LITHIUM IRON PHOSPHATE

LEAD ACID REPLACEMENT

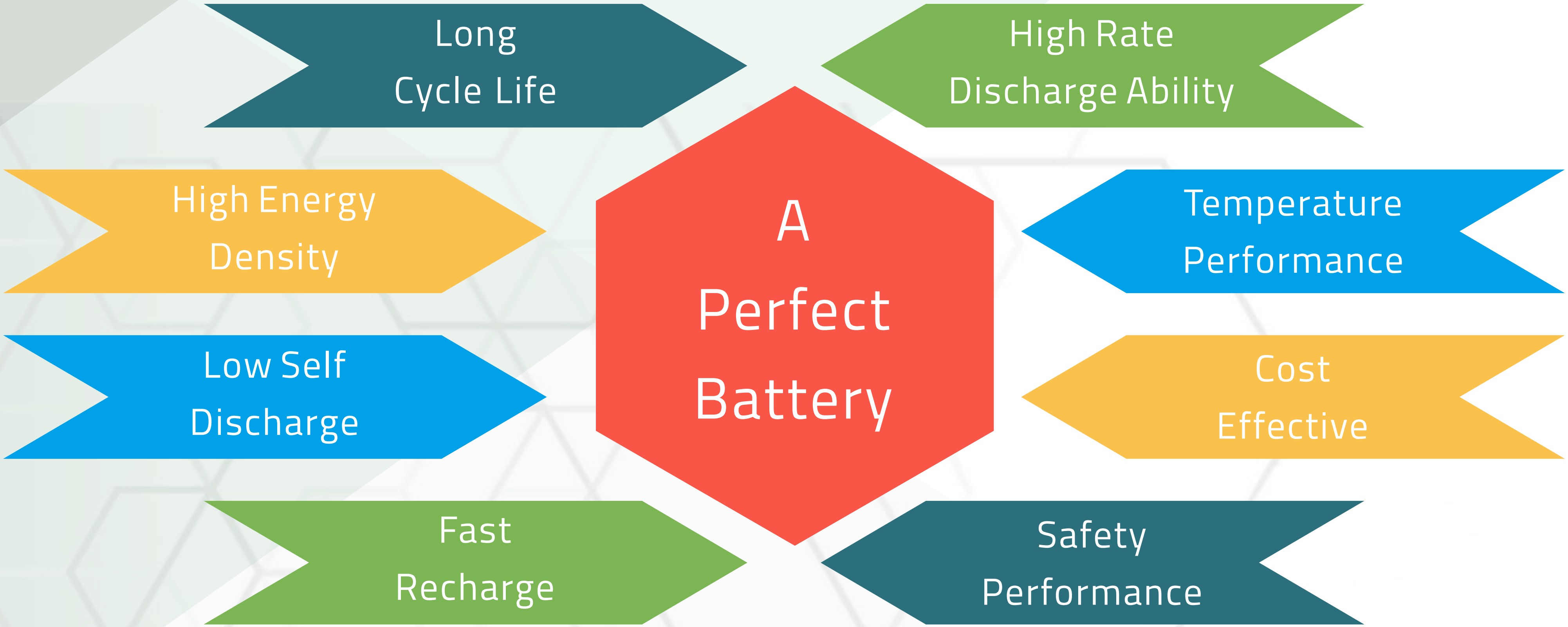
FROM ANTBATT

ANTBATT

Why is LiFePO4 Better Than Lead Acid?

Is LiFePO4 Really Expensive Than Lead Acid?

WHAT IS A PERFECT BATTERY?



ANTBATT LITHIUM ION PHOSPHATE VS LEAD ACID

LEAD ACID VS LIFEPO$_4$

	Lead Acid	$LiFePO_4$
Long Cycle Life	>200 cycles	>2000 cycles
High Energy Density	35-40Wh/kg	80-120Wh/kg
Low Self Discharge	15month/25°C: >50%SOC	15month/25°C: >80%SOC
Fast Recharge	5-10 hours	0.5-5 hours
High Rate Discharge Ability	3-5C, Capacity Reduce	5-40C, Capacity Stable
Temperature Performance	0.5C | 10°C-50%Capacity; 0°C-45% Capacity	0.5C | 10°C-98%Capacity; 0°C-84% Capacity
Cost Effective	Cheap Price, Low Performance, Short Life	5 times Price, High Performance, 10 times Life
Safety Performance	Lead is harm for human, H_2SO_4 is corrosive	The safest lithium battery technology so far, need BMS protection

