Forklift Battery Extraction: Overhead vs. Side Removal

Competing Designs for Forklift Battery Compartments

Two types of battery compartments are typically found in electric forklift fleets, differentiated by method of access. Electric forklifts configured for **overhead extraction** place batteries vertically into battery compartments. **Side removal** compartments provide access through a removable gate in the truck's flank, allowing battery extractors to gently pull batteries into carts or charging racks.

Horizontal removal, on the other hand, provides important safety benefits by limiting vertical travel. When batteries are held higher in the air, they become more of an accident risk. There are also operational cost benefits to side-removal systems, which are especially evident for facilities with larger lift truck fleets.

Leading manufacturers of electric forklifts frequently offer both systems as options, allowing consumers to choose the appropriate design for different applications. However, some fleet managers choose lift trucks based on the battery handling equipment they already own. These systems are often designed to service batteries for older lift trucks, which could be decades behind the technological curve. Reimagining a facility's battery handling infrastructure can often provide a more attractive return on investment.

In this article, we will analyze some of the factors that affect battery compartment design while focusing on several key considerations:

1. We will compare overhead- and side-extraction battery compartments and the equipment required for each design.
2. We will consider the market implications of forklift battery compartment designs.
3. Final analysis will show that side-extraction forklift battery compartments often provide better returns on investment for operations that run multiple shifts and change batteries frequently.
4. Overhead-extraction battery compartments with reliable gantry cranes may provide advantages for facilities that infrequently remove batteries, or that rely on a pre-existing fleet of forklifts configured for overhead battery removal.
5. Ultimately, the price-per-change analysis favors side-extraction systems; improved gantry cranes are an effective option for facilities that are not ready for full fleet conversion.

Figure 1. BHS Power Drive Gantry Cranes can be configured to match forklift fleets that require vertical battery extraction.

Prevalence of Lead Acid Batteries for Forklifts

The demand for electric lift trucks continues to rise in markets around the world. Between 1993 and 2014, the number of electric forklift trucks shipped by manufacturers in the United States has nearly doubled, from 29,210 factory shipments in 1993 to 57,543 in 2014.

Electric lift trucks are most likely to be powered by lead acid batteries. A 2014 survey conducted by the Industrial Truck Association asked industry professionals to rank the five leading sources of electric power in order of prevalence over the next three years; lead acid batteries came in first by a wide margin.

Given the popularity of the electric lift truck and the dominance of lead acid batteries, the issue of battery compartment design has significance across all sectors of the economy. After all, every enterprise and government in the world benefits from efficient material handling practices (in fact, this has compelled some state and local governments to offer incentives to operations that convert their fleets from combustible fuel sources to electrical power). Battery design directly affects the overall efficiency and return on investment.

The Challenge and Necessity of Forklift Battery Handling

Electric lift trucks are also considered safer than the alternatives, but given the large size and weight of the average forklift battery, proper material handling procedures are essential. According to the U.K.'s Health and Safety Executive, more than 25 workers are injured by batteries in the workplace

each year. In the United States, injury rates are comparatively lower per capita; a yearly mean of 63 workers were injured by being struck by batteries between 2011 and 2013, according to the Bureau of Labor Statistics.

The rates of battery-related injury are improving, thanks in no small part to advances in battery handling equipment. In 2013, only 20 workers in the U.S. were injured by battery strikes. Compare this to 1996, when, as the trade journal *Occupational Health & Safety* reports, contact with batteries caused 1,547 non-fatal injuries that resulted in lost work days.

While the industry has made incredible progress with battery handling safety, appropriate battery changing equipment is still necessary to protect workers. The average weight of a forklift battery is more than 2,000 pounds. This is certainly not a design flaw — batteries are meant to be heavy. Forklifts rely on the tremendous weight of lead acid batteries to provide ballast against loads. Without several thousand pounds of counterbalance, these heavy-duty trucks could tip forward, exposing workers to injury and risking damage to products and warehouse infrastructure.

To safely handle objects as heavy as industrial batteries, facilities need to use dedicated material handling equipment. In fact, European Union Council directive 90/269/EEC requires employers to "use the appropriate means, in particular mechanical equipment, in order to avoid the need for the manual handling of loads by workers." Regulations like this exist to keep workers safe, and forklift battery changers are designed to meet the same goal, regardless of the battery compartment design.

Equipment Required for Each Type of Battery Extraction

The Occupational Safety and Health Administration requires employers in the United States to provide workers with "a conveyor, overhead hoist, or equivalent material handling equipment" for handling batteries (29 CFR 1910.178(g)(4)). Depending on whether forklifts incorporate vertical- or side-extraction battery compartments, the equipment required to meet this important OSHA requirement will vary.

