

**Lithium Polymer cell technology provides a number of advantages over Lithium ion in underwater applications.**

Increased electrical power requirements in underwater applications require the use of new higher energy density cell technologies. As the oil and gas industry moves into deeper water and starts to employ ocean floor drilling this has necessitated the move away from hydraulically to electrically powered valves and equipment.

Typically, batteries used in underwater applications are Lead acid. However, due to the significantly higher energy density and lower weight of Lithium ion it is now beginning to replace Lead acid in these applications. The next iteration of cell technology is Lithium Polymer; these cells provide a number of performance and safety advantages over that of Lithium ion.

Safety - the lithium-salt electrolyte of Lithium ion is held in a liquid organic solvent form which requires a cylindrical or prismatic shaped metal case to contain it. This is unlike Lithium Polymer, which having a solid or gel polymer composite electrolyte will not leak if the foil container is breached. In addition, since the volume of free electrolyte is greatly reduced in the laminated construction of Lithium Polymer cells this minimizes the quantity of flammable material that can potentially be released in the event of catastrophic cell failure. It is for these reasons that the Lithium Polymer cell is regarded as a safer alternative to Lithium Ion.



Figure 1. Typical prismatic, Lithium ion cell showing cylindrical construction and metal casing.

Performance - Polymer cells are housed in flexible, foil pouches which offer a number of advantages in packing density. Without intercell spacing between cylindrical cells and the lack of metal casing, the energy density of Li-Poly batteries is over 20% higher than that of a classic Li-ion battery as a result of being packed more densely. The lack of a metal cell casing also means a Lithium Polymer battery can be lighter and can be specifically shaped to fit the device it will power.



Figure 2. Typical Lithium Polymer cells showing foil casings and flat form factor which maximises energy density for a given volume when compared to Lithium Ion cells.

Cell manufacturers and independent test organisations have shown that at deep sea pressures (690bar) Lithium Polymer not only survives but performs well without the need for housing within a pressure vessel; a simple oil filled pressure compensating vessel is all that is required. This greatly reduces the weight and cost of the overall battery solution.

**The Lithium Poly Advantage**

	<b>Lithium Ion</b>	<b>Lithium Polymer</b>
Volumetric Density	280Whr/ltr	320Whr/ltr
Gravimetric Density	170Whr/kg	200Whr/kg
Reactivity	Very High	Very High
Cost	US\$400/kWhr	US\$500/kWhr
Internal Impedance	Low	Very Low
Safety Circuitry	Required	Required
Charge Rate	>2C	>10C

Summary

- Greater energy density for a given volume
- No pressure vessel is required for underwater use; a simpler, lighter, cheaper, oil filled housing is all that is required
- Li-Poly has a lower life cycle degradation rate, significantly increasing operational life
- Lower weight
- Safer
- Increased run times
- Lower overall battery costs
- Greater mechanical robustness