LI-ION TECHNOLOGY

HAWKER FLEX Li3

OWNER'S MANUAL

c UL us LISTED

UL Listing applies in the United States and to inner tray of certain models only.

HAWKER®

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CONTENTS

INTRODUCTION

The information contained in this document is critical for safe handling and proper use of the HAWKER® FLEX Li³ lithium-ion battery for powering electrical industrial trucks. It contains a global system specification as well as related safety measures, codes of behavior, a guideline for commissioning, and recommended maintenance. This document must be retained and available for users working with and responsible for the battery. All users are responsible for ensuring that all applications of the system are appropriate and safe, based on conditions anticipated or encountered during operation.

This owner's manual contains important safety instructions. Read and understand all of these instructions before installing, handling or operating the battery. Failure to follow these instructions may result in serious injury, death, destruction of property, damage to the battery and/or void the warranty.

This owner's manual is not intended as a substitute for any training on handling and operating the industrial truck or HAWKER® FLEX Li³ battery that may be required by local laws, entities and/or industry standards. Proper instruction and training of all users must be ensured prior to any handling of the battery system.

Refer to the Terms and Abbreviations at the end of this document.

For service, contact your sales representative or call:

1-877-7HAWKER (USA and Canada)

or visit www.hawkerpowersource.com

Your Safety and the Safety of Others is Very Important

⚠ WARNING You may be seriously injured if you don't follow these and other related instructions.

Product Application

HAWKER® FLEX Li³ batteries are designed for industrial truck traction applications. Any other use is not permitted. Only HAWKER®-approved chargers are to be used to charge HAWKER® FLEX Li³ batteries.

The truck harness used between HAWKER® FLEX Li³ batteries and the industrial truck is dictated by the truck OEM. The truck harness shall comply with requirements in relevant standards for current carrying capability and truck interface requirements (UL 583 for UL certification or EN 1175 and EN 60204-1 for CE and UKCA certification). Truck harness compliance with relevant standards shall be confirmed by the truck OEM and/or integrator.

⚠ WARNING Installing the battery in a non-compliant truck is a fire risk due to the potential for improperly sized cable harnesses and will void the warranty.

Battery Architecture

The parts of the battery are shown in **Figure 1**.

View of inner tray of the battery in **Figure 2**.

Figure 1: Outer Tray Features

Figure 2: Inner Tray Features

Figure 3: Details of the Electrical Interface

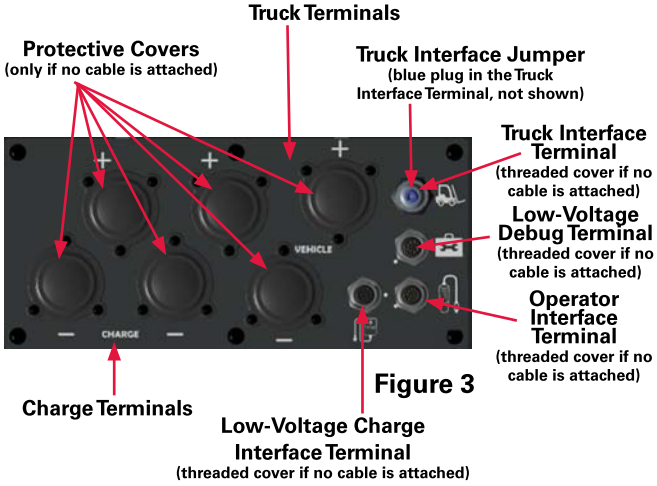


Figure 3

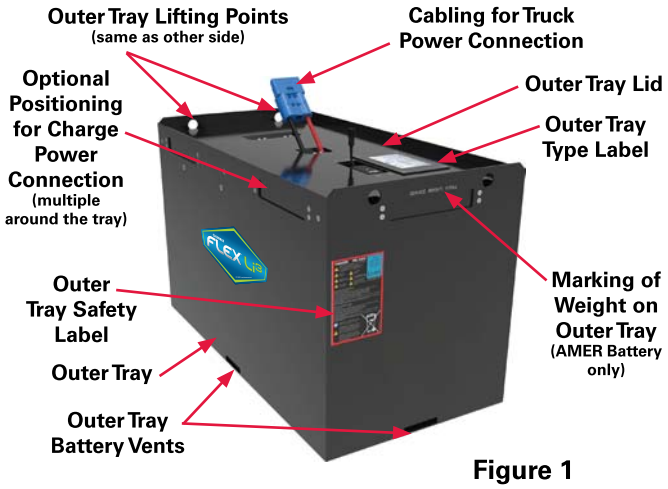


Figure 1

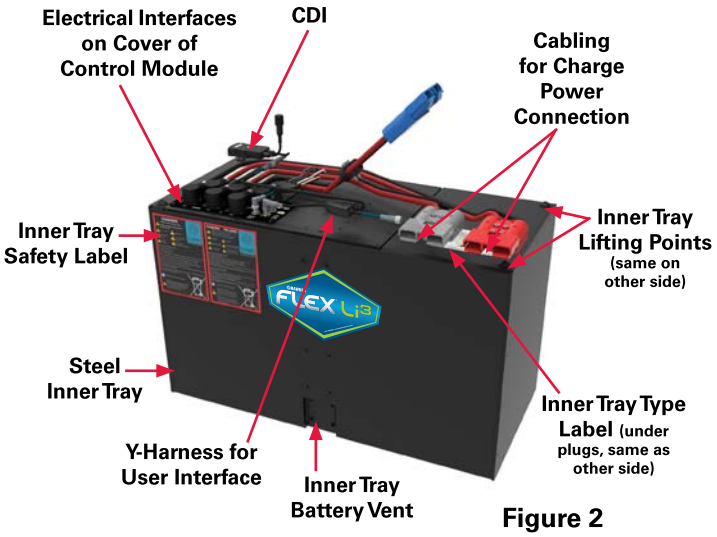


Figure 2

Battery Architecture (cont.)

