# Comparing Hydraulic and Electric Power Sources for Forklift Battery Changers

Hydraulic power is frequently used for industrial lifting equipment, and the smooth linear force generated by hydraulic cylinders makes the technology a natural choice for machines that lift heavy loads frequently. Forklift battery handling equipment generally follows this tendency, and most of the machines at work in modern battery rooms use hydraulic circuits to provide their primary lifting force.

However, as forklift battery handling equipment evolves, more mechanical systems are present within each piece of machinery. The most efficient battery rooms for high-throughput applications combine multiple tiers of charging stands with a heavy-duty Operator Aboard Battery Extractor, which moves both horizontally and vertically to change out batteries efficiently.

With the introduction of multiple axes of movement, manufacturers of battery handling equipment began to experiment with different sources of motive power. The contemporary battery handling market offers equipment that incorporates hydraulic or electric machinery, and sometimes both power sources.

Figure 1. BHS Operator Aboard Battery Extractor Systems can be configured with a variety of hydraulic and electrical motive power sources.

Warehouse management professionals can choose from three distinct options. Many battery changers are fully hydraulic, but some models rely entirely on electric motors instead, and hydraulic-electric units use hydraulic circuits for lifting and extracting batteries while relying on an electric motor drive for floor travel.

Which source of motive power is most effective for this highly specialized application, and will a certain option provide improved efficiency during critical change-out procedures?

Each power source has distinct advantages, but for three out of four of the types of motion provided by Operator Aboard Battery Extractors, hydraulic power is a more efficient choice with a better overall return on investment. As a result, most experienced battery room managers continue to prefer hydraulic power to electric motors. This is not to discount the value of electric motors, especially when utilized as the generative force behind floor travel.

In this article, we will explore the advantages of both hydraulic and electric power for forklift battery changers while making several recommendations for cost-effective battery room outfitting.

## Axes of Motion Traversed by Operator Aboard Battery Extractors

Choosing a power source begins with identifying the types of motion that the machines must provide to safely change out forklift batteries. Operator Aboard Battery Extractors move along four distinct axes — two for the vehicle, and two for the battery extractor arm:

1. The carriage travels laterally across the floor.
2. The carriage travels vertically, accessing higher tiers of battery racking.
3. The extractor arm rotates within the battery bed.
4. The extractor arm extends outwards into battery racks.

Hydraulic systems can use a single pump to power any number of actuators, whereas electric models depend on separate electric motors for each axis of movement.

Electric motors might provide more efficient operation if the machine only moved along one or two of these axes, but with all four types of motion to power, hydraulic circuits are the stronger option. In a fully hydraulic battery extractor, all four types of motion can be powered by the same pump, centralizing the power source and limiting the number of parts that could develop problems due to mechanical wear.

Electric systems would have to use separate motors for each axis of travel — each one representing a potential point of mechanical failure. This can allow for more frequent repairs, which can put sudden limitations on a facility's forklift fleet.

## Conditions Unique to Forklift Battery Room Applications

Forklift batteries can create hazards in storage and charging areas, and the most reliable battery handling equipment will limit these hazards through safe design elements.

Two particular challenges posed by forklift batteries make hydraulic machines more suitable for battery rooms: weight and the possibility of corrosive runoff.

1. **Weight -** Forklift batteries are designed to be extremely heavy so that they can provide ballast for the lift forks. The machines that handle these loads - which can easily surpass 3,000 pounds per battery - must incorporate motors that provide heavy-duty lifting power without excessive energy costs.

   The trade magazine *Machine Design* reports that while electric motors deliver high rotational speed and produce adequate torque in lighter application, lifting equipment designed for particularly heavy loads is often better served by hydraulic power.

   If a load exceeds an electrical motor's lifting limits, the motor's windings can burn, requiring repair or replacement. Hydraulic motors aren't damaged by excessive loads; they will simply stop if the load exceeds the lifting force generated by the fluids.

