installations. Correct wiring is essential to ensure optimum performance and system longevity. All wire "runs" should utilize **identical wiring gauge** and **identical wire lengths** between PHI 1.3 Batteries and the common negative or positive "Bus" or Load. Figure 2.0 depicts four PHI 1.3 Batteries that have been wired in Parallel. This configuration requires **8 identical lengths of appropriately heavy gauge copper wire**.

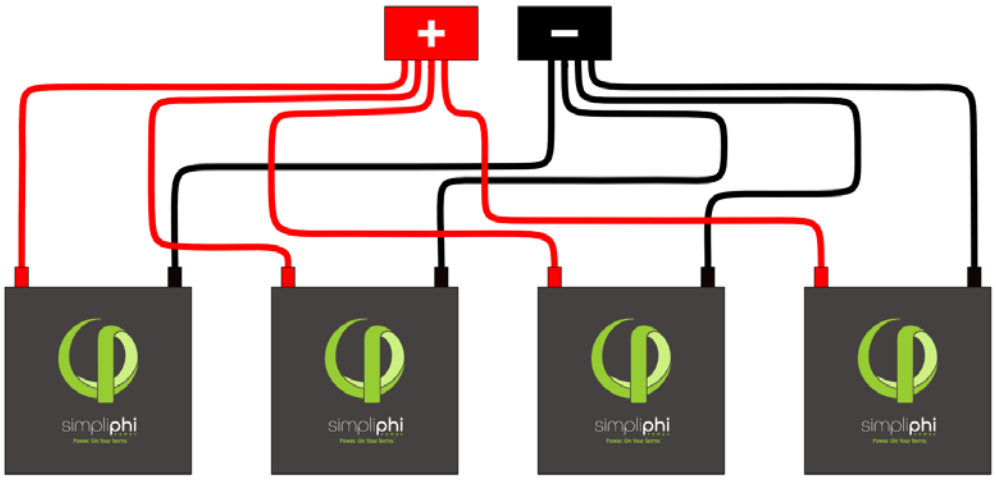

Figure 2.0 - Four PHI 1.3 Batteries in Parallel

Helpful Tips:

- Use identical length and gauge wire to balance the load across the PHI 1.3 Batteries.
- Determine the cable length for the PHI 1.3 Battery terminal farthest from the bus.
- Make all PHI 1.3 Battery cables a matching length.
- Additional cabling or slack that remains with the shorter distance runs can be coiled and secured with Zip Ties.

Wiring Methods:

1. For 1 to 8 units: Wire directly to inverter & charge controller equipment.
2. For 6 to 20 units: Use a DC combiner or panelboard.
3. For 20+ units: Connect the PHI 1.3 Battery terminals directly to a common bus.

4.2 – Battery Wiring Methods

4.2.1 – Connecting Cable Leads to the PHI 1.3 Batteries

Before connecting the cable leads to the PHI 1.3 Battery, please be aware of the following information concerning power cabling, considerations for power cable terminations as well as installation environments.

CAUTION: Spark may be present when connecting wires to PHI 1.3 terminals.

CAUTION: Do not reverse polarity. It will void the Warranty. Use a volt meter to check polarity before connecting terminals. A brief small spark is often present when connecting the leads to a PHI 1.3 Battery. Example: If the Positive has been connected, a small spark will likely be present when connecting the Negative lead. **This is a normal occurrence**. Complete all connections in a clean, ventilated, well-lit area. To avoid spark or electrical event when connecting the terminal leads on the PHI 1.3 Battery, turn the equipment off, connect cables with appropriate battery mating connectors to the equipment and make final connections to the batteries.

Power Cabling for the PHI 1.3 Battery is not included. Your qualified installer or application specifications will determine the wire gauge for your system. Connection to the PHI 1.3 Battery terminal should only be made using appropriate mating connectors. Your installer can source these.