The battery has a modular design. The power modules allow products to be scaled to an application by adding additional power modules to provide more power and energy capability for a given assembly.

The power modules contain lithium-ion cells, which are assembled into various series/parallel configurations, depending on the application voltage requirements. The power module contains embedded cell voltage and temperature measurements along with the capability to balance the cells during operation.

The battery is protected by a functional safety-qualified Battery Management System (BMS) which is packaged into a control module. This control module contains safety components and logic to control main contactors, preventing the operation of the battery in unsafe and abusive conditions.

The battery, excluding cable harness, is designed to be rated to IP54.

Safety Features:
- A functional safety-qualified electronic monitoring and control system to ensure safe electrical operation (voltage, current, and temperature limits)
- A safe shutoff strategy to respond if limits have been violated (voltage, current, and temperature)
- A contactor and fusing strategy to minimize the impact of accidents or misusing the battery like short circuits or pulling the charge plug under load
- Ungrounded separated charging circuit
- Dedicated handling/lifting points
- Dedicated venting solution to mitigate the impacts of the resulting outgassing
- A steel inner tray to provide mechanical protection for the battery

Low-Voltage Interface Terminals: There are multiple low-voltage interfaces on the outside of the control module which must be connected during commissioning, depending on the end user requirements.

Low-Voltage Charge Interface Terminal: This is a required connection for all batteries. This interface connects the charge adapter to the control module, allowing for the required CAN communication between the battery and the charger.

Truck Interface Terminal: This optional interface provides the possibility to provide specific integration functions if the battery is to be fully integrated into the truck. The truck interface is not a requirement from HAWKER® but may be required by the truck manufacturer.

- **Interlock:** Allows the truck to send a signal to tell the battery to shut down.
- **Early Warning Signal (EWS):** Battery provides a discreet signal to the truck 10 seconds before battery shutdown.
- **External Key Signal:** If implemented, truck key actuation allows the turning on of the battery.
- **Jumper:** If installed, do not remove the cap on this connection as this may result in the battery no longer operating.
- If the use of this signal as the interface with the truck is necessary and it was not previously discussed with HAWKER®, please contact your HAWKER® Service Representative for support, as prequalification and a specific cable are required.

Operator Interface Terminal: Connection point for Y-harness that connects to CAN Data Interface (CDI) and the optional user interfaces.

The low-voltage interfaces are protected by a 0.5 A fuse.

Low-Voltage Debug Interface Terminal: Debug interface used for HAWKER® service purposes.

NOTE: For any unused connector, the threaded cover must be fastened in place to prevent the ingress of foreign material.

Operator Interfaces

An operator interface is required to be installed into the truck cabin for ease of use and to ensure the operator is alerted to any visual or audible alerts such as low State of Charge (SoC). This in-cabin operator interface can be either the Battery Discharge Indicator or the HAWKER® Advanced Battery Interface (ABI) smart battery dashboard.

This requirement of an in-truck interface can only be eliminated if full industrial truck OEM integration options are utilized, allowing the truck's existing operator interfaces to be utilized. Truck OEM integrations require prequalification and approval from both HAWKER® and the truck manufacturer.

All operator interfaces are equipped with a push button that can activate and deactivate the battery.

During operation as the SoC decreases, the operator interfaces will begin to emit an audible beeping alarm and provide visual warnings when the battery reaches the Warning Level SoC. After the battery drops below the Alert Level, the alarm will increase in speed. Continuing to run the battery without charging will ultimately result in the battery deactivating due to low SoC.

All operator interfaces connect to the battery via the Y-harness cable for the operator interfaces.

Figure 4: CAN Data Interface (CDI)

The main purpose of the CDI is to control the flow of information from the BMS to external data platforms, including allowing a CANbus connection between the battery and industrial truck if the customer decides on this option. Using CANbus connectivity allows data and warnings to be displayed via the industrial truck dashboard instead of other operator interface devices. Please consult HAWKER® on this option, as it requires engineering consultation and prequalification with the industrial truck OEMs.

All batteries will be supplied with the CDI, which is attached directly to the battery or via the Y-harness. In most cases, the CDI will be hidden once the battery is installed into an industrial truck. The CDI does feature an activation/deactivation button and LED display to allow interaction with the battery if accessible or when a battery is outside of an industrial truck.

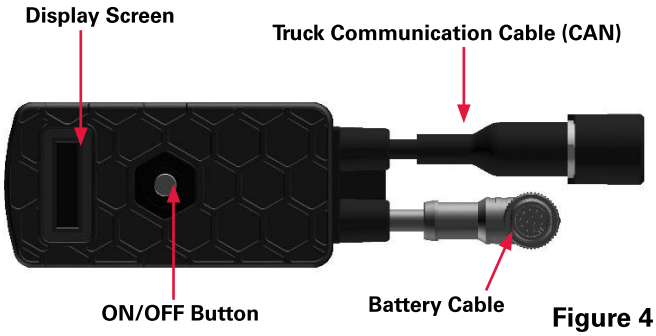


Figure 4

The buzzer and LED behavior for the devices is as follows:

- Warning SoC — ON 1 sec./OFF 1 sec.
- Alert SoC — ON 0.5 sec./OFF 0.5 sec.
- BMS error — ON 0.1 sec./OFF 0.1 sec.

For full truck integration, the CAN cable must be connected from the CDI to the truck.

NOTE: In the case of full industrial truck OEM integration, the battery will cease to function if the CDI or wires to the CDI are broken. Contact your HAWKER® Service Representative for repair or replacement.

The CDI data can be read wirelessly through the HAWKER® MOD-ifi™ smart device app available on both iOS® and Android™ platforms. Contact your HAWKER® Service Representative for login details.

