Comparative Analysis:
BHS Battery Extractors vs. the Competition

Comparing Forklift Battery Extractors from Different Manufacturers

All forklift battery changers serve the same general purpose -- operations need to transport a 1-2 ton battery from the truck's battery compartment to the charging rack, and vice versa -- but they vary substantially in terms of design, efficiency, initial investment, and ongoing maintenance costs.

This comparison of the five leading operator aboard battery changers reveals that BHS products offer the greatest combination of benefits with the most durable and efficient battery handling equipment at every price point.

Analysis of these high-capacity extractor systems shows several distinct mechanical differences, which for the purposes of this comparison, can be sorted into five categories:

Figure 1. The BHS Triple Stack Battery Extractor (BE-TS) offers a greater opportunity to optimize floor space for valuable warehousing functions.

1. **Extractor Arm Design:** For side-extraction systems, there are essentially only two competing arrangements for the mechanical arms that push and pull batteries into place.

   In one arrangement, a T-shaped extractor arm rises up from the base of the carriage. In the other, the arm dangles from a traveling bridge above the battery beds. The T-shaped arm leverages weight against the base of the carriage, spreading the force around a larger, sturdier area. Above-battery extractor arms must absorb horizontal force along the traveling bridge, and may even place stress on the alternate axis travel shaft.

   Drive screws (or rack-and-pinion tracks), travel shafts, and other key components of extractor arms can be either enclosed in metal shields or exposed. Exposed components can collect dirt and debris, leading to higher maintenance costs and greater operational limits.

2. **Type of Grip:** Three connection devices are typically used in battery changers. The most basic is a simple hook and chain, which can be appropriate for lift trucks that require overhead battery extraction. Operator-aboard systems generally incorporate one of two more advanced technologies: a powerful vacuum cup or an electromagnet. Depending on the application, it is preferred to use vacuum cups, as they cause the least wear on battery cases and are most forgiving of irregularities in battery case surfaces.

3. **Battery Compartment Bed:** Most battery changers use roller beds to facilitate transfers. All of the track-mounted vehicles examined in this analysis use dual roller beds to carry batteries. However, some systems use powered rollers while others incorporate non-powered, free-rolling beds. When not actuated, hydraulic powered rollers act as a brake for batteries. This safety feature makes powered rollers a preferable choice.

4. **Lift Mechanism:** Lift mechanisms for the battery beds and operator carriages range from simple rack-and-pinion to a tube-in-tube system with hydraulic equalization to a complex lift chain system.

   The strongest lift systems include features that limit stress on mechanical components, such as the Non-Inner-Flow (NIF) manifold system used in BHS Battery Extractors, as well as a velocity fuse to protect operators and loads from free fall caused by failure of the hydraulic system. The velocity fuse immediately shuts off flow when fluid velocity exceeds that of normal operation, as it would if a hose were to break. Without hydraulic flow, the carriage remains safely suspended, preventing serious injury and costly equipment damage.

5. **Drive System:** Floor travel is an essential part of every battery change-out. Most of the models described in this document use a simple drive system: a standard axle powered by a single motor. When this motor requires service, the entire operation is put on hold while the necessary repairs are performed. Depending on the experience of the repair staff and other factors, downtime can easily consume a shift, causing significant productivity losses.

   In order to provide more reliable travel, BHS Battery Extractors utilize an advanced, dual independent floor drive system. In normal operation, the two powered drive wheels work simultaneously, providing smooth, reliable motion along the track. In the rare event that one motor requires repair, the remaining motor will still function, preventing costly downtime.

The independently powered drive wheels are also designed for simple repairs. To replace damaged components, service technicians only need to remove four bolts and two hydraulic fittings. This modular design allows technicians to replace the entire floor drive unit in about an hour -- less than a quarter of the replacement time required by single-actuated drive axle designs.

Product Comparison: BHS Battery Extractors, MTC PCE Power Changers, Multi-Shifter® Vehicles, Sackett Hydra Handlers, and Carney Battery Bull Changers

Here are the results of our detailed point-by-point comparison between BHS Battery Extractors and similar products offered by competing manufacturers. For more information, contact your BHS dealer or account manager.

