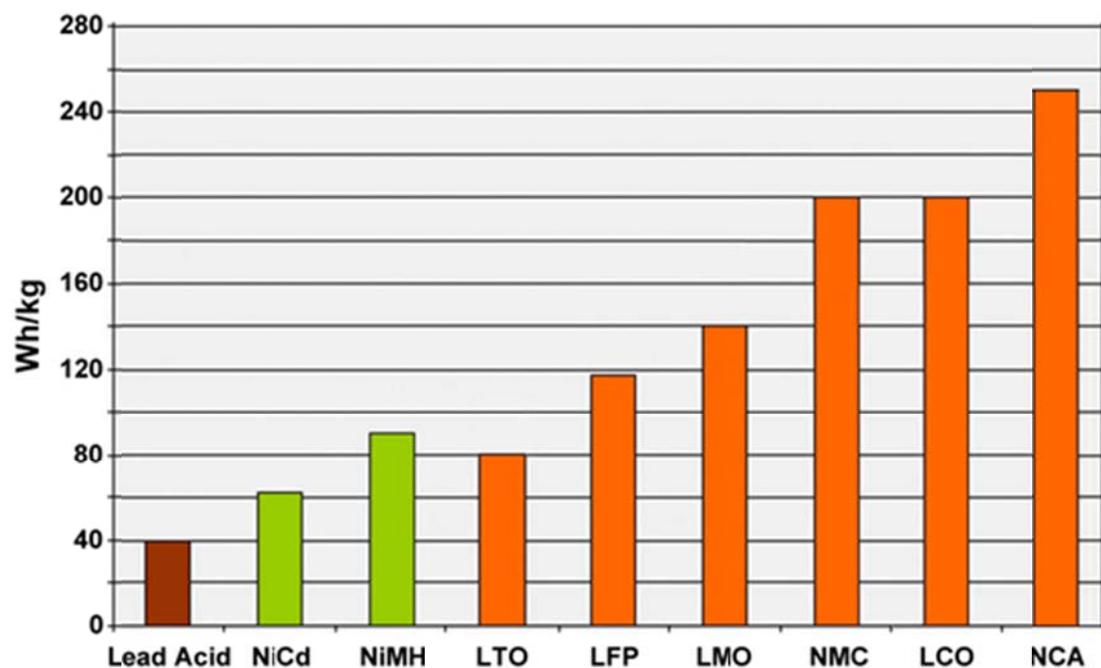


LITHIUM BATTERY SAFETY CONCERNS

Recent news stories regarding Lithium Batteries causing fires in Cell Phones, Hover Boards and in Aircraft have frightened RV Owners and Manufacturers resulting in genuine concern regarding using Lithium Batteries in RV's. These concerns while real, are mainly due to the lack of knowledge most people have regarding Lithium Batteries. First, there is not just one type of Lithium Battery Chemistry used to make these batteries! There are several types of chemistries that are combined with other elements and Lithium to manufacture batteries that produce different amounts of Watts per kilogram (see Chart). **Based on the information below Progressive Dynamics has decided to develop Converter/Chargers that support the Lithium Iron Phosphate Chemistry (LFP) because of better safety features, lower cost and long battery life.**



The goal of Lithium Batteries is to store as much battery energy (Watts) as possible with the lowest weight! As you can see the Lead/Acid batteries that we have used for over 100 years can only store 40 Watts/Kilogram (2.2 Lbs.). Now higher capacity Lithium Batteries have come to the RV market in a huge way providing much more Storage Capacity/Kilogram and are the future of battery power for the RV, Boating and other Industries.

COMPARING THE ADVANTAGES & FEATURES OF THESE DIFFERENT TYPES

The #1 Lithium Battery for power storage is the NCA ([Nickel Cobalt Aluminum](#)) which, can store over 240 Watts/Kilogram! With that in mind the obvious choice for a high-power RV or Marine Battery would be the NCA type. However, there are some problems with this type including, Possibility of **Thermal Runaway, if fully or over charged, High Cost** and **Environmental Concerns**. The "C" in NCA stands for **Cobalt** a radioactive element that is expensive and could be detrimental to the environment. This type of battery is used in Medical devices, industrial, electric powertrains (Tesla Cars).

The 2nd best battery for maximum Watts/Kilogram is the LCO type ([Lithium Cobalt Oxide](#)) with 200 Watts/Kilogram. This type is typically used in Mobile phones, tablets, laptops, cameras. This type also contains **Cobalt has Hi Costs** and as you have seen there is a possibility of **Thermal Runaway, if fully or over charged.**

The 3rd best battery for maximum Watts/Kilogram is the LMC type ([Lithium Nickel Manganese Cobalt Oxide](#)) with 200 Watts/Kilogram. This type is typically used in E-bikes, medical devices, EVs, industrial. This type also contains **Cobalt have Hi Costs** and there is a possibility of **Thermal Runaway, if fully or over charged.**

#4 is Lithium Manganese Oxide with 100 – 150 watts/Kilogram. Drawbacks include **Low Cycle Life** (300-700) when compared to other lithium types with 2,000 – 5,000 Cycles and full or over charge may cause **Thermal Runaway.** Typically used in Power tools, medical devices, electric power trains (i.e. Electric Vehicles).

The 5th is the LFP [Lithium Iron Phosphate](#) (LiFePO_4) and **is the Safest**, with 120 Watts/Kilogram or almost three times the equivalent storage capacity of a similar sized Lead/Acid RV Battery at ½ the weight. This is the type of Lithium Battery Progressive Dynamics Converter/Chargers were designed to operate with. There were other reasons for the decision to support LFP Battery Chemistry including the following.

In 1996, the University of Texas (and other contributors) discovered phosphate as cathode material for rechargeable lithium batteries. Li-phosphate offers good electrochemical performance with low resistance. This is made possible with Nano-scale phosphate cathode material. The key benefits are high current rating and long cycle life, besides good thermal stability, enhanced safety and tolerance if abused.

Li-phosphate is more tolerant to full charge conditions and is less stressed than other lithium-ion systems if kept at high voltage for a prolonged time. As a trade-off, its lower nominal voltage of 3.2V/cell reduces the specific energy below that of cobalt-based lithium-ion. As with most batteries, cold temperature reduces performance and elevated storage temperature shortens the service life, and Lithium Iron phosphate is no exception. Li-phosphate has a higher self-discharge than other Li-ion batteries, which can cause balancing issues with aging. Cleanliness in manufacturing is of importance for longevity. There is no tolerance for moisture, lest the battery will only deliver 50% cycles of Advertised. Note: modern LFP batteries are completely hermetically sealed to prevent moisture problems. Other Distributors with warranties to ensure customer service and satisfaction. We have been testing these batteries in our laboratory, at our distributors and with RV Manufacturers in the field for several years and have not heard of any problems with **Thermal Runaway.**

An **Additional Safety Feature** that is included in today's LFP Batteries, is a Built-In **Battery Management System (BMS)**. This system constantly monitors all Battery Cells for proper Temperature and Voltage (Hi & Low) then automatically disconnects the battery from the charger and the RV 12-Volt circuits if any these limits are exceeded, preventing any battery damage. The other important function the BMS provides, is to monitor and automatically balance all the cell voltages during charging (Note: A 12-Volt Lithium Battery consist of 4 or more cells wired in series/parallel). The BMS ensures that all cells are properly charged equally.

Data above is from the website batteryuniversity.com