Battery Discharge Indicator (BDI): This device can be installed outside of the battery compartment to allow operators to view the SoC and the presence of a battery error as well as to provide easy access to an activation/deactivation button. The series of lights will indicate SoC, whilst audible alarms will notify the operator that the battery requires recharging or that there are battery errors. Continued operation after the BDI indicated low SoC will ultimately result in the deactivation of the battery due to low SoC. The BDI must be permanently and securely fixed in a position for the operator to view the BDI for information and access the button.

Operator Interfaces (cont.)

Figure 5: Battery Discharge Indicator (BDI)
Figure 6: State of Charge Indicator Logic on BDI

HAWKER® ABI Dashboard:
Figure 7: HAWKER® ABI Dashboard

Advanced Battery Interface: The HAWKER® ABI smart battery dashboard is an operator interface that provides operators with more detailed battery information. The HAWKER® ABI device includes the activation/deactivation button, audible alarms, and visual alarms. The HAWKER® ABI device must be installed per the installation instructions provided with the HAWKER® ABI smart battery dashboard. The HAWKER® ABI device must be permanently and securely fixed in a position for the operator to view the information and access the button.

Refer to HAWKER® ABI smart battery device manual for further information.

CANbus Connectivity: The HAWKER® FLEX Li³ battery can be integrated into an OEM industrial truck CANbus system which allows full integration of the battery.

Please contact your local HAWKER® Service Representative for this option.

This option requires engineering consultation between HAWKER® and the industrial truck OEM.

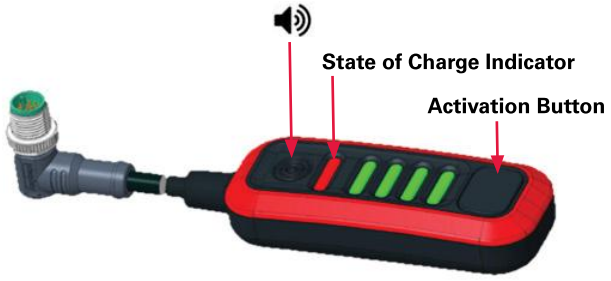


Figure 5

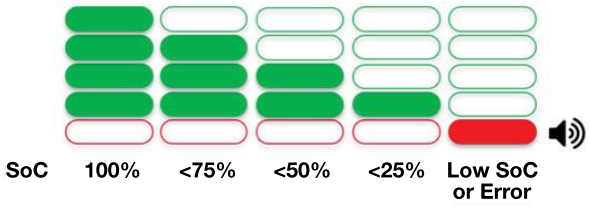


Figure 6

Figure 7

Safety

Important Safety Instructions

- Read all safety and operation instructions before operating this battery.
- Anybody involved in unpacking, handling, operating, or maintenance of this battery must receive appropriate training and use appropriately rated tools and personal protective equipment.
- Follow all regulatory requirements for handling electrical systems. The voltage of an electrical system may impact what regulations are applicable. To determine the maximum voltage for this battery, see Appendix A: Ratings Table.
- Do not over-discharge or overcharge lithium-ion batteries as this poses a substantial risk of damaging the battery.
- Only store and operate the battery within the limitations given in the sections on operational data and limits, and environmental limits.
- Keep the battery away from heat sources.
- Keep the battery away from ignition sources.
- Do not operate the battery in hazardous environments.
- Store only in monitored areas with suitable fire control and protection per local requirements, including local fire regulations.
- Operate only in monitored areas with suitable fire control and protection per local requirements, including local fire regulations.
- Do not customize the battery hardware or software as supplied by HAWKER®.
- Only operate with HAWKER®-approved interface devices.
- Service of the battery must only be performed by HAWKER®-approved technicians.
- Dismantling the battery is not authorized except by qualified HAWKER® Service Representatives due to the numerous hazards involved with dismantling a lithium-ion battery.
- In the case of any error that cannot be reset, do not attempt to continue the operation of the battery until support and direction is provided by HAWKER®.
- Do not leave the truck idle in temperatures below the battery operating temperature as this may result in the truck becoming non-operational. If the battery's internal temperature is below the operating range it will not provide power to operate the truck.
- Do not attempt to operate this battery in temperatures above the operating range.
- Do not expose the battery to extended periods of direct sunlight that allow the temperature of the battery to rise above the storage or operating temperatures of the battery.
- Only handle and store the battery in a dry environment.
- Do not operate the battery outdoors without suitable weatherproof protection.
- Do not immerse the battery in water.
- Do not install the battery on the underbody of an electrical industrial truck.
- Do not operate battery in condensing environments.
- Do not clean the battery with pressurized water.

Interoperation with Truck and Battery Charger

- The instructions in this owner's manual do not replace or supersede the instructions for the truck and battery charger.
- The operation limits given in this owner's manual do not replace or supersede the permissible operation parameters of the industrial truck or battery charger.
- Installation of this battery impacts both the electrical and mechanical safety of the truck. Consult with the industrial truck OEM to ensure this battery is compatible with the truck and complies with the OEM requirements.
- Only charge this battery with HAWKER®-approved chargers for HAWKER® FLEX Li³ batteries.
- The battery must be installed in a truck with appropriately sized cables.

Risks Posed During Normal Operation

- This battery is designed to be stable and tolerant to the applications within the scope laid out in the operating conditions; however, battery systems are inherently hazardous.
- Do not short the battery terminals. A shorting event with a high current may occur because of the low internal resistance of the lithium-ion battery. A resulting electric arc fault may emit an intense hot flash of infrared, visible, and ultraviolet light. Molten and vaporized metal may be ejected. Toxic fumes may be released. Components may become extremely hot.

Safety (cont.)

- The weight and size of the battery make the battery cumbersome to handle.
- Always properly restrain the battery. Failure to restrain the battery may result in the battery shifting or dropping. Additionally, this may result in the battery crushing, pinching, or impacting personnel or nearby equipment.