	BHS Battery Extractor	MTC PCE Power Changer	Multi-Shifter	Sackett Hydra-Handler	Carney Battery Bull
Travel Speed	240 fpm (TS / QS) 190 fpm (Others)	180 fpm	300 fpm	200 fpm	225 fpm
Lift Speed	26 fpm	21 fpm	39 fpm (Quad 30 only)	18 fpm	18 fpm
Extractor Arm	Base-mounted T-arm	Base-mounted T-arm	Dangling rotating grip	Base-mounted T-arm	Dangling T-arm
Extractor Arm Components	Enclosed, dual chromed hardened shafts	Exposed single shaft	Exposed single shaft, overhead bridge	Exposed rack-and-pinion	Exposed single shaft, overhead bridge
Battery Grip	Vacuum or Magnet	Vacuum or Magnet	Magnet	Vacuum or Magnet	Magnet
Roller Beds	Dual, powered	Dual, powered	Non-powered	Dual, powered	Dual, powered
Lift System	Four point cylinder lift with NIF manifold	Electric drive rack-and-pinion	Hydraulic cylinders with tube-in-tube	Hydraulic, lift chain	Hydraulic (BBH) or Electric (BBE)
Drive System	Dual independent drive wheels	Single-actuated drive axle	Single-actuated drive axle	Single-actuated drive axle	Single-actuated drive axle

Figure 2. Brand Comparison Chart.

BHS Battery Extractors vs. MTC PCE Multi-Level Power Changers

Both BHS Battery Extractors and MTC PCE Multi-Level Power Changers utilize a base-mounted T-arm with vacuum extraction that pulls with 1,000 pounds of horizontal force. Optional magnetic grips are available for both models. Both models use powered rollers in dual storage beds, with safety features that prevent operators from discharging batteries unless that the vehicle is positioned properly.

Despite these similarities, the two systems differ significantly in the following ways:

- **Extractor Arm Components:** The vital components in the BHS Battery Extractor's push/pull arm are almost completely protected from dirt and debris, leading to longer-lasting parts and fewer maintenance requirements. The MTC PCE, on the other hand, leaves components exposed, allowing contaminants to interfere with the drive screw, shaft, and cabling.

  The BHS extractor arm travels along a pair of chromed hardened shafts while the MTC PCE uses a less robust single-shaft design.

- **Control Panel Design:** PCE Power Changer operators must learn to navigate a more complex control panel, with three separate joysticks controlling vehicle travel, powered rollers, and extraction arm movements, five or more buttons, and a superfluous mercury vacuum gauge.

  The multi-directional vacuum pivot joystick allows simultaneous movement of the extractor arm and its pivot point, creating overly complex movements that add to the difficulty of lining up the extractor arm with the battery. A single joystick is used to control both roller beds, which could allow for unintentional battery discharge if the operator is unfamiliar with the design.

  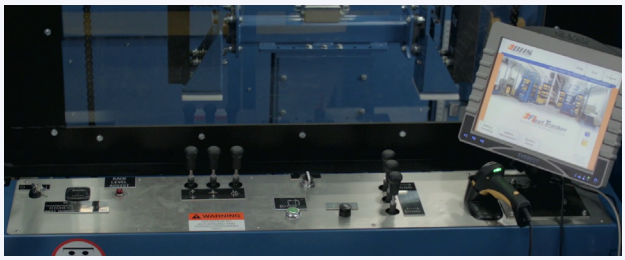

  Figure 3. The BHS BE Control Console is simple and includes six single-function lever valves and a three point safety switch.

  The BHS Battery Extractor control console was designed to be simple, user-friendly, and ergonomic. A series of clearly-labelled dual-directional levers control lift, travel, and extractor arm movement. Operators require less training and experience less fatigue than when working with competing systems -- this allows for a safer and more productive operation overall.

- **Maintenance Requirements:** MTC PCE Multi-Level Power Changers require significant maintenance, with scheduled tasks every week, month, half-year, and year. Daily requirements include checking/refilling hydraulic oil, cleaning rollers, and greasing the pivot arm.

BHS Battery Extractors feature a low-maintenance design that favors simplicity, with fewer exposed components. With only eleven zerk fittings for lubrication and the fewest electrical components in the industry, the BHS Battery Extractor offers better performance with fewer interruptions.

- **Drive Wheel Design:** MTC PCE Power Changers control floor travel with a single motor and a drive axle. This design does not have a backup motive power source, and requires significantly more time to repair. With MTC drive systems, a single mechanical mishap can delay change-outs for an entire forklift fleet.

  The dual independent floor drive used by BHS Battery Extractors allows facilities to complete battery changes even if one of the drive units requires repair.

BHS Battery Extractors vs. Multi-Shifter® Forklift Battery Systems

Multi-Shifter® takes a completely different approach to battery handling, and offers a relatively low price tag at the expense of lifetime operating efficiency. They produce a stripped-down single-level changer called a Uni-Shifter as well as the multi-level Quad-30.

The Quad-30 is Multi-Shifter's largest vehicle, and it is marginally faster than any of the other products examined here. When dealing with a 4,000 pound load, though, safety and ergonomics take precedence, especially since most efficiency issues are due to poor fleet management rather than pure mechanical extraction speed.