GENERAL COMPARISON

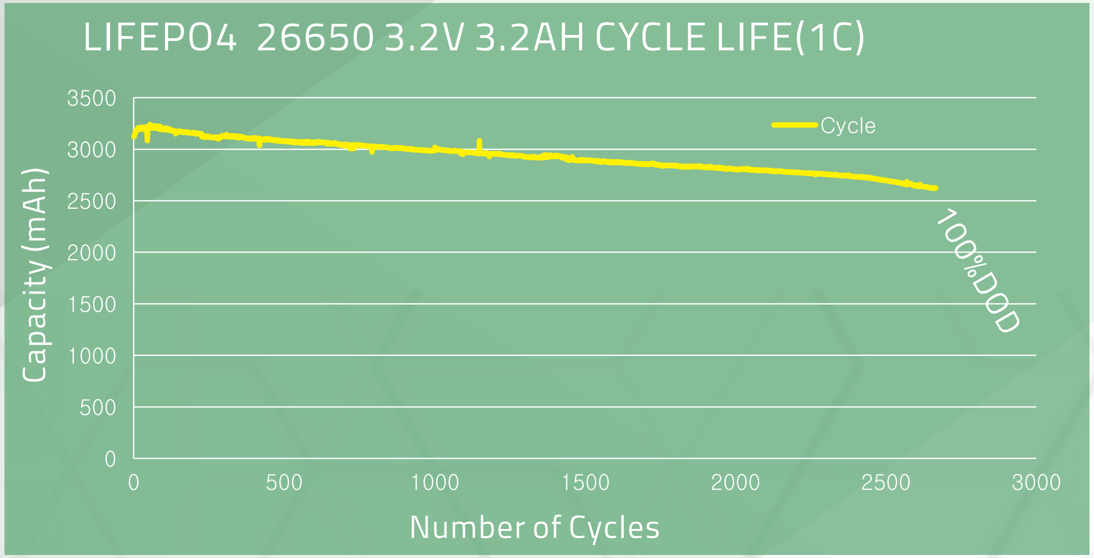
PARAMETERS

ITEM	LEAD ACID	$LiFePO_4$
Cell Nominal Voltage	2.0V	3.2V
Cathode Material	PbO_2	LiFePO4
Anode	Pb	Graphite
Electrolyte	H_2SO_4	Organic Electrolyte
Manufacturing Access Level	Easy	Difficulty
Market Share	Large (Traditional)	Growing fast (New Energy)
Weight Energy Density	30~50Wh/Kg	100~150Wh/Kg
Volume Energy Density	60~90Wh/L	200~250Wh/L
Discharge DOD by C_1	63~67%	99~100%
Recharge Method	Boost Charge, Float Charge,	CC/CV, (Float Charge is OK)
Fast Charge Ability	No	Good
Recharge Voltage	2.35V/Boost; 2.23~2.37/Float	3.65V/cell
Cycle Life (C_5, 25°C,100%DOD, 80% remain)	200~300	2000~3000
Cycle Life (C_5, 25°C,50%DOD, 60% remain)	550~650	4000~4500
Working Temperature Range	-10~55°C	-20~65°C
Discharge Capacity by -20°C C_2	Approx. 15%	Approx. 55%
Self-Discharge/Month (100%, 25°C)	15~30%	<3%
50% SOC Remain Storage Period	16 Months	>30Months
Assembly Flexibility	Standard Blocks	Any kinds of Shape
Environmental Protection	Polluted	Meets RoHS
Protection Circuitry	Not needed	Need it to keep Battery Healthy
Assembly Base	2V, 6V,12V Units	3.2V Units
Installation Direction	Top need to be upside	Any Directions
Safety	Electrolyte is corrosive	Safe
IATA Safety Level	Class 8	Class 9