Damaged Batteries

- Exposure of the battery to conditions outside of its operational and environmental limits poses a substantial risk of damage to the battery. Do not assume that damage to the battery will be apparent.
- If the battery experiences conditions outside of the allowable limits as stated in this document, cease and do not resume operation, and contact your HAWKER® Service Representative.
- If the mechanical integrity of the battery is compromised (e.g., penetration of the case, rupture of case, etc.) cease and do not resume operation of the battery and contact your HAWKER® Service Representative.
- Stop the operation of the battery if there is a crush, pinch, cut or other damage to the power cables or power connectors.
- Damaged lithium-ion batteries may spontaneously catch fire. If this occurs the battery may release jets of hot, flammable, corrosive, and toxic liquids/gases, smoke containing components such as hydrofluoric acid and carbon monoxide.
- In case of battery fire, evacuate all personnel from the area and follow the guidance in the Fire Extinguishing section of this manual.
- If any material from a damaged battery, such as liquid electrolyte, comes into contact with a person's skin or eyes, rinse the affected areas with clean water for at least 15 minutes. Then immediately obtain medical attention.
- If any material from a damaged battery, such as liquid electrolyte, comes into contact with the mouth or is swallowed, rinse out the mouth and the area around the mouth. Then immediately obtain medical attention.
- If gases or vapors produced by a damaged battery are inhaled, move the victim to fresh air. Immediately obtain medical attention.
- Contact with heated gases or components of a damaged battery may cause serious thermal burns. Treat any thermal burns, then immediately obtain medical attention.

Additional information can be found in the Safety Data Sheet for the Lithium-ion Battery (Module) SDS:829515.

Fire Event Guidance

In the unlikely event of a thermal runaway, which may result in a visible release of gas and/or intensive smoke buildup from the battery, **evacuate the location immediately and contact Emergency Response**. If there is an irritation of the respiratory tract, seek immediate medical attention.

Firefighting operations must be performed based on guidance provided in the Lithium-ion Battery (Module) SDS:829515 by trained firefighters with full **personal protective equipment** and self-contained breathing apparatus. Ensure that emergency responders are informed that the battery has lithium-ion chemistry. Any indication of a thermal runaway (gas, heat, vapors, or smoke) requires fire suppression methods to be applied. The absence of flame is not sufficient to consider the thermal runaway event stopped or extinguished.

Large amounts of spray water can be used effectively to cool the battery and contain a lithium-ion battery thermal runaway.

In the case of the battery outgassing or after the suppression of the fire, store the battery in a safe place outside for a minimum of 24 hours. It is recommended to monitor the temperature frequently to detect any potential new heat generation. In the instance that a thermal runaway reoccurs, follow the same firefighting methods as described above.

LIMITS AND HANDLING

Operational Data and Limits

- Nominal capacity (C1): see Appendix A: Ratings Table.
- Nominal voltage: see Appendix A: Ratings Table.
- Discharge current (continuous): 1xC1, up to a max of 320 A (limited by traction cable harness).
- Max charge current (continuous): 1xC1, up to a max of 640 A (limited by charging cable harness[es]).
- The permissible truck operation battery temperature range is 14°F (-10°C) to 131°F (+55°C).
- The permissible charge operation battery temperature range is 32°F (0°C) to 122°F (+50°C).
- The BMS safely manages current limits based on temperature.

Environmental Operation Limits

- The permissible battery storage temperature range is -40°F (-40°C) to 140°F (+60°C).
- The permissible truck operation battery temperature range is 14°F (-10°C) to 131°F (+55°C).
- The permissible charge operation battery temperature range is 32°F (0°C) to 122°F (+50°C).
- The permissible relative humidity range is 0-95% non-condensing.
- HAWKER® Engineering must verify and approve in writing operation of this battery in cold storage applications.

Handling

General Handling Considerations

- Unpacking and handling the battery is only allowed by trained personnel that are familiar with the potential risks of lithium-ion batteries and hazardous voltages (voltages greater than 60 volts DC) as applicable for industrial trucks and for lifting heavy loads.
- Avoid sudden accelerations, decelerations, drops, and other mechanical abuse conditions while handling the battery.
- Handling must only be performed after the battery is disconnected from all electrical loads and charge sources and verified in an OFF state. This can be done using one of the operator interfaces by verifying that the screen and lights are all OFF when connected to the battery. Voltage across the traction connector may also be checked to ensure contactors are open.
- Prior to lifting, secure all connectors and cables so that they will not be crushed, pinched, or otherwise damaged during the lift. User interfaces may be removed prior to handling.
- Appropriate PPE must be worn during all lifts.
- Appropriate lifting methods and tools that can safely lift and control the load must be checked prior to all lifts. Tools must be properly rated for weight.
- If the battery has an outer tray, attach lifting tools to the outer tray lifting points.
- The battery must only be lifted vertically. Do not allow the battery to swing during lifting.
- The operational and safety instructions of the lifting gear manual must be respected.
- If the battery is being handled while installed on a truck, for instance during the battery installation or removal operation, the truck must be secured to prevent movement.

Handling (cont.)

Preparing Battery without Outer Tray for Handling

- Remove the sealing bolts from the threaded mounting holes on the inner tray.
- Install the HAWKER®-supplied lifting attachments for the battery.
- After handling the battery, the lifting interface on the four-point connection on the battery must be removed and the sealing bolts must be fitted again to seal the thread holes. The acceptable torque is based on the bolt size: M8 bolts should be torqued to 34 Nm ± 2 Nm; M12 bolts should be torqued to 66 Nm ± 4 Nm.

NOTE: For transportation and storage safety reasons, all HAWKER® FLEX Li³ batteries are shipped at a partial SoC. Before the first operation (refer to page 12: Operation) or further storing the battery (refer to page 16: Storage) it is required to check the SoC (refer to page 6: Operator Interfaces) and recharge the battery if needed (refer to page 13: Battery Charging).