Considerations for Power Cable Terminations

Please factor in the below information for power cable terminations:

- PHI 1.3 uses SB50 Anderson Connectors
  - 12V connections are YELLOW
  - 24V connections are RED
- Power Cable Wire Gauge: Generally anywhere from 6 AWG to 2/0 AWG or larger

Protection from the Environment

To protect the positive and negative contacts, anticorrosive compounds or epoxies are occasionally used in harsh or marine climate installations. Please contact your Electrician or Qualified Installer to determine if this is advisable, and if so, what solution best suits your application.

4.2.2 – Final Connection of the Installation

Final installation and operation guidelines will be dictated by your Electrician and Installer based on the overall properties of and procedures for the equipment in your installation and any code requirements that apply to your region. SimpliPhi Power, Inc. technicians and sales staff are available to provide any additional information on the PHI 1.3 Battery as needed. Please contact SimpliPhi Power for any technical support at your convenience. SimpliPhi Power, Inc. is committed to providing safe, reliable energy storage and management that is maintenance free, non-toxic and long-lasting. This commitment extends to our customers, valued installers, partners, and to the community at large. Please be aware of the potential electrical hazards before interacting with any and all electrical or mechanical devices. Please take all necessary precautions in your projects and installations. Please refer to Section 1.0 above for safety guidelines.

PHI 1.3 Batteries feature a Low Battery Voltage Cut Off (LBCO). This is a self-protection mechanism that prevents over discharge. The LBCO will cause the PHI 1.3 Battery to turn off once batteries approach Zero Capacity or 100% Depth of Discharge.

Most, if not all, inverters have related features. These features are often referred to as “Load Disconnect”, “Load Shedding” or similar. These features are there to protect the PHI 1.3 Battery bank from excessive discharge. In instances of low battery voltage, when there is no incoming energy to recharge the PHI 1.3 Battery bank, the inverter will disconnect the load and remain in standby until the PHI 1.3 Battery bank is recharged.

For off grid installations, where charge energy is only provided by renewable energy such as PV arrays, Inverter “Load Disconnects” are generally set at a value that will allow a system to remain online and in standby for at least 24 hours (10% at top of charge and 10% at bottom of charge). This allows a system to stay online until at least one full day of sun can recharge the PHI 1.3 Battery bank.

In any application, off-grid or grid-tied, if your PHI 1.3 Battery bank is reaching the LBCO, load disconnects, or load shedding set points may need to be adjusted. Refer to Programming section.

In case of LBCO, cycle the DC Battery Disconnect (inverter), in order to reset the system. Only complete this procedure when there is a charge source available, otherwise, the system will simply reach LBCO in a short time period and shut down again.

5.0 – Programming

5.1 – Operating Parameters per Warranty

Although the PHI 1.3 Batteries are capable of performing at very high rates and depths of discharge within a very wide temperature range, in order to achieve extended life cycles and to comply with the Warranty, the operating parameters, indicated in Tables 2.0 and 3.0 below, must be applied based on desired Warranty/cycle life.

Table 2.0 – Warranty Operation Parameters

Recommended Operating Conditions for 5 Year Warranty						
Equivalent to 80% Retained Capacity	10,000 cycles		5,000 cycles		3,500 cycles	
Discharge/Charge Rate[1,2]	C/2 (2 hour)					
DoD[4]	80%		90%		100%	
Operating Temperature °F (°C)	32 to 110 (0 to 43)		32 to 120 (0 to 49)		32 to 120 (0 to 49)	
Programming Settings for Ancillary Equipment	**12V**	**24V**	**12V**	**24V**	**12V**	**24V**
High Cut-Off Voltage (V)	14.5	29	14.5	29	14.5	29
Absorb (V)[3]	14	28	14.4	28.8	14.4	28.8
Recharge (V)[3,4]	12.65	25.3	12.65	25.3	12.65	25.3
Low Cut-Off Voltage (V)[3]	12.55	25.1	12.4	24.8	12	24