While there is no industry-standard speed limit for battery changing vehicles, battery changers coast slightly before stopping -- with the operator and the battery load lifted seven or more feet into the air, a more abrupt stop could be dangerous. Keeping top travel speeds around 200 fpm is better for safety and for motor lifespans.

Multi-Shifters have several other fundamental disadvantages including:

- **Overhead Dangling Grip:** Rather than a T-shaped extractor arm with durable dual travel shafts, Multi-Shifters move batteries with a dangling overhead grip. This arm moves along the X-axis with a traveling overhead bridge, and along the Y-axis with a single, exposed travel shaft. The single-sided arm pivots to grip batteries on opposite sides of the pass-through battery beds.

  This design has more points of articulation that bear the push/pull force of battery changing processes. In contrast, the twin hardened shafts that support the extractor arm on BHS systems offer superior durability with a simpler design.

- **Free-Rolling Battery Beds:** Multi-Shifters use non-powered roller beds to transfer batteries, relying on the downward force of the battery's weight and the single magnet on the extractor arm to keep batteries in place during transfer -- even when the carriage is suspended several tiers high.

  When pushing batteries off of the roller bed into the truck or shelf, Multi-Shifters must navigate the single-sided pull arm around to the appropriate side of the battery. This is a lengthier process than merely activating power rollers.

  In addition to providing more immediate motion while unloading batteries, powered rollers also provide some braking action while the carriage travels. They only roll when the operator engages them, creating more stability and safer battery changes.

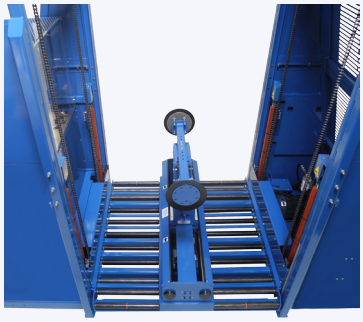

Figure 4. The BHS Battery Extractor Compartments includes five powered rollers, and six heavy-duty idler rollers, two of which are marked with a high-visibility, painted groove for ease of alignment.

- **Single-Actuated Drive System:** Multi-Shifters provide floor travel with only one motor and a drive axle. This system does not provide an alternate motor to protect against downtime due to inevitable repair requirements.

- **Lack of Vacuum Option:** Multi-Shifter® only offers a magnetic arm. Vacuum extractors are the gentlest on forklift battery cases, since they spread the force of the grip over a larger area and do not abrade surfaces like a hard magnet face does. They also do not depend on the thickness of the steel battery case to determine grip force -- vacuum extractors provide a consistent grip on any battery.

BHS Battery Extractors vs. Sackett Systems Hydra-Handlers

Like BHS Battery Extractors, the standard Hydra-Handlers from Sackett Systems use a base-mounted T-arm to push and pull batteries. They both have a hefty 10,000 pound capacity and offer both vacuum and magnetic grips.

There are major differences in extractor arm design, however, and BHS offers advantages in lift mechanics that Hydra-Handlers lack:

- **Extractor Arm Travel System:** Hydra-Handlers control extractor arm movement with a rudimentary rack-and-pinion linear travel device. With

all teeth exposed along the travel path, dirt, debris, and contaminants can easily build up in the system, requiring frequent maintenance and possibly even repair requirements.

The fully-enclosed drive screw that powers BHS extractor arms offers a more reliable alternative. The dual chromed hardened shafts secure the extractor arm with four-point bearing contact, for more durable, longer-lasting service.

- **Lift Stability:** Standard Hydra-Handler systems do not match the lift speeds of BHS Battery Extractors, and the BHS four-point cylinder lift provides superior stabilization. Hydra-Handlers lack the Non-Inner-Flow manifold system that BHS vehicles use to hydraulically lock lift cylinders for stability as weight shifts during battery change-outs.

- **Lift Safety:** BHS four-point cylinder lift systems feature velocity fuse protection which ensures that the battery carriage will never fall, even if hydraulic systems are damaged. This innovative device keeps workers and equipment safe from disaster -- Hydra-Handlers lack this important safety feature.

- **Drive Wheel Dependability:** Like other battery changers discussed above, Sackett Systems uses a single-actuated drive axle to power Hydra-Handler floor travel. The disadvantages of this system include a lack of mechanical fail-safes, difficulty in repair and longer replacement times.

BHS Battery Extractors vs. Carney Battery Bull Changers

Carney Battery Bull changers come in three models, including one all-electric model (the Battery Bull Electric, or BBE) that places greater draws on warehouse electrical systems. The Battery Bull Hydraulic (BBH) and the Battery Bull Narrow (BBN) are essentially the same design, with the BBH using two roller beds and the BBN only equipped with one.