Installation into Industrial Truck

Mechanical Installation

- This battery is designed to be a drop-in replacement of a lead-acid battery intended to power an electric industrial truck. Modifications of truck firmware, truck settings, or truck hardware may be necessary to accommodate the lithium-ion battery. Consult with industrial truck OEM for required modifications. Depending on the intended application, connectors, ballast, tray size, etc., must be customized to ensure the drop-in compatibility.
- Upon receipt of the battery, it must be checked for any obvious signs of damage to both battery and all cables, plugs, and accessories.
- Before installation, check that the battery is supplied with the appropriate cable harness to connect the battery to the industrial truck.
- Ensure that the battery weight and center of gravity requirements per the truck manufacturer are followed. Weight and overall dimensions are listed on the type label located on the battery pack.
- The battery must be handled in a way to mitigate the risk of drop events and crashes. The correct tools, lifting points, and method should be used.
- After placement of the battery into the truck's battery compartment, the technician must ensure that the battery is mechanically fixed in the truck against the movement as specified by the industrial truck manufacturer. After the battery is fixed in the truck's battery compartment, all cabling must be checked once again in order to ensure that no cables, wires, or plugs have been crushed, pinched, or cut.

Electrical Installation

- The model number for this battery begins with a 24, 36, 48, or 80 for batteries intended to replace 24 V, 36 V, 48 V, or 80 V nominal lead-acid batteries respectively.
- The battery must be connected with the appropriate cables and connector to the industrial truck per the truck manufacturer's recommendation.
- Only use HAWKER®-approved fasteners, connectors, cabling, and plugs with this battery.
- The cable dimensioning and DC connecting plug will vary depending on the truck and end-user requirements. The truck harness shall comply with relevant requirements for current carrying capability and truck interface requirements. Compliance shall be confirmed by the truck OEM.

NOTE: Defective cables and connectors can result in functional issues and/or severe safety hazards such as short circuits and/or fire. Cables and connectors must be regularly inspected for any damage or issues. Cables and connectors should only be repaired or replaced by an authorized HAWKER® Service Representative using the correct factory replacement parts. No substitution is allowed.

Operation

Anybody using this battery must be trained on the aspects of the battery they are responsible for as required by local laws and regulations.

The battery must be handled, operated, stored, maintained, and serviced in accordance with the instructions in this owner's manual. Failure to follow the instructions in this owner's manual can result in serious damage to the battery and may result in serious injury. Failure to follow the instructions in this owner's manual or using parts that are non-original will void the battery warranty.

Opportunity charging is highly recommended to maximize the daily run time capability of the battery. It will also optimize the service life of the battery by decreasing the discharge window of the battery.

The capability of the battery to power the truck decreases at a low State of Charge (SoC). If the truck is operated at a low SoC, this may result in the battery shutting down with or without a 10-second warning. If this occurs, slowly drive the truck to a matching charger after reactivating the battery.

At very low SoC there is a risk of the battery locking out to prevent permanently damaging the cells. If the battery deactivates with a message displayed on the CDI that indicates "Battery Lockout," the pack is locked out and will not turn on again without the visit of a service technician. Contact your HAWKER® Service Representative to inspect the battery to return it to operation.

In contrast to lead-acid batteries, it is beneficial to operate this battery at a partial state of charge.

The battery temperature influences the capacity of the battery. For example, the run time may be reduced at lower temperatures.

Battery temperatures at the extreme ends of the temperature limits as stated in this owner's manual will influence performance, possibly resulting in an unexpected shutdown.

Respect all visual and audible warnings from the user interface devices.

This battery is designed to be charged indoors in the truck.

Activation/Deactivation of Battery

The battery will deactivate automatically when a no-load condition is detected for a default setting of 8 continuous hours to ensure that an unused battery is not deeply discharged.

Activation:
Activate the battery for truck operation using the push button on any user interface. Provided the pack is not connected to a charger and there are no battery errors, the battery will automatically switch to the traction state, applying power to the truck. In all cases, a short press of about half a second is required.
The battery is activated when it is plugged into the charger. This allows battery activation and charging even without previous activation of the battery by other measures above.

Deactivation:
The battery will deactivate after a default of 8 hours when there is less than a default of 3 A current draw. If different values for these are desired, contact your HAWKER® Service Representative to make the changes.
To manually deactivate the battery, press the push button on any user interface for 3 to 5 seconds. Holding for longer may result in turning the pack OFF and then back ON. The industrial truck should be shut down prior to deactivating the battery.

NOTE: When deactivating the battery there is a ~20 second shutdown sequence in which an audible alarm will be heard. Pushing the button again during this time will stop the shutdown procedure and return the pack to a fully ON state.

Activation/Deactivation of Battery (cont.)

If the battery is activated continuously for more than three days, the battery must be connected to a charger (see "Battery Charging" below) or deactivated and afterward activated manually with the above procedure to allow a self-test of safety functions.

⚠ WARNING If the battery is locked out due to over-discharge while using (Refer to page 12: Operation) or missed charges during storage (Refer to page 16: Storage) pressing the push button will not power up the traction power, but the BMS and some internal diagnostics. This will discharge the battery even further and may damage the battery irreversibly. Always recharge the battery as soon as possible after reaching low SoC.

Battery Charging

Never charge the battery via the traction connector. For charging, the charging plug(s) must be connected to the HAWKER®-approved charger. Unlike in lead-acid batteries, while the battery is installed in the truck, the traction connector of the battery should remain connected to the truck. Upon plugging in the first charge plug, power to the industrial truck is disabled so the truck cannot be operated inadvertently.

This battery must only be charged by HAWKER®-approved chargers for lithium-ion, which are specially designed to allow CAN communication with the battery to control the battery recharge. This ensures a safe and optimal operation of the system. All operating instructions found in the owner's manual of the charger must be followed. Charging occurs using an ungrounded separated charging circuit.

NOTE: Never attempt to charge using the connector from the battery to the truck.

