ENERGY
SOLUTIONS



Energy Solutions Simplified

In many organizations, the cost of energy is important, and it's not just about how much you use, but also when and how you use it. In this complex, high-stakes game of efficiency, gains or losses can result from a wide variety of factors, so it is critical to understand the details while keeping an eye on the big picture.

Crown's V-Force Energy Solutions can simplify the answers to your energy needs, not only as a single source for a comprehensive selection of batteries, chargers and power accessories but as a knowledgeable partner that understands how forklifts can consume and conserve power while getting the job done. It's big-picture thinking coupled with a focus on the details that solves complicated power challenges.



Knowledge Is Power

A V-Force Energy Solution is more than a selection of products that meet your design specification. Each solution leverages our team's experience with both forklifts and motive power products across a variety of customer applications using a consultative approach to develop a solution that fits your application requirements.

Assess

Our Energy Solutions team conducts a thorough assessment of both your current and future-state operations, including an application survey, power study, data modeling and more.

Recommend

Based on the results of the application assessment and data modeling, we recommend improvements that can include V-Force products and accessories, process modifications and charging strategies.

Implement

Through our team of highly trained technicians, we work with your operation to implement energy processes and procedures designed to attain your business goals.

Manage

Crown's V-Force Energy Solutions team provides ongoing support, analytics and reporting to monitor and sustain progress and help you adapt your energy strategy to meet changing requirements.

Integrated, End-to-End Solutions

No matter which power source or technology proves to be the best choice for your operation, our goal is to provide a highly integrated solution in which forklifts, batteries, chargers and ongoing support work together to help optimize efficiency and uptime. This compatibility of components can deliver substantial operational advantages: reduced maintenance and parts replacement, improved safety during charging and operation, as well as time, money and energy savings.



Consultative Approach

Crown utilizes analytical tools and data to recommend a powerful energy management solution designed to meet your business goals.



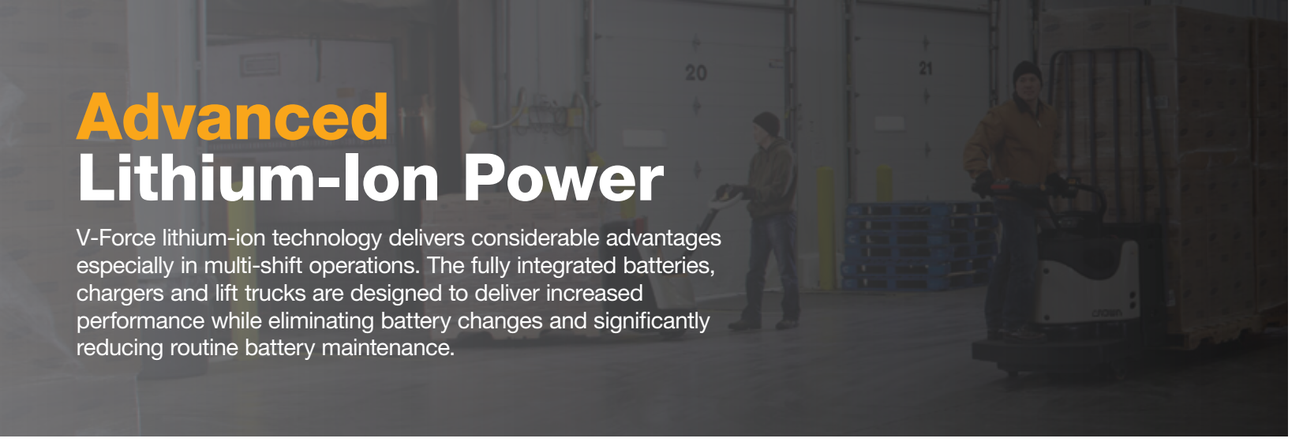
Versatile Technology

Our team will help you determine optimal energy solutions for your fleet and applications—including batteries, chargers and accessories—to meet operational needs and reduce energy costs.



Ongoing Support

Crown's trained technicians provide application support, ongoing maintenance, performance measurement and the sustainable disposal of expired battery units.



Advanced
Lithium-Ion Power

V-Force lithium-ion technology delivers considerable advantages especially in multi-shift operations. The fully integrated batteries, chargers and lift trucks are designed to deliver increased performance while eliminating battery changes and significantly reducing routine battery maintenance.

Low Maintenance, Lower Costs
Eliminates the time consuming tasks associated with lead-acid batteries including watering or special battery rooms.

Flexible Battery Tier Solutions
Our consultative approach helps determine your application's performance requirements, with multiple battery tiers to consider duty cycle, warranty and cost.

No Battery Swapping
One lithium-ion battery can handle one shift or multiple shifts with no need for extra batteries or the downtime required to change them.

Increased Safety
Zero emissions during charging means no gassing and no exposure to harmful acids and vapors.

Longer Life
Lithium-ion batteries outperform lead-acid batteries, saving replacement and service costs over time.

Greater Throughput
A V-Force lithium-ion battery provides up to three times more daily throughput of its rated amp hour capacity a comparable lead-acid battery.

Improved Efficiency
Charge using up to 16% less energy, work longer and charge less frequently with higher sustained voltage throughout each shift.

Consistent Performance in the Cold
Lithium-ion battery technology maintains more of its voltage and capacity in low temperature environments versus other technologies.

True Opportunity Charging
Increase uptime with periodic opportunity charging, with higher charger return rates that enable one lithium-ion battery to achieve more run time in a 24-hour period.

3X AMP HOUR THROUGHPUT | **16%** MORE ENERGY EFFICIENT

Opportunity Charge without Reducing Battery Life
Lithium-ion batteries are well-suited to opportunity charging throughout an entire shift. During periodic discharge, they maintain consistent power output and can be opportunity charged during operator breaks or shift changes, even if only for a few minutes at a time, without causing the damage that would occur in a lead-acid battery. By opportunity charging during natural breaks during the operator's shift, the same battery will last longer before being fully discharged.

	Lithium-Ion Charging
Usable Battery Capacity - Daily	Contingent on available charge time
Start Rate+	Up to 390 amps per hour
Balancing	Auto-balancing via CAN communication
Weekly Charging Requirement	100% once per week
Stand and Cable Management	Recommended to minimize abuse installed at point of use
Average Life Expectancy*	**6+** years
Warranty - Number of Cycles	**3,600**

*Dependent on customer application consumption rates (consult Crown's V-Force team for specifics)

Discover the V-Force
Lithium-Ion Difference

V-Force lithium-ion batteries feature a level of integration and component compatibility that sets it apart from other power solutions. The intelligent, connected nature of the battery, charger and lift truck creates increased efficiency and provides predictable, reliable performance and is available in multiple tiers.



Intelligent
Our battery management system extends battery life by preventing operation outside warrantied conditions. It measures individual cell temperatures and voltage while protecting against deep discharge, short circuit and overcharging. An emergency warning system enables the operator to bring the lift truck and load to a controlled stop before the battery ceases operation.

Integrated
V-Force lithium-ion batteries are fully integrated with the full line of Crown lift trucks for flexibility, scalability and convenience. Each lift truck's on-board display shows discharge levels and event codes to promote safety and protect battery life. A conveniently accessible lateral charge port enables convenient opportunity charging without opening the lift truck or removing the battery.

3 Battery Tiers
Crown offers three battery tiers that enable customers to match their power solution to their duty cycle, lifespan and budgetary requirements.



Proven Lead-Acid Power

V-Force lead-acid batteries continue to provide the material handling industry with cost-effective, dependable power and reliable performance. With both flat plate and tubular designs available, V-Force lead-acid batteries can power a wide range of applications and duty cycles, including multi-shift operations.



- Proven technology with lower initial cost
- Models to accommodate light to heavy-duty cycles
- Supports conventional, opportunity and fast charging methods
- Powers one to three-shift operations depending on power consumption and charging processes



Tubular Advanced design that increases active material surface area, extending runtime for increased productivity. Bolt-on intercell connectors simplify maintenance by allowing the technician to isolate, remove and replace cells while minimizing the risk of spark or ignition. Options for high-capacity cells or standard cells with reduced watering requirements.



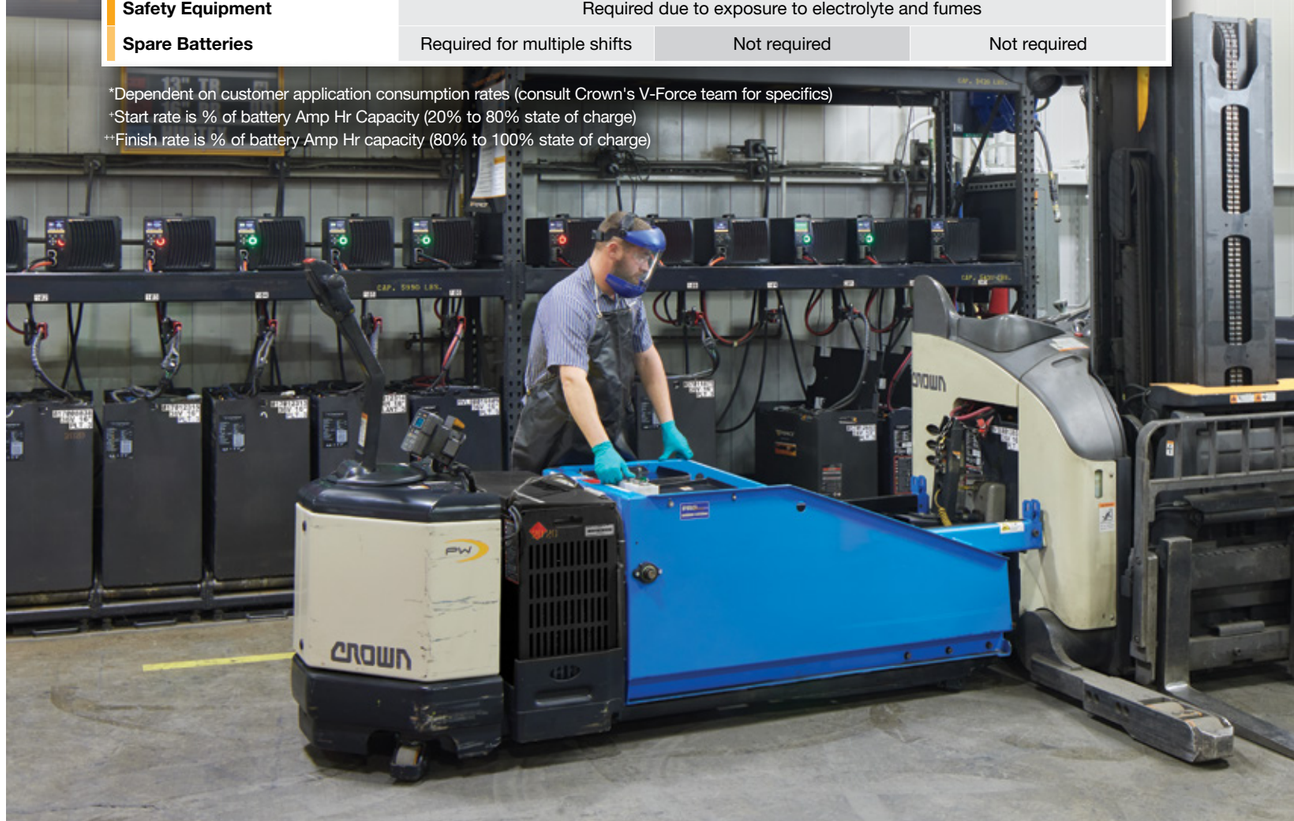
Flat Plate Traditional, time-tested design that employs heavy grid construction to limit corrosion and a five-layer wrap to minimize positive active material shedding. Cost-effective, yet still includes more active material for greater performance and capacity. Flat plate designs excel in high-charge return applications.

Charging Options

Lead-acid batteries can accommodate three different types of charging methods. Analysis of your application may indicate that a mix of charging methods is appropriate, based on the tasks performed by each of your lift trucks. Crown's consultative approach can help you choose the right combination of charging methods to extend battery life and performance in your application.

	Lead-Acid Battery Charging		
	Conventional	**Opportunity**	**Fast Opportunity**
Usable Battery Capacity - Daily	**80%**	Not to exceed 125%	Not to exceed 160%
Start Rate[+]	**<16%**	**25%**	**40%**
Finish Rate[++]	**5%**	**5%** Limited to once daily	**5%** Limited to once daily
Daily Charging Requirement	**8** hrs charging **8** hrs cooling **8** hrs discharging	**7** hrs charging **8** hrs cooling **9** hrs discharging	**6** hrs charging **8** hrs cooling **10** hrs discharging
Equalization	Required Weekly		
Stand and Cable Management	Recommended to minimize abuse		
Battery Watering	Weekly	Weekly	Weekly
Average Life Expectancy*	5+ years	3-5 years	3-5 years
Warranty - Number of Cycles	1,500		
Safety Equipment	Required due to exposure to electrolyte and fumes		
Spare Batteries	Required for multiple shifts	Not required	Not required

*Dependent on customer application consumption rates (consult Crown's V-Force team for specifics)
[+]Start rate is % of battery Amp Hr Capacity (20% to 80% state of charge)
[++]Finish rate is % of battery Amp Hr capacity (80% to 100% state of charge)



Extend Your Lead-Acid Battery Life

Getting the most from your energy solution isn't just about choosing and using the right batteries. It also requires understanding how they operate, providing proper care and maintenance and protecting the cables and connectors that are part of your system. Crown can pre-configure batteries with accessories that help you monitor and water them to maintain battery health.

Maintain Your Investment

Crown offers a full line of V-Force battery watering accessories to help streamline regular maintenance. Choose from watering deionizers, water carts, watering guns and monitoring devices to help produce, transport and deliver purified, deionized water when and where it is needed.

Make Lead-Acid Batteries Smart

The V-Force Battery Monitoring Identification Device (BMID) brings a new level of intelligence to lead-acid batteries and shares valuable data to help you use them more efficiently. Improve battery health by monitoring electrolyte levels and performing automatic temperature compensation during charging. Equalization monitoring and automatic initiation of weekly equalization cycles help extend battery life.



The BMID enables lifetime data tracking for charging, alarm and equalization history.

Preserve Your Connections

Battery cables and connectors, when not properly protected, are small items that can turn into big points of failure when damaged due to improper protection. Don’t risk the integrity of your forklift power system by leaving them to chance. For cable management products and many other battery and charger accessories, download the latest One Source Lift Truck Parts catalog at crown.com.

Versatile Charging Options

V-Force modular chargers are revolutionizing forklift power systems with a smart, connected design that brings added efficiency and transparency to the charging process. Up to 97% energy efficient, they can communicate with batteries and one another to optimize charge times and power usage with both lead-acid and lithium-ion batteries.

High Efficiency = Energy Savings

Today's V-Force HF chargers are up to 97% efficient. Older technology chargers are between 55 and 75% efficient. Higher efficiencies reduce power consumption and lower energy costs.

Optimize Battery Life

Industrial batteries are a major investment. V-HFM³ chargers reduce the amount of heat generated during the charge cycle by closely controlling the output current. Charge termination by dV/dt (change in voltage over time) prevents the battery from over or under charging which optimizes the life of a battery.

Reporting Capabilities

The V-HFM³ chargers record up to 10,000 events. Users can easily identify issues before the battery is damaged and the performance of your operation is affected.

Space Savings in the Warehouse

The V-HFM³ chargers have a compact design and can be easily mounted at the point of use in a customer's facility.



Choose the Capacity and Features You Need



FS3 FS4 FS6 V-HFE

V-HFM³ Series

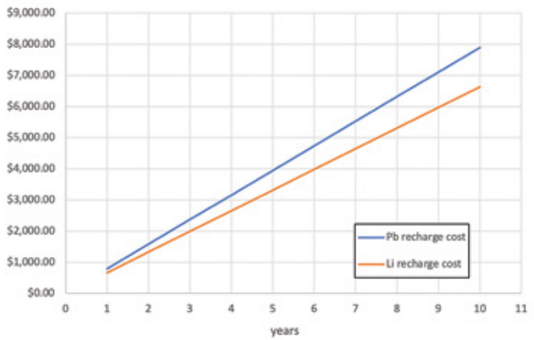
- Multi-voltage capability enables one charger to be configured to charge virtually any lead-acid or lithium-ion lift truck battery in your operation, from 24-96 volts.
- Automatic voltage sensing identifies a battery upon connection and applies the correct charging profile without the use of a monitoring device.
- A built-in web browser-accessible interface and support for Wi-Fi, ethernet, and USB connections enables access to diagnostics.

V-HFE Series

- Cost-effective, high frequency charger for basic conventional lead-acid charging applications.
- Offers the same energy efficiency as the V-HFM³ Series but without connectivity features and remote management.
- Easily configured battery capacity, cable length, equalization cycles, start delay, cool down period and charge profile from the interactive front panel display.

High-Efficiency, High-Frequency Chargers Provide Cost Savings

Charging Cost Comparison



Notes: annual Kwh throughput estimate based on 36v 1,000Ah, 300 cycles/yr to 80% DoD, recharge cost based on 95% charger eff and $.07/Kwh

Lithium-ion battery charging is up to 16% more efficient than lead-acid charging.

Comprehensive Service and Support

Crown takes an integrated approach to energy solutions that goes beyond the components and hardware. We provide forklifts, batteries and chargers, but they're coupled with comprehensive service and consultation before, during and after implementation to help you meet your energy goals.



One Source for Reliable Service

Crown service technicians are trained to service forklifts, batteries and chargers. Their understanding of what forklifts need, how they operate and the nuances of forklift and battery integration enables them to provide a comprehensive service solution. Crown's expertise in monitoring, diagnostics, repair and maintenance helps increase uptime.



Sustainability Focused

Crown's people, products, processes and facilities all play a part in our continuous commitment to environmentally smart business practices. We support recycling lead-acid and lithium-ion batteries.

ecologic

Clean Environment. Smart Business.

Printed on elemental chlorine free and sustainably forested paper.

crown.com

You can count on Crown to sell lift trucks designed for safe operation, but that's only part of the safety equation. Crown encourages safe operating practices through ongoing operator training, safety-focused supervision, maintenance and a safe working environment. Go to crown.com and view our safety section to learn more.

Because Crown is continually improving its products, specifications are subject to change without notice.

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SF20554 Rev. 10-26
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