BHS Battery Extractors compare favorably to Battery Bull systems in a few key areas:

- **Structural Durability:** Compared to BHS changers, Battery Bulls offer a lighter structural design. A heavy-duty superstructure and match welding of the inner and outer frames make BHS systems the most stable and durable in the industry. A point-by-point comparison between comparable models from the two brands reveals the difference:

	BHS Double Stack Batery Extractor (BE-42-2-DS)	Carney Battery Bull Hydraulic (BBH)
Dimensions (L x W x H)	166” x 72” x 92”	160” x 73.25” x 134” (includes antenna)
Weight (empty)	6,800 lb	4,710 lb
Load Capacity	10,000 lb	9,000 lb

Figure 5.This chart compares the two largest double-stack systems from BHS and Carney Battery Handling Ltd. Smaller dual-level systems are also available, though Carney sources list the same weight and load capacity for all sizes of hydraulic Battery Bull systems (BBH).

Despite similar length and width, the BHS Battery Extractor weighs over a ton more than the Battery Bull. This is due to the BHS heavy-duty superstructure, which provides the most stable foundation available.

- **Battery Grip Choice:** As noted above, vacuum extractors cause the least wear on battery cases. Battery Bull systems only offer the standard electromagnetic grip on extractor arms. BHS offers a choice between vacuum and magnetic grips.

- **Extractor Arm Placement.** Battery Bulls use an overhead placement for their extractor arms. The design is similar to that of the Multi-Shifter, with an overhead bridge controlling movement along one axis and a single shaft travelling along the other.

  The dual-shaft, four-point bearing contact design, featured in BHS extractor arms, provides more durable and reliable performance.

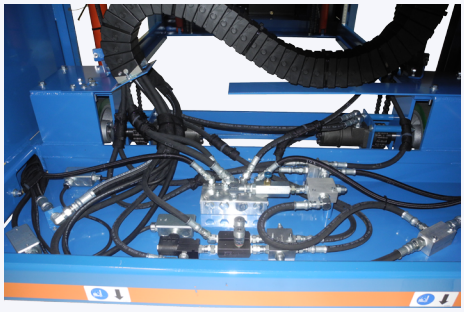

Figure 6. The BHS Battery Extractor Hydraulic System includes a simple hydraulic circuit for ease of operation, maintenance, and repairs.

- **Hydraulic System Routing.** BHS Battery Extractors neatly bundle and protect the bulk of the hydraulic system in an accessible panel beneath the operator carriage. This simple design makes maintenance as easy as possible, while also limiting stress on the hydraulic lines.

  The Battery Bull Hydraulic (BBH) routes hydraulic lines through the tubing of the carriage frame itself, subjecting them to greater wear as every movement of the vehicle rubs vital hosing against the metal edges of the frame. When these lines require repair, they must be completely pulled out of the tubing then re-threaded back through, adding time and difficulty to maintenance tasks.

Conclusion: BHS Battery Extractors Outmatch the Competition

This comparison focuses on five crucial components of battery changing systems: the **extractor arm**, the **battery grip** at the end of the extractor arm, the **battery bed**, the carriage **lift mechanism**, and the floor travel **drive system**.

BHS battery changing equipment also incorporates a range of exclusive features that are not available from other manufacturers:

- Electrical and hydraulic system components include non-proprietary parts whenever possible, keeping maintenance costs low for the life of the equipment.
- All vital components are enclosed, for a sturdier, more durable operation and greater safety.
- BHS battery extractors are subject to some of the most rigorous quality assurance practices in the industry, including two exhaustive 108-point inspections and 6 - 10 hours of actual operation to ensure mechanical optimization.

In each of these systems, BHS has the most dependable engineering with the lightest maintenance requirements. BHS offers the only dual-travel-shaft extractor arm with enclosed components. BHS provides a choice between vacuum or magnetic grips. Powered roller beds with a synchronized, crossbed, eight-point equalization system offer the greatest control and a level inner frame during every battery change. BHS Battery Extractors are equipped with a four-point cylinder lift, including the exclusive Non-Inner-Flow (NIF) hydraulic manifold. This technology helps maintain a level roller bed at all times, adjusting for the shifting weight of batteries as they roll onto and off of the carriage. Only BHS Battery Extractors include the velocity fuse safety feature, which prevents disaster if hydraulic systems sustain damage. With two independently-powered drive wheels, BHS provides the most reliable travel system in the industry. Modular design makes drive unit replacement simple. When comparing BHS to its competitors, the motto stands justified that BHS products are “durable, powerful, and beyond”.

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