NOTE: HAWKER® FLEX Li³ Li-ion batteries will be shipped at or below 30% State of Charge (SoC) to comply with HAWKER® policy on the handling of lithium-ion systems during transport.

The battery system is equipped with driveaway protection that will disconnect the traction power, disabling the truck if any battery charging plug is connected to a charger. This mitigates the risk of an operator accidentally driving away when the charger is still connected.

- Charge the battery only in an appropriate environment. Additionally, follow all environmental requirements from the charger.
- The charge plug has embedded anti-arc contacts to reduce arcing while performing inadvertent hot disconnect operations.

NOTE: The CAN-enabled charge connector from the battery must be plugged into the matching CAN-enabled charge connector from the charger. Otherwise, the charging will not start as there will be no CAN communication between the battery and the charger.

- Depending on the battery, there is a dual or single connector charging capability.
- At present, communication options such as Ethernet, Programmable Logic Controllers, and remote lights cannot be optioned on the charger.
- While installed in the industrial truck, the battery should not be disconnected from the industrial truck to charge, nor is it required to open the lids and covers on the battery compartment.

Battery Charging (cont.)

Charging Sequence

- Ensure that the battery and charger cables have no damage prior to connecting.
- Ensure that connectors are free of contamination prior to connecting.
- Connect the charger to the battery charging cable. The battery will either have a SINGLE or DUAL charging cables, depending on the battery model and application charge rate.
- Once a charging cable is connected, the traction contactor will open, removing power from the truck for driveaway protection.
- If the battery is OFF, the charger will automatically wake the battery and begin to charge.
- Charging will begin after the CAN communication has started between the battery and the charger, which occurs when the charging cable with CAN is connected. The optimal charge current will automatically be determined based on the battery conditions (SoC, temperature, etc.) and charger conditions (temperature, charger size). The charge level will dynamically change during the charging process, ensuring fast charging and ensuring an optimal lifetime of the product. If the battery detects a fault condition, the charging will stop.
- If required to stop charging prior to completing the charge, such as during opportunity charging, press the ON/OFF button on the charger prior to disconnecting. The battery must not be disconnected while still being charged by the charger.
- After a full charge cycle is complete, the charger screen will indicate that charging is complete. At this point it is no longer supplying current to the battery, and the charge plug(s) should be disconnected from the battery. After completely disconnecting the charge plug(s) the battery will then automatically open the charge path and close the traction path, which will supply power to the truck.

Service and Maintenance

The battery has been designed to be virtually maintenance-free. However, external cabling, connectors, etc. (including operator interfaces) must be regularly examined to ensure there is no damage to such parts and to fulfill local regulations. If any of these parts are damaged or show signs of serious wear, they need to be replaced. Please contact your HAWKER® Service Representative for all repairs and replacements. All repairs must be done by a HAWKER® technician trained on lithium-ion products.

All power cables must be checked every time the battery has been exposed to any type of stress, whether it be overvoltage, overcurrent, or mechanical stresses such as crushing.

Cleaning Instructions

- The exterior of the battery can be cleaned using warm water and an antistatic cloth.
- Ensure the battery is deactivated before cleaning.
- Do not clean the battery with pressurized water.

Troubleshooting

Battery does not provide power to the truck.

- Ensure the battery is turned ON using an operator interface.
- Deactivate and reactivate the battery.
- Ensure the battery is not connected to the charger. Power to the truck is turned OFF during charging to prevent driving away from the charger.
- Confirm there are no active errors listed on the user interface. In case of errors, review error ID checklist (in the next column).
- Inspect power cables to the truck to ensure they are not damaged.
- If the battery has OEM integration, check the communication cables between the truck and the battery.
- Contact your HAWKER® Service Representative for further troubleshooting steps.

Battery will not charge.

- Ensure the charger is powered and the charger does not have any errors. In case of an error on the charger, follow the instructions in the charger owner's manual.
- Deactivate and reactivate the battery.
- Ensure charging cables are properly connected to a HAWKER® lithium-ion enabled charger.
- Ensure the charge communication cable is connected to the charge communication port.
- Confirm there are no active errors listed on the battery user interface. In case of errors, review error ID checklist (in the next column).
- Check connectors, auxiliary pins, and CAN cables for damage.
- Contact your HAWKER® Service Representative for further troubleshooting steps.

No response from the battery when attempting to operate CDI.

- Ensure CDI is connected to the Operator Interface Terminal on the battery.
- Ensure the communication cable between the battery and CDI is not damaged.
- Contact your HAWKER® Service Representative for further troubleshooting steps.

Error ID checklist and recommended actions.

- View the CDI or HAWKER® MOD-ifi™ smart device app for the most recent error ID or error IDs. Below is a description of the reason for the displayed error IDs along with corrective actions.
- If error ID 401 is displayed, contact your HAWKER® Service Representative as the battery has been locked out and the battery will not operate without a service visit.
- If error ID 3 is displayed, ensure the proper shutdown/start-up procedure for the battery and truck is being followed:
  - 3 – Battery shutoff time exceeded due to industrial truck drawing too much current during shutdown of battery.
- If one or more of the following error ID(s) are displayed, check the power cables and ensure there are no issues with the truck:
  - 479 – Battery short circuit event detected due to external sources.
  - 7 – Battery turning ON while being put under excessive electrical load.
  - 14 – Battery connected to an external device at higher than allowable voltage.
  - 62 or 63 –The current to the truck is excessively noisy.
- If one or more of the following error ID(s) are displayed, the battery should be charged:
  - 39 or 481 – Discharge current limit exceeded due to reduced performance limits at low SoC.
  - 45 or 477 – Lower cell voltage limit exceeded.
  - 49 – Lower battery pack voltage limit exceeded.
  - 70 – Lower battery SoC limit exceeded.
  - 169 – Charging is needed due to low SoC.
  - 39 or 481 – Discharge current limit exceeded due to reduced performance limits at temperature extremes. Place the battery in an environment where it can return to normal operating temperatures.
- In case any other error ID shows up, please contact your HAWKER® Service Representative for further troubleshooting direction.