ANTBATT **LITHIUM ION PHOSPHATE VS LEAD ACID**

PERFORMANCE COMPARISON

CYCLE LIFE

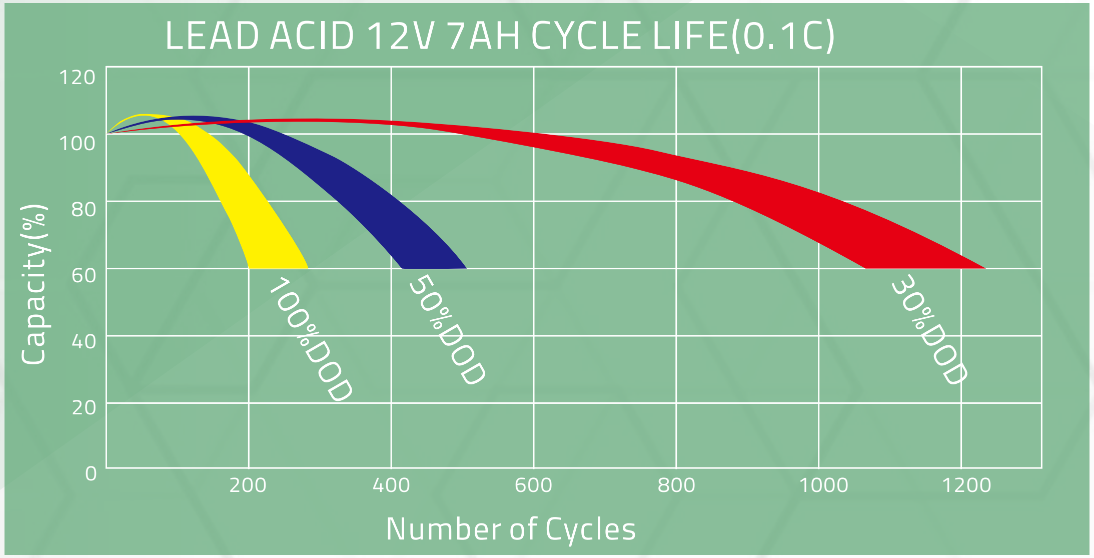


TESTING CONDITION:

1. Temperature: 20~30°C
2. DOD(Dept of Discharge): 100%
3. Charging Current: 1C(3.2A CC/CV)
4. Discharge Current: 1C (3.2ACC)

TESTING RESULTS:

Cycle Life > 2500 cycles



TESTING CONDITION:

1. Temperature: 20~30°C
2. DOD: 100%/50%/30%
3. Charging Current: 0.1C(2.45V/cell)
4. Discharge Current: 0.1C (700mACC)

TESTING RESULTS:

