

APPLICATION NOTE:

Pylontech Lithium-Ion Replacement For Lead Acid Batteries With Axpert and InfiniSolar Inverters



1) INTRODUCTION:

Lithium-Ion is regularly chosen for new installations or as a suitable replacement for lead-acid batteries which have reached the end of their life in a solar PV storage system. Reasons for Lithium-Ion being selected include:

- Lighter weight.
- Higher efficiency.
- Greater depth of discharge.
- Higher cycle life.
- Better maintained voltage during the discharge cycle.
- Lower lifetime costs.
- Lower impact on the environment.
- Longer warranty available.

The [Pylontech US2000B Plus](#) is a highly suitable option for both new systems and for ones that need their lead acid batteries to be replaced. The US2000B is a battery system, developed with their own Lithium Iron phosphate cell to ensure the highest safety value and most promising life cycle. A self-designed BMS (Battery Management System) protects the cell from abnormal temperature, current, voltage, SOC (State of Charge) and SOH (State of Health).



Advantages of the Pylontech Lithium-Ion battery include:

- More than 6000 cycles with 80% DOD.
- Compact and fashionable design.
- Delivers up to 5kW for 15 seconds with single module (2.4kWh).
- Modular design gives the end customers the power of choice of capacity.
- [Compatible](#) with the Axpert and Infinisolar inverters.
- Simple buckle fixing minimizes the installation time and cost.
- Safety Cert. TÜV CE UN38.3.
- Up to 10-year [warranty](#) available, if registered on the Pylontech portal.

In most cases, it is expected that the lifetime cost of a Lithium-Ion battery would be less than half that of a lead-acid battery bank of equivalent capacity. The example below compares a 400Ah lead acid battery bank to a 250Ah Lithium bank, using pricing and specifications of products currently available:

- For lead acid: 2200 cycles @ 50% DOD (C10 rating); unit pricing = R4,500.
- For Lithium: 6000 cycles @ 80% DOD; unit pricing = R13,900.

LEAD ACID PRICE PER kWh					PYLONTECH LITHIUM-ION PRICE PER kWh				
Lead Acid Bank (48V)	Cycles @ 50% DOC	kWh Storage	Initial cost	Price per kWh	Pylon Bank	Cycles @ 80% DOC	kWh Storage	Initial cost	Price per kWh
8x200Ah (400Ah)	2200	9.6kWh	R36,000	R1.72	5 x US2000B Plus (250Ah)	6000	9.5kWh	R69,500	R1.22

From this example, it can be concluded that while the initial cost of lead acid batteries may be lower at around 50% of the cost of Pylontech, over the life cycle the price per kWh of lead acid is up to 40% more expensive.

2) BATTERY SIZING:

When considering the size of the of the required Lithium battery bank there are two key factors:

1. The usable storage capacity
2. The power required

Both aspects should be considered and the number of Pylontech Lithium-Ion batteries specified should meet at least the minimum required based on both criteria.

a. Storage Capacity:

The Pylontech Lithium-Ion battery has a DOD of 80% when used with the Axpert or Infinisolar inverters which compares to 50% for typical lead-acid batteries. In order to provide the same storage capacity the minimum suggested replacement options, whereby Pylontech is used to replace the most commonly used 48V lead acid battery banks, are shown in the table below:

PYLONTECH LITHIUM-ION LEAD ACID REPLACEMENT PACKAGES			
Current Solution		Minimum Recommended Replacement	
Lead Acid Bank(48V)	kWh Useable (50% DoD)	Pylontech Lithium-Ion Bank	kWh Useable (80%DoD)
4 x 150Ah (150Ah)	3.6kWh	2 x US2000B Plus (100Ah)	3.8kWh
4 x 200Ah (200Ah)	4.8kWh	3 x US2000B Plus (150Ah)	5.7kWh
8 x 150Ah (300Ah)	7.2kWh	4 x US2000B Plus (200Ah)	7.6kWh
8 x 200Ah (400Ah)	9.6kWh	5 x US2000B Plus (250Ah)	9.5kWh
12 x 150Ah (450Ah)	10.8kWh	6 x US2000B Plus (300Ah)	11.4kWh
12 x 200Ah (600Ah)	14.4kWh	8 x US2000B Plus (400Ah)	15.2kWh

So for example, a 150Ah 48V lead acid battery bank comprising 4 x 150Ah batteries and giving an effective 3.6kWh of storage at 50% DOD could realistically be replaced with 2 x Pylontech US2000B Plus Lithium-Ion batteries which provide 3.8kWh storage at 80% DOD.

In many cases the original lead-acid battery bank being replaced may have been too small to fully meet the client's requirements and therefore consideration should be given to replacing it with a Lithium-Ion battery bank with a larger capacity.

b. Power Rating:

When used with Axpert or Infinisolar inverters, a Pylontech Lithium-Ion battery will deliver 1.5kWh usable energy when discharged at 1.2kW, and at 600W power draw 1.9kWh usable energy can be utilised.