Table 3.0 – Operating Limitations

Operating Limitations for PHI 1.3 Batteries		
[1] Limitations by Model	12V	24V
Continuous Discharge Rate (A)	40	25
Continuous Charge Rate (A)	40	25

- 1. Continuous charge/discharge rate limitations vary per PHI battery model. Refer to Table 3.0.
- 2. 60A Discharge/Charge Rate (10 minutes maximum)
- 3. Levels are typically @ 25°C and may need adjusting at temperature extremes.
- 4. Recharge voltage is typically set nominally higher than LBCO to initiate recharge before cut-off. Some applications (i.e. backup only) may desire setting these levels higher to ensure minimum SoC in the event of primary power outage.
- When performing rapid deep charge/discharge cycles, the PHI 1.3 Battery should be allowed to "rest" 15 mins in between.

CAUTION: Verify polarity at all connections before energizing system. Reverse polarity at the PHI 1.3 Battery terminals will void the Warranty and destroy the PHI 1.3 Batteries.

CAUTION: Before commissioning the system, the appropriate controller and inverter settings must be programmed per the manufacturer's recommendations. Consult the manufacturer's manuals and/or access technical support (Schneider, SMA, Magnum, Outback, etc.). The above-listed Charge Controller Integration tables are for general reference only.

CAUTION: All SimpliPhi Power products are designed to work exclusively in parallel. Never connect in series to achieve higher voltages**.**

6.0 – SimpliPhi Technical Support

For technical support related to your PHI 1.3 Battery, please contact us as follows:

805.640.1874
techsupport@simpliphipower.com

Appendix A – Material Safety Data Sheet

A.1 – Product Identification

Product Name: Electronically Managed Energy Storage Device (Battery)
Models: PHI 1.3
Product Use: Lithium ion storage batteries - Harmony Code #8507.60.0000, Foreign Trade Schedule B
Manufacturer: SimpliPhi Power, Inc., Ojai Ca. U.S.A. 805 640 6700

A.2 – Composition and Ingredient Information

Under normal use, the PHI 1.3 Battery does not expose the user to hazardous ingredients.

USA: The PHI 1.3 Battery is an article pursuant to 29 CFR 1910.1200 and, as such, is not subject to the OSHA Hazard Communication Standard Requirement.

The information contained in this Material Safety Data Sheet contains valuable information critical to the safe handling and proper use of the product. This MSDS should be retained and available for employees and other users of this product.

Canada: This is not a controlled product under WHMIS. This product meets the definition of a "Manufactured Article" and is not subject to the regulations of the Hazardous Products Act.

A.3 – Hazards Identification

Table 4.0

Common Chemical Name	CAS #	Percent of Content (%)	Classification & Hazard Labeling
Lithium Ferrous Phosphate (LiFePo4)	15365-14-7	25-35	Eye, Skin, Respiratory Irritant
Carbon, as Graphite	7440-44-0	12-18	Eye, Skin, Respiratory Irritant
Aluminum Metal	7429-90-5	3-7	Inert
Copper Metal	7440-50-8	5-9	Inert
Electrolyte		12-17	Mixture:
Ethylene Carbonate	96-49-1		Flammable; Reactive; Sensitizer
Dimethyl Carbonate	616-38-6		Eye, Skin, Respiratory Irritant
Ethyl Methyl Carbonate	623-53-0		
Lithium Hexafluorophosphate	21324-40-3		

Preparation Hazards and Classification: Not dangerous with normal use. The PHI 1.3 Battery should not be disassembled or incinerated. Exposure to the ingredients contained within or their combustion products could be harmful. Appearance, Color, and Odor: Solid object, no odor.

Primary Route(s) of Exposure: Risk of exposure will only occur if the PHI 1.3 Battery or cell is mechanically, thermally or electrically abused and the enclosure is compromised. If this occurs, exposure to electrolyte solutions contained within the PHI 1.3 Battery or cell may occur by inhalation, eye contact, skin contact and ingestion.