Cycle Life At Different DOD

100%DOD: 200~300 cycles

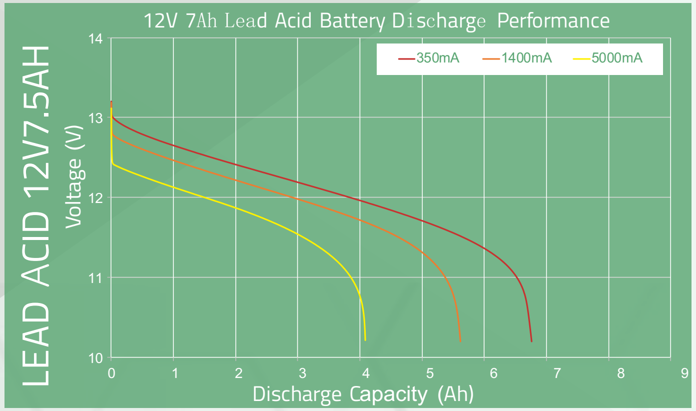
50%DOD: 400~500 cycles

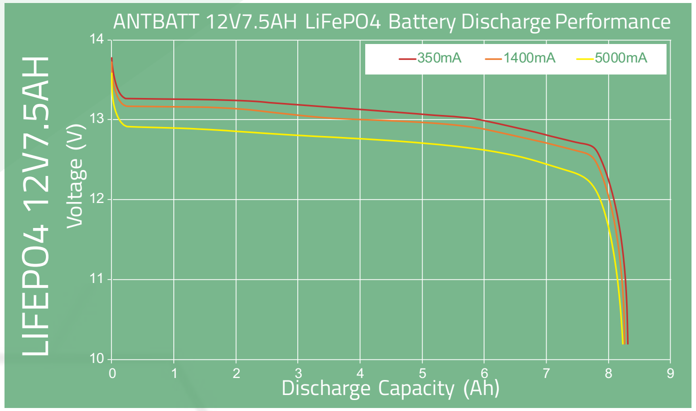
30%DOD: 1000~1200 cycles

ANTBATT **LITHIUM ION PHOSPHATE VS LEAD ACID**

PERFORMANCE COMPARISON

DISCHARGE EFFICIENCY

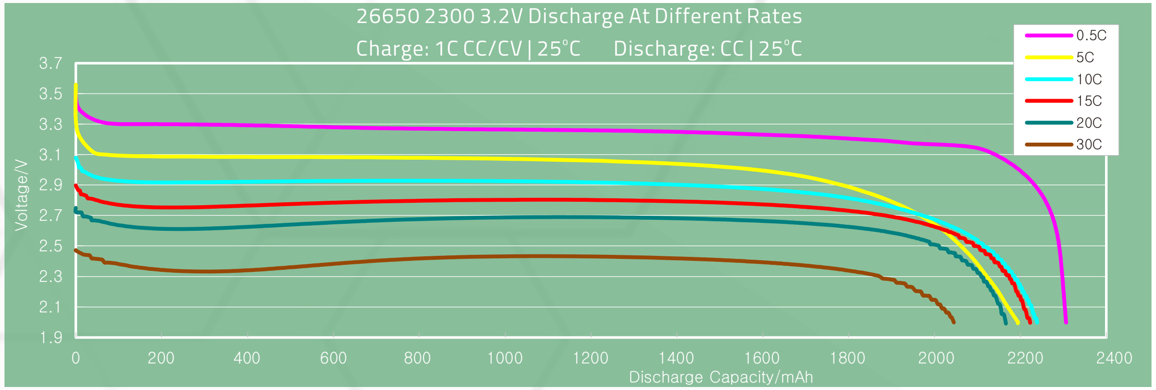




This is a discharge performance curve of a 12V 7Ah lead acid battery from a leading manufacturer at room temperature. By constant current, the battery fails to meet its rated capacity, even at 350mA (0.05C) discharge rate. When the battery is subjected to higher loads of 1400mA(0.2C) and 5000mA (0.7C) the voltage drops is more severe and the delivered

By comparison, AntBatt LiFePO4 12V7.5AH is the same size as its lead acid equivalent but less than half the weight. This battery exhibits a consistently flat voltage profile throughout its discharge until energy is depleted. This superior performance is maintained even at higher discharge currents, and the discharge capacity keeps stable even the discharge rate changes.

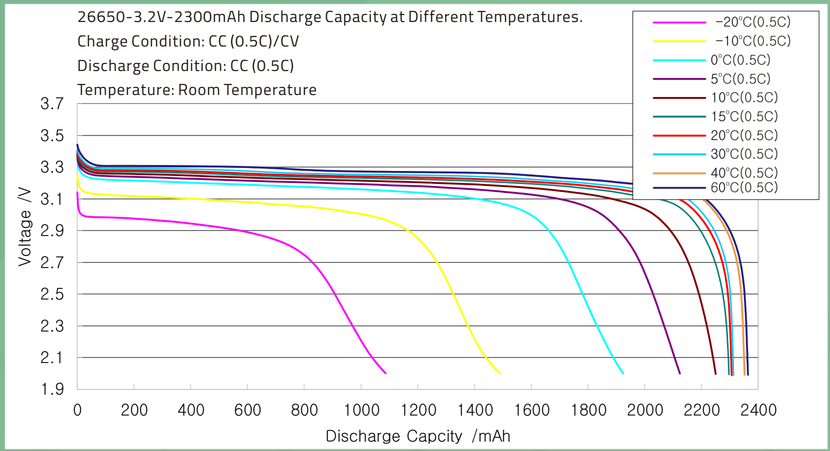
This is a discharge curve of a high rate 26650 cell,
it shows that the discharge capacity difference is very limited.



ANTBATT LITHIUM ION PHOSPHATE VS LEAD ACID

PERFORMANCE COMPARISON

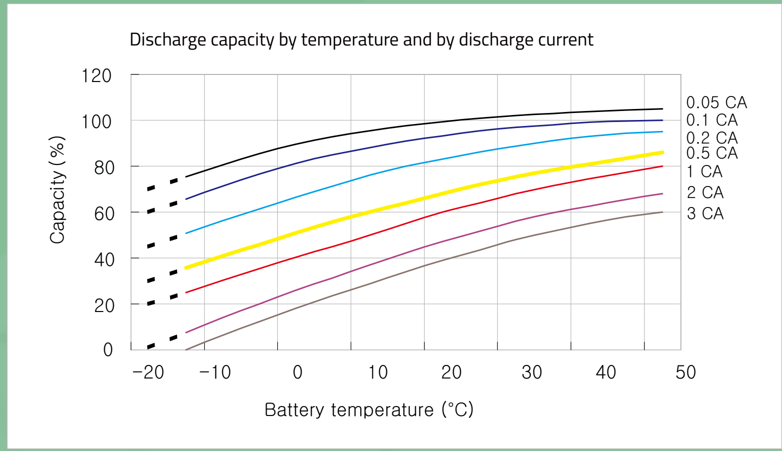
TEMPERATURE PERFORMANCE



This testing graph shows us the different discharge capacity under temperature influence.