2. **Electrolyte Leaks/Spills -** Electric motors are more vulnerable to contaminants than hydraulic systems. When handling batteries, some amount of electrolyte loss is inevitable. Facilities can easily control runoff with drip pans and AcidSorb Pillows, but battery room equipment should be designed to tolerate exposure to electrolyte and other pollutants.

   Copper or aluminum windings can be damaged by the corrosive materials that can build up on forklift battery changing equipment. Hydraulic systems are often better prepared to resist the tough environment of a forklift battery room.

## Comparing Energy Efficiency Between Electric and Hydraulic Power

Generally, electric motors are more energy efficient drivers of motion than hydraulic systems. Under certain conditions, however, hydraulic machines can do the same work with less of a draw on the electrical grid. With electricity consumption so directly linked to a company's bottom line, this is a consideration that facility managers must take seriously — particularly in larger battery rooms.

The trade publication Power Electronics reports that hydraulic equipment draws less power than comparable electric machinery in three particular situations:

1. The machine repeatedly moves back and forth along a predefined path.
2. Lifting and/or supporting particularly heavy loads is part of the machine's daily work.
3. The work requires the equipment to move along many axes of motion.

Figure 2. AcidSorb Pillows from BHS absorb and neutralize electrolyte that can leak from forklift batteries, and change color when the neutralization process is complete.

This list is also a fair description of the technical requirements of forklift battery handling equipment, so it follows that all-hydraulic systems can provide greater energy efficiency for most operations. Of course, every facility has a unique set of needs, and managers should conduct careful efficiency studies before upgrading battery handling equipment.

## Maximizing Safety and Efficiency in Hydraulic Battery Lifting Equipment

Figure 3. BHS Triple Stack Battery Extractors are available in fully hydraulic models or with an Electric Drive for floor travel.

Hydraulic power is also an efficient choice for battery change-out procedures for another reason; due to the heavy weight of forklift batteries, any reduction in the weight of the equipment within the battery bed can substantially improve efficiency. Hydraulic actuators are much lighter than electric motors, so they reduce the force needed to move loads within the battery bed.

When powered by a variable displacement hydraulic pump, hydraulic battery changers can provide even greater gains in efficiency. These devices draw less power by idling when not actively in use. The hydraulic systems in every BHS Battery Extractor includes a variable displacement hydraulic pump for the most efficient operation available.

This high level of efficiency is more difficult to reach when lift function is powered by an electric motor. Electric motors require gearboxes to regulate the speed of motion, and larger gearboxes lose efficiency by generating heat. Industry publication Machine Design recommends that engineers assume efficiency losses of about 10 percent for every engagement between gear wheels.

Size is another issue for electric motors in forklift battery handling equipment. To generate the force required to lift thousands of pounds, electric motors must use a large number of windings. This makes them larger, heavier, and more expensive than motors that generate less torque.

## Lift Truck Battery Changer Safety Features

With hydraulic lift machines, it is possible to include a wide range of safety features. Every BHS Battery Extractor provides several layers of redundancy to prevent lift system failure.

Safety features include the Non-Inner Flow Manifold in the four-point cylinder lift, as well as velocity fuse protection, which immediately locks lift cylinders in place, arresting falls before they begin. These exact features are not available on all-electric models, although similar safety improvements may be gained through other technologies.

## Combining Hydraulic and Electric Power for Forklift Battery Change-Outs

In their simplest form, hydraulic devices excel at driving linear motion, while electric motors naturally create strong rotary motion. Perhaps the most efficient way to power the various movement systems of forklift battery changers would be to take advantage of the strengths of both hydraulic and electric motors, creating a hybrid machine with an electric floor drive and hydraulic lift and battery extraction functions.

The floor drive systems in BHS Battery Extractors can be powered by the machine's hydraulic unit or connected to a separate electric motor controlled by a variable frequency drive (VFD). With this range of options, BHS Battery Extractors can be tailored to match every application's unique needs with maximum efficiency.

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