STORAGE AND LABELS

Storage

During storage, it is recommended to turn the pack ON at least every six months to confirm SoC has not dropped below 30% SoC. Recharge to greater than 30% SoC if the SoC has dropped below 30% SoC.

The battery must be stored in a dry environment away from fire, sparks, and heat.

The allowable storage temperatures are -40°F (-40°C) to 140°F (60°C). To ensure battery health and maximize service life, the maximum temperature of the long-term storage location should be less than 95°F (35°C).

The storage area must be compliant with local regulations (including fire, safety, and building regulations) for lithium-ion batteries.

The battery must only be stored in an upright position (i.e., installed in the vehicle) with all service lids properly attached.

During storage, it is not necessary to disconnect the power connection between the industrial truck and battery; however, it is highly recommended to disconnect the truck and battery communication connector, as there may be trickle discharge.

If the battery is removed from the industrial truck for storage and one or more of the harnesses is removed from the battery, the battery terminals must be covered with insulation that can only be removed by the use of a tool, or the battery must be stored in a properly labeled, suitable container that can only be opened by use of a tool or key.

For storage of greater than one month, precautions must be taken to ensure the battery is not deeply discharged. The pack must be stored at greater than 30% SoC. In addition, processes and recharge methodology must be in place to ensure that the battery does not discharge to 5% SoC in storage.

Description of Battery Labels

Label Type:

The type label, located on the side of the inner tray displays important information about the battery, including:

- Manufacturer Name & Logo
- Part & Serial Number
- Nominal Voltage
- Nominal Capacity
- Nominal Mass

Example of Type Label

Description of Battery Labels (cont.)

Label Type:

Danger Label

The danger label, located on the side of the battery, contains warnings critical for the safe usage of the battery.

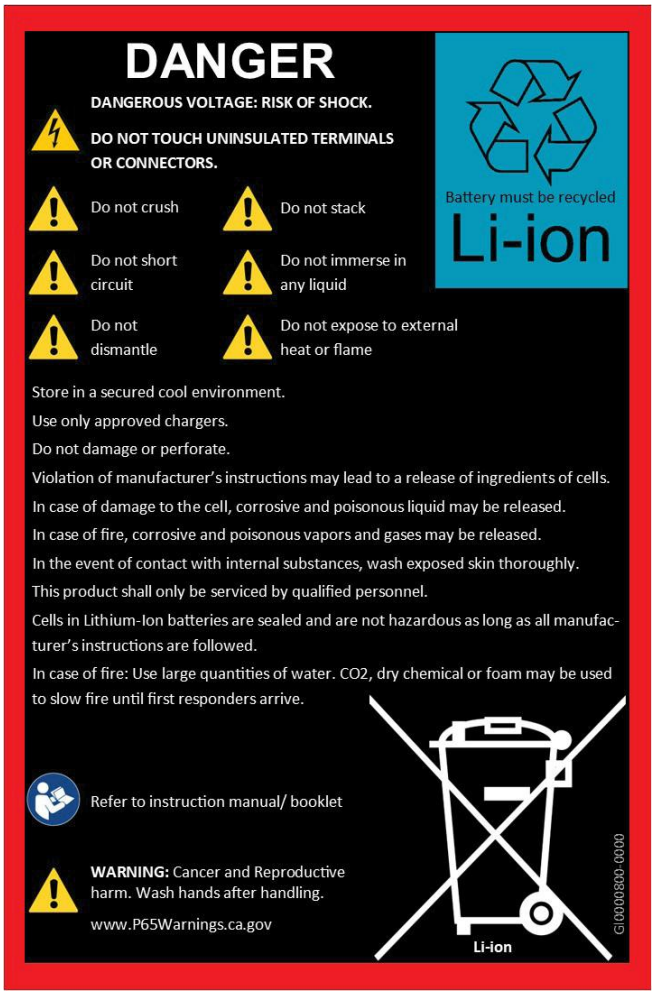
This symbol indicates that the user has to refer to the instruction manual/booklet before use.

This symbol indicates that this battery must not be disposed of as unsorted municipal waste.

This symbol is used to show that this battery must be recycled and contains lithium-ion.

This symbol is used to indicate warning statements.

This symbol indicates the risk of electrical shock.



Shipping Lithium-ion Batteries

All persons involved in shipping batteries must comply with all applicable regulations.

All persons involved in shipping batteries must be trained as required by local regulations to ship hazardous goods.

Unpacking and packing of batteries shall only be performed by electrically trained personnel.

Because of their inherent stored energy and flammability, lithium-ion batteries are considered "Dangerous Goods" and must be transported in accordance with all regulations. The classification for the battery is Class 9, according to UN "Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria", Chapter 38.3 (known as UN 38.3). Air shipment requires competent authority approval according to the local jurisdiction's department of transportation.

Shipping Lithium-ion Batteries (cont.)

This battery complies with UN 38.3. Test summaries are available upon request.

Damaged batteries must be transported based on all applicable regulations for damaged lithium-ion batteries. These requirements are in addition to the standard UN 38.3 criteria. Contact your HAWKER® Service Representative for assessment and support in transporting damaged batteries.

For further transport and regulatory information (USA and EU; classifications and labeling) refer to Lithium-ion Battery (Module) SDS:829515 instructions or regulations by the International Civil Aviation Organization (ICAO), International Air Transport Association (IATA), International Maritime Dangerous Goods (IMDG), Convention concerning the Carriage of Goods by Rail (CIM), and Annex A: International Regulations concerning the Carriage of Dangerous Goods by Rail (RID) codes. Other laws and regulatory requirements may apply.

Disposal and Recycling

Dispose of the battery in accordance with all local regulations relating to disposal of lithium batteries. Failure to do so may result in serious damages being assessed.