Testing Condition:
Charging Current: 0.2C CC/CV | Discharge Current: 0.5C CC

Testing Result:
60°C Capacity Rate: 102%
40°C Capacity Rate: 102%
30°C Capacity Rate: 100%
20°C Capacity Rate: 100%
15°C Capacity Rate: 100%
10°C Capacity Rate: 98%
5°C Capacity Rate: 92%
0°C Capacity Rate: 84%
-10°C Capacity Rate: 65%
-20°C Capacity Rate: 48%



This testing graph shows us the different discharge capacity under temperature and C rate.

To Comparison with LiFePO4, we only chose the 0.5C Rate show the result:

Testing Result:
50°C Capacity Rate: 85%
40°C Capacity Rate: 80%
30°C Capacity Rate: 72%
20°C Capacity Rate: 66%
15°C Capacity Rate: 62%
10°C Capacity Rate: 57%
5°C Capacity Rate: 50%
0°C Capacity Rate: 45%
-10°C Capacity Rate: 40%
-20°C Capacity Rate: <30%

ANTBATT LITHIUM ION PHOSPHATE VS LEAD ACID

PERFORMANCE COMPARISON

HIGH ENERGY DENSITY

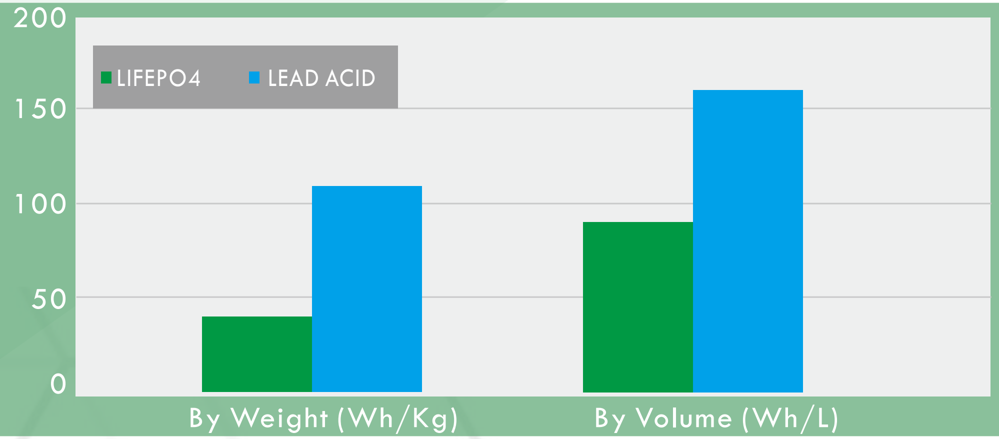
How to get the Weight Energy Density:

Battery Energy (Wh)/Battery Weight(Kg)=Energy Density(Wh/kg)

How to get the Volume Energy Density:

Battery Energy (Wh)/Battery Size(L or Dm^3)=Weight Density(Wh/L)

LIFEPO4 battery averagely has 1/3 the weight, 1/2 the volume of LEAD ACID battery.



12V7.5AH/90Wh/151x65x94mm (0.923L)

Volume Energy Density: 97.5Wh/L

WEIGHT ENERGY DENSITY
-LEAD ACID : 2.45KG -->36.7Wh/kg
-LIFEPO4: 1.1KG------> 81Wh/kg

12V100AH/1200Wh/342x173x232mm(13.72L)

VOLUME ENERGY DENSITY: 87.5Wh/L

WEIGHT ENERGY DENSITY
LEAD ACID: 30.4KG | 39.5Wh/kg
LIFEPO4: 13.6KG | 94.1Wh/kg

26650-3.2V-3200MAH (10.24Wh)
WEIGHT: 86g (0.086kg)
SIZE: 26(dia)x65(H)mm(0.0345L)

