Li-ion Battery Development for Forklift Trucks in North America
北米フォークリフト向けリチウムイオン電池開発

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Abstract

Rapid growth in multiple material handling sectors has driven needs in the industry for more powerful, effective equipment. That growth drove a need for improved, more capable power sources. In response to the need for increased power and data enabled devices, Raymond developed the Energy Essentials line including Lithium batteries (LIB). In addition, business operations began needing more storage space to cope with growing product variability. The LIB removed the need for large battery rooms and regular battery maintenance. This returned floor space to operations and required less intervention from personnel, who could now return battery maintenance time to value added activities. Developing a telematics enabled, NMC (Nickel Manganese Cobalt) chemistry power source maximized battery capacity and performance of our lift trucks. The battery’s long cycle life, with stable performance, ensures a good investment for our customers. Market acceptance has gone well, and adoption continues to increase year over year.

Keywords: Lithium ion Battery, NMC, Cycle life, UL certification

1 Introduction/Background

The material handling industry continues to seek energy power sources, capability of providing increased performance and superior uptime. Lithium-ion batteries (LIB) continue to expand the horizons of vehicle performance and rapid charging capability. The concept of charging at point of use and high C-rate charging was now possible. Customers began to demand maximum performance and quick return on investment.

Raymond developed the Energy Essentials battery to address these customer needs and application requirements. Through this premium LIB offering, some customers, because of their application / lift truck usage, have been able to reduce battery counts on site and achieve more throughput with a single battery. When it is possible to deploy a single battery solution, per truck, the need for battery changing is removed, as part of the process and improvements in operational efficiency and floor space utilization can be realized [Figure 1].

Raymond has now released multiple UL Listed battery voltage offerings to support the class I-III model lineup. Telematics and integrated data support, with the PSI battery communication option, now enable improved fleet optimization and real time battery data reporting. Additional, complimentary product offerings are being developed now to support the Energy Storage Solutions needs of the future.

1) C-rate: It is a measure of the rate at which a battery is discharged relative to its maximum capacity. A 1C rate means that the discharge current will discharge the entire battery in 1 hour. For a battery with a capacity of 100 Amp-hrs, this equates to a discharge current of 100 Amps.

2) PSI: Power Source Integrated. It enables data liberation for both lithium and hydrogen fuel cells, reporting 12 unique performance metrics through the iWAREHOUSE GATEWAY™.

Figure 1 LIB family from Energy Essentials
2 Features and Benefits of Product

The Raymond LIB offerings are technology rich and have industry leading features. UL compliance, reliability, and durability were designed in. The battery requires limited maintenance over its lifetime - no daily watering and emits no harmful vapors or gases during normal operation.

Projects to release 24V and 36V battery offerings have been completed. 48V batteries will be launched by time of this article’s release. Premium cycle life and energy density were top priorities and resulted in the decision to utilize NMC chemistry and these features on this critical path.

2.1 High cycle life

The special ceramic separator technology used allows the battery to be used in wider temperature ranges and helps to maximize the cell’s potential. Figure 2 shows the ceramic separator’s results during characterization testing for heat.

NMC chemistry was selected for its energy density. Due to the proprietary cell chemistry, special ceramic separator, and customized Battery Management System (BMS), the Energy Essentials battery delivers industry leading cycle life. Figure 3 shows Lab testing results that demonstrated cycle life in excess of 5000 cycles. This means much higher cycle life performance than current competitor levels of up to 3000 cycles. This allows Raymond to offer a product with industry leading performance and value.

2.2 UL certification

Energy Essentials batteries are inherently designed to UL2580 to ensure compliance and strong performance.

Should battery customization be required, or even the need for an alternate battery be pursued, Raymond supports requests through our third-party EPS approval process. Customer first, always.

2 Conclusions

The results of years of development and testing, offerings under the Energy Essentials distributed by Raymond brand are now available across the full product line with UL2580 listings [Figure 1]. These batteries have already been delivering strong performance in applications and adoption continues to increase, year over year. Sales trends show accelerating sales and more customer interest in LIB. Raymond is delivering industry leading total cost of ownership with these batteries [Figure 4, Table1].

Overall customer adoption continues to grow. During this development, we created a joint working group to provide more high efficiency products to meet customer satisfaction as one TMHNA. A development cadence is in process for next generation batteries, with even more improved performance.