Therefore, to take into account the expected current draw of the inverter, SegenSolar recommends that the minimum number of Pylontech Lithium-Ion batteries be linked to the site-specific base load as follows:

Recommended Base Load	Max Nominal Load	No. of Pylontech Lithium-Ion 2.4kWh Batteries
1.2kW	2.4kW	2
1.8kW	3.6kW	3
2.4kW	4.8kW	4
3.0kW	6.0kW	5
3.6kW	7.2kW	6
4.2kW	8.4kW	7
4.8kW	9.6kW	8
6.0kW	12.0kW	10

3) OTHER CONSIDERATIONS:

Pylontech have provided a detailed [set-up document](#) to follow when using their batteries. This needs to be followed closely, and the [warranty validation form](#) needs to be returned, in order for the battery warranty to be valid.

Safe handling of Pylontech batteries is of key importance. When handled properly and in accordance with the parameters specified by the manufacturer, Lithium batteries are safe during use. Improper handling or conditions leading to improper operation can cause leakage of battery substances and products of decomposition and reactions associated with these, which can cause personal injury and environmental damage. Since a wide variety of chemical substances are used, always follow the manufacturer's directions for immediate measures and first-aid measures in the event of an accident. Safety is described in detail in the [safe handling document](#).

The Pylontech [installation manual](#) provides clear steps to ensure the correct set-up and installation of the batteries in a system. Before installation, be sure to cut off the grid power and make sure the battery is in the turned-off mode. Also remember:

- Wiring must be correct, do not mistake the positive and negative cables, and ensure no short circuit with the external device.
- It is prohibited to connect the battery and AC power directly.
- The embedded BMS in the battery is designed for 48VDC, please **DO NOT** connect the battery in series.
- The battery system must be well grounded and the resistance must be less than 1 ohm.
- Please ensure the electrical parameters of battery system are compatible to related equipment.
- Keep the battery away from water and fire.

When comparing replacement options, it is important to consider all items including [cables](#), [cabinets](#), cost of maintenance and lifetime costs. SegenSolar provides a range of cabinets custom-made for Pylontech Lithium-Ion batteries, including floor-mounted units capable of holding between 2 and 5 batteries, and [wall-mounted units](#) capable of holding 2 batteries.

4) SYSTEM MONITORING AND BATTERY COMMUNICATION:

The [ICC](#) (Inverter Control Centre) is a product from [Centurion Solar](#), and is the ideal monitoring solution for systems comprising Pylontech lithium ion batteries and Voltronic inverters. In off-grid installations, detailed system analysis is possible. In on-grid installations, will control the inverter based on the SOC reported by the Pylontech BMS.



One of the major issues with the Axpert inverter is inaccurate voltage control. Due to the small voltage range of the Pylon between empty and full, the inaccurate voltage control of the Axpert means that poor performance can be experienced in systems designed for self consumption by using Solar and batteries as primary power sources. The Axpert may prematurely switch to the grid and stop using solar and batteries to power loads, and this will result in the system only using a small percentage of the available capacity of the Pylontech. In some cases it's been known that the system will use limited battery capacity and less than intended when the system is setup to prioritise battery power.

Adding the ICC will greatly improve the cycling efficiency of the Axpert, as the ICC will use the SOC reported by the BMS of the Pylontech battery to control when the Axpert will use grid or battery. By using SOC based control, the system will be able to use the full rated capacity of the Pylontech battery if set to do so. The ICC will therefore increase the overall value of the system as the full 80% DOD of the Pylontech can be used in a self consumption battery cycling setup. The Axpert cannot mix different power sources to supply the connected load and can either use the grid or the battery(solar and battery) to supply the load. Precise DOD control provided by the ICC will allow the system to use the maximum that it can from the battery and avoid using the grid. Accurate battery monitoring will allow the user to take control of the system and to get as much value out of it as possible.

The ICC offers the following features:

- Real-time monitoring of all the different power sources in use in a solar system (solar panels, batteries, grid power, etc).
- All data is captured, stored and can be exported for a specific time period.
- Specific monitoring of the batteries in use.
- Can monitor up to 9 inverters in parallel.
- Support for a host of different Voltronic inverters, including the new InfiniSolar 4 Super inverter.
- Can monitor grid tie as well as hybrid inverters.
- Support for Pylontech batteries with true SOC and voltage monitoring.
- Hourly trend analysis of the load, the solar panels, the batteries as well as the utility consumption and/or production.
- Easy setup now with integrated hotspot and configuration wizard.

The following YouTube links provide a hands-on guide for use: [Initial Setup](#) assist with connecting to the ICC using VNC and how to change basic settings.

[Configuring cloud-based monitoring](#) is a guide on everything regarding monitoring.

[How to use ICC + Pylontech Cable](#) assists with the setup with ICC and Pylontech.

5) SEGENSOLAR PORTAL SERVICES:

The SegenSolar portal has a [System Designer](#) tool which allows you to create your own battery packages. Please speak to your account manager or technical support representative if you require training on how to use the System Design tool. The design tool will allow you to create a quote quickly and easily with all the necessary components.

6) FURTHER NOTES:

About Pylontech:

Pylon Technologies, Co. Ltd, founded in October 2009, is a pioneer for LFP (Lithium-Ion Phosphate) batteries deployed in energy storage systems and electric vehicles. Pylontech is among a handful of companies who have vertically integrated the entire Lithium battery industrial chain. Recently, the company has invested the equivalent of over USD 400 million to set up Huangshi Pylon Technologies Co. Ltd in Huangshi city, Hubei Province, with this factory growing annual battery production capacity to 2 GWH.

Further info: <http://www.pylontech.com>

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