ENERGY DENSITY:
WEIGHT ENERGY DENSITY: 119.07Wh/kg
VOLUME ENERGY DENSITY: 296.81Wh/L

LIFEPO4 12V7.5AH/0.9kg/94x82x75mm
WEIGHT ENERGY DENSITY: 106.7 Wh/kg
VOLUME ENERGY DENSITY: 166Wh/L

LIFEPO4 12V100AH/11.6kg/115x224x310mm
WEIGHT ENERGY DENSITY: 110.3Wh/kg
VOLUME ENERGY DENSITY: 160Wh/L

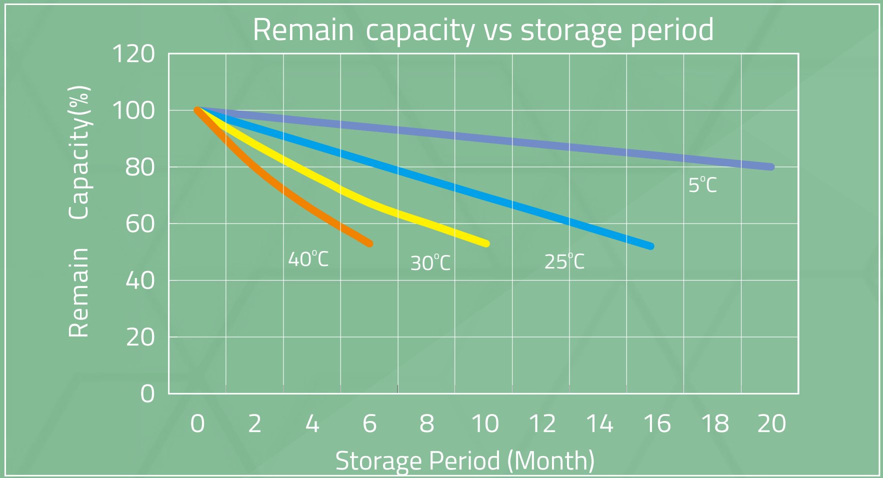
ANTBATT LITHIUM ION PHOSPHATE VS LEAD ACID

PERFORMANCE COMPARISON

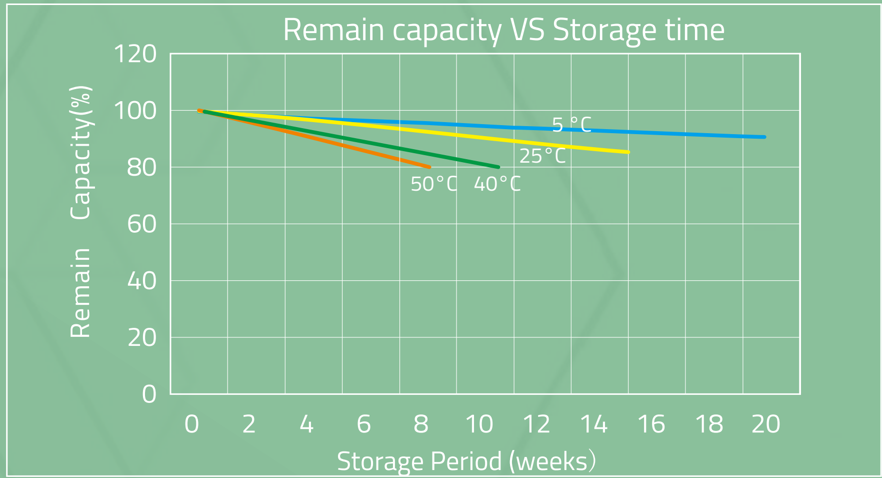
SELF DISCHARGE RATE

LiFePO4 Battery’s Self Discharge Rate is much lower than LEAD ACID Battery.

LEAD ACID



LIFEPO4



ANTBATT LITHIUM ION PHOSPHATE VS LEAD ACID

PERFORMANCE COMPARISON

WHICH IS MORE ECONOMIC

LEAD ACID VS $LIFEPO_4$

FROM THE COMPARISON,
WE CAN SEE LIFEPO4 BATTERY SOLUTION IS MUCH MORE COST-EFFECTIVE
IN LONG TERM CONSIDERATION

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LITHIUM ION PHOSPHATE VS LEAD ACID

LIFEPO4 BATTERY LIST

FOR LEAD ACID REPLACEMENT

LITHIUM IRON PHOSPHATE (LIFEPO4) BATTERIES		6.4V9.6Ah	12.8V7.5Ah	12.8V12Ah	12.8V20Ah	12.8V32Ah	12.8V40Ah	12.8V55Ah	12.8V60Ah	12.8V100Ah	12.8V200Ah
											