Potential Health Effects:

Inhalation: Inhalation of material from a sealed PHI 1.3 Battery is not an expected route of exposure. Vapors or mists from a ruptured PHI 1.3 Battery may cause respiratory irritation.

Ingestion: Swallowing of material from a sealed PHI 1.3 Battery is not an expected route of exposure. Swallowing mists from a ruptured PHI 1.3 Battery may cause respiratory irritation, chemical burns of the mouth and gastrointestinal tract irritation.

Skin: Contact between the PHI 1.3 Battery and skin will not cause any harm. Skin contact with positive and negative terminals of high voltages may cause burns to the skin. Skin contact with a ruptured PHI 1.3 Battery can cause skin irritation.

Eye: Contact between the PHI 1.3 Battery and eye will not cause any harm. Eye contact with the contents of a ruptured PHI 1.3 Battery can cause severe irritation to the eye. Medical Conditions Aggravated by Exposure: Not Available

A.4 – First Aid Measures

Skin Contact: Wash affected area with lukewarm water for at least 30 minutes. If irritation or pain persists, seek medical attention.

Eye Contact: Wash affected eye with lukewarm water for at least 30 minutes. Rinse with saline solution if possible. Seek medical attention.

Inhalation: Move victim to fresh air and remove source of contamination from area. Seek medical attention.

Caution: In all cases if irritation persists, seek medical assistance at once.

A.5 – Firefighting Measures

Extinguishing Media: Water, carbon dioxide, dry chemical powder and foam are most effective means to extinguish a Lithium Ferrous Phosphate (LFP) battery fire.

Fire Fighting Procedure: Put on fully protective gear, including self-contained breathing apparatus, goggles, fireproof jacket and gloves.

Unusual Fire and Explosion Hazards: Exposing PHI 1.3 Battery pack or cell to excessive heat, fire or over voltage condition may cause a leak, fire, hazardous vapors and hazardous decomposition products. Damaged or opened cells can result in rapid heating and the release of flammable vapors

Appendix B – PHI 1.3 Battery Safety & Green Attributes, Certifications

This Appendix section covers the PHI 1.3 Battery safety attributes and certifications, such as the lack of thermal runaway and off-gassing, UN DOT certification and UL compliance. It also covers the PHI 1.3 Battery's green attributes – from products to materials to disposal, as well as relevant environmental and ecological considerations.

B.1 – Safety Attributes and Certifications

B.1.1 – Intrinsically Safe Operation and Installation

The PHI Lithium Ferrous Phosphate (LFP) battery cell component is made with an intrinsically safe cathode material (iron phosphate). This creates a strong molecular bond, which withstands extreme conditions, prolongs cycle life, and maintains integrity with little or no maintenance over extended periods of time. There is virtually no danger of Thermal Runaway, as there may be with Lead Acid, NiCd, and Lithium Cobalt type batteries. No venting or cooling is required. No precautions or special structural considerations are necessary when installing PHI 1.3 Batteries.

B.1.2 – No Safety Hazards due to Off-Gassing, Exposure to Acids, Thermal Runaway

PHI 1.3 Batteries do not vent dangerous gasses, such as hydrogen and oxygen, because there are no chemicals used in the creation of the electrical energy, in contrast to Lead Acid and other battery chemistries. There are no dangers of exposure to sulfuric acid because PHI 1.3 Batteries do not have caustic electrolytes. Thermal runaway is not an issue with PHI products due to the basic nature of Lithium Ferro Phosphate cell chemistry utilized in all our power storage products.

B.1.3 – PHI 1.3 Battery Control and Protective Circuitry

SimpliPhi Power Inc. utilizes balancing, voltage regulation, thermal, current controls, as well as other protective measures, in its PHI 1.3 Battery Management System (BMS). This protective circuitry is embedded in the architecture of each PHI 1.3 Battery.

