

Protecting the Power Source

The *iBattery*[™] asset management system helps electric lift truck fleet owners optimize battery life and performance, increase productivity and drive down operating costs.

The Raymond Corporation
Greene, NY

Lead-acid batteries for an electric lift truck can cost almost as much as the purchase price of the actual lift truck — yet those batteries are seldom optimized and are often misused in high-volume warehouse operations. Now, the *iBattery*™ asset management system from The Raymond Corporation gives fleet owners unprecedented power to monitor real-time battery condition and make decisions that optimize battery life and performance.

The *iBattery* system is the latest enhancement of Raymond's *iWarehouse*® fleet optimization system. Fleet owners with *iWarehouse* installed in their facilities can easily add the *iBattery* feature, which gives both lift truck operators and management personnel easy access to essential information on every battery on every truck. The system automatically monitors key battery parameters and provides information that helps users:

- Reduce battery replacement and save dollars
- Minimize electricity consumption
- Avoid overheating, overdischarge and other conditions that could cause battery damage or void battery warranties
- Give operators accurate “fuel gauge” readings to help ensure timely charging
- Ensure that only the appropriate battery is placed on a given truck
- Collect and analyze data for record keeping and fleet management

In short, *iBattery* monitoring allows users to sustain optimum productivity while keeping a tight rein on operating expenses.

Why data matters

Lift truck batteries are an essential part of the warehouse operation. If the trucks are to operate at peak efficiency, their batteries must be maintained in peak condition. This depends on timely charging; cooling and watering; and periodic inspection. The key to performing these tasks well is to monitor the battery consistently — not just to react when damage already has been done. The ultimate goal is to maintain a state of health as close as possible to 100 percent throughout the battery's life expectancy.

Until now, there was no way to gather critical battery information directly with the battery in use. Further, older battery monitoring systems had severely limited ability to gather data. For example, previous systems sensed voltage but not current and, therefore, could not measure energy in or energy out. There was no automatic data collection and reporting — users had to rely on rigorous manual logging of data and meticulous record keeping. In contrast, the *iBattery* system monitors a wide range of critical information that includes:



- > Battery state of charge
- > Water level
- > Battery age and condition
- > Battery temperature
- > Battery compatibility with the lift truck
- > Battery error codes or error conditions

To enable optimum performance, this information is available both to lift truck operators and to warehouse supervisors, who can see the big picture and monitor and adjust operating practices when appropriate.

How *iBattery* works

The *iBattery* system uses an electronic module that includes voltage and current sensors, a water-level probe, and multiple temperature sensors. The module stays with the battery, continuously collecting information whether it is on the truck or being charged. The *iBattery* system also includes a communication system that automatically transfers battery information to the lift truck once every second. To complement the sensor module, an auxiliary processor module (APM) installed in the lift truck combines the battery information with data from the lift truck and forwards it on to the *iWarehouse* system. Facility managers can then access the data through a web-based dashboard.

Once the system is installed, certain battery information that is critical to lift truck performance is available immediately to the operator on the truck display:

- > Battery state of charge
- > Water level
- > An alert if the battery temperature is above a preset threshold
- > An alert or truck reaction if a battery placed on a truck has the wrong capacity, wrong voltage or insufficient weight for that vehicle

In addition, the warehouse supervisor and lift truck service technician receive immediate notification of battery faults through the *iAlert*® module of the *iWarehouse* system. Other data on battery usage and overall efficiency is relayed through the *iWarehouse* system, where managers can use it to perform analyses and create reports. The battery data can be used to generate information, such as:

- > How often the battery has been equalized
- > If and when the battery discharged in an overtemperature condition
- > If and when the battery was discharged with a low-water condition



- > If and when the battery was underdischarged
- > If and when the battery was overdischarged
- > A general state-of-health calculation

In dollars and cents

Monitoring with the *iBattery* system has tangible benefits to operating cost and productivity because it helps detect battery conditions or operating practices that can damage or ruin batteries, reduce their power storage capacity, and curtail overall lift truck fleet uptime.

Lengthening life

A benefit of the analysis begins with the initial cost of the wet-cell, lead-acid batteries commonly used in lift trucks. In North America, the energy information for a typical lift truck lead-acid battery is 36 volts, 750 ampere hours, 26 kilowatt hours and C/6 rate 125 amperes. These batteries cost on average about \$5,000 and, if used and maintained properly, have a useful life of 1,500 charge/discharge cycles (roughly five years). Any percentage reduction in battery life means the same percentage increase in cost for battery purchases. Thus, a battery with a life that is shortened by half through misuse means 50 percent of that battery's cost (\$2,500) is wasted. By extension, a 50-truck fleet in which batteries last four years instead of five (20 percent less) increases the cost of new batteries by \$1,000 per truck, or \$50,000 in total. Conditions that can shorten battery life, and that are monitored by *iBattery*, include:

- > **Low water level.** The battery water level must be checked at the end of each charge because some water is lost during the charge/discharge process. Water loss exposes the lead plate material in the cell and removes that part of the plate from the chemical process of producing electricity.
- > **High temperature.** Using energy while driving the lift truck adds heat to the battery, and the charging process raises battery electrolyte temperature by 20 degrees Fahrenheit or more. Because the battery is a large, dense mass, it takes several hours for it to cool. If it is not cooled for a long enough time, its temperature will continue to rise, risking long-term damage. Studies show that 120 F is the top electrolyte temperature that will not severely degrade battery life.¹ Another study shows that if warmer than 80 F, a battery will store energy but will lose an estimated 50 percent of its overall life for every 15 F it operates warmer than that temperature.²
- > **Low temperature.** A battery loses its ability to store and release energy as it gets cold. For example, a battery at 30 degrees Fahrenheit delivers about 75 percent as much energy as one at 70 degrees Fahrenheit. In cold-storage applications, batteries in a low state of charge can be vulnerable to freezing, which may cause catastrophic physical damage.

Sustaining production

Industry convention says 80 percent of battery capacity is available for a given work cycle. A typical cycle calls for six hours of use in an eight-hour shift. The recommended procedure is to charge the battery for eight hours, let it cool for eight hours and then use



it for a shift. Thus, a three-shift operation needs one battery per truck per shift. In this example, a 750 ampere-hour battery would use 600 ampere hours (20.8 Kilowatt hours) in six hours of work, or use power at an average rate of 100 amperes continuously for six hours.

Misuse in various forms can reduce a battery's capacity to hold charge. A 20 percent loss would reduce a battery's effective capacity from 600 ampere hours to 480 ampere hours, possibly not enough to last a shift. This would mean taking the truck out of service for a battery exchange. If that process takes 15 minutes, then 4.2 percent of the shift's productive time is lost — a substantial drop in productivity. This also means:

- > More batteries needed to accommodate a multiple-shift operation
- > Added labor costs for more frequent battery exchanges and recharging
- > More energy lost in more frequent recharging (the process is only about 80 percent efficient)

The *iBattery* system accurately monitors and displays the battery's state of charge and so helps users prevent conditions that can reduce battery capacity:

- > **Overdischarge.** Lead-acid batteries should never be discharged beyond 80 percent of their ampere-hour rating; doing so can permanently reduce capacity.
- > **Underdischarge.** Lead-acid batteries have "memory." For example, a battery routinely discharged only 40 percent eventually will be limited to 40 percent of its original rated capacity (300 ampere hours for a 750 ampere-hour battery).
- > **Failure to equalize.** Typically, batteries require an equalizing charge about every seven to 10 days to bring the battery back to its full rating. Equalizing is essentially a deep-charging process that stirs the electrolyte and ensures that charge is distributed uniformly. If not equalized, a battery can lose up to 50 percent of its capacity.

Stability

Lift trucks are designed to be steady and stable. Stability is affected by various factors, including lift truck weight and weight distribution. Lift truck lead-acid batteries are heavy — those on larger trucks often weigh more than 2,000 pounds. Batteries typically serve as counterbalance weights. Therefore, an incorrect battery too light for the truck may affect the ability to lift. The *iBattery* system "tags" each battery to a specific truck. If the wrong battery is placed on-board, the truck panel displays a fault code and the lift function is disabled.

Better data, better performance

As the lift trucks' power source, batteries are essential contributors to warehouse productivity, cost-efficiency, performance and profit. The *iBattery* system brings tools that help manage batteries — and thus lift truck fleets — with more precision and certainty than ever before.



Sidebar

All the details

Data collected from each lift truck battery through the *iBattery™* system includes:

- > Battery identification number
- > Battery voltage
- > Battery type (e.g., wet cell, AGM, VRLA)
- > Battery weight
- > Six-hour ampere-hour rating
- > Real-time battery temperature
- > Water level
- > Real-time sample current
- > Real-time sample voltage
- > Optional temperature/water sensor installed
- > Ampere hours during discharge
- > Ampere hours during regeneration
- > Ampere hours rapid (fast) charge
- > Ampere hours normal charge
- > Ampere hours equalizing charge
- > Battery state of charge
- > Fault codes
- > Software version number



Footnotes

¹ East Penn Manufacturing Co., Inc.; Lyon Station, PA.

² Marsh K. Battery Book One: Lead Acid Traction Batteries. Mount Kisco, NY: Curtis Instruments Inc.; 1981.



About The Raymond Corporation

The Raymond Corporation is a global provider of unmatched material handling technology, expertise and support to increase productivity and cost-efficiency. High-performance, reliable *Raymond*[®] lift trucks range from a full line of manual and electric pallet trucks and walkie stackers to counterbalanced trucks, *Reach-Fork*[®] trucks, orderpickers and *Swing-Reach*[®] trucks. Through its *CustomCare*[™] approach, Raymond and its Sales and Service Centers deliver a comprehensive package of personalized enterprise solutions — like the *iWarehouse*[®] fleet optimization system, in-depth industry knowledge and consulting, flexible financing, OSHA-compliant training, and industry-leading asset protection — to optimize warehouse operations.

For additional information about The Raymond Corporation or to locate a Raymond Sales and Service Center, visit the company website at www.raymondcorp.com or call 800-235-7200.

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