Typical Voltage		6.4V	12.8V								
Typical Capacity		9.6Ah	7.5Ah	12Ah	20Ah	32Ah	40Ah	55Ah	60Ah	100Ah	200Ah
Typical Energy		61.4Wh	96Wh	153.6Wh	256Wh	410Wh	512Wh	714Wh	768Wh	1280Wh	2560Wh
Max. Continuous Discharge Current		7A	15A	25A	40A	50A	60A	70A	80A	100A	120A
Typical Discharge Cut-off Voltage		5V	10V								
Charge Voltage		7.2V/7.3V	14.4V/14.6V								
Charge Method		Constant Current, Then Constant Voltage （CC/CV）									
Max. Charge Current		9.6A	7.5A	12A	20A	32A	40A	55A	60A	80A	100A
Internal Resistance		≤50mΩ	≤70mΩ	≤60mΩ	≤50mΩ	≤45mΩ	≤35mΩ	≤30mΩ	≤30mΩ	≤20mΩ	≤15mΩ
Operating Temperature	Charge	0oC to +45oC									
	Discharge	-20oC to +60oC									
Typical Weight		0.68kg	1.1kg	1.7kg	2.7kg	4.8kg	5.75kg	8.1kg	8.82kg	13.6kg	29.6kg
Nominal Dimensions	Length	90mm	151mm	151mm	181mm	195mm	197mm	257mm	259mm	342mm	522mm
	Width	70mm	65mm	98mm	77m	130mm	165mm	132mm	168mm	173mm	240mm
	Height	101mm	94mm	95mm	167mm	178mm	170mm	200mm	208mm	212mm	224mm
Termination		T1	T2	T2	T3	T5	M6	M6	M6	M8	M8
Protection		Protection against over-charge, over-discharge, over-current, over-temperature. Cell balancing function included									

WHY BUILD CUSTOMIZED BATTERY PACKS?

>FLEXIBLE & BETTER PRODUCT DESIGN

There is no liquid electrolyte exist in the lithium battery cells, so we can lay down the battery pack in any directions as we want.

And there are many different size cells available, so we can assemble the battery pack in thousands of assembly structures to get the optimal battery shape.

>BETTER PERFORMANCE

Assemble bigger battery packs by the existing 12V LiFePO4 Batteries seems more easier, but it's not a good way to assemble a good battery pack:
A, if you do the series connection by 12V blocks, you may face the capacity shortage when the battery pack get older, because the balance can't work between 12V packs; also, you need to check with us to make sure the BMS can stand the final battery pack voltage.
B, if you do the parallel connection, the balancing is always proceeding between the 12V packs, so we need to check the 12V pack voltages to make sure the balancing current is not too big to make the BMS go to over current protection.

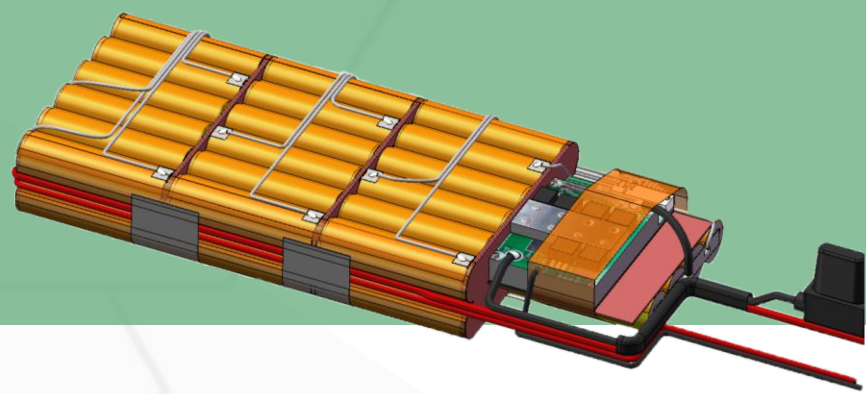
HOW TO GET A CUSTOMIZED BATTERY PACK?

We need some basic info to build a battery pack:

1. Battery Pack Voltage & Capacity
2. Battery Pack Max. Continuous Output Power
3. Battery Weight & Dimension
4. Battery Pack Housing
5. Charge & Discharge Terminal

and other detail and special requirement.

Then, we will be able to design the battery pack according to customers' requirement.



THANK YOU

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