B.1.4 – UN DOT Certified Cells

The Lithium Ferrous Phosphate (LFP) cells are independently certified to withstand the UN DOT T1-T8 testing guidelines with no special circuitry added. These tests include short circuit, over-voltage, overcharging, extreme temperature, high altitudes, shock and extreme vibration testing.

B.1.5 – UL Compliance

The Lithium Ferrous Phosphate cells within the PHI 1.3 Batteries fully comply with the safety testing parameters of UL 1642.

B.1.6 – RoHS Compliant

SimpliPhi Power 1.3 Batteries are RoHS compliant. Any RoHS compliant component is tested for the presence of Lead (Pb), Cadmium (Cd), Mercury (Hg), Hexavalent chromium (Hex-Cr), Polybrominated biphenyls (PBB), and Polybrominated diphenyl ethers (PBDE). For Cadmium and Hexavalent chromium, there must be less than 0.01% of the substance by weight at raw homogeneous materials levels. For Lead, PBB, and PBDE, there must be no more than 0.1% of the material, when calculated by weight at raw homogeneous materials. Any RoHS compliant component must have 100 ppm or less of mercury and the mercury must not have been intentionally added to the component. In the EU, some military and medical equipment are exempt from RoHS compliance.

B.2 – Green Attributes, Environmental & Ecological Considerations

B.2.1 – Materials

The primary materials (lithium, iron, phosphate) that make up PHI 1.3 Batteries are environmentally benign and pose very few polluting or environmentally degrading by-products in the harvesting and refinement processes. This is especially true when compared to those of lead acid, NiCad, and NiMH batteries.

B.2.2 – By Products

There are no toxic by-products associated with the assembly or use of PHI 1.3 Batteries, such as off-gassing hydrogen, sulfuric acid spillage, lead contamination, or explosive chemicals.

B.2.3 – Operation

There is no need for maintenance, such as adding water or chemicals, nor is there corrosion of terminals or containment facilities, or dispersion of fumes as with other battery types. Once installed, PHI 1.3 Batteries are maintenance free.

B.2.4 – Life Cycles

PHI 1.3 Batteries are designed for thousands of cycles while maintaining 80 percent or more of their initial capacity. To achieve this, it is critical to follow the operating conditions outlined in the Warranty.

B.2.5 – Disposal

PHI products are non-hazardous, may be disposed of without damage to the ecosystem, and returned to the earth, while easily recombining with the elements without harmful by-products. The outer casing and brackets contain steel, aluminum, copper, cardboard, and recyclable plastic. Lithium Ferrous Phosphate (LFP) materials can also be recycled through established battery centers if desired**.**

B.2.6 – Lithium Ferrous Phosphate Batteries and the Environment

As the use of this battery chemistry in larger batteries becomes more common, questions of sustainability and environmental impact inevitably arise. Of the lithium ferrous phosphate chemistries being considered for large format batteries, SimpliPhi Power believes that batteries based on our proprietary lithium ferrous phosphate chemistry and circuitry offer a clear advantage, not only over alternate Li-ion chemistries (lithium cobalt oxide), but all battery chemistries that are currently commercially available. This belief is based on the minimal environmental impact associated with the manufacturing of PHI 1.3 Batteries, the extended cycle life and the significantly smaller end-of-life footprint that results from the use of PHI 1.3 Batteries.

B.3 – Summary

The Lithium Ferrous Phosphate (LFP) cells utilized throughout the entire PHI and LibertyPak product lines are classified as non-hazardous by OSHA and WHMIS. They are non-toxic, unlike NiMH, NiCad or Lead Acid types of batteries (including AGM). The PHI 1.3 Batteries contain the least amount of toxic metals, and are the most eco-friendly of all common battery types. Lithium easily combines into harmless compounds when disposed of. The PHI 1.3 Batteries are the least polluting rechargeable batteries on the market today – no fumes, leaking, or gas discharge and no chemicals or acids to worry about. Designed and Assembled in the USA Using Exclusive American Patented Technologies.