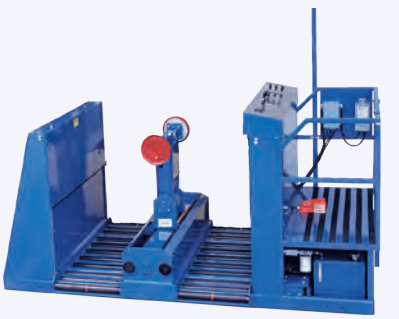

Figure 2. BHS Operator Aboard Battery Extractors (BE) efficiently remove and replace batteries for side-extraction lift trucks.

Overhead-extraction battery compartments require equipment that can lift batteries clear of the compartment's upper limits, which can easily exceed 30 inches for large forklift batteries. The full height that a battery must be lifted will vary with the lift truck design, but it is not uncommon to require suspending the battery several feet into the air.

Powerful vertical hoists, such as the BHS Power Drive Gantry Crane, can improve the safety and efficiency of battery changes when working with these vertical-extraction designs. This equipment provides space-saving modular design, and can grow and expand with forklift fleets.

Side-extraction battery changing equipment typically pulls batteries out of the compartment with a vacuum or magnetic extractor arm. Powered rollers assist in a smooth transfer from the truck, into the extractor battery bed, and finally into charging racks.

These designs keep batteries at a constant height during the extraction and replacement processes, sometimes only a few inches from the floor. With side-pull battery extractors, the cart itself is adjustable, travelling vertically to line up with the roller height of the forklift.

Battery-changing equipment such as the BHS Mobile Battery Extractor or Operator Aboard Battery Extractors retain firm control of batteries during every extraction and reinstallation.

Efficiency and Cost Analysis in Battery Changing Tasks

Vertical removal and replacement of a forklift battery takes 10-12 minutes with trained staff and a high-quality powered gantry crane. A lift truck configured for side-removal only requires 2-3 minutes with a BHS Operator Aboard Battery Extractor.

In 2012, the median pay for forklift operators in the United States was $15.16 per hour. That year, benefits accounted for an average cost of $9.48 per employee, per hour. Adding these figures, and adjusting for inflation, operations are likely spending around $25.85 per hour for the staff most likely to be responsible for forklift battery changes.

Therefore, the personnel cost for each battery change produces the following comparison:

Personnel Cost per Battery Change	
Overhead Extraction	$4.30 -$5.17
Side Extraction	$0.86 - $1.29

Figure 3. Personnel cost comparison between the two leading designs of forklift battery compartments. Sources: Occupational Outlook Handbook and the Bureau of Labor Statistics.

Returns on investment are clear; facilities that switch to side-extraction fleets can regain costs at the rate of $3.44 to $3.88 per battery change. If a facility completes 100 battery changes per day, savings would amount to $344-$388 per day, or nearly $2,000 per week (based on a five-day workweek.)

Conclusion: Side Extraction Lift Trucks Provides Better Efficiency with Frequent Battery Changes

While dependable gantry cranes can provide reliable safety and clear ergonomic benefits during battery changes, overhead-extraction compartments do not provide the same financial benefits of a side-extraction fleet.

Side-pull battery extraction also provides safety benefits by reducing the distance between the battery and the ground during the change-out process, and by resting batteries in a cart or a compartment during travel. Because of this combination of features, side-extraction provides lift truck fleets with more efficient battery handling capabilities, which can mean a substantially more productive fleet overall (provided that other aspects of battery fleet management are also optimized).

There is evidence that side extraction is quickly becoming the industry standard. *Industrial Equipment News* reports that the popularity of side-removal for forklift batteries is increasing among forklift users. Echoing this observation, a 2014 article in the British Safety Council's magazine, *Safety Management*, reported that "most" lift trucks use side-access for battery removal; the same article pointed to a drop in workplace injuries, suggesting that safety was improving in every area of the material handling industry.

Every operation will need to perform a careful cost analysis before committing to a full conversion. Managers of facilities with limited battery handling needs may prefer to work with older equipment and forego a full conversion to side-extraction. In these cases, BHS Gantry Cranes and Battery Lifting Beams provide reliable service while significantly improving the safety of the operation, when used correctly. It's also important to note that while vertical battery extraction may be less efficient than side extraction, appropriate equipment outfitting and fleet battery management practices will still allow for excellent productivity overall.

For greenfield operations and for facilities purchasing new lift truck fleets, however, side extraction systems will offer a better return on investment, especially considering the productive benefits outlined above. In any case, managers should consider the features of each technology when building battery rooms or when considering equipment upgrades.

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