Do not dismantle, incinerate, or crush battery systems.

Dismantling the battery is not authorized except by qualified HAWKER® personnel due to the numerous hazards involved with dismantling a lithium-ion battery.

In case of irreparable failure, the battery must be taken out of operation and your HAWKER® Service Representative contacted.

Due to the risks posed by damaged lithium-ion batteries, damaged lithium-ion batteries require specialized handling and recycling. Do not dispose of this battery as unsorted municipal waste.

HAWKER®, in line with local regulations, will accept HAWKER® FLEX Li³ products at specific facilities for disposal. Contact your local HAWKER® Service Representative for specific recycling instructions for your region.

Appendix A: Ratings Table

The model number for this battery begins with a 24, 36, 48, or 80 for batteries intended to replace 24 V, 36 V, 48 V, or 80 V nominal lead-acid batteries respectively.

Model Number	Nominal Voltage (V)	Min Voltage (V)	Max Voltage (V)	Nominal Energy (kWh)	Nominal Capacity (Ah)
24-L1-20-4.7	25.55	19.6	29.4	4.7	185
24-L1-24-9.5	25.55	19.6	29.4	9.5	370
24-L1-24-14.2	25.55	19.6	29.4	14.2	555
36-L1-40-8.1	36.5	28.0	42.0	8.1	222

Appendix A: Ratings Table (cont.)

Model Number	Nominal Voltage (V)	Min Voltage (V)	Max Voltage (V)	Nominal Energy (kWh)	Nominal Capacity (Ah)
36-L1-40-12.2	36.5	28.0	42.0	12.2	333
36-L1-42-12.2	36.5	28.0	42.0	12.2	333
36-L1-42-16.2	36.5	28.0	42.0	16.2	444
36-L1-42-20.3	36.5	28.0	42.0	20.3	555
36-L1-46-16.2	36.5	28.0	42.0	16.2	444
36-L1-46-20.3	36.5	28.0	42.0	20.3	555
36-L1-46-24.3	36.5	28.0	42.0	24.3	666
36-L1-46-28.4	36.5	28.0	42.0	28.4	777
36-L1-48-20.3	36.5	28.0	42.0	20.3	555
36-L1-48-24.3	36.5	28.0	42.0	24.3	666
36-L1-48-28.4	36.5	28.0	42.0	28.4	777
36-L1-48-32.4	36.5	28.0	42.0	32.4	888
36-L1-48-36.5	36.5	28.0	42.0	36.5	999
48-L1-60-7.6	51.1	39.2	58.8	7.6	148
48-L1-60-11.3	51.1	39.2	58.8	11.3	222
48-L1-62-11.3	51.1	39.2	58.8	11.3	222
48-L1-62-15.1	51.1	39.2	58.8	15.1	296
48-L1-62-18.9	51.1	39.2	58.8	18.9	370
48-L1-64-15.1	51.1	39.2	58.8	15.1	296
48-L1-64-18.9	51.1	39.2	58.8	18.9	370
48-L1-64-22.7	51.1	39.2	58.8	22.7	444
48-L1-64-26.5	51.1	39.2	58.8	26.5	518
48-L1-66-18.9	51.1	39.2	58.8	18.9	370
48-L1-66-22.7	51.1	39.2	58.8	22.7	444
48-L1-66-26.5	51.1	39.2	58.8	26.5	518
48-L1-66-30.3	51.1	39.2	58.8	30.3	592
48-L1-66-34.0	51.1	39.2	58.8	34.0	666
48-L1-72-30.3	51.1	39.2	58.8	30.3	592
48-L1-72-34.0	51.1	39.2	58.8	34.0	666
48-L1-72-37.8	51.1	39.2	58.8	37.8	740
48-L1-72-41.6	51.1	39.2	58.8	41.6	814
48-L1-72-45.5	51.1	39.2	58.8	45.4	888
48-L1-72-49.2	51.1	39.2	58.8	49.2	962
48-L1-72-52.9	51.1	39.2	58.8	52.9	1036
48-L1-72-56.7	51.1	39.2	58.8	56.7	1110
80-L1-80-17.8	80.3	61.6	92.4	17.8	222
80-L1-80-26.7	80.3	61.6	92.4	26.7	333
80-L1-80-35.7	80.3	61.6	92.4	35.7	444

Appendix A: Ratings Table (cont.)

Parameter	Value	Unit/Description
Impulse Withstand	500	V
Peak Withstand Current (Ipk)	2000	A
Short-time Withstand Current (Icw)	1600	A@1s
Icc	100	kA
Relative Humidity	0-95	% Non-Condensing
Type of Construction	Removable	
Form of Internal Separation	Form 1	No Internal Separation
Types of Electrical Connections	DDD	All Able to be Disconnected
EMC Classification	Environment A	Industrial
Macro-environment	Pollution Degree 3	
Designed IP Rating	IP54	

Terms and Abbreviations

Term/Abbreviation	Explanation/Description
BDI	Battery Data Indicator
BMS	Battery Management System
C_1	Capacity at one-hour rate of discharge or charge
CDI	CAN Data Interface
DC	Direct Current
LV	Low Voltage (may also refer to communication)
OEM	Original Equipment Manufacturer
PPE	Personal Protective Equipment
SDS	Safety Data Sheet
SoC	State of Charge
SOH	State of Health
Activated	In an ON state
Deactivated	In an OFF state
Cable Harness	DC cable and plug that that connects to the industrial truck or battery charger.
Operation	Refers to charging or discharging the battery. Includes idling of the battery while activated.
Storage	Refers to the battery being stored.
Handling	Refers to activities such as lifting, moving, positioning the battery. Includes connecting and disconnecting the charge and power cables.
Maintenance	Cleaning the battery and inspection of the battery and connected components (charging cables and user interfaces) for damage.
Service	Operations performed by HAWKER® Service Representatives to restore